



## BRIDGE INSPECTION MANUAL Edition of 2020



Revised June 16, 2020

**ARKANSAS DEPARTMENT OF TRANSPORTATION**  
**BRIDGE INSPECTION MANUAL**  
June 16, 2020 Edition

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# Chapter 1: Bridge Inspection Program

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## ***Foreword***

This Bridge Inspection Manual is written to establish a uniform and formal procedure for the bridge inspection process for ArDOT and to comply with the Code of Federal Regulations, Part 650 Subpart C. These requirements provide for regular and systematic inspection of bridges on, under or over public highways and streets in the interest of public safety and protection of the public investments in such structures.

The ARDOT Bridge Inspection Manual is a combination of guidelines, example forms, charts, policies and procedures designed as an aid to all who are concerned with bridge inspections. This manual will be used in conjunction with the following documents:

1. 1995 FHWA "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges", 2012, 2018 Errata;
2. 1986 FHWA "Inspection of Fracture Critical Bridge Members";
3. The Manual for Bridge Evaluation, 3<sup>rd</sup> Edition, 2018;
4. NHI Course No. 130055 "Safety Inspection of In-Service Bridges" Participant's Workbook;
5. 1986 FHWA "Culvert Inspection Manual";
6. Manual for Bridge Element Inspection, 2<sup>nd</sup> Edition, 2019;
7. 1989 FHWA, "Underwater Inspection of Bridges";
8. Bridge Inspector's Reference Manual (BIRM), 2012;
9. Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 6<sup>th</sup> Edition, with 2015 Interim Revisions;
10. Metrics for the Oversight of the National Bridge Inspection Program, 2017;
11. Arkansas's current "Local Government Procedures For Compliance With The National Bridge Inspection Standards".

## ***History and Purpose***

Federal law required all states to develop and implement a bridge inspection program following the 1967 collapse of the Silver Bridge over the Ohio River that resulted in 46 deaths.

As a result of this bridge failure the Federal-Aid Highway Act of 1968 required the Secretary of Transportation, with the state highway agencies, to develop National Bridge Inspection Standards (NBIS). The Act also required each state to establish and maintain a current inventory of all bridges on the Federal-Aid Highway System. The Surface Transportation Assistant Act of 1978 greatly expanded the program to require that all bridge length structures on the public highway system (state, county, city) be inspected. Currently there are approximately 12,800 structures and 72.5 million ft<sup>2</sup> of deck area in Arkansas' bridge inventory.

ARDOT has an agreement with local owners to be responsible for the inspection and load rating of bridge length structures on the state and locally owned public road systems in compliance with the NBIS. ARDOT will annually bill local owners for 20% of the associated administration costs for the bridges under their jurisdiction. In addition, a voluntary program was developed where local owners could secure load posting materials from ARDOT stock piles at a reduced cost if program procedures were followed. Initially this assistance was only for the initial posting of the bridges, but it was expanded to enable material requisition to be made as needed.

In January 1985, ARDOT's Bridge Inspection Program was significantly reorganized to address the workload and more effectively use its personnel. The District Construction Engineer was designated as the District Bridge Inspection Engineer. This person is responsible for coordinating and monitoring the program at the District level. Full time District Bridge Inspectors, perform the inventory and inspection of bridges within the District. Also, as part of this reorganization, the Structures Inventory and Rating Section in Bridge Division was created to consolidate the functions of report processing and load capacity rating. Overall the Heavy Bridge Maintenance Section provides coordination of the Bridge Inspection Program. Local governments were made aware that failure to comply with their posting responsibilities could result in loss of Federal Aid Highway Funding.

In July 2004, inspection data was no longer reported on paper forms but entered into a computer program called PONTIS. PONTIS served as the Bridge Management file and queries could now be run from its database.

FHWA introduced a bridge safety initiative in 2011 with subsequent revisions to systematically perform QA. The initiative measures are a data-driven, risk-based review, and analysis of 23 metrics that determine how States are performing their bridge inspection programs.

In May 2011, the State Heavy Bridge Maintenance Engineer was designated the Bridge Inspection Program Manager. The Staff Heavy Bridge Maintenance Engineer was designated the Assistant Bridge Inspection Program Manager. The District Construction Engineers were designated the District Bridge Inspection Program Managers. These title changes were made to better define the roles and responsibilities of personnel involved with the bridge inspection program.

In June 2011, the Bridge Management Engineer position was transferred from the Bridge Division to the Maintenance Division to initiate the development of a bridge management program. The process was

started with improvements to the Maintenance Activities (Form V) Database to better track maintenance needs, critical findings and completed work on bridges.

In December 2013, the Department and the Federal Highway Administration signed a Systematic Bridge Preservation Agreement to allow preapproval of Federal participation on bridge preservation activities without the need for the Department to provide separate justification for each project. This Agreement was updated in June of 2018 and can now be used by the Department personnel as a systematic approach in determining when bridge preservation activities meet the criteria for eligible Federal participation. Bridge Preservation Guidelines were developed to more clearly define the goals and strategies of bridge preservation called for in the Systematic Bridge Preservation Agreement.

In June 2014, the Department hired Bentley to provide the next generation of bridge inspection software (InspectTech) for the Department and to integrate the maintenance needs database into the bridge inspection software. The software includes an iPad app for the collection of field data and sync with a web version. Besides mobile data collection it provides inspection management, performance measure management, maintenance need management and MAP-21 compliance. The software was put into production March 2, 2015.

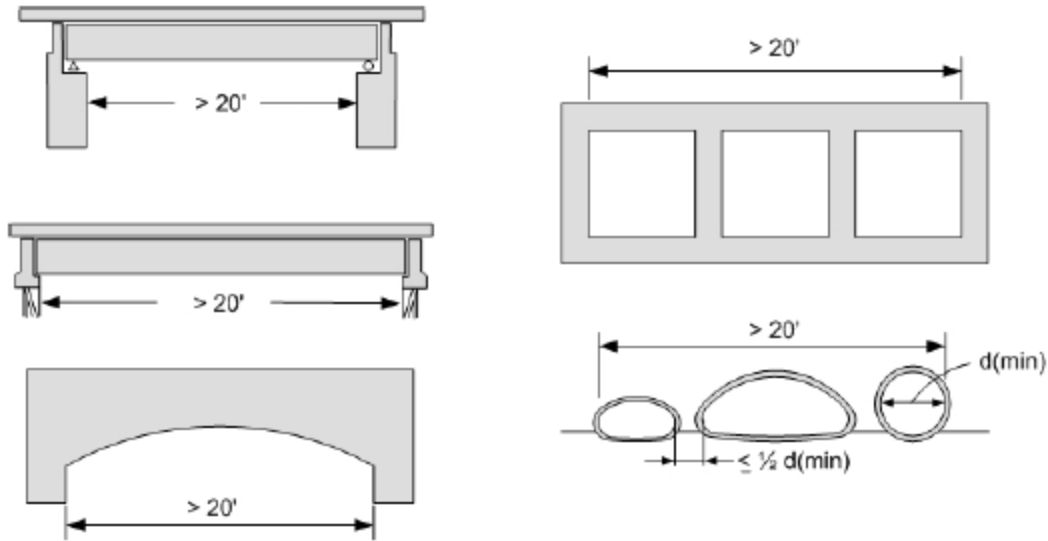
In January 2020, the Department moved to the InspectX mobile bridge inspection platform and moved the bridge data to the cloud.

This Manual is not intended to supplant proper training or the exercise of judgment by the Inspector or a Program Manager, and communicates only the minimum requirements necessary to provide for public safety. Any Program Manager may require the sophistication of inspection, load rating or the testing of materials to be higher than the minimum requirements.

### ***General Definitions***

1. **DEFINITION OF A BRIDGE:** A bridge is a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between under-copings of abutments or spring lines of arches, or extreme ends of openings. To determine the length, measure back to back of back-walls of abutments or from paving notch to paving notch. If the location of the backs of back-walls cannot be exactly determined, Inspectors can then measure the distance between the paving notches to determine structure length.

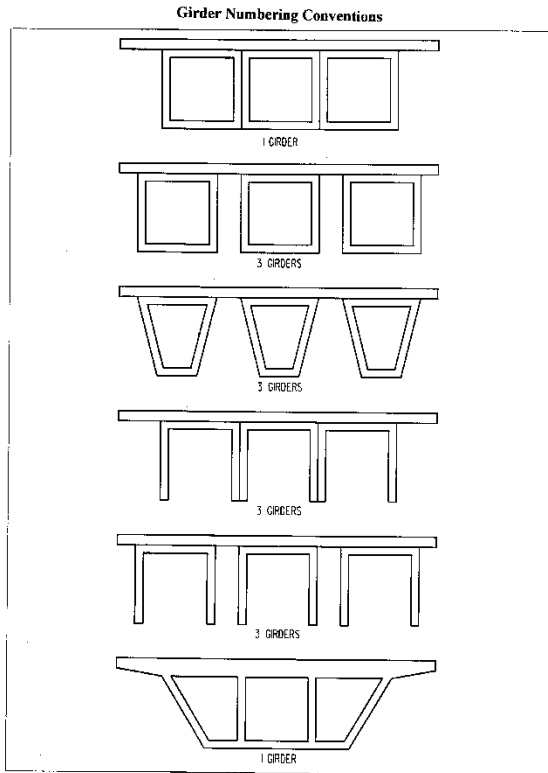
A multiple pipe culvert shall also be classified as a bridge length structure if the clear distance between openings is less than half of the smaller adjacent opening and the overall length of structure (out to out of pipe openings) is 20 feet or more.



2. **SIDE DRAIN STRUCTURE:** Side drain structures on the State Highway System that are bridge length and are known to carry public, commercial, industrial or major farm transportation will be inventoried, assigned a bridge number and inspected under the bridge inspection program.

All other side drain structures, even though bridge length in nature, will be considered as minor drainage structures.

3. **FRACTURE CRITICAL:** Fracture critical bridges are non-redundant such that failure of a single tension steel member or tension steel component could be expected to result in collapse of the structure.
4. **MAINTENANCE:** Routine or incidental work that generally restores the condition of the bridge and does not significantly increase the structural and/or durability characteristics of the original bridge.
5. **REHABILITATION:** The major work necessary to restore the structural integrity of portions of the original bridge that are deteriorated as well as work necessary to correct major safety defects. Rehabilitation may include, where necessary, complete removal and replacement of deteriorated components of the existing bridge.
6. **NUMBER OF GIRDERS:** See the following diagram showing examples for determining the number of girders in various situations.



### ***Overview and Funding***

Following established guidelines and practices, the District Bridge Inspectors use their specialized training and experience to enter inspection data into the InspectX inspection software. The District Bridge Construction Engineer serves as the Local Program Manager and supervises the inspection process and is responsible for the accuracy of the reports. Bridge Division's Inventory and Rating Section utilize the information gathered by the Bridge Inspector to perform a detailed review and load rating. This data is submitted at least annually by the HBM Section to the FHWA Washington Office where it is compiled to form the National Bridge Inventory (NBI) report to Congress.

### ***Goals of the Bridge Inspection Program***

The ultimate objectives of the Bridge Inspection Program are to facilitate safe travel over public bridges and to maximize benefits from the use of public funds. Bridge Inspection data is the foundation for the entire bridge management system. Information obtained during the inspection will be used for determining needed maintenance and repairs, identifying preservation needs, prioritizing rehabilitations and replacements, for allocating resources, and for evaluating and improving design for new bridges. The accuracy and consistency of the inspection and documentation is vital because it not only impacts programming and management of the bridge inventory but also affects public safety.

## ***Quality Control***

Quality Control (QC) is the enforcement of procedures that are intended to maintain the caliber of bridge inspection and documentation at or above the NBIS standard. Quality control is the responsibility of every person involved in the daily activities of the bridge inspection program.

The Routine Inspections in the District bridge inventory will be alternated between bridge inspecting teams. When it is not logistically feasible to rotate through the entire inventory within the District, the District Construction Engineer may implement an alternate procedure of rotating through a minimum of 30% of the inventory. This rotation of bridge inventory supports peer-to-peer exchange of ideas and indicates if the inspection teams are performing in a similar manner.

To insure that the routine inspection of bridges within the District bridge inventory is alternated between bridge inspection teams, the Heavy Bridge Maintenance Section will make a check each January of the percent of rotation within each District.

As part of the QC, either the Assistant Bridge Inspector or Inspector shall review the inspection information entered by the other team member. The following items are the minimum required for the review of an inspection:

- Review NBI Items 90, 91, 92, and 93 (Inspection dates and Frequencies) for completeness and accuracy.
- For state bridges, a bridge layout and a cross-section view shall be stored as a pdf file in the Asset Files/Plans tab.
- Photos should be included for:
  - Bridge looking down roadway (Routine Inspections)
  - Elevation view of bridge and set as the default image (Routine Inspections)
  - Posting and clearance signs (Routine & Under Record Clearance Inspections)
  - Maintenance items that warrant either a “CF”, “A” or “B” priority
  - Conditions that rate 4 or lower on the NBI scale
  - Elements that rate a Condition State 4: “Severe”
  - Repaired bridge elements
  - Deck on a state bridge representing “typical” deck conditions showing both top and bottom of deck
- Photos for roadway and elevation views are included in the Asset (Manager Files)
- Review ARDOT Agency Tab for accuracy and verify an email is included for Local Owners
- Review Under Records Tab for accuracy
- Review Element Inspection Tab for accuracy for State Bridges and Local Bridges on NHS
- If inspection is late, the proper documentation has been entered into the Late Reason drop down box on the ARDOT Agency Form
- Maintenance items have been entered if required
- Attach any drawings, plans or files that support the inspection under the appropriate tabs
- Verify that the inspection schedule has been updated for the next inspector
- Verify that any “Special Inspections” left in the schedule are necessary and removed if not
- Verify that NBI Items 58,59,60 or 62 correlate well with the Elements Conditions and the Maintenance Items

The Assistant should also ask questions if there is something that he/she does not agree with in the report. In an ideal situation everyone will agree, but ultimately it is the Inspector's responsibility.

**The Bridge Inspector shall always be on site** during the inspection and the Assistant Bridge Inspector shall always (with rare exceptions) be on site with the Bridge Inspector so that two sets of trained eyes are looking at the bridge. If the Assistant is unable to accompany the Inspector then other personnel should accompany the Inspector during the bridge inspection for safety considerations.

The InspectX Bridge Inspection Software is used to manage the bridge inspection process. The system eliminates transfer errors from written reports, automates the scheduling and type of inspections performed and is used to perform data validation checks. The database is regularly backed-up and it is part of the permanent bridge record. Changes to the database are restricted to authorized personnel only.

Only personnel familiar with Arkansas's Bridge Inspection Manual and qualified by NBIS standards are used in conducting bridge inspections and oversight. The Heavy Bridge Maintenance Section maintains documentation of the qualifications and training of all bridge inspection personnel. The Section also maintains the Bridge Inspection Manual and updates the manual as directed by the Bridge Inspection Committee and/or State Bridge Inspection Program Manager.

The Bridge Inspection Manual contains the Department's policy and procedures for the Bridge Inspection Program. It is essential that the Bridge Inspector be fully aware of all these policy and procedures. Therefore, each Bridge Inspector shall certify that they have read the Bridge Inspection Manual and the State Bridge Inspection Program Manager shall retain this certification with the Bridge Inspector's training documentation. New Inspectors are responsible for sending this certification to HBM.

Bridge Inspectors and Program Managers are assigned to all public bridges in the state of Arkansas by the ARKANSAS DEPARTMENT OF TRANSPORTATION. Having one entity administrate the bridge inspection program promotes uniformity and control throughout the program.

### ***Quality Assurance***

Quality Assurance (QA) is a measurement of the level and consistency of the overall program. Quality assurance will measure the quality and uniformity of the inspection and documentation, and identify specific items or procedures in the program where clarification, revision, or additional training is needed.

Federal Highway Administration (FHWA) (QA) - A bridge safety initiative was introduced by the FHWA in 2011 with subsequent revisions to systematically perform QA. The initiative measures are a data-driven, risk-based review, and analysis of 23 metrics that determine how States are performing their bridge inspection programs.

FHWA determines the Compliance Levels for each of the 23 metrics by sampling and data-mining bridge inspection and inventory information across the entire state. A **satisfactory** rating means that the State is adhering to the NBIS regulations with perhaps a few minor, isolated deficiencies that do not affect the overall effectiveness of the program. A rating of **actively improving** means that there is a Plan of Corrective Action (PCA) in place to improve noncompliant metrics. FHWA will rate the State bridge inspection program as **unsatisfactory** if metrics rated as noncompliant do not have a PCA or a State is not actively complying with an existing PCA.

The 23 metrics are represented in 5 groups:

- Metric 1 – **Organization**
- Metrics 2-5 – **Qualifications of personnel**
- Metrics 6 – 11 – **Inspection Frequency**
- Metrics 12 – 21 – **Inspection Procedures**
- Metrics 22 & 23 - **Inventory**

District (QA) - The District Construction Engineer shall make periodic bridge site visits at various locations to compare report results and observed field conditions. Repeat QA inspections of the same structure should be kept to a minimum unless the rating has changed. The District Construction Engineer shall assess the accuracy of Items 58, 59, and 60 of the NBIS and determine if appropriate notes and photographs have been provided. Any discrepancies between the report and observed conditions shall be resolved with the Bridge Inspector. A Quality Assurance NBIS Report Form X shall then be submitted to the Bridge Inspection Program Manager by E-mail. A minimum of one bridge per quarter per inspector (4 bridges/year/inspector) shall be reviewed. Since the purpose of the review is to compare how conditions are reviewed by the Inspector and the District Construction Engineer it is necessary that the QA inspection closely follow the actual inspection. Therefore the QA inspection and its documentation shall be completed and turned in by the end of the month following the quarter in which the inspection was completed. It is also recommended that the majority of inspections reviewed be selected from those structures that have at least one of the following:

- A significant change in the condition rating(s) since the last inspection
- A designation of structurally deficient or functionally obsolete.
- Fracture critical structures
- Posted structures

In addition to the bridge site visits, the District Construction Engineer reviews every Maintenance item entered for any bridge. This process assures that an Engineer is aware of any serious concerns an Inspector may have on a bridge. State bridges receive additional scrutiny by the District Maintenance Engineer when the Maintenance Item is evaluated and either set to Monitor or Assigned for repair.

Central Office (QA) - The Central Office conducts checks on the data from the bridge inspection database. Discrepancies are investigated and resolved. Procedural recommendations for improvements are made to the Bridge Inspection Committee or to the Program Manager where common errors are found. The following is a list of data checks:



Frequency	Check
Annual	Rotation of Recent Routine Inspections – Percentage.
Monthly	Maintenance items in Open state for over 30 days.
Monthly	Maintenance item in Repair Complete for over 30 days.
Monthly	Posting - beginning and ending both match calculated posting and is not closed
Monthly	Ensure bridges that should be posted are marked as such in Item 41.
Monthly	Maintenance items must have completion date if completed
Monthly	Alert Inspector if number of distinct bridges to check in any of the next 6 months exceeds 30.
Monthly	For posted bridges, check to ensure 2 routines are scheduled for 24 months frequency but offset by 12 months in the schedule.
Monthly	If bridge condition is Poor (58,59,60,62 <= 4), ensure routine scheduled for 24 months offset by 12 months with a Other Special Recurring set at 24 months
Weekly	Bridges have inspection scheduled. If item 5a = 1, then Routine; otherwise Underclearance
Weekly	Bridge have an active inspector assigned.
Monthly	Check that NBIS bridges have a Routine Inspection set for either 24 or 48 months.
Monthly	Check that Fracture Critical inspections are set for 24 month
Monthly	Check that bridges that have a maintenance need and that are not owned by the state have owner email address.

Inspection teams from HBM will independently re-inspect approximately 4% of the Districts inspections yearly. The re-inspections shall occur within a few months of the District's inspection so as to limit the possible changes in bridge condition. The QA Inspection Teams will rate Items (58, 59, 60, or 62) and note any Maintenance Items that they rate as a "B" or higher. The teams will also identify elements and their quantity for state bridges. In addition to these items the QA teams will verify the following NBI items:

NBI 001: State Code	NBI 043B: Struc. Type, Main: Type Des./Con.
NBI 002: Highway Agency District	NBI 044A: Struc. Type, Appr. Spans: Mat./Des.
NBI 003: County (Parish) Code	NBI 044B: Struc. Type, Appr. Spans: Type Des/Con.
NBI 006: Feature Intersected	NBI 045: Number of Spans in Main Unit
NBI 007: Facility Carried by Structure	NBI 046: Number of Approach Spans
NBI 008: Structure Number	NBI 047: Inventory Route, Total Horizontal Clearance
NBI 009: Location	NBI 048: Length of Maximum Span
NBI 010: Minimum Vertical Clearance	NBI 049: Structure Length
NBI 016: Latitude	NBI 050A: Curb or Sidewalk Width: Left Side
NBI 017: Longitude	NBI 050B: Curb or Sidewalk Width: Right Side
NBI 028A: Lanes on the Structure	NBI 051: Bridge Roadway Width, Curb-To-Curb
NBI 028B: Lanes Under the Structure	NBI 052: Deck Width, Out-To-Out
NBI 032: Approach Roadway Width	NBI 053: Min. Vert. Clearance OVER Bridge Roadway
NBI 033: Bridge Median	NBI 054A: Min. Vert. Under Clearance: Ref. Feature

NBI 034: Skew	NBI 054B: Minimum Vertical Under Clearance
NBI 035: Structure Flared	NBI 055A: Min. Lat. Under Clearance on Rt.: Ref. Feat.
NBI 036A: Traffic Safety Feat.: BR. Railings	NBI 055B: Min. Lat. Under Clr. on Rt.: Min. Lat. Under Clr.
NBI 036B: Traffic Safety Features: Transitions	NBI 056: Minimum Lateral Under Clearance on Left
NBI 036C: Traf. Safety Feat.: Appr. Guardrail	NBI 061: Channel and Channel Protection
NBI 036D: Traf. Safety Feat.: Appr. Grail. Ends	NBI 071: Waterway Adequacy
NBI 041: Struc. Open, Posted, Closed to Traf.	NBI 072: Approach Roadway Alignment
NBI 042A: Type of Service: ON Bridge	NBI 107: Deck Structure Type
NBI 042B: Type of Service: UNDER Bridge	NBI 108A: Type of Wearing Surface
NBI 043A: Struc. Type, Main: Kind Mat./Des.	NBI 112: NBIS Bridge Length

Once the re-inspections are completed for a District, Central Office personnel shall review the inspections and compare with the District's inspections. Variances of more than one for NBI items 58, 59, 60, and 62 shall be investigated along with Maintenance Items noted "B" or worse that were not noted in the District's inspection. A closeout training session shall be held with each District to go over the results.

Survey questionnaires are filled out periodically to collect feedback from the Bridge Inspectors and the Assistant Inspectors on their perception of the Inspection Program. This information is used internally to identify weakness, make improvements and track the progress of the bridge inspection program.

The Bridge Inspection Committee schedules appropriate periodic refresher training as needed. Refresher training could include NHI training, in-house training, webinars, on-line training, or any other training approved by the Bridge Inspection Committee. Bridge Inspectors and Program Managers should attend this training every three years. Bridge Inspection Program personnel should provide the Program Manager documentation of additional relevant training that may be completed beyond mandatory training. The Program Manager maintains a list of relevant training successfully completed by Bridge Inspectors, Assistant Bridge Inspectors and Program Managers.

**QUALITY ASSURANCE NBIS REPORT FORM X**

BR. NO.	<u>RT/SEC/LM</u>	ITEM 58	ITEM 59	<u>ITEM 60</u>	COMMENTS	<u>DATE</u>

\_\_\_\_\_  
DISTRICT CONSTRUCTION ENGINEER

\_\_\_\_\_  
DATE

\_\_\_\_\_  
HEAVY BRIDGE ENGINEER

\_\_\_\_\_  
DATE

### ***Qualifications of Program Personnel***

The State Program Manager shall be the State Heavy Bridge Maintenance Engineer. This position shall meet all the requirements of 23 CFR, Subpart C 650.309(a) and 650.313(g).

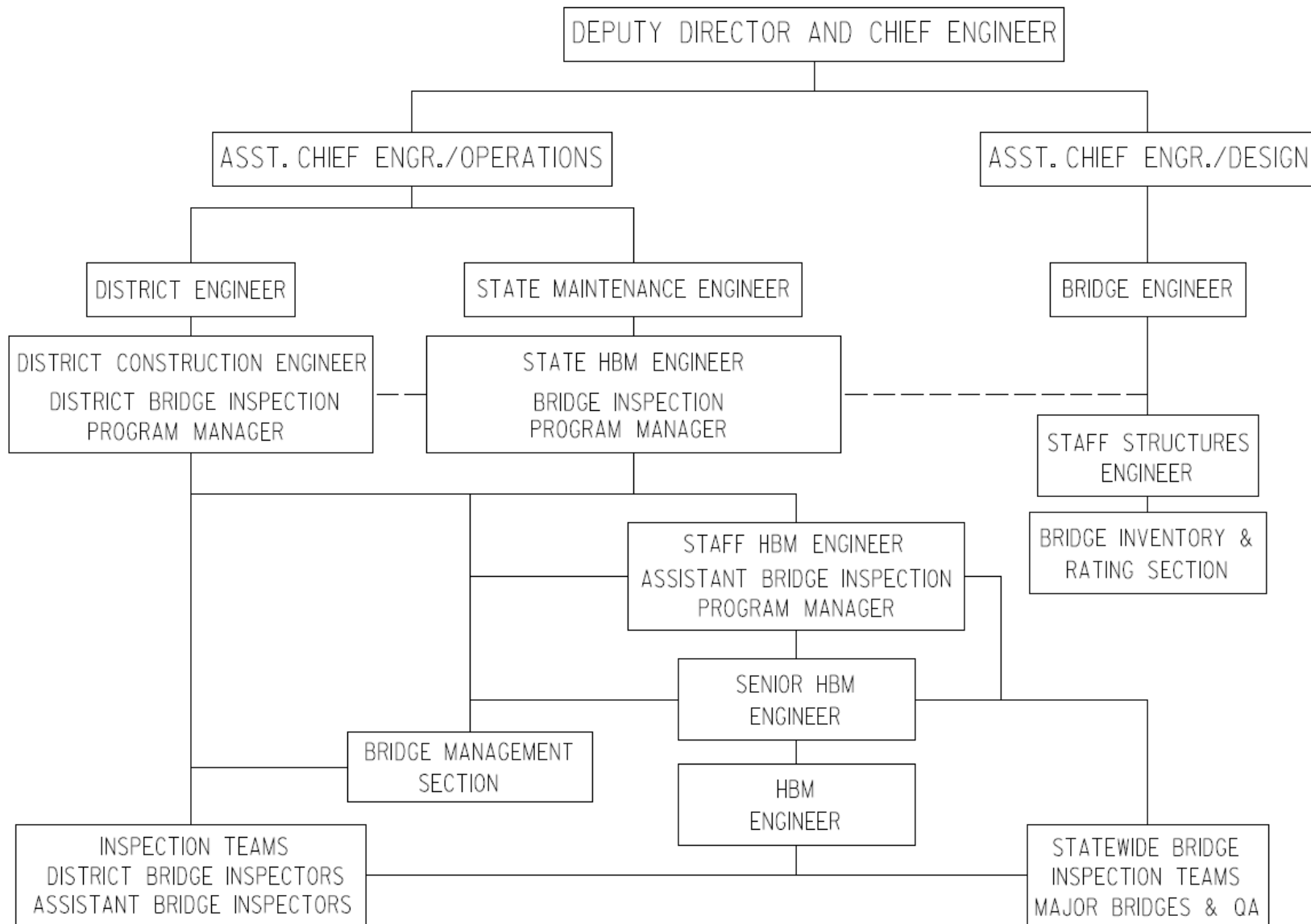
The Department policy is that District Bridge Inspection Engineer (DCE) serves as the Local Program Manager and is required to meet the requirements of 23 CFR, Subpart C 650.309(a) and 650.313(g). After accepting a position that requires NBIS program manager responsibility, the District Bridge Inspection Engineer shall successfully complete the FHWA NHI "Safety Inspection of In-Service Bridges" comprehensive training course as availability allows. The goal is to complete this training within one year of assuming program manager responsibilities.

Bridge Inspectors are required to meet the requirements of 23 CFR, Subpart C 650.309(b) and 650.313(g) including already successfully completing the FHWA NHI "Safety Inspection of In-Service Bridges" comprehensive training course. Bridge Inspectors are also **required** to provide training and mentoring to Assistant Bridge Inspectors to assist in their development as Bridge Inspectors. This requires the Bridge Inspector and Assistant Bridge Inspector to work together as a team with the Bridge Inspector providing direct oversight of the Assistant Bridge Inspector. Though the inspection is a team effort the Bridge Inspector retains the ultimate responsibility of the inspection and the Bridge Inspector shall retain "ownership" of the inspection in InspectX.

The Assistant Bridge Inspector position was created to develop a pool of candidates for the Bridge Inspector position. If the Assistant Bridge Inspector does not demonstrate progress in the skill set and knowledge required to be a Bridge Inspector, then serious consideration should be given to remove the Assistant from the Bridge Inspection Program.

When no applicant for Bridge Inspector is received who meets the above minimum bridge inspection experience requirements, The State Program Manager, in concurrence with the local FHWA Division Office, may make an evaluation of an applicant's total bridge experience and skill. If the experience/skill is found satisfactory, that applicant may be selected and utilized for bridge inspections with the stipulation that additional quality assurance procedures will be required until that applicant meets the required experience level.

# BRIDGE INSPECTION PROGRAM ORGANIZATIONAL CHART



### ***Bridge Inspection Program Charges***

The purchase of supplies, inspection equipment and training for the inspection program will be handled by the following procedure:

1. Each District will purchase all necessary supplies on a District Requisition charged to the District Budget and Function 1520. This is for items being taken into stock and issued out to the inspection team as the need arises.
2. Assignment of supplies to the inspection teams by the District Storeroom will be to Budget 895, Function 3400, and the appropriate Job Number and FAP Number as shown in the following table.
3. In lieu of the method described in 1 and 2 above, individual, small purchase items may be purchased by Confirmation Purchase Order using the District Requisition Number and as described in the Accounting Manual under Section 30, page 30-2. Charges are to be made to Budget 895, Function 3400 and the appropriate Job Number as shown in the following table.
4. Training that is chargeable to the Bridge Inspection Program will have a Job Number and FAP Number assigned to it and should be charged to Budget 895 and Function 3400.

# **BRIDGE INSPECTION PROGRAM CHARGES**

Effective Date October 1, 2019

FUNCTIONAL CLASS CODE (SI & A, ITEM 26)	OWNER (SI & A ITEM 22)	CHARGES (TIME, EQUIPMENT, SUPPLIES)*		
		JOB NO.	FUNCTION	FAP NUMBER
01, 02, 06, 07, 11, 12, 14, 16, or 17 (ON - FA SYSTEM)	STATE COUNTY CITY	012344	3400	Z240-NBIS-076
		012345	3400	Z240-NBIS-077
		012346	3400	Z240-NBIS-078
08, 09 OR 19 (OFF-FA SYSTEM)	STATE COUNTY CITY	012344	3400	M2E3-NBIS-076
		012345	3400	M2E3-NBIS-077
		012346	3400	M2E3-NBIS-078

\*See notes 1 and 2 concerning methods for purchasing and charging equipment and supplies

## ***Inspection Equipment***

The following list is the inspection equipment authorized for purchase. Additional equipment needs authorization from the Heavy Bridge Maintenance Engineer.

1. Boat, 15' aluminum or metal alloy
2. Ladder, aluminum extension 24'
3. Steel Tape, in case, 50' white clad
4. Steel Tape, 100'
5. Reel, Fold Crack, 100' tape (reel only)
6. Measuring wheel tape
7. Non-Metallic Tape, 50' with case
8. Hand Level, with case
9. Carpenter Level, 18"
10. Grade Level
11. Plumb Bob, brass with sheath, 14 oz.
12. Level Rod, fiber glass 25' oval type
13. Range Pole, 8', two section
14. Calipers, 6" outside
15. Hammer, geological type, 22 oz.
16. Clip Board, legal size, heavy duty
17. Binoculars, 7x, with case
18. Digital Camera, with case
19. Tool Belt, with pouch
20. Ball Peen Hammer, 12 oz., fiber glass handle
21. Hammer, claw, 16 oz.
22. Hammer, shop, double face sledge, 3 lb., 15" handle
23. Pick, garden pick mattock, 36" handle
24. Round Point Shovel, D handle, hollow back
25. Folding Rule, 6' w/extension
26. Pocket Rule, 12', white clad w/hook and lock
27. Inspection Mirrors, 2" x 4", 18" extension handle
28. Hip Boots
29. Waders with Suspenders
30. Screw Driver, square blade, stand tip 15"
31. Pliers, heavy duty
32. Wrench, crescent, 12" regular handle, 1 5/16" capacity
33. Brace and Bits, bits 1/2" dia. X 12" – 15"
34. Brush, wire, 1 1/8" x 6", four rows
35. Center Punch, 1/2" x 5 1/2"
36. Cold Chisel, 3/4" x 7 1/2"
37. Carpenter Wrecking Bar, 24"
38. Life Preserver Work Vest, A and P Type V
39. Drop Harness
40. Lanyard, for drop harness
41. First Aid Kit
42. Chain Drag, lamination detector
43. iPad with case (Supplied by HBM)



- 44. Electronic Depth Finder
- 45. Reflective Safety Vest
- 46. Leather Gloves
- 47. Safety Goggles
- 48. Snake Chaps
- 49. Dye Penetrant
- 50. Flashlight
- 51. Electronic Range Finder
- 52. Ultrasonic Thickness Gauge (Phase II UTG-2900 Recommended)
- 53. Lever Pit Gauge
- 54. Grinder or drill with Grinding Disk
- 55. Toolbox
- 56. Miscellaneous items approved by Bridge Inspection Program Manager

# Chapter 2: Inspection Requirements

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## ***Assigning New Bridge Numbers***

When you need a new bridge number email Dave Fuller or Dale Bittle with the following information and they will put the bridge into InspectX for your use:

- 1) Bridge number, if assigned on a job. If not known, it will be assigned and provided to the Inspector.
- 2) Owner
- 3) District
- 4) County
- 5) Latitude (decimal)
- 6) Longitude (decimal)
- 7) Route carried
- 8) Planned inspection date
- 9) Inspection frequency
- 10) Bridge No. replaced
- 11) Construction Job No. (If applicable)

## ***New Structure***

For a new structure on a new alignment and open to public traffic, an NBIS inspection is to be completed and SI&A data is to be inputted into the inventory as soon as possible. At a minimum, it should be completed within 90 days of completion of the work (open to public travel) for state bridges or 180 days for local bridges. Completed new structures not open to traffic are not subject to the NBIS since they are technically closed. However, once a new structure is open to traffic, it is subject to the NBIS and the inventory is to be updated with the new SI&A data within the 90/180 day timeframe. Where possible, the initial inventory inspection should be completed before the structure is open to traffic. This inspection can also be used to assist in completing the final punch list for the new structure.

## ***New Structure Under Stage Construction***

Staged construction of a new structure presents additional variables in determining when to complete an NBIS inspection. For a new structure on a new alignment, the portion of the new structure open to public traffic is to be inspected at a regular frequency to ensure its safety. This safety “Special Inspection” is to be completed as much as possible in accordance with the NBIS and there should be an explanation in the comment field explaining why it was performed. The initial Routine (NBI) inspection and recording of SI&A data is required once **all** of the staged construction is complete (not the contract) and the new structure is carrying full traffic. The new SI&A data is to be entered into the inventory within the 90/180 days.

## ***Existing Structure Being Replaced***

For an existing structure being replaced with a new structure on a new alignment, the existing structure is to be inspected per the NBIS as long as it remains in service as a highway bridge open to public traffic. For an existing structure being replaced with a new structure on the same alignment and under staged construction, the portion of the existing/new structure open to public traffic is to be inspected per the NBIS.

A Routine NBIS inspection should be completed as close to the start of construction as possible to provide a 24 month period for construction without the need of inspection. This is assuming the structure does not warrant more frequent monitoring with an Other Special Recurring inspection. Once the new structure is complete and carrying full traffic the Routine (NBI) inspection is to be finished and the new SI&A data is to be entered into the inventory within 90/180 days. The DCE or someone from the inspection team shall notify HBM's Bridge Asset Management Section and Bridge Design Rating Section that the existing structure is no longer in service and can be archived.

If an NBIS inspection cannot be conducted due to reasonable circumstances such as a hazardous project site or conditions unfavorable to complete an inspection, then those circumstances should be documented. See "Routine (NBI) Inspection" for additional guidance when circumstances interfere with an inspection.

### ***Temporary Structure***

For a temporary structure being used to carry public traffic while the permanent structure is closed, the temporary structure is to be inspected in accordance with the NBIS. The temporary structure is not required to have its own individual SI&A data in the inventory. Generally, the structure being rehabilitated or replaced remains in the inventory and appropriate SI&A data, Items 10, 41, 47, 53, 54, 55, 56, 70, and 103 are to be coded for the temporary structure. **The Bridge Inspector shall email Bridge Rating notifying them of the temporary structure so that they can update Item 70.** Once the permanent structure is complete and open to public traffic, an NBIS inspection is to be completed and updated SI&A data is to be inputted into the inventory within 90/180 days.

### ***Frequency***

Please make note: inspectX scheduling is different than inspecttech. The frequencies talked about in this chapter relate to the frequencies in inspectX (in the inspection and in schedule). The values in the chapter below **must** go into inspectX when an inspection is scheduled OR the inspection is performed. The scheduled inspections can be more frequent than the actual frequency.

Since the NBIS Oversight Program started evaluating our bridge inspection program using the 23 Metrics, the program has had perceived compliance issues concerning the frequency of inspections. This issue stems from the fact that our program requires a greater frequency of inspection in some instances than is required by the NBIS. Therefore, in order to better align with the NBIS, the following criteria will be used.

1. Routine (NBI) Item 91 and Fracture Critical Inspection Item 92A frequencies will be set at 24 months except for designated 48 month Routine (NBI) culverts.
2. Bridges requiring weight limit postings will also require a "Routine" inspection **frequency** (Item 91) of 24 months as noted above but will be **scheduled** for every 12 months;
3. Bridges with condition ratings (Items 58 thru 62) less than 5 will require a "Other Special Recurring" inspection frequency (Item 92C) of 24 months with a date following 12 months after the 24 month "Routine (NBI)" inspection. This "Other Special Recurring" will include only those elements on the bridge that precipitated the "Other Special Recurring" inspection such as deck, superstructure, etc. If the bridge is already **scheduled** (for example, posted bridges) for a "Routine" at 12 month or less, then no "Other Special Recurring" needs to be set up. Note, the schedule here is referring to the

date you actually set to do the inspection and not the frequency shown in NBI values or the Inspection Overview found in the InspectX Schedule;

4. Structures with a vertical clearance of 15' or less above the route or 15' or less when a public highway is under the structure will require an "Under Record Clearance" inspection frequency of 24 months following 12 months after the 24 month "Routine (NBI)" inspection. If a Routine is actually completed every 12 months then no Under Record Clearance inspection is required since the clearance is checked during a Routine;
5. Structures designated as fracture critical will require a "Fracture Critical" inspection **frequency** (Item 92A) of 24 months as noted above but will be **scheduled** for every 12 months;
6. Structures with known deficiency or a special feature may utilize an "Other Special Recurring" inspection. When used because of a known deficiency the frequency, (Item 92C) should be set for 24 months with a date following 12 months after the 24 month "Routine (NBI)" inspection. The Other Special Recurring inspection may be scheduled as needed to adequately monitor;
7. Scour prone bridges (NBI-Item 113) with a rating of less than 5 will require an "Underwater Type 2" inspection frequency (Item 92C) of 24 months but will be scheduled for every 12 months.

If in the opinion of the inspector, a bridge requires a more frequent inspection, then the Inspector may reduce the frequency of **scheduling** as necessary.

### ***Inspection Types***

The ARDOT inspection program records nine different types of inspection which are: Routine National Bridge Inventory (NBI), Fracture Critical, Underwater (Dive), Underwater Type 2, Under Record Clearance, Other Special Recurring, Accident, Scour POA and Special. Each of these inspections has a particular purpose and is described on the next page.

**Summary Table of Frequency & Inspection Types**

<b>Type of Inspection</b>	<b>NBIS Schedule/ InspectX listed Frequency</b>	<b>InspectX Schedule</b>
Regular Bridge Routine - Item 91	24	24 month Routine
Predetermined Culvert Routine - Item 91	48	48 month Routine
Posted Bridge	24	12 month Routine - Change Item 90 inspection date at each inspection
Poor Bridge Routine - Item 91 Other Special - Item 92C	24	A Routine and Other Special Recurring should be set to 24 month and the inspection dates Items 90 and 93C should be offset by 12 months
Fracture Critical - Item 92A	24	12 month
Under water (Dive) - Item 92B	Varies	Normally 60 month - Filled in by HBM
Other Special - Item 92C  If needed	24	If Item 92C is needed for a deficiency other than poor, the Inspector should schedule a Other Special Recurring in InspectX as often as needed.
Underwater Type 2	NA <sup>1</sup>	Varies - 60 month max
Under Clearance Record	align="center">NA	12 month For Clearance less than 15' Non-NBI Bridge
		24 month For Clearance less than 15' NBI Bridge (Alternate w/Routine)
Other Special Recurring  If needed	24	The Inspector should schedule in InspectX as often as needed to adequately monitor the deficiency.
Accident	NA	Once - As Needed
Scour POA	NA	Once - As Needed
Special	NA	Once - As Needed

<sup>1</sup>An underwater Type 2 can also be coded as Other Special (Item 92C) when a bent is scour prone or scour critical. Item 92C would still be 24 month and scheduled in InspectX as needed to monitor.

## ***Minimum Information Needed on Drawings Created by Inspection Teams***

### Superstructure Cross Section

- Curb to curb and out to out of deck dimensions
- Slab/deck thickness
  - If thickness varies, please show
  - If stay-in-place forms are present, include the form dimensions and thickness.
- When present, curb/parapet/railing details – Dimensions and sizes. For rail shapes define, or give sizes.
- For girder type bridges
  - Type, number and dimension of girder spacing (if all are not the same, show individual spaces)
    - If steel girder designation isn't known, show flange(s) width and thickness, web thickness, and overall depth; If a cover plate is present, show the length, width and thickness and distance of the beginning referencing the beginning of the girder or nearest bent.
    - For steel plate girders, show the width, thickness and length of each flange and the web. Sometimes there's a change in plate size on the girder length.
    - For steel girders, note if shear connectors exist, if possible.
  - Timber and RC – depth and width
  - Channel beams – unit width and depth, leg width and depth below slab, slab thickness; grout keyway dimensions
- When wearing surface and/or cover is present, show type and thickness

### Substructure

- Cap length, width and depth dimensions
- Piling/columns
  - Cross section dimensions
  - Spacing, including the distance from end of cap
- Footings, if present and visible
  - Length, width and depth
  - If foundation piling is present and visible, size and spacing (Likely won't be visible)
- Main member bearing locations on the bent cap, including the distance from ends of cap (for analyzing cap)

### Bridge Profile

- Bridge length and individual span lengths
- Channel Profile
  - On the initial drawing, include the channel profile.
  - If bridge is or might be scour susceptible, more frequent channel profiles would be needed.

### RC Culverts

- Overall length, back face of wall at beginning to back face of wall at end.
- Thickness of end and intermediate walls; top and bottom slab, if possible;
- For multi-boxes: Show span lengths, center of wall to center of wall. Box sizes can be different.
- Barrel lengths
- Amount and type of cover
- Type of culvert – precast or cast-in-place

#### RC, Metal, or Other Pipe Culverts (round, arch, etc...)

- Diameter (round); Height and depth (arch)
- Wall thickness
- Barrel lengths
- Layout of pipes – distance between them, number of pipes, etc.
- Amount and type of cover

#### Truss

- Profile
  - Truss length
  - Panel lengths
  - Panel heights, center of floor-beam to pin at top of panel
  - Panel members configuration
- Cross section
  - Width, center to center of trusses
  - Roadway dimensions carried by truss (similar to a span cross section)
  - Floor-beam data
  - Stringer data and location, if present

#### Arch (varies with type and size)

- Profile
  - Arch length
  - Spacing of columns/vertical members
  - Vertical members heights, center of floor-beam to arch member
- Cross section
  - Width, center to center of arch
  - Roadway dimensions carried by arch (similar to a span cross section)
  - Floor-beam data
  - Stringer data and location, if present
  - Dimensions/size for all members

#### RR Car

- Profile
  - Overall length
  - Length of center sill sections (deep, shallow, and transitions), and distance of the beginning referencing the beginning of the girder or nearest bent.
  - Location of struts and floor beams
- Cross Section
  - Lateral spacing of members
  - Member size data
  - Decking type and size data

### ***Routine (NBI) Inspection***

This is a recurring inspection that is made to assess the overall bridge condition and to record any inventory changes from a previously recorded inspection. They are performed on 24-month frequency (NBI Item 91). They may be scheduled more often as directed in this document. This inspection is made to access all elements of the bridge with a clearly visible observation to fully ascertain the existence and extent of any deficiencies. It also includes clearances for the bridge so there is no reason to have a Routine and Under Clearance Inspection schedule for the same date. Pictures shall accompany the Routine inspection showing:

- Bridge looking down roadway
- Elevation view of bridge
- Posting and clearance signs (if applicable)
- Maintenance item(s) that warrants a “CF” (critical finding), an “A” or “B” priority
- Conditions that rate 4 or lower on the NBI scale
- Repaired bridge elements
- Typical deck for state bridges showing both top and bottom of the deck
- Elements in condition state 3 or 4.

Any bridge without plans shall have micro-station drawings depicting span lengths, cross-section of superstructure types and views of the substructure. Pictures of hand drawings and scanned into micro-station are not acceptable. The drawings shall be of such detail so that the Rating Section may ascertain the needed details to determine any posting needs. Drawings shall be updated as needed to reflect changes that may affect the bridge rating. At a minimum, the drawings shall be checked every 10 years for accuracy and the review dated added to the drawing.

The Initial Inspection is included in Routine (NBI) inspections. This is the first inspection of a new or reconstructed bridge added to the inventory. The District Bridge Inspector should collect as much of the NBI and ARDOT data as possible. Contact the Central Office for data that is not available. District personnel should coordinate with the District Bridge Inspector when these bridge jobs are nearing completion so that plans can be made to inspect the bridge before it is opened to traffic and submit the new bridge data to the Central Office in a timely manner as required by the NBIS. The District Construction Engineer is charged with the responsibility of ensuring that the Inspector is made aware of those bridge jobs and the inspection should be completed prior to final inspection of the job.

When it is necessary to fully ascertain the existence of or the extent of any serious deficiencies, In-Depth Inspection procedures will be used as part of the Routine (NBI). In-Depth inspection procedures are used to identify any serious deficiencies not readily detectable using routine inspection procedures. This may include nondestructive field tests and/or other material tests. For example, pins of Pin/Hanger bridges and Pinned Truss Bridges shall receive an Ultra Sonic Inspection scheduled every 24-months.

Routine inspections (NBI Item 91 = 24 month) that are going to fall 1 month late should have a reason documented in the drop down box for Late Reason found on the ARDOT Agency Form when the inspection is completed. Routine inspections (Item 91 = 24 month) that are going to fall more than 1 month late need to first receive approval from the FHWA Bridge Engineer. Bridge Inspectors/Local Program Managers should submit late reasons for approval directly to [Pritesh.Mehta@dot.gov](mailto:Pritesh.Mehta@dot.gov) and the Heavy Bridge Maintenance Engineer should be included in the submittal. The late reason should also be documented in the drop down box found on the ARDOT Agency Form.



No Routine NBI Inspection should exceed 3 months late (27 months). If a Routine NBI Inspection is not able to be performed for some reason, the cause should be noted in the General Observation note. A modified Routine NBI Inspection, still coded as a Routine (NBI), should then be conducted as thoroughly as possible and followed by a Special Inspection when possible to address those items not covered in the in the modified Routine NBI Inspection.

For all state bridges and local bridges on the NHS system, a Routine Inspection will also include an element inspection as described in the “Manual for Bridge Element Inspection” with current interims and Chapter 10 of this Manual. Element inspections are required no more than once every two years. The following local bridges will require element inspections:

Bridge #	District
22044	1
19727	4
20877	6
04259	6
04260	6

The inspection types of Fracture Critical and Underwater Type 2 may be performed at the same time as a Routine (NBI) inspection.

### ***Fracture Critical Inspection***

This is a recurring inspection with Item 92A set for 24 months but **scheduled** for 12 months or less. This is a close-up, hands-on inspection performed on bridges with fracture critical details. Fracture Critical inspections shall be limited to the bridge components in question with a full Routine (NBI) inspection not being necessary unless it is scheduled. For example, on fracture critical bridges, inspections would be limited to only those tension steel members that are fracture prone and whose failure might result in partial or complete collapse of the bridge.

In addition, no Fracture Critical Inspection should exceed 3 months late (27 months). If a normal Fracture Critical Inspection is not able to be performed for some reason, the cause should be noted in the late reason drop down box found on the ARDOT Agency Form. A modified Fracture Critical Inspection, still coded as a Fracture Critical, should then be conducted as thoroughly as possible followed by a Special Inspection when it becomes possible to address those items not covered in the modified Fracture Critical Inspection.

The objective of Fracture Critical Bridge Inspection is to evaluate, by means of standard bridge inspection procedures the condition of those portions of a bridge that are considered Fracture Critical (FC).

By definition, Fracture Critical Bridges are defined as non-redundant steel bridges such that failure of a single steel tension member or tension component could be expected to result in collapse of the structure. On most FC Bridges only the FC elements will require inspection on a yearly basis while the other elements of the bridge can be inspected on the normal cycle as deemed applicable for the particular bridge.

Types of bridges considered FC will be but not limited to all trusses, one or two girders per span bridges, pin and hangers on two girder bridges, steel framed bent cap bridges, suspension bridges, railroad car bridges, and steel tied arch bridges

All bridges with FC elements on the public roads shall be inspected using FC inspection techniques. ARDOT policy will require that FC bridge elements be inspected one or more times per year as deemed necessary by the Inspector, District Bridge Inspection Engineer, or Central office.

### ***Underwater (Dive) Inspection***

This is a recurring inspection with a frequency of 60 months or less. Underwater (Dive) Inspections shall be performed by Consultants and the information shall be inputted by the Central Office. This is an evaluation of those portions of a bridge that are below the water line that meet one or more of the following conditions:

- a) Bridge without fully encased steel piles and continuously submerged which are not able to be inspected by normal observations.
- b) Structures where observed deterioration or misalignment above the waterline is thought to be caused by deterioration or distress below the waterline.
- c) Structures that appear to have significant problems below the waterline as determined by an Underwater Type 2 Inspection and are deemed necessary to make supplemental inspection by a diver.
- d) Damage by accident or natural forces where detailed results will not be revealed by other types of inspection.
- e) Bridges that have high traffic volumes exceeding 10,000 and crossing major rivers such as the Arkansas, St. Francis, and White River.

The most complex, costly, and hazardous type of underwater inspection requires the use of a diver. Other appropriate techniques should be considered before utilizing a diver.

Piers of major bridges are of a massive construction and often embedded in rock, or are on massive foundations. This type structure has a built-in integrity from both a design and construction viewpoint. Divers for this type pier should only be considered when warranted by criteria's b, c, d, and e of Underwater (Dive) Inspection.

When pile bents are exposed to water, they are usually in shallow streams that dry up sometime each year. Inspection of this type bent can normally be made by some other inspection method; however, in some instances, an inspection by a diver may be advantageous or mandatory.

An Inspector shall submit any bridge that meets one of the conditions listed for a Dive bridge to the Heavy Bridge Maintenance section to be evaluated for an Underwater (Dive) Inspection. If needed, the bridge will be combined with other bridges in that geographical area and an Engineer Consultant selected for a dive inspection. If after evaluation the bridge is found not to warrant a dive inspection, the HBM section shall document the reasons for not diving the bridge in the "Scour Tab" of the asset.

NOTE: The Mississippi River and Red River crossings will be excluded from this case due to the nature of the extremely high water velocities and other dangerous conditions, but Underwater Type 2 Inspections will be conducted.

Underwater Dive inspections that are going to fall 1 month late should have a reason documented in the late reason drop down box found on the ARDOT Agency Form. Underwater inspections that are going to fall more than 1 months late need to first receive approval from the FHWA Bridge Engineer. The Heavy Bridge Maintenance Section should submit late reasons for approval directly to [Pritesh.Mehta@dot.gov](mailto:Pritesh.Mehta@dot.gov). The reason should also be documented in the late reason drop down box found on the ARDOT Agency Form. An Underwater Dive Inspection **will** be coded under the (NBI) 92B as an Underwater Inspection.

### ***Underwater Type 2 Inspection***

This is a recurring inspection that ideally would be scheduled along with the Routine Inspection and during low water conditions if possible. Bridges requiring Underwater Type 2 inspections will include bridge length structures on the public highway system crossing water and having a minimum of 3 tons load limit. Culverts with an (Item 113) greater than “4” will be excluded.

A channel profile shall be provided for bridges where the channel and/or overbank material is an erodible material. This would include bridges where water is present only periodically.

All bridges requiring Underwater Type 2 Inspection will be inspected every 60 months or more frequently if judged necessary due to eroding water or detrimental conditions. The Inspector may also consider scheduling every 48 months to better align with the two year inspection cycle. Steel pile bridges in a corrosive environment will have a high priority for inspection and frequency of inspection. Following emergency situations - such as flooding, accident damage, or substructure settlement – an Underwater Type 2 inspection will be performed. Use this type of inspection when underwater evaluation is made for:

- Channel depth or profile by means of soundings using an electronic depth finder, measured probe or measured line with weight.
- Conditions of submerged substructure elements while wading, using a close visual or tactile (hands-on) examination and/or probing of the elements and adjacent streambed. Refer to the inspection levels described in the FHWA “Underwater Inspection of Bridges” report.

Soundings around piers and bents should be made on all bridges subject to scour from swift running water or where previous flooding has occurred. If, in the estimation of the District Bridge Inspection Engineer, scour could be a problem for a certain bridge during a flood, he should call for soundings from the bridge side, cat-walk or the bridge inspection unit. These soundings should then be compared with those from the normal river stages for any problems and should become a permanent part of the inspection file for that bridge.

Results of soundings should be plotted in Microstation or in an automated drawing in an Excel form showing the channel bottom in relation to footings or pile tip elevations, if available. Other methods of presentation may be used provided each bridge element is cataloged with condition number and type inspection used. Where it is necessary or useful, drawings should be presented to accurately describe the condition. Notes should be recorded under Item (61) Channel/Channel Protection. Underwater type 2 drawings should be combined and placed under the asset files so that a trend can be identified. The latest drawing should be placed under the inspection report files.

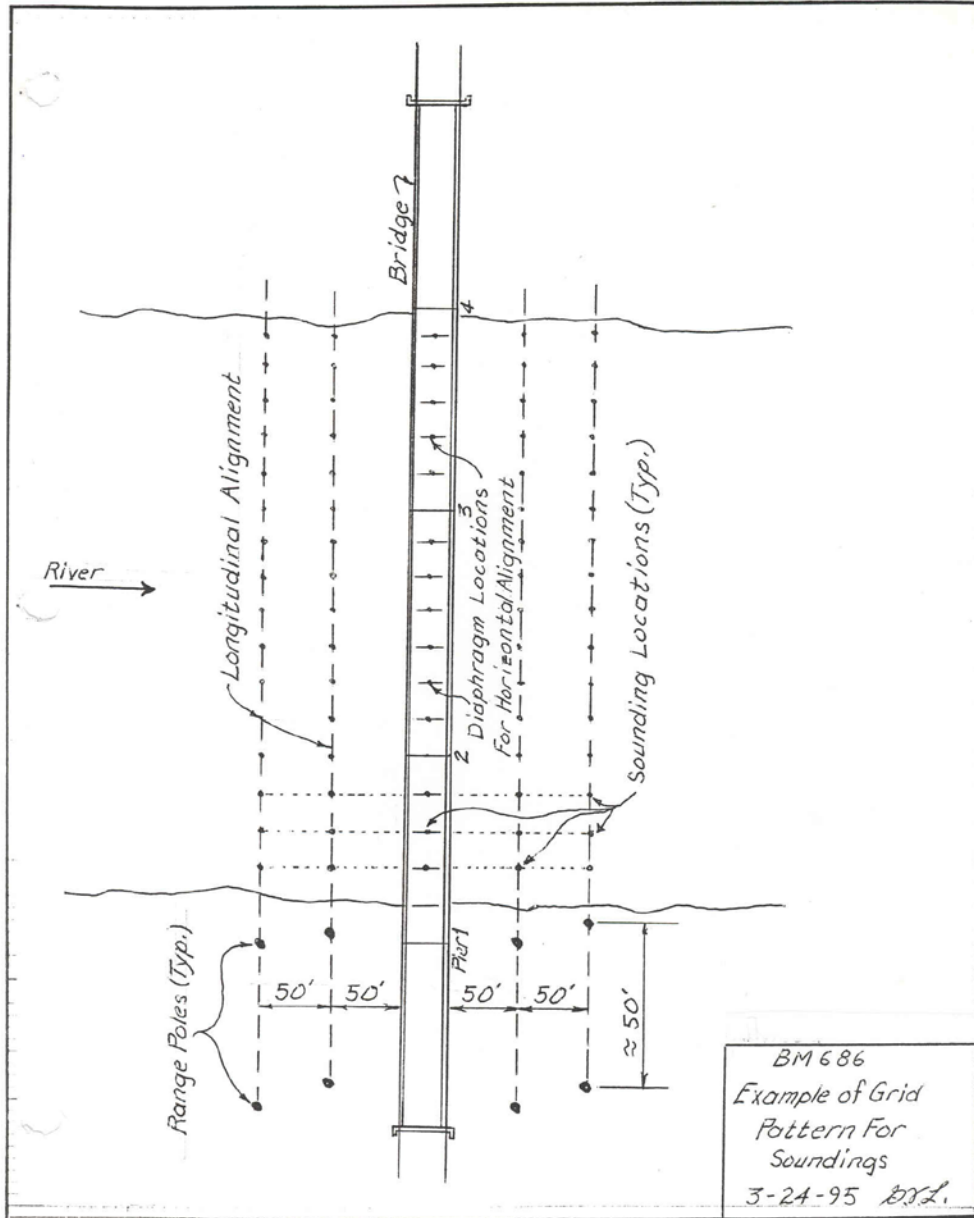
A simple method of taking a stream profile would be to measure the distance to the ground or bottom from the bridge deck at 10' intervals along the side of the bridge. Where deemed necessary by the District Bridge Inspection Engineer, a stream bed profile should be taken from 500' upstream to 500' downstream of the bridge.

One method that will aid in documenting soundings is to establish a grid pattern (see the example on the next page). To establish longitudinal alignment (parallel to bridge) place two range poles set on the bank 50' from the side of the bridge 50' apart. Establish longitudinal alignment on both the upstream and downstream sides of the bridge. To establish the grid pattern for transverse alignment use the bridge diaphragms and piers. Soundings should be made with reference to some point of known elevation on the bridge such as top of cap. The actual depth at each reference point of the grid may be determined by means of an electronic depth finder, measured probe, or measured line with weight. The electronic depth finder is more practical in swift water.

Structural components submerged in water generally of a shallow nature can easily be reached by probing rod or other tools (rod of approx. 12 ft. length). The probe will be one of the most useful tools available for an Underwater Type 2 Inspection in shallow water. A 12 to 15 foot long aluminum, 3/4" diameter, telescoping pole with pointed end is recommended. The inspector can "feel" along the side of piles and columns for weak spots and deterioration. Where areas are found to be suspect, other methods of inspection may have to be used for supplemental investigation.

Scour POA Inspections may use underwater inspection methods (probe/profile/wade) but they are for a specific purpose. If the inspection is documented as a Scour POA Inspection then there is no need to also document it as an Underwater Type 2 inspection.

An Underwater Type 2 Inspection **will not** be coded under the (NBI) 92B as an Underwater Inspection. Neither will an Underwater Type 2 Inspection be coded under the Other Special Inspection (NBI) 92C unless it is to monitor a known or suspected deficiency. For example, if it is a scour critical bridge and you are doing an Underwater Type 2 Inspection then that is a known (or suspected) deficiency and its date will be coded as Other Special Inspection (NBI) 92C.



DISTRICT \_\_\_\_\_ COUNTY \_\_\_\_\_ ROUTE \_\_\_\_\_ SECTION \_\_\_\_\_ LOG \_\_\_\_\_ BRIDGE NO. \_\_\_\_\_

### ***Under Clearance Record Inspection***

This is a recurring inspection that is performed to monitor the clearance of a bridge. This could be for a NBI bridge or a Non-NBI bridge such as a pedestrian bridge, railroad bridge, or other structure. Refer to FHWA Recording and Coding Guide. A picture of clearance posting sign should be included in the report. A under clearance drawing should be used to detail the vertical and horizontal clearance as a highway or railroad passes under the bridge. These values will be used to code Items 54, 55, 56, and 69.

By Arkansas State Law 27-35-207, the maximum height of any vehicle on state highways is 13'-6", unless a greater height is authorized by a special permit.

According to Maintenance Memorandum 95-10, "It shall be Department policy to post the actual clearance of all bridges that have a vertical roadway clearance of 15'-0" or less." ... "In addition, changes in vertical clearance due to maintenance activities should be measured by the District Bridge Inspector and reported to the Bridge Rating Section and the Permits Section as soon as possible. Bridges whose vertical clearance has been reduced to 15' or less shall be posted."

All structures over public roads and railroads shall have their vertical clearance checked every two years at a minimum and should be recorded as part of a Routine (NBI) inspection. A separate Under Clearance Record Inspection is not required when a Routine (NBI) Inspection is done. When the vertical clearance is 15' or less, the vertical clearance shall be checked yearly at a minimum.

If a Routine (NBI) is not scheduled when a clearance check is required, then the clearance should be recorded as an Under Clearance Record Inspection. If the under clearance is 15' or less and you are not doing a Routine (NBI), then an Under Clearance Record Inspection should be done.

### ***Other Special Recurring Inspection***

This is a recurring inspection for a known or suspected deficiency that does not fall under another category. This is an inspection that will be performed between the Routine (NBI) inspections. In general, only those elements on the bridges that precipitated the inspection will be assessed (i.e., a full inspection is not required at this time).

Other Special Recurring Inspections should not fall on the same date as a Routine (NBI) if it is something you would normally look at in a Routine (NBI) inspection. Say for example you want to look at a finger joint every year and you have a 24 month Routine (NBI) schedule. You should look at the finger joint during the Routine (NBI) so you don't need a Other Special Recurring for that inspection. Set your Other Special Recurring for 24 month and start it 12 month after your Routine (NBI). That way you look at the finger joint each year.

When scheduling an Other Special Recurring Inspection, add a comment in the comment box explaining why you are doing an Other Special Recurring. An Other Special Recurring Inspection will be coded under the (NBI) 92C as an Other Special Inspection only when it is for a known deficiency (i.e. scour critical, structurally deficient, etc.). Item 92C will be set at 24 months frequency but the date scheduled as often as needed.

### ***Accident Inspection***

This is a one-time non-recurring inspection that will be performed as necessary whenever a bridge is damaged, or suspected to have been damaged by vehicular or water traffic. If the event has not changed the condition of the structure, the inspection schedule should not change. The Inspector should include documentation in the report that the bridge was inspected and record any damage found. A particular awareness of the potential for litigation must be exercised in the documentation of damage inspections. Since an Accident Inspection is not recurring, it **will not** be coded under the (NBI) 92C as an Other Special Inspection.

In addition, if the damage was extreme enough to cause a load restriction on the bridge, then a follow-up Special Inspection should be performed after repairs have been completed. After which the Rating Section should be notified that a special inspection noting the repairs has been completed.

### ***Scour POA Inspection***

The Plan Of Action (POA) for a scour critical bridge should be attached in Asset Details/Asset Files/Scour tab.

If the POA calls for an inspection at a regular interval then that inspection should be coded as an Underwater Type 2 Inspection rather than a Scour POA Inspection. The Scour POA Inspection is a one-time unscheduled inspection (or documentation) that will be performed as necessary whenever directed by the scour plan of action after a triggering event. Requirements for the inspection can be found in the Scour Plan of Action.

The Scour POA Inspection was created to track when an action is taken based on the scour plan of action. The Event Monitoring Form that must be filled out to satisfy the scour POA should be scanned and attached to the **inspection report** in the Scour Tab located in the Pictures/Files. If it is a Local Bridge, then the form will be the only thing in the report and a note should be made in the “Comments” section when creating the report. It should read “Documenting local action only”.

If the inspection is documented as a Scour POA Inspection then there is no need to also document it as an Underwater Type 2 inspection. A Scour POA Inspection **will not** be coded under the (NBI) 92C as an Other Special Inspection.

## **Bridge Scour Plan of Action(SPOA) - Event Monitoring Form**

ARDOT Bridge No.: \_\_\_\_\_ Route carried: \_\_\_\_\_

Waterway crossed: \_\_\_\_\_

### **Description of data entered for the Scour Monitoring Event Report items below:**

**Inspected by:** *(name of person who performed the action(s) identified in the POA)*

**Date:** *(date of bridge monitoring to perform actions identified in POA)*

**Triggering event description:** *(Significant rainfall that raises water elevation to "Q25" or "Bank full" level)*

**High water:** *(Q25 or approximate "Bank full" water surface elevation, reference mark)*

**Action taken:** *(description of actions performed at bridge; if accessible, for example: soundings taken, closed bridge, notified owner of action need, verified bridge stability...)*

**Length of time out of service:** *(if any...)*

**Damage:** *(approach washout, abutment or pier settlement, wing wall damage, if any ...)*

**Repairs:** *(if any...)*

**Repair cost(s):** *(if any...)*

**Opened to traffic:** *(full, partial-one lane, load restrictions, emergency only ...)*

**Date opened:** *(if closed...)*

**Approved by:**

**IMPORTANT:** Place a copy of the completed/updated monitoring history document in the bridge file after each triggering event

### **Scour Monitoring Event Report**

**Inspected by:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Triggering event description:** \_\_\_\_\_

**High water:** \_\_\_\_\_

**Action taken:** \_\_\_\_\_

**Length of time out of service:** \_\_\_\_\_

**Damage:** \_\_\_\_\_

**Repairs:** \_\_\_\_\_

**Repair cost(s):** \_\_\_\_\_

**Opened to traffic:** \_\_\_\_\_

**Date opened:** \_\_\_\_\_ **Approved by:** \_\_\_\_\_



### ***Special Inspection***

This is a one-time unscheduled inspection that does not fit into one of the other inspection categories. It will be performed as necessary. The requirements for this inspection vary depending on the need for the inspection. This inspection **will not** be coded under the (NBI) 92C as an Other Special Inspection. When a special inspection is scheduled, there should be an explanation in the comment field explaining why it was performed.

### ***Late Inspection Justification Requirements***

Routine (NBI) 24 Month Frequency	<= 24 <sup>1</sup>	25	26 <sup>2</sup>
Extended Routine (NBI) 48 Month Frequency	<= 48	49	50
Fracture Critical	<= 24 <sup>1</sup>	25	26 <sup>2</sup>
Underwater (Dive)	<= 60	61	62
Note: A month is defined as a calendar month, not by days or weeks.	Inspection is completed before or in the month that it is due.	Late reason is approved by the Local Program Manager and documented in the late reason drop down box of ARDOT Agency Form.	Late reason is sent to FHWA for validation at least 10 days before the end of the 1st month past its due date. Approval from FHWA may be granted before the end of the 1st month past its due date and documented in the late reason drop down box found on the ARDOT Agency Form.

<sup>1</sup> The 12 month **scheduled** frequency is Department policy and not required by NBIS, therefore; approval from FHWA is based on the NBIS requirement of 24 months.

<sup>2</sup> The Department policy is that no Routine (NBI) or Fracture Critical Inspection should exceed 27 months except those approved for an Extended Routine (NBI). If one of these inspections cannot be performed in this time frame due to construction, weather, equipment problems, etc., a modified Routine (NBI) or Fracture Critical Inspection should be conducted as thoroughly as possible, followed by a Special Inspection when possible to address those items not covered in the modified Routine (NBI) or Fracture Critical Inspection.

### ***Extended Routine (NBI) Inspection Interval***

Paragraph 650.305(c) of the NBIS states, "The maximum inspection interval may be increased for certain types or groups of bridges where past inspection reports and favorable experience and analysis justifies the increased interval of inspection. If a State proposes to inspect some bridges at greater than a 2 year interval, the State shall submit a detailed proposal and supporting data to the Federal Highway Administrator for approval." FHWA Technical Advisory T 5140.21 states that submissions to the FHWA requesting longer inspection intervals must contain the following information as a minimum:

- (A) Structure type and description, age, load rating, condition and appraisal rating, volume of traffic carried, ADTT, major maintenance or structural repairs performed within the last 2 years, and an assessment of the frequency and degree of overload that is anticipated on the structure.
- (B) A discussion of failure experience, maintenance history, and latest inspection findings for the group of structures.
- (C) The proposed inspection interval.

The approved extended NBI inspection interval meet the following criteria:

- Reinforced concrete box culverts built with contract design plans
- Inventory rating of 15 tons or greater
- ADT less than 50,000 vehicles per day
- Field condition rating factor (NBIS – Items 61 and 62) of 7 or greater (Indicating very minimal maintenance need)

The Routine (NBI) inspection frequency of 48 months can be maintained as long as the conditions conform to the listed criteria. Central Office maintains the list of approved bridges and periodically verifies that the bridges meet the listed criteria. No additional bridges can be added to the group without approval.

### ***Numbering Bents, Spans, Beams, etc.***

If plans are available, the bents and spans shall be numbered as on the plans. When plans are not available, bents and spans shall be numbered in the report in the direction of the log mile. Beams shall be numbered as on the plans. If no plans are available, beams shall be numbered left to right looking in the direction of the log mile.

### ***Mechanically Stabilized Earth (MSE) Walls***

Mechanically Stabilized Earth (MSE) walls that function as a bridge abutment shall be inspected by the bridge inspector. The inspection will include the first 50 feet of an MSE wall perpendicular from the end of the bridge and the transverse portion under the bridge. Material leaching through the joints in the wall, vegetation growing through joints in the wall, and any differential settlement should be noted in the report.

### ***Replacement of Bridges by Non-Bridge Length Structures***

When a bridge length structure currently on the bridge inventory is replaced by a non-bridge length structure or is removed and not replaced, send an email or memo to the Bridge Inventory section with a

copy to the Heavy Bridge Maintenance Section requesting it be removed with an explanation of the situation.

# Chapter 3: InspectX Software

## ***Inventory***

Dashboard - Dashboards on each tab provide a general visual overview of the tabular data that can be found in the list sections of each module in inspectX.

List – use the list to show bridges in excel format. To add or delete columns – click on the three dots on the column headers and select columns to add or delete. To export the list to excel, click the excel icon in the upper right hand corner. Sort the list by clicking on the column headers.

Map – the map displays the x/y coordinates in NBI 16 and 17 of the bridges that meet the criteria of the filter. All will show if no filter is applied. To export results to map, click the google earth icon in the upper right hand corner. This will download a .kml file which can be used within google earth, google maps or maps.me. Maps.me is a very good app for offline navigation. It will let you add as many points to the map as you want. Unlike google maps, maps.me app will show all the points even if you don't have data.

Filters – are the inspectX version of a Query. Saved filters can be set to visible by individuals or by public. Saved filter criteria can't currently be viewed.

Elements - The elements section shows the elements on the bridges for whatever filter is applied. The quantities and corresponding percentages are shown for each element. These elements can be exported to excel for further analysis. For information pertaining to specific defects, contact HBM. HBM has database queries set up to look for certain defects.

## ***Schedule***

The Schedule tab at the top next to the inventory tab is being worked on. After HBM finishes cleaning up inspection data, this tab will be very useful. This tab will show which bridges are overdue in terms of NBI overdue. The summary for the schedule tab shows the scheduled dates for Routine, Underwater, F.C. and Special inspections.

## ***Inspection***

### Asset Files – attach files under “Asset Files”

#### Asset Fracture Critical:

- Fracture Critical Procedure
- Fracture Critical Drawing
- Fracture Reference Photo
- Blank Fracture Critical Inspection Report
- Blank Pin Document (If Fracture Critical Member)

#### Asset Plans:

- Layout PDF (Multiple Layout sheet can be formed into one document)
- Cross-section PDF (Multiple Cross-sections can be formed into one document)

#### Asset Sketch:

- Underwater type 2 inspection drawing and or channel soundings
- Combine to show multiple profiles (from separate inspections)
- Most updated under clearance drawing
- Most updated grid deck drawing

#### Asset Other Files:

- Lanes Log Lane Closure
- Pin Document (If Not Fracture Critical Member)
- AHP Request form

### Report Files – attach files under “Report Files”

#### Report Fracture Critical:

- Filled out Fracture Critical Inspection Report
- Pin Document (If Fracture Critical Member)

#### Report Sketch:

- Under Clearance Drawing
- Most updated grid deck drawing
- Underwater type 2 inspection drawing and or channel soundings.
  - Keep the drawing from the latest inspection here.

#### Report Other Files:

- Pin Document (If Not Fracture Critical)

Note: Underwater type 2 drawings should be combined and place under the asset files so that a trend can be identified. The latest drawing should be placed under the inspection report files.

### ***Photo Assignments***

<b><u>Type of Photo</u></b>	<b><u>Where to Attach In InspectX</u></b>
Inventory (roadway)	Inspection Direction
Elevation	General Observation – drag this photo to be the #1 photo in InspectX
Load Posting Signs	NBI 41 Posting
Typical Deck	NBI 58 Deck
Typical soffit/under surface	NBI 58 Deck
Fracture Critical photos	Put in fracture critical procedure and attach to asset. Attach photos to their relative location. Photos of two girder system – attach to super.
All others	Assign to same item that you normally do. All photos will have to have a photo assignment to be included in the report. If you have a photo that does not fit as an NBI, Element, Defect or Maintenance, assign the photo to the General Observation.

### ***Maintenance***

#### Inspecttech Maintenance Items:

- There are not “assignments” like there were in Inspecttech.
- Inspecttech used an outside filter to show when a maintenance item was “assigned” to a particular individual.
- Although the maintenance item in Inspecttech was “assigned” to a particular Engineer, anyone with the Engineer role could still go to the asset and open the maintenance item and change information within the maintenance item.
  - There were issues with assigning maintenance items to particular individuals in Inspecttech, thus we have done away with this.
  - This will prevent any maintenance items from being lost or held up by a single individual.
- Please try to forget the idea of “assigning maintenance” – this never worked in inspecttech like it was intended.

#### InspectX Maintenance Items:

- To view maintenance items, do one of two things:
  - Jump to structure, then click on maintenance, click the eye.
  - Click on the large maintenance title at the top – filter for maintenance items and view from this page.
- A maintenance item cannot be assigned to particular user.

- The excel sheet has the diagram of what the intended roles vs. the permissions

### ***Maintenance Items Operation***

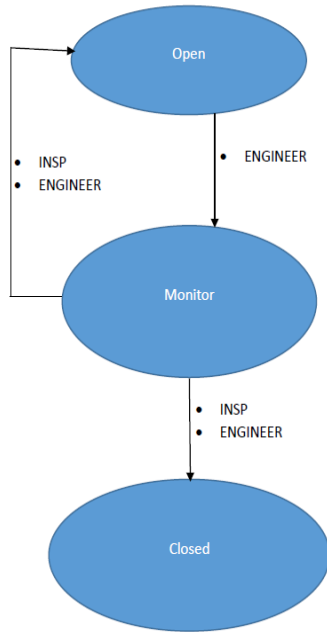
- i. The Construction Engineer (local program manager) needs to be the Engineer that looks at all “open” maintenance items.
  - a. Go to maintenance
  - b. Filter status for “open”
  - c. This is the entire list that the construction engineer needs to look at and change the status.
- ii. Construction Engineer – within this list, click on the structure number to go to asset, click on the asset maintenance tab, click the eye, click edit. Construction Engineer needs to be involved with Maintenance Items on bridges.
  - a. Change status to forward state
  - b. Change priority if needed
  - c. Add comments if needed
- iii. Maintenance Engineer – Filter for status of “forward State”
  - a. Change status to either “monitor” or “assign”
  - b. Change priority if needed
  - c. Add comments if needed
  - d. Most items would be monitor. Assign only if you plan to do the work.
- iv. DCE or DME or others can change status from monitor and assign to repair documented
  - a. Add comments and photos
  - b. Enter date completed.
- v. DCE/DME can change status from repair documented to closed or back to open.

#### **Notes:**

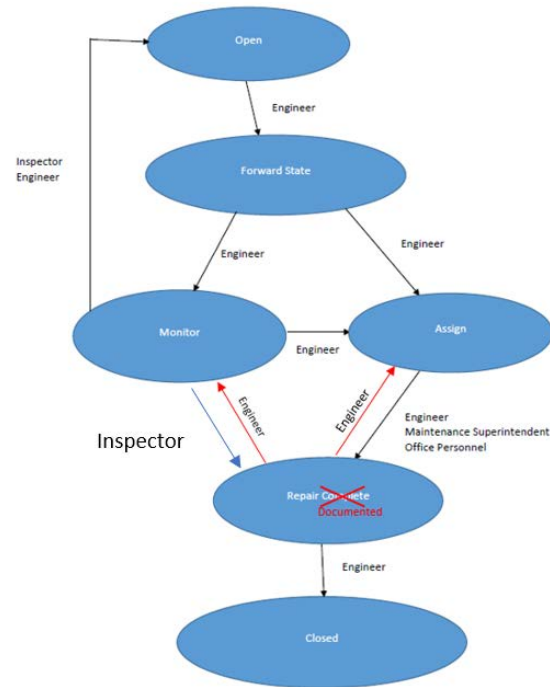
- Locally owned bridges just have status of open, monitor, and closed.
- “forward state” does not mean it is forwarding like an email
- Refer to the attached images for complete workflow capabilities.
- While DCE and DME have specific intended roles, they have the same permissions so that they have backup (in case one is on vacation, switches job, or needs assistance)

## Maintenance WorkFlows

### Locally Owned Maintenance Workflow



### State Owned Maintenance Workflow



## Draw

The draw feature in both the desktop and ipad application can be used to draw and annotate on a picture and save as a picture or a file on a bridge or an inspection.

### Inspection in the Field with inspectX:

- Put under water type II notes in the substructure NBI 60 notes.
- For new structures – open up an inspection -> go to inventory tab at the top -> scroll to the very bottom category -> enter each of the fields that you are responsible for.
- For Inspection Direction: enter “S to N”, “N to S”, “E to W”, or “W to E”
- Values that do not change do not need to be entered in again.
  - Previous values will carry over
- **NBI items 90, 91, 92/93 A,B,C**
  - The values are automatic within InspectX
  - NBI 92 frequencies are based on the frequency that is in the schedule.
    - Make sure to list Routine and Fracture Critical inspections as 24 month.
    - For Other Special Recurring: refer to frequencies of inspections for information on which frequency to set.
- Under Records: All information in the InspectX under records pertains to the Under Route (U).
  - There is not information stored here any longer for the On Structure (O).
- Scheduling a bridge:
  - List the team’s inspector as the Team Leader



- List the team's inspector and assistant inspector as the "Inspector"
  - List the team's inspector and assistant inspector as the "Reviewer"
  - This might not be how it is when it is carried over from InspectTech
  - You will have to add other names to the inspection roles
  - Pay attention and choose correct frequency
  - Pay attention and choose correct inspection type and element/NBI only
- To make any changes to an approved inspection:
  - Schedule an asset for a "Record Change" inspection
  - Perform necessary changes and approve.
  - Just need the person making the changes as the team lead, inspector, reviewer listed.
- Deck Width Vs. Out-to-Out:
  - These are the same thing. Item 52 is Deck Width, Out to out
- Maintenance:
  - When you create a maintenance item, write the comments in the deficiencies.
    - When changes are made to the status – put comments in the comments box
  - Assign all maintenance items to a component on the bridge
    - Posting problems – type of work: posting issue – component: approach
- Passwords:
  - For the initial use of inspectX, the password/login information will not be the same as your ArDOT login.
  - Use the one you have set up with it right now.
    - Default is "Password@123"
  - I will send out info when this changes to the ArDOT login.

# Chapter 4: Restrictions

## ***Serviceability***

When it is apparent that a critical aspect of a bridge is not functioning as designed or jeopardizes the structural capacity and has an appraisal of “Poor” and the basic condition factor guidelines do not adequately cover the situation, the District Bridge Inspection Engineer (District Construction Engineer), or an Engineer from Heavy Bridge Maintenance, or an Engineer from the Bridge Inventory and Rating Section should be consulted. If the assessment warrants a condition rating other than that reflected by the condition guidelines this should be explained in the comments area using the Engineer’s name.

When the appraisal for a critical aspect of a bridge is “Poor”, the condition rating for Item 58, 59, or 60 should be “4” or less. Element conditions should also be changed to coincide with Item 58, 59, or 60.

Examples for this situation would be:

A reinforced concrete slab bridge on pile bents in basically good condition but the spans are sliding off the caps (losing bearing area) and the bents have a definite lean.

A continuous steel girder bridge in good condition but the steel bearings are sliding off the end bent cap.

Concrete pile bents in good condition but are leaning or greatly out of plumb.

## ***Bridge Closures***

Any structure that cannot carry a minimum live load of 3 tons is recommended for closure. The following procedures will be used for notification immediately after the structure has been determined to be recommended for closure.

### ***Bridge Closure for Non-State Owned Bridges***

- A. If inspection reveals a dangerous situation that the inspector is sure that it requires immediate closing, he should:
  1. As able, restrict access to the bridge and inform the traveling public of the danger.
  2. Immediately notify the owner and local law enforcement that the bridge should be closed and notify the District Construction Engineer (DCE).
  3. The DCE will:
    - a. Immediately investigate the need to close the bridge.
    - b. Promptly notify the owner and the local law enforcement of his findings and whether the bridge should remain closed.
    - c. Promptly provide the inspection report and other appropriate information to the Bridge Division.
  4. Bridge Division will promptly send by certified mail official notification letters to the owner.

- B. If inspection reveals a dangerous situation, but the inspector is not sure immediate closing is required, he should:
1. Immediately notify the District Construction Engineer (DCE).
  2. The DCE will:
    - a. Immediately investigate the need to close the bridge.
    - b. If bridge closing is required, immediately as able, restrict access to the bridge and notify the owner and the local law enforcement of the need to close the bridge.
    - c. Promptly provide the inspection report and other appropriate information to the Bridge Division.
  3. Bridge Division will promptly send by certified mail official notification letters to the owner.
- C. If the Rating Section of Bridge Division determines by load analysis that a bridge should be closed, the following steps should be taken:
1. Bridge Division will:
    - a. Send by certified mail official notification letters to the owner.
    - b. Inform the DCE by telephone.
  2. The DCE will make prompt, verbal notification to the owner.

If the local owner has not closed the bridge within two business days of being notified of the need for closure, an Administration Official (Assistant Chief or higher) of the ARDOT will directly contact the local owner to persuade the owner to immediately comply with the bridge closure.

#### ***Bridge Closure for State Owned Bridges***

- A. If inspection reveals a dangerous situation that the inspector is sure requires immediate closing, he should:
1. As able, restrict access to the bridge. Inform the traveling public of the danger.
  2. Request assistance from the local maintenance yard to properly close the bridge.
  3. Immediately inform the District Engineer (DE) or the DCE.
- B. If an inspection reveals a dangerous situation that the inspector is not sure requires closing, he should immediately inform the DE or the DCE.
- C. If the Rating Section of Bridge Division determines by load analysis that a bridge should be closed, the Rating Section should immediately inform the Bridge Engineer and the DE or the DCE that immediate closure is required.

### ***Abandonment of Bridges by Local Governments***

According to 23 U.S.C. 101(a) (21), The term public road means “any road or street under the jurisdiction of and maintained by a public authority and open to public travel.” As such, the public authority has a responsibility to the public to maintain any bridge that can be traversed by the public. To remove a bridge from the local inventory the public authority must provide certification to the District Construction Engineer of one of the following:

- The ownership and responsibility has been transferred to another public authority.
- The owner must maintain restricted access to the structure so that the public may not traverse the structure.
- The road is not open to public access.

### ***Posting for State Owned Bridges***

The District Maintenance Engineer shall see that all posting issues for state owned bridges in their respective Districts are addressed within 30 days of notification.

A report of current load posting requirements for all State-owned bridges by District will be generated by the Bridge Rating Section for quarterly documentation. This list will include all of the bridges that require posting and their current posting status. The bridges requiring attention will be highlighted. This report will be sent to the District Construction Engineers via email and posted on the ARDOT drive: \\csd4\Room 901(DRB)\StateQtrBIWLReports.

This information will also be used to update the Bridge Restrictions Map located on the ARDOT web page by the Staff Structures Engineer or his designate.

The District Area Maintenance Supervisors are responsible for verifying that all signs are in place as shown on the quarterly load posting report. The Area Maintenance Supervisor will submit a Monthly Verification of Bridge Weight Limit Signs form to the District Maintenance Engineer by the 15<sup>th</sup> of each month. The District will submit the completed forms to the Bridge Rating Section as documentation of compliance regarding posting. The Bridge Rating Section will review the monthly forms received from each District and confirm that the InspectX database has been updated as required.

Between quarterly reports, if the recommended posting for a bridge decreases or the structure requires posting for the first time as a result of a load rating analysis, the Bridge Rating Section will notify the State Program Manager, Staff Structures Engineer, District Maintenance Engineer, District Construction Engineer and Bridge Inspectors via email. The email shall convey the reason for the posting change. The Construction Engineer will see that a maintenance item in InspectX is updated or created as needed.

### ***Posting for Non-State Owned Bridges***

A Weight Limit Posting Certification document will be sent by the Bridge Rating Section to the Local Owners for the posting requirements by October 1<sup>st</sup>. This document serves as yearly documentation of posting status. The document will provide a list of all bridges specific to the local Owner and the posting requirements for those bridges according to current information in the InspectX database. The Weight Limit Posting Certification document is described further in the current issue of “Local Government Procedures for Compliance with the National Bridge Inspection Standards” prepared and distributed by the ARDOT.

Verification of posting and requisition of materials for posting are detailed in the publication "Local Government Procedures for Compliance with the National Bridge Inspection Standards". The yearly documentation of verification and posting of locally owned bridges shall be submitted by the Local Owners to the respective District by December 31 and forwarded to the Bridge Rating Section. This annual verification from the Local Owners will be used by the Bridge Rating Section to update the Asset on the InspectX database and the Districts will update the corresponding Maintenance Items.

A local bridge that should be posted for 15 tons or less and is missing posting numbers or is posted too high, should be addressed within one month of notification. Posting issues that are over 15 tons should be addressed within two months of notification. The owner of the bridge will be promptly notified verbally and with an official notification by either certified mail or email marked delivery receipt. In addition, the local owner will receive an automated email notice on the 15<sup>th</sup> of each month of this posting issue from the inspection software until the owner has verified completion and it has been documented completed in the corresponding Maintenance Item. The District Construction Engineer, State Program Manager, Staff Structures Engineer, and the FHWA Bridge Engineer will also receive an email of all posting issues. The email shall convey the reason for the posting change. The Chief Legal Counsel of the Association of Arkansas Counties (AAC) will receive an email report of county posting issues when help is required for compliance.

The District Construction Engineer shall review the email notifications for local bridges and if any posting issue has passed the required timeframe to be addressed, the District Construction Engineer shall make contact with the Local Owner by phone to discuss the safety concern and a plan for resolution shall be worked out. If a posting issue has passed its required timeframe of action by two months or more, the State Program Manager will confer with the Assistant Chief of Operations for assistance in resolving the posting issue. The Chief Legal Counsel of the AAC shall be included in consultation for those issues involving counties.

When a bridge is found to have a weight posting safety issue during a bridge inspection, the District Bridge Inspection staff will send a Maintenance Needs Report to inform the Owner of the deficiency within one week of the inspection. The Owner shall be instructed by the District Inspection Staff to submit a Form VIII as documentation that the posting has been corrected. The Owner shall also be encouraged to include dated photographs showing legal signs at both ends of the bridge. The Department will accept verbal, a returned Form VIII or email notification from the Owner as documentation of completed posting and the date and means of notification shall be recorded in the bridge inspection software.

Upon written notification (Form VIII or other) by the Owner of a structural change, or the addition or the removal of a bridge from their inventory, ARDOT will inspect the bridge if deemed necessary for an inventory update.

Between annual certifications, if the inspection frequency of a bridge changes or the recommended posting for a bridge decreases or the structure requires posting for the first time as a result of a load rating analysis, the Bridge Rating Section will notify the District Construction Engineer and the District Bridge Inspectors via electronic mail. The District Construction Engineer will then notify the Owner by telephone and by letter and someone from the inspection team will add it to the Maintenance items and adjust schedule frequency as needed for that bridge. If a posting change requires a change in the current posting, the District Construction Engineer shall notify the Local Owner by letter and include the required posting numerals and a filled out Form IX to be signed and returned. In addition to the annual certifications, all

weight posted bridges will be required to be inspected at least annually and photographs taken to verify the posting status. The Public shall be kept aware of the posting status of locally owned bridges. This will be accomplished by the Department maintaining an up to date map showing all locally owned posted bridges. This will be made available to the Public through the web portal [www.idrivearkansas.com](http://www.idrivearkansas.com).

#### ***Tracking of Bridge Weight Posting Issues***

The HBM Section shall track all bridge weight posting issues. This tracking will be used to ensure that follow up with the Owner is completed and documented for those issues more than 2 months past the required timeframe of action.

**Weight Limit Signs General Information**

**ARKANSAS HIGHWAY & TRANSPORTATION DEPT.**

**BRIDGE DIVISION**

**VERIFICATIONS OF BRIDGE WEIGHT LIMIT SIGNS**

Inspected By J.P. Jones

Sheet 1 of 3

Date of Inspection 6-15-04

County Little River

Dist. No. 3

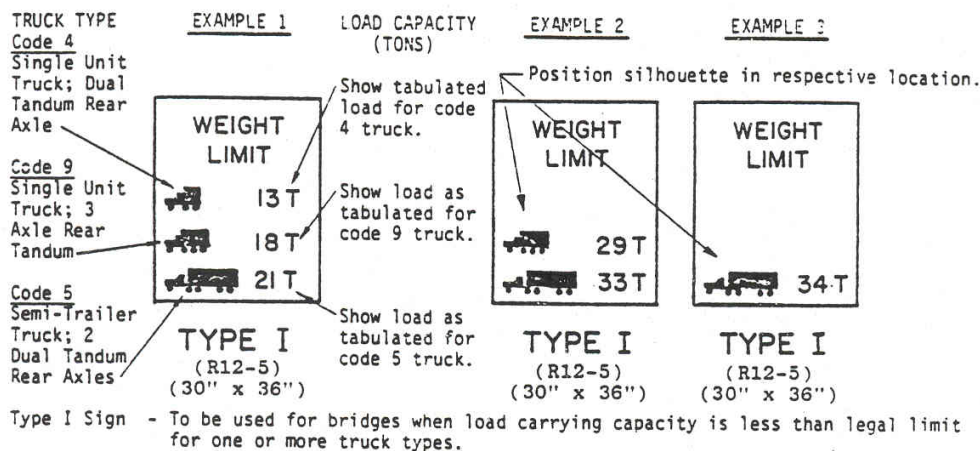
LOCATION RT-SEC.-LOG	BRIDGE NO.	TYPE OF SIGN—WT. IN TONS			NO. SIGNS IN PLACE	REPLACEMENT MADE BY & DATE	COMMENTS
		TRUCK CODE	I WEIGHT LIMIT	II WEIGHT LIMIT			
		4 9 5	<div style="border: 1px solid black; padding: 2px; display: inline-block;">                     11T 17T 21T                 </div>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">                     4 TONS                 </div>			
		4	9	5			
233-1-2.22	M3426	13	18	21	—	2	
233-1-4.22	M3542	—	29	33	—	2	
233-2-8.62	4210	—	—	34	—	2	
249-0-2.42	M2110	—	—	—	4	1	JPJ 6-22-04 3 signs in 2 months

NOTE: VERIFY WEIGHT LIMIT SIGNS IN PLACE. REPORT TO BE SUBMITTED BY AREA FOREMAN TO THE MAINTENANCE SUPERINTENDENT BY THE 15th OF EACH MONTH.

ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

STANDARD WEIGHT LIMIT SIGNS FOR BRIDGE POSTING

TYPES AND EXAMPLES OF WEIGHT LIMIT SIGNS



\*Note: Minimum posting for any bridge shall be 3 tons. Bridge warrants closing if the weight limit is less than 3 tons.

EXAMPLES SHOWING APPLICATION OF TABULATED LOAD CAPACITY




EXAMPLE	STATUS OF TRUCKS RESTRICTED ON BRIDGE	SAFE LOAD CAPACITY CODE	TABULATED LOAD CAPACITY*	POST BRIDGE FOR	SIGN TYPE
No. 1	All less than legal limit	3	413,918,521	413,918,521	I
No. 2	One single unit & semi-trailer	4	424,929,533	929,533	I
No. 3	One semi-trailer truck	4	425,931,534	534	I

Note: If safe load capacity code is 4 or less, bridge will not carry legal loaded truck(s) and is to be posted for the respective truck(s). See page 1.48 for maximum legal load operating vehicles governing load rating of bridge structures.

\*EXPLANATION OF TABULATED LOAD CAPACITY

CODE TONS

Code 4 Truck	4	13	
4=Dual Tandem Axle Truck	13		13=Gross Load of 13 Tons Allowed on Bridge
Code 9 Truck	9	18	
9=Triaxle Rear Tandem Tr'k.	18		18=Gross Load of 18 Tons Allowed on Bridge
Code 5 Truck	5	21	
5=Semi-Trailer Truck	21		21=Gross Load of 21 Tons Allowed on Bridge

MAXIMUM LEGAL LIMITS		
TRUCK CODE		TONS
4		22
9		31
5		40

GENERAL APPLICATION OF WEIGHT LIMIT SIGNS  
MAINTENANCE DIVISION  
ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

DRAWING NO. BM 420



# Chapter 5: Maintenance Needs

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## ***Maintenance Module***

The Maintenance Module is a component of InspectX that functions outside of the Collector Module so that repair work and/or comments concerning a maintenance need can be documented after the inspection report has been approved and locked from editing. The maintenance needs that are stored in the Maintenance Module are required to adequately describe the condition of a bridge and may be included whenever a printed inspection report is required.

Please note: InspectX maintenance needs will not update to the bridge page until the inspection that contains the maintenance need has been approved.

## ***Inspector Workflow for Maintenance Needs***

When adding a new maintenance item on the iPad, set the required fields: Date, Priority, and Description and attach any photos you may have taken. The item(s) will be uploaded when you upload the inspection report.

An old maintenance item that is not completed will be downloaded to the iPad when the asset is downloaded. Each maintenance item should be checked to see if the condition has changed. If changes are observed, the Description, Date and/or Priority should be updated and any needed photos taken. If the item's priority has increased, the workflow must be changed to "Open" after the inspection report is uploaded so that the DCE can "Review" the item again. Do not change the workflow unless the priority has increased or there is no longer a maintenance need for the item.

**If you observe an item on a state bridge that has been completed, note it in the Maintenance Comments box and set the Date Repairs Completed box.** Use the date you inspected or were notified if the actual date is unknown. The program is set up so that Inspectors cannot set State items to complete because an Engineer is required to sign off on the repair work for state bridges. This item will show up in the "State – Repair Complete Approval Required" filter that the DME should periodically check.

If the Bridge Inspector observes or is notified that an item on a local bridge has been completed, note the work done in the Work Description box and set the Date Repairs Completed box. Use the date you inspected or were notified if the actual date is unknown. Note in the Maintenance Comments box how the determination was made the repairs were completed (observation, notification from owner, etc.). Set the Workflow Stage to "Completed". Either the Inspection Team or Engineer may set a local bridge to "Completed".

To view all the pictures for a Maintenance Item you will need to look in the Rollup View which is located at the bottom of the Maintenance Item as the edit icon.

The following headings make up the main Maintenance Item form:

- Date Reported – The date the Maintenance Item was created or changed.
- Priority – The ranking of significance of the Maintenance Item.

- Type of work – Used to identify Posting safety issues and tracking of preservation activities by Central Office.
- Component – part of the bridge that the maintenance need is associated with.
- Deficiency Description – Describe the location of deficiency and a description of it.
- Work Description – Describe how the deficiency was repaired.
- Date Repairs Completed – The date the repairs were completed or if not known; the date when repairs were observed or District was notified.
- Maintenance Comments – Any additional comments that do not fit other note areas.

### ***Priority Codes***

CF = Critical Finding; action goal of 2 weeks

A = Safety Deficiency; requires prompt action

B = Pressing; within 6 months

C = Important; within 12 months

D = Routine; within 24 months

G = General/Preventive Maintenance

### ***Critical Findings***

All critical findings should have an updated picture(s) at each inspection. Conditions that constitute a critical finding include, but are not limited to the following:

<b>Condition of Critical Finding</b>	<b>Typically found by</b>
A partial or complete collapse of the bridge	Inspection
Structural or other defects that pose a definite and immediate public safety hazard	Inspection
A load rating of less than 3 Tons	Load Rating
Bridge not completely closed but closure is required	Inspection
A scour analysis results in a Scour Critical Item 113 of $\leq 2$	Scour Assessment
The bridge is open and a condition rating of 2 or less for any of the following Items: <ul style="list-style-type: none"> <li>• Deck, Item 58</li> <li>• Superstructure, Item 59</li> <li>• Substructure, Item 60</li> <li>• Culvert, Item 62</li> <li>• Channel and Channel Protection, Item 61</li> </ul>	Inspection

To record a critical finding, the Inspector would enter it into the Maintenance Needs describing both the critical finding and its location. It would be assigned a “CF” priority which should normally be addressed in some way within two weeks. This does not mean that the repair must be completed in that time frame but some action such as scheduling a repair action or requiring additional monitoring is required. The District

Construction Engineer may adjust the “CF” timeframe as necessary depending on the severity of the critical finding.

When the critical finding has been entered into the database it is subject to review by the District Construction Engineer. Once the District Construction Engineer agrees with the Bridge Inspector’s recommendation, it is marked reviewed in the software and becomes “active”. If the “CF” priority could warrant a change in the load posting, the District Construction Engineer shall immediately send an email to Bridge Division, Rating Section for further analysis. If the finding necessitates a reduced load rating, the Rating Section will immediately notify the District who will then address it if it is a state bridge or forward on to the local bridge owner. A critical finding should be looked at intervals not exceeding 12 months. This can be achieved with a special inspection.

It shall be the responsibility of the District Maintenance Engineer to see that all “CF” priorities on state bridges are assigned and the assignment noted in the inspection software. The District Maintenance Engineer will follow the progress of the State “CF” priority to its completion and see that corrective actions are entered into the inspection software. For bridges inspected by the state-wide Bridge Inspector, the District Maintenance Engineer duties shall be fulfilled by the Staff Heavy Bridge Maintenance Engineer.

If a “CF” priority involves a locally owned bridge, the owner of the bridge will be promptly notified verbally and with an official notification letter by either certified mail or email marked delivery receipt. In addition, the local owner shall receive an email Maintenance Needs report generated from the inspection software every month until recorded complete in the inspection software. For that reason, the Bridge Inspector shall verify that an owner email has been entered into the inspection software under the ARDOT Agency Form.

After action has been taken on City/County bridges, local governments shall complete the Maintenance Needs report (or Form VIII) and submit to the District. The District Construction Engineer shall see to it that returned information is entered into the database. The Form VIII will be scanned and attached to one of the Maintenance Items that were completed. If the local owner reports the critical finding completed, then the complete date should be filled in and the Maintenance Item should be marked completed in the software. Any action the owner reported should also be included in the note for the Maintenance Item. **If a posting issue is reported complete, Item 41 needs to be updated with a record change inspection.** Attachments, notes for Maintenance Needs and date of completion must be entered before the workflow is marked complete. Once a Maintenance Need is marked complete you cannot perform any other action to the Maintenance Need.

**All critical findings (State and Local) shall have remarks in the “Maintenance Comments” within two weeks of becoming active.** This could include an assignment of a crew or noting where the local owner has been informed.

All critical findings shall be monitored and tracked by the Heavy Bridge Maintenance Section. An Engineer shall review each critical finding and document the review in the Maintenance Comments field of the Maintenance Need. If the item is not deemed an actual critical finding, it shall be reclassified as another priority.

**Priority Code A**

Safety deficiency; requires prompt action.

This priority code is for deficiencies that should be prioritized and scheduled for prompt action. Examples would be: joint steel broken and projecting into traffic; navigational lighting that is out or damaged; the failure of one interior timber beam in a system of 6 beams; one failed interior pile in a four pile system; and missing posting sign. The inspector should notify the owner as soon as possible. Pictures of “A” priorities should always be taken and attached to the Maintenance Need.

**Priority Code B**

Important; 6 month completion goal.

This priority code is for deficiencies that should be prioritized and scheduled for a 6 month completion goal. Examples would be: potholes developing in the bridge deck; posting signs that need improvement but are still legible; bracing members that require replacing; or a crack developing at the end of a steel cover plate in a multi-beam system. If a deficiency could transition to a safety deficiency if unattended beyond 6 months, then the deficiency should be completed within 6 months. Pictures of “B” priorities should always be taken and attached to the Maintenance Need.

**Priority Code C**

Routine; within 12 months.

This priority code is for deficiencies that should be prioritized and scheduled within the next 12 months. Examples would be: bridge railing damaged; removal of drift build-up from piers; minor bolts missing in a primary member; and a timber deck with a few deteriorated timbers.

**Priority Code D**

Routine; within 24 months.

This priority code is for deficiencies that can be scheduled for repairs within the next 24 months. Examples would be: minor pot holes; bridge railing that needs reattachment; beam ends rusted through at non critical locations; repairing leaking joints; cleaning out drains; and vegetation removal from channel.

**Priority Code G**

General/Preventive maintenance.

This priority code is for general maintenance that can be scheduled as the work load permits. Examples of this type work would be: cleaning bridge decks; washing down bent caps; and painting steel beams.

The examples given above and below are not meant to cover all situations and be all inclusive but are only meant to be illustrations, the inspector should use his best judgment to set priority.

**Maintenance Needs for Bridge Weight Postings**

Bridge weight postings that do not convey the needed safety warning to the traveling public shall receive an “A” priority code. An “A” priority would include missing posting signs, unreadable posting signs and postings that reflect a weight limit above the recommended posting. Other posting issues such as obscured but readable numerals or postings shall receive a “B” priority code. Postings that reflect a weight

limit below the recommended postings may receive a “G” priority at the Inspector’s discretion since it is not considered a safety issue.

Vandalism of weight posting signs shall be documented in the Maintenance Items under the Work Code by using the drop down selection “Vandalism Problem”. Other weight posting issues that are a priority “A” or “B” shall use the drop down selection “Other Posting Problem”. All weight limit posting issues of a safety nature shall have one of these two codes to satisfy FHWA requirements for tracking of posting safety issues.

### ***Additional Examples of Bridge Maintenance Needs and Associated Priority Codes***

The following list is intended to provide typical examples when bridge maintenance needs should be reported on the Bridge Maintenance Needs. The priority codes associated with each maintenance need item is for typical conditions; however, the priority may be revised by the bridge inspector as deemed necessary to accommodate unusual situations. **The list is not intended as all inclusive**, but does serve as a guide for general classes of maintenance needs to be reported.

<b><u>Priority</u></b>	<b><u>Approach Roadway</u></b>	<b><u>Priority</u></b>	<b><u>Railing</u></b>
B-D	Approach Slab	B-D	Bridge/Parapet
C	Pavement Relief Jts.	B-D	Pedestrian
C	Shoulders	B-D	Median Barrier
D	Drainage - Off Bridge		
B-C	Guide Rail	<b><u>Priority</u></b>	<b><u>Clean/Flush</u></b>
A-B	Safety Issues for Load Limit Signs	G	Deck
B	Missing Clearance $\geq 13'-6"$	D	Pedestrian
A	Missing Clearance $< 13'-6"$	B-D	Bearing/Bearing Seat
B	Cut Brush To Clear Signs	B-D	Steel Horizontal Surfaces
<b><u>Priority</u></b>	<b><u>Deck</u></b>	<b><u>Priority</u></b>	<b><u>Painting</u></b>
B-D	Asphalt Wear Surface	G	Superstructure - Spot
CF-C	Timber Deck	G	Substructure - Spot
CF-C	Concrete Deck	D	Superstructure - Full
B-D	Concrete Sidewalk	D	Substructure - Full
B-D	Concrete Curb/Parapet		
<b><u>Priority</u></b>	<b><u>Deck Joints</u></b>	<b><u>Priority</u></b>	<b><u>Steel Superstructure</u></b>
A-D	Sliding Plate	CF-C	Stringer
A-D	Finger Joint	CF-C	Floorbeam
C-D	Compression Seal	CF-C	Girder
C-D	Joint Sealant	C-D	Diaph/Lat Bracing
A-D	Steel Extrusion	CF-C	Pin/Hanger
C-D	Other Types		

**Priority      Timber Superstructure**

CF-C      Stringer  
B-C      Other Members

**Priority      Truss**

CF-C      Member  
C      Portal  
CF-C      Member

**Priority      Reinf Conc/Prestress**

CF-D      Stringer  
C-D      Diaphragm  
B-D      Other Members

**Priority      Bearings**

B-D      Steel  
B-D      Steel  
B-D      Expansion  
B-D      Pedestal/Seat  
C-D      Lubricate

**Priority**

B-D      Abutments  
B-D      Abutment Slopewall  
C-D      Backwall  
C-D      Wing  
CF-B      Temporary Bent  
CF-C      Piers  
CF-C      Pile  
C-D      Masonry  
CF-C      Footing

**Priority**

B-D      Vegetation/Debris  
CF-C      Scour Hole  
B-D      Deposition  
B-D      Rock Protection  
C-D      Stream Deflector

**Priority**

C-D      Headwall/Wings  
C-D      Apron/Cutoff Wall  
B-C      Barrel

**Substructure**

**Erosion Control**

**Culvert**

***NBIS Form VIII Guidelines***

After repairs have been performed on City/County bridges, local governments shall complete Form VIII and submit to the District to be used to update the Maintenance Item(s). The Form VIII should be linked to one of the completed items before it is marked Completed and becomes locked from changes. If the returned Form VIII indicates that major structural repairs have been performed, a new "Special" inspection will be required.

ARKANSAS' BRIDGE INSPECTION PROGRAM  
FOR LOCAL GOVERNMENTS

Bridge Revisions Affecting Inventory Data

\*\*\* NOT FOR USE IN BRIDGE WEIGHT LIMIT SIGN REQUISITION OR CERTIFICATION \*\*\*

County or City Name: \_\_\_\_\_ Official's Signature: \_\_\_\_\_

* Bridge Number	* Route Number or Name and Feature Under Bridge	Description of Work Performed	Date Work Performed	** Recommended Action (ARDOT Use Only)

\* Refer to current "Bridge Inventory/Posting Certification" Report or other ARDOT notification (Maintenance Needs report, letter, etc...)

\*\* Recommended Actions by ARDOT District Office:

- 1 = Schedule Bridge Inspection and update database with revised inspection data
- 2 = Work performed does not necessitate reinspection (No Further Action Taken)

PLEASE SUBMIT THE COMPLETED FORM PROMPTLY TO YOUR ARDOT DISTRICT CONSTRUCTION ENGINEER

# Chapter 6: Steel Inspections

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## ***Steel Terminology***

**Fracture Critical Member** – A fracture critical member (FCM) is a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse. Bridges that contain fracture critical members are fracture critical bridges.

**Fatigue** – Fatigue is the tendency of a member to fail at a stress level below its yield stress when subject to cyclical loading. Fatigue is the primary cause of failure in fracture critical members. Describing the process by which a member fails when subjected to fatigue is called failure mechanics.

**Redundancy** – Redundancy is defined as a structural condition where there are more elements of support than are necessary for stability. Redundancy means that should a member or element fail, the load previously carried by the failed member will be redistributed to other members or elements. These other members have the capacity to temporarily carry additional load, and collapse of the structure may be avoided. On non-redundant structures, the redistribution of load may cause additional members to also fail, resulting in a partial or total collapse of the structure. There are three basic types of redundancy in bridge design:

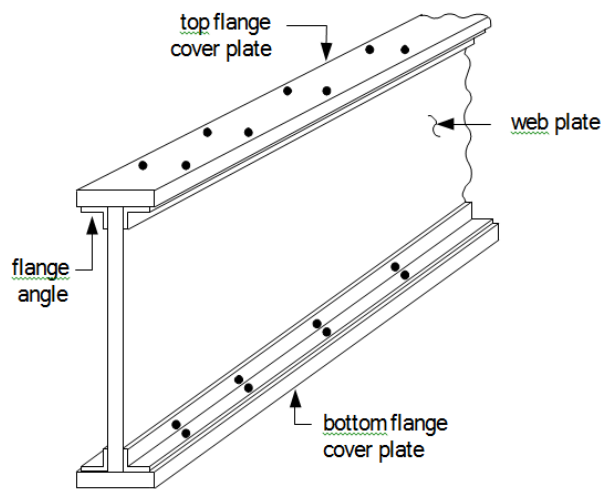
- Load Path Redundancy
- Structural Redundancy
- Internal Redundancy

**Load Path Redundancy** – Bridge designs that have three or more main load-carrying members or load paths between supports are considered load path redundant. If one member were to fail, the bridge load would likely be redistributed to the other members, and bridge failure may not occur. An example of load path redundancy is a multi-girder bridge.

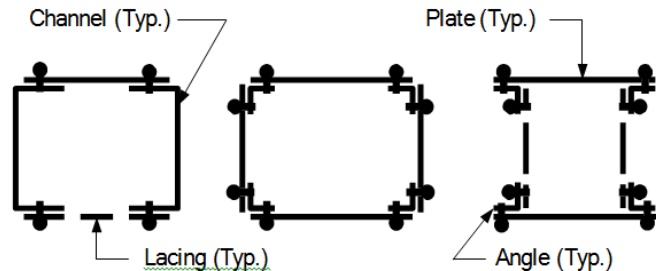
**Structural Redundancy** – Bridge designs which provide continuity of load path from span to span are referred to as structurally redundant. Continuous span arrangements consisting of three or more spans are considered structurally redundant. In the event of an interior member failure, loading from that span can be redistributed to the adjacent spans, and bridge failure may not occur. Continuous spans are structurally redundant except for the end spans, where the development of a fracture would effectively cause two hinges, one at the abutment and one at the fracture itself. This situation would lead to structural instability.

**Internal Redundancy** – Internal or member redundancy exists when a bridge member contains three or more elements that are mechanically fastened together so that multiple independent load paths are formed. Failure of one member element might not cause total failure of the member. Examples of internally redundant members are shown in the following figures.





Internally Redundant Riveted I-Beam



Internally Redundant Riveted Box Shapes

Internal redundancy of a member can be decreased or eliminated by repairs that involve welding. The welds provide paths for cracks to travel from one element to another

Bridge inspectors should be concerned primarily with **load path redundancy**. The inspector should neglect structural and internal redundancy and classify all bridges with less than three load paths as non-redundant. Non-redundant bridge configurations in tension contain fracture critical members.

### ***Fracture Critical Procedure***

A Fracture Critical Procedure is required for any bridge with a fracture critical member. It will be developed for each fracture critical bridge and attached in Asset Details/Asset Files/Fracture Critical tab. The Word document will include the following:

- A description of the fracture critical aspects of the structure
- Equipment and procedures required to access each fracture critical member
- Tools necessary for inspection, including any special equipment such as non-destructive testing devices.

Also, reference photos and a micro-station framing plan drawing or schematic labeling each fracture critical location shall be linked at the same location. An elevation view shall be included for trusses.

Upon completion of the Fracture Critical Inspection Procedure, the Inspector shall inform the Heavy Bridge Maintenance Section the procedure is available for review. An Engineer from the Heavy Bridge Maintenance Section shall verify that all fracture critical members have been identified and properly labeled. Once the procedure has been approved, the Engineer shall record the approval.

The Form III shall continue to be used to list all fracture critical elements, the inspection method used and the current condition factor at the time of inspection. The Form III shall be linked in the InspectX database under Picture/Files and Fracture Critical tab.

A complete list of all FC bridges will be maintained by the Central Office; this list will contain but not be limited to:

1. The bridge number, District, county, route, section, and logmile;
2. The method of inspection for each element.

All elements of FC bridges will be inspected by one or more of the methods of inspection listed below.

### ***Visual Inspection***

The most useful method of inspection is Hands-On Visual Inspection where the inspector makes an up close examination of each FC element. In most cases this will require a mechanical lift system or ladder to get up close to examine the detail. A borescope can be used in examining obscured members and a Lever Pit Gauge can be useful in estimating section loss. A keen eye is often the best tool for finding cracks. When cracks cycle open and close, the crack surfaces rub against each other, creating a fine steel powder that easily oxidizes when exposed to the environment. This often leads to rust staining, or discoloration, as the oxidized material bleeds from the cracks. This can offer quick visual detection of problem areas, but should not be used as the sole means of detection. Experience has shown that cracks have generally propagated to a depth between one-fourth and one-half the plate thickness before the paint film is broken, permitting the oxide to form. This occurs because the paint is more flexible than the underlying steel.

### ***Dye Penetrant Inspection***

Dye Penetrant Inspection (DPI) is effective in finding cracks that are open to the surface of steel elements. DPI method of examination should be used where it is suspected that a crack is present in a FC or Fracture Prone Element. DPI testing requires training in the use of the materials and surface preparation; its use is limited to suspicious areas.

A location where DPI will be useful is in the examination of ends of cover plates where rust stains are coming through the paint or the paint is cracked and a crack in the weld is suspect.

Dye penetrant is a three-part system applied to an area where a crack is suspected. Each component is usually contained in small, pressurized cans that can be easily transported in the field. The first step is cleaning/degreasing the area to remove surface contaminants; use a wire brush to remove heavy corrosion, but avoid grinding as it tends to smear out the crack. Then a liquid dye (commonly red in color) is sprayed onto the surface, and this dye seeps into the cracks. After a specified time (~60-90 seconds), the excess dye is wiped away from the surface. A white developer is then sprayed in the same area the dye was applied. The dye within the crack is then drawn out by the white developer, clearly showing the crack.

### ***Magnetic Particle Inspection***

Magnetic Particle Inspection (MPI) is effective in finding cracks that are open to the surface or below the surface of steel elements. MPI method of examination should be used where it is suspected that a crack is present in a FC or Fracture Prone Element. MPI testing requires training in the use of the materials, equipment and surface preparation; it also requires a considerable amount of time to make the test. Contact Heavy Bridge Maintenance if this test needs to be used.

A location where MPI will be useful is in the examination of ends of stiffener plates where rust stains are coming through the paint or the paint is cracked and a crack in the weld is suspect.

### ***Ultra Sonic Inspection***

This method of examination requires the use of Ultrasonic Inspection (UT) test equipment to examine for cracks that cannot be seen with the eye. This method of examination should be used where it is suspected that a crack is present in a FC element.

UT for flaw detection is a nondestructive method in which high-frequency acoustic waves are introduced into a material by a transducer placed on the surface. The acoustic wave propagates through the material and is reflected by discontinuities in the material. The reflected acoustic waves are detected by the transducer. The resulting waveform is analyzed to identify reflections that may be caused by discontinuities in the material. The technology can be used to detect weld flaws such as cracks, inclusions, weld porosity, or lack of fusion.

UT technology can be applied to truss members, steel girders, or other steel bridge components with a plate-like geometry (i.e., parallel surfaces). UT is often used for determining the thickness of a test member. Thickness gages are commonly used for the detection of section loss resulting from corrosion in steel bridge members. UT technology can also be applied to in-service bridges to detect and/or monitor the following:

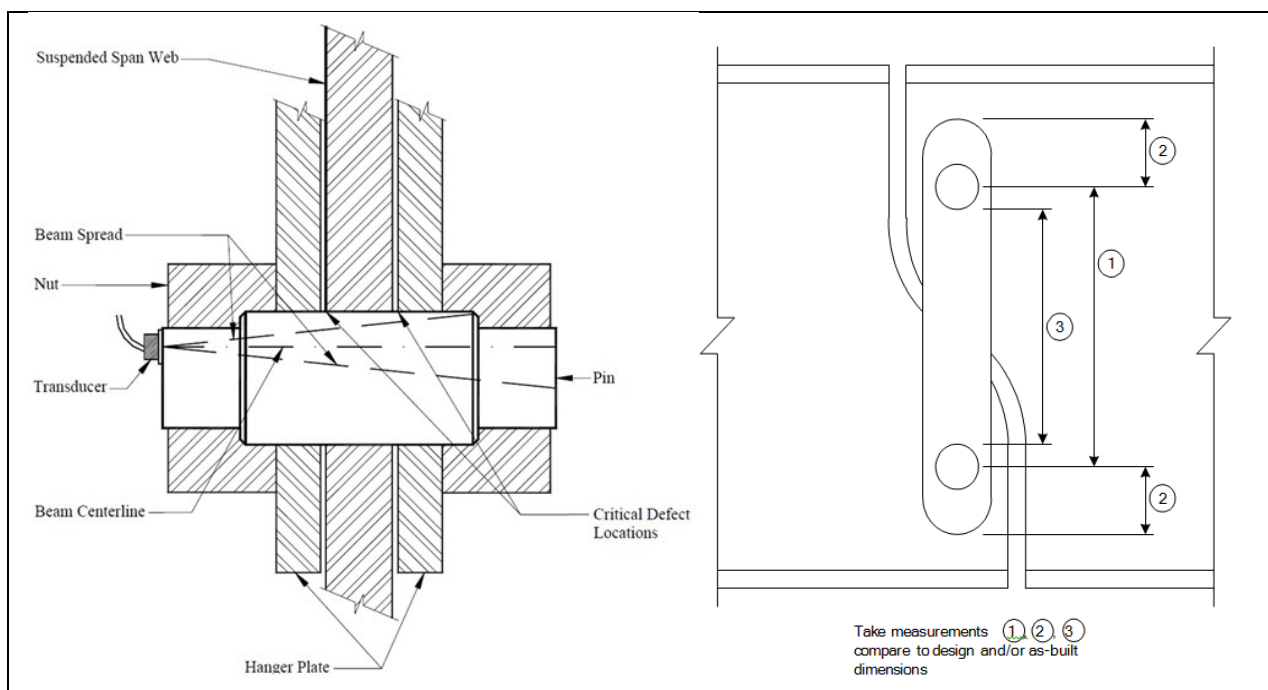
- Cracks in steel bridge members.
- Weld flaws such as cracks, slag inclusions, weld porosity, or lack of fusion in steel bridge members.
- Cracks in steel bridge components such as pins, hangers, and eyebars.
- Fractured anchor bolts.
- Thickness of a steel plate.
- Length of a bridge pin or anchor bolt.

Pins of Pin/Hanger bridges and Pinned Truss bridges will be inspected using UT equipment because most of the pin is hidden from view. Visual inspection practice doesn't reveal the potential cracks in the pins {Do not strike pins with a hammer to check soundness}. Since sound pins are so critical to bridges, the time and expense is well justified. It will be ARDOT practice to inspect pins using UT every 24 months or less as deemed necessary by the inspector.

When truss gusset plate section loss cannot be detected or adequately quantified by traditional measurement devices (calipers, depth probe, tape-measure, etc.), UT equipment will be used to adequately document the corrosion. The thickness measurements and their locations will be thoroughly documented. This information will be included in the inspection report for reference in conducting future inspections and to monitor the progress of corrosion. It will be ARDOT practice to inspect gusset plates requiring UT inspection every 24 months or less as deemed necessary by the inspector. Additional information on Nondestructive Evaluation (NDE) can be found at <https://fhwaapps.fhwa.dot.gov/ndep/Default.aspx>

### ***Pin and Hanger Assemblies***

We currently have 3 methods to evaluate our pin and hanger assemblies. The first is a simple visual inspection of a pin and hangers including joints and wind locks if present. The second is UT which is useful in determining whether or not you have a crack. The third is measuring the actual dimensions between the pins and also the distance from each pin to the end of the hanger assembly and compare these values to the planned dimensions. This is useful in documenting wear in the assembly. See the following drawings as an example of UT inspection and documentation inspection.



Try to determine if movement is taking place. Corrosion can cause fixity at pin and hanger connections. This changes the structural behavior of the connection and is a source of cracking. Powdery red or black rust where surfaces rub indicates movement. It may or may not indicate appreciable section loss. An unbroken paint film across a surface where relative movement should be taking place indicates the pin is frozen.

Some movement due to traffic vibration may be observable. If this movement is excessive, or if there is significant vertical movement with live load passage, the pins or pin holes may be excessively worn. Contact the HBM section as this may warrant a pin/hanger replacement.

The expansion dam, beam ends, and any other structural components in the hinge area should be studied to see if any unusual displacements have taken place.

Examine the hanger plates for cracks due to bending of the plate from a frozen pin connection. Observe the amount of corrosion buildup between the webs of the girders and the back faces of the plates. Inspect the hanger plate for bowing or out-of-plane distortion from the webs of the girders. Any welds should be investigated for cracks. If the plate is bowed, check carefully at the point of maximum bow for cracks that might be indicated by a broken paint film and corrosion.

Measure the distance between the back of the hanger and the face of the web at several locations. Compare these measurements from location to location and hanger to hanger. Variations greater than 1/8 inch could indicate twisting of the hanger bars or lateral movement due to rust packing. These measurements should be carefully described and recorded in permanent notes for comparison with measurements taken at the next inspection.

### ***Steel Failure Mechanics***

Steel failure mechanics involves describing the process by which a member fails when subjected to fatigue. The fatigue failure process of a member consists of three stages:

- Crack Initiation
- Crack Propagation
- Fracture

Crack Initiation - Cracks most commonly initiate from points of stress concentrations in structural details. The most critical conditions for crack initiation at structural details are those combining high stress concentrations due to: flaws, connections and out-of-plane distortions.

Crack Propagation - Once a fatigue crack has initiated, applied cyclic stresses cause propagation, or growth, of a crack across the section of the member until it reaches a critical size, at which time the member may fracture.

Fracture - Once a crack has initiated and propagated to a critical size, the member fractures. Fracture of a member is the separation of the member into two parts. The fracture of a critical member may cause a total or partial bridge collapse.

### ***Fatigue Cracking***

Most critical conditions for fatigue cracking are those which involve a combination of flaws and stress concentrations. Girders, stringers, floorbeams, diaphragms, bracing, truss members, hangers, and other members must be structurally connected. Bridge structures, particularly those that are welded, cannot be fabricated without details that cause some level of stress concentrations.

### ***Welds***

Welds are the connections of metal parts formed by heating the surfaces to a plastic (or fluid) state and allowing the parts to flow together and join with or without the addition of filler metal. The term base metal refers to the metal parts that are to be joined. Filler metal, or weld metal, is the additional molten metal generally used in the formation of welds. The complete assembly is referred to as a weldment. Conditions of stress concentration are often found in weldments and can be prone to crack initiation.

The four common types of welds found on bridges are groove welds, fillet welds, plug welds, and tack welds.

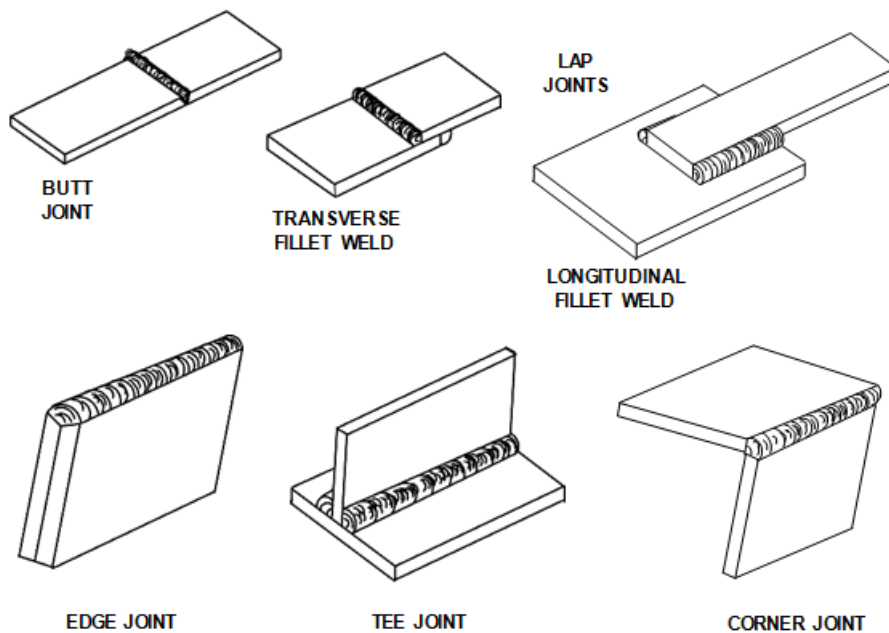
*Groove Welds* – Groove welds, which are sometimes referred to as butt welds, are used when the members to be connected are lined up edge to edge or are in the same plane. Full penetration groove welds extend through the entire thickness of the piece being joined, while partial penetration groove welds do not. Weld reinforcement is the added filler metal that causes the throat dimension to be greater than the thickness of the base metal. This reinforcement is sometimes ground flush with the base metal to qualify the joint for a better fatigue strength category.

*Fillet welds* – Fillet welds connect members that either overlap each other or are joined edge to face of plate, as in plate girder assembly of web and flange plates. Fillet welds are the most common type of weld because large tolerances in fabrication are allowable when members are lapped over each other instead of fitted together as in groove welds.

*Plug welds* - Plug and slot welds pass through holes in one member to another, with weld metal filling the holes and joining the members together. Plug welds have sometimes been used to fill misplaced holes. These repairs are very likely to contain flaws and micro-cracks that can result in the initiation of fatigue cracking. Plug welds are no longer permitted by AASHTO for bridge construction.

*Tack welds* - Tack welds are small welds commonly used to temporarily hold pieces in position during fabrication or construction. They are often made carelessly, without proper procedures or preheating, and can be a fatigue-prone detail.

Both plug and tack welds are smaller than fillet and groove welds but they can be the source of serious problems to bridges and should be investigated closely.



Types of Welded Joints

All welding processes result in high built-in residual tension stresses, which are at or near the yield point in the weldment and in the base metal adjacent to it. Load-induced stress concentrations also often occur at welded bridge connections, where these residual tensile stresses are high. This combination of stress concentration and high residual tensile stress is conducive to fatigue crack initiation. Such cracks

typically begin either at the weld periphery, such as at the toe of a fillet weld, where there typically can be sharp discontinuities, or else at an internal discontinuity such as a slag inclusion or porosity. In the initial stages of fatigue crack growth, much of the fatigue life is expended by the time a crack has propagated out of the high residual tensile stress zone.

Welded details tend to be less forgiving of small weld discontinuities than riveted details because welds are more sensitive to repeated stresses. Once cracking starts to develop, it can destroy the member base metal as a result of the continuous path provided by the welded connections. Cracking has developed more frequently in welded bridges because of flaws that escape detection, the use of details less fatigue resistant than assumed in the design, and secondary and displacement induced stresses.

### ***Crack Areas***

It is important the Inspector realizes that cracks are only readily detectable visually as a through crack after most of the fatigue life cycle is gone. The following areas have a higher possibility of cracking and should receive close scrutiny:

- Plug welds
- Tack welds
- Out-of-Plane bending
- Nicks, notches and indentations (Truck Impacts)
- Flange/web coping without proper radius
- Flame cuts
- Toe of a transverse stiffener that is welded to the web
- Poor quality welds
- Intersecting welds

Any web cracks discovered in a tension zone should be brought to the immediate attention of an Engineer in the HBM Section and/or in the Rating Section.

Fatigue cracks can also develop at welded details in the compression regions of steel bridge members. However, when a crack propagates out of the weld tensile- residual-stress zone and into the adjacent compression region, the crack growth usually stops. Because of this, the inspection of welded details in regions of nominal compressive stress is of lower priority than in tension regions.

### ***Riveted and Bolted Details***

Fatigue cracking can occur at riveted or bolted details, particularly as the result of secondary or displacement-induced stresses, or from assembly tack welds which have not been removed. Framing connections intended to provide only simple support, but by their function tend to resist bending moment, are suspect locations. Fortunately, crack growth is often inhibited by multiple element members, i.e., internal redundancy.

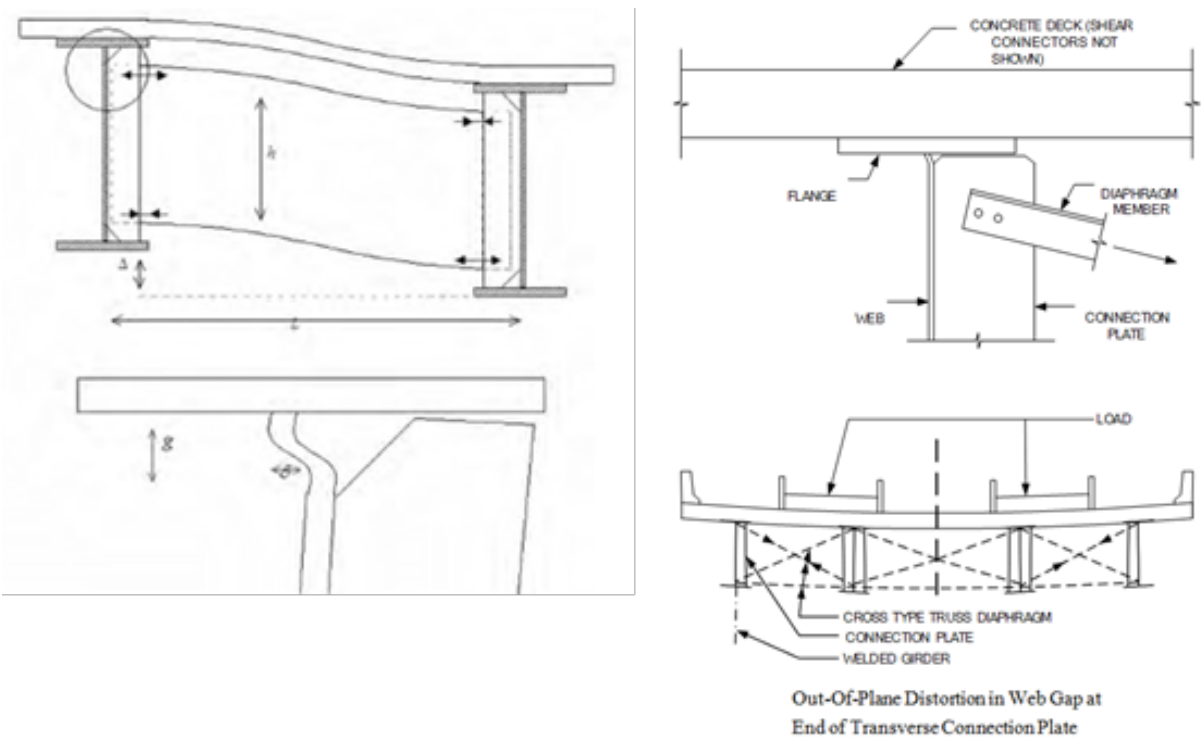
Most riveted bridges were constructed prior to the 1960's when bolted connections became common. Because of their age and the number of stress cycles already experienced, the close inspection of riveted members and connections in bridges with high truck traffic volume is necessary. In general, the locations where fatigue cracks develop in riveted bridges are similar to those in welded bridges.

### ***Out-of-Plane Distortion***

Deflection of floorbeams or diaphragms can cause out-of-plane distortion in the girder webs. You will see this more when you have skewed bridges where the diaphragms are not skewed and are subjected to large differential vertical deflections. If the girder flange is relatively thick and stiff against lateral displacement, most of the deflection is accommodated by bending of the web plate across a small web gap between the flanges and end of vertical connection plates.

When cracks form in planes parallel to the stresses between the flanges and end of vertical connection plates they are not typically detrimental to the performance of the structure. Even though distortion induced cracks are usually parallel to the primary stress direction, they can turn perpendicular. Retrofits such as drilled holes are often used when cracks turn perpendicular to the primary stresses.

Once an out-of-plane bending crack is identified, it is extremely important that all similar locations on the structure also be carefully inspected to search for similar damage.



Two very common instances are in the web gap at unconnected cross-frame connection plates, that is, connection plates which are not attached to the beam or girder flanges, and at similar web gaps at floorbeam connections to main girders.



When distortion-induced cracking develops in a bridge, there are usually large numbers of cracks that form before corrective action is taken, because the cyclic stresses are often very high. As a result, many cracks form simultaneously in the structural system.

### **Corrosion**

Corrosion is the most common form of defect found on steel bridges. More section loss results from corrosion than from any other cause. However, few bridge failures can be attributed solely to corrosion. Shallow surface corrosion is generally not serious but is quite common when the paint system has failed. Measurable section loss is significant as it may reduce the structural capacity of the member. Accurately measuring and documenting the extent and location of section loss is one of the primary responsibilities of the bridge inspector, and is essential in evaluating the load-carrying capacity of a steel bridge.

The bridge inspection report should accurately describe the location and extent of any significant section loss - section loss is typically expressed as a percentage of the original cross-sectional area.

- On members subjected to axial loading (such as truss members), section loss is typically expressed as percentage of the entire member cross-section. *For example: "truss bottom chord member L2-L3 has 15% section loss at the L2 connection".*
- On members subjected to bending moment (such as girders or beams), section loss is typically expressed as percentage of the bottom flange, top flange, or the web cross-section. *For example: "the bottom flange of the girder 5 has 10% section loss at the 1<sup>st</sup> deck drain east of Pier 2".*

When describing section loss in an inspection report, it is important that the extent of section loss not be misrepresented. For example, the bottom flange of a girder has a 1" diameter hole which constitutes 15% of the total bottom flange cross-section. While the flange has rusted completely through at the hole, this **should not** be described as "the bottom flange has 100% section loss", but rather as "the bottom flange has 15% section loss" (or "the bottom flange of a girder has a 1" diameter hole").

If the original cross-section has not yet been determined, it may be better to describe the location and dimensions of the area with section loss. For example: Girder 3 has 4" wide by 2" high area of pitting (up to 1/8" deep) at Abutment 1 bearing".

### **When Measurements Are Needed**

As a general rule, section loss measurements should be taken if the approximate section loss on a primary structural steel member exceeds 5% of the total member cross-section (or 5% of the flange or web cross-section). As it is not generally practical to accurately measure and document every area of section loss on a bridge, some judgment must be used by the inspector in prioritizing the locations where section loss measurements are taken. Highly stressed portions of the structure (such as the bottom flange near the center of a span) should be prioritized for section loss measurements. If section loss is present at similar details throughout a bridge, measurements should be taken at locations that appear to have the most severe and/or extensive section loss.

## **Corrosion Likely Locations**

The locations where corrosion (and section loss) will occur on a bridge are typically predictable - steel members exposed to salt spray or covered by debris will typically have section loss. The exact locations will vary depending upon the structural configuration and features present on the bridge - locations where corrosion (and section loss) is likely to occur include the following:

- Structural members located below deck joints
- Bearing areas
- Areas below deck drains or adjacent to downspouts
- Areas located directly above traffic (exposed to salt spray)
- Horizontal surfaces, field splices, or other details that tend to accumulate debris
- Fascia girders, beams, or stringers will typically have more corrosion and section loss than interior members - particularly along the exterior bottom flange.
- On bridges with concrete decks, corrosion will tend to be localized (below deck joints or leaching cracks) - on bridges with timber decks, corrosion may be widespread.
- Through truss and pony truss bridges will typically have section loss along the bottom chord, particularly at the panel point connections - section loss may be present on the truss members or gusset plates. Truss diagonal and vertical members will typically have corrosion at the railing connections, at the curb level, and at the bottom chord connections.
- Steel box girders (or other box sections) will develop internal corrosion if moisture accumulates within the box section.
- Steel piling will typically have corrosion at the waterline and/or ground line.

## **Cleaning Prior to Inspection**

In order to properly inspect a steel member, and to determine the extent of section loss, the steel must first be cleaned of any dirt, debris, or excess flaking rust. A large build-up of debris on a steel member indicates not only inadequate maintenance, but also indicates inadequate inspection. A bridge inspector should have ready access to cleaning tools such as a shovel, spade, whisk broom, wire brush, pick hammer, or scraper. Inspection during (or immediately after) re-painting contracts will often allow for more precise section loss measurements.

## **Methods of Measurement**

During a bridge inspection, initial section loss is often estimated (often aided by a straight edge or ruler) - as section loss advances, more precise measurements may be necessary. Calipers are a simple and inexpensive method of measuring the thickness of the remaining steel, but they may not be able to reach some locations (such as a girder web). An ultrasonic thickness gauge or a pit gauge are effective in obtaining thickness measurements - these can be used in confined areas or locations where only one side of the member is accessible.

## **Field Notes and Cross-Section Diagrams**

On areas of severe section loss, field notes may be required. Field notes should be thorough, concise, and readable - they should include not only the thickness measurements, but the exact location where those measurements were taken. To determine the extent of section loss on a structural member, the original

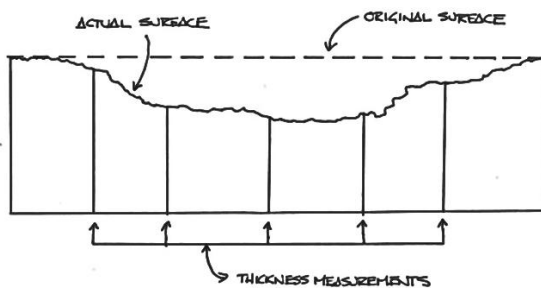
cross section area must be known. If no plans are available, measurements and thickness readings should be taken in areas without section loss to establish a basis for the section loss calculations. Plan dimensions and thicknesses should be verified.

Cross-section diagrams are helpful in documenting field measurements and performing section loss calculations. If possible, blank forms (with cross section diagrams) should be prepared prior to taking field measurements. To facilitate section loss calculations, the exact location of all thickness readings should be recorded - areas with section loss should be clearly indicated.

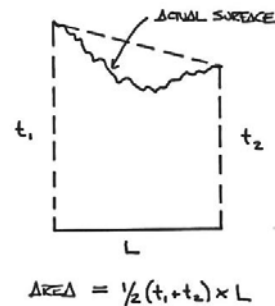
All cross-sections should be recorded in a micro-station drawing and attached under Report Info/Picture Files/Sketch.

### Section Loss Calculations

When performing section loss calculations, the level of accuracy will generally depend on how many thickness measurements are taken - the more measurements are taken, the greater the accuracy. One common method of calculating section loss is to simply take the average of several thickness measurements over a portion of the member cross-section. A slightly more accurate method is to divide the cross-section into trapezoidal sub-areas, based upon the exact locations of the thickness measurements - these areas are then calculated separately and added up. Whatever method is used, it should be done clearly and consistently, so the calculations can be easily checked and verified.



Cross-section showing location of thickness measurements



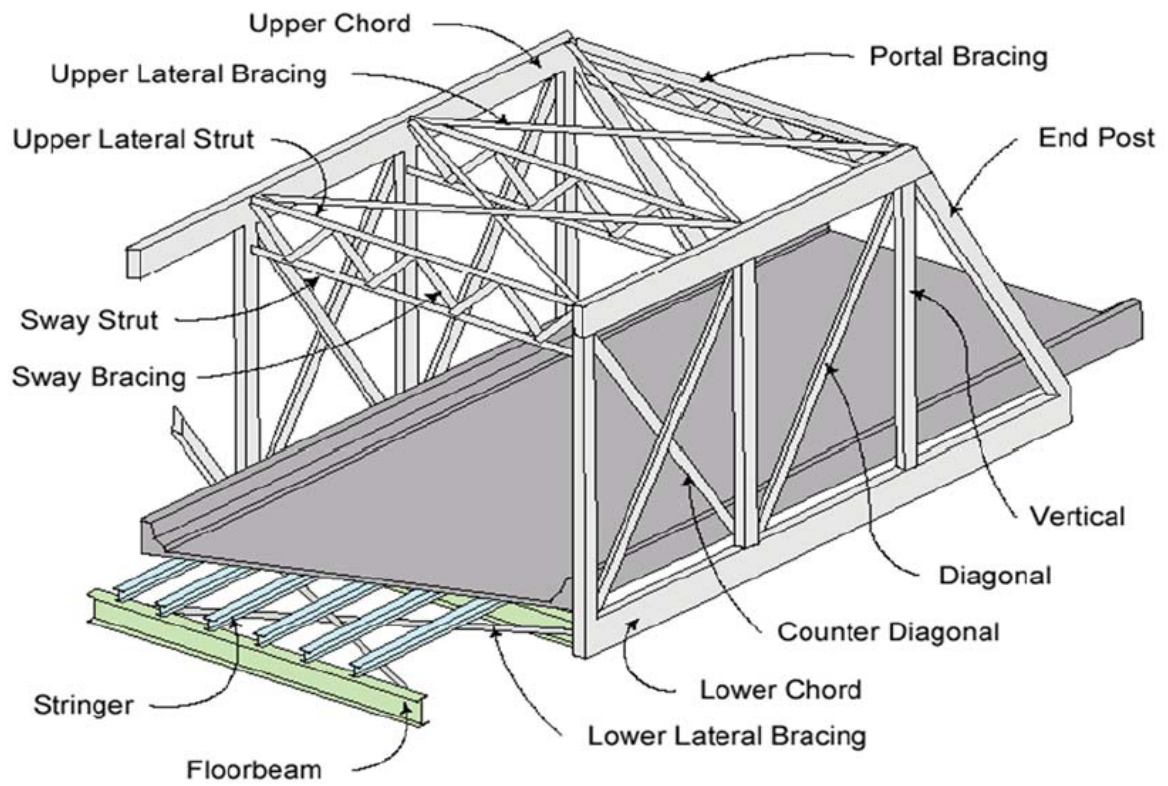
Trapezoidal sub-area

### Truss Bridge

A truss bridge is actually two parallel trusses that are tied together by the floor beams and lower lateral bracing at the lower chords, and by the struts, portals, and upper lateral bracing at the upper chords. The trusses themselves are composed of the upper chord which is the topmost member of the truss, the lower chord which is the bottom member of the truss, and vertical and diagonal members that connect the upper and lower chords. Floor beams, with and without stringers, support the deck. The upper and lower lateral bracing provide lateral stability to the trusses, as well as hold them parallel to each other.

The following drawing is a breakdown of the typical elements of a truss bridge.

## Elements of a Truss



# Chapter 7: Concrete Inspections

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## **Delamination**

Delamination in concrete can be a serious problem and often are “heard” before they are seen. The most common NDE method for concrete structures is by sounding. Sounding is used to determine the presence of delamination within a concrete element and is typically performed using a hammer on the surface of concrete substructure units and using a chain drag when evaluating the condition of a concrete deck. Delamination typically results from corrosion of the reinforcement bars or de-bonding in the case of a concrete overlay.

The test procedure involves delineating between sound and unsound concrete by the sound produced when struck by a metal object such as a hammer or chain. With little experience an Inspector can begin to delineate the different sounds produced. However, it does take a trained ear to differentiate defects that are located further below the surface and to clearly identify the true limits of defects. Many delamination are visible on the surface due to the general deterioration of the concrete, but others show no visual signs and require another NDE method to locate.

## ***Chain Drag***

The chain drag is a method of sounding concrete and is typically used to evaluate the condition of a concrete bridge deck. The chain drag allows inspectors to cover a large area of deck surface in a short time with a reasonable amount of accuracy. The chain drag survey is also a low cost alternative to other NDE methods. Due to its low cost, many agencies use this method as an initial evaluation to determine the need for further investigation. Like hammer sounding methods, the chain drag test is subjective, and therefore requires an experienced inspector to perform the survey with a high degree of accuracy. Also, localized areas are harder to detect with a chain drag, and may require hammer sounding to provide accurate limits of the delamination. Due to the nature of the test, localized areas of delamination are more difficult to detect.

The chain drag survey simply entails dragging a chain over the concrete surface and listening for the sound difference between sound and unsound areas of concrete. The device typically consists of a four or five sections of chain mounted to an 18” (+/-) long tube. The chain sections are 12” to 18” long and the tube is connected to a handle that can be fabricated to any length for operator comfort. The test is performed by dragging the chain sections across the surface of the concrete and marking areas that produce a dull sound. Care must be taken to accurately differentiate and mark the unsound areas. This usually involves going over a suspect area several times to clearly identify the locations of unsound concrete. A grid system should be constructed on the surface of the deck so that delaminated areas can be plotted easily. This test usually involves two people conducting the test: one to drag the chain and one to do the marking.

## ***Reinforced Concrete***

Reinforced concrete is designed so that the concrete carries the required compression while the embedded steel carries the tension. Cracking in the concrete may indicate that the steel is not sufficient to carry the tension loads so special attention is given to cracks.

The following concrete elements are considered Primary Members:

- Rigid frames (Cast-in-place and precast)
- Filled arches
- Arch ribs, spandrel columns, and spandrel walls
- Cast-in-place slabs
- Precast reinforced concrete slabs
- Cast-in-place through girders
- T-Beams (stem portion if cast-in-place, entire unit if precast)
- Channel Beams

When inspecting these types of structures the following should be visually checked:

- Deterioration at the end of the beam which can lead to loss of bearing area and local crushing of the remaining concrete.
- Near bearing areas at the ends of slabs, girders, T-beams, channel beams, etc., for spalling and cracked concrete. Any diagonal cracking in spandrel columns or at the ends of beams, girders, etc., is serious.
- Areas near supports for diagonal (shear) cracks occurring on exposed vertical surfaces and projecting diagonally toward the top of the girder, beam, etc.
- Tension areas at mid-span of simple spans for flexural cracks extending transversely across the underside of the primary member. Longitudinal flexural cracks in the deck when the primary rebars are transverse. Transverse flexural cracks in tops of beams (slab portions) at or near piers on continuous spans.
- Areas with efflorescence indicating contaminated concrete and with rust stains indicating rebar corrosion. Spalling, delaminations, and pop-outs commonly associated with deterioration. In severe cases, rebars will be exposed; determine the section loss of any exposed rebars.
- Longitudinal cracks between adjacent channel or T-beams indicating possible broken shear keys, differential deflections under passage of live loads, leakage, etc.
- Shear or torsional cracks at open spandrel arch floor systems, bent cap interfaces, or in spandrel bent caps or columns. Cracks in tension areas of spandrel bent caps (i.e., mid-span at the bottom and ends at the tops).
- Deterioration of closed spandrel arches and spandrel walls to include cracks, discoloration, spalling, exposed rebars, etc. Differential movement, change of alignment/profile or loss of fill.
- Shear cracks in rigid frame beams (beginning at the frame legs and propagating toward the adjacent span), in the frame legs (beginning at the top and propagating downward), and in the ends of frame beams at end spans.

- Flexural cracks in tension areas of rigid frames at the bottom of the frame beam at mid-span, inside faces of frame legs at mid-height, the base of each frame leg, and the outside corners of a simple-span slab frame.
- Areas at, near, or under drainage features such as scuppers, weeps, curb lines, etc., for the loss of fill or deterioration of concrete.
- Areas of previous repairs, impact damage, honeycombing, scaling, and any other conditions indicating potential deterioration of concrete or rebars.

### ***Reinforced Concrete Slab Spans Lengthening***

Many long reinforced concrete (R.C.) slab span bridges have joint incompressibility problems and should be monitored closely. Over time, the ½" compressible joints in R.C. slab span bridges deteriorate allowing incompressible material to enter the joints. As the bridge contracts due to cooler weather, additional material will enter the joints. The additional material in the joint will "hold" the joint wider during the expansion that comes with warmer weather and the bridge will "grow" resulting in increased bridge length. It has been documented that R.C. slab span bridges, with a length of 1000', have "grown" as much as 20". This increase in bridge length can cause several problems:

- Intermediate bents may be pushed out of plumb causing a rotated cap.
- The span on one side of the intermediate bent may be higher than the other side due to the rotated cap.
- A pushed over bent along with the bridge length growth may cause a loss of bearing area for the slab end which may necessitate a helper bent to "catch" the slab span end.
- At bridge ends you may have approach slabs pushed up, end posts broken and guard rails damaged

Since this is a problem that "grows" over time it is extremely important to record the ongoing movement so that precautions or remediation actions may be taken before serious consequences. The documentation may include measurements of joint widths along with corresponding temperatures, remaining bearing areas at slab ends and measurements of how much bents are out of plumb.

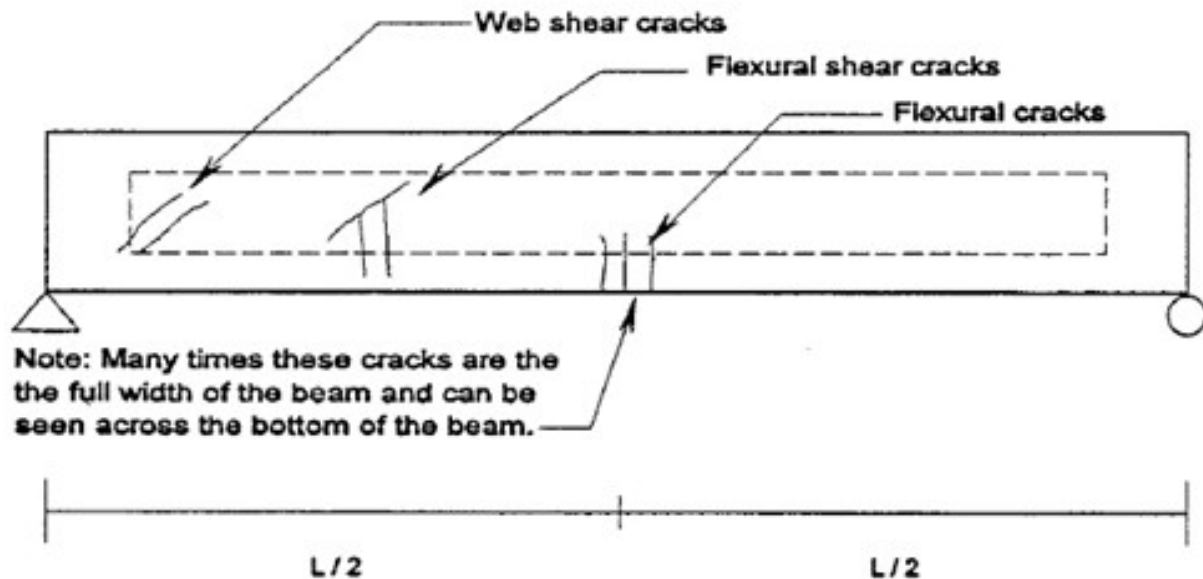
### ***Prestressed Concrete***

Most cracks in prestressed beams are potentially serious since tensile forces exist that might not have been accounted for in the design. Vertical or diagonal tension cracks in prestressed members are signs that the prestressing steel (tendon) has failed or is failing, and the loads are being carried by adjoining beams. This is a serious condition and steps should be taken to ensure the stability of the bridge as soon as possible.

Generally, there are three main types of structural cracks (see figure below):

- Web Shear Cracks - Diagonal tension causes a crack at or near the support. These cracks typically extend up and away from the support at an approximately 30° angle (45° if not prestressed).
- Flexural Shear Cracks - Found between the support and maximum moment area. These cracks consist of both vertical and diagonal cracks occurring together.
- Flexural Cracks - Usually found in the vicinity of the maximum moment. These cracks are normal to the longitudinal axis and extend vertically through the tendon locations.

Additionally, cracks occur in the ends of prestressed members due to de-tensioning forces. These cracks generally can be seen across the beam end and/or along the sides and bottom at the end.



When inspecting these types of structures the following should be visually checked:

- Any sagging by individual members could indicate overloading or loss of prestress.
- Support area for diagonal cracking (shear).
- Deterioration at the end of the beam which can lead to loss of bearing area and local crushing of the remaining concrete.
- Mid-span area (maximum moment) for flexural cracks.
- Between mid-span and bearing for flexural shear cracks.
- Longitudinal cracking at prestressing steel tendon levels.
- Horizontal deflections (sweep) may indicate asymmetric loading from either non-uniform prestressing forces or tendon failure.
- Spalled areas for exposed tendons.
- Shear keys for grout displacement and evidence of leakage.

In addition to the visual check, the following activities should be performed:

- Sound the beams at the support area and mid-span location and any other areas showing deterioration.
- Evaluate and estimate or, if possible, measure any loss to exposed tendons and note location.
- Quantify de-bonded tendons and fully or partially broken tendons. Note these locations.
- Investigate previously repaired areas.
- Document findings with notes, photographs and drawings including full crack and deterioration documentation.



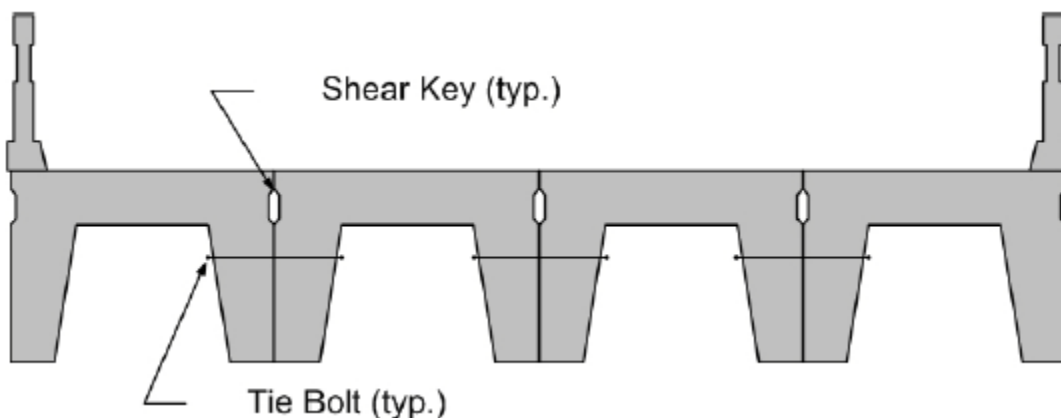
The two most common causes of losing prestressing forces are impact and corrosion. Generally, deterioration occurring in prestressed concrete members is evident to the Inspector, but in some cases, serious but latent corrosion of the prestressing strands may exist without many outward signs of problems. Be sure to check for:

- Concrete delamination, hairline cracks, efflorescence or rust stains at the level of the prestressing strands, which can indicate strand corrosion.
- Longitudinal cracks in the beam may be the result of expansion forces caused by prestressing steel corrosion.
- Efflorescence, leakage, and staining indicate the likelihood of prestressing steel corrosion and a diminished load carrying capacity.
- Concrete delamination or spalling are more definitive signs of prestressing steel corrosion and diminished capacity.
- Check for tendon damage if any of the beams have been impacted. Cracks spreading from the damaged area indicate extent of prestress loss.
- Longitudinal cracks in the wearing surface may indicate that the shear keys of the primaries have failed or are not working as designed.

Recent research has suggested that once outward signs of prestressing steel corrosion are visible, deterioration occurs very rapidly. The Inspector should pay particular attention to areas where the concrete is patched.

### ***Concrete Channel Beams***

Concrete channel beams are usually precast and consist of a conventionally reinforced deck cast monolithically with two stems. Precast channel beam stems may be conventionally reinforced or may be prestressed but in Arkansas you would normally be looking at conventionally reinforced. Stem tie bolts and shear keys are used to achieve monolithic action between precast channel beams.



While both the tie bolts and grouted shear keys are mechanisms for the units to work together to carry the traffic load, the main feature needed to transfer load is that grout is placed in the shear key between the units. The notes on the superstructure should state whether the tie bolts are in place and whether or not the shear key is grouted. If you can't see the shear key because there is an overlay, then you should note if there are longitudinal cracks in the asphalt over the shear keys and if the units are spalling. It may be that

you notice the units appear to act or not act together while traffic is traveling on the span. Your observations should also be recorded to help the Rating Section in their load rating.

Concrete channel beams are an extremely robust unit. They can lose much of the cover over the reinforcing in their stems in the center of the span before they have a reduction in their capacity. As long as the reinforcing has good embedment at the ends of the units there is little concern for a load reduction due to bending. If you have deteriorated concrete at the ends of the units where you could have a loss of embedment of the reinforcement, you should immediately notify Bridge Rating for this is a serious condition.

The units will almost always fail in shear before bending. Shear cracking will normally occur about 15 inches from the face of the bearing and run at a 45 degree angle from the bottom of the stem and move away from the support. Prior to 1974 there was no shear reinforcement in the units so shear cracks in these older units could be a serious concern and the Rating Section should be made aware of problems.

# Chapter 8: Timber Inspections

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## ***Timber Bridge Overview***

Wood is an organic material rather than a manufactured material such as concrete, steel, or masonry and it tends to be less homogeneous and more susceptible to various recurring random defects. Lumber is generally classified according to its species, size, and natural variations.

Wood is a natural engineering material that is prone to deterioration caused by decay fungi, insect attack, fire, and through mechanical damage. Typically, areas of high moisture content in decking, girders, abutment caps and pilings create conditions suitable for biological damage. Types of biological damage include decay and insect damage caused by a variety of species of fungi and insects such as ants or termites. The application of preservative treatment by pressure methods enhances the durability of timber bridge components, but regular inspections are vital for the identification of damage and implementation of timely repairs and proactive maintenance programs. Mechanical damage might include damaged members or mechanical fasteners.

## ***Visual Signs of Deterioration***

The simplest method for locating external deterioration is visual inspection. An inspector observes bridge elements for signs of actual or potential deterioration. Visual inspection requires strong light and is useful for detecting intermediate or advanced surface decay, water damage, mechanical damage, or failed members. Visual inspection cannot detect early stage decay, when remedial treatment is most effective. A visual inspection should focus on identifying the extent of the following signs of deterioration.

## ***Fruiting Bodies***

Although they do not indicate the amount or extent of decay, fruiting bodies provide a positive indication of fungal attack. Some fungi produce fruiting bodies after small amounts of decay have occurred while others develop only after decay is extensive. When fruiting bodies are present, they indicate the possibility of a serious decay problem. The presence of decay fungi and fruiting bodies indicate that the member has high moisture content, usually above 28% on a dry weight basis. Plant or moss growth in splits and cracks, or soil accumulation on the structure, indicates that adjacent wood has been at a relatively high moisture content for a sustained period and may sustain growth of decay fungi. It is important to include maintenance activities that remove dirt accumulation and plant growth from timber elements.

## ***Sunken Faces or Localized Collapse***

Sunken faces or localized surface depressions can indicate underlying decay. Decay voids or pockets may develop close to the surface of the member, leaving a relatively thin, depressed layer of intact or partially intact wood at the surface.

### ***Staining or Discoloration***

Staining or discoloration of wood indicates that the wood has been subjected to water and potentially has high moisture content, making it susceptible to decay. Rust stains from connection hardware are also an indication of wetting.

### ***Insect or Animal Activity***

Insect activity is often identified by the presence of holes, frass, and powder posting. For wood boring insects like carpenter ants, frass is defined as the mix of insect excrement and excavated wood material from timber members where they are active. The presence of insects may also indicate the presence of decay, as carpenter ants often create tunnels and nests in decay cavities. Carpenter ants deposit sawdust in gallery openings, trapping moisture and increasing the rate of decay of an element. In addition to insects, birds often nest under bridge decks, where the nests may trap moisture against a timber element that can potentially increase the moisture content resulting in localized decay.

### ***Checks and Splits***

Timber members are susceptible to drying and weathering, which often result in surface and deep surface checks, ring shake, end checks, and through splits. Checks and splits in members can indicate a weakened member, and also create an entry for moisture to enter the element. If a check or split develops to a sufficient depth, the inner untreated wood is susceptible to moisture and decay fungi. This will create conditions that can result in severe decay and premature deterioration of a timber bridge element. Railing posts, and abutment cap ends are typically the most common location to observe lumber checking or splitting. In rail posts, overtightening of bolts during construction can contribute their occurrence. Severe splits in timber abutment caps often lead to substantial decay and should be thoroughly evaluated, especially when multiple spans are butted together over the support, or when the wood deck does not shelter the cap beam effectively.

### ***Weathering or Impact Damage***

Frequently, weathering and aging of bridge elements has an impact on the performance and durability of timber bridges. This occurs with both timber and non-timber materials like bituminous or other wear layers. Other natural weathering damage occurs to timber piles exposed to water and materials flowing down the river or stream. Members in the mud zone, (+/- 2 ft. of normal water level) have ideal conditions (oxygen, moisture) to promote decay. This can affect the structural performance both through loss of cross-section and the removal of the preservative treatment.

Additional damage to timber bridge components can be caused by impact from vehicle traffic. Snowplows can create damage to timber curb and railings during winter months, as the curb is hidden by snow. Floating objects, such as trees and logs, can also damage timber substructure during high flow rates associated with heavy rain events or seasons.

### ***Miscellaneous Conditions***

During visual inspections of timber bridge components, there are other significant conditions that need to be further explored using the full combination of inspection and assessment techniques. These conditions

can include the rotation of timber piers and abutments caused by the loss of fill behind the backwall or by some other mechanism. Misalignment of caps and piles will not effectively transfer vehicle loads to the ground, causing piles to be overstressed in bending and compression. A second significant condition is the build-up of road materials like gravel or sand that hold moisture in contact with structural timber elements.

### ***Sounding and Probing Techniques***

One of the most commonly used techniques for detecting deterioration is to hit the surface of a member with a hammer or other object. Based on the sound quality or surface condition, an inspector can identify areas of concern for further investigation using advanced tools like a stress wave timer or resistance micro-drill. Deteriorated areas typically have a hollow or dull sound that may indicate internal decay. Care must be taken to not confuse the sound associated with high moisture content pile with decay. A pick hammer commonly used by geologists is recommended for use in timber bridges because it allows inspectors to combine the use of sound and the pick end to probe the element.

Probing with a moderately pointed tool, such as an awl or knife, locates decay near the wood surface as indicated by excessive softness or a lack of resistance to probe penetration and the breakage pattern of the splinters. A brash break indicates decayed wood. A splintered break reveals sound wood. Although probing is a simple inspection method, experience is required to interpret results. Care must be taken to differentiate between decay and water-softened wood that may be sound but somewhat softer than dry wood. Probes can also be used to assess the depth of splits and checks. Flat bladed probes like pocket knives or calibrated feeler gauges are recommended for use in this process.

### ***Drilling and Coring Techniques***

Drilling and coring are the most common methods used to detect internal deterioration in wood members. Both techniques are used to detect the presence of voids and to determine the thickness of the residual shell when voids are present. Drilling is usually done with an electrical power drill or hand-crank drill equipped with a 3/8 to 3/4-in. diameter bit. Power drilling is faster, but hand drilling allows the inspector to monitor drilling resistance and may be more beneficial in detecting pockets of deterioration. In general, the inspector drills into the member in question, noting zones where drilling becomes easier and observing drill shavings for evidence of decay. The presence of common wood defects, such as knots, resin pockets, and abnormal grain, should be anticipated while drilling and should not be confused with decay. The inspection hole is probed with a bent wire or a thickness gauge to measure shell thickness. Since these holes are typically 1/4 to 1/2 in. diameter, they should be plugged with a wood dowel section that has been soaked in a preservative.

HBM now has a micro-driller with a bit only 1/8" in width. This machine can take readings and graph both lateral and rotational resistance as it drills. The Inspector may request HBM to use the micro-driller when additional information is needed about a pile.

Coring with an increment borer (often used for determining the age of a tree) also provides information on the presence of decay pockets and other voids. The resultant solid wood core can be carefully examined for evidence of decay. In addition, the core can be used to obtain a measure of the depth of preservative penetration. Typically, coring should be conducted on a horizontal plane. To prevent moisture and insect entry, a bored-out core hole should be plugged with a wood dowel section that has been soaked in a preservative.

# Chapter 9: NBI Inspection Guidance

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## ***Introduction***

A bridge inspection includes examining the structure, evaluating the physical condition of the structure, and reporting the observations and evaluations on the bridge inspection report. ARDOT currently uses two separate condition rating systems for bridges and culverts - the NBI condition ratings and the structural element condition ratings. All state bridges and local bridges on the NHS shall be evaluated under both systems. Local bridges not on the NHS need only be evaluated under the NBI rating system.

## ***NBI Condition Rating Summary***

The NBI condition ratings describe the general overall condition of a bridge (or culvert) - these ratings must be reviewed during each inspection. There are 5 NBI condition ratings - they are rated on a numerical scale of 1 to 9 (with 9 being “new” condition).

- NBI Deck Condition Rating (Item #58)
- NBI Superstructure Condition Rating (Item #59)
- NBI Substructure Condition Rating (Item #60)
- NBI Channel and Channel Protection Condition Rating (Item #61)
- NBI Culvert Condition Rating (Item #62)

Bridges are typically rated in three components - deck, superstructure, and substructure. If a bridge spans over a waterway, the channel (FHWA Item #61) must also be rated. For filled spandrel arch bridges the NBI superstructure and substructure items should be rated, but the NBI deck rating may be entered as “N”.

- FHWA Item #58 describes the general overall condition of the deck (or slab) - this includes the underside of the deck. The wearing surface, railings, curbs, sidewalks, expansion joints, and deck drains should typically not be considered in this rating.
- FHWA Item #59 describes the general overall condition of the superstructure - this includes all structural components (slabs, arches, trusses, girders, or beams) located above (and including) the bearings. This rating should consider any deterioration, misalignment, or collision damage.
- FHWA Item #60 describes the general overall condition of the substructure - this includes all structural components (piers, abutments, pilings, or footings) located below the bearings. This rating should consider any settlement, tipping, misalignment, undermining, or scour. Wingwalls or retaining walls (up to the first expansion or construction joint) may be considered in this rating.

Culverts are rated as a single component (FHWA Item #62) - if water flows through a culvert, the channel (FHWA Item #61) must also be rated. FHWA Item #62 describes the general overall condition of the culvert. This rating should consider the condition of the culvert barrel, joints and seams, as well as any deflection, distortion, misalignment, settlement, scour, or voiding of backfill. Headwalls, wingwalls or aprons (up to the first construction joint) should be included in this rating.

The following general guidelines apply to the NBI Condition Ratings:

- New bridges and culverts are initially assigned NBI ratings of “9” (excellent condition) unless there were flaws in its construction.
- Repaired bridge components should typically not be rated higher than “7” (good condition).
- An NBI rating of “5” (fair condition) or less generally implies that repairs are recommended - NBI ratings of condition “5” or less will also reduce the Bridge Sufficiency Rating.
- An NBI rating of “4” (poor condition) or less may impact the required inspection frequency.
- An NBI rating of “3” (serious condition) or less generally implies that immediate repairs, structural analysis, or a new load rating is necessary.
- An NBI rating of “2” (critical condition) indicates a critical deficiency. NBI ratings of “2” should be adjusted immediately after the deficiency is addressed.
- Temporary supports (shoring, bracing, or underpinning) should generally not improve the NBI rating. *One exception would be if a critical condition was corrected with temporary shoring (the NBI rating should be raised from condition 2 after the temporary repairs have been performed).*
- The load carrying capacity should not be considered when determining the NBI condition ratings.

Use the tables below as general guidelines for rating NBI numbers 58-60 and 62.

**General Guidelines on Code Definitions**

Code	Condition	Description
9	Excellent	No defects.
8	Very Good	Insignificant defects.
7	Good	Isolated minor defects.
6	Satisfactory	Widespread minor or isolated moderate defects.
5	Fair	Some moderate defects; strength and performance of the component are not affected.
4	Poor	Widespread moderate or isolated major defects; strength or performance of the component is affected.
3	Serious	Major defects; strength or performance of the component is seriously affected. Condition likely requires more frequent monitoring, corrective action, and/or load restrictions.
2	Critical	Major defects; component is severely compromised.
1	Imminent Failure	Bridge is closed to traffic due to condition. Corrective action may return bridge to service.
0	Failed	Bridge is closed and will not reopen.

**Material Specific, Defect Severity Descriptions**

<b>Material</b>	<b>Defect</b>	<b>Minor</b>	<b>Moderate</b>
Concrete	Delamination, Spall, Patched Area	Delamination. Patched Area. Spall less than 6" in diameter or less than 1" deep.	Unsound patched area. Larger/Deeper Spalls.
	Exposed Rebar	Present without measurable section loss.	Present with measurable section loss.
	Exposed Prestressing	NA	Present.
	Cracking*	Unsealed medium width cracks or unsealed medium map cracking.	Wide cracks or heavy map cracking.
	Abrasion, Wear	Exposed but secure coarse aggregate.	Aggregate is loose or has popped out.
	Efflorescence, Rust Staining	Surface white or leaching with little build-up.	Heavy build-up or rust staining (from reinforcing steel).
Steel	Corrosion	Present. Freckled rust.	Section loss is evident.
	Cracking	Effectively arrested.	Not arrested.
	Connection	Connection is functionalizing as intended but has loose fasteners or pack rut without distortion.	Missing fasteners; broken welds; or pack rust with distortion.
Timber	Cracking	Effectively arrested.	Not arrested.
	Decay, Section Loss	Affects up to 10% of the member section.	Affects more than 10% of the members section
	Checks, Shakes	Penetrates 5%-50% of the thickness of the member; not in a high stress zone.	Penetrates more than 50% of the member thickness and length equal to or greater than the member depth, or penetrates more than 5% of the member thickness in a high stress zone.
	Splits, Delamination	Length is less than the member depth or it is effectively arrested.	Length equal to or greater than the member depth; not arrested
	Abrasion, Wear	Affects up to 10% of the member section.	Affects more than 10% of the member section.

\*Concrete cracking:

- Insignificant - width less than 0.012" or 0.004" (prestressed) and medium cracks that have been sealed.
- Medium - width ranging from 0.012-0.05 or 0.004-0.009 (prestressed).
- Wide - width greater than 0.05" or 0.009" (prestressed).
- Medium Map Cracking – Spacing of 1'-3'.
- Heavy Map Cracking – Spacing less than 1'.



### **General Defect Severity Descriptions**

<b>Defect</b>	<b>Minor</b>	<b>Moderate</b>
Distortion	Distortion that has been mitigated or does not require mitigation.	Distortion that requires mitigation
Settlement*	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits
Scour**	Exists within tolerable limits or has been arrested with effective countermeasures.	Exceeds tolerable limits, but is less than critical limits determined by scour evaluation or design analysis.
Deterioration	Breakdown or deterioration has initiated.	Significant deterioration or breakdown.

\*Settlement defect applies only to substructure components. Superstructure or deck components may indirectly show the effects of settlement but should be evaluated by the resulting defects not the settlement itself. Tolerable settlement can be considered as uniform or minor in the extent it is not causing other bridge defects or increased impact loads from traffic on the bridge.

\*\*See the NBI Coding Guide (1995) pages 75-76 for guidance on tolerable and critical limits.

### **NBI Item Numbers**

NBI condition codes are properly used when they provide an overall characterization of the general condition of the entire component being rated. Conversely, they are improperly used if they attempt to describe localized or nominally occurring instances of deterioration or disrepair. Correct assignment of a condition code must, therefore, consider both the severity of the deterioration or disrepair and the extent to which it is widespread throughout the component being rated.

Although the FHWA Coding Guide states that it is improper to use the condition codes to describe localized instances of deterioration or disrepair, it also states that the Inspector must consider both the severity and extent of the deterioration. With this in mind, there are occasions when a severe, localized condition affects the structural capacity of a component member.

While the NBI condition ratings describe the general overall condition of a bridge, there are additional NBI items that need to be coded. The rating system was developed by the Federal Highway Administration (FHWA), and is outlined in the “FHWA Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges”. Inspection teams should refer to this guide for guidance in how to code item numbers for bridges. Some additional guidance is given in this chapter for certain item numbers that may need further explanation. The following item numbers fall under the responsibility of the Inspector.

<b>Inspector Responsibly (86 NBI Fields)</b>	
NBI 001: State Code	NBI 047: Inventory Route, Total Horizontal Clearance
NBI 002: Highway Agency District	NBI 048: Length of Maximum Span
NBI 003: County (Parish) Code	NBI 049: Structure Length
NBI 004: Place Code	NBI 050A: Curb or Sidewalk Width: Left Side
NBI 005A: Inventory Route: Record Type	NBI 050B: Curb or Sidewalk Width: Right Side

NBI 005B: Inventory Route: Rt. Signing Prefix	NBI 051: Bridge Roadway Width, Curb-To-Curb
NBI 005C: Inventory Route: Level of Service	NBI 052: Deck Width, Out-To-Out
NBI 005D: Inventory Route: Route Number	NBI 053: Min. Vert. Clearance OVER Bridge Roadway
NBI 005E: Inventory Route: Direction Suffix	NBI 054A: Min. Vert. Under Clearance: Ref. Feature
NBI 006: Feature Intersected	NBI 054B: Minimum Vertical Under Clearance
NBI 007: Facility Carried by Structure	NBI 055A: Min. Lat. Under Clearance on Rt.: Ref. Feat.
NBI 008: Structure Number	NBI 055B: Min. Lat. Under Clr. on Rt.: Min. Lat. Under Clr.
NBI 009: Location	NBI 056: Minimum Lateral Under Clearance on Left
NBI 010: Minimum Vertical Clearance	NBI 058: Deck
NBI 011: Milepoint	NBI 059: Superstructure
NBI 016: Latitude	NBI 060: Substructure
NBI 017: Longitude	NBI 061: Channel and Channel Protection
NBI 019: Bypass Detour Length	NBI 062: Culverts
NBI 021: Maintenance Responsibility	NBI 071: Waterway Adequacy
NBI 022: Owner	NBI 072: Approach Roadway Alignment
NBI 027: Year Built	NBI 090: Inspection Date
NBI 028A: Lanes on the Structure	NBI 091: Designated Inspection Frequency
NBI 028B: Lanes Under the Structure	NBI 092A: Critical Features: Fracture Critical Details
NBI 032: Approach Roadway Width	NBI 092A: Critical Features: Fracture Critical Required
NBI 033: Bridge Median	NBI 092B: Critical Features: UW Inspection
NBI 034: Skew	NBI 092B: Critical Features: UW Inspection Required
NBI 035: Structure Flared	NBI 092C: Critical Features: Special Inspection
NBI 036A: Traffic Safety Feat.: BR. Railings	NBI 092C: Critical Features: Special Insp. Required
NBI 036B: Traffic Safety Features: Transitions	NBI 093A: Critical Feat. Insp. Date: Fract. Critical Details
NBI 036C: Traf. Safety Feat.: Appr. Guardrail	NBI 093B: Critical Feat. Insp. Date: Underwater Inspection
NBI 036D: Traf. Safety Feat.: Appr. Grail. Ends	NBI 093C: Critical Feat. Insp. Date: Special Inspection
NBI 038: Navigation Control	NBI 100: STRAHNET Highway Designation
NBI 039: Navigation Vertical Clearance	NBI 101: Parallel Structure Designation
NBI 040: Navigation Horizontal Clearance	NBI 102: Direction of Traffic
NBI 041: Struc. Open, Posted, Closed to Traf.	NBI 103: Temporary Structure Designation
NBI 042A: Type of Service: ON Bridge	NBI 106: Year Reconstructed
NBI 042B: Type of Service: UNDER Bridge	NBI 107: Deck Structure Type
NBI 043A: Struc. Type, Main: Kind Mat./Des.	NBI 108A: Type of Wearing Surface
NBI 043B: Struc. Type, Main: Type Des./Con.	NBI 108B: Type of Membrane
NBI 044A: Struc. Type, Appr. Spans: Mat./Des.	NBI 108C: Deck Protection
NBI 044B: Struc. Type, Appr. Spans: Type Des/Con.	NBI 111: Pier or Abutment Protection
NBI 045: Number of Spans in Main Unit	NBI 112: NBIS Bridge Length
NBI 046: Number of Approach Spans	NBI 116: Min. Nav. Vertical Clearance, Vertical Lift Bridge

### ***Item 1 - State Code***

This is always coded "05" and "Region 6"

### ***Item 3 - County Code***

Arkansas numbers the 75 counties by alphabetical order, placing St. Francis County just after Sharp County. FHWA spells out Saint Francis placing it just before Saline County. Also, the FHWA numbers the counties using the formula: (Arkansas County number x 2) – 1 Example: Randolph County is 61; FHWA number is (61 X 2) – 1 = 121.

### ***Item 4 - City/Town/Place Code***

Select a city from the item's pick list. Notify the Central Office if the name is not available for the bridge.

### ***Item 5A - Record Type***

There are two types of National Bridge Inventory records: "on" and "under". Code the first digit (leftmost) using one of the following codes:

<u>Code</u>	<u>Description</u>
1	Route carried "on" the structure
2	Single route goes "under" the structure
A through Z	Multiple routes go "under" the structure

When determining the coding of Item 5A for multiple "under" records, use the following hierarchy of route types:

1. If the route is a STRAHNET (Item 100 = 1, 2, or 3), it has the highest priority. If several STRAHNET types exist, the route with Item 100 = "1" is to be coded first, with others in descending order. Main lanes have precedence over ramps and frontage roads.
2. Non-STRAHNET U.S. highways have the next priority.
3. Non-STRAHNET state highways have the next priority.
4. Non-STRAHNET county routes or city streets have the lowest priority.

Example 1 - Interstate main lanes and frontage roads under a bridge.

<u>Item 5A</u>	<u>On/Under</u>	<u>Route Description</u>
A	1 <sup>st</sup> Route under	The right hand main lane in the direction of the log mile
B	2 <sup>nd</sup> Route under	The left hand main lane in the direction of the log mile
C	3 <sup>rd</sup> Route under	The right hand frontage road in the direction of the log mile
D	4 <sup>th</sup> Route under	The left hand frontage road in the direction of the log mile

Example 2 - Interstate main lanes and ramp and STRAHNET U.S. highway under a bridge

<u>Item 5A</u>	<u>On/Under</u>	<u>Route Description</u>
A	1 <sup>st</sup> Route under	The right hand interstate main lane in the direction of the log mile
B	2nd Route under	The left hand interstate main lane in the direction of the log mile
C	3rd Route under	The interstate ramp
D	4th Route under	The STRAHNET U.S. highway

Example 3 - STRAHNET U.S. highway, Non-STRAHNET state and county highways under a bridge

<u>Item 5A</u>	<u>On/Under</u>	<u>Route Description</u>
A	1 <sup>st</sup> Route under	The STRAHNET U.S. highway
B	2nd Route under	The Non-STRAHNET state highway
C	3rd Route under	The Non-STRAHNET county highway

Example 4 - Two Non-STRAHNET state highways and a county highway under a bridge

<u>Item 5A</u>	<u>On/Under</u>	<u>Route Description</u>
A	1 <sup>st</sup> Route under	The Non-STRAHNET state highway that is most important, usually indicated by a smaller route number or higher ADT
B	2nd Route under	The other Non-STRAHNET state highway
C	3rd Route under	The Non-STRAHNET county highway

“Under” signifies that the inventor route goes “under” the structure. When this item is coded 2 or A through Z, only the following items must be coded for the under record: Items 1, 3-11, 16, 17, 19, 20, 26-30, 42, 43, 47-49, 100-104, 109 and 110. All other items may remain blank.

***Item 5E - Directional Suffix:***

Refer to the FHWA Recording and Coding Guide - Code "0" (i.e., not applicable) for bridges carrying two-way traffic. For bridges carrying one directional traffic - such as parallel bridges on the Interstate where one bridge carries East-bound traffic and the other bridge carries West-bound traffic - code "1" through "4", as applicable.

***Item 6B –Critical Facility Indicator***

Will no longer be coded and a blank space will be inserted in its place

***Item 7 –Facility Carried By Structure:***

Refer to the FHWA Recording and Coding Guide. Many of the counties have changed the road numbers over the years to accommodate 911 systems and have changed their road numbers. The Inspector shall update this road number as they become aware of it. The facility carried is printed on the Maintenance Needs and is useful for the local owners in bridge identification.

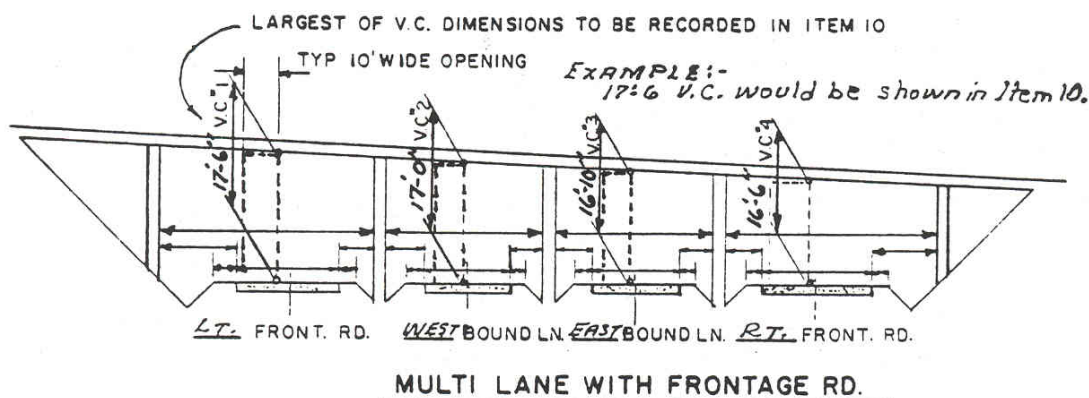
### Item 10 - Inventory Route, Minimum Vertical Clearance

Code the minimum vertical clearance **over** the **inventory route** identified in Item 5, whether the route is "on" the structure or "under" the structure. The minimum clearance for a 3-meter width of the pavement or traveled part of the roadway where the clearance is the greatest shall be recorded and coded as a 4-digit number truncated to the hundredth of a meter (with an assumed decimal point). For structures having multiple openings, clearance for each opening shall be recorded, but only the greatest of the "minimum clearances" for the two or more openings shall be coded regardless of the direction of travel. This would be the **practical maximum clearance**. When no restriction exists or when the restriction is 30 meters or greater, code 9999. Coding of actual clearances between 30.0 and 99.99 meters to an exact measurement is optional.

#### \* MULTIPLE ROADWAY OPENINGS:

Show least vertical dimension for the largest 10' wide opening of each opening on Form IIIB. (See sketch below)

Record the largest of these vertical dimensions in Item 10.



### Item 27 - Year Built

For a known date, this should be the date the structure is open to traffic. Do not use the date on the name plate or date let to contract unless no better information is available. For a bridge that has been widened or otherwise reconstructed, this date is the date of the original construction - not the reconstruction date. For a structure that has been completely rebuilt, a new structure number should be requested. Do not show as reconstructed. Item 27B should be coded "K" if the year built is known or "E" if the year built is estimated.

### ***Item 32 – Approach Roadway Width***

If there is a step down at the shoulder or median greater than 1" do not include the shoulder or median width in the measurement unless it is a temporary construction condition that is clearly signed and will be remedied in the near future.

### ***Items 36a, 36b, 36c and 36d – Traffic Safety Features***

Refer to the FHWA Recording and Coding Guide and the following FHWA website:

[https://safety.fhwa.dot.gov/roadway\\_dept/countermeasures/faqs/qa\\_bttabr.cfm](https://safety.fhwa.dot.gov/roadway_dept/countermeasures/faqs/qa_bttabr.cfm)

If the as-built railing system does not meet safety requirements but is in good condition, the traffic safety features are noted under Item 36. Maintenance Needs should be noted only when the as built railing is damaged or deteriorated requiring maintenance. If a bridge was originally constructed without an approach guardrail then Maintenance Needs notation would not be required.

### ***Item 43B – Main Span Design***

Concrete T-beams should be coded 1/04. Concrete channel beams (precast units) should be coded 1/22.

### ***Item 44B – Approach Span Design***

Concrete T-beams should be coded 1/04. Concrete channel beams (precast units) should be coded 1/22.

### ***Item 47 – Inventory Route, Total Horizontal Clearance***

If the curb or other obstruction is less than 6" high, this dimension should be measured to the rail or other obstruction that is 6" or higher.

### ***Item 53. Minimum Vertical Clearance Over Bridge Roadway***

This is the clearance for the route of the "on" record.

### ***Item 54b. Minimum Vertical Underclearance***

Code the most restrictive clearance for any route under the bridge. Use Form IIIB to record dimensions. A revised Form IIIB should be completed and submitted to the Central Office whenever a change in underclearance (vertical or horizontal) occurs.

### ***Item 58 - Deck***

The lowest rating for the deck of any span will always dictate the rating of the deck, and if that deck is integral, then it dictates the rating of the superstructure, as well. The converse is not true. That is, on integral decks, the deck rating may be higher than the superstructure rating but may never be lower i.e., Deteriorated deck girder ends may be rated 6 or 7 with the deck in good condition rated 8. Similar conditions could exist on other integral type spans. If the bridge has slab spans the deck and superstructure rating should be the same. In addition to using the general condition guidelines on page 84-86 and as contained in the FHWA Coding Guide, the following descriptive codes shall also be used to assist in evaluating the condition of various components.

**Codes Applicable to Decks of Different Materials**

CODE	GENERAL DESCRIPTION	GENERAL TERMS	CONCRETE	STEEL	TIMBER
N	Not Applicable		Use N for Culverts	Use N for Culverts	Use N for Culverts
9	Excellent Condition	No Defects	<i>No Defects</i>	<i>No Defects</i>	<i>No Defects</i>
8	Very Good	Insignificant Defects.	Minor Transverse Cracks. No Spalling, Scaling, Delamination	Tightly Secured. No Rust.	Tightly Secured. No Crushing, Rotting, or Spalling.
7	Good	Isolated Minor Defects	Sealable Cracks, Light Scaling (less than ¼”), No Spalling but visible tire wear in wheel line	Loose at some connections, Few Cracked Welds /Broken grids, Minor Rust	Minor Cracking or Splitting. Few loose Planks.
6	Satisfactory	Widespread minor or isolated moderate defects.	Excessive Number of Open Cracks (5’ spacing) Med. Scaling (1/4”- 1/2” deep) Spalling 2% or Less Area: Delam. Area < 5%	Considerable Rust / Initial Sect. Loss, Loose at Many Locations. Some Cracked Welds / Broken Grids.	Minor Number of Rotted or Crushed Planks. Many Cracked, Split or Loose. No Sect. Loss on Fire Damage.
5	Fair	Some moderate defects; strength and performance of the component are not affected	2 – 5% Area Spalled, 5 – 15% Area Delam., Heavy scaling (1/2” to 1” depth), Partial / Full Failures, Considerable leaching through deck	Heavy Rust with Areas of Sect. Loss, Loose at Numerous Locations, Numerous Cracked Welds / Broken Grids.	Numerous Planks Cracked, Split, Rotted Or Crushed. Majority of Planks Loose. Minor Sect. Loss From Fire Damage.
4	Poor	Widespread moderate or isolate major defects; strength or performance of the component is affected.	> 5% Spalled Area, 15 – 20% Delam., This area include any repaired areas or areas in need of corrective action, Many full depth present or imminent, Leaching throughout	Heavy Rusting with Considerable Sect. Loss., Some Holes, Majority of Welds Cracked and/or Grids Broken.	Majority of Planks Rotted, Crushed and/or Split. Significant Sect. Loss From Fire Damage Reducing Load Capacity of the Member
3	Serious	Major defects; strength or performance of the component is seriously affected. Condition typically necessitates more frequent	+ 20% Delam., Many Full Depth Failures	Critical Signs of Structural Distress	Critical Signs of Structural Distress. Major Fire Damage Substantially Reducing Load Capacity of the Member.



		<b>monitoring, corrective actions, or load restrictions.</b>			
<b>2</b>	<b>Critical</b>	<b>Major Defects; component is severely compromised.</b>	<b>Full Depth Failures Over Much of Deck</b>	<b>Many Holes Through Deck.</b>	<b>Advanced Deterioration with Partial Deck Failure.</b>
<b>1</b>	<b>Imminent Failure</b>	Bridge Closed. Corrective Action Possible	<b>Bridge Closed. Corrective Action Possible.</b>	<b>Bridge Closed. Corrective Action Possible.</b>	<b>Bridge Closed. Corrective Action Possible.</b>
<b>0</b>	<b>Failed</b>	<b>Bridge Closed. Replacement Necessary.</b>	<b>Bridge Closed. Replacement Necessary.</b>	<b>Bridge Closed. Replacement Necessary.</b>	<b>Bridge Closed. Replacement Necessary.</b>

A deck rehabilitated by hydro-demolition and then overlaid will mainly be rated based on the condition of the top of the deck. The bottom of the deck may lower the rating by no more than one. This is to account for the poor concrete being removed during the rehabilitation. The Federal Coding Guide and the BIRM does not yet address decks that have been rehabilitated in this manner so this guidance supersedes their guidance for bridges rehabilitated by hydro-demolition.

### ***Item 59 - Superstructure***

Rate and code the conditions in accordance with the general condition ratings in the FHWA Coding Guide, pages 84-86, and the following descriptive codes which shall be used as an additional guide in evaluating the superstructure condition.

Two sets of descriptive codes shall be used to evaluate this item: (1) the codes applicable to all superstructures which are not tied to a specific type of material, and (2) the codes applicable to concrete, steel or timber superstructures. The lowest of the codes determined shall be reported.

#### ***Codes Applicable to all Superstructures***

Code	Description
N	Use for all culverts.
9	No noticeable or noteworthy deficiencies which affect the condition of the superstructure.
8	Minor collision damage without misalignment or corrective action required.
7	Minor longitudinal or transverse movement of the superstructure.
6	Minor collision damage to nonstructural support elements.
5	Substantial, but not critical, collision damage to structural support elements (through girders, trusses, etc.).
4	Critical collision damage sustained to structural support elements and precautionary measures may be needed such as temporary shoring. Bearings may be frozen from corrosion, misaligned, and are causing problems to superstructure or substructure.
3	Damage or disintegration of a structural support element which requires shoring, auxiliary splices or substitute members.
2	Permanent deformation of main support member or members.
1	Bridge closed. Corrective action may put back in light service.
0	Bridge closed. Replacement required.

*Codes Applicable to Superstructures of Different Materials*

CODE	GENERAL DESCRIPTION	GENERAL TERMS	CONCRETE	STEEL	TIMBER
N	Not Applicable		Use N for Culverts	Use N for Culverts	Use N for Culverts
9	Excellent Condition	No Defects	No Noteworthy Deficiencies	No Noteworthy Deficiencies	No Noteworthy Deficiencies
8	Very Good	Insignificant Defects	Negligible Scaling, Insignificant Accident Damage.	No Visible Rust.	Minor Cracking / Splitting of Beams / Stringers at Non-Critical Locations.
7	Good	Isolated Minor Defects	Non-Structural Hairline Cracks Without Disintegration	Some Rust but no Section Loss.	Insignificant Decay Cracking or Splitting of Beams / Stringers.
6	Satisfactory	Widespread minor or isolated moderate defects.	Minor Deterioration	Initial Section Loss (minor pitting, scaling, or flaking) in Non-Critical Areas.	Some Decay. Cracking or Splitting of Beams / Stringers. No Section Loss From Fire Damage.
5	Fair	Some moderate defects; strength and performance of the component are not affected.	Substantial Deterioration. Hairline Structural Cracks / Spalls. Possible Reinf. Steel Section Loss (minor).	Initial Section Loss in Critical Areas, Fatigue or out-of-plane bending in non-critical areas,	Substantial Decay, Cracking, Splitting of Beams / Stringers. Fire Damage with Minor Measurable Section Loss.
4	Poor	Widespread moderate or isolate major defects; strength or performance of the component is affected.	Extensive Disintegration. Measurable Structural Cracks. Large Spall Areas. Reinf. Steel Exposed With Measurable Section Loss.	Measurable Section Loss in Critical Stress Area. Fatigue Bending Cracks Possible in Major Structural Elements, Hinges may be frozen from corrosion	Extensive Decay, Cracking, Splitting or Crushing of Beams or Stringers. Significant Section Loss From Fire Damage Reducing Load Carrying Capacity.
3	Serious	Major defects; strength or performance of the component is seriously affected. Condition typically necessitates more frequent monitoring, corrective	Severe Disintegration. Large Structural Cracks. Advanced Corrosion in Exposed Reinf. Steel. Localized Loss of Bond.	Severe Section Loss in a Critical Stress Area.	Severe Decay, Cracking, Splitting or Crushing of Beams or Stringers. Major Fire Damage Substantially Reducing Load Carrying Capacity.

		actions, or load restrictions.			
2	Critical	Major Defects; component is severely compromised.	Concrete Disintegrated Around Reinf. Steel with Loss of Bond. Numerous Large Structural Cracks. Possible Local Bearing Failures.	Severe Section Loss in Many Areas With Holes at Numerous Locations.	Beam Ends Crushed or Split with Some Deck Settlement. Further Deterioration of Conditions Noted in Code 3.
1	Imminent Failure	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.
0	Failed	Bridge Closed. Replacement Necessary.	Bridge Closed. Replacement Necessary.	Bridge Closed. Replacement Necessary.	Bridge Closed. Replacement Necessary.

### ***Item 60 - Substructure***

Rate and code the condition in accordance with the previously described general condition ratings in the FHWA Recording and Coding Guide, pages 84-86, and the following additional descriptive codes which shall be used as an additional guide in evaluating the substructure condition. The rating factor given to Item 60 should be consistent with the one given to Item 113 whenever a rating factor of 2 or below is determined for Item 113 – Scour Critical Bridges.

Two sets of descriptive codes shall be used to evaluate this item: (1) the codes applicable to all substructures which are not tied to a specific type of material, and (2) the codes applicable to concrete, steel or timber superstructures. The lowest of the codes determined shall be reported.

#### ***Codes Applicable to all Substructures***

Code	Description
N	Use for all culverts.
9	No noticeable or noteworthy deficiencies which affect the condition of the substructure. Insignificant scrape marks caused by drift or collision.
8	Shrinkage cracks, light scaling, or insignificant scaling that does not expose reinforcing steel. Insignificant damage caused by drift or collision with no misalignment and not requiring corrective action.
7	Deterioration or initial disintegration, cracking with some 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. Insignificant decay, cracking, or splitting of timber. Minor scouring may have occurred.
6	Moderate deterioration or disintegration, spalls, cracking and leaching on concrete or masonry units with little or no loss of bearing area. Initial (measurable) loss of steel section. Some initial decay, cracking, or splitting of timber. Fire damage limited to surface scorching of timber with no measurable section loss. Shallow, local scouring may have occurred near foundation.
5	Concrete or masonry units show some section loss with exposed reinforcing steel possible. Measurable section loss in steel members. Moderate decay, cracking, or splitting of timber, a few secondary members may need replacement. Fire damage limited to surface charring of timber with minor, measurable section loss. Some exposure of timber piles as a result of erosion, reducing the penetration. Scour may be progressive and/or is becoming more prominent with a possibility of exposing top of footing, but no misalignment or settlement noted.
4	Structural cracks in concrete and masonry units. Substantial decay, cracking, splitting, or crushing of primary timber members, requiring some replacement. Fire damage with significant section loss of the member. Extensive exposure of timber piles as a result of erosion, reducing the penetration and affecting the stability of the unit. Additional cross bracing or backfilling is required. Extensive scouring or undermining of footing affecting the stability of the unit and requiring corrective action.

- 3 Severe disintegration of concrete. Generally, reinforcing steel exposed with advanced stages of corrosion. Severe section loss in critical stress areas. Major fire damage to timber which will substantially reduce the load carrying capacity of the member. Bearing areas seriously deteriorated with considerable loss of bearing. Severe scouring or undermining of footings affecting the stability of the unit. Settlement of the substructure may have occurred. Blocking and shoring considered necessary (not just precautionary) to maintain the safety and alignment of the structure.
- 2 Concrete cap is soft and spalling with reinforcing steel exposed with no bond to the concrete. Top of concrete cap is split or concrete column has undergone shear failure. Structural steel members have critical section loss with holes in the web and/or knife-edged flanges typical. Primary timber members crushed or split and ineffective. Scour is sufficient that substructure is near state of collapse. Pier has settled.
- 1 Bridge closed. Corrective action may put back in light service.
- 0 Bridge closed. Replacement necessary

*Codes Applicable to Substructures of Different Materials*

CODE	GENERAL DESCRIPTION	GENERAL TERMS	CONCRETE	STEEL	TIMBER
N	Not Applicable		Use N for Culverts	Use N for Culverts	Use N for Culverts
9	Excellent Condition	No Defects	No Noteworthy Deficiencies. Insignificant Scrape Marks.	No Noteworthy Deficiencies. Insignificant Scrape Marks.	No Noteworthy Deficiencies. Insignificant Scrape Marks.
8	Very Good	Insignificant Defects	Cracks, Light Scaling, or Insignificant Spalling Not Exposing Reinf. Steel. Insignificant Damage with no Misalignment Not Requiring Correction.	Insignificant Damage with no Misalignment Not Requiring Correction.	Insignificant Damage with no Misalignment Not Requiring Correction.
7	Good	Minor Defects	Deterioration or Initial Disintegration, Cracking with Some Leaching or Spalls. No Effect on Bearing Area. Minor Cracking Due to Leakage of Exp. Device.	Some Rust Without Measurable Section Loss. Minor Scour Possible.	Insignificant Decay Cracking or Splitting. Minor Scour Possible.
6	Satisfactory	Widespread minor or isolated moderate defects.	Moderate Deterioration, Disintegration, Spalls and Cracking with Leaching. Little Loss of Bearing Area Possible. Shallow Local Scour Near Foundation Possible.	Initial Measurable Section Loss. Shallow Local Scour Near Foundation Possible.	Initial Decay, Cracking or Splitting. Shallow Local Scour Near Foundation Possible. Fire Damage Limited to Surface Scorching. No Section Loss.
5	Fair	Some moderate defects; strength and performance of the component are not affected.	Some Section Loss with Exposed Reinf. Steel Possible. Scour More Prominent Possibly Exposing Footing but no Settlement or Misalignment.	Measurable Section Loss. Scour More Prominent Possibly Exposing Footing but no Settlement or Misalignment.	Moderate Decay, Cracking or Splitting. Fire Damage Resulting in Minor Measurable Section Loss. Some Exposure as a Result of Erosion Reducing Pile Penetration. No Settlement or Misalignment.
4	Poor	Widespread moderate or isolate major defects; strength or performance of the component is affected.	Structural Cracks. Extensive Erosion / Scour Reducing Penetration or Affecting Stability Requiring Correction.	Extensive Section Loss. Extensive Erosion / Scour Reducing Penetration or Affecting Stability Requiring Correction.	Substantial Decay, Cracking, Splitting or Crushing of Primary Members Requiring Some Replacement. Significant Section Loss Due to Fire Reducing Load Carrying

					Capacity. Extensive Erosion / Scour Reducing Penetration Affecting Stability Requiring Correction.
3	Serious	Major defects; strength or performance of the component is seriously affected. Condition typically necessitates more frequent monitoring, corrective actions, or load restrictions.	Severe Disintegration Exposing Reinf. Steel with Advanced Stages of Corrosion. Severe Section Loss in Critical Stress Areas. Bearing Area Loss. Severe Scour Affecting Stability. Settlement Possible. Shoring Necessary.	Severe Section Loss in Critical Stress Areas. Bearing Areas Seriously Deteriorated with Bearing Loss. Severe Scour Affecting Stability. Settlement Possible. Shoring Necessary.	Severe Section Loss in Critical Stress Areas. Major Fire Damage Substantially Reducing Load Capacity. Bearing Area Loss. Severe Scour Affecting Stability. Settlement Possible. Shoring Necessary.
2	Critical	Major Defects; component is severely compromised. s	Spalling Soft Concrete Exposing Reinf. Steel Without Bond. Failure Cracks in Caps and Columns. Scour Resulting in Near Collapse. Settlement.	Critical Section Loss. Holes in Web or Knife Edge Flanges. Scour Resulting in Near Collapse.	Ineffective Primary Members Due to Crushing or Splitting. Scour Resulting in Near Collapse.
1	Imminent Failure	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.	Bridge Closed. Corrective Action Possible.
0	Failed	Out of Service	Bridge Closed. Replacement Necessary.	Bridge Closed. Replacement Necessary.	Bridge Closed. Replacement Necessary.



### ***Item 62 - Culvert***

Rate and code the conditions in accordance with the general condition ratings in the FHWA Coding Guide and the following descriptive codes which shall be used as an additional guide in evaluating the superstructure condition.

#### ***Codes Applicable to all Culverts***

Code	Description
N	Not applicable.
9	No deficiencies.
8	No noticeable or noteworthy deficiencies which affect the condition of the culvert. Insignificant scrape marks caused by drift.
7	Shrinkage cracks, light scaling, and insignificant spalling which does not expose reinforcing steel. Insignificant damage caused by drift with no misalignment and not requiring corrective action. Some minor scouring has occurred near curtain walls, 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 curtain walls, wingwalls, or pipes. Metal culverts have a smooth curvature, non-symmetrical shape, significant corrosion, or moderate pitting.
5	Moderate to major deterioration or disintegration, extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection in one section, significant corrosion or 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 curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting.
3	Any condition described in Code 4 but which is excessive in scope. Severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe scour or erosion at curtain walls, wingwalls, or pipes. Metal culverts have extreme distortion and deflection in one section, 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 required to maintain traffic. Metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion.

- 1 Bridge closed. Corrective action may put bridge back in light service.
- 0 Bridge closed. Replacement necessary.

***Item 71 – Waterway Adequacy***

The values given are based on the Functional Classification (Item 26) of the route and the description of waterway adequacy (i.e., for a structure on Interstate route, a code of "7" would not be a valid code).

The following table is a summary of the FHWA Recording and Coding Guide's discussion on Item 71 and can be used as an aid in coding that item.

***Codes Applicable to Waterway Adequacy***

Principal Arterials- Interstates, Freeways, or Expressways	Other Principal And Minor Arterials and Major Collectors	Minor Collectors, Locals	DESCRIPTION	OVERTOPPING FREQUENCY	TRAFFIC DELAY
<b>Code</b>					
<b>N</b>	<b>N</b>	<b>N</b>	Bridge Not Over a Waterway		
<b>9</b>	<b>9</b>	<b>9</b>	Bridge Deck and Roadway Approaches Above Flood Water Elevations (High Water). Chance of Overtopping is Remote.	> 100 yrs.	
<b>8</b>	<b>8</b>	<b>8</b>	Bridge Deck Above Roadway Approaches. Slight Chance of Overtopping Roadway Approaches.	11 to 100 yrs.	
<b>6</b>	<b>6</b>	<b>7</b>	Slight Chance of Overtopping Bridge Deck And Roadway Approaches.	11 to 100 yrs.	
<b>4</b>	<b>5</b>	<b>6</b>	Bridge Deck Above Roadway Approaches. Occasional Overtopping of Roadway Approaches With Insignificant Traffic Delays.	3 – 10 yrs.	Passable in Hours.
<b>3</b>	<b>4</b>	<b>5</b>	Bridge Deck Above Roadway Approaches. Occasional Overtopping of Roadway Approaches With Significant Traffic Delays.	3 – 10 yrs.	Passable in Several Days.
<b>2</b>	<b>3</b>	<b>4</b>	Occasional Overtopping of Bridge Deck and Roadway Approaches with Significant Traffic Delays.	3 – 10 yrs.	Passable in Several Days.
<b>2</b>	<b>2</b>	<b>3</b>	Frequent Overtopping of Bridge Deck and Roadway Approaches with Significant Traffic Delays.	< 3 yrs.	Passable in Several Days.
<b>2</b>	<b>2</b>	<b>2</b>	Occasional or Frequent Overtopping of Bridge Deck and Roadway Approaches with Severe Traffic Delays.	< 3 yrs.	Long Term.
<b>0</b>	<b>0</b>	<b>0</b>	Bridge Closed.		

### ***Item 92C – Other Special***

This is for monitoring a particular known or suspected deficiency. For our purposes, this would include our “Other Recurring Special Inspection” and could include an “Underwater Type 2 Inspection” if there is a known or suspected deficiency.

### ***Item 103 – Temporary Structure Designation***

Refer to the FHWA Recording and Coding Guide. Where detour bridges for contract jobs are encountered, this item should be coded "T" and only Items 10, 41, 47, 53, 54, 55, 56, and 70 are to be completed for the temporary structure. Items 91, 92A, 92C, and 107 should be completed based on the condition of the structure without temporary measures. The structure number will be retained.

### ***Item 106 – Year Reconstructed***

This is the year in which extensive work was performed to reconstruct or rehabilitate the structure. Extensive work is defined as major work required to restore the structural integrity and extend the useful life of a bridge. For a bridge that has been widened or otherwise reconstructed more than once, this date should be the most recent date of reconstruction. Item 106B should be coded "K" if the reconstruction date is known or coded "E" if the reconstruction date is estimated.

Some examples of reconstruction or rehabilitation work are:

- Full depth replacement or hydro-demolition and overlay of bridge deck where the replaced portion(s) of the deck is 50% or more of the original bridge deck area.
- Bridge widening which adds one or more traffic lanes or results in substructure widening.
- 50% or more of superstructure or substructure units replaced.

Refer to the FHWA Recording and Coding Guide for some types of work NOT to be considered as reconstruction or rehabilitation.

### ***Item 113 – Scour Critical Bridges***

The inspector should not enter a value for Item 113 for new bridges. The inspector will inform the Staff Structures Engineer in the Bridge Division Rating Section for initial coding of Item 113 of a new bridge.

If an inspector finds evidence of scour critical conditions, this should be documented in the inspection and reported to the Staff Structures Engineer in the Bridge Division Rating Section for reevaluation.

If an inspector finds evidence that scour countermeasures, such as riprap dumped next to a pier or bent, were placed at a bridge, this should be documented in the inspection and reported to an Engineer in the Bridge Division Rating Section for reevaluation.

Future changes to the initial coding of Item 113 are to be made only by an Engineer in the Bridge Division Rating Section.

The Plan Of Action (POA) for a scour critical bridge is located under Files and the Scour tab in the bridge inspection software. Click on the drop down box "Scour" to view the POA. Document any action taken related to the POA.

# Chapter 10: Element Inspection Guidance

## Introduction

Structural element condition ratings divide a bridge into separate components which are then rated individually based upon the severity and extent of deterioration. This rating system was developed by the American Association of State Highway and Transportation Officials (AASHTO), and is outlined in the “Manual for Bridge Element Inspection” – First Edition, 2013 with current Interims. Structural element condition ratings will provide input data for a Bridge Management System (BMS) which can be used to identify present maintenance needs, and is intended to provide cost-effective options for long-range bridge maintenance and improvement programs (using computer projections of future deterioration).

This chapter is designed to answer questions that the Bridge Inspection Teams may have concerning coding the elements. The feedback from the Inspections Teams will be integral into developing this chapter into a useful tool.

## Element Level Condition States

The condition rating of a bridge component is coded with a rating of ‘4’ (worst) through ‘1’ (best). The bridge elements are rated in quantitative units or percentages for each condition state.

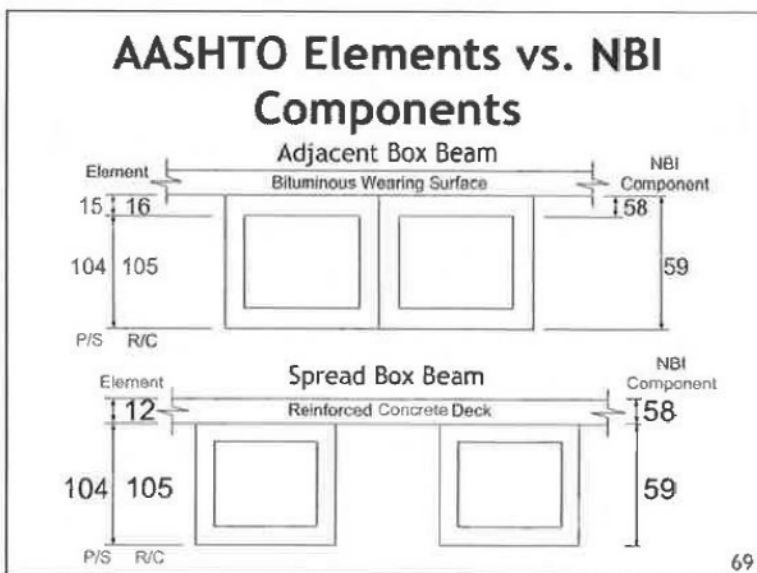
The condition of each element is determined by performing a field inspection and recording quantities of the element that have identified defects. The evaluation of the item is complete when the sum of all four condition states equals 100%. Ratings shall be rounded up to the nearest integer. The following chart provides a general guideline on how to collect and quantify the element.

Generic Item – Condition States (CS)				
Defect	<b>GOOD</b> Condition State 1	<b>FAIR</b> Condition State 2	<b>POOR</b> Condition State 3	<b>SEVERE</b> Condition State 4
Adjective	Quantity that is Good	Quantity that is Fair	Quantity that is Poor, does not warrant a structural review	Warrants Structural Review OR the defect impacts the strength or serviceability of the element
Maintenance Response -->	Monitor Protect Repair Rehab Replace	Monitor Protect Repair Rehab Replace	Monitor Protect Repair Rehab Replace	Monitor Protect Repair Rehab Replace

Condition State 4 Warrants a structural review or a structural review was performed and the defect impacts strength or serviceability. This is reserved for critical conditions that are beyond the specific defects defined in Condition States 1 through 3. Quantities in CS4 may often have implications that affect public safety OR reduction in load capacity. If the inspector determines that there is an impact on the load capacity or a direct impact on safety then the 4 is the appropriate rating. All Quantities in CS4 must be accounted for with quantitative descriptions and/or pictures.

### **AASHTO Elements vs. NBI Components**

The following are examples of AASHTO Elements and how they compare to NBI Components:



Background Information: *AASHTO Manual for Bridge Element Inspection, FHWA Coding Guide*

#### **Adjacent box beam**

AASHTO elements:

- 15 - Prestressed concrete top flange
- 16 - Reinforced concrete top flange
- 104 - Prestressed concrete box beam
- 105 - Reinforced concrete box beam

NBI components:

- 58 - Deck
- 59 - Superstructure

#### **Spread box beam**

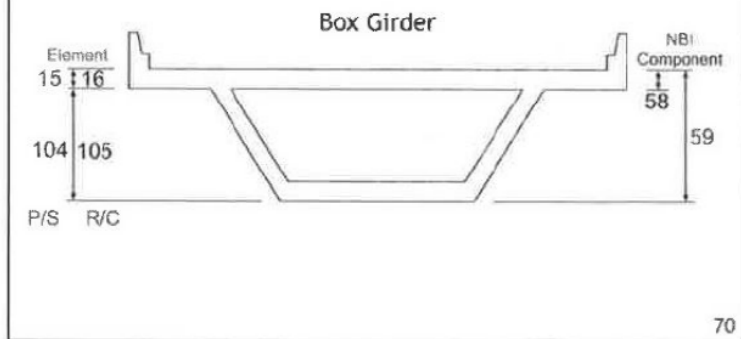
AASHTO elements:

- 12 - Reinforced concrete deck
- 104 - Prestressed concrete box beam
- 105 - Reinforced concrete box beam

NBI components:

- 58 - Deck
- 59 - Superstructure

## AASHTO Elements vs. NBI Components



### Box girder

AASHTO elements:

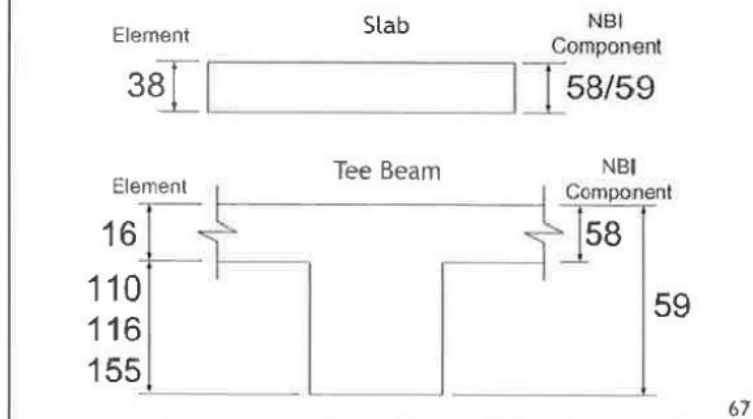
- 15 - Prestressed concrete top flange
- 16 - Reinforced concrete top flange
- 104 - Prestressed concrete box girder
- 105 - Reinforced concrete box girder

NBI components:

- 58 - Deck
- 59 - Superstructure

Background Information: AASHTO *Manual for Bridge Element Inspection*, FHWA Coding Guide

## AASHTO Elements vs. NBI Components



### Slab

AASHTO elements:

- 38 - Reinforced concrete slab

NBI components:

- 58 - Deck
- 59 - Superstructure

### Tee beam

AASHTO elements:

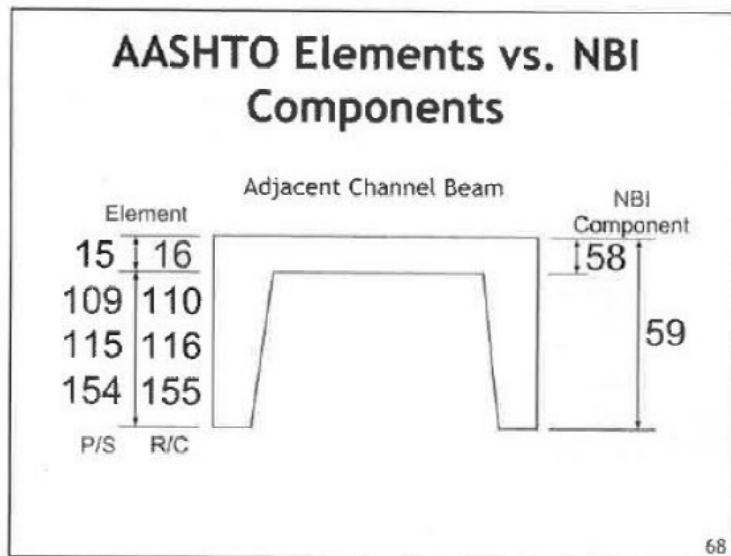
- 16 - Reinforced concrete top flange
- 110 - Reinforced concrete girder
- 116 - Reinforced concrete stringer
- 155 - Reinforced concrete floorbeam

NBI components:

- 58 - Deck
- 59 - Superstructure

Background Information: AASHTO *Manual for Bridge Element Inspection*, FHWA Coding Guide





Background Information: *AASHTO Manual for Bridge Element Inspection, FHWA Coding Guide*

#### Adjacent Channel Beam

AASHTO elements:

- 15 - Prestressed concrete top flange
- 16 - Reinforced concrete top flange
- 110 - Reinforced concrete girder
- 116 - Reinforced concrete stringer
- 155 - Reinforced concrete floorbeam
- 109 - Prestressed concrete girder
- 115 - Prestressed concrete stringer
- 154 - Prestressed concrete floorbeam

NBI components:

- 58 - Deck
- 59 - Superstructure

#### ***Weathering Steel Protective Coating***

The inspection of weathering steel bridges differs from that of painted steel bridge. The entire surface area of weathering steel is covered in a patina or rust layer. The inspector must distinguish between a protective and non-protective oxide coating. Slight variations in color and texture are important indicators of non-protective coating requiring close inspection. Inspector shall note any section loss associated with coating failure in the appropriate item.

#### ***Visual Color Table for Weathering Steel***

Color	Film Stage	Condition
Yellow-Orange	Initial stage of exposure	Acceptable
Light Brown	Early stage of exposure	Acceptable
Chocolate brown to purple brown	Development of protective oxide	Acceptable
Black	Non-protective oxide	Failed

The oxide film must be tested by tapping or by vigorously wire brushing to determine whether the film is adhering to the substrate. The oxide film texture may debond in the form of granules, flakes, or laminar sheets. Physical and visual means are used in conjunction to accurately determine the condition of the oxide film. New weathering steel require 3 to 5 years to stabilize. An inspector should

keep in mind the year built when evaluating the oxide film. The interior surfaces are likely to exhibit the same color of the exterior beams, but sheltered from the wind and rain the initial dusty surface is not sweep clean, thus becoming embedded and leaving a coarse finish.

#### ***Texture Table for Weathering Steel***

<b>Texture</b>	<b>Surface Stage</b>	<b>Condition</b>
Tightly adherent, capable of withstanding hammering or vigorous wire brushing	Protective oxide film	Acceptable
Dusty	Early stage of exposure	Acceptable
Granular	Possible development of non-protective oxide	Acceptable
Small flakes, 1/4" diameter	Non-protective oxide	<b>Failed</b>
Large flakes, 1/2" diameter	Non-protective oxide	<b>Failed</b>
Laminar sheets of nodules	Non-protective oxide, severe corrosion	<b>Failed</b>

#### ***Defect Hierarchy***

The ASHTO *Manual for Bridge Element Inspection* lists multiple defects to be used for specific bridge elements constructed of specific materials. A defect in a worse condition state (higher number on the 1-4 scale) controls over a separate defect for the same unit of quantity for the element. For example, if there is a spall of condition state 3 and exposed rebar of condition state 2 for the same square foot of deck, that square foot should be recorded as having a defect of spalling in condition state 3. To provide guidance in the situation that multiple defects of the same condition state are present at the same unit of quantity, the defects are listed below in a top first hierarchy format. The inspectors still should use their own judgement, for instance a concrete girder with 20 feet of cracking in condition state 2 but within those 20 feet it contains 6" of efflorescence in condition state 2 it would be acceptable to record the 20 feet as condition state 2 for the defect cracking. Below is the hierarchy that may be used as a guide.

#### **Reinforced Concrete (All Elements)**

- 6000 - Scour (Substructure Only)
- 4000 - Settlement (Substructure Only)
- 1090 - Exposed Rebar
- 1080 - Delamination/Spall/Patched Area
- 1120 - Efflorescence/Rust Staining
- 1130 - Cracking
- 1190 - Abrasion/Wear

#### **Prestressed Concrete (All Elements)**

Same hierarchy as Reinforced Concrete given that: 1100 – Exposed Prestressing supersedes 1190 – Exposed Rebar for all elements.

**Steel (All Elements)**

- 6000 - Scour (Substructure Only)
- 4000 - Settlement (Substructure Only)
- 1010 - Cracking
- 1020 - Connection
- 1900 - Distortion
- 1000 - Corrosion

**Timber (All Elements)**

- 6000 - Scour (Substructure Only)
- 4000 - Settlement (Substructure Only)
- 1140 - Decay/Section Loss
- 1160 - Cracking
- 1170 - Split/Delamination
- 1150 - Check/Shake
- 1020 – Connection
- 1180 - Abrasion/Wear

**Masonry**

- 6000 - Scour (Substructure Only)
- 4000 - Settlement (Substructure Only)
- 1640 - Masonry Displacement
- 1620 - Split/Spall
- 1630 - Patched Area
- 1610 - Mortar Breakdown

**Joints**

- 2370 - Metal Deterioration or Damage
- 2310 - Leakage
- 2320 - Seal Adhesion
- 2330 - Seal Damage
- 2340 - Seal Cracking
- 2360 - Adjacent Deck or Header
- 2350 - Debris Impaction

**Bearings**

- 2220 - Alignment
- 2210 - Movement
- 2240 - Loss of Bearing Area
- 2230 - Bulging, Splitting or Tearing
- 1020 – Connection
- 1000 - Corrosion

### **Steel Protective Coating**

- 3440 - Effectiveness
- 3420 - Peeling/Bubbling/Cracking
- 3410 - Chalking
- 3430 - Oxide Film Degradation Color/Texture Adherence (Weathering Steel Only)

### **Concrete Protective Coating**

- 3540 - Effectiveness
- 3510 - Wear

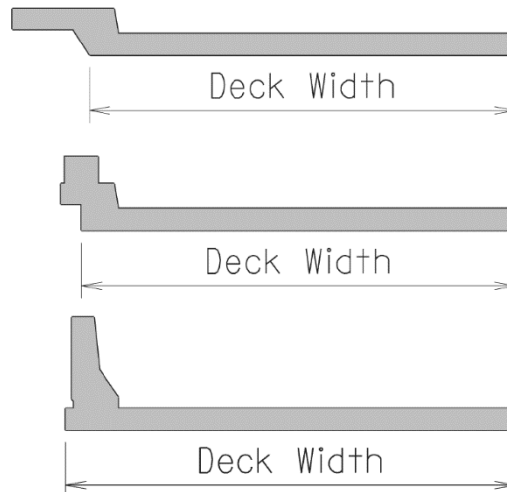
### ***Guidance for Determining Elements and Quantities***

#### **General Notes**

These definitions and quantity calculation guides are specifically for the AASHTO elements, not the NBI components. As noted before, this is to serve as a guide. Inspectors will need to use their judgement identifying and calculating quantities for elements.

#### **Decks and Slabs**

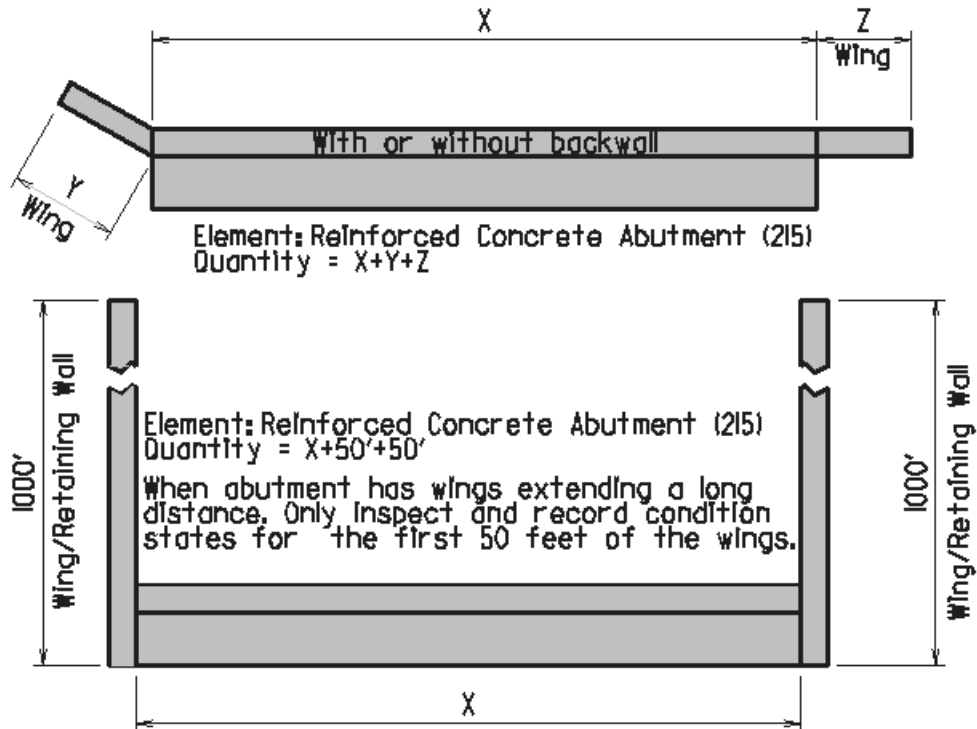
The *AASHTO Manual for Bridge Element Inspection* states the quantity calculation should be determined edge to edge for each linear foot of deck length. The edge of the deck is considered the edge of the traffic carrying component. See the sketch below.

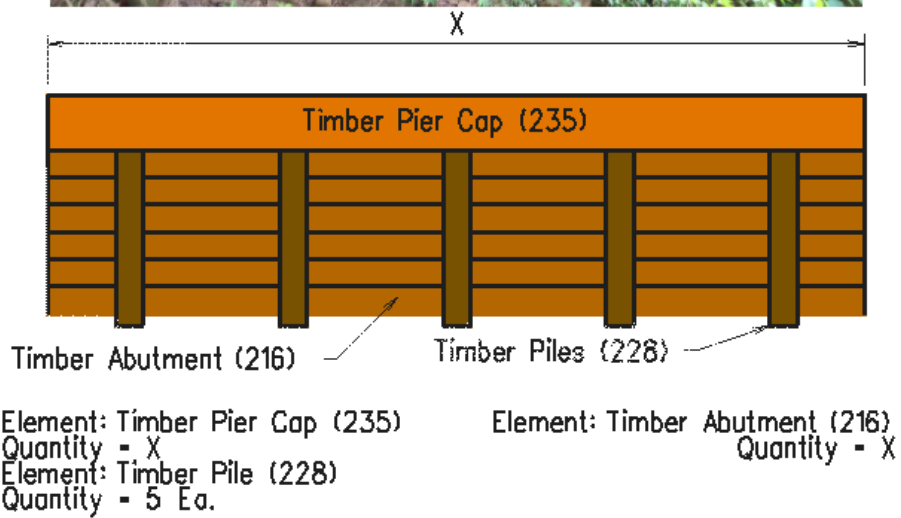


Polymer overlays consisting with coarse aggregate shall be recorded as a Wearing Surface. Low viscosity “Healer Sealers” with only fine aggregate (sand) should be recorded as Concrete Protective Surface.

## Abutments

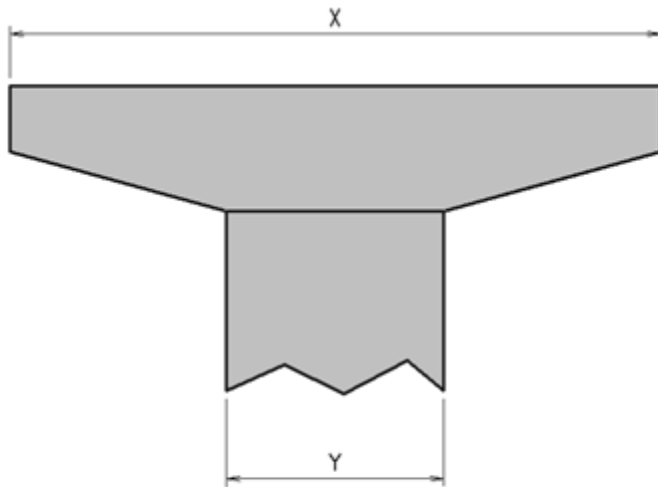
Substructure features at the end of the bridge that retain the embankment will be recorded as abutments. End bents that consist of separate components to transfer vertical loads and to retain embankment will need to be recorded with multiple elements. The elements transferring vertical loads should be identified in the same manner as elements at intermediate bents. End bent consisting of just a cap on piles and wingwalls should be recorded as an abutment. Below are some diagrams and pictures to serve as a guide, as always the inspectors will need to use their judgement.



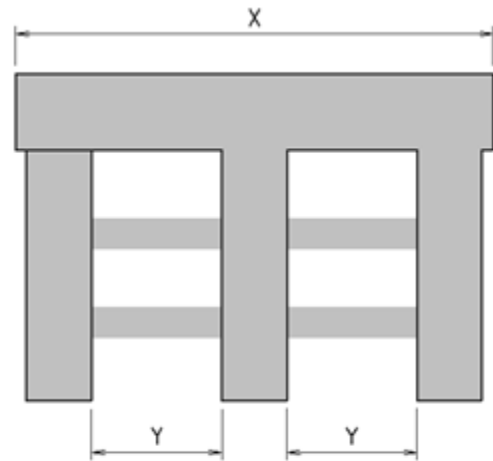


### **Intermediate Bents**

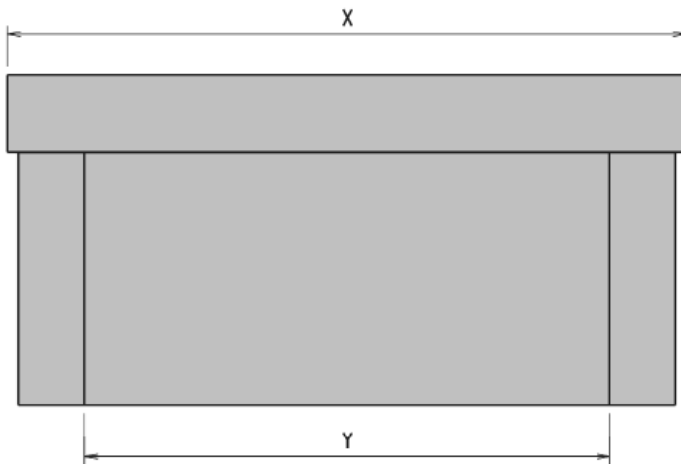
The following diagrams provide clarity for certain types of intermediate bents.



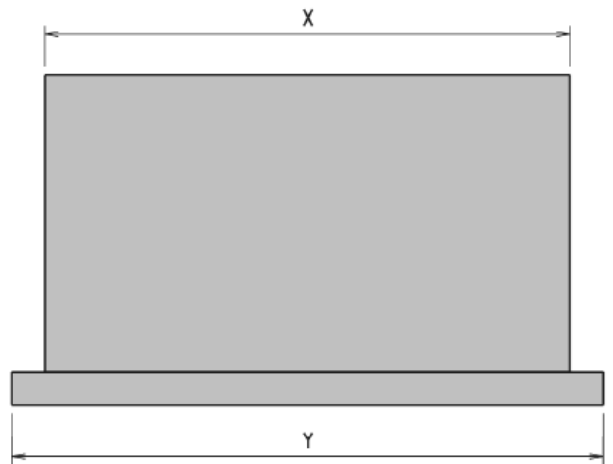
Element: Reinforced Concrete Pier Cap (234)  
 Quantity = X  
 Element: Reinforced Concrete Pier Wall (210)  
 Quantity = Y (If Y >= 10')  
 Element: Reinforced Concrete Column (205)  
 Quantity = 1 Ea. (If Y < 10')



Element: Reinforced Concrete Pier Cap (234)  
 Quantity = X  
 Element: Reinforced Concrete Pier Wall (210)  
 Quantity = 2\*Y  
 Element: Reinforced Concrete Column (205)  
 Quantity = 3 Ea.



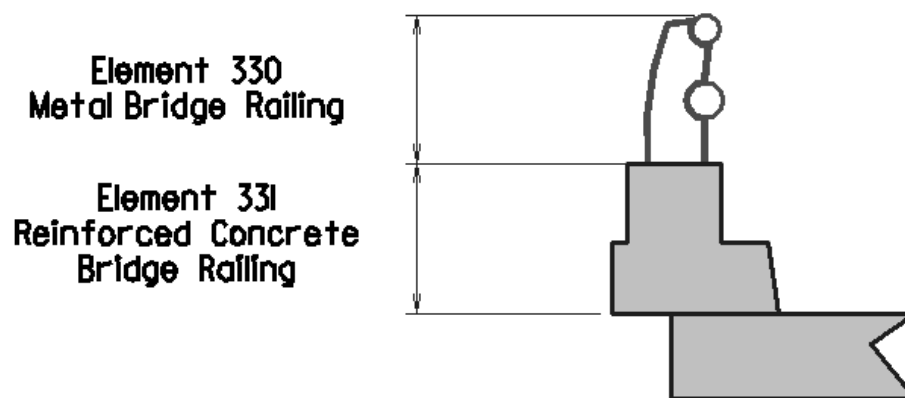
Element: Reinforced Concrete Pier Cap (234)  
 Quantity = X  
 Element: Reinforced Concrete Pier Wall (210)  
 Quantity = Y  
 Element: Reinforced Concrete Column (205)  
 Quantity = 2 Ea.



Element: Reinforced Concrete Pier Wall (210)  
 Quantity = X  
 Element: Reinforced Concrete Pile Cap/Footing (220)  
 Quantity = Y

## **Bridge Rails**

- Bridge rails may consist of more than one element. Therefore, multiple element numbers may be required for recording the condition of a rail. See the example below.
- The quantity for bridge rails should be calculated only using the sections on the bridge, approach rails are not included.
- In the situation that defects to the underside of the bridge beyond the limits of the edge of slab as described above, may be recorded in the rail. These quantities will be recorded in linear feet. Use element notes to specify location as needed.



## **Joints**

- Joints under an asphalt overlay shall be documented to have the defect debris impaction in condition state 3. If the inspector has good reason to believe the joints were protected during the overlay, such as a functioning sliding plate, the condition state should reflect this fact. Likewise, the inspector may record condition state 4 for any defect if warranted.

This chapter is designed to answer questions that the Bridge Inspection Teams may have concerning coding the elements. The usefulness of this chapter is directly related to the feedback from the Inspections Teams.



# Chapter 11: Agency Field Guidance

**Guidance Table for Agency Fields**

<u>Item Number</u>	<u>Display Name</u>	<u>Data-base Column Name</u>	<u>Item Length</u>	<u>Data Type</u>	<u>Group Responsible</u>	<u>Database Description</u>	<u>General Description</u>
A-1	BridgeGroup	col_1da13c8	20	string	HBM	BridgeGroup	Label HBM for bridges inspected by HBM. Label D2 means inspected by D2. Used for inspections outside of geographic district.
A-2	Wearing Surface Thickness	col_ab5944e	7	Float Null	Inspector	NULL	Thickness of wearing surface in inches
A-3	Weathering Steel	col_e744dc9	0	string	Inspector	Weathering Steel	Yes/No response to bridge having weathering steel
A-4	Pin / Hanger	col_2eb16f9	0	string	Inspector	Pin / Hanger	Yes/No response to bridge having pin/hanger system
A-5	Stay In Place Forms	col_69b96d7	0	string	Inspector	Stay In Place Forms	Yes/No response to bridge having stay in place forms
A-6	Steel Tons	col_bc5f574	9	Float Null	HBM	NULL	Amount of steel tons that bridge has in total
A-7	(41) Structure Open/Posted/Closed	col_492f7c4	1	string		Structure Open/Posted/Closed	Duplicated NBI field - will be deleted soon
A-8	Road / Route Name	col_72f37f5	0	string		Road / Route Name	Duplicated NBI field - will be deleted soon
A-9	Section	col_3e20503	0	string	Inspector	Section	Section of route in which the bridge carries
A-10	Zone	col_0dc55f3	0	string	Inspector	Zone	Zone of Route in which the bridge carries
A-11	Seismic	col_4f78055	0	string	HBM	Seismic	Yes/No response to bridge having seismic design
A-12	Seismic Year/Zone	col_6d96a89	0	string	HBM	Seismic Year/Zone	Year and zone in which the bridge was seismically designed for

A-13	School District Email	col_26e5975	0	string	Inspector	School District Email	school district Email for which the bridge carries bus route for
A-14	Owner Email	col_4d68d71	0	string	Inspector	Owner Email	County/City contact email for the owner responsible for the bridge
A-15	Late Reason	col_d44b46b	0	string	Inspector	Late Reason	Late reason for which the bridge inspection was late - reason also email to FHWA
A-16	Code 4 Vehicle (22 tons)	col_b8c6e42	6	Float Null	Rater	NULL	Rating field
A-17	Code 9 Vehicle (31 tons)	col_5ab974f	6	Float Null	Rater	NULL	Rating field
A-18	Code 5 Vehicle (40 tons)	col_af33b3b	6	Float Null	Rater	NULL	Rating field
A-19	Code 4 (Beginning)	col_01cf942	6	Float Null	Inspector	NULL	In Field Posted Value
A-20	Code 4 (end)	col_53ab0c7	6	Float Null	Inspector	NULL	In Field Posted Value
A-21	Code 9 (Beginning)	col_37ab7e3	6	Float Null	Inspector	NULL	In Field Posted Value
A-22	Code 9 (End)	col_f2a12cb	6	Float Null	Inspector	NULL	In Field Posted Value
A-23	Code 5 (Beginning)	col_0c3b03e	6	Float Null	Inspector	NULL	In Field Posted Value
A-24	Code 5 (End)	col_9320bf4	6	Float Null	Inspector	NULL	In Field Posted Value
A-25	APHN	col_d70395c	0	string	HBM	APHN	Arkansas Primary Highway Network - identical to field in TPP
A-26	STIP Replacement Year	col_ea38eaa	0	Float Null	HBM	NULL	Year that stip shows to replace - can be found in program management bridge work view
A-27	Job Number	col_46bf24b	0	string	Inspector	Job Number	Job number (ardot) under which the contract for the bridge is located
A-28	Prog. Job Number	col_6034648	7	string		Prog. Job Number	
A-29	Old Bridge Number	col_2edfe99	0	string	Inspector	Old Bridge Number	Old bridge number if this structure replaced existing

A-30	New Bridge Number	col_ced8de9	0	string	Inspector	New Bridge Number	New bridge number if being replace
A-31	Bridge Condition Index	col_67122bc	6	Float Null	HBM	NULL	Calculated field based off of variables
A-32	Bridge Replacement Cost	col_28e660f	9	floatNull	HBM	NULL	Calculated field based off of variables
A-33	Arnold_Road ID	col_84527bb	0	string	HBM	Arnold_Road ID	Linear referencing system identification
A-34	Arnold_LM	col_df55af3	9	Float Null	HBM	NULL	Linear referencing system identification
A-35	Antilog_RoadID	col_ee53a74	0	string	HBM	Antilog_Road ID	Linear referencing system identification
A-36	Antilog_LM	col_722cb7e	9	Float Null	HBM	NULL	Linear referencing system identification
A-37	Notes	col_2b1ab90	0	string	Inspector	AHTD Agency Notes	Inspector's note field
A-38	3 Axle Vehicle (EV2)	col_b3b52bf	0	Float Null	Rater	3 Axle Vehicle (EV2)	Rating field
A-39	4 Axle vehicle (EV3)	col_d1c8dbf	0	Float Null	Rater	4 Axle vehicle (EV3)	Rating field
A-40	5 or more Axle Vehicle (Notional Rating Load)	col_b097dab	0	Float Null	Rater	5 or more Axle Vehicle (Notional Rating Load)	Rating field
A-41	Load rating date (YYYY-MM-DD)	col_5be0820	0	string	Rater	Load rating date	Rating field for the date of rating
A-42	Load rater	col_e35fd79	0	string	Rater	Load rater	Drop down value for the load rater
A-43	Programmed Job #	col_df6a3b1	0	string		Programmed Job #	
A-44	Load Rating Notes	col_7bd1fb8	0	string	Rater	Load Rating Notes	Notes for the load rater to enter
A-45	Bats Present	col_79a70f4	0	string	Inspector	Bats Present	Yes/No response to bridge having bats
A-46	Asset Files	col_3e1ecf0	99	string		For storing inspection files	
A-47	SU4	col_eaedad0	0	float	Rater	NULL	Rating field
A-48	SU5	col_3536f12	0	float	Rater	NULL	Rating field
A-49	SU6	col_c377cfb	0	float	Rater	NULL	Rating field

A-50	SU7	col_46e 90a1	0	float	Rater	NULL	Rating field
A-51	Inspection Direction	col_cfd a320	0	string	Inspector	NULL	Drop down value for the direction that the bridge was inspected.

### ***Structural***

Bridge Group – The group, District or HBM, that is responsible for inspection.

Wearing Surface Thickness – For structures which have an overlay (i.e., asphalt, timber runner, etc.) above the structural deck or for structures under fill, record the depth from the top of the structural deck to the roadway surface. If major variation of depth occurs, record the average depth and show extremes on a Form III sketch. If the measurement is over 99.9", record 99.9 and show the actual measurement on a Form III sketch.

Weathering Steel - Code "Y" for yes, if the bridge is constructed of weathering steel or "N" for no, if the bridge is not constructed of weathering steel.

Pin / Hanger - Code "H" for Pin and Hanger articulated bridges and Code "P" for Pin Bridges such as Pin Trusses.

Stay In Place Forms – Code “Y” for yes, if the bridge has stay in place forms or “N” for no, if the bridge does not have stay in place forms.

Steel Tons – This is the structural steel in bridge and can be found on the quantity sheet. It is used in cost estimates for bridge painting contracts.

Structure Open/Posted/Closed – This will be populated from Item 41.

### ***Location***

Road/Route Name -

Section -Complete the "Section Number" from the ARDOT Route and Section Map.

Zone - Complete the "Zone" from the County Zone Map.

### ***Seismic***

Seismic - Code “Y” if the bridge is designed using Seismic design specifications.

Seismic Year/Zone –

### ***Notification***

School District Email – To be used at a later date.

Owner Email – The Inspector shall see that this is filled in so that email notifications for critical findings may be sent out through the database.

Late Reason – This is a drop down menu that should be used when the inspection is going to be late.

### ***Load Posting***

Calculated:

Code4 Vehicle - Posting is required for tonnages less than 22 tons.

Code9 Vehicle - Posting is required for tonnages less than 31 tons.

Code5 Vehicle - Posting is required for tonnages less than 40 tons.

Posted:

Code4 - Code the actual posting on the signs at the thru approach to the bridge - refer to the drawings in Chapter 14. Posted bridges will be inspected at least every 12 months.

Code9 - Code the actual posting on the signs at the thru approach to the bridge - refer to the drawings in Chapter 14. Posted bridges will be inspected at least every 12 months.

Code5 - Code the actual posting on the signs at the thru approach to the bridge - refer to the drawings in Chapter 14. Posted bridges will be inspected at least every 12 months.

### ***STIP***

APHN - The Arkansas Primary Highway Network has four classifications:

0 = not on APHN

1 = NHS (All NHS routes Interstates included)

2 = Other Arterials (functionally classified as principal arterials or minor arterials)

3 = Critical Service Routes (routes that parallel the interstate - keep in mind some of these routes can be NHS or Arterials - higher function wins out)

4 = Other high traffic routes (routes with ADT over 2,000 and lead to a town with a population of 5,000 or more)

STIP - Input a value of 2 if the bridge is included in the Statewide Transportation Improvement Program. This field can be used to prevent the bridge from being included in any Bridge Management scenarios.

Job Number – The job number under which the bridge was built.

Old Bridge Number – The bridge number of the bridge that this bridge replaced.

New Bridge Number – No idea why this is here. May eliminate.

## ***NBIS FORM GUIDELINES***

When a drawing is required for one of following forms it should be drawn in micro-station.

NBIS Form IIA Guidelines - Form IIA is for describing the condition of Hanger and Pin Assemblies on Articulated and Suspended Spans. Number the spans and joints according to the drawing at the bottom of Form IIA. Number the beams from left to right looking toward increasing log mile. Comments and remarks should be used as much as possible.

NBIS Form III Guidelines - Form III is used for notes/drawings that are not covered in other forms such as soundings, FC items, wearing thickness, etc.

NBIS Form IIIB Guidelines - Form IIIB is for detailing the vertical and horizontal clearance as a highway or railroad passes under the bridge. These values will be used to code Items 54, 55, 56, and 69.

NBIS Form IV Guidelines - Form IV is to be used to help describe the superstructure and substructure when contract plans are not available and it's necessary to draw and detail the bridge. The form is self-explanatory and has space for comments. If the beam spacing is not uniform or there are different beam sizes it may be necessary to describe the geometry on Form III.

NBIS Form IVA Guidelines - Form IVA is for describing the different members of a truss. Form III should be used to detail Elevation and cross sections of the truss and detail more complicated truss members.

# Chapter 12: Inspection of Signs

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## ***Major Sign Structure Inspection***

Sign structures are very important to the traveling public for their informational value. The structural integrity of these signs is also critical to the safety of the traveling public due to the location at which these structures are built. If a sign structure falls into traffic it could cause a serious accident. It is important to routinely perform and document inspections of these sign structures.

Results of the inspection will be maintained at the District level and not sent to the Bridge Division except for the initial inspection. Contact Maintenance Division if there is cause for concern.

All charges for sign structure inspection should be made to the county, route and section under Function 481, "Structure Inspection".

## ***The 5 Major Classifications of Sign Structures***

1. Overhead – characterized by space frame welded or bolted structural sections spanning over the highway supported by 2 or 4 column towers resting on concrete footings and pedestals and in some instances resting on some portion of a bridge (see Sketch No. 1).

Members are described as top and bottom chords; verticals; diagonals; top and bottom horizontals; and top, bottom and interior diagonals. Towers can be in the form of space welded or bolted structural sections made up of vertical chords, and similar descriptions.

2. Propped Cantilever – characterized by space frame welded or bolted structural sections extending out over the roadway with one end supported and an additional support part way out the overhead section toward the other end. The end is supported by a single 2 or 4 column tower and the prop is a single 2 column tower. Both supports rest on concrete footings and pedestals and in some instances rest on some portion of a bridge (see Sketch No. 2).

Members are described identical to those in the Overhead.

3. Overhead Cantilever – characterized by space frame welded or bolted structural sections extending out over the roadway with only one end supported by a single 4 column tower resting on a concrete footing and pedestal and in some instances resting on some portion of a bridge (see Sketch No. 3).

Members are described identical to those in the Overhead.

4. "T" Mount – characterized by space frame welded or bolted structural sections where the frames are mounted on a single tower to form a "T" with the frames extending out from the tower in two directions. The tower rests on a concrete footing and pedestal and in some instances rest on some portion of a bridge (see Sketch No. 4).

Members are described identical to those in the Overhead.

5. Bracket Mount – characterized by steel structural sections welded and bolted together to form a sign frame support that is bolted to the bridge (see Sketch No. 5).

There are 4 types of materials associated with major sign structures:

- Aluminum – used in a high percentage of overhead space frames of simple and cantilever design.
- Galvanized Steel – used in a high percentage of overhead space frames and bracket mount sign structures.
- Stainless Steel – may be used in bolts for aluminum structures.
- Concrete – used in foundations for sign structures.

#### ***Types of Inspection for Major Sign Structures***

- Inventory Inspection – This inspection is made after initial erection to assure proper construction. This will also serve as the first inspection made for initial documentation purposes. A copy of this inspection will be sent to Bridge Division.
- Routine Inspection – Most inspections will be made every four (4) years after the inventory inspection. Bridge mounted sign structures whether overhead, overhead cantilever, or bracket mount will be inspected at a minimum of every two (2) years.
- Special Inspection – Special inspections will be made after a major wind event or traffic incident that might have damaged the structure. Special inspections will be made to inspect specific areas of concern (that the inspector deems necessary).

#### ***Inspection Procedures for Major Sign Structures***

1. Inspect the foundation for cracks and concrete deterioration.
2. Inspect the anchor bolts for rust deterioration, missing nuts, cracks and broken bolts.
3. Inspect the base plates for rust deterioration and cracks especially around welds.
4. Inspect support columns and towers for cracks in welds, bulging from the effect of freezing water in closed sections that do not drain, and rust from the inside of closed galvanized sections that were not galvanized on the inside.
5. Inspect bolted connections for broken, missing and loose nuts and bolts. Also check for rust deterioration in connections due to incorrect bolt type – stainless steel or aluminum bolts should be used in aluminum.
6. Check space frame members for cracks and breaks. Aluminum welds are prone to fatigue cracking.
7. Check signs and fixtures for proper attachment.

Watch for locations where sign structures are set close enough to the road that winter salt spray and snow plow wind rows can accumulate on the base support and cause deterioration of anchor bolts and concrete pedestals.



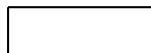
### ***Documentation for Major Sign Structures***

Each major sign structure has been given a unique number; contact Bridge Division for numbers.

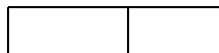
The unique number will be in the form “TTrrccnn”, where:

“TT” indicates the type structure as follows:

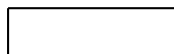
OH – Overhead Structure



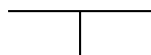
PC – Propped Cantilever



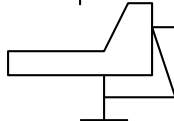
OC – Overhead Cantilever



TM – “T” Mount



BM – Bracket Mount



“rrr” indicates the Route as 430 or 030.

“cc” indicates the County code as 60 indicates Pulaski County.

“nn” indicates a unique number for the structure on that route.

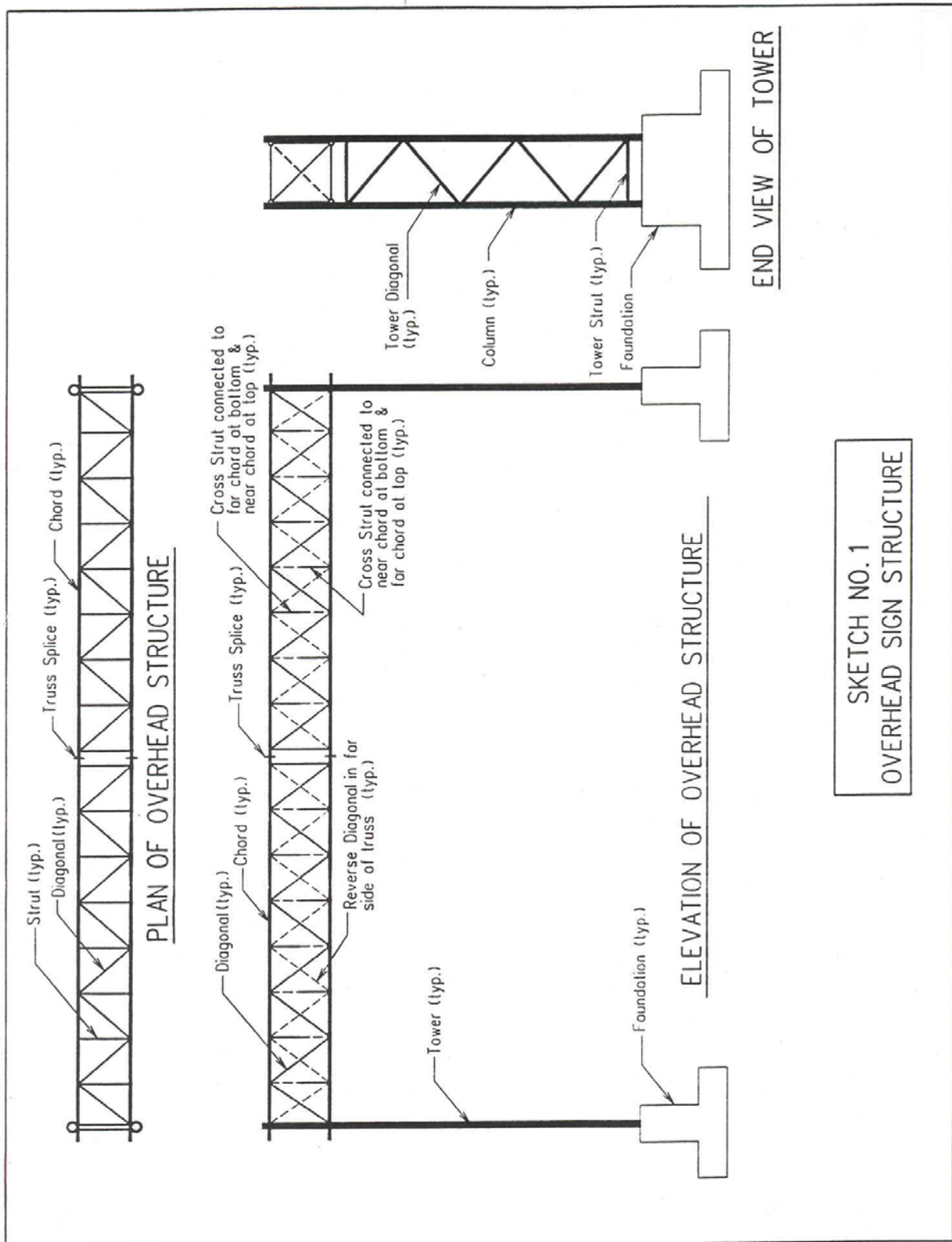
Sign Structure numbers should be painted or stamped on all structures in a prominent location.

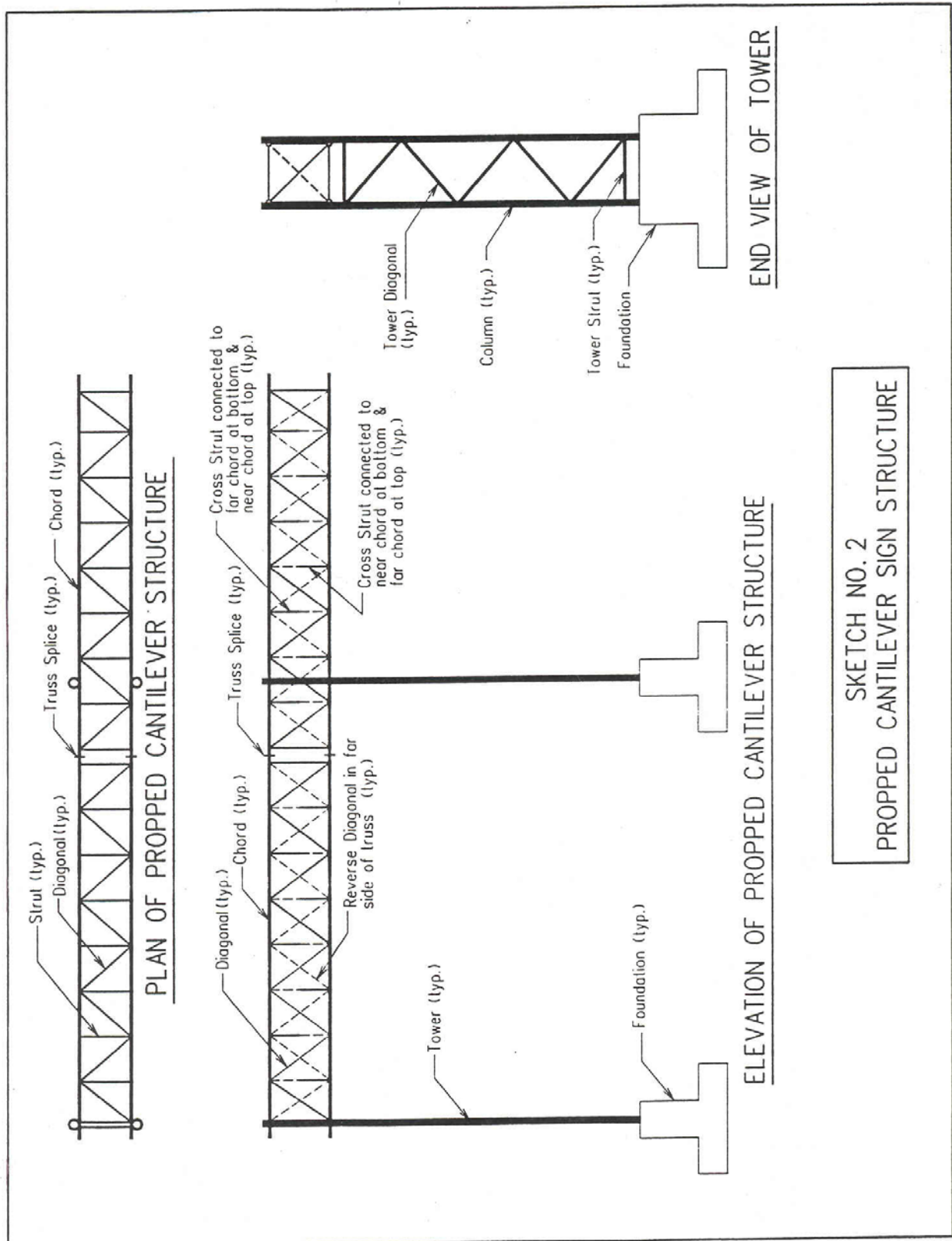
Use a Form III drawing/notes where needed for any clarification of inspection.

Include date of inspection, inspector(s), and type of inspection.

Rate the overall condition of the Foundation, Columns, and Superstructure using the same system a used in bridge rating.

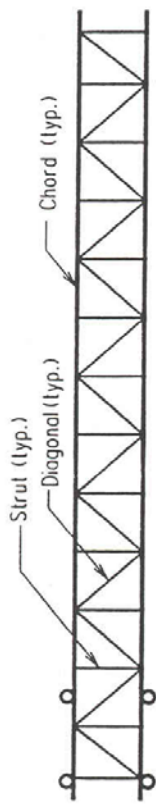
Any maintenance and repair needs should be documented on the inspection report and a copy forwarded to the District Maintenance Engineer.



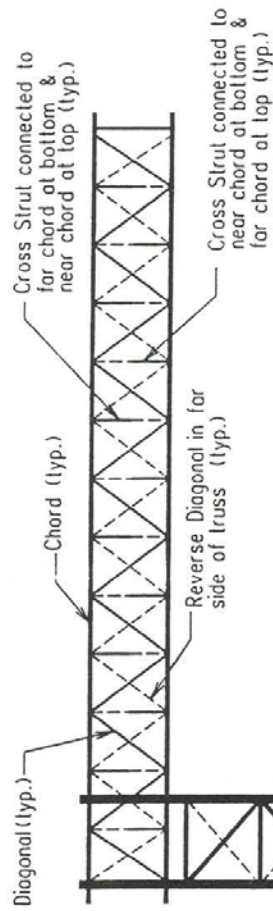


SKETCH NO. 2  
PROPPED CANTILEVER SIGN STRUCTURE

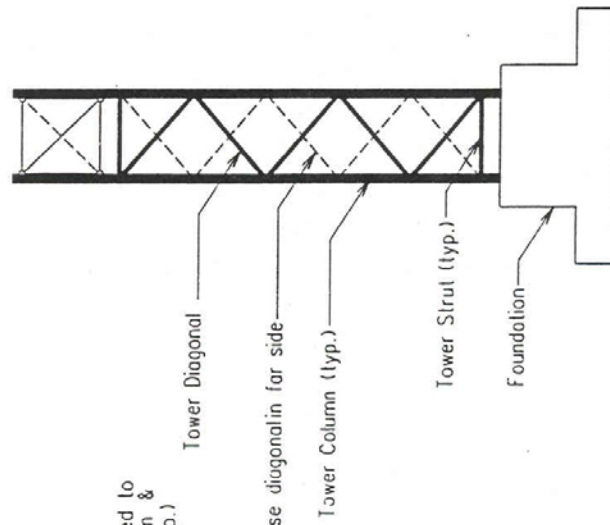
728



PLAN OF CANTILEVER STRUCTURE

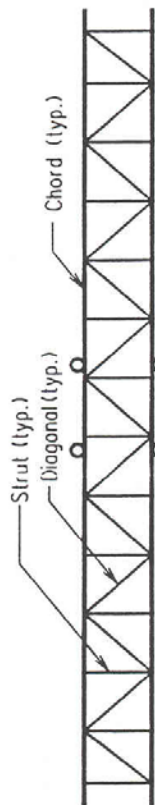


ELEVATION OF CANTILEVER STRUCTURE

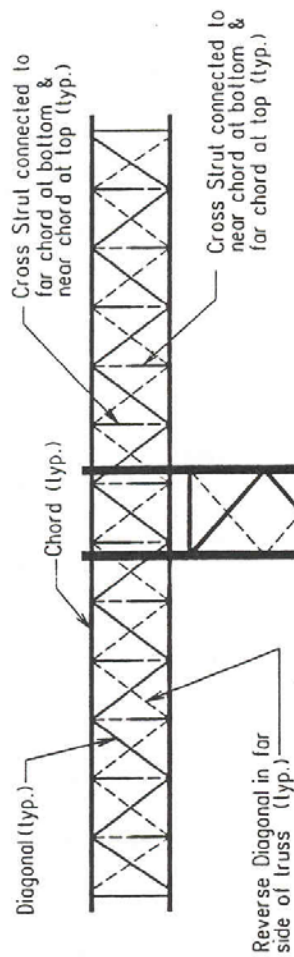


END VIEW OF TOWER

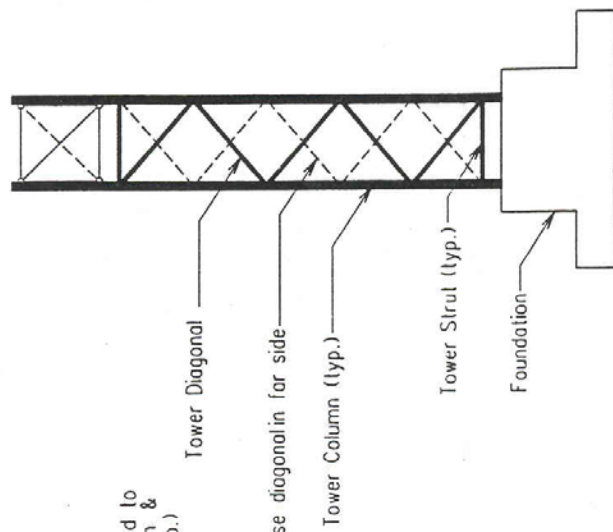
SKETCH NO. 3  
CANTILEVER SIGN STRUCTURE



PLAN OF T-MOUNT STRUCTURE

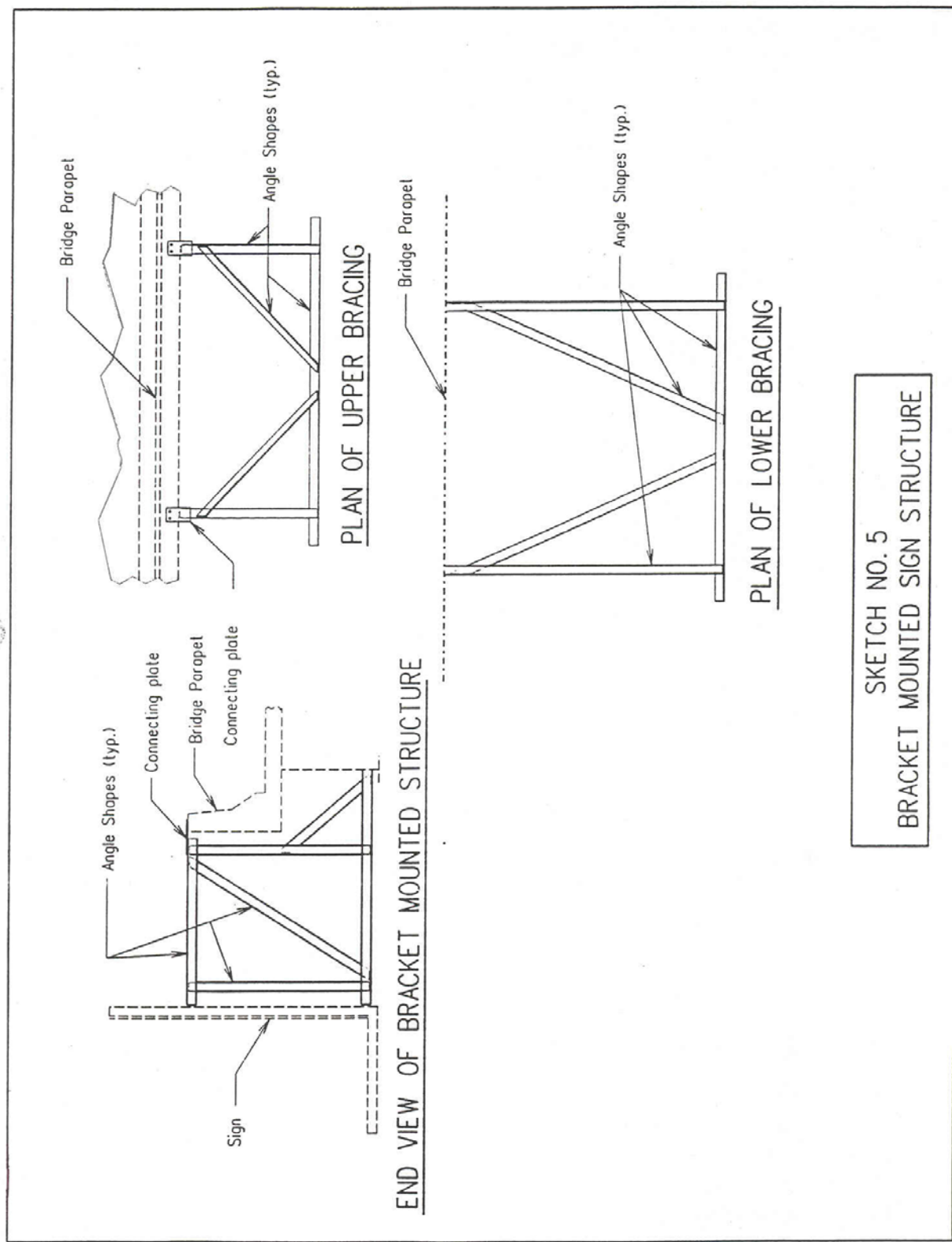


ELEVATION OF T-MOUNT STRUCTURE



END VIEW OF TOWER

SKETCH NO. 4  
T-MOUNT SIGN STRUCTURE



SKETCH NO. 5  
BRACKET MOUNTED SIGN STRUCTURE

# Chapter 13: Inspection of High Mast Poles

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## ***High Mast Light Pole Inspection***

High-Mast Light Poles are important to the safety of the traveling public due to the illumination they give to interchanges. High-Mast Light Poles could also be dangerous to the public due to the height of these structures and their vicinity near the roadways. A failure could cause a serious accident. It is important to perform and document inspections on these structures.

Results of the inspection will be maintained at the District level with no submittals to the Bridge Division. If there is cause for concern contact the Maintenance Division.

Only High-Mast Light Poles greater than 95 feet will be considered for the purpose of inspection. All charges for High-Mast Pole inspection should be made to the county, route and section under Function 481, "Structure Inspection".

## ***The 2 Major Classifications for High Mast Light Poles***

1. ROUND slip in fit – characterized by their round tubular shape of progressively smaller diameter made up of 2, 3, 4 or 5 sections.
2. MULTI-SIDED slip in fit – characterized by their multisided tubular shape of progressively smaller diameter made up of 2, 3, 4 or 5 sections.

Material for High-Mast Light Poles is steel. Steel High-Mast Light Poles are either galvanized or exposed. Exposed steel is of the type designed for that purpose and is characterized as having a rough rusty texture. Galvanized steel is characterized as having a rough zinc texture both inside and outside.

## ***Types of Inspection for High Mast Light Poles***

- Inventory Inspection – This inspection is made after initial erection to assure proper construction. This will also be the first inspection made for initial documentation purposes.
- Routine Inspection – Most inspections will be made every four (4) years after the inventory inspection. At this inspection all items of the structure will be examined.
- Special Inspection – Special inspections will be made after a major wind event or traffic incident that might have damaged the structure. Special inspections will be made to investigate specific areas of concern for a particular structure.

## ***Inspection Procedures for High Mast Light Poles***

1. Inspect footings for cracks and deterioration.
2. Inspect anchor bolts for missing nuts and broken or rusted bolts.
3. Inspect base plates for cracks.
4. Inspect slip together sections for cracks, pack rust development, and section loss.

5. Inspect tubular sections for cracks, section loss and loss of galvanized coating.

High-Mast Light Poles may be inspected using field binoculars or spotting scopes where it is not possible to get up close.

***Documentation for High Mast Light Poles***

Each High-Mast Light Pole should be given a unique number, route, section and log mile.

The unique number should be in the form “rrrcnn” where:

“rrr” indicates the Route as 430 or 030.

“cc” indicates the County code as 60 indicates Pulaski County.

“nn” indicates a unique number for the structure on that route.

The unique number should be painted or stamped on the structure for identification.

Include date of inspection, inspector(s), and type of inspection.

Use a Form III drawing/notes where needed for any clarification of inspection.

Structural deficiencies should be reported to the District Maintenance Engineer if owned by ARDOT. Other structural deficiencies should be sent to the owner.



# **Appendix A**

## **NBIS Code of Federal Regulations (CFR) Chapter 23 Highways – Part 650**

JANUARY, 2005 NBIS REGULATIONS

CODE OF FEDERAL REGULATIONS  
PART 650--BRIDGES, STRUCTURES, AND HYDRAULICS

1. The authority citation for part 650 continues to read as follows:

Authority: 23 U.S.C. 109 (a) and (h), 144, 151, 315, and 319; 33 U.S.C. 401, 491 et seq., 511 et seq.; 23 CFR 1.32; 49 CFR 1.48(b), E.O. 11988 (3 CFR, 1977 Comp. p. 117); Department of Transportation Order 5650.2 dated April 23, 1979 (44 FR 24678); sec. 161 of Public Law 97-424, 96 Stat. 2097, 3135; sec. 4(b) of Public Law 97-134, 95 Stat. 1699; and sec. 1057 of Public Law 102-240, 105 Stat. 2002; and sec. 1311 of Pub. L. 105-178, as added by Pub. L. 105-206, 112 Stat. 842 (1998).

2. Revise subpart C to read as follows:

**Subpart C--National Bridge Inspection Standards**

Sec.

650.301 Purpose.

650.303 Applicability.

650.305 Definitions.

650.307 Bridge inspection organization.

650.309 Qualifications of personnel.

650.311 Inspection frequency.

650.313 Inspection procedures.

650.315 Inventory.

650.317 Reference manuals.

**Subpart C--National Bridge Inspection Standards**

**§ 650.301 Purpose.**

This subpart sets the national standards for the proper safety inspection and evaluation of all highway bridges in accordance with 23 U.S.C. 151.

**§ 650.303 Applicability.**

The National Bridge Inspection Standards (NBIS) in this subpart apply to all structures defined as highway bridges located on all public roads.

**§ 650.305 Definitions.**

Terms used in this subpart are defined as follows:

*American Association of State Highway and Transportation Officials (AASHTO) Manual. "Manual for Condition Evaluation of Bridges," second edition, published by the American Association of State Highway and Transportation Officials (incorporated by reference, see Sec. 650.317).*

*Bridge.* A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

*Bridge inspection experience.* Active participation in bridge inspections in accordance with the NBIS, in either a field inspection, supervisory, or management role. A combination of bridge design, bridge maintenance, bridge construction and bridge inspection experience, with the predominant amount in bridge inspection, is acceptable.

*Bridge inspection refresher training.* The National Highway Institute "Bridge Inspection Refresher Training Course" <sup>1</sup> or other State, local, or federally developed instruction aimed to improve quality of inspections, introduce new techniques, and maintain the consistency of the inspection program.

*Bridge Inspector's Reference Manual (BIRM).* A comprehensive FHWA manual on programs, procedures and techniques for inspecting and evaluating a variety of in-service highway bridges. This manual may be purchased from the U.S. Government Printing Office, Washington, DC 20402 and from National Technical Information Service, Springfield, Virginia 22161, and is available at the following URL: <http://www.fhwa.dot.gov/bridge/bripub.htm>.

*Complex bridge.* Movable, suspension, cable stayed, and other bridges with unusual characteristics.

*Comprehensive bridge inspection training.* Training that covers all aspects of bridge inspection and enables inspectors to relate conditions observed on a bridge to established criteria (see the Bridge Inspector's Reference Manual for the recommended material to be covered in a comprehensive training course).

*Critical finding.* A structural or safety related deficiency that requires immediate follow-up inspection or action.

*Damage inspection.* This is an unscheduled inspection to assess structural damage resulting from environmental factors or human actions.

*Fracture critical member (FCM).* A steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse.

*Fracture critical member inspection.* A hands-on inspection of a fracture critical member or member components that may include visual and other nondestructive evaluation.

*Hands-on.* Inspection within arms length of the component. Inspection uses visual techniques that may be supplemented by nondestructive testing.

*Highway.* The term "highway" is defined in 23 U.S.C. 101(a)(11).

*In-depth inspection.* A close-up, inspection of one or more members above or below the water level to identify any deficiencies not readily detectable using routine inspection procedures; hands-on inspection may be necessary at some locations.

*Initial inspection.* The first inspection of a bridge as it becomes a part of the bridge file to provide all Structure Inventory and Appraisal (SlandA) data and other relevant data and to determine baseline structural conditions.

*Legal load.* The maximum legal load for each vehicle configuration permitted by law for the State in which the bridge is located.

*Load rating.* The determination of the live load carrying capacity of a bridge using bridge plans and supplemented by information gathered from a field inspection.

*National Institute for Certification in Engineering Technologies (NICET).* The NICET provides nationally applicable voluntary certification programs covering several broad engineering technology fields and a number of specialized subfields. For information on the NICET program certification contact: National Institute for Certification in Engineering Technologies, 1420 King Street, Alexandria, VA 22314-2794.

*Operating rating.* The maximum permissible live load to which the structure may be subjected for the load configuration used in the rating.

*Professional engineer (PE).* An individual, who has fulfilled education and experience requirements and passed rigorous exams that, under State licensure laws, permits them to offer engineering services directly to the public. Engineering licensure laws vary from State to State, but, in general, to become a PE an individual must be a graduate of an engineering program accredited by the Accreditation Board for Engineering and Technology, pass the Fundamentals of Engineering exam, gain four years of experience working under a PE, and pass the Principles of Practice of Engineering exam.

*Program Manager.* The individual in charge of the program, that has been assigned or delegated the duties and responsibilities for bridge inspection, reporting, and inventory. The program manager provides overall leadership and is available to inspection team leaders to provide guidance.

*Public road.* The term "public road" is defined in 23 U.S.C. 101(a)(27).

*Quality assurance (QA).* The use of sampling and other measures to assure the adequacy of quality control procedures in order to verify or measure the quality level of the entire bridge inspection and load rating program.

*Quality control (QC).* Procedures that are intended to maintain the quality of a bridge inspection and load rating at or above a specified level.

*Routine inspection.* Regularly scheduled inspection consisting of observations and/or measurements needed to determine the physical and functional condition of the bridge, to identify any changes from initial or previously recorded conditions, and to ensure that the structure continues to satisfy present service requirements.

*Routine permit load.* A live load, which has a gross weight, axle weight or distance between axles not conforming with State statutes for legally configured vehicles, authorized for unlimited trips over an extended period of time to move alongside other heavy vehicles on a regular basis.

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

*Scour critical bridge.* A bridge with a foundation element that has been determined to be unstable for the observed or evaluated scour condition.

*Special inspection.* An inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency.

*State transportation department.* The term "State transportation department" is defined in 23 U.S.C. 101(a)(34).

*Team leader.* Individual in charge of an inspection team responsible for planning, preparing, and performing field inspection of the bridge.

*Underwater diver bridge inspection training.* Training that covers all aspects of underwater bridge inspection and enables inspectors to relate the conditions of underwater bridge elements to established criteria (see the Bridge Inspector's Reference Manual section on underwater inspection for the recommended material to be covered in an underwater diver bridge inspection training course).

*Underwater inspection.* Inspection of the underwater portion of a bridge substructure and the surrounding channel, which cannot be inspected visually at low water by wading or probing, generally requiring diving or other appropriate techniques.

#### **§ 650.307 Bridge inspection organization.**

- (a) Each State transportation department must inspect, or cause to be inspected, all highway bridges located on public roads that are fully or partially located within the State's boundaries, except for bridges that are owned by Federal agencies.
- (b) Federal agencies must inspect, or cause to be inspected, all highway bridges located on public roads that are fully or partially located within the respective agency responsibility or jurisdiction.
- (c) Each State transportation department or Federal agency must include a bridge inspection organization that is responsible for the following:
  - (1) Statewide or Federal agency wide bridge inspection policies and procedures, quality assurance and quality control, and preparation and maintenance of a bridge inventory.
  - (2) Bridge inspections, reports, load ratings and other requirements of these standards.
- (d) Functions identified in paragraphs (c)(1) and (2) of this section may be delegated, but such delegation does not relieve the State transportation department or Federal agency of any of its responsibilities under this subpart.
- (e) The State transportation department or Federal agency bridge inspection organization must have a program manager with the qualifications defined in § 650.309(a), who has been delegated responsibility for paragraphs (c)(1) and (2) of this section.

#### **§ 650.309 Qualifications of personnel.**

- (a) A program manager must, at a minimum:
  - (1) Be a registered professional engineer, or have ten years bridge inspection experience; and
  - (2) Successfully complete a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.
- (b) There are five ways to qualify as a team leader. A team leader must, at a minimum:
  - (1) Have the qualifications specified in paragraph (a) of this section; or
  - (2) Have five years bridge inspection experience and have successfully completed an FHWA approved comprehensive bridge inspection training course; or
  - (3) Be certified as a Level III or IV Bridge Safety Inspector under the National Society of Professional Engineer's program for National Certification in Engineering Technologies (NICET) and have successfully completed an FHWA approved comprehensive bridge inspection training course; or
  - (4) Have all of the following:
    - (i) A bachelor's degree in engineering from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology;
    - (ii) Successfully passed the National Council of Examiners for Engineering and Surveying Fundamentals of Engineering examination;
    - (iii) Two years of bridge inspection experience; and
    - (iv) Successfully completed an FHWA approved comprehensive bridge inspection training course; or
  - (5) Have all of the following:
    - (i) An associate's degree in engineering or engineering technology from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology;
    - (ii) Four years of bridge inspection experience; and
    - (iii) Successfully completed an FHWA approved comprehensive bridge inspection training course.
- (c) The individual charged with the overall responsibility for load rating bridges must be a registered professional engineer.
- (d) An underwater bridge inspection diver must complete an FHWA approved comprehensive bridge inspection training course or other FHWA approved underwater diver bridge inspection training course.

#### **§ 650.311 Inspection frequency.**

- (a) Routine inspections.
  - (1) Inspect each bridge at regular intervals not to exceed twenty-four months.
  - (2) Certain bridges require inspection at less than twenty-four month intervals. Establish criteria to determine the level and frequency to which these bridges are inspected considering such factors as age, traffic characteristics, and known deficiencies.
  - (3) Certain bridges may be inspected at greater than twenty-four month intervals, not to exceed forty-eight-months, with written FHWA approval. This may be appropriate when past inspection findings and analysis justifies the increased inspection interval.
- (b) Underwater inspections.

- (1) Inspect underwater structural elements at regular intervals not to exceed sixty months.
- (2) Certain underwater structural elements require inspection at less than sixty-month intervals. Establish criteria to determine the level and frequency to which these members are inspected considering such factors as construction material, environment, age, scour characteristics, condition rating from past inspections and known deficiencies.
- (3) Certain underwater structural elements may be inspected at greater than sixty-month intervals, not to exceed seventy-two months, with written FHWA approval. This may be appropriate when past inspection findings and analysis justifies the increased inspection interval.
- (c) Fracture critical member (FCM) inspections.
  - (1) Inspect FCMs at intervals not to exceed twenty-four months.
  - (2) Certain FCMs require inspection at less than twenty-four-month intervals. Establish criteria to determine the level and frequency to which these members are inspected considering such factors as age, traffic characteristics, and known deficiencies.
- (d) Damage, in-depth, and special inspections. Establish criteria to determine the level and frequency of these inspections.

**§ 650.313 Inspection procedures.**

- (a) Inspect each bridge in accordance with the inspection procedures in the AASHTO Manual (incorporated by reference, see § 650.317).
- (b) Provide at least one team leader, who meets the minimum qualifications stated in § 650.309, at the bridge at all times during each initial, routine, in-depth, fracture critical member and underwater inspection.
- (c) Rate each bridge as to its safe load-carrying capacity in accordance with the AASHTO Manual (incorporated by reference, see § 650.317). 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.
- (d) Prepare bridge files as described in the AASHTO Manual (incorporated by reference, see § 650.317). Maintain reports on the results of bridge inspections together with notations of any action taken to address the findings of such inspections. Maintain relevant maintenance and inspection data to allow assessment of current bridge condition. Record the findings and results of bridge inspections on standard State or Federal agency forms.
- (e) Identify bridges with FCMs, bridges requiring underwater inspection, and bridges that are scour critical.
  - (1) Bridges with fracture critical members. In the inspection records, identify the location of FCMs and describe the FCM inspection frequency and procedures. Inspect FCMs according to these procedures.
  - (2) Bridges requiring underwater inspections. Identify the location of underwater elements and include a description of the underwater elements, the inspection frequency and the procedures in the inspection records for each bridge requiring underwater inspection. Inspect those elements requiring underwater inspections according to these procedures.
  - (3) Bridges that are scour critical. Prepare a plan of action to monitor known and potential deficiencies and to address critical findings. Monitor bridges that are scour critical in accordance with the plan.

- (f) Complex bridges. Identify specialized inspection procedures, and additional inspector training and experience required to inspect complex bridges. Inspect complex bridges according to those procedures.
- (g) Quality control and quality assurance. Assure systematic quality control (QC) and quality assurance (QA) procedures are used to maintain a high degree of accuracy and consistency in the inspection program. Include periodic field review of inspection teams, periodic bridge inspection refresher training for program managers and team leaders, and independent review of inspection reports and computations.
- (h) Follow-up on critical findings. Establish a statewide or Federal agency wide 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.

#### **§ 650.315 Inventory.**

- (a) Each State or Federal agency must prepare and maintain an inventory of all bridges subject to the NBIS. Certain Structure Inventory and Appraisal (SI&A) data must be collected and retained by the State or Federal agency for collection by the FHWA as requested. A tabulation of this data is contained in the SI&A sheet distributed by the FHWA as part of the "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges," (December 1995) together with subsequent interim changes or the most recent version. Report the data using FHWA established procedures as outlined in the "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges."
- (b) For routine, in-depth, fracture critical member, underwater, damage and special inspections enter the SI&A data into the State or Federal agency inventory within 90 days of the date of inspection for State or Federal agency bridges and within 180 days of the date of inspection for all other bridges.
- (c) For existing bridge modifications that alter previously recorded data and for new bridges, enter the SI&A data into the State or Federal agency inventory within 90 days after the completion of the work for State or Federal agency bridges and within 180 days after the completion of the work for all other bridges.
- (d) For changes in load restriction or closure status, enter the SI&A data into the State or Federal agency inventory within 90 days after the change in status of the structure for State or Federal agency bridges and within 180 days after the change in status of the structure for all other bridges.

#### **§ 650.317 Reference manuals.**

- (a) The materials listed in this subpart are incorporated by reference in the corresponding sections noted. These incorporations by reference were approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. These materials are incorporated as they exist on the date of the approval, and notice of any change in these documents will be published in the **Federal Register**. The materials are available for purchase at the address listed below, and are available for inspection at the National Archives and Records Administration (NARA). These materials may also be reviewed at the Department of Transportation Library, 400 Seventh Street, SW., Washington, DC, in Room 2200. For information on the availability of these materials at NARA call (202) 741- 6030, or go to the following URL: [http://www.archives.gov/federal\\_register/code\\_of\\_federal\\_regulations/ibr\\_locations.html](http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html) In the event there is a conflict between the standards in this subpart and any of these materials, the standards in this subpart will apply.



(b) The following materials are available for purchase from the American Association of State Highway and Transportation Officials, Suite 249, 444 N. Capitol Street, NW., Washington, DC 20001. The materials may also be ordered via the AASHTO bookstore located at the following URL: <http://www.aashto.org/aashto/home.nsf/FrontPage>.

- (1) The Manual for Condition Evaluation of Bridges, 1994, second edition, as amended by the 1995, 1996, 1998, and 2000 interim revisions, AASHTO, incorporation by reference approved for § § 650.305 and 650.313.
- (2) 2001 Interim Revision to the Manual for Condition Evaluation of Bridges, AASHTO, incorporation by reference approved for § § 650.305 and 650.313.
- (3) 2003 Interim Revision to the Manual for Condition Evaluation of Bridges, AASHTO, incorporation by reference approved for § § 650.305 and 650.313.

<sup>1</sup> The National Highway Institute training may be found at the following URL: <http://www.nhi.fhwa.dot.gov/Home.aspx>