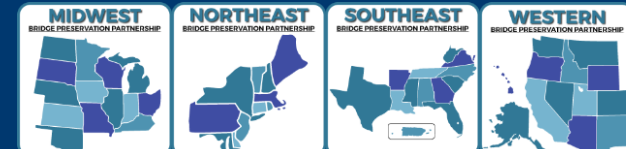




Photo: 2020 Prize Bridge National Winner – Manning Crevice (Idaho) – Photo Credit: Ken Saindon

Roadmap to Preservation for Steel Bridges

Bill McEleney; National Steel Bridge Alliance, Retired



What is Bridge Preservation ?



Bridge Preservation is “actions or strategies that prevent, delay or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good (*or fair*) condition and extend their life. Preservation actions may be preventative or condition-driven”

Source: AASHTO Board of Directors, Policy Resolution PR-3-11, October 17, 2011

Brief History

- 2013 - [AASHTO Committee on Bridges & Structures](#), Bridge Preservation Technical Subcommittee, BPTC (formerly known as T-9) developed Mission and Vision statements and 4 Objectives. Objective 4, regarding corrosion, recognizes the issue for both steel and concrete bridges and specifically includes beam end corrosion.
- 2015 – BPTC clarifies Mission to indicate that preservation actions are for both new and existing bridges
- [AASHTO Committee on Maintenance](#), Bridge Technical Working Group
- [AASHTO Preservation Management](#)
 - 4 Regional Preservation Partnerships
- [FHWA Bridge Preservation](#) Expert Task Group
- NCHRP
- Various Industry Groups and Suppliers

Outline

- Superstructure Topics only
 - Steel Beam / Girder bridges



- Prevent, Delay or Reduce Deterioration
- Restore Function
- Extend Life

Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.

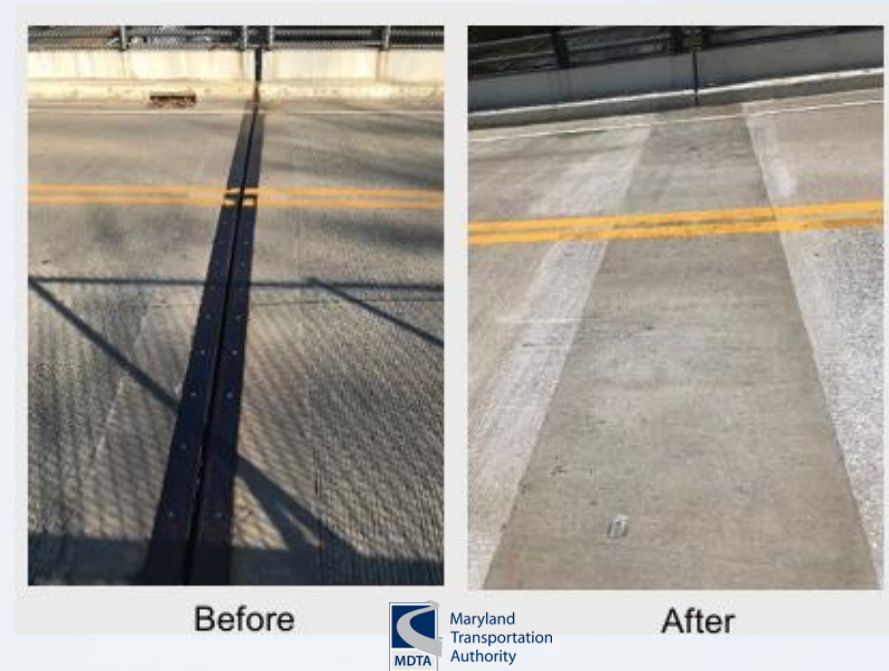
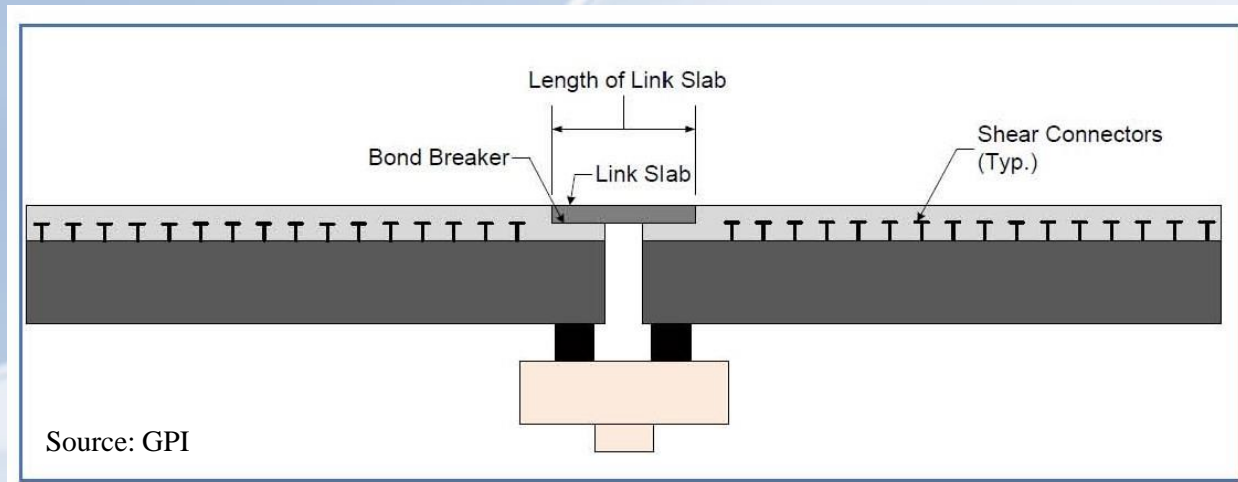
Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.
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 - *Continuous Girders / Decks* – [AISC Engineering Journal, 3rd Quarter 1987](#)



Prevent, Delay or Reduce - Design

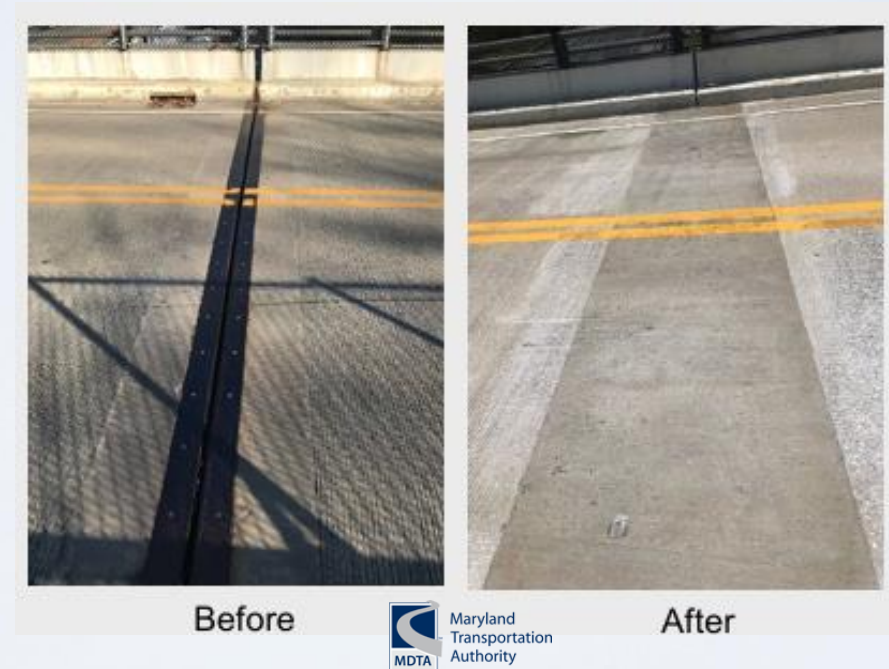
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Prevent, Delay or Reduce - Design

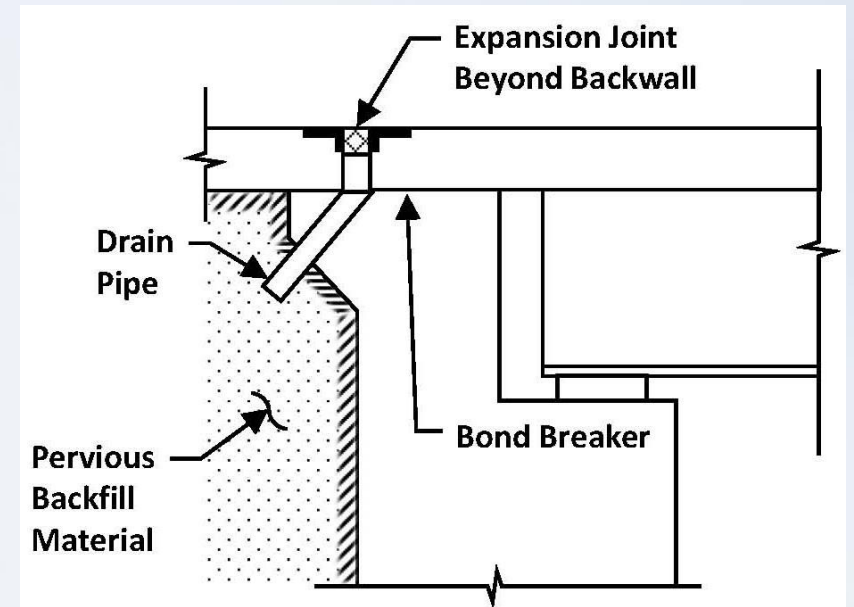
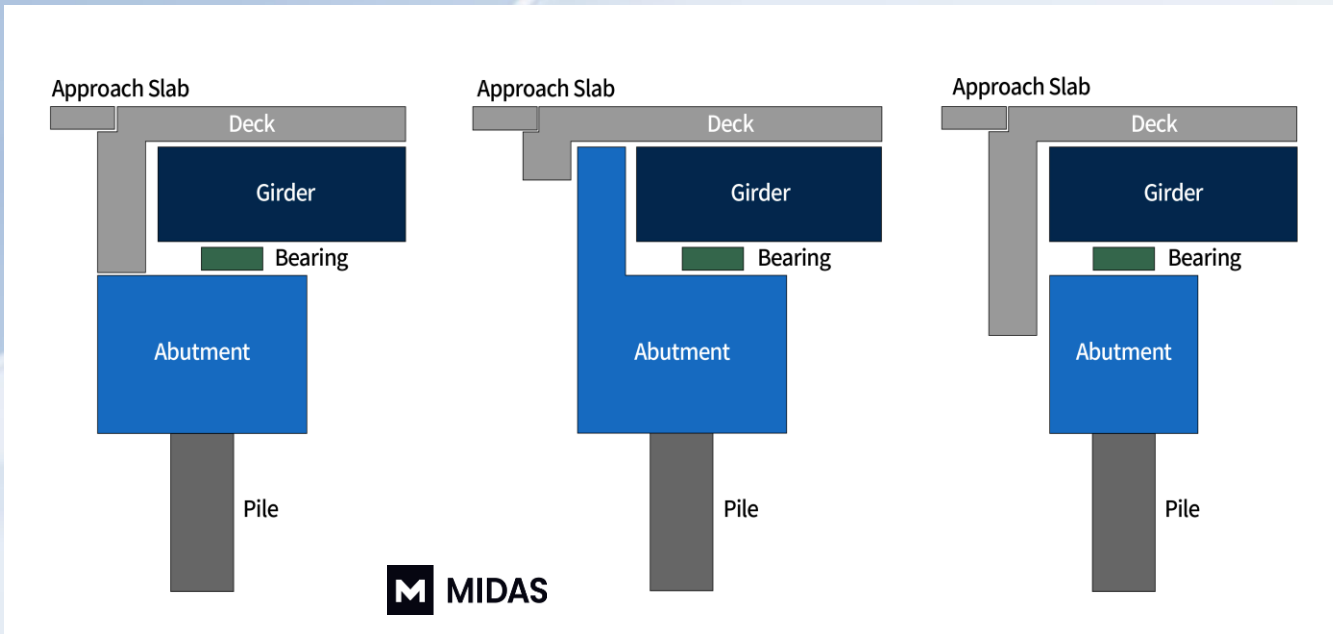
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 - Continuous Girders / Decks – [AISC Engineering Journal, 3rd Quarter 1987](#)
 - *Link Slab* – [FHWA UHPC Link Slab Design Example, 2023](#)

‘I can state that there (have) not been any visible or drivability problems with the link slabs on any of the bridges. So, you can say that they have been performing well and as-intended for all of these years’



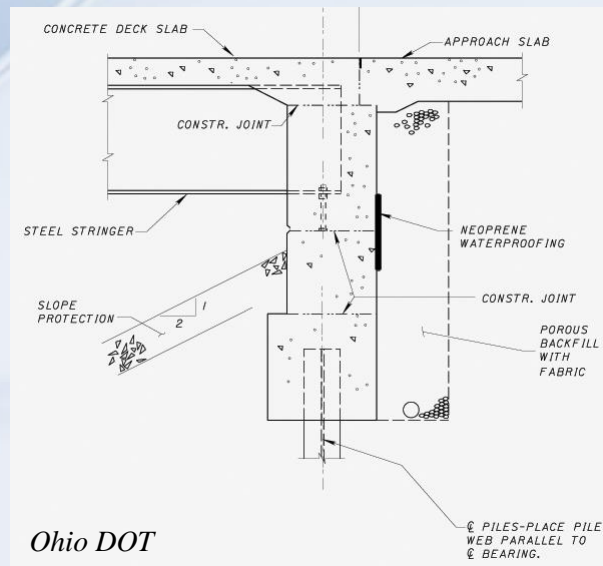
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 - *Deck Extensions / Slab over Back Wall*

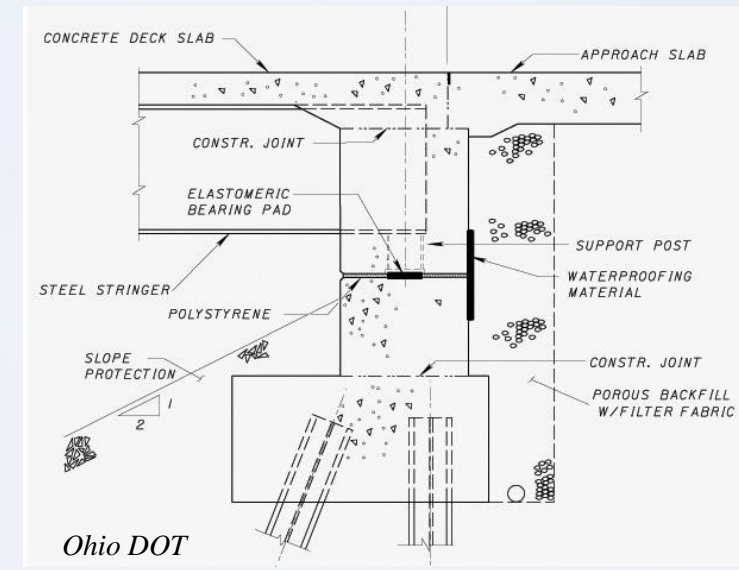


Prevent, Delay or Reduce - Design

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 - Continuous Girders / Decks – [AISC Engineering Journal, 3rd Quarter 1987](#)
 - Link Slab – [FHWA UHPC Link Slab Design Example, 2023](#)
 - Deck Extensions / Slab over Back Wall
 - *Abutments* - [AISI Integral Abutments for Steel Bridges, 1996](#)



Ohio DOT



Ohio DOT

Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.
- Move / Minimize / Eliminate Expansion Joints
- Select Corrosion Protection to Suit Service Environment
 - *Weathering Steel* – [NSBA Uncoated Weathering Steel Reference Guide, 2022](#)
 - [FHWA Weathering Steel Performance Data Collection, 2024](#); [FHWA LTBP InfoBridge Portal website](#)

Table 2.1-1—Overview of Recommendations for UWS use in Various Environments

Micro-Environment	Macro-Environment		
	All Others	High Time of Wetness ¹	Coastal ²
All Others	UWS is ideal choice	Use UWS thoughtfully	Use UWS thoughtfully
Highway Crossings with Extreme Salt Use ³	Use UWS thoughtfully	Use UWS thoughtfully	Use UWS thoughtfully
Water Crossings with Low Vertical Clearance ⁴	If minimal vegetation ² , use UWS thoughtfully; if dense vegetation ² , UWS not recommended	UWS not recommended	UWS not recommended
Sites with Dense Vegetation or Shelter ⁵	UWS is ideal choice, if vegetation can be maintained and, for water crossings, adequate vertical clearance over water ⁴ provided	UWS not recommended	Depending on severity, UWS not recommended or UWS with sacrificial thickness ⁶ recommended



Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.
- Move / Minimize / Eliminate Expansion Joints
- Select Corrosion Protection to Suit Service Environment
 - Weathering Steel – [NSBA Uncoated Weathering Steel Reference Guide, 2022](#)
 - *Single Coat IOZ Paint System* – [NSBA Single Coat Inorganic Zinc Protection for Steel Bridges, 2023](#)



NASA

‘Several of the original panels exposed in 1969, painted with a single coat of inorganic zinc without a topcoat, are still showing complete corrosion protection of the carbon steel at the BCTS’ (paper published in 2015).

Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.
- Move / Minimize / Eliminate Expansion Joints
- Select Corrosion Protection to Suit Service Environment
 - Weathering Steel – [NSBA Uncoated Weathering Steel Reference Guide, 2022](#)
 - Single Coat IOZ Paint System – [NSBA Single Coat Inorganic Zinc Protection for Steel Bridges, 2023](#)
 - *Other Corrosion Protection Systems* – [Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work, Helsel 2022](#)

Table 1A Estimated Time Before First Maintenance, Helsel 2022

	Coats / Mils	C2 - Mild	C3 - Moderate	C5 - Severe - I
Epoxy Zinc/Epoxy/Polyurethane	3 / 10	29	20	14
Organic Zinc/Epoxy/Polyurethane	3 / 7	27	18	13
Inorganic Zinc/Epoxy	2 / 7	26	18	14
Inorganic Zinc	1 / 3	21	15	5*
Metalizing (minimum 85% zinc)	1 / 8	33	22	16
Metalizing/Sealer	2 / 9	35	25	18
Hot Dip Galvanizing	NA / 4	100	90	72

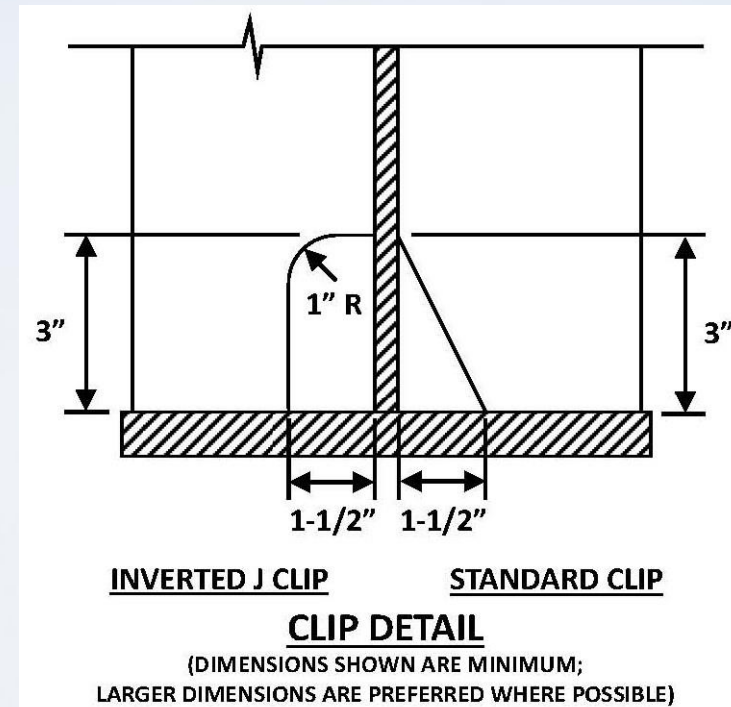
Prevent, Delay or Reduce

- Preservation starts with original design and will be
- Move / Minimize / Eliminate Expansion Joints
- Select Corrosion Protection to Suit Service Environment
- Design / Detail for Corrosion Protection
 - Access during fabrication / construction



Prevent, Delay or Reduce - Design

- Preservation starts with original design and will benefit from past experience.
- Move / Minimize / Eliminate Expansion Joints
- Select Corrosion Protection to Suit Service Environment
- Design / Detail for Corrosion Protection
 - Access during fabrication / construction
 - Drainage in service



Prevent, Delay or Reduce – In Service

- Maintenance – Routine or Preventative
 - *Cleaning* – [FHWA Bridge Preservation Guide, 2018](#)

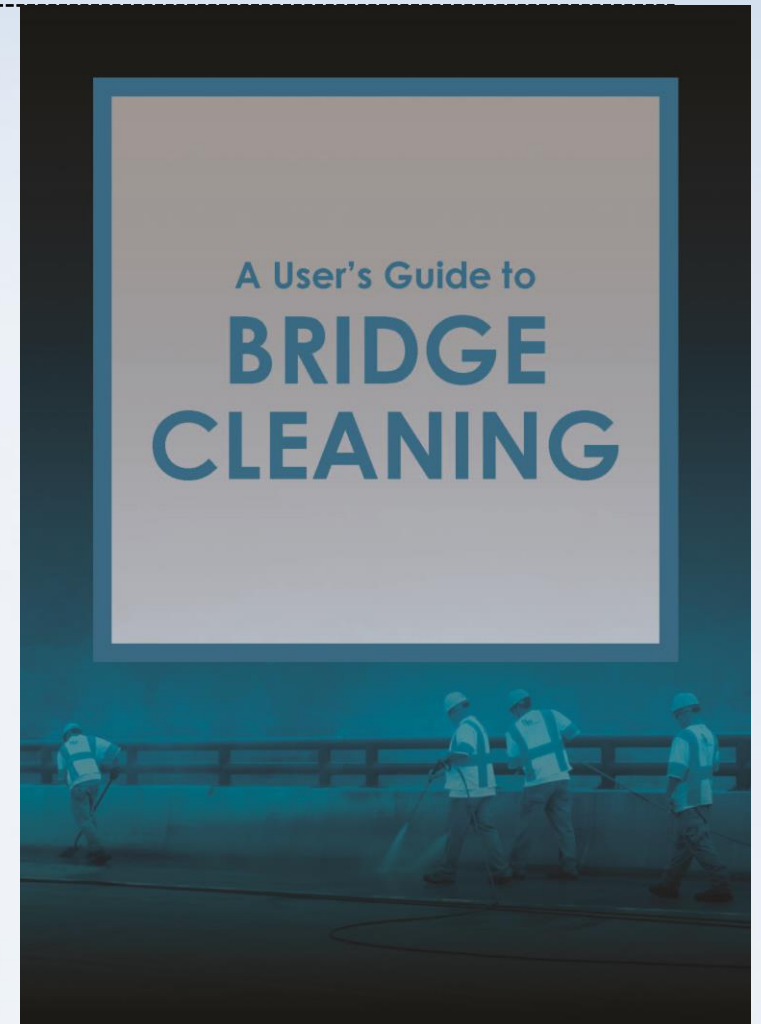
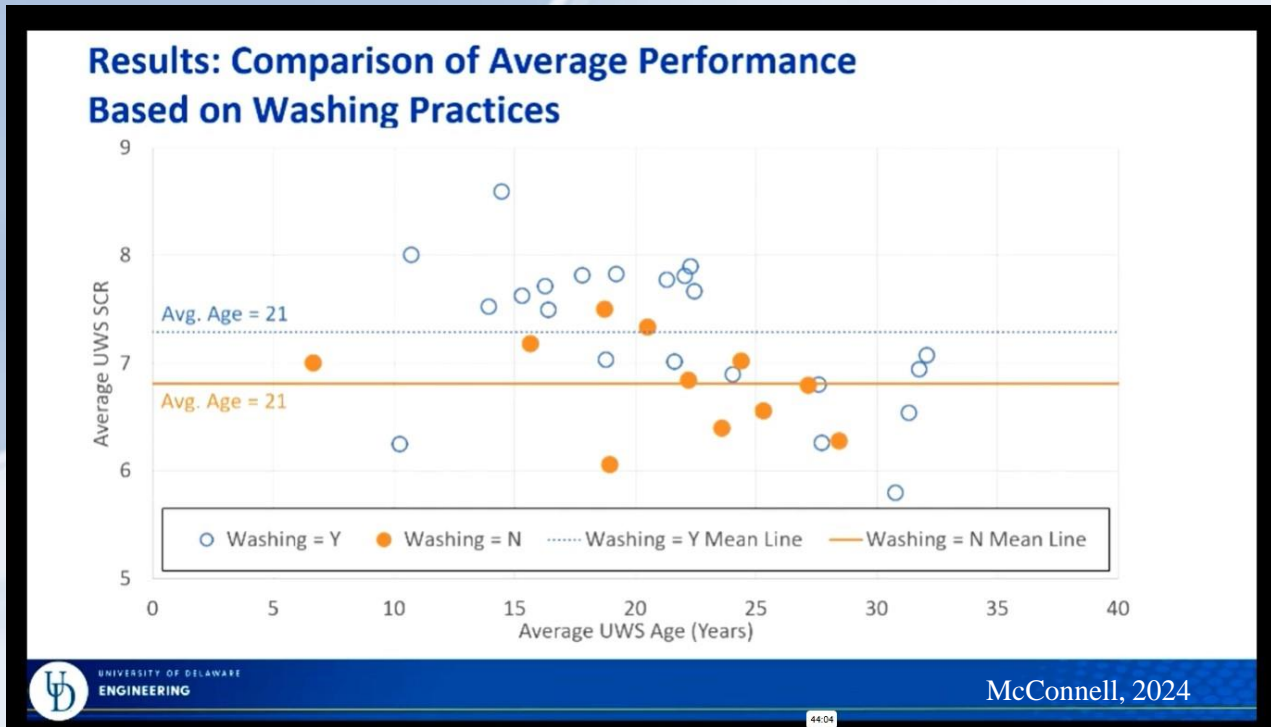
Table 4. Federal funds eligibility summary.

Action	Activities	Eligible for Federal Funds
Maintenance	Routine Maintenance	No
Preservation/Preventive Maintenance	Cyclical Maintenance	Yes
	Condition-Based Maintenance	Yes
Rehabilitation	-	Yes
Replacement	-	Yes



Prevent, Delay or Reduce – In Service

- Maintenance – Routine or Preventative
 - Cleaning – [FHWA Bridge Preservation Guide](#)
 - *Washing* – [TSP2 Pocket Guide, Users Guide to Bridge Cleaning](#)



Prevent, Delay or Reduce – In Service

- Maintenance – Routine or Preventative
- Preservation – Programmed or Condition Driven
 - *Expansion Joints* – [NCHRP 12-100, Guidelines for Maintaining Small Movement Bridge Expansion Joints, 2016](#)
– also AASHTO Guide

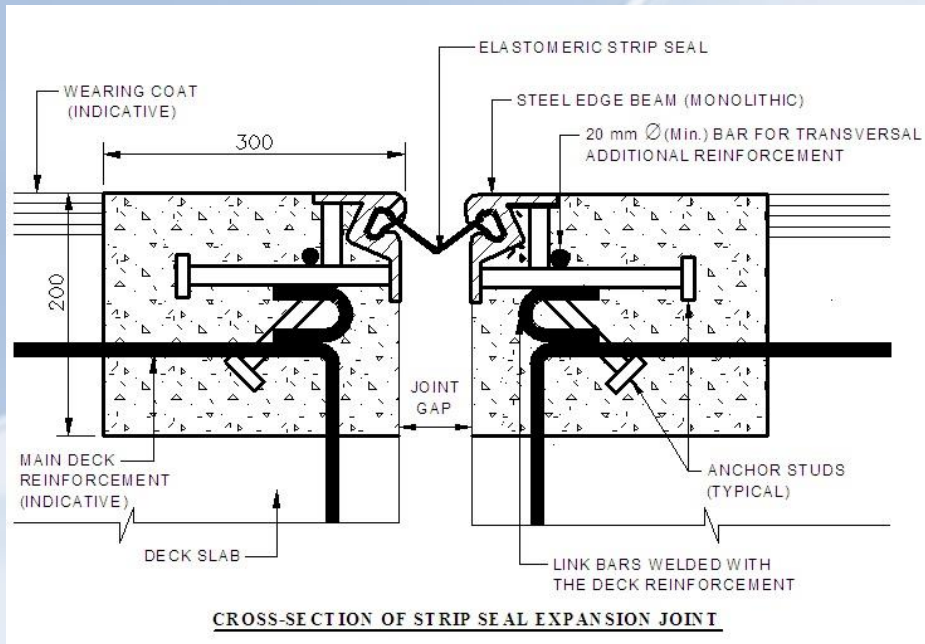
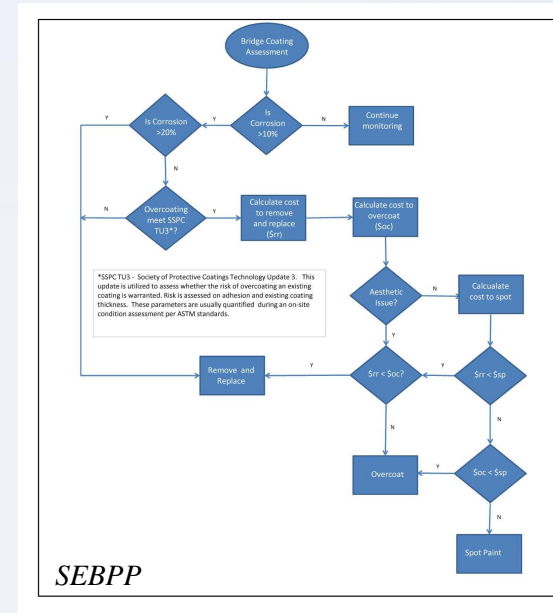


Table 7 Performance Metrics (NCHRP 12-100, 2016)

	Max Opening (in)	Joint Mvmt (in)	Expected Life (yrs)
Asphalt Plug joint	3	<1.5	7.5
Compression Seal	4.25	<2.5	10
Closed Cell Foam	4	<2-3	8.9
Open Cell Foam	4	<4	8
Inverted "V" & "M" type	4	<4	8
Strip Seals	4	<3-4	16
Pourable 2-part Silicon joint	3	<1	7.5

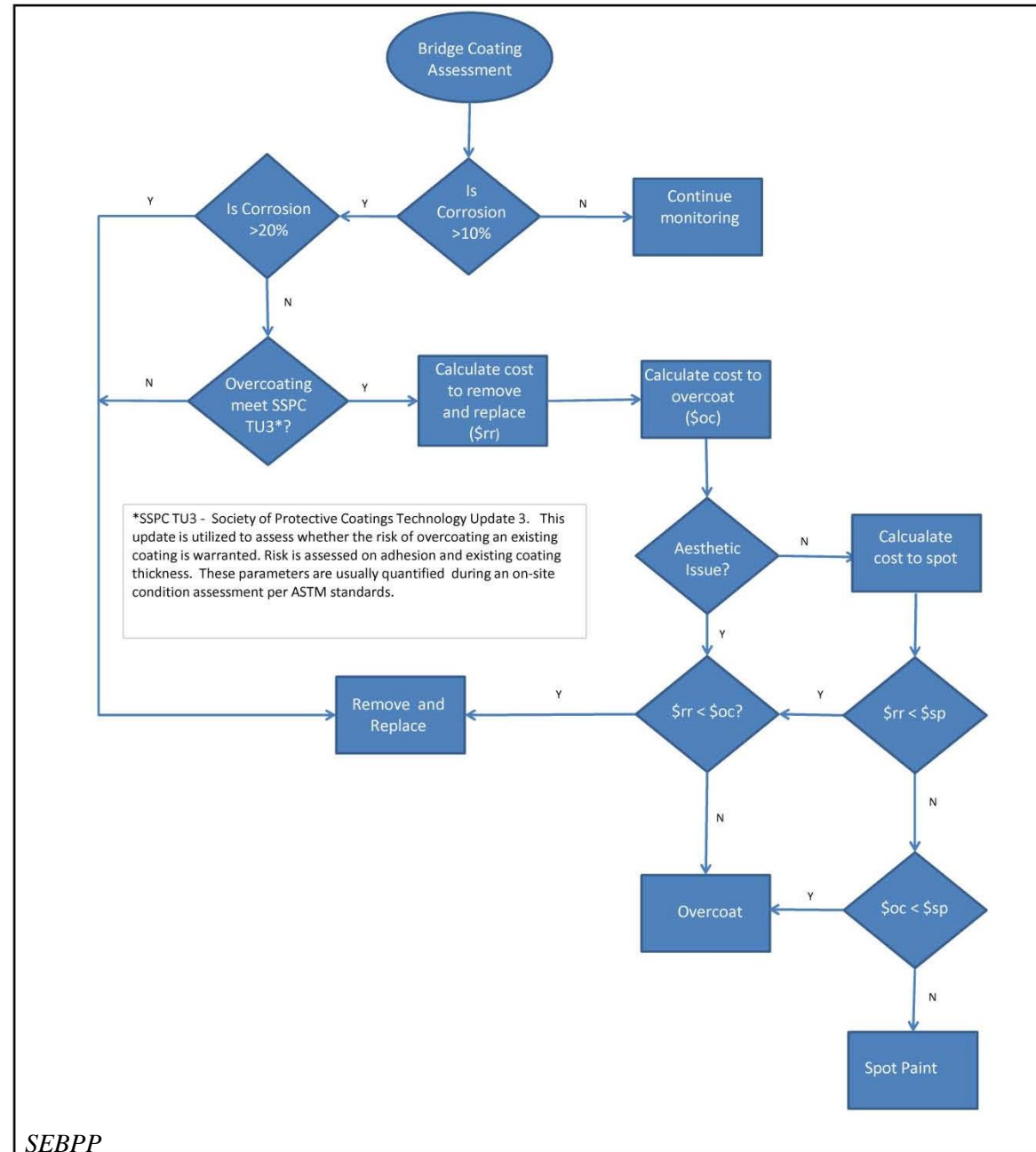
Prevent, Delay or Reduce – In Service

- Maintenance – Routine or Preventative
- Preservation – Programmed or Condition Driven
 - Expansion Joints – NCHRP 12-100, [Guidelines for Maintaining Small Movement Bridge Expansion Joints](#)– also AASHTO Guide
 - *Coatings* – [SEBPP A Rational Approach for Planning Steel Bridge Repainting Projects, 2014](#)



Prevent, Delay

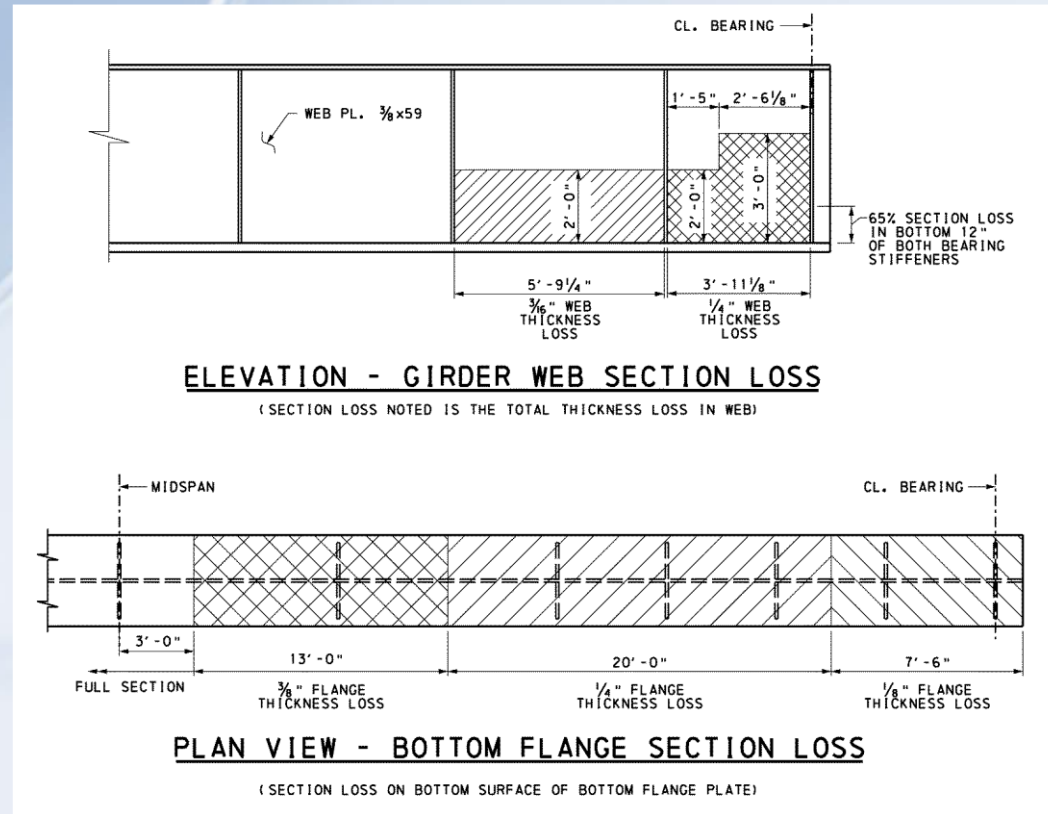
- Maintenance – Routine
- Preservation – Program
 - Expansion Joints – NCHRP 108, also AASHTO Guide
 - Coatings – SEBPP A Ratio



Expansion Joints—

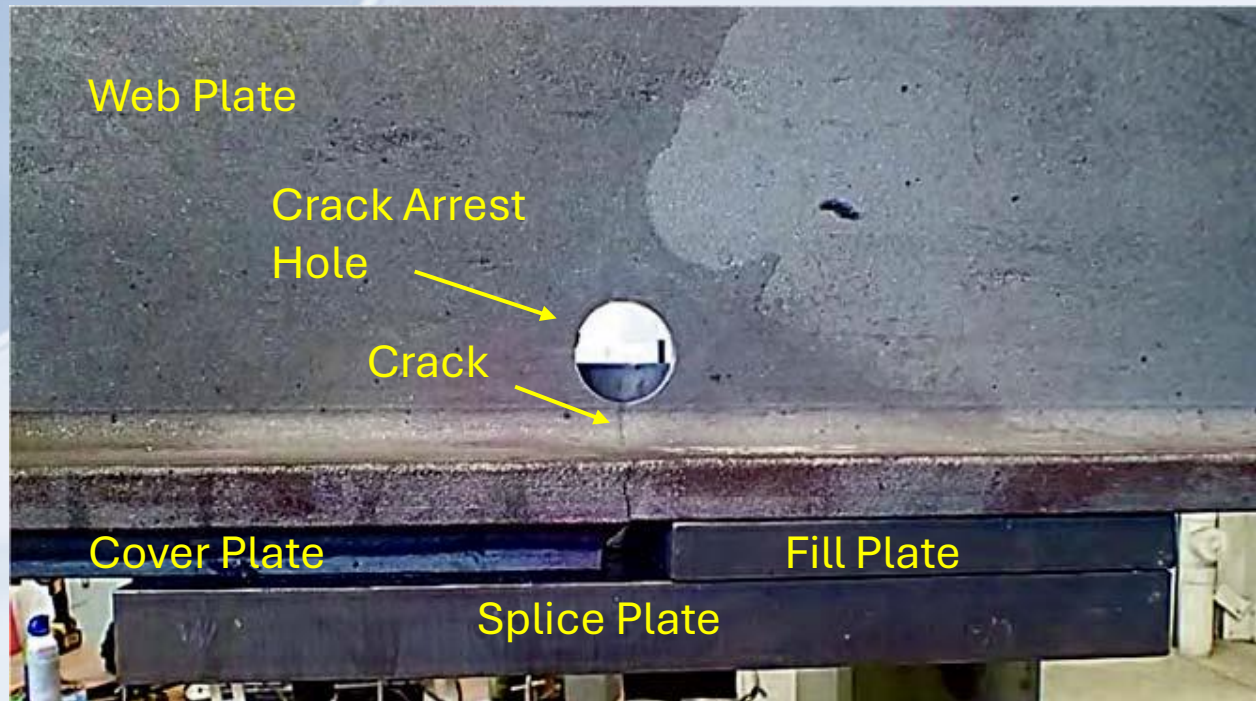
Restore Function

- Beams / Girders
 - *Cover Plates* – [FHWA Report on Techniques for Bridge Strengthening](#)



Restore Function

- Beams / Girders
 - Cover Plates – [FHWA Report on Techniques for Bridge Strengthening](#)
 - *Fatigue / Fracture Issues* – [Steel Bridge Collaboration G14.1, Maintenance Guidelines for Steel Bridges Addressing Fatigue Cracking and Details at Risk of Constraint-Induced Fracture, 2021](#)



Restore Function

- Beams / Girders
 - Cover Plates – [FHWA Report on Techniques for Bridge Strengthening](#)
 - Fatigue / Fracture Issues – [Steel Bridge Collaboration G14.1, Maintenance Guidelines for Steel Bridges Addressing Fatigue Cracking and Details at Risk of Constraint-Induced Fracture, 2021](#)
 - *Heat Straighten* – [FHWA Manual for Heat Straightening, Heat Curving and Cold Bending, 2023](#)
 - *See outdoor demo*



Restore Function

- Beams / Girders
- Beam / Girder End Corrosion
 - Cover Plates – [FHWA Report on Techniques for Bridge Strengthening](#)

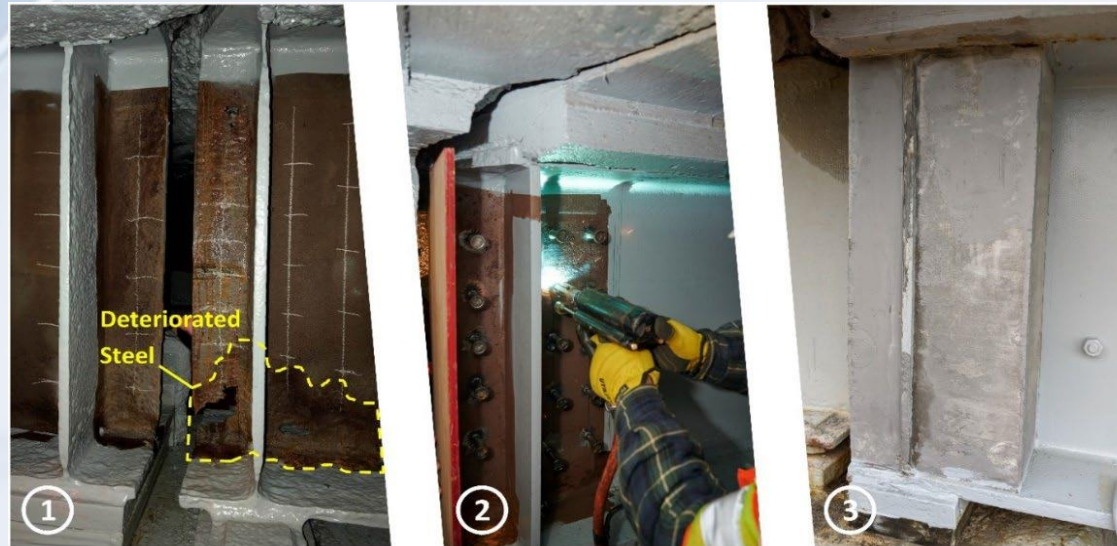
Restore Function

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- Beam / Girder End Corrosion
 - Cover Plates – [FHWA Report on Techniques for Bridge Strengthening](#)
 - *Replace* – some or all of beam end



Restore Function

- Beams / Girders
- Beam / Girder End Corrosion
 - Cover Plates – [FHWA Report on Techniques for Bridge Strengthening](#)
 - Replace – some or all of beam end
 - *Encase* - [Guidelines for the Utilization of UHP Concrete in the Rehabilitation of Steel Bridge Girder Ends](#)



All images: © 2020 Arash Zoghi, University of Connecticut

Restore Function

- Beams / Girders
- Beam / Girder End Corrosion
- Other – Steel Bridge Collaboration G14.2, Guidelines for Field Repairs and Retrofits of Steel Bridges, 2023

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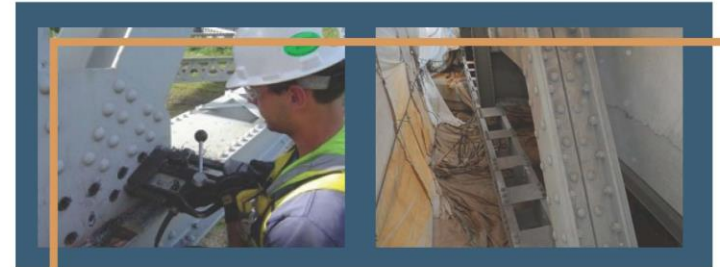
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Section 4 Strengthening

Section 5 Impact Repairs

Section 6 Bearings & Anchor Rods

Section 7 Damage Occurring During Construction



Guidelines for Field Repairs and
Retrofits of Steel Bridges
G14.2—2023



AMERICAN ASSOCIATION
OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS
AASHTO



AASHTO/NSBA STEEL BRIDGE COLLABORATION

American Association of State Highway
and Transportation Officials

National Steel Bridge Alliance

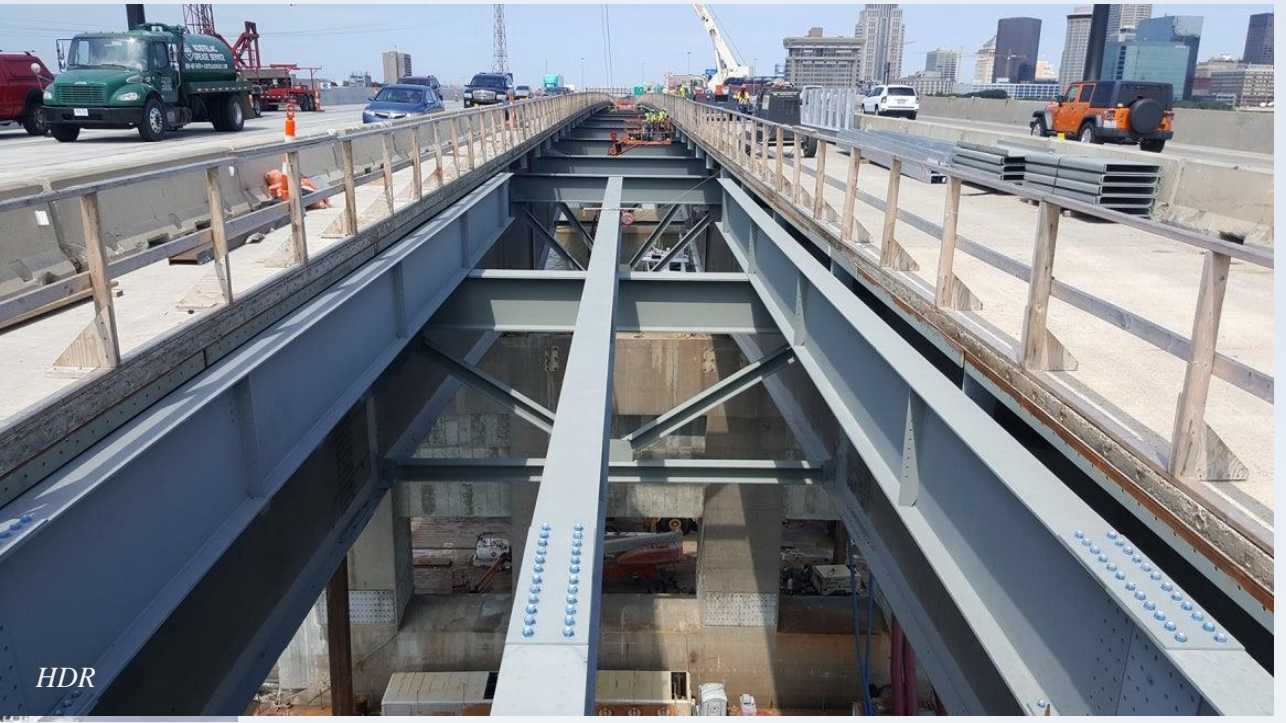
Extend Life

- Beams / Girders
 - *Strengthen* – [FHWA Report on Techniques for Bridge Strengthening, 2018](#)



Extend Life

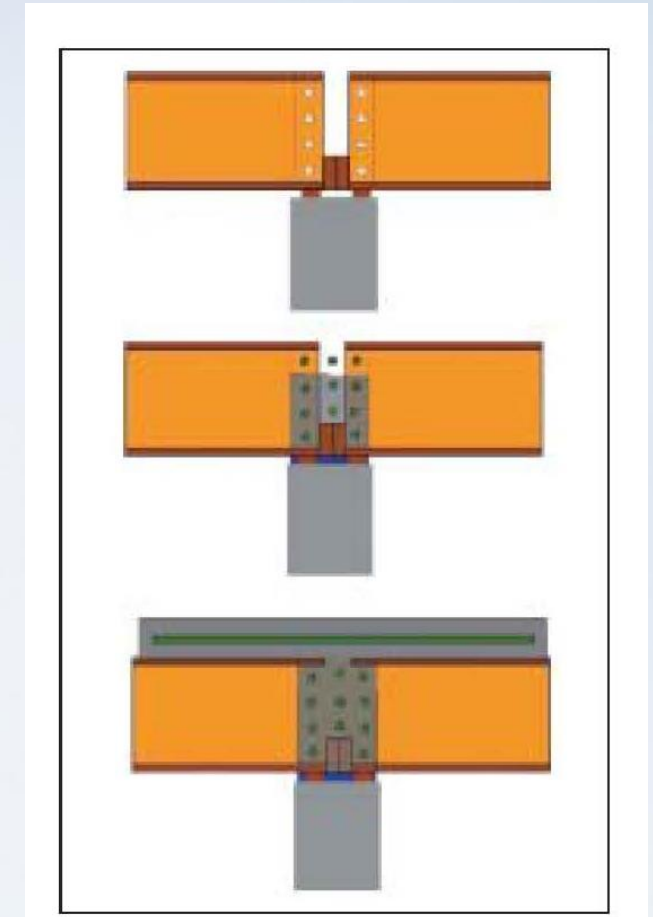
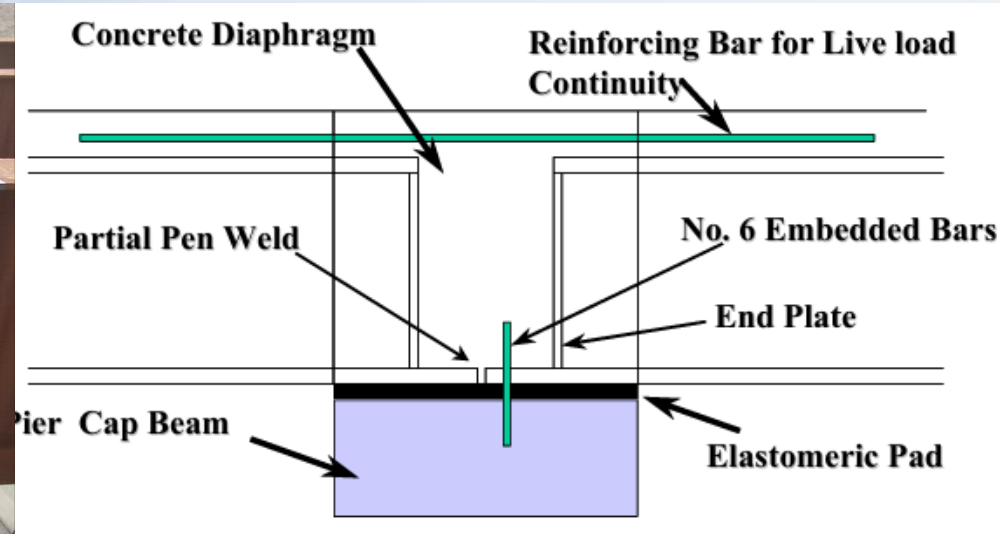
- Beams / Girders
 - Strengthen – [FHWA Report on Techniques for Bridge Strengthening, 2018](#)
 - Widen – [Poplar Street Bridge Rehabilitation and Widening](#)



Extend Life

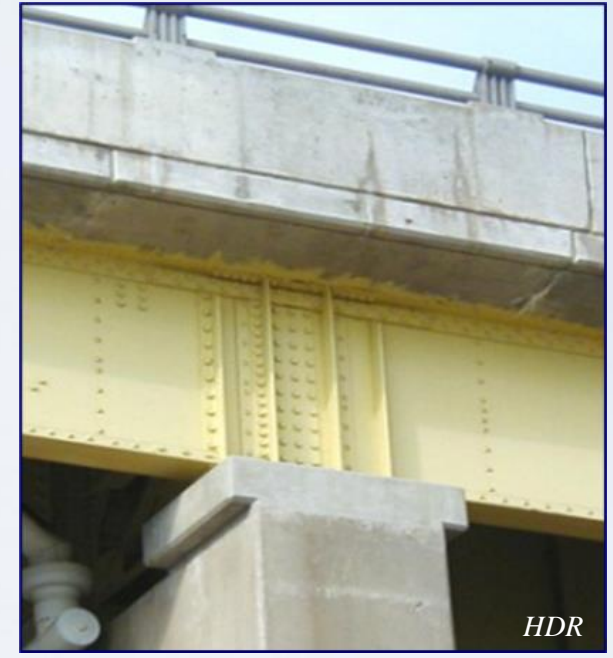
- Beams / Girders

- Strengthen – [FHWA Report on Techniques for Bridge Strengthening, 2018](#)
- Widen – [Poplar Street Bridge Rehabilitation and Widening](#)
- *Simple for DL, Continuous for LL* – [AISC Engineering Journal 2014](#)



Extend Life

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Extend Life

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- Widen – [Poplar Street Bridge Rehabilitation and Widening](#)
- *Simple for DL, Continuous for LL* – [AISC Engineering Journal 2014](#)
- *Reclassify Non-Redundant Steel Tension Member to System Redundant Member* – [Implementation of Redundancy Terms Under 2022 NBIS](#)
 - *Thursday morning session w/ Dr. Rob Connor*



Extend Life - Repurpose

- Oklahoma I-40 Crosstown Expressway



BOB ALBRIGHT



DOUG HOKE / THE OKLAHOMAN

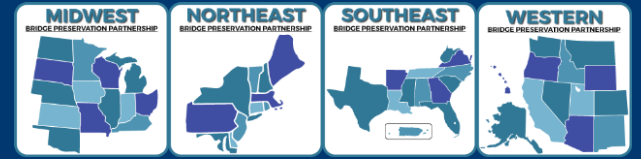
Extend Life - Repurpose

- [Oklahoma I-40 Crosstown Expressway](#)
- [Ohio Salvaged Steel Program](#)



Short Span Steel Bridge Alliance

???



Thank You

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