

Bridge Inspection

Exploring the Bridge Inspection Process from Deck to Foundation

ASHE Harrisburg Back-to-Basics Lunch & Learn

Presented by: Luke Hacker, EIT, CBSI

April 7, 2026



We Make a Difference



Introduction

Luke Hacker, EIT, CBSI

- Pennsylvania State University, Class of 2017
- Michael Baker International, Harrisburg



Bridge Inspection Basics



Specifications,
Regulations,
Publications



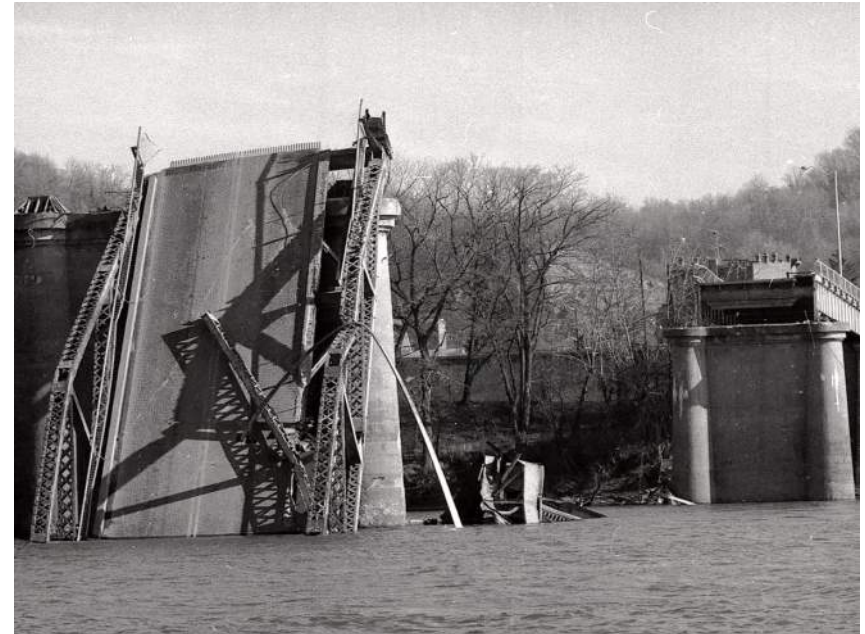
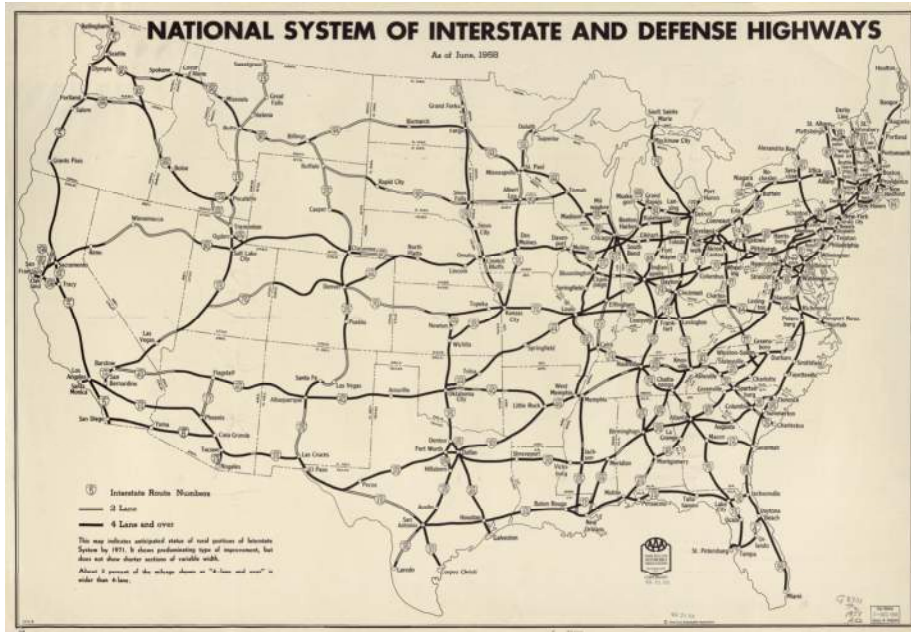
Why?

- Ensuring safety
- Protect public investment
- Enabling oversight and bridge inspection program support
- Maintain accurate bridge records and reports to owners
- Administering risk-based, data driven, performance management



History of Bridge Inspection

- Federal Aid Highway Act of 1956
- Silver Bridge Collapse of 1967



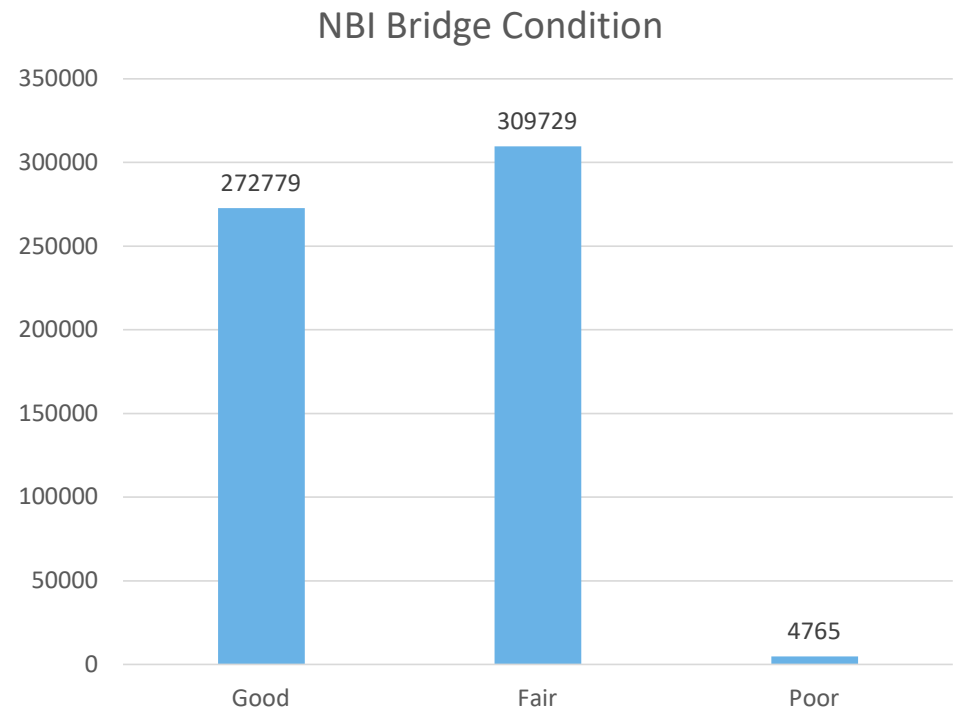
National Bridge Inspection Standards

- CFR Part 650, Title 23, Subpart C – National Bridge Inspection Standards
- Minimum standards for the proper safety inspection and evaluation of bridges
- Federal regulations – “THE LAW”
- Revised and added to over the years to include regulations for:
 - Culverts
 - NSTM bridges
 - Underwater inspections
 - Scour vulnerable bridges



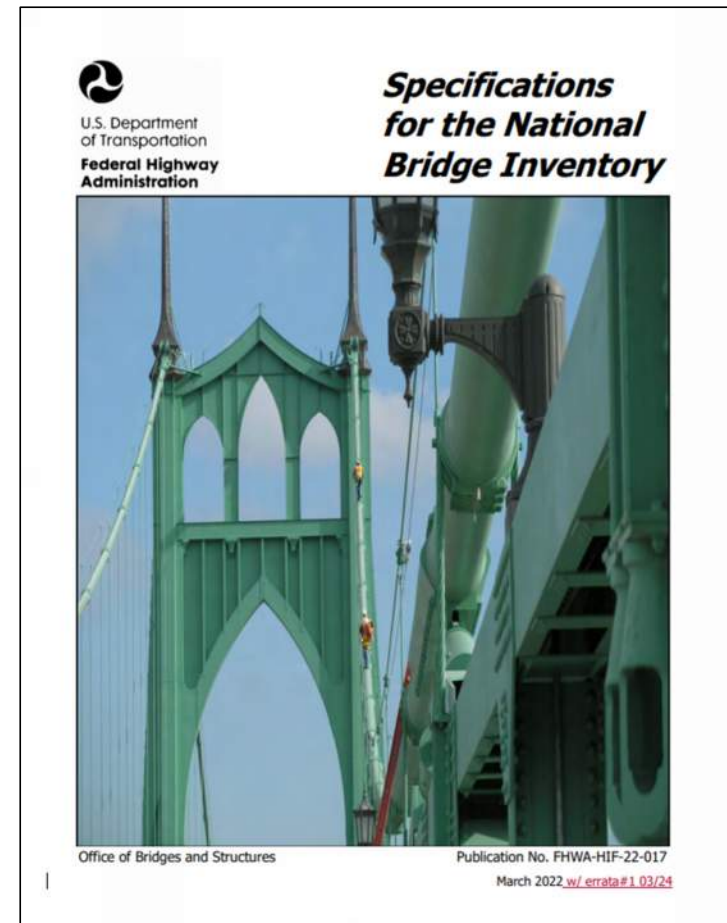
2025 National Bridge Inventory Data

- 624,193 bridges on National Bridge Inventory
 - State & Federal bridges over 20 feet
- 272,779 (44%) in Good Condition
- 309,729 (50%) in Fair Condition
- 41,685 (6%) in Poor Condition
- 23,314 (4%) in Pennsylvania
- 16,422 (2.6%) are NSTM
- 19,690 (3.2%) are Scour Critical



SNBI

- Specifications for National Bridge Inventory (SNBI)
- Developed in coordination with NBIS regulation
- Provides specifications for reporting data



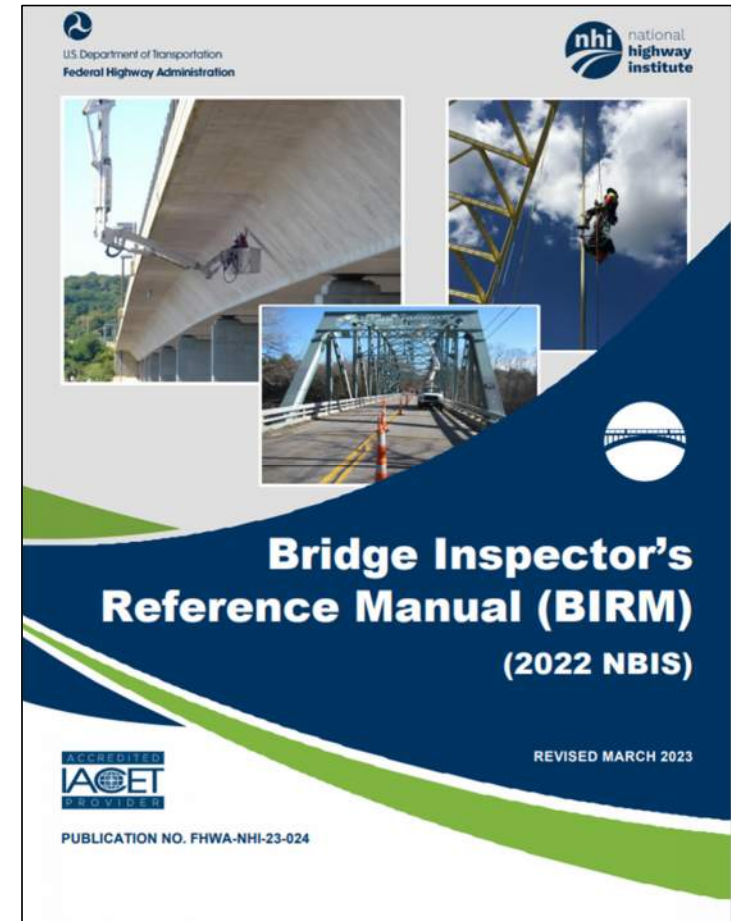
What Is Bridge Inspection?

- Accurate and thorough assessment of each bridge's condition
- Visual, Physical and Advanced inspection methods
- Proper documentation and reporting of deficiencies
- Required data collection for asset management



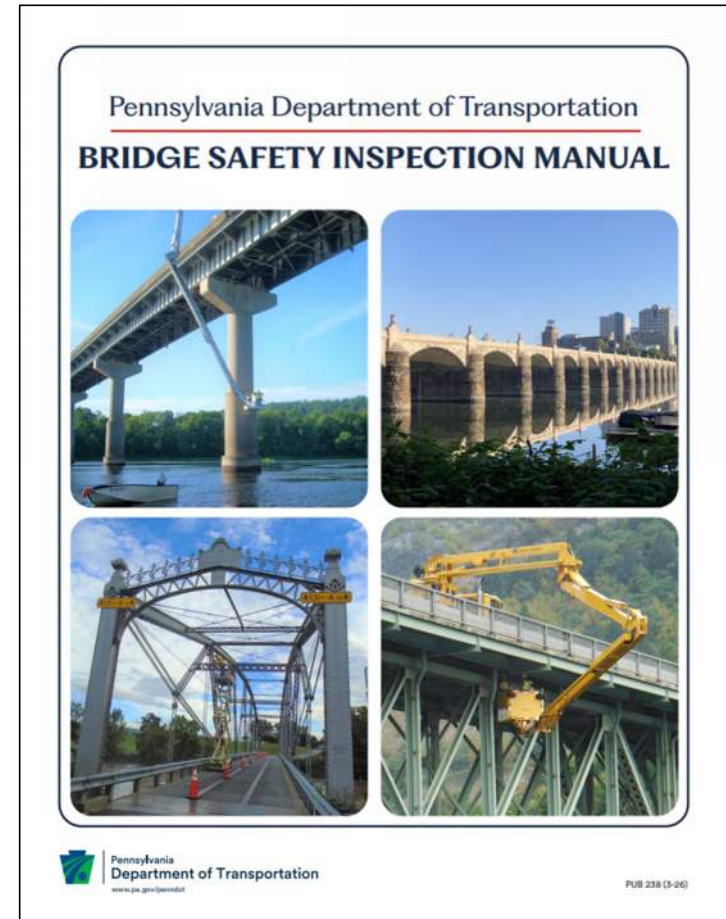
BIRM

- Bridge Inspector's Reference Manual (BIRM)
- FHWA manual on procedures and techniques for inspecting and evaluating bridges



Publication 238

- PennDOT Bridge Safety Inspection Manual
- Policies and procedures for PA Bridge Inspection Program



Bridge Components

- Roadside Hardware (Bridge Railing & Transition)
- Deck
- Joints
- Superstructure
- Bearings
- Substructure
- Culvert

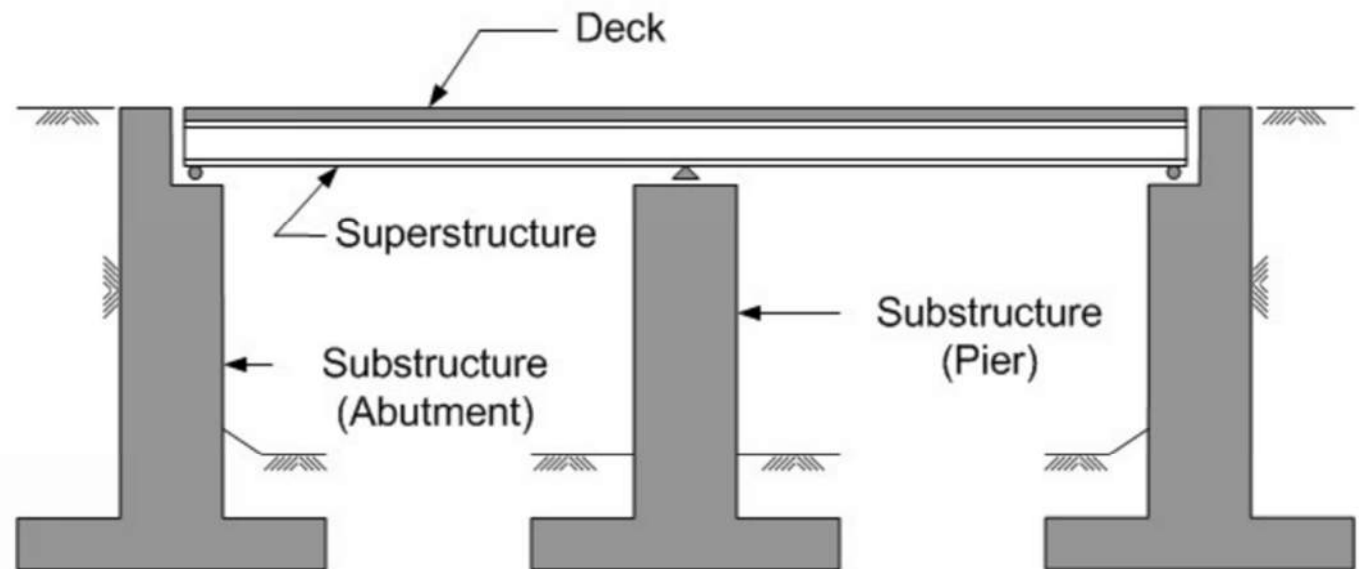


Figure 4.1.2 Major Bridge Components



Bridge Condition Ratings

Table 20. Codes and descriptions for component condition ratings.

Code	Condition	Description
N	NOT APPLICABLE	Component does not exist.
9	EXCELLENT	Isolated inherent defects.
8	VERY GOOD	Some inherent defects.
7	GOOD	Some 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 and/or performance of the component is affected.
3	SERIOUS	Major defects; strength and/or performance of the component is seriously affected. Condition typically necessitates more frequent monitoring, load restrictions, and/or corrective actions.
2	CRITICAL	Major defects; component is severely compromised. Condition typically necessitates frequent monitoring, significant load restrictions, and/or corrective actions in order to keep the bridge open.
1	IMMINENT FAILURE	Bridge is closed to traffic due to component condition. Repair or rehabilitation may return the bridge to service.
0	FAILED	Bridge is closed due to component condition, and is beyond corrective action. Replacement is required to restore service.

GOOD {
FAIR {
POOR {

From BMS:

	Current	Previous
IE.05 Inspection Date: *	02/02/2026	02/17/2022
IE.08 Inspection Type:	R	R
B.C.01 Deck:	7	7
B.C.02 Superstructure:	8	8
B.C.03 Substructure:	7	7
B.C.04 Culvert:	N	N
B.C.05 Railings: *	7	4
B.C.06 Transition: *	7	3
B.C.07 Bearings:	6	6
B.C.08 Joints:	7	7
B.C.09 Channel:	N	N
B.C.10 Channel Protection:	N	N
B.C.11 Scour: *	N	--
B.C.14 NSTM:	N	N
B.C.15 Underwater:	N	N
WA.01 SCBI:	N	N
WA.02 SCBI Category:	--	--
WA.43 Streambed Material:	--	--
:		
B.C.12 Bridge Condition:	G	G



Component Condition Rating

Defect Severity:

Table 47. Concrete - defect severity guidance for component condition ratings.

Defect	Minor	Moderate
Delamination, Spalling, Patched Area	Delamination, small spall, or patched area that is sound.	Large spall or patched area that is unsound or showing distress.
Exposed Rebar	Present without measurable section loss.	Present with measurable section loss.
Exposed Prestressing	Present without section loss.	Present with section loss.
Cracking	Unsealed medium width cracks or unsealed medium pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.
Abrasion, Wear, Scaling	Exposed coarse aggregate, but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix.
Efflorescence, Rust Staining	Surface white or leaching with little or no build-up. No rust staining present.	Rust staining or heavy build-up of efflorescence.

Table 48. Steel - defect severity guidance for component condition ratings.

Defect	Minor	Moderate
Corrosion	Freckled rust. Corrosion has initiated.	Section loss is evident.
Cracking	Crack that has been effectively arrested.	Crack that has not been arrested.
Connection	Loose fasteners, or pack rust without distortion. Connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion.

Defect Extent:

Extent	% When Using SF	% When Using EA or LF
Isolated: Occurs in one or a few areas	< 2%	< 15%
Some: More than isolated and less than widespread	2% to 10%	15% to 35%
Widespread: Present in many separate areas of a component	> 10%	> 35%



Bridge Elements

- Quantitative condition assessment data collected during bridge inspections
- Includes bridge elements that make up bridge components
- Indicates severity and extent of defects



Element Condition States

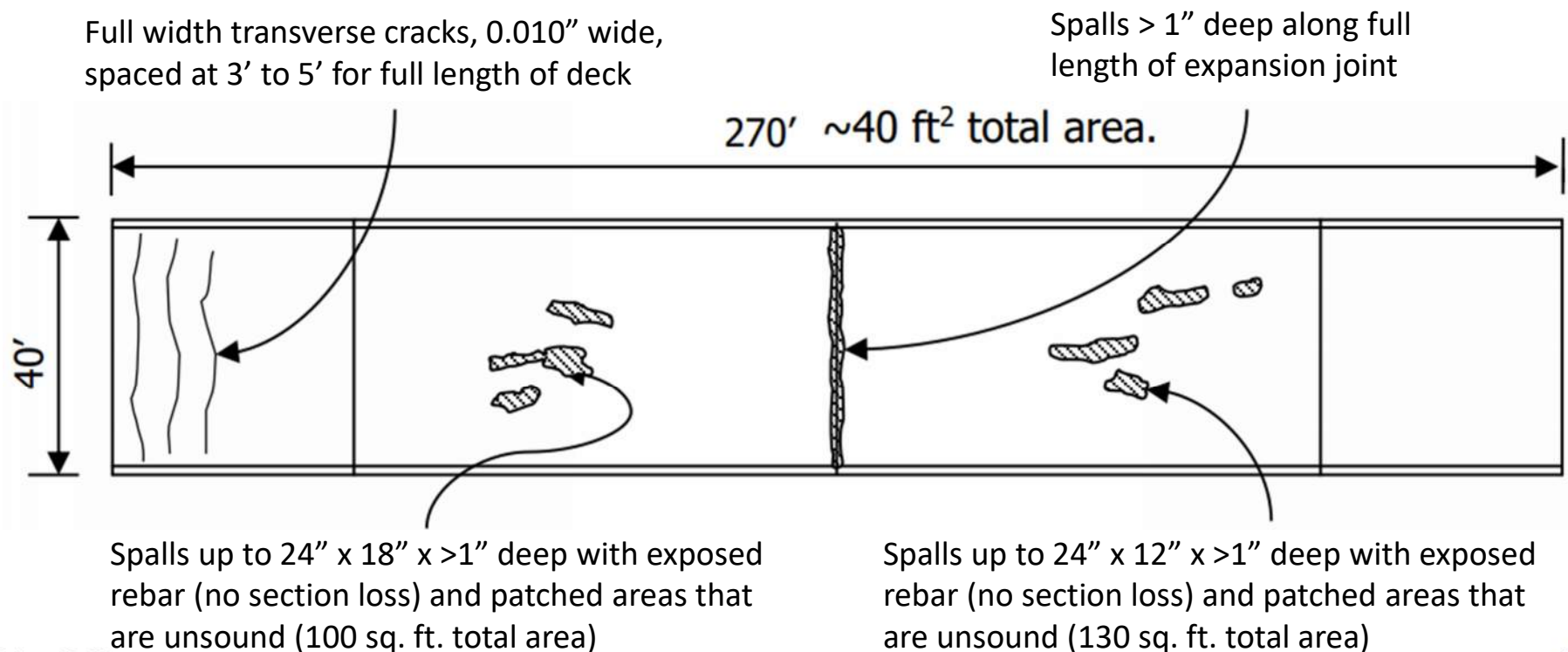


Reinforced Concrete - Condition State Definitions				
Defect	CS 1 - Good	CS 2 - Fair	CS 3 - Poor	CS 4 - Severe
Delamination / Spall / Patched Area (1080)	None	Delaminated. Spall 1 in. or less deep or 6 in. or less in diameter. Patched area that is sound.	Spall greater than 1 in. deep or greater than 6 in. diameter. Patched area that is unsound or showing distress. Does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the elements or bridge. Or a structural review has been completed and the defects impact strength or serviceability of the elements or bridge. If the condition is the result of impact damage, then damage is the predominant defect recorded for this location on the element.
Exposed Rebar (1090)	None	Present without measurable section loss.	Present with measurable section loss, but does not warrant structural review.	
Efflorescence / Rust Staining (1120)	None	Surface white without build-up or leaching without rust staining.	Heavy build-up with rust staining.	
Cracking (RC and Other) * (1130)	Insignificant cracks or moderate width cracks that have been sealed.	Unsealed moderate width cracks or unsealed moderate pattern (map) cracking.	Wide cracks or heavy pattern (map) cracking.	
Abrasion / Wear (PSC/RC) (1190)	No abrasion or wearing	Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete.	Coarse aggregate is loose or has popped out of the concrete matrix due to abrasion or wear.	
Distortion (1900)	None	Distortion not requiring mitigation or mitigated distortion.	Distortion that requires mitigation that has not been addressed but does not warrant structural review.	
Settlement (4000)	None	Exists within tolerable limits or arrested with no observed structural distress.	Exceeds tolerable limits but does not warrant structural review.	
Scour (6000)	None	Exists within tolerable limits or has been arrested with effective countermeasures.	Exceeds tolerable limits, but is less than the critical limits determined by scour evaluation and does not warrant structural review.	
Damage (Impact Related) (7000)	Not applicable	The element has impact damage. The damage caused by the impact has been assessed as Condition State 2 based on the material-specific defects description(s); however, Damage is the predominate defect recorded for this location on the element.	The element has impact damage. The damage caused by the impact has been assessed as Condition State 3 based on the material-specific defects description(s); however, Damage is the predominate defect recorded for this location on the element.	



Component Condition Rating Example

- Deck Condition Rating Example – RC Bridge Deck (270' L x 40' W)



Component Condition Rating Example

Location	Defect(s)	Severity	Extent
1	Cracking	Inherent	Throughout (widespread)
2	Spalling	Moderate	~ 40 ft ² (isolated)
3	Spalling with exposed rebar, patched area that is unsound	Moderate	~ 100 ft ² (isolated)
4	Spalling with exposed rebar, patched area that is unsound	Moderate	~ 130 ft ² (isolated)



Some Moderate Defects



Deck Component
Condition Rating:
“5 – Fair”



Inspection Techniques

- Visual
 - Using eyes to identify defects
- Physical
 - Measuring tape – Measure size of defects
 - Crack card – Measure width of cracks
 - Hammer – Sound for delaminated concrete, remove spalls or rust/section loss
 - Scour pole – Probing for scour and undermining
- Advanced
 - Dye penetrate testing
 - D-meter
 - Magnetic particle testing



Common Defects

- Concrete

- Cracking
- Delamination
- Spalling
- Exposed Rebar



- Steel

- Corrosion/Pack Rust
- Section Loss
- Fatigue Cracks

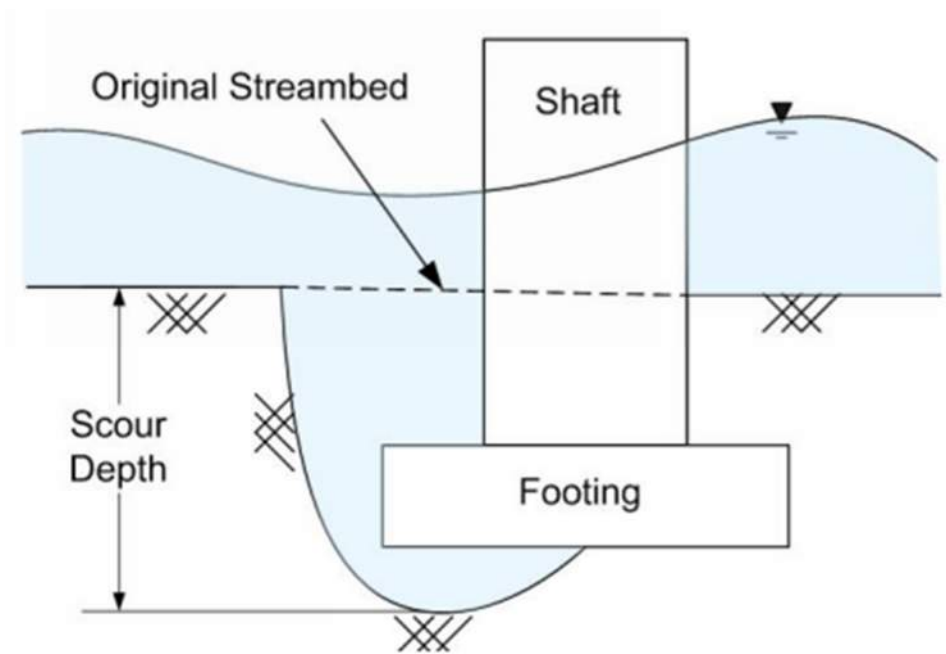


Common Defects

- Leaking Joints
- Movement / Settlement
- Collision Damage
- Flood Debris



Scour



Other Data Collection

- Vertical Clearances
- Horizontal Clearances
- Waterway Features



BMS3

- PennDOT Bridge Management System 3
- System for recording and storing bridge inventory and inspection data

The screenshot displays the BMS3 web application interface. The top navigation bar includes a menu icon, the BMS3 logo, and a user welcome message 'Welcome mbj_lukehacker'. The main content area is titled 'Inspection Links > Deck' and features a search bar with 'BRKEY: 15364' and 'BMS ID: 23401601001924'. Below this, there are sections for 'Deck Conditions' and 'Deck Details'. The 'Deck Conditions' section shows 'B.C.01 Deck Condition Rating: 5 - Fair' and 'Overall Deck Notes: The deck is in fair condition due to some moderate defects.' The 'Deck Details' section lists various bridge attributes such as 'B.G.01 NBIS Bridge Length: 72.0 ft', 'B.G.05 Bridge Width (O/O): 24.0 ft', and 'DK.02 Estimated Chloride Content: 0 %'.

Deck Conditions	
B.C.01 Deck Condition Rating:	5 - Fair
Overall Deck Notes: The deck is in fair condition due to some moderate defects.	
DK.01 Wearing Surface Condition Rating: 5 - Fair	
Overall Wearing Surface Notes: Integral concrete wearing surface - Worn with exposed aggregate. - At near, T from end of deck along double yellow (in wheel path), previous (24" L x 36" W x 2.5" D) spill with 1 exposed rebar that has been repaired with asphalt patch. - At near right end of deck, (48" L x 36" W) asphalt patch with adjacent previous (12" L x 16" W x 2.25" D) spill at end of deck in wheel path with 1 exposed rebar that has been repaired with asphalt patch. - There is minor edge spalling along the far end of the deck and the pier expansion joint.	

Deck Details	
B.G.01 NBIS Bridge Length:	72.0 ft
B.G.05 Bridge Width (O/O):	24.0 ft
B.G.06 Bridge Width (C/C):	22.4 ft
B.G.07 Left Curb or Sidewalk Width:	0.0 ft
B.G.08 Right Curb or Sidewalk Width:	0.0 ft
B.G.10 Bridge Median:	0 - No median
B.G.13 Maximum Bridge Height:	15 ft
B.G.15 Irregular Deck Area:	sf
DK.02 Estimated Chloride Content:	0 %
DK.03 Estimated Chloride Content Date:	11/17/2009
DK.04 Deck Cracking Metric:	0.00 YD/SY
DK.05 Protect Install Year:	
DK.06 Protect Install Note:	
DK.07 Wearing Surface Thickness:	0.5 in
DK.08 Wearing Surface Thickness Date:	10/07/2025



Inspection Report

- Inspection Summary
- BMS3 Inspection Forms
- Photographs
- Defect Sketches
- Waterway Sketches and Cross Sections
- Standard Inspection Forms and Templates



BRIDGE SAFETY INSPECTION REPORT

BRKEY: 15364
BMS ID: 23-4016-0100-1924
BRIDGE NAME: GRADYVILLE ROAD 32805 (3695B03)
DISTRICT: 06
COUNTY: 23 - Delaware
MUNICIPALITY: 23/209 - THORNBURY
LOCATION: GRADYVILLE ROAD 32805
FACILITY CARRIED: GLEN MILLS ROAD
FEATURE INTER: CHESTER CREEK
POSTING: A - Open, no restriction
NBIS LENGTH: Y - Long Enough

Prepared for PADOT by Michael Baker International, Inc.



COMPARISON			
Label	Field Name	Current	Previous
7A01	Inspection Date	Oct 7, 2025	Apr 15, 2025
7A03	Inspection Type	R - Regular (routine)	I - Interim (special)
1A01	Deck	5 - Fair	5 - Fair
1A04	Superstructure	4 - Poor	4 - Poor
1A02	Substructure	5 - Fair	5 - Fair
1A03	Culvert	N - N/A	N - N/A
1A02	Railings	3 - Inadeq for cond	3 - Inadeq for cond
1A02	Transitions	N - not applicable	N - not applicable
1B01	Bearings	5 - Fair	5 - Fair
1B01	Joints	5 - Fair	5 - Fair
1A05	Channel	5 - Fair	5 - Fair
1A05b	Channel Protection	5 - Fair	5 - Fair
1A13	Scour	9 - No Scour	9 - No Scour
1A14	Underwater	N - N/A	N - N/A
1A15	NSTM	N - N/A	N - N/A
4A08	SCBI	3 - SC - Unstable	3 - SC - Unstable
4A08b	SCBI Category	B	B
1N15	Streambed Material	A4	A4
4A14	Bridge Condition	P - Poor	P - Poor

NOT FOR PUBLIC RECORD - STRUCTURE SAFETY INSPECTION STUDY
This document is the property of the Commonwealth of Pennsylvania, Department of Transportation. The data and information contained herein are part of a structure safety inspection study. This safety study is only provided to those official agencies or persons who have responsibility in the highway transportation system and may only be used by such agencies or persons for safety-related planning or research. The document and information are not public pursuant to federal law and may not be published, released or disclosed without the written permission of the PA Department of Transportation.



Michael Baker
INTERNATIONAL

BMSID: 134012401001924 Status: 2 - Submitted Inspection Record: 10/07/2025 - Type 27E	Superstructure Pages Date Printed: 11/14/2025
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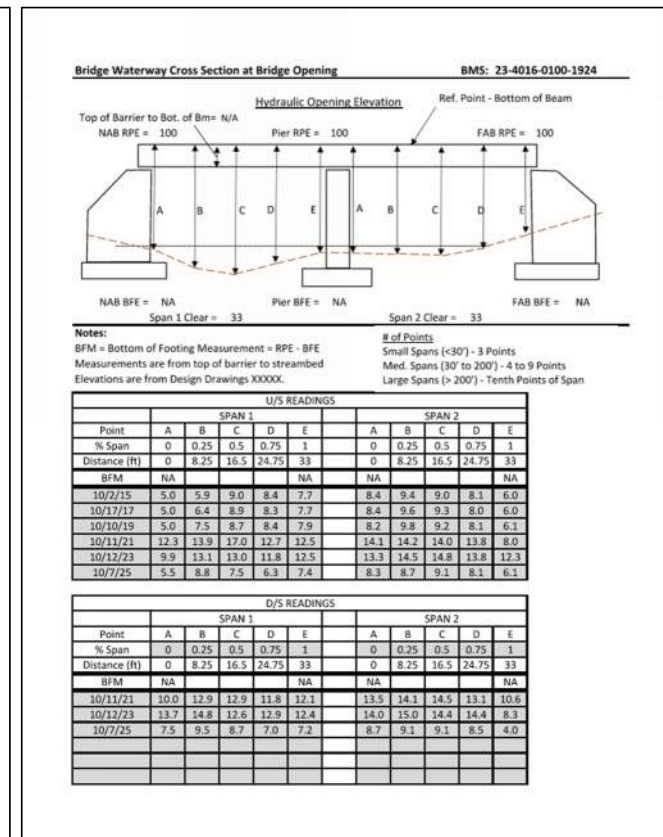
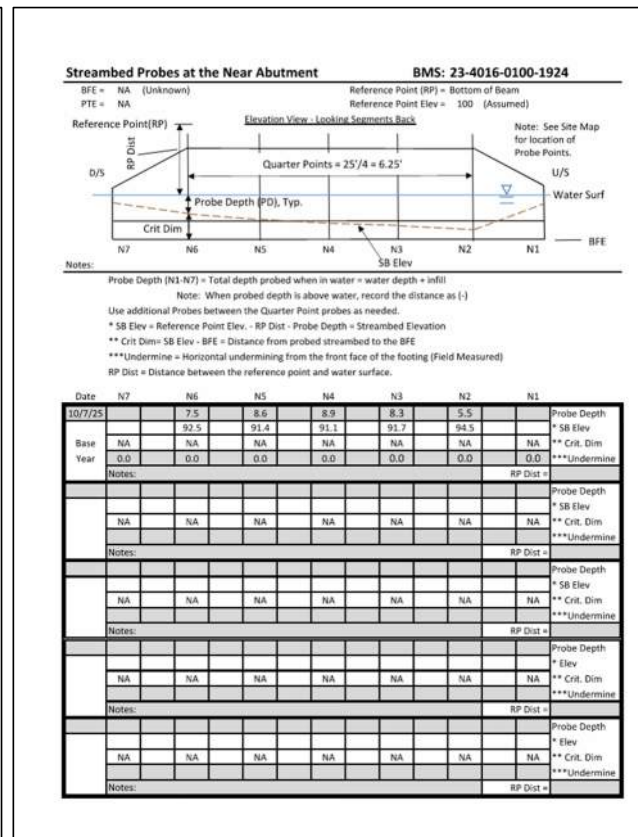
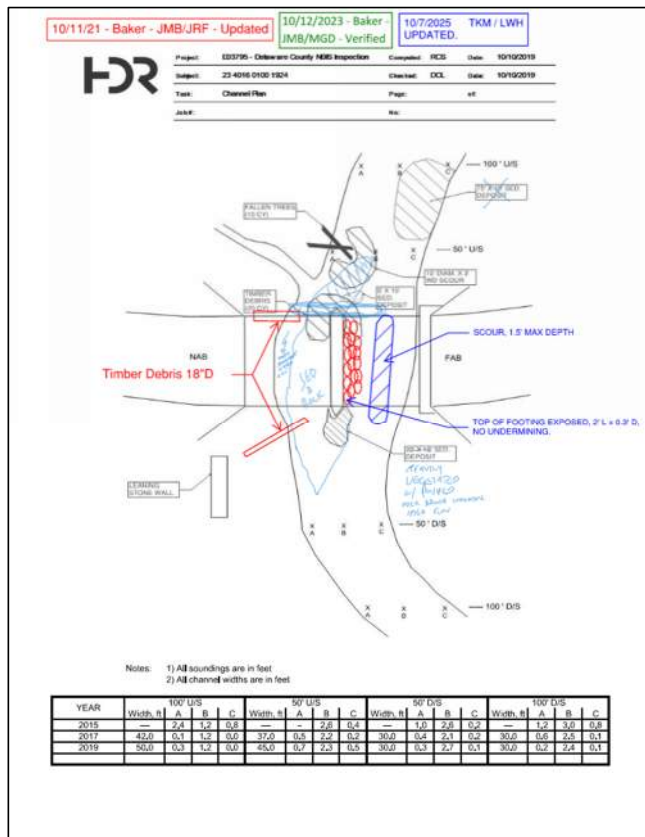
Superstructure Conditions	
1A04 Superstructure Condition Rating:	4 - Poor
Overall Superstructure Notes: (0) Rolled steel beams x (2) spans (simple) The superstructure is in poor condition with widespread moderate and isolated major defects.	
6848 Combustible Material Under Bridge:	12 - No Reportable Materials
Combustible Material Under Bridge Notes: None.	
6835 New Coating Since Last Inspection:	☐ 2 - Critical
6836 Protective Coating Rating:	2 - Critical
6837 Protective Coating (Extent) Rating:	4 - Blast + 20-40%
Overall Protective Coating Notes: The overall protective coating is failing at the beam ends and fascias.	

Superstructure Details	
5B11 Main Spans: 2	5B14 Approach Spans: 0
VD31 Bridge Seat Cleaning: 1	
VD32 Bridge Seat Cleaning Notes:	
VD33 Scuppers w/Downspouts: 0	VD34 Scuppers w/out Downspouts: 0

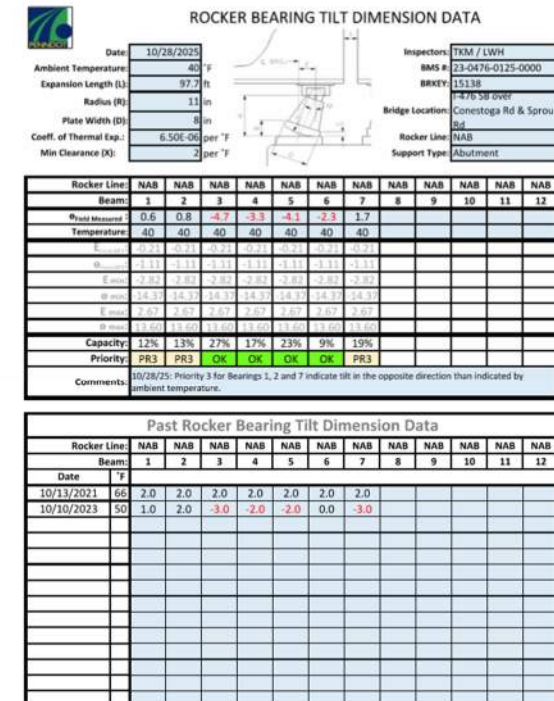
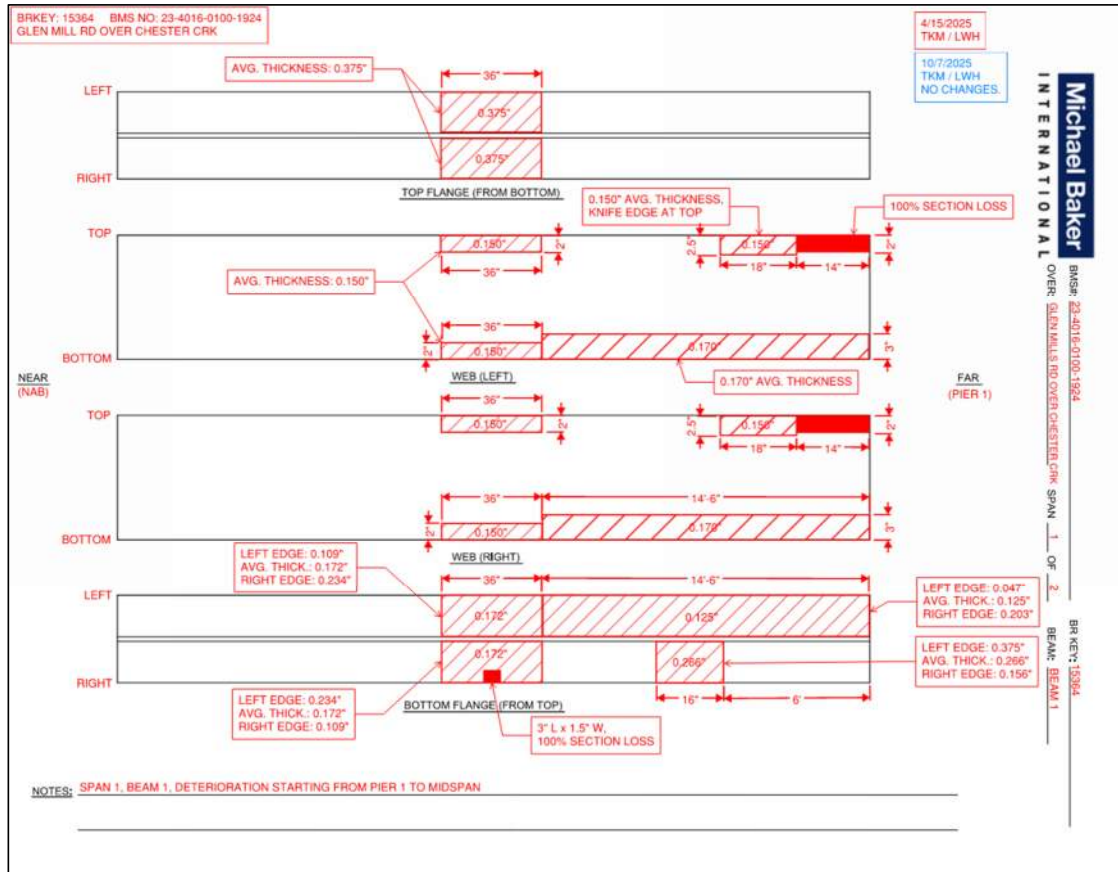
Superstructure Inspection Notes
Girders/Beams: 10/7/2025: MB1 performed a Routine / Interim inspection to assess the deterioration of the fascia beams and status of the Priority 1 maintenance item repairs. No repairs have been made. No significant changes in section loss. Beams will continue to deteriorate without repairs. - Beam ends at the NAB and FAB have been repaired with a 6"x6"x1/2" double angle connection welded to the web and anchored to the concrete end diaphragm with 7/8" diameter anchor bolts. - Beam 6 in both spans was previously repaired with steel angles along the web at midspan in Span 1 and at the beam end at the pier in Span 2. - At the abutments, all bottom flanges exhibit section loss extending in front of the diaphragm, with the worst case being Beam 6 at the FAB with a remaining 2" wide knifed flange. The condition is similar at Beam 4 at the NAB with a 3.5" knifed flange. - At near abutment, interior beam ends, lower web, 1' x 3' H x 1/16" section loss, typically adjacent to the end concrete diaphragm. - All interior beams exhibit some peeling paint on the flanges and areas of surface rust with minor section loss. - Fascia Beams (1 and 8) are typically rusted with areas of section loss. The top and bottom 2" of web typically exhibits heavy rust with negligible to 1/16" section loss. - Section loss surrounding the bridge railing posts is typical. - See Section Loss Sketches for full details. Girders/Beams notes continued in 'FloorsBeams' below: FloorsBeams: Girders/Beams Continued: -Span 1, Beam 1 -Areas of advanced section loss. -At midspan, there is 1/8" remaining of the bottom flange left edge, estimated 3/8" remaining of the left top flange, and 0.150" remaining in the lower and upper web. -At 3/4 span, there is 1/16" remaining along the bottom flange left edge, knifing along the bottom flange right edge, and an estimated 1/4" remaining of the left top flange. -At the pier, area of 100% section loss at top of web (14" L x 2" H). -Span 2, Beam 1 -At pier, there is 1/8" avg. remaining on the bottom flanges, section loss along the lower web, and area of 100% section loss

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Inspection Report



Inspection Report



Maintenance Recommendations

- Inspectors recommend what maintenance should be performed during an inspection
- Maintenance recommendations have different priorities based on severity

<u>Code</u>		<u>Description</u>	<u>Timeframe</u>
0	Critical	Immediate response	Within 7 days
1	High Priority	As soon as work can be scheduled	Within 6 months
2	Priority	Prioritize	Routine inspection interval (24 mo.)
3	Schedule	Add to scheduled work	Add to schedule
4	Program	Add to programmed work	When funds are available
5	Routine	Non-structural	Routine program



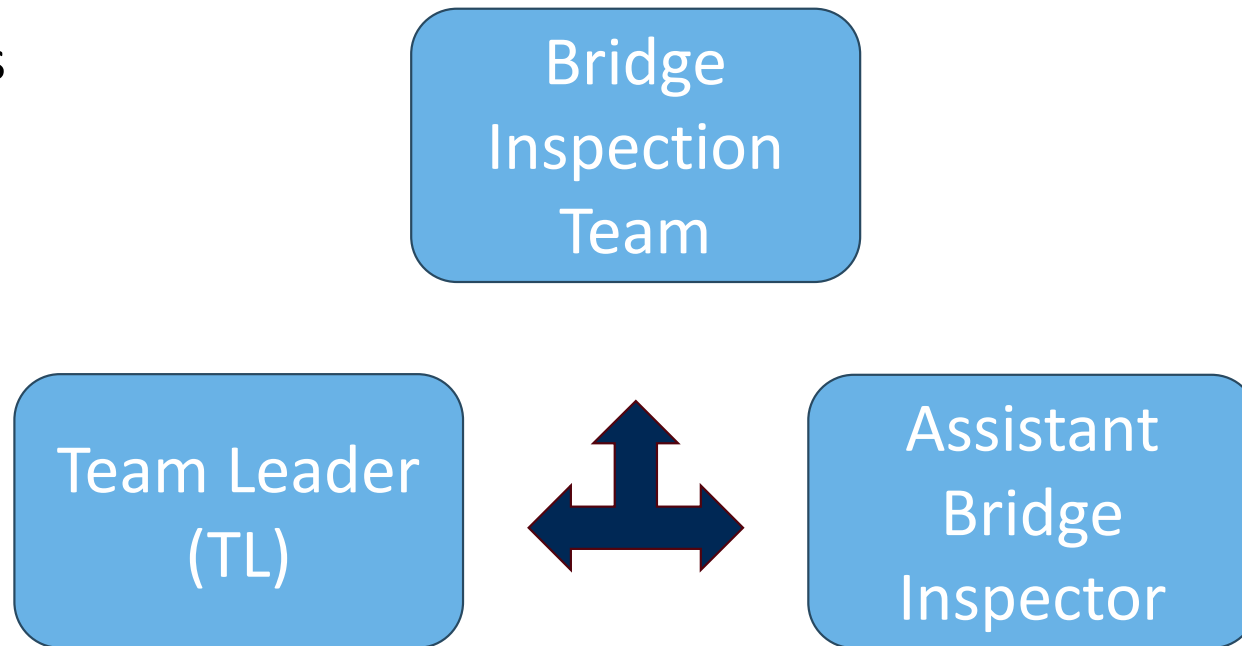
Load Rating Recommendation

- Inspectors recommend if a load rating analysis should be performed based on defects and changes in condition
- Bridges may need to be posted for a restricted weight limit based off load rating analysis
- Load raters use information collected during inspection to perform load rating



Who Inspects Bridges?

- Bridge Owners
- Consultants



Inspector Qualifications

- Team Leader Qualifications
 - 2-week FHWA bridge inspection training course
 - Experience qualifications (one of the following)
 - PE
 - 5 years of experience
 - Bachelors, FE, 2 years of experience
 - Associates, 4 years of experience
 - On-going refresher training
- Assistant Inspector Qualifications
 - 2-week FHWA bridge inspection training course



When Do We Perform Inspections?

Types of Bridge Inspections

- Initial
- Routine
- Underwater
- NSTM
- Damage
- In-Depth
- Special
- Scour Monitoring
- Service

Inspection Interval

After construction

24 or 48 months

6, 48, 24, or 72 months

6, 12 or 24 months

Following extreme event (collision)

6 or 12 months



How Do We Perform Bridge Inspections?

- Simplest Access:
 - From Ground - Ladders
 - In Waterway – Waders
- Special Access Equipment and Methods



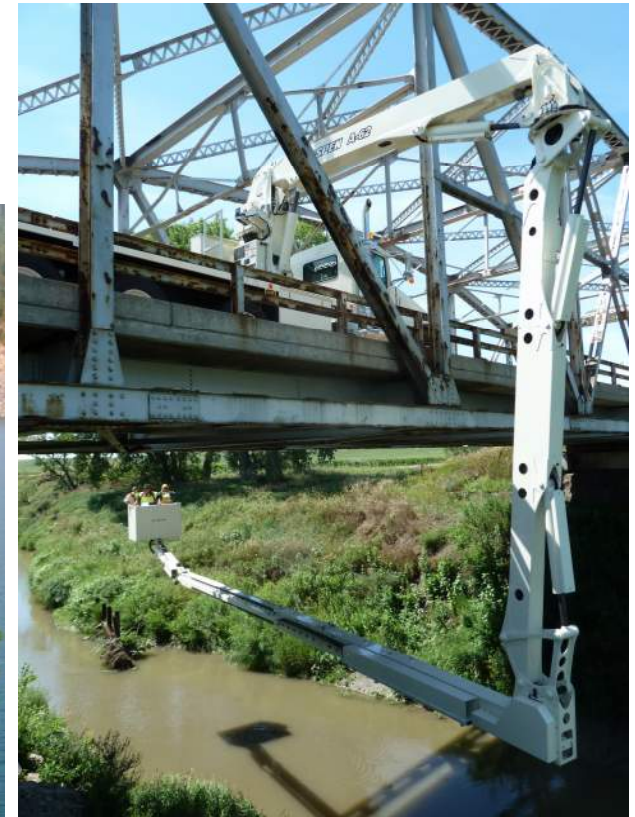
We Make a Difference



How?

Special Access Equipment

- Underbridge Inspection (UBI) Unit – “Snooper”



How?

Special Access Equipment

- Underbridge Platforms



How?

Special Access Equipment

- Bucket Truck or Boom Lift



How?

Special Access Equipment

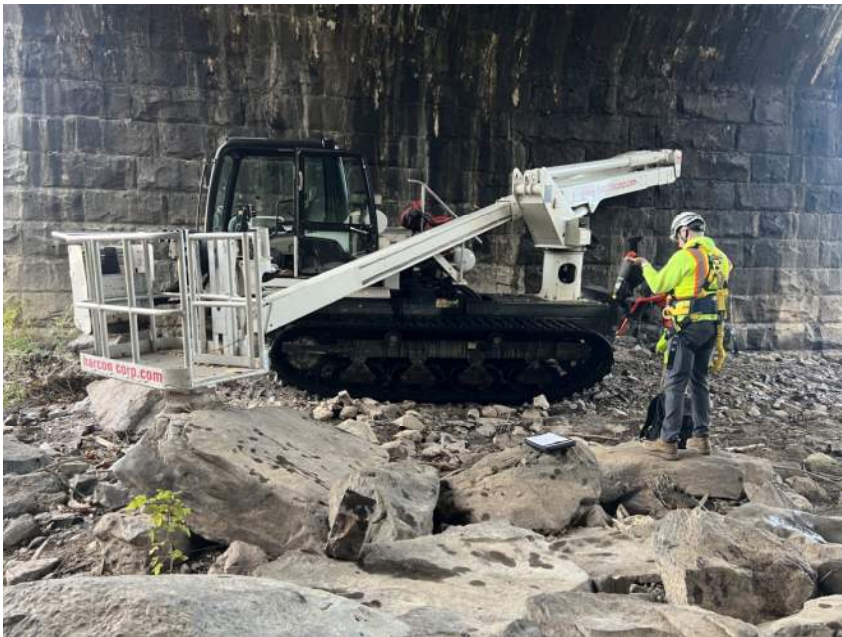
- Boat or Bucket Boat



How?

Special Access Equipment

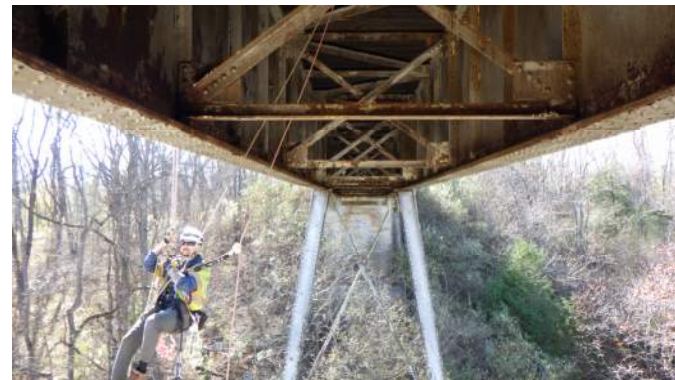
- Tracker



How?

Special Access Equipment

- Rope Access (SPRAT)



How?

Special Access Equipment

- UAS (Drones)



Conclusion

- Bridge inspection is essential for ensuring safety
- Allows owners to properly maintain and manage assets
- Condition documentation and data collection for owners and federal oversight





We Make a Difference

Questions?

Feel free to reach out:
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