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TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Bridge Element Data Use in the U.S.

March 29, 2023

2:30 – 4:00 PM

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.

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REGISTERED CONTINUING EDUCATION PROGRAM

Purpose Statement

State departments of transportation (DOTs) have been transitioning to the use of element inspection data to document bridge conditions. This webinar will summarize the findings of a synthesis study and provide case studies from current state DOT practices. Presenters will share processes to ensure the quality of bridge element inspections, data accuracy, define and use of performance measures, and the business processes that use bridge element data.

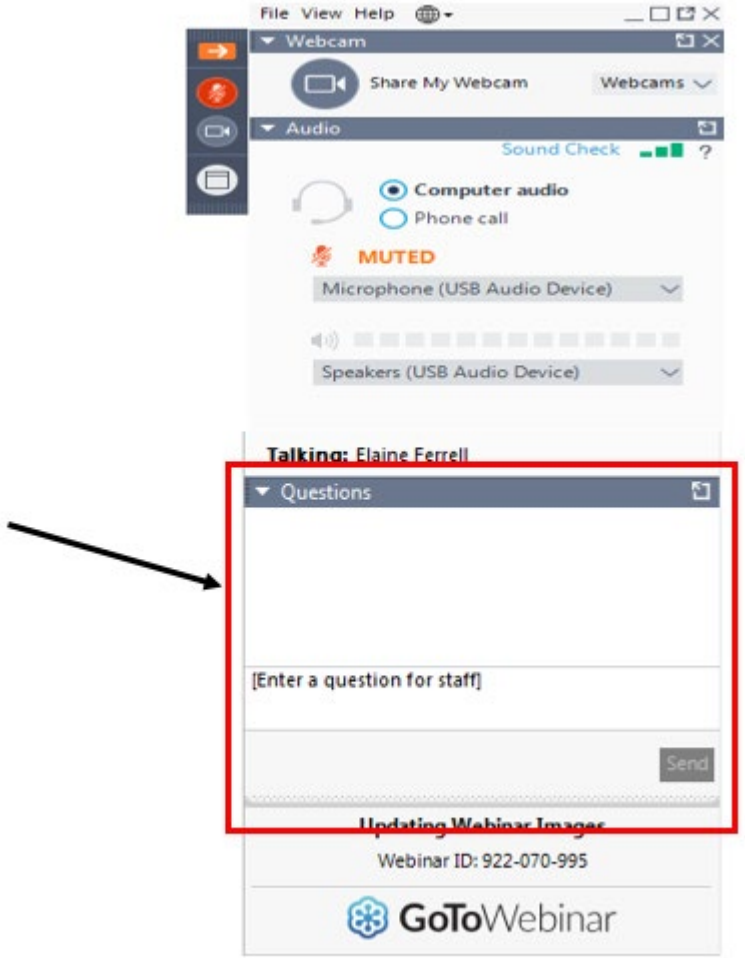
Learning Objectives

At the end of this webinar, you will be able to:

- Describe the current state DOT practice on collecting element-level data
- Evaluate the status of use of bridge element data for decision-making
- Identify performance measures or business processes based on element data for implementation

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters

Nancy Heuther
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AASHTO TSP2/ NCPP at Michigan State University

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Minnesota State University, Mankato

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Synthesis Summary and Findings

Başak Bektaş, Ph.D.
Assistant Professor of Civil Engineering
Minnesota State University, Mankato

Introduction

- The objective of this synthesis was to document current state DOT practices and experience regarding collecting and ensuring the accuracy of element-level data. The synthesis also examined how DOTs are using the data from inspection reports.
- The information was obtained from three sources:
  - Literature Review
  - Survey
  - Case Examples
    - Florida, Kentucky, Michigan, **Minnesota**, **Rhode Island**, and **Wisconsin**

Literature Review

- History of Bridge Element Data
- Bridge Element Data Quality
- Performance Measures Based on Element Data
- Models Based on Element Data

100% response rate
50 state DOTs and the District of Columbia DOT participated in the survey.

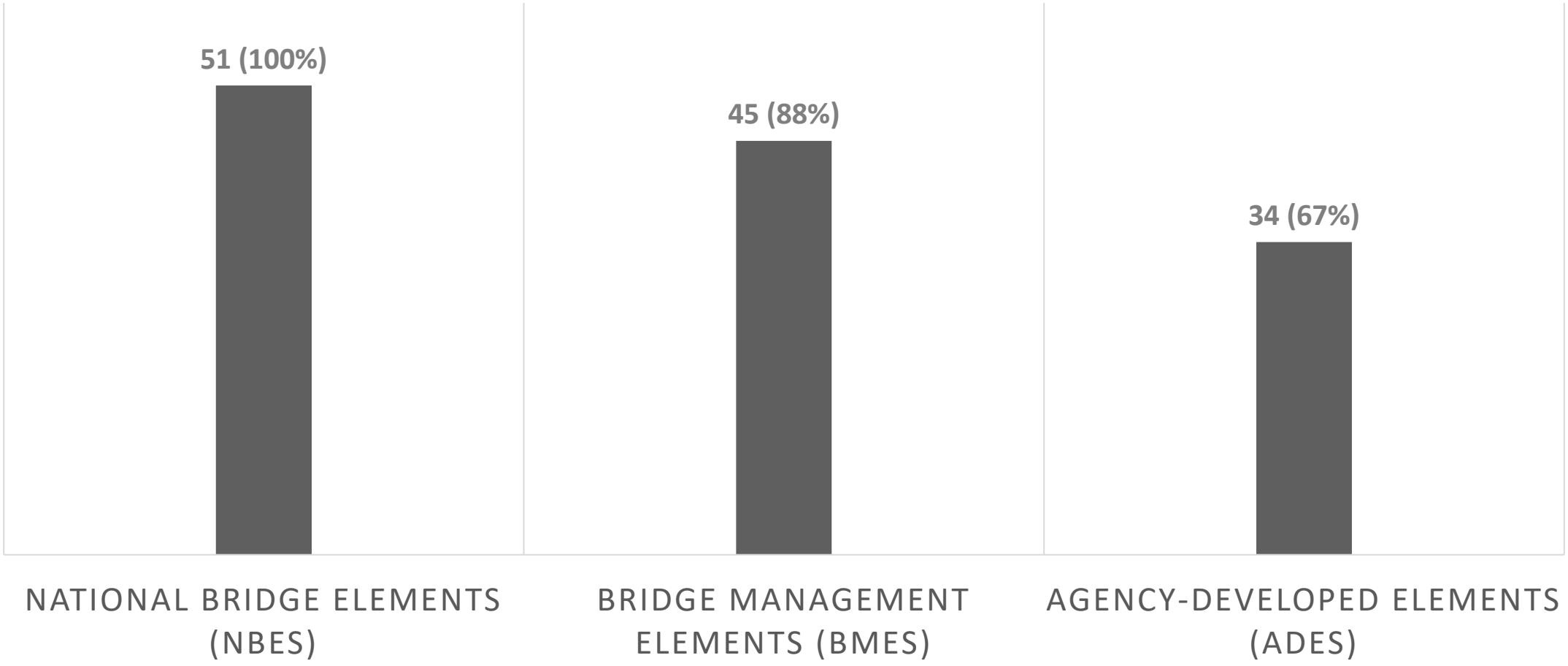
Survey questions were organized into the following categories:

- State of the Practice in Bridge Element Data Collection
- Quality Control and Quality Assurance for Bridge Element Data
- Performance Measures and Models
- Use of Bridge Element Data in Asset Management

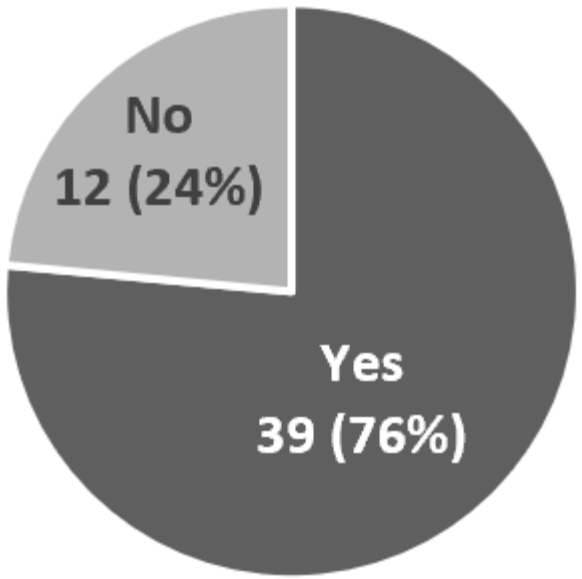
State of the Practice

State of the Practice in Bridge Element Data Collection

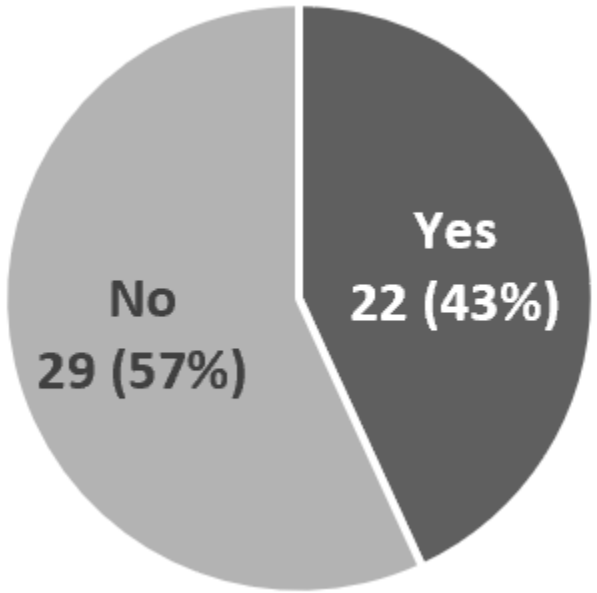
Number of State DOTs that Collect Data for Each Element Type



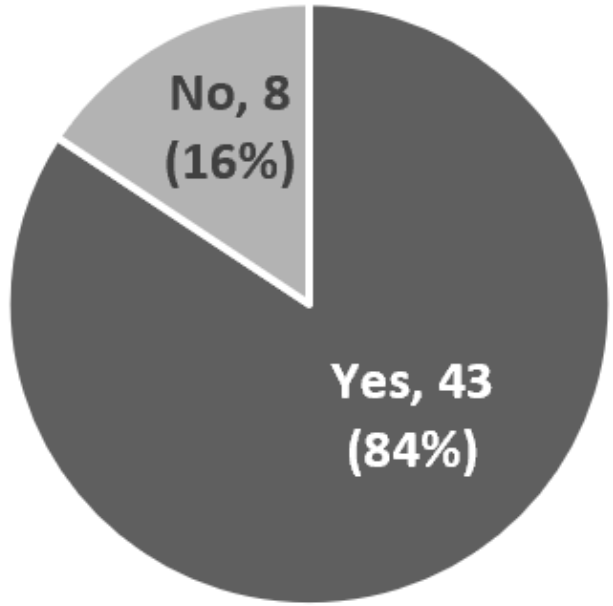
Defects?



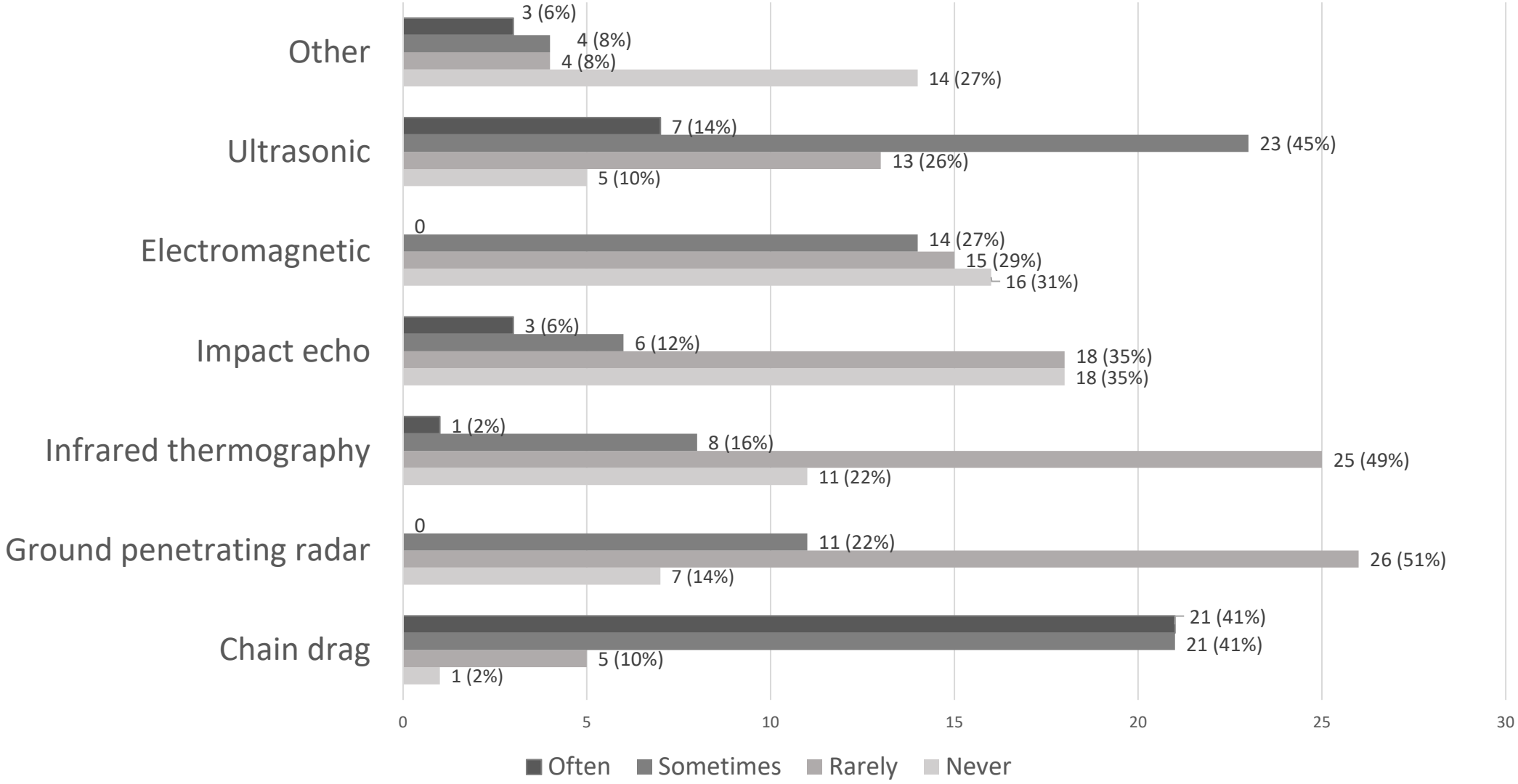
Environments?



Use of NDE?

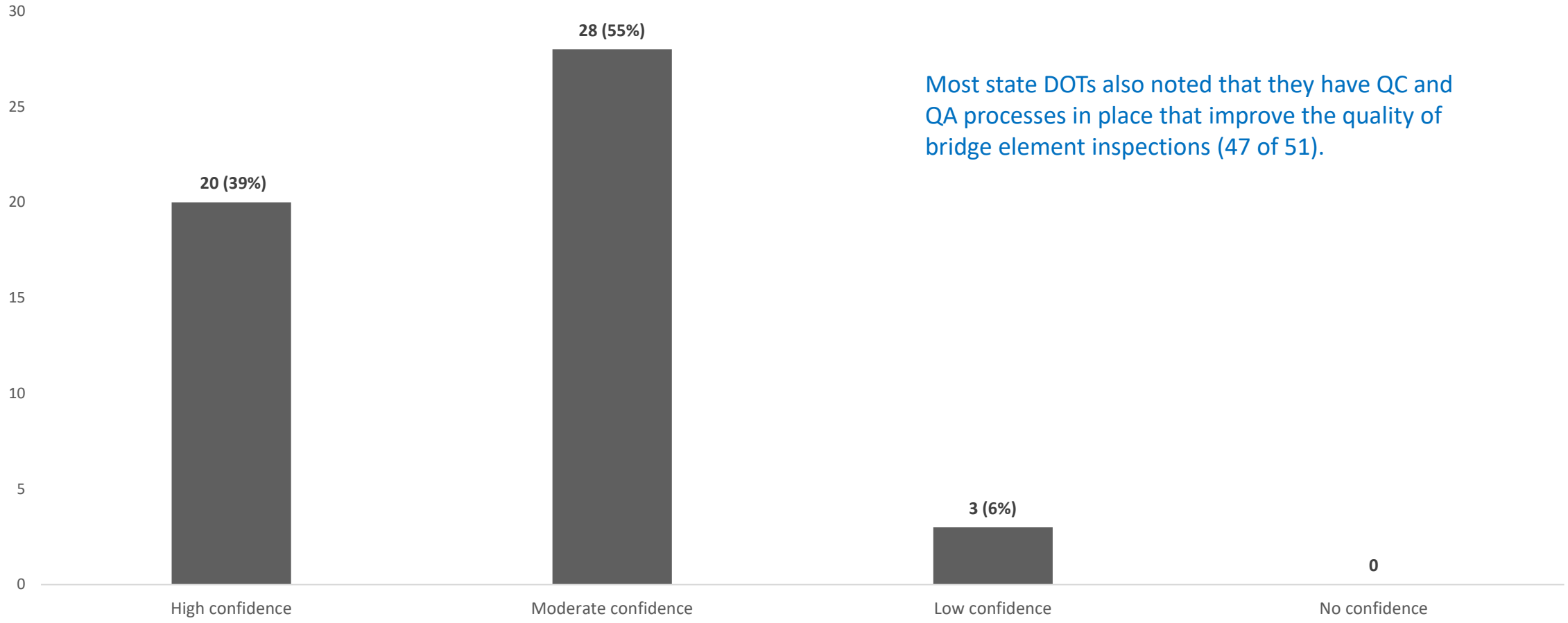


Use Frequency of NDE Techniques, by Percentage of All State DOTs



Quality Control and Quality Assurance for Bridge Element Data

Agency Confidence in the Quality of Bridge Element Data

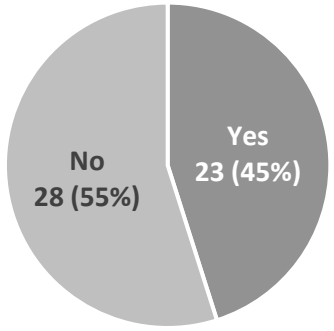


Most state DOTs also noted that they have QC and QA processes in place that improve the quality of bridge element inspections (47 of 51).

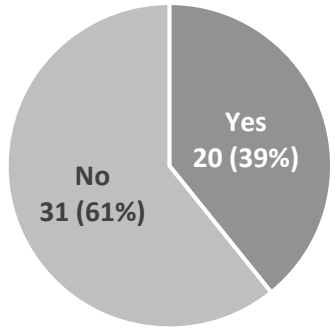
Performance Measures and Models

Use of Performance Measures and Decision Trees Based on Bridge Element Data

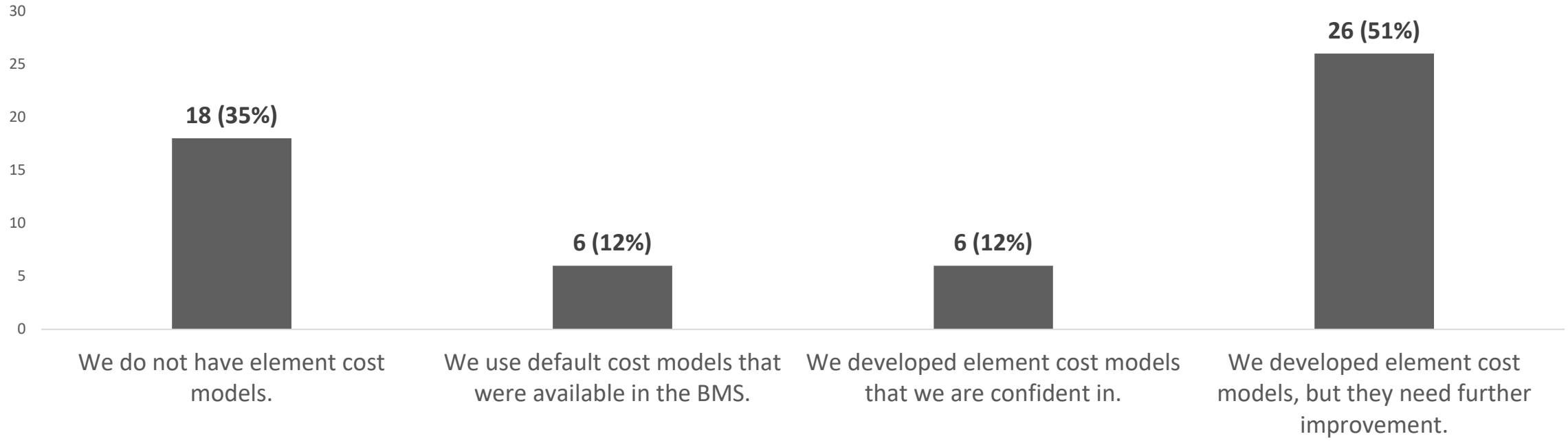
Use of performance measures based on element data



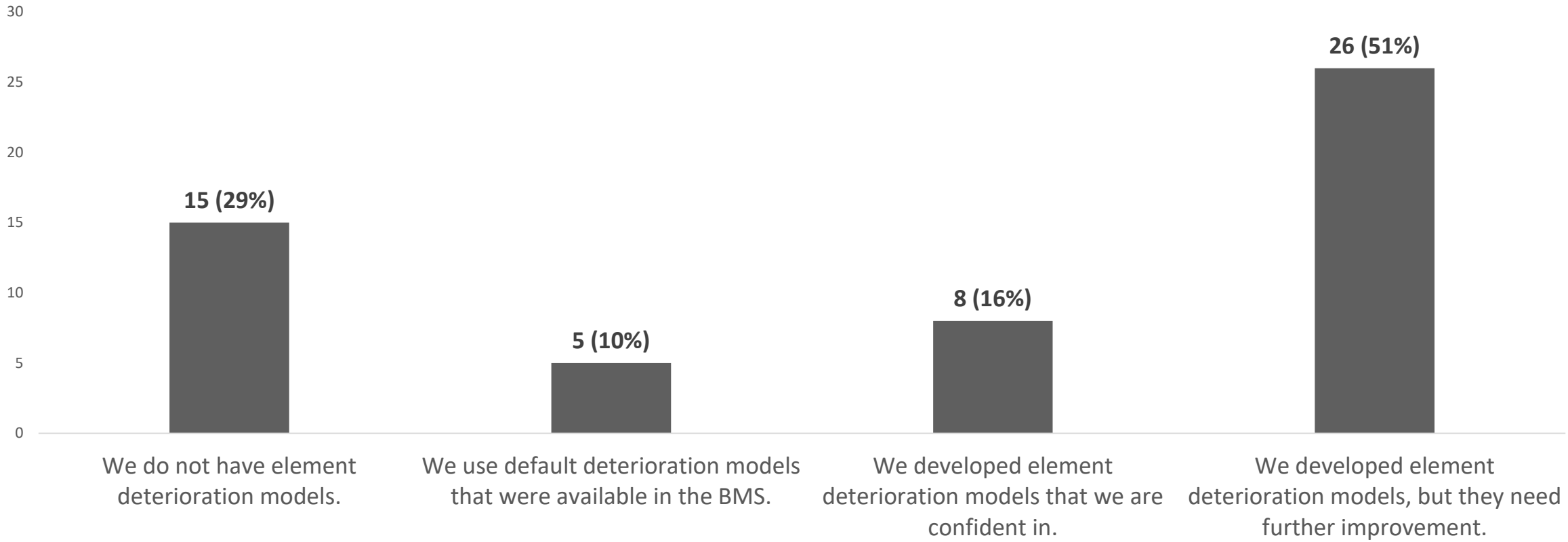
Project decision rules or decision trees based on bridge element data



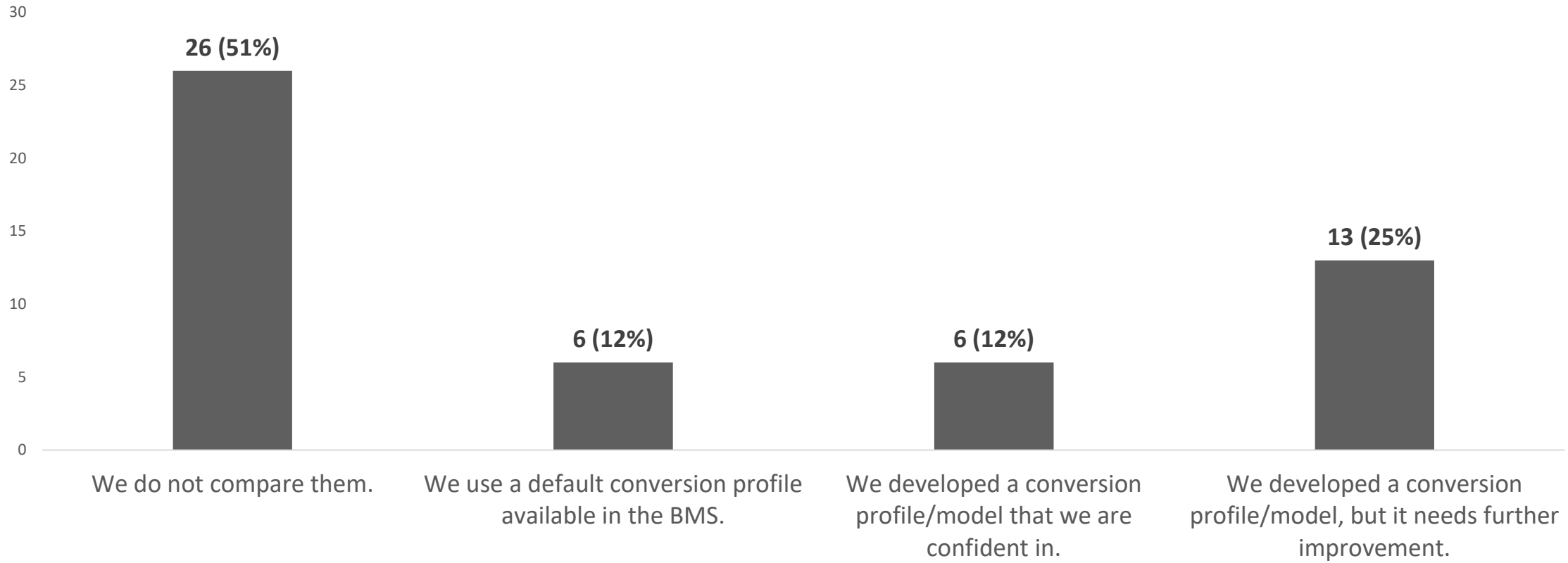
Element Cost Models



Element Deterioration Models

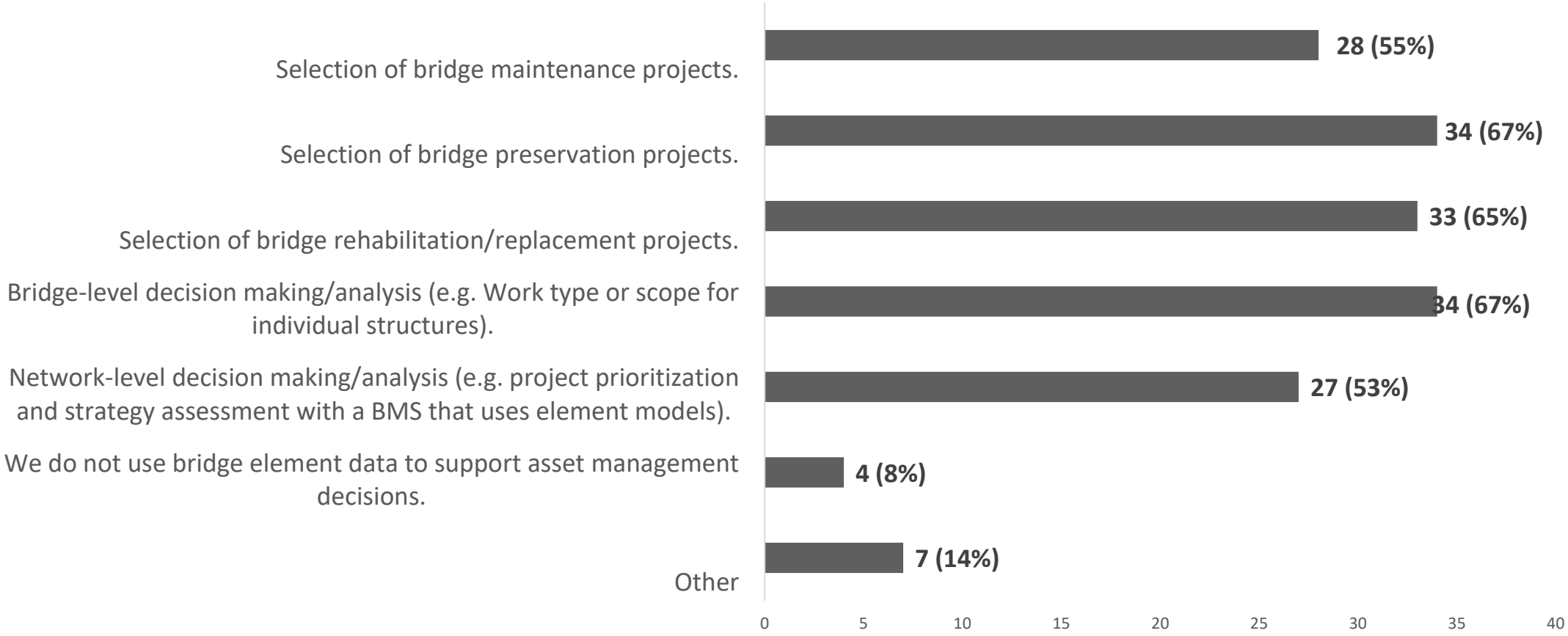


Element Condition Data and NBI GCR Comparison

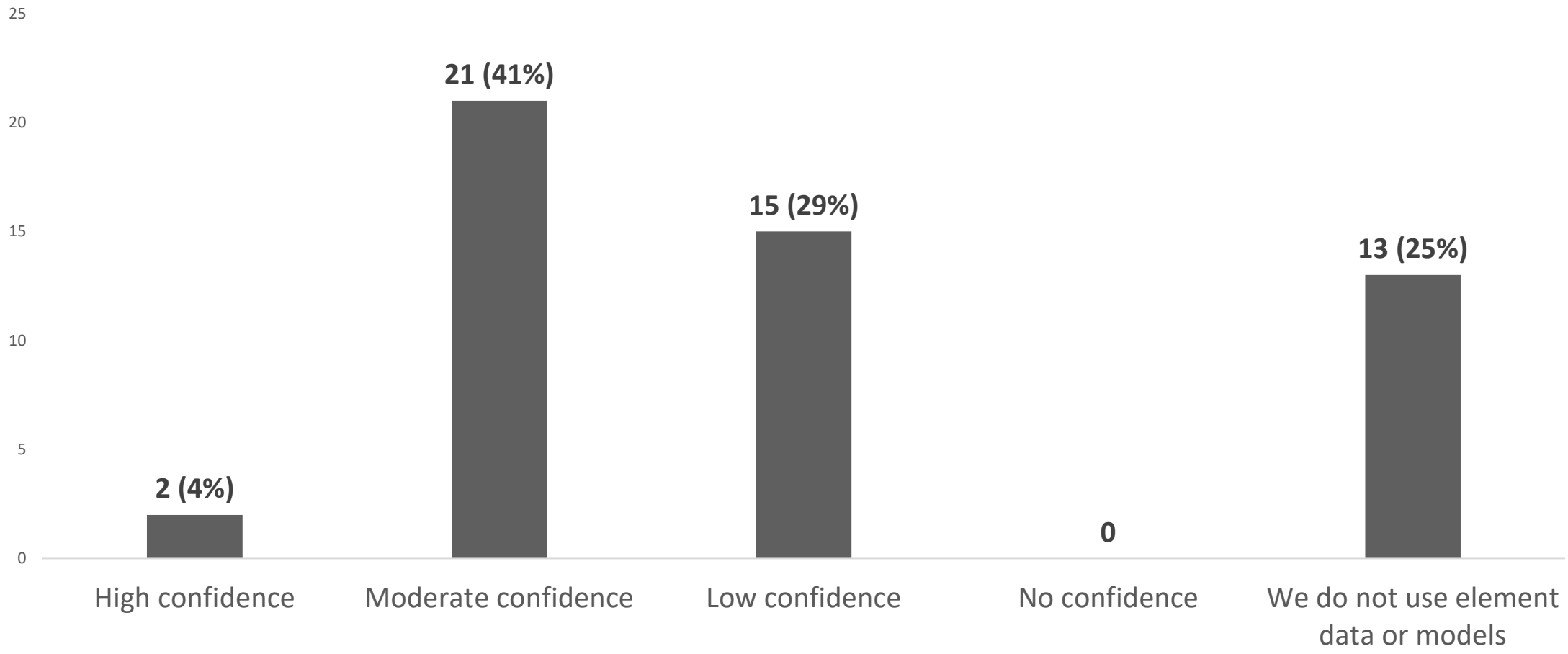


Use of Bridge Element Data in Asset Management

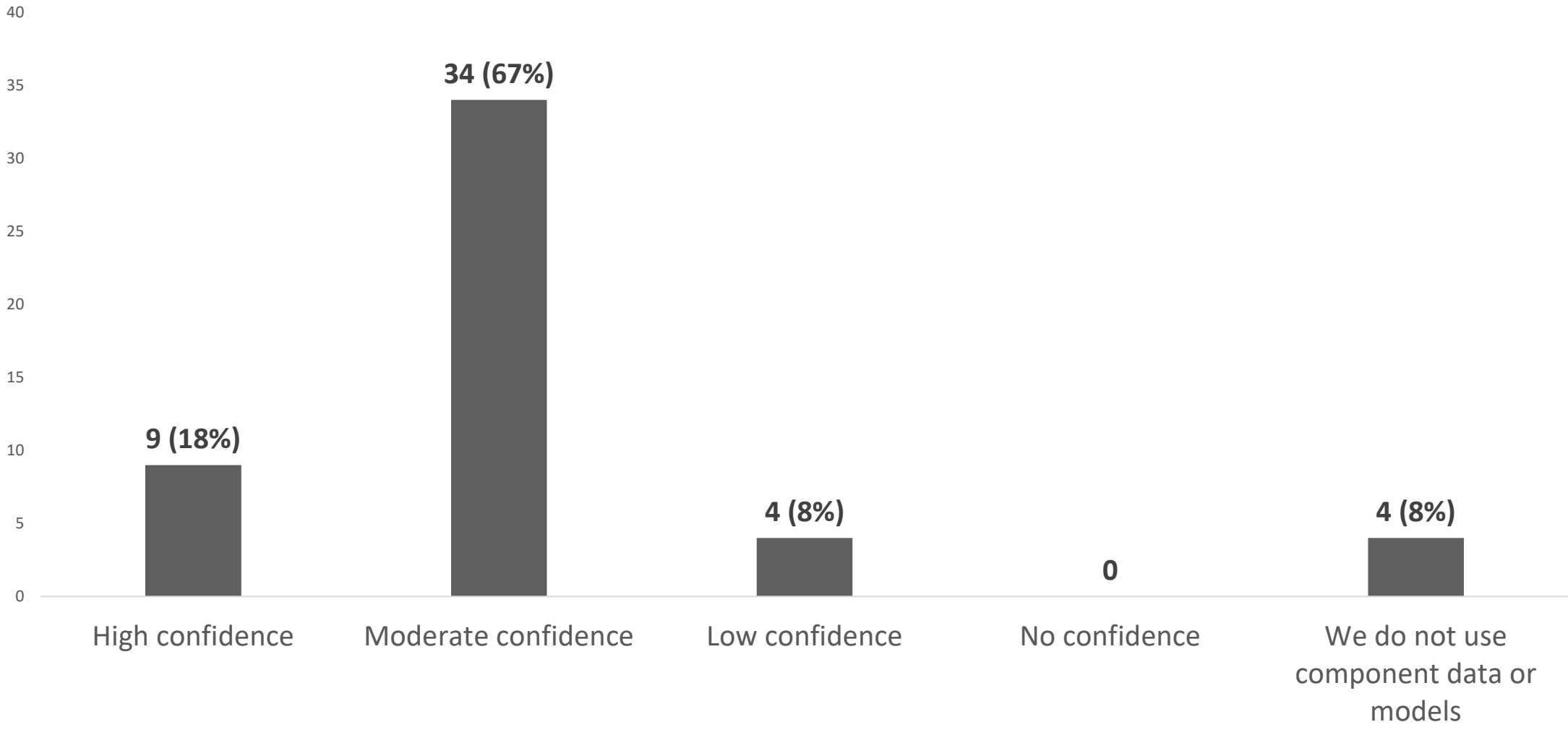
State DOT Use of Element Data in Asset Decision-Making



Confidence in Decisions Based on Element Data or Models



Confidence in Decisions Based on Component Data or Models



Major Findings about Agency Practice

All DOTs are collecting NBE and BME data aligned with federal guidelines while 67% of the state DOTs are also gathering data for ADEs. Agencies are also collecting data on element defects (76%), but data gathering on environments is less common (43%).

State DOT NDE methods often include chain drags for bridge deck inspections and sometimes involve electromagnetic or ultrasonic testing (or both) for element inspections. NDE tools such as impact-echo tests, IRT, GPR, dye-penetrant testing, and D-Meters are also employed, but less frequently.

Major Findings about Agency Practice

- Compared to NBI GCRs, bridge element data are more quantitative and detailed. However, state DOTs report more confidence in the results based on component data.
- Less than half of the state DOTs have established project decision rules, decision trees, or performance measures based on bridge element data.
- One-fourth of the state DOTs express confidence in their element cost and deterioration models.
- 26 state DOTs do not compare element condition data and NBI GCRs.

Major Findings about Agency Practice

One-fourth of the state DOTs do not integrate element data or models into asset management decisions.

Confidence in models and decision-making based on component data is relatively high compared to the same measure of decisions based on element data or models.

State DOTs do have plans to improve element performance measures and models. The relatively more robust confidence in decisions based on component data and models may stem from the lengthier history of state DOTs applying and developing models for component data.

Major Findings about Agency Practice

The most common uses of element data in asset decision-making involve the selection of bridge preservation projects, bridge-level decision-making (e.g., choice of work type or scoping for individual structures), and selection of bridge rehabilitation or replacement projects.

State DOTs also commonly apply element data in choosing bridge maintenance projects and making network-level decisions.

Aside from four state DOTs, all of the rest report some form of use for bridge element data.

Beam Ends

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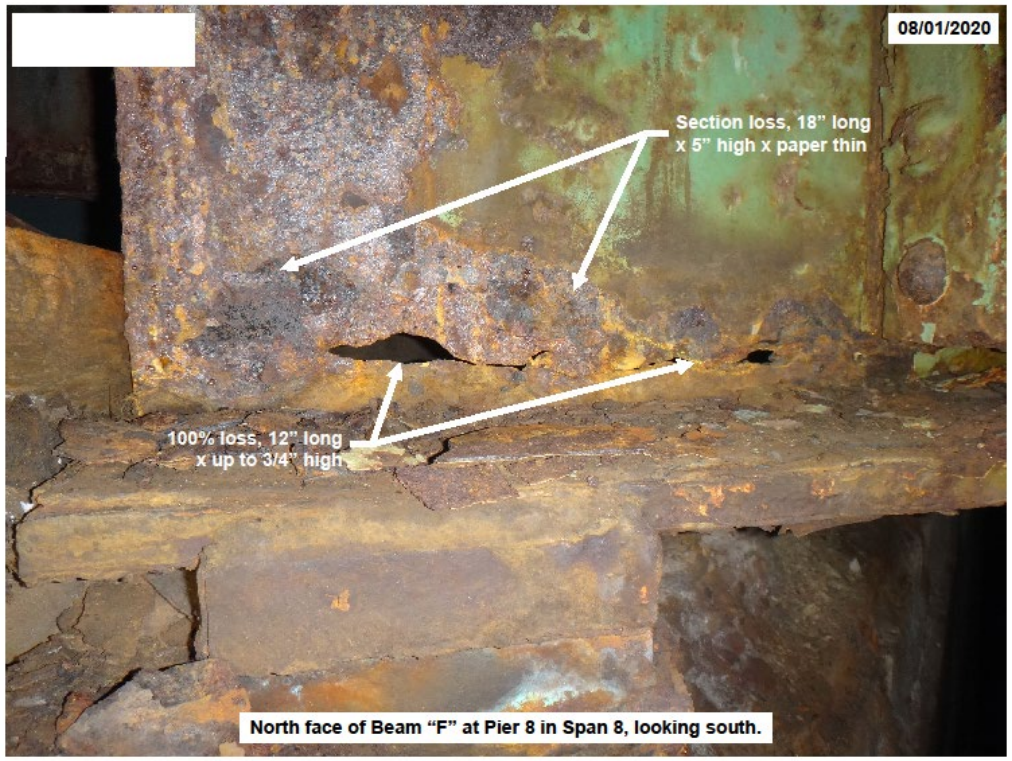
Steel Beam Ends
Element 8107

Rhode Island Department of Transportation Bridge engineering wanted a way to track the condition of the end of the steel beam separate from the rest of the beam. It had been noted that the ends of the beams were where most of the significant deterioration occurred.



Good Bridge Element data

It just needed more Definition

Element 8107—Steel Open Girder/Beam ENDS

Description: The Last and First 5 ft. of All steel open girders regardless of protective system.

Classification: State of Rhode Island Bridge Element **Units of Measurement**: ft

Quantity Calculation: The Last and First 5 ft. of all the lengths of each girder (10 ft. per Girder/Beam) this length plus the element 107 should equal the total length of the Girder/Beam. The 5 ft. is measured from the End of the Girder/Beam.

Condition State Definitions

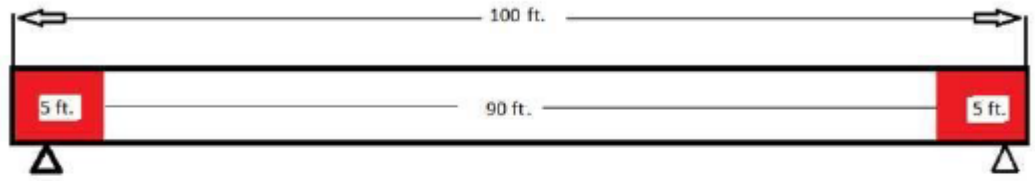
	Condition States			
	1	2	3	4
Defects	GOOD	FAIR	POOR	SEVERE
Corrosion (1000)	None.	Freckled rust. Corrosion of the steel has initiated.	Section loss is evident or pack rust is present but does not warrant structural review.	The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.
Cracking (1010)	None.	Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar.	Identified crack that is not arrested but does not warrant structural review.	
Connection (1020)	Connection is in place and functioning as intended.	Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended.	Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review.	
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.	
Damage (7000)	Not applicable.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.	The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

Element Commentary

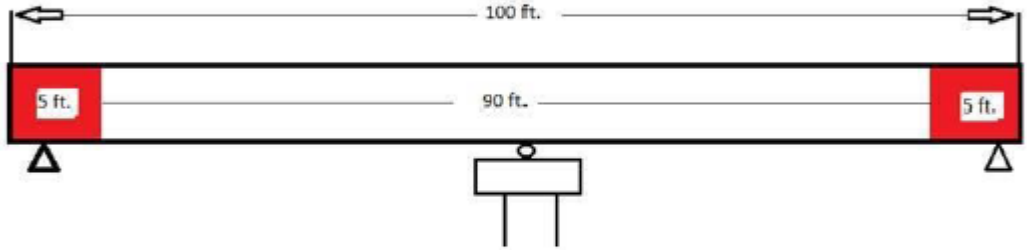
Condition evaluation for this element includes the web face and the top and bottom faces of the flange.

Than during the next round of inspection we change over to the new Elements

Attached is the information on a new Rhode Island element. The element 8107 (Ends of Steel Open Girder/Beam) is to be used on the next inspection of a bridges with element 107 (Steel Open Girder/Beam). 10 Feet per Girder/Beam should be deducted from the total quantity of element 107 (5 ft. Per end) and the condition of the area should be list in element 8107. The remaining area of the Girder/Beam and its condition should be recorded under element 107. The 5 ft. is measured form the end of Girder/Beam.



Or



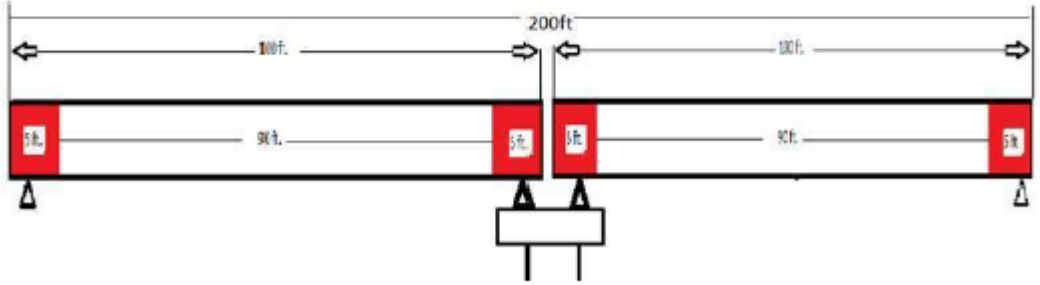
Old element 107 = 100ft.

Now

Element 8107 =10 ft.

Element 107 = 90 ft.

Or



Old element 107 = 200ft.

Now

Element 8107 =20 ft.

Element 107 = 180 ft.

The Report
This is run Automatically on a monthly basis and sent directly to the Load Rating Department

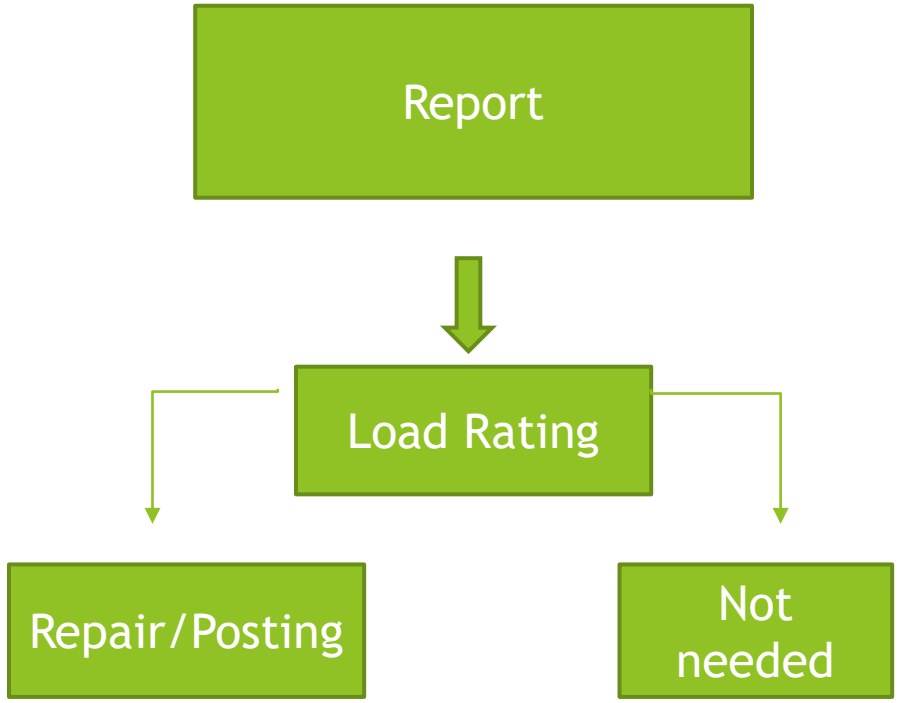
3/23/2023

STEEL BEAMS IN CONDITION STATES CS3/CS4

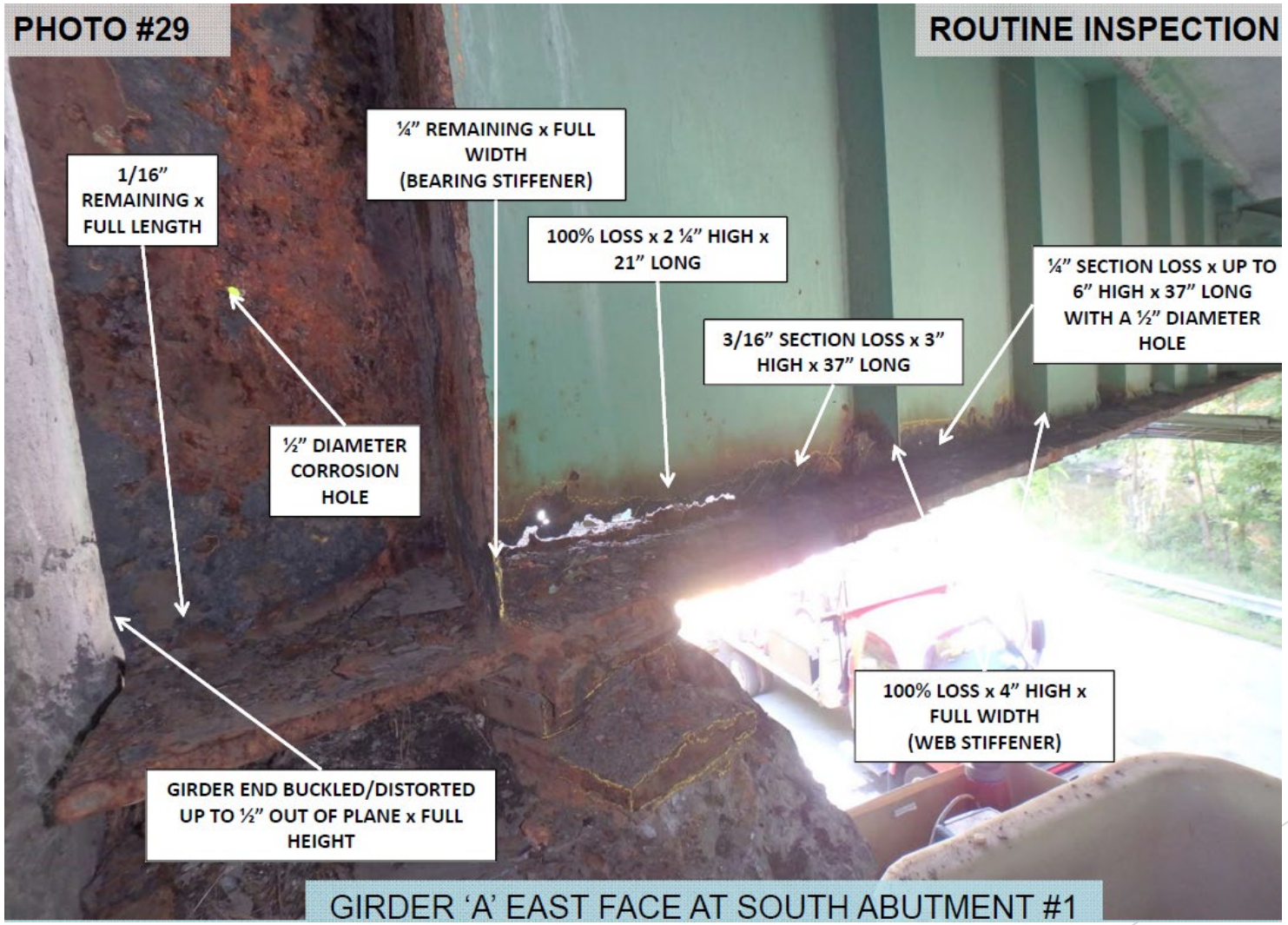
Bridge ID	Route Carried	Crossing	Bridge Group	Load Rating Status	Municipality	Rating Date	RW Group	PTS ID	Insp Date	NBIS Cond	Environ	Elem Qty 3	Elem Pct 3	Elem Qty 4	Elem Pct 4
003101	WASH SEC BIKE PATH	RI 117 MAIN ST	N9	NA22	Coventry	2021/07/01			2021/07/01	5	3.00	6.00	30.00	0.00	0.00
037001	EXETER RD	AMTRAK	A1	A_C	North Kingstown	2021/12/19	18_HR	TBD	2021/12/19	5	3.00	75.00	75.00	25.00	25.0(
037201	RI 138 KNGSTOWN RD	AMTRAK & ACCESS RD	A1	RW_ADV102019	South Kingstown	2022/12/13	54B	0201L	2022/12/13	5	3.00	18.00	15.00	0.00	0.00
042001	WASH SEC BIKE PATH	WILBUR AV	N9	NA22	Cranston	2021/07/01			2021/07/01	5	3.00	10.00	50.00	0.00	0.00
055201	I-95 NB & SB	WATER ST	20	A_C	Pawtucket	2021/06/28	03	0114R	2021/06/28	5	1.00	23.00	12.78	0.00	0.00
055701	EXCHANGE ST	I-95 NB & SB	25	RW_ADV082019/TBA20	Pawtucket	2021/11/21	03	0013N	2021/11/21	5	3.00	60.00	34.29	0.00	0.00
057601	RAMP BR-4	I-95 RAMP BC	54	A_C	Providence	2022/11/11	75TB_5	0018B	2022/11/11	4	3.00	0.00	0.00	26.00	26.0(
059501	MASSASOIT AV RAMP	RAMP ER-4 (SEE RVR CRSS)	49	C11_2020/TBA20	East Providence	2022/10/06	49	TBD	2022/10/06	6	3.00	32.00	21.33	0.00	0.00
062401	RI 37 EB & WB	RI 2 NEW LONDON AV	17	A_C	Cranston	2022/09/13	51C	TBD	2022/09/13	5	3.00	17.00	12.14	0.00	0.00
062501	RI 37 EB & WB	POWER ROAD	17	A_C	Cranston	2021/06/14	51C	TBD	2021/06/14	5	3.00	22.00	15.71	0.00	0.00
063701	RI 37 WB	AMTRAK	A1	TBA21/A_C	Warwick	2022/11/07	51C	TBD	2022/11/07	3	3.00	176.00	73.30	17.00	7.10
065001	RI 24 NB	EAGLEVILLE RD	12	C11_2020	Tiverton	2021/04/26	15D	TBD	2021/04/26	6	3.00	18.00	30.00	0.00	0.00
065021	RI 24 SB	EAGLEVILLE RD	12	C11_2020	Tiverton	2021/04/26	15D	TBD	2021/04/26	6	3.00	16.00	26.67	0.00	0.00
065501	I-95 NB & SB	THURBERS AV	35	C05_2019	Providence	2021/11/10	02	0013B	2021/11/10	5	3.00	73.00	16.59	0.00	0.00
066001	I-95 NB & SB	AMTRAK	A1	A_C	Providence	2022/12/21	04_R	2603M	2022/12/21	4	3.00	125.00	14.21	7.00	0.80
068501	COWESETT RD	I-95 NB & SB	30	C08_2019	Warwick	2022/09/20	58C		2022/09/20	4	3.00	40.00	40.00	10.00	10.0(
068601	I-95 NB	RI 4 SOUTH CNTY FWY RAMP	26	C11_2018	Warwick	2021/09/12	52A		2021/09/12	6	3.00	25.00	41.67	0.00	0.00
069401	PEDESTRIAN BRIDGE	RI 114 PAWTUCKET AV	N6	NA22	East Providence	2021/09/30			2021/09/30	5	3.00	100.00	71.43	0.00	0.00
070001	I-195 WB	SEEKONK RIVER	9W	C11_2018	East Providence	2022/07/22	57T_10	0014N	2022/07/22	4	3.00	110.00	100.00	0.00	0.00
074521	I-295 SB	STILLWATER RD	09	A_C	Smithfield	2022/12/07	10	0013R	2022/12/07	5	3.00	18.00	25.71	0.00	0.00
074601	RI 7 DOUGLAS PIKE	I-295 SB	16	A_C	Smithfield	2021/05/13	17A	0013A	2021/05/13	5	3.00	20.00	16.67	0.00	0.00
074621	RI 7 DOUGLAS PIKE	I-295 NB	16	IH/A_C	Smithfield	2022/05/11	17A	0013A	2022/05/11	6	3.00	13.00	10.83	0.00	0.00

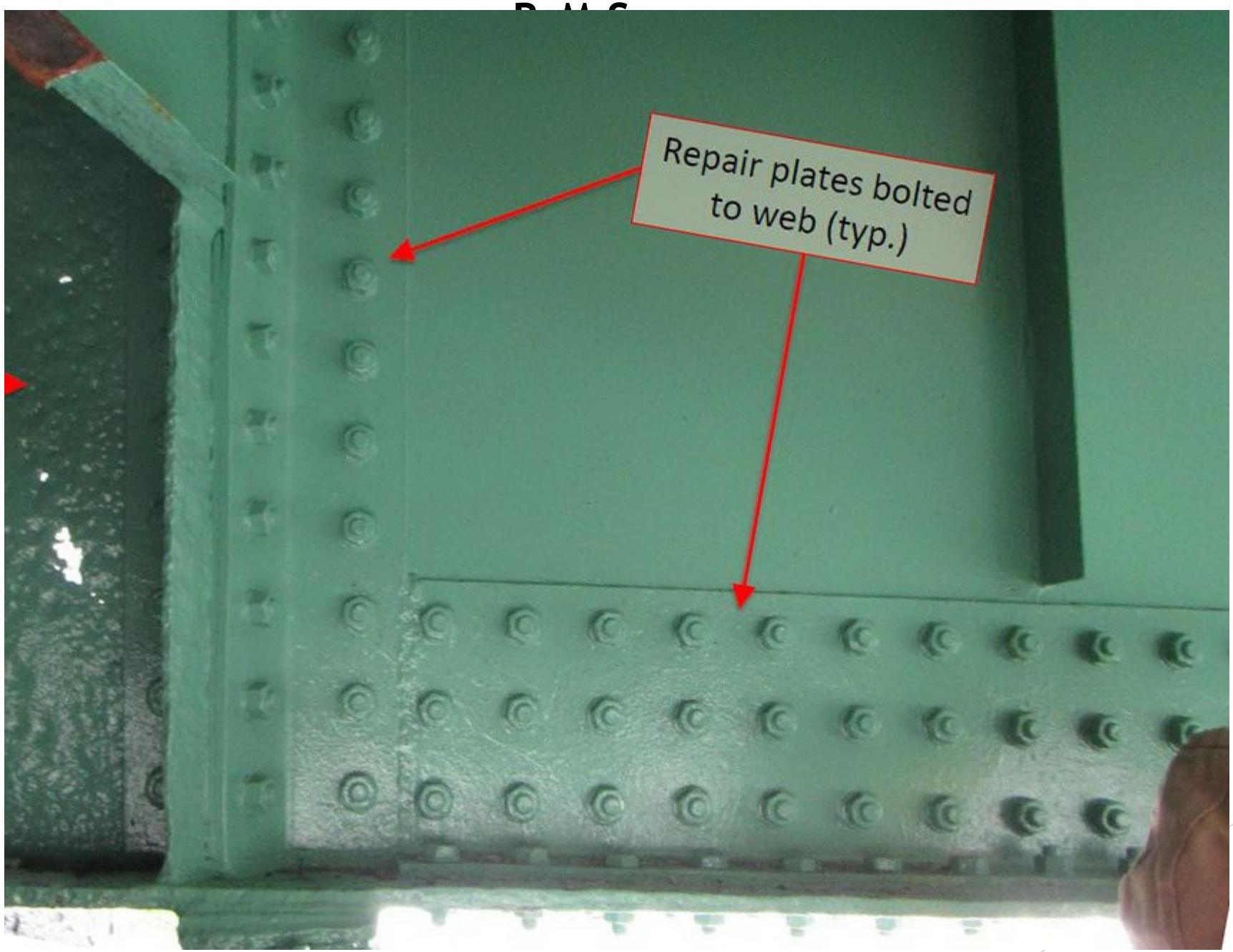
Note: Report does not inclued pedestrian/bike path bridges
and only those bridges with >10% CS3 OR >0% CS4

The Load Rating Department
decides if a new load rating needs to be done and, from that, possibly selected steel repairs or Posting



Steel Repair




Repair plates bolted to web (typ.)

Questions?

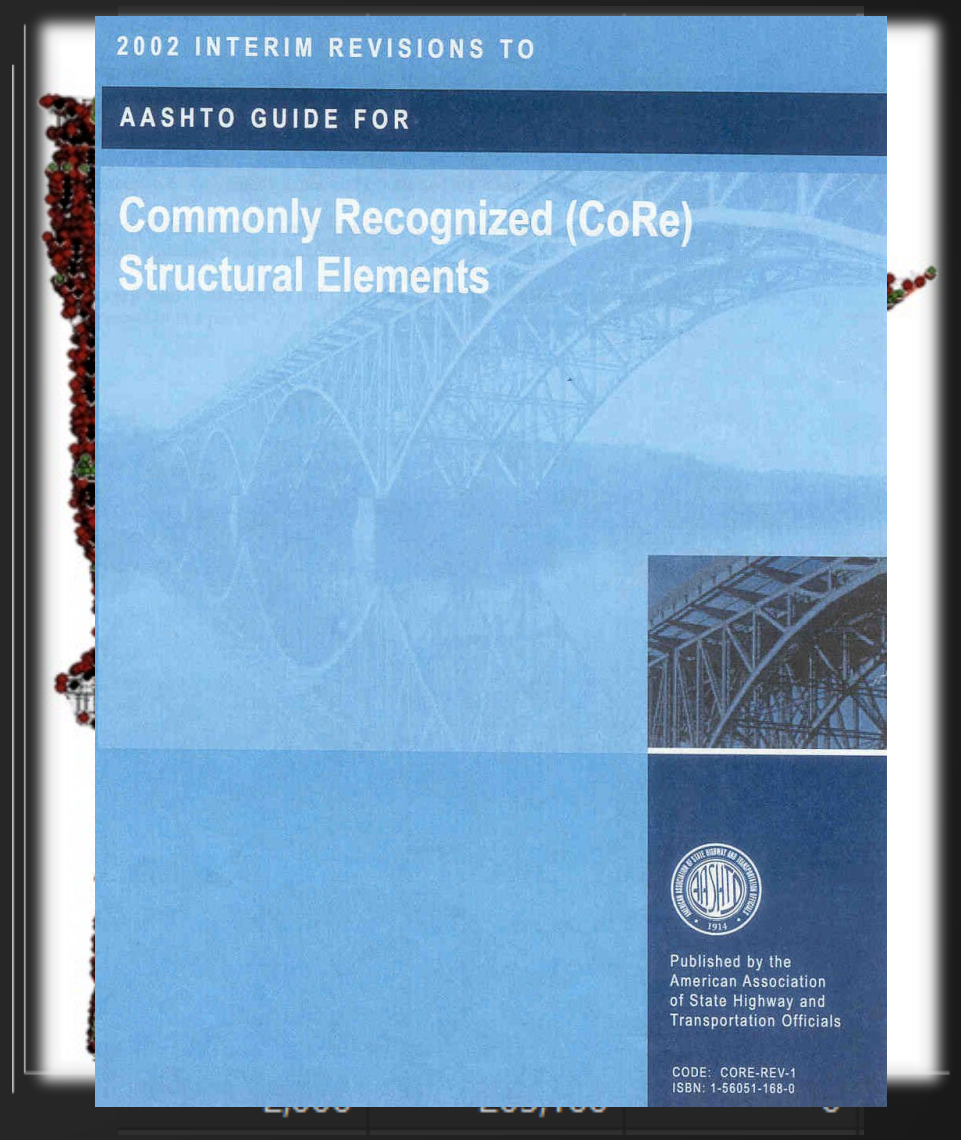
Minnesota's Bridge Inspection Element Level Collection & Use

DEPARTMENT OF TRANSPORTATION

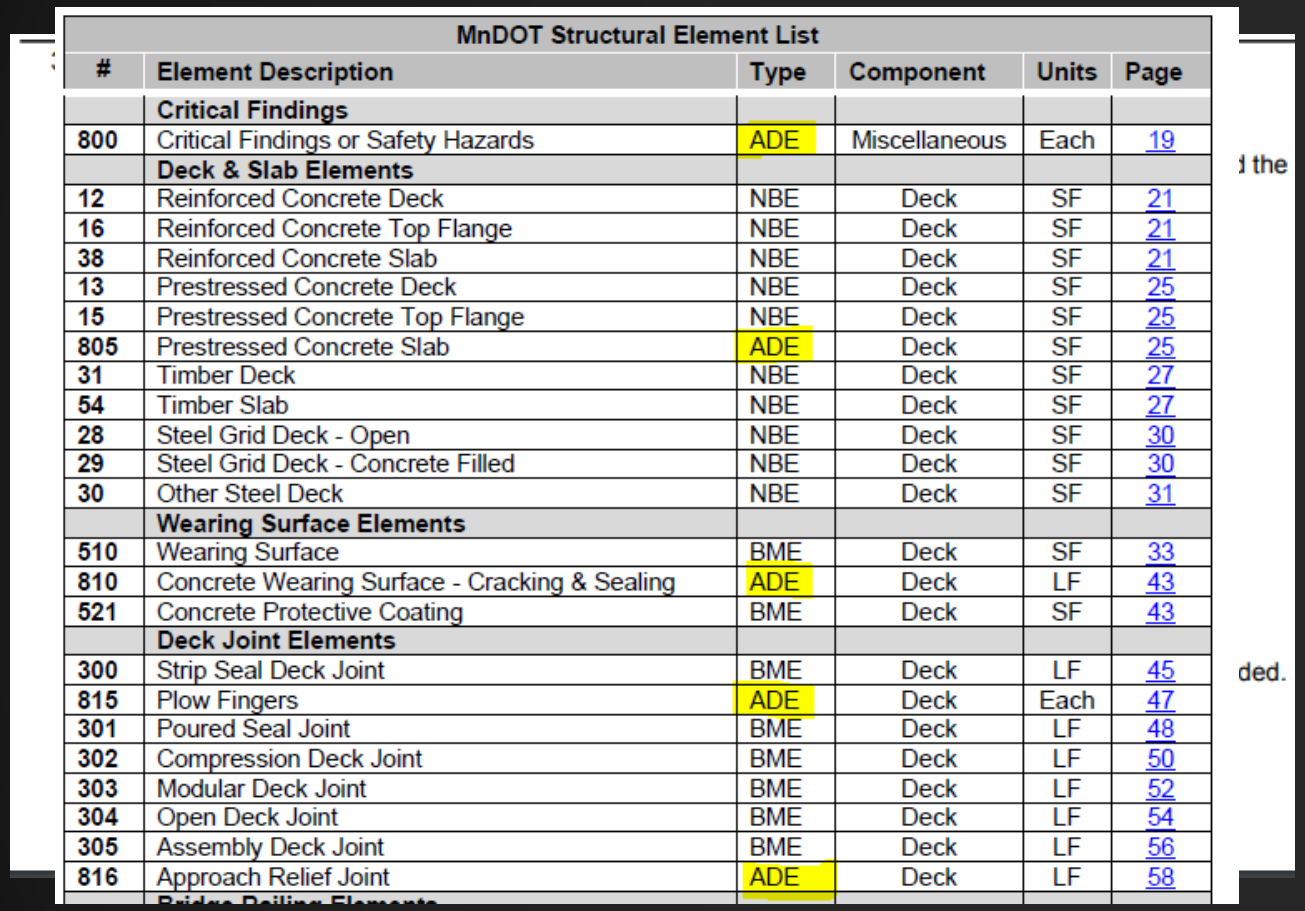
David Hedeen, P.E.
Asset Management Engineer
Minnesota DOT | Bridge Office

Minnesota's History

- CoRe collection since 1994
- All ~22k structures
- 219 inspection agencies
- 2015 in-house migrator to National Bridge Elements



Minnesota's Approach



MnDOT Structural Element List

#	Element Description	Type	Component	Units	Page
	Critical Findings				
800	Critical Findings or Safety Hazards	ADE	Miscellaneous	Each	19
	Deck & Slab Elements				
12	Reinforced Concrete Deck	NBE	Deck	SF	21
16	Reinforced Concrete Top Flange	NBE	Deck	SF	21
38	Reinforced Concrete Slab	NBE	Deck	SF	21
13	Prestressed Concrete Deck	NBE	Deck	SF	25
15	Prestressed Concrete Top Flange	NBE	Deck	SF	25
805	Prestressed Concrete Slab	ADE	Deck	SF	25
31	Timber Deck	NBE	Deck	SF	27
54	Timber Slab	NBE	Deck	SF	27
28	Steel Grid Deck - Open	NBE	Deck	SF	30
29	Steel Grid Deck - Concrete Filled	NBE	Deck	SF	30
30	Other Steel Deck	NBE	Deck	SF	31
	Wearing Surface Elements				
510	Wearing Surface	BME	Deck	SF	33
810	Concrete Wearing Surface - Cracking & Sealing	ADE	Deck	LF	43
521	Concrete Protective Coating	BME	Deck	SF	43
	Deck Joint Elements				
300	Strip Seal Deck Joint	BME	Deck	LF	45
815	Plow Fingers	ADE	Deck	Each	47
301	Poured Seal Joint	BME	Deck	LF	48
302	Compression Deck Joint	BME	Deck	LF	50
303	Modular Deck Joint	BME	Deck	LF	52
304	Open Deck Joint	BME	Deck	LF	54
305	Assembly Deck Joint	BME	Deck	LF	56
816	Approach Relief Joint	ADE	Deck	LF	58

- 28 Agency Defined Elements
- Do not collect defects
  - Carried over smart-flag, "defect element"
- Heavy use of narratives

Minnesota Effort's to Ensure Data Quality

- Registered Engineer must review/approve all reports
- In-house delivered annual training program
- Rigorous QA/compliance efforts
  - Use element data to identify when load posting signs missing/incorrect

#890: Load Posting or Vertical Clearance Signing (1 Each)

This element applies only to Load Posting signs or Vertical Clearance signs mounted on or in advance of a bridge (or culvert). If load posting or vertical clearance signing is required and/or present, this element must be rated.

- The actual load posted weight limits and/or posted vertical clearances present at the bridge should be documented in the element notes (and confirmed with the structure inventory).

Defect or Item	Condition States			
	1 Good	2 Fair	3 Poor	4 Severe
Signage Present and/or Correct	Required load posting or vertical clearance signing is properly installed.	All required signing is present. Placement may not be ideal.	Vertical clearance signing (at or in advance of bridge) is absent or incorrect.	Load posting signing (at or in advance of bridge) is absent or incorrect.
Damage or Deterioration	Load posting or vertical clearance signs are in good condition (superficial any damage or deterioration).	Load posting or vertical clearance signs have moderate damage or deterioration but are still readable.	Vertical clearance signing (at or in advance of bridge) is severely damaged or unreadable. Repair or replacement is required.	Load posting signing (at or in advance of bridge) is severely damaged or unreadable. Repair or replacement is required.

Condition Rating Examples (Load Posting or Vertical Clearance Signing)

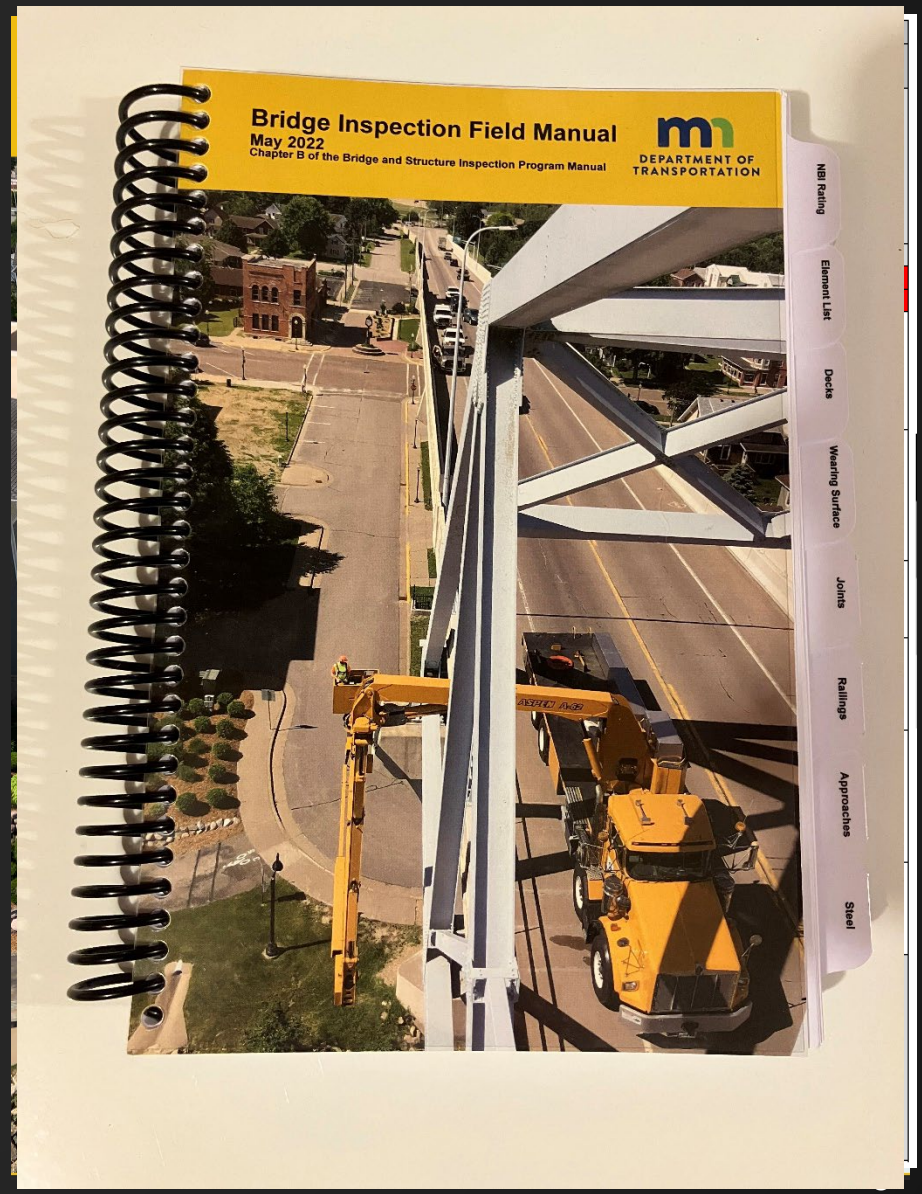
Condition State 2
Vertical Clearance sign is bent but is still readable

Condition State 4
Load posting sign is severely bent

Condition State 4
Load posting sign is not readable

Minnesota Inspection Manual

- Custom Inspection Field Manual
- Adopts AASHTO requirements
  - Adds details where necessary
  - Removes irrelevant items
- Packed with photos to illustrate descriptions
- 205 pages, printed/bound copy distributed regularly



Minnesota's Current Use of Element Level Data

JOINT NEEDS PRIORITIZATION	
priority	**priority description**
1	leaking joint, bridge has joints over piers
2	leaking joint, over 50% of total quantity
3	leaking joint, less than 50% of total quantity
4	no leaking joints

PIERCAP NEEDS PRIORITIZATION	
priority	**priority description**
1	pier cap has >=10% (CS3 or CS4)
2	pier cap has >=5% and <10% (CS3 or CS4)
3	pier cap has >=0% and <5% (CS3 or CS4)
4	pier cap has 0% CS3 or CS4

- Maintenance needs
- Joints
  - Location
  - Severity
- Pier caps
  - Early flag for scoping needs assessment
    - In-depth inspection
    - In-house maintenance
    - Infill Wall needs

Protective Species ADE 900

- Unique approach to help with identifying structures with protective species
- Actively train inspectors to look for signs of protected bird species, and flag it with this element
- Also assists with tracking endangered bats who may be using a bridge as a roosting site

Defect or Item	Condition States			
	1	2	3	4
Protected Species	New structure (not yet inspected), **or** structure has not been fully inspected (due to access limitations, etc.)	No evidence of protected species nesting or roosting on the structure (currently or in the recent past)	Protected bird species and/or nests (swallows, falcons, etc.) are present on the structure.	Bats or evidence of bats is present on the structure (add notes on location)

Condition State 3
Robbin's nest on a bridge beam

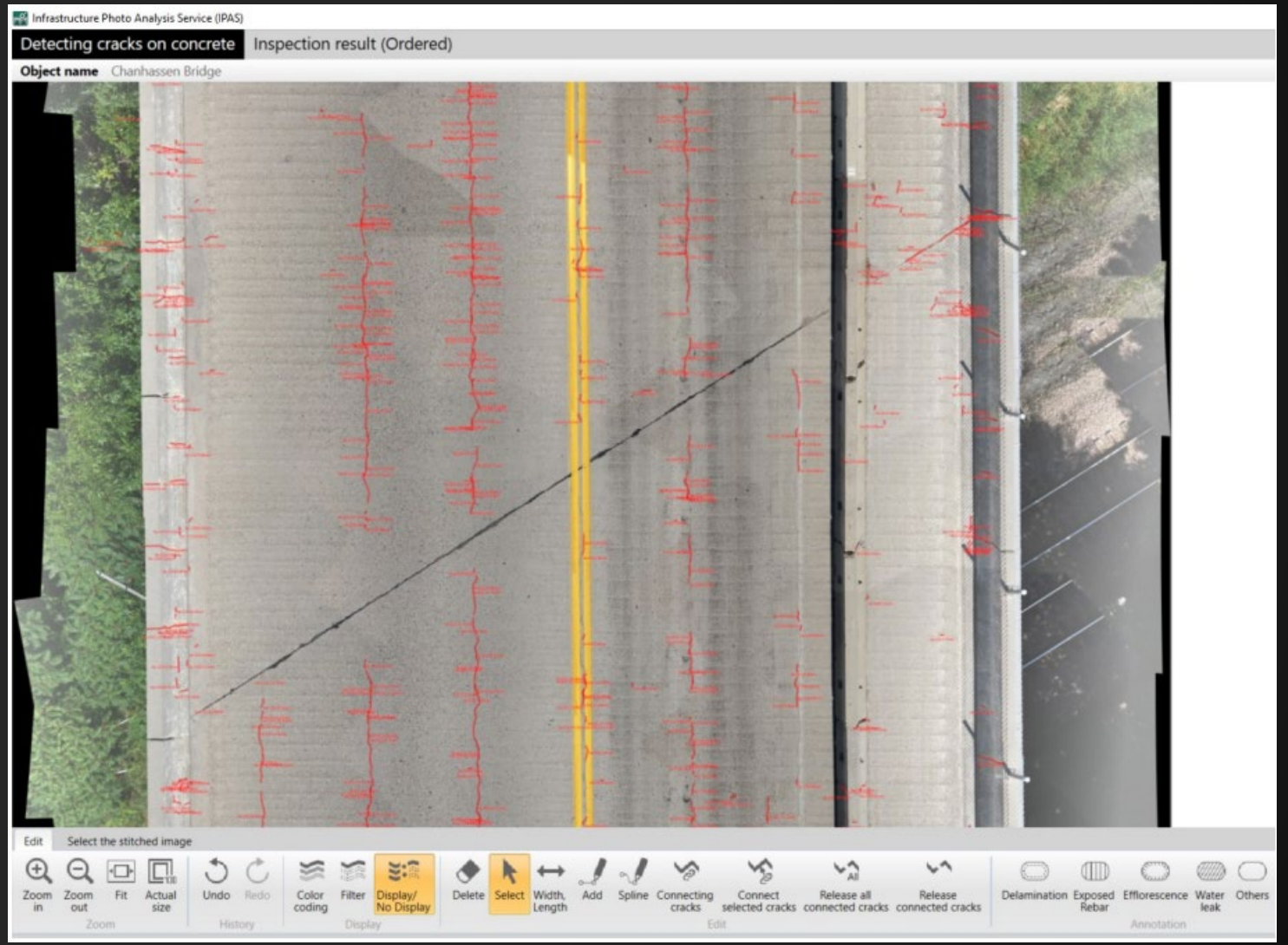
Condition State 3
Great horned owl in a large stick nest on a bridge

Condition State 4
Bats roosting on the underside of a deck joint

Condition State 4
Bats droppings on an abutment bearing seat

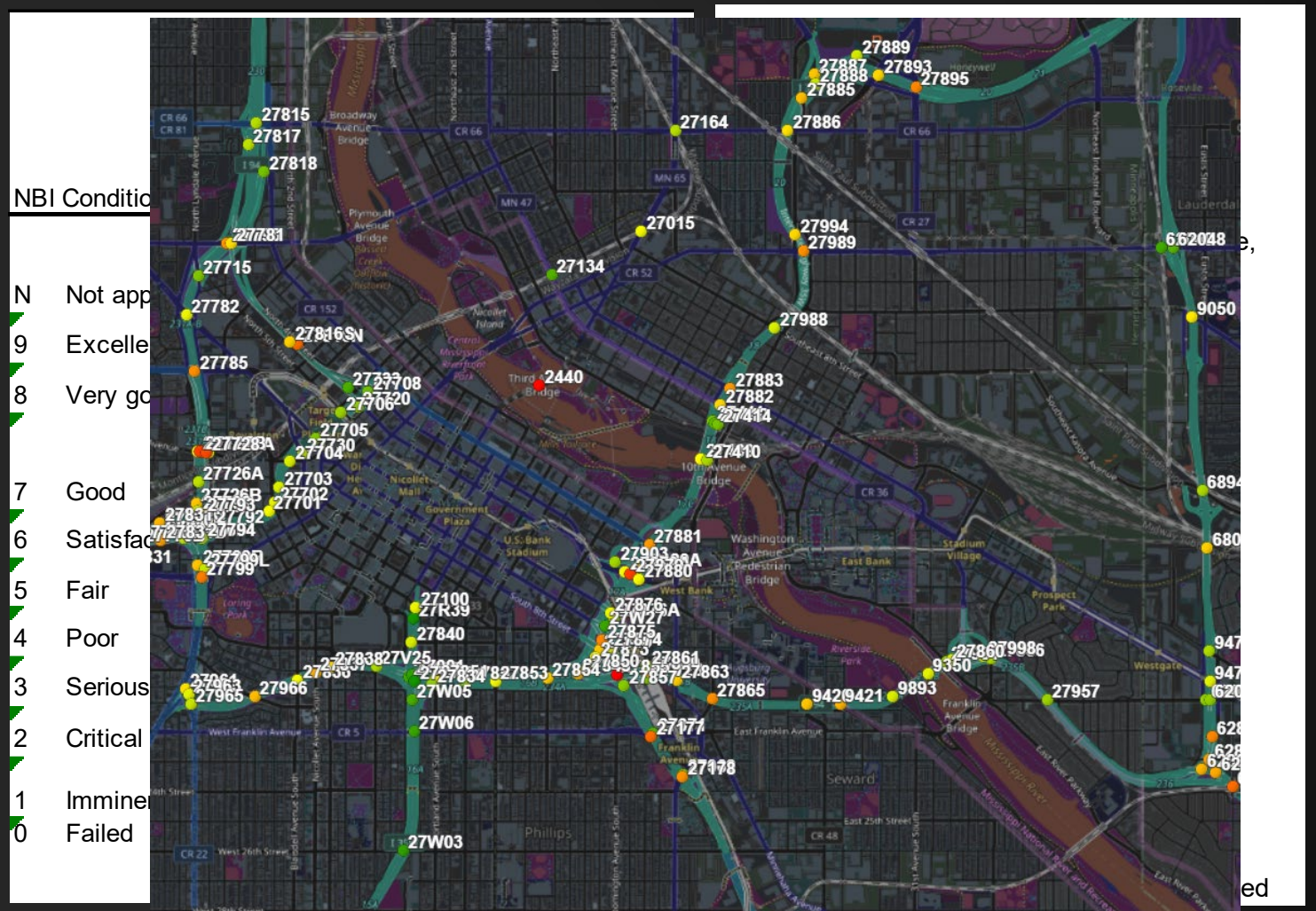
Minnesota's Agency Defined Element 810

- ADE used for Cracking & Sealing of Decks
  - Tracks the quantity and severity of deck cracking
  - Used for maintenance prioritization
- Experimenting with drone & AI collection



Minnesota's Bridge Planning Index

- Risk score that considers
  - Inventory/Inspection Data
    - Including element level
- Condensed to 0-100 scale
- Used as an input to help prioritize project selection



Element Level Deterioration

- Deterioration models from MWBPP Pooled Fund Study
  - Small population of data overcame by pooling resources
  - Yielded insights on how element level data deteriorates
  - Minnesota is in implementation phase with this research

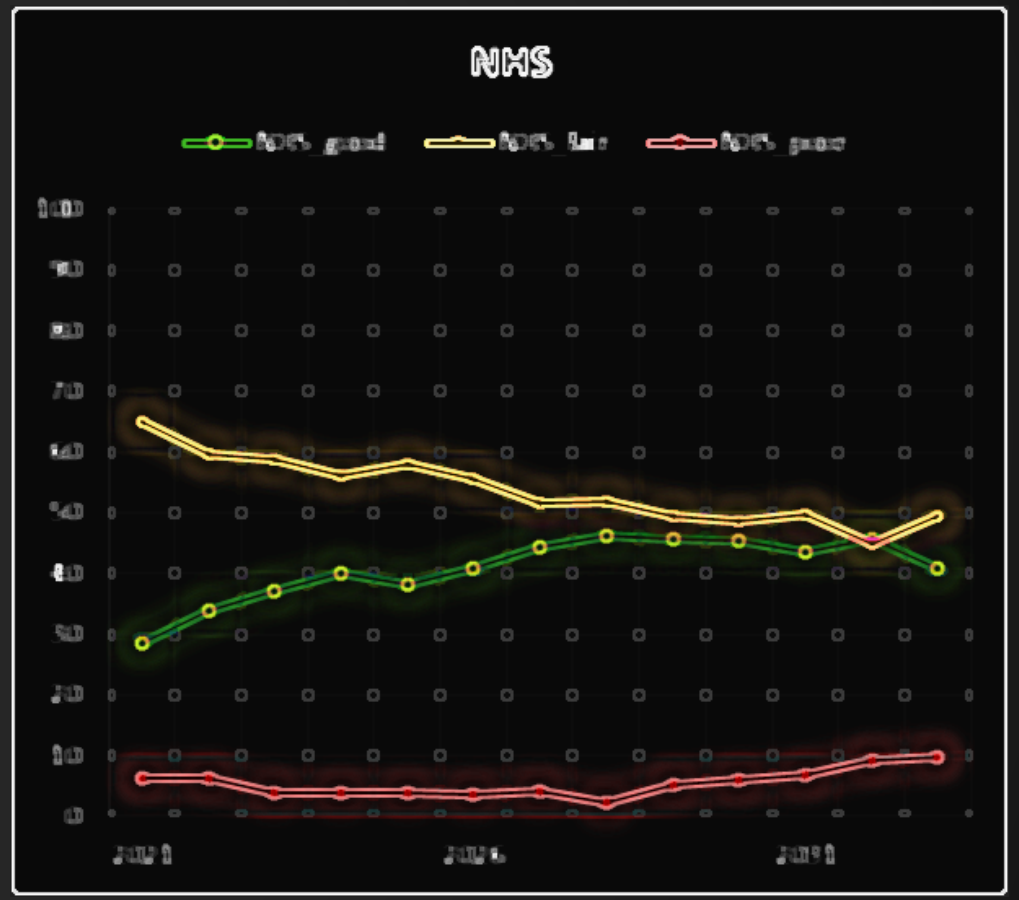
https://www.pooledfund.org/Details/Study/655

Table E-2. Summary of transition times for element condition states (years)

Element Group or Defect	1->2	2->3	3->4
Task 6.1 – RC Deck (for use without protection factor)	43.6	19.7	24.8
Task 6.1 – RC Deck (for use with protection factor)	38.3	24.5	13.8
Task 6.2 – RC Slab (for use without protection factor)	66.8	17.6	49.3
Task 6.2 – RC Slab (for use with protection factor)	43.7	21.5	28.3
Task 6.4 – RC Decks After Major Preservation	38.9	36.5	12.1
Task 7.1 – Wearing Surface	24.6	11.1	13.0
Task 7.2 – Expansion Joints	5.8	5.9	6.0
Task 7.3 – Defect 1080 (Delamination)	328.2	8.7	33.6
Task 7.4 – Defect 3440 (Paint System Effectiveness)	19.2	2.2	2.9
Task 7.5 – Defect 1000 (Steel Corrosion)	25.6	23.2	59.8
Task 7.6 – RC Pier Caps	69.4	12.4	68.0
Task 7.6 – RC Abutments	40.9	16.6	47.6
Task 7.6 – RC Pier Walls	50.3	15.6	25.4
Task 7.6 – RC Columns	23.8	11.3	80.5

Element Level Performance Targets

- Minnesota has issue with using Component Condition Data for performance targets
  - Oversimplification of structure health
  - Doesn’t account for smaller preservation efforts
- Launched a research effort aimed to:
  - Establish data driven targets based on granular element level data
  - Emphasize elements with high benefit/cost ratio
  - Stretch scoring range
  - https://www.dot.state.mn.us/research/RFP/NS/NS637.pdf



Minnesota's Bridge Inspection Element Level Collection & Use

DEPARTMENT OF TRANSPORTATION

David Hedeen, P.E.
Asset Management Engineer
Minnesota DOT | Bridge Office

Case Study: Wisconsin

Philip Meinel, PE

WisDOT Bureau of Structures
Development Section

TRB Webinar: Bridge Element Data Use in the U.S.

BUREAU OF STRUCTURES

March 29, 2023

Case Study Emphasis

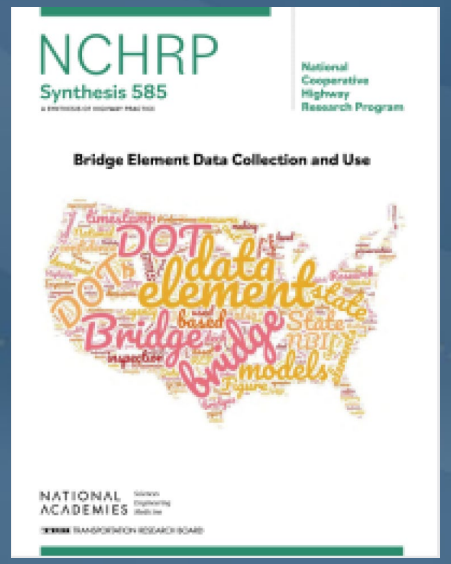
Learning Objectives

At the end of this webinar, participants will be able to:

1. Describe the current practice on collecting element-level data
2. Evaluate use of bridge element data for decision-making
3. Identify performance measures or business processes based on element data for implementation

Collecting Data

- NCHRP Synthesis 585, page 45
  - List of some WI elements and defects



- Bare wearing surface (Element 8000).
- Asphaltic concrete overlay (Element 8511).
- Asphaltic concrete overlay with membrane (Element 8512).
- Thin polymer overlay (Element 8513).
- Concrete overlay (Element 8514).
- Delamination, spalls, patched area, pothole (Defect 3210).
- Cracking (Defect 3220).

--Wearing Surface Defects

- Reinforced concrete deck (Element 12).
- Delamination, spalls, patch areas, exposed rebar (Defect 1080).

-- Deck Defect

Collecting Data

- WI Inspection Field Manual, page 97

2020

WISCONSIN DEPARTMENT OF TRANSPORTATION

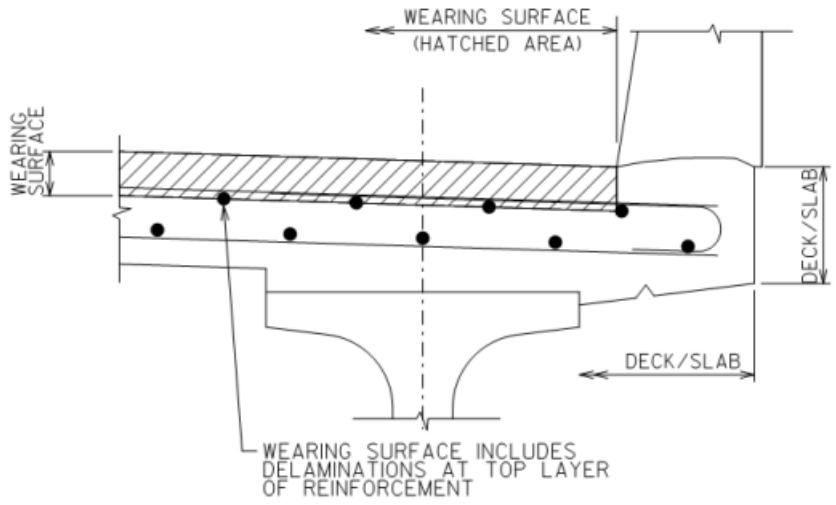
STRUCTURE INSPECTION FIELD MANUAL

Wisconsin Department of Transportation

Chapter 3.J – Wearing Surfaces

J. Wearing Surfaces

Wearing Surfaces	
510 – Wearing Surfaces (Other)	SF
8000 – Wearing Surface (Bare)	SF
8511 – AC Overlay	SF
8512 – AC Overlay & Membrane	SF
8513 – Thin Polymer Overlay	SF
8514 – Concrete Overlay	SF
8515 – Polyester Concrete Overlay	SF



SECTION

Defect 3120 - IR/Thermography or GPR Results for delaminations down to the top layer of reinforcement should be quantified under Defect 3210 under the applicable wearing surface element.

Why Wearing Surface ADEs?
What would you program?

- There's only enough $ for one deck replacement…
  - Bridge A – Original RC Deck has 10% in CS2.
  - Bridge B – Original RC Deck has 10% in CS2.

Why Wearing Surface ADEs?
What would you program?

- There's only enough $ for one deck replacement…
  - Bridge A – Original RC Deck has 10% in CS2.
    - Delamination from sounding top of deck
  - Bridge B – Original RC Deck has 10% in CS2.
    - Visual delamination of underside of deck

Why Defects?
What would you program?

- There's only enough $ for one concrete overlay…
  - Bridge A – Original RC Deck has 10% of wearing surface in CS2.
  - Bridge B – Original RC Deck has 10% of wearing surface in CS2.

?

Why Defects?
What would you program?

- There's only enough $ for one concrete overlay…
  - Bridge A – Original RC Deck has 10% of wearing surface in CS2.
    - Defect is 3210 Delamination/spall/patching
  - Bridge B – Original RC Deck has 10% of wearing surface in CS2.
    - Defect is 8911 Abrasion/Wear/Rutting

Element Deterioration 2018

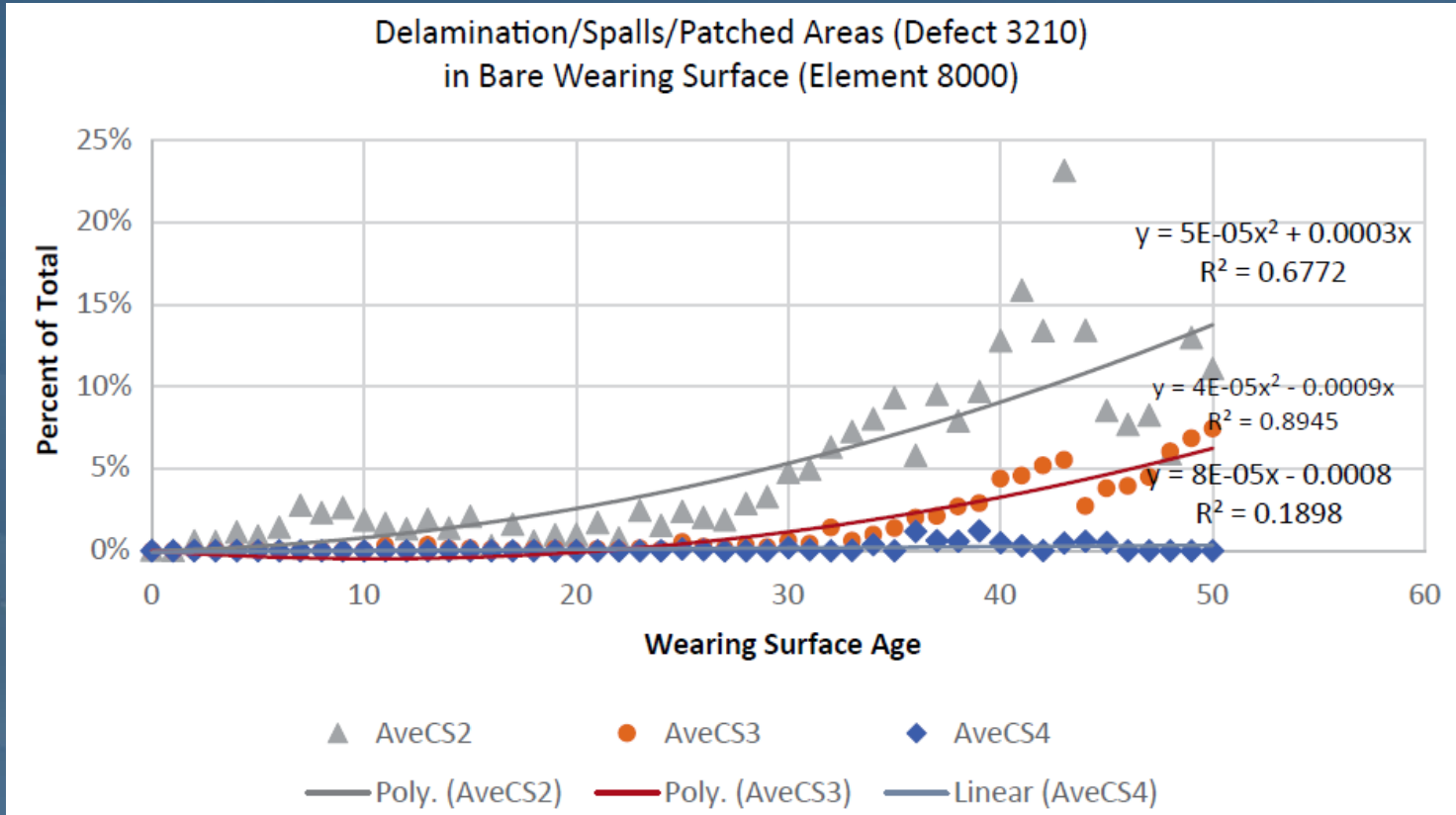


Figure 4-14. Wisconsin DOT deterioration curve for delamination/spalls/patched areas in bare wearing surfaces.

Element Deterioration 2018

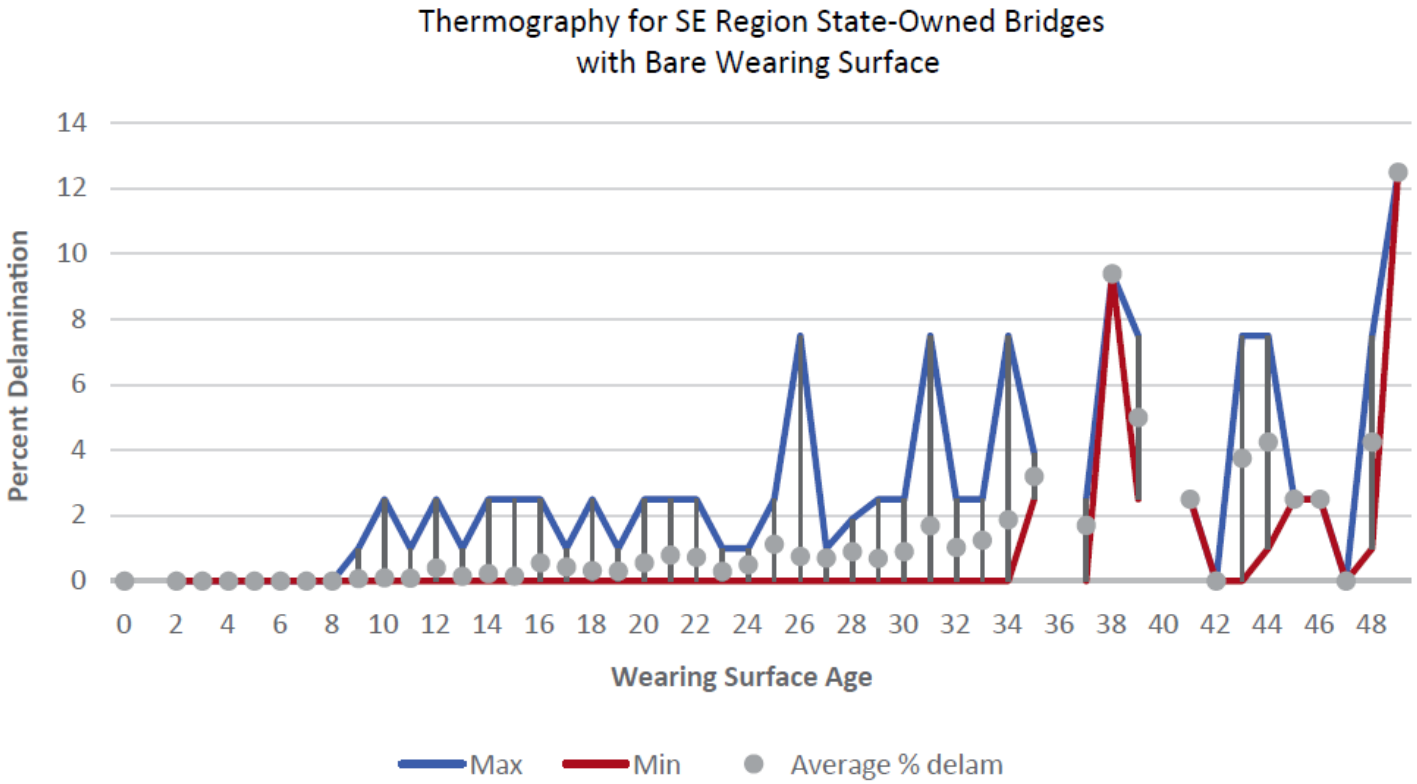


Figure 4-15. Wisconsin DOT percent delamination by wearing surface age based on thermographic inspections.

Element Deterioration 2018

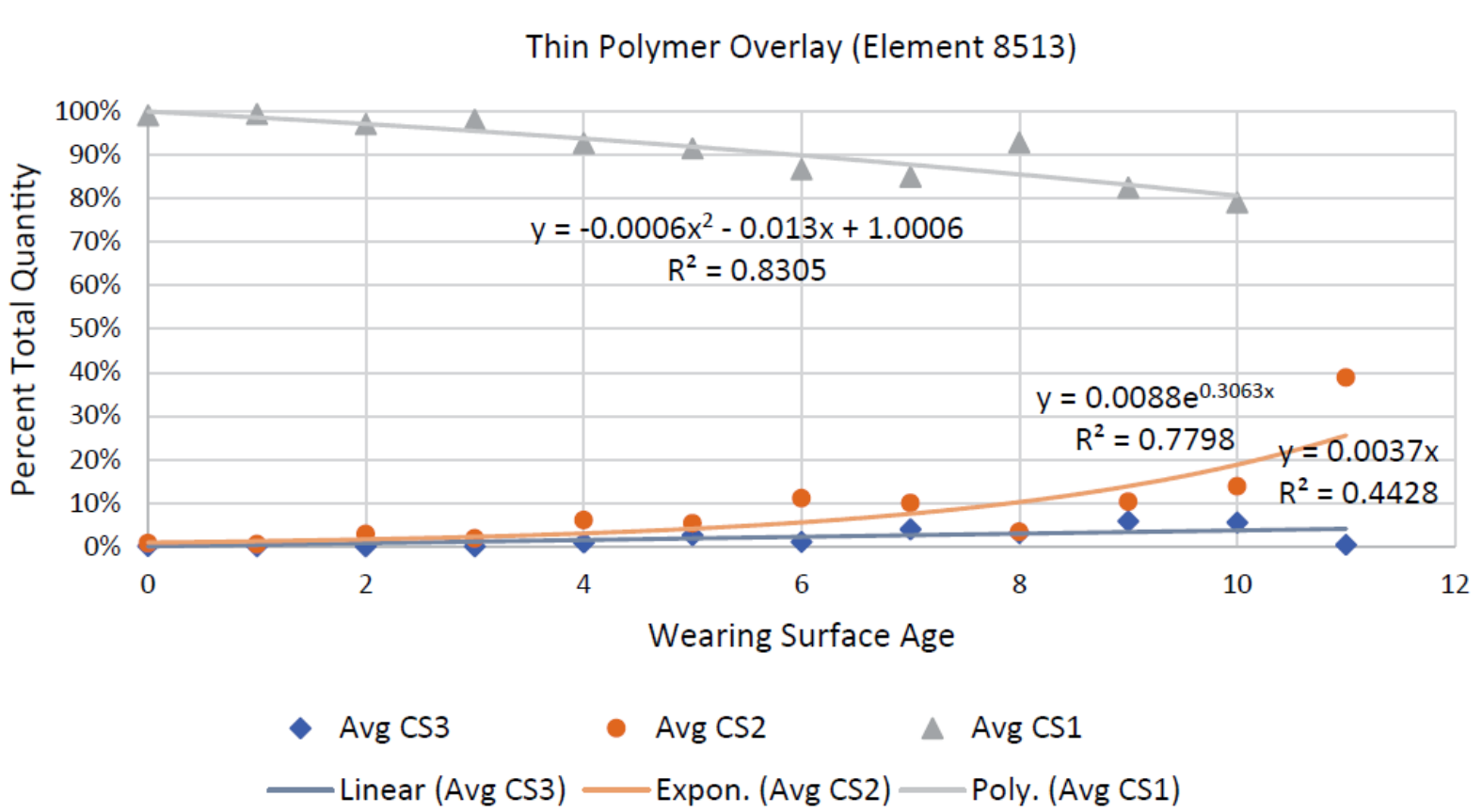


Figure 4-17. Wisconsin DOT age-based deterioration curve for thin polymer overlay.

Element Deterioration 2018

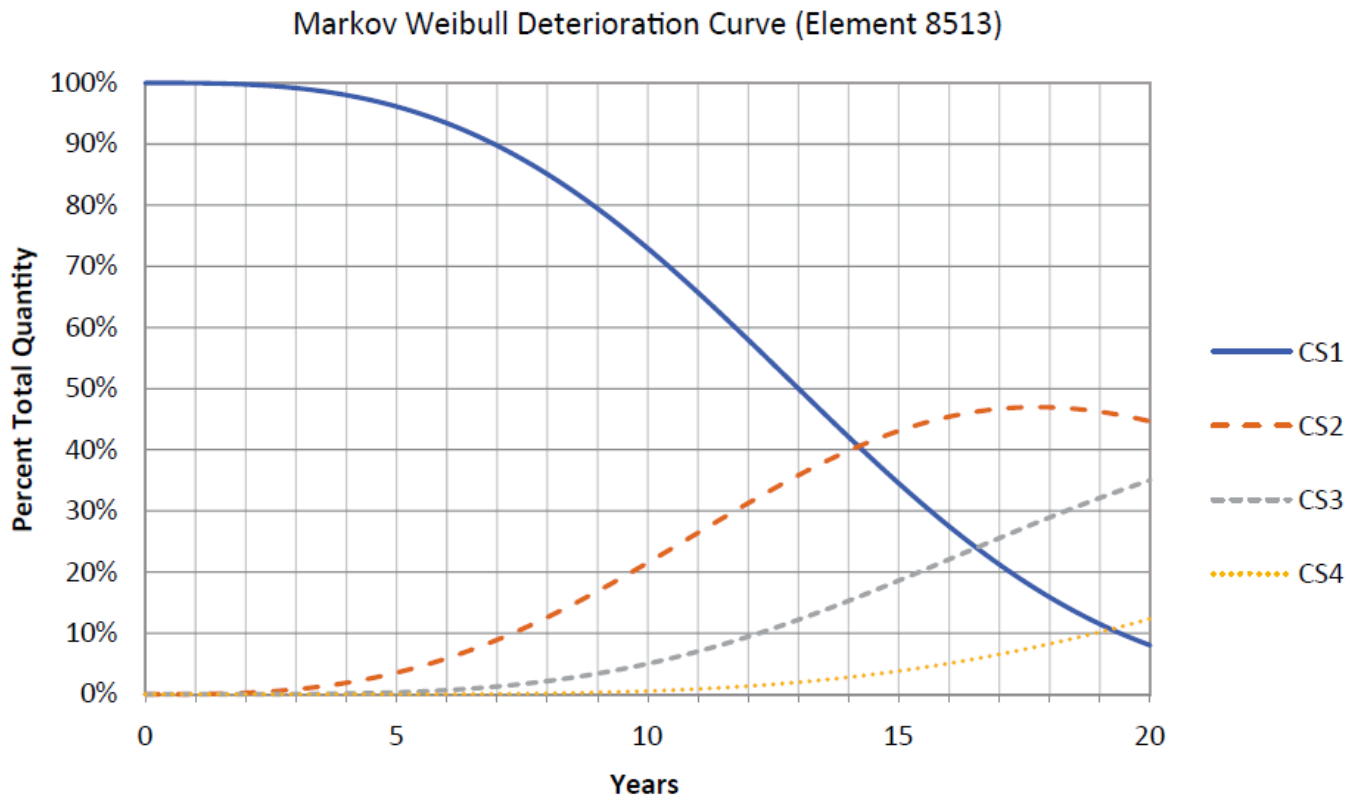
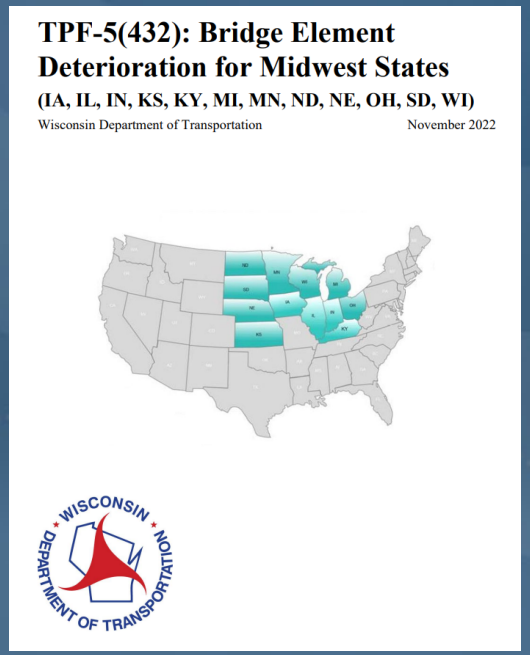
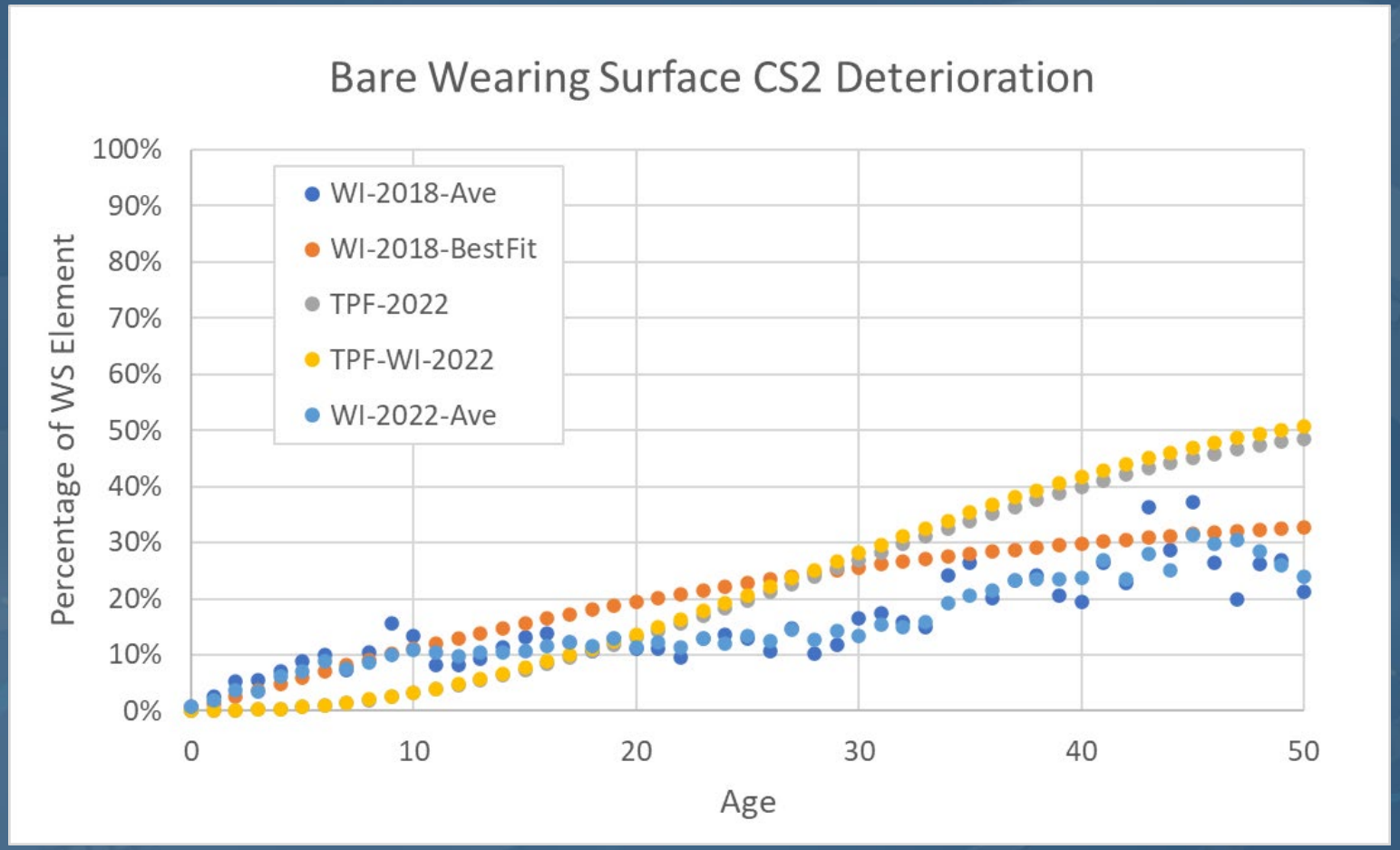


Figure 4-16. Wisconsin DOT Markov-Weibull deterioration curve for thin polymer overlay.

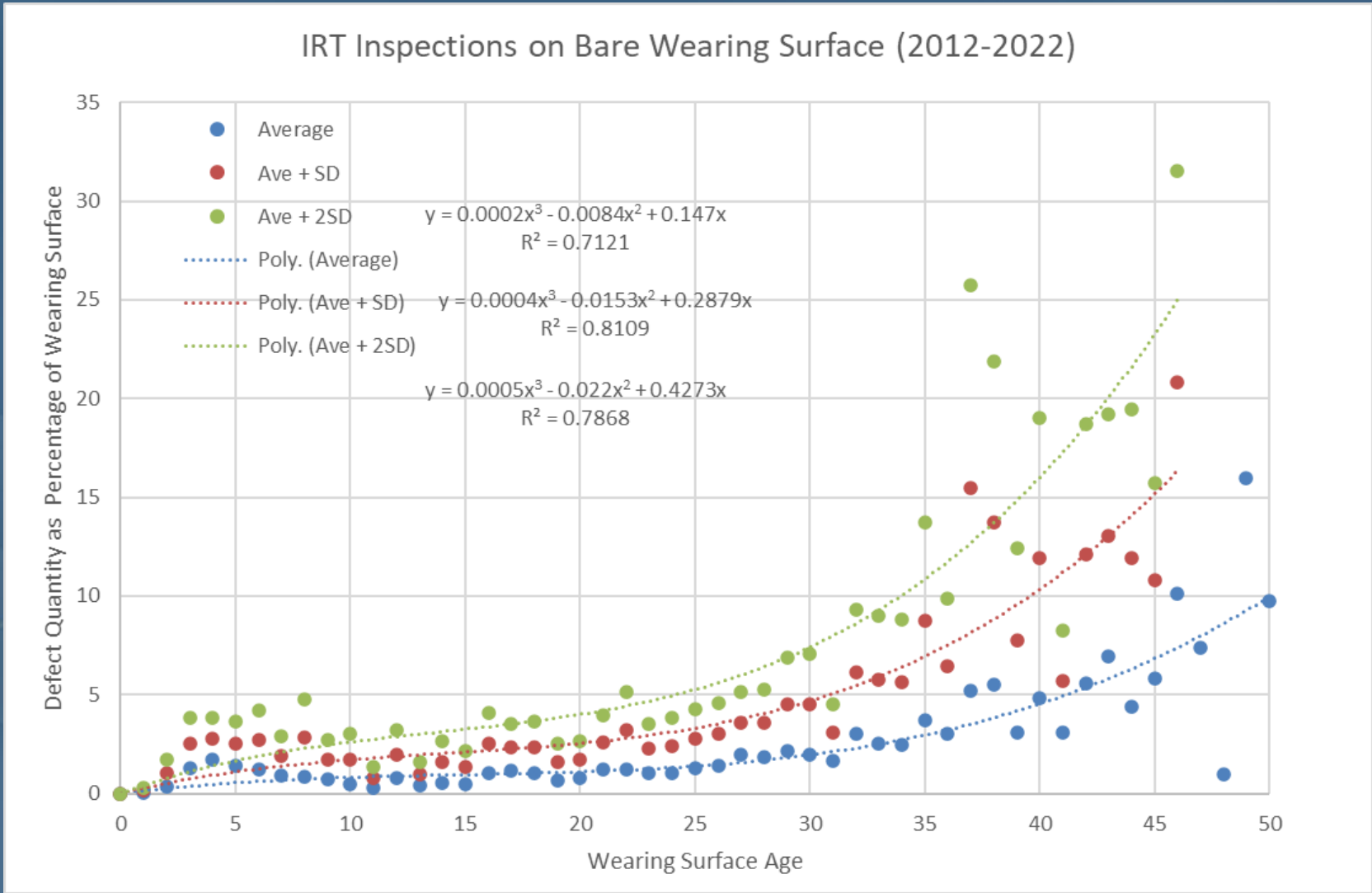
Element Deterioration 2022

- TPF-5 (432) Bridge Element Deterioration for Midwest States

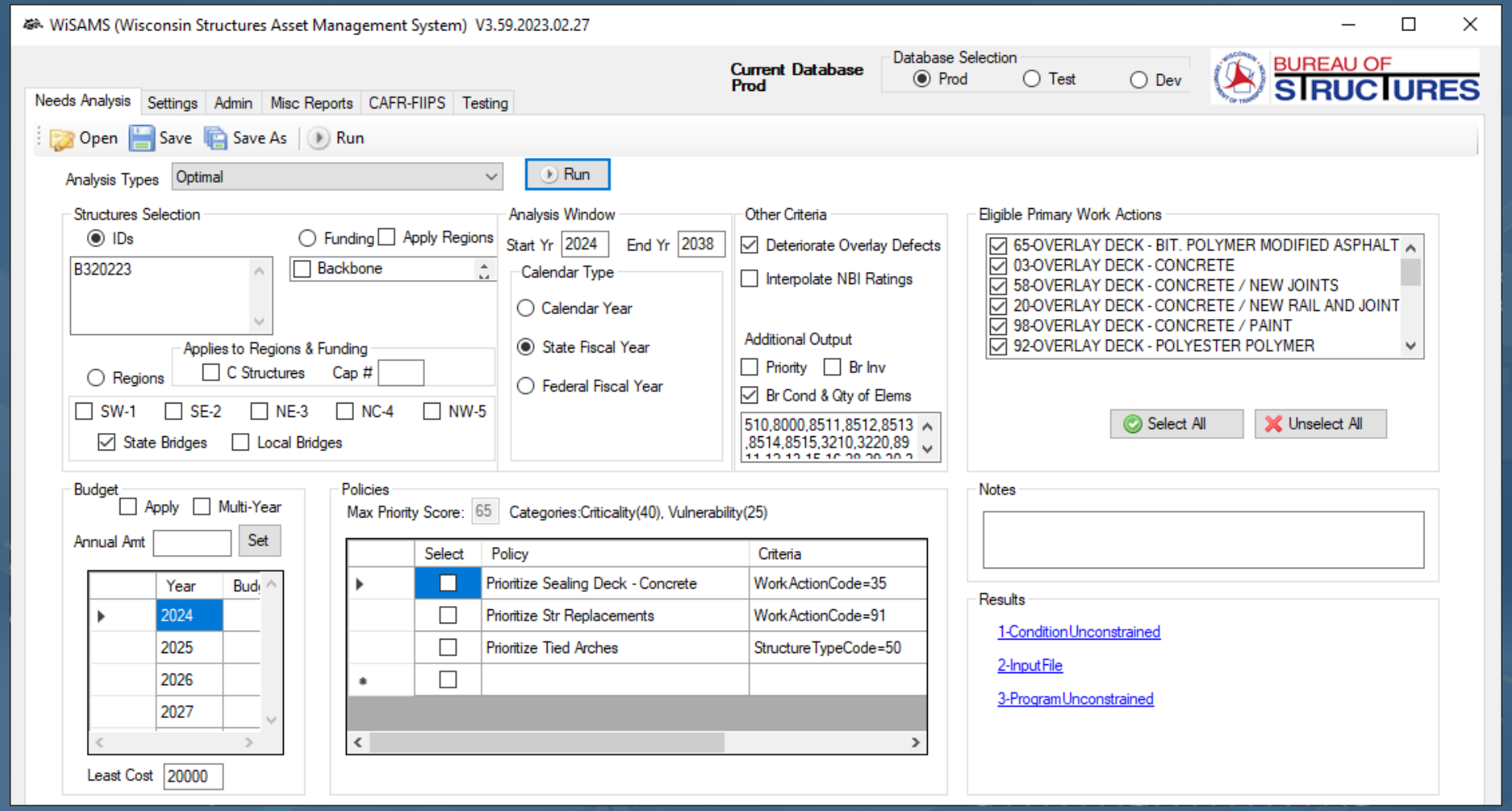




Element Deterioration 2022



BMS Optimizer



BMS Optimizer

- Example Action: Re-apply Thin Polymer Overlay (TPO)
- Example rule:

NUMOVERLAY = 0 AND NUMTHINPOLYMEROVERLAYS <4 AND NDEC ≥5 AND
((Q2OF1080 + Q3OF1080 + Q4OF1080)/QTOF1080PARENT <0.01))
AND ((Q3OF8513 + Q4OF8513)/QTOF8513 >0.15))

  - In English:
    - No previous thick overlays
    - Not an excessive number of previous TPOs
    - Deck NBI ≥ 5
    - Deck still in very good condition with very little delamination
    - More than 15% of the existing TPO has spalled off

BMS Optimizer

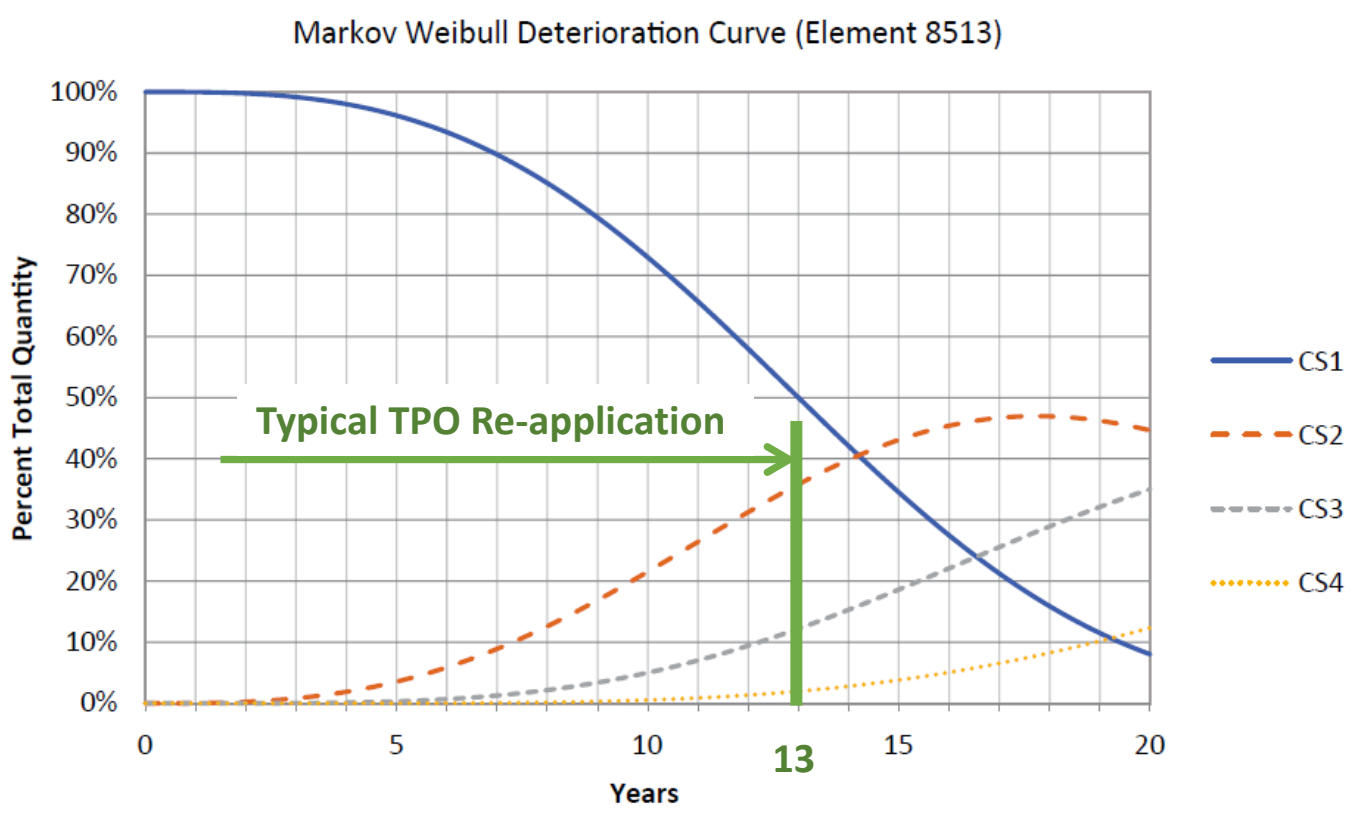


Figure 4-16. Wisconsin DOT Markov-Weibull deterioration curve for thin polymer overlay.

Thank you!

Questions?

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April 5, 2023

TRB Webinar: Bridge Management Systems for Strategic Asset Management

April 12, 2023

TRB Webinar: Using Ultra-High Performance Concrete for Bridges

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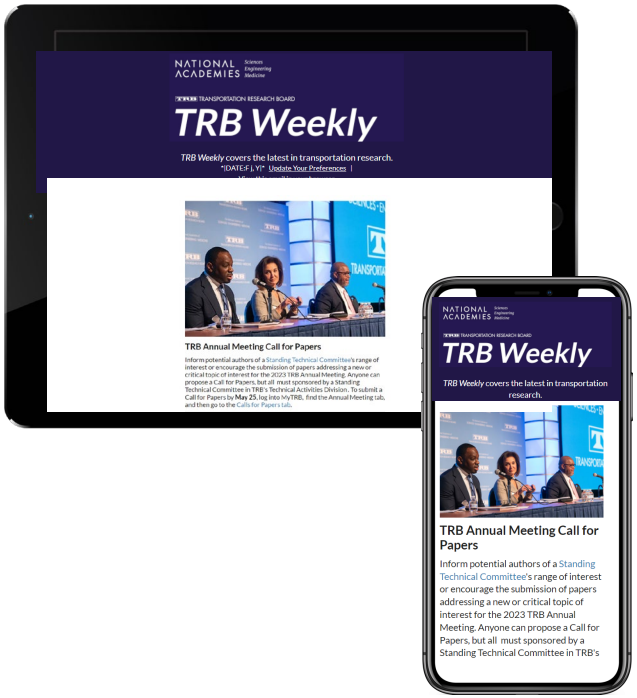

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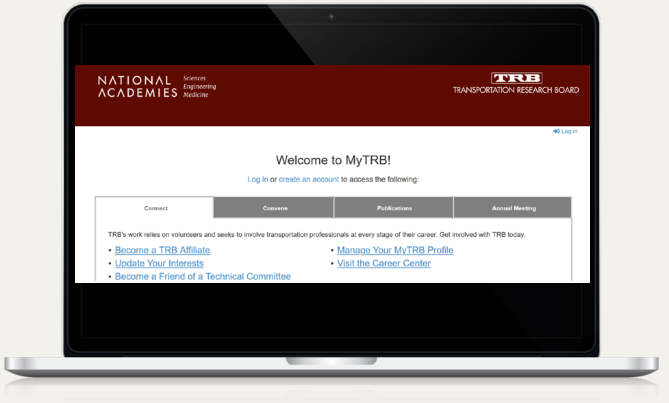

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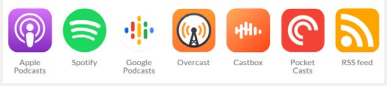

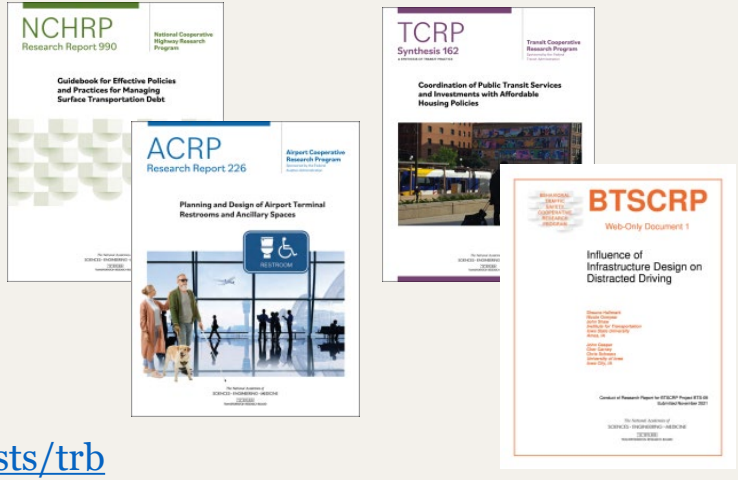

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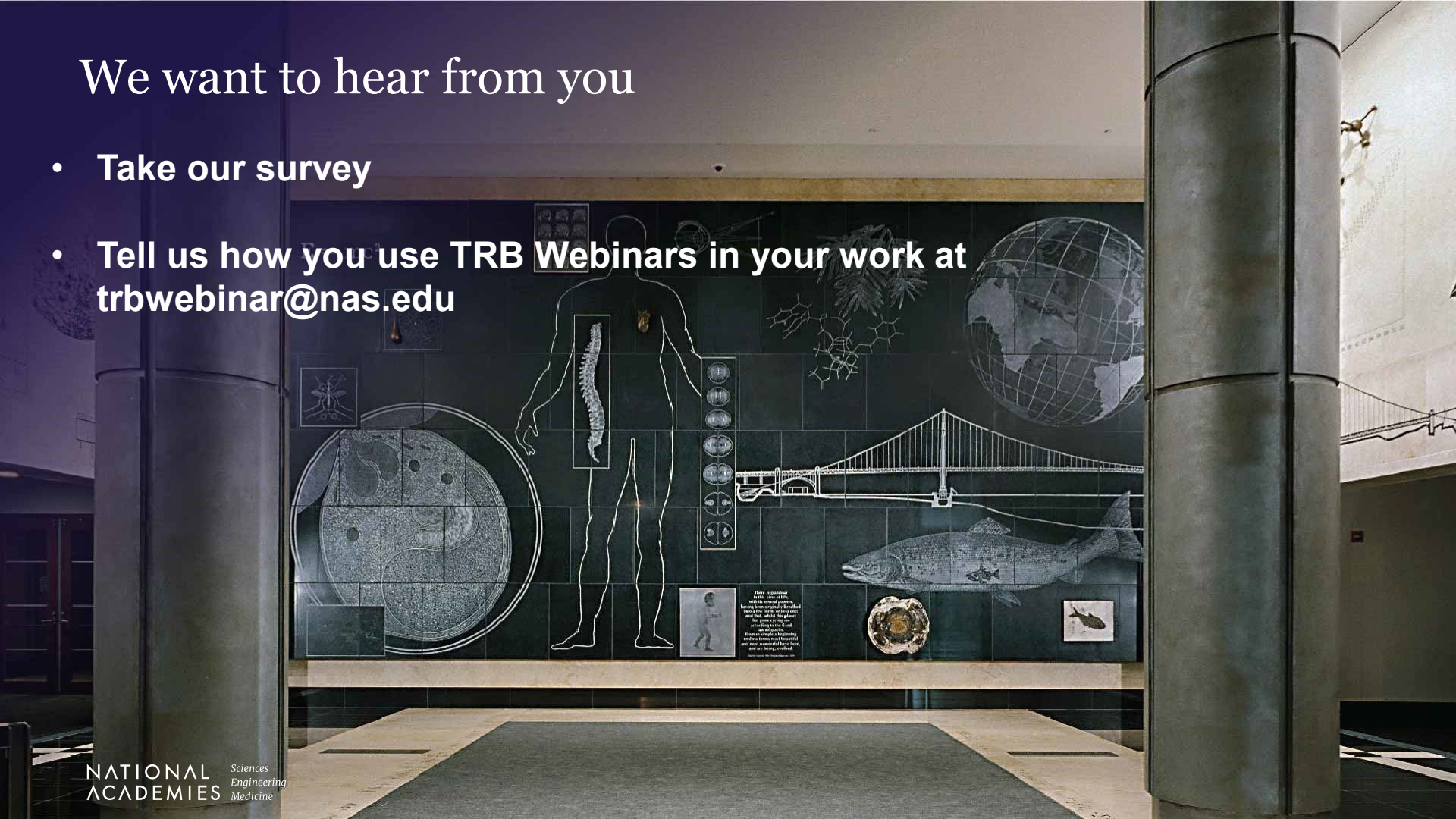

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