Bridge Preservation & Maintenance

2024 NTRM Symposium

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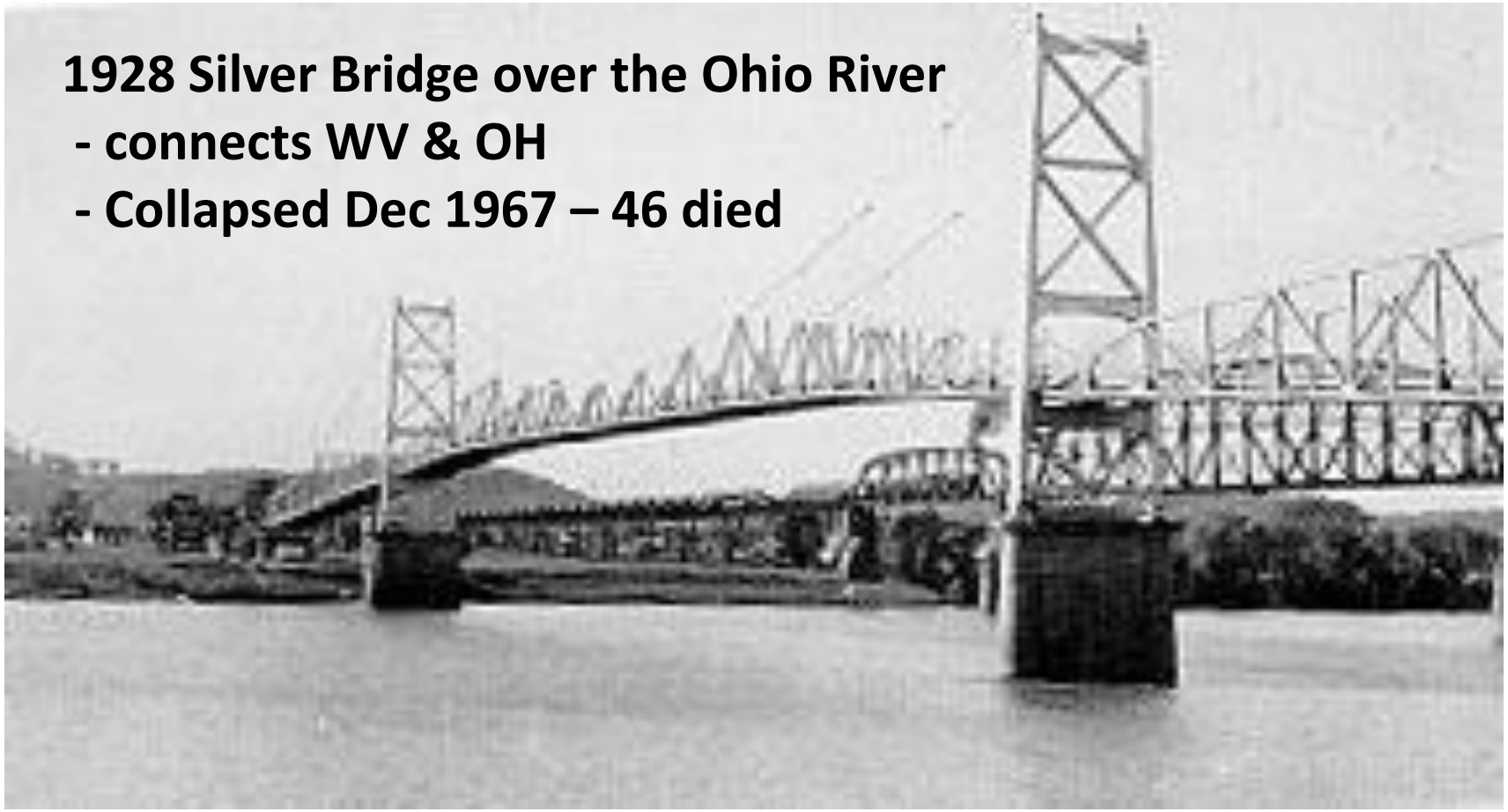
NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

History


1928 Silver Bridge over the Ohio River
- connects WV & OH
- Collapsed Dec 1967 – 46 died

History

Silver Bridge collapse
Dec. 15, 1967

https://www.fhwa.dot.gov/highwayhistory/national_bridge_inspection_standards.cfm

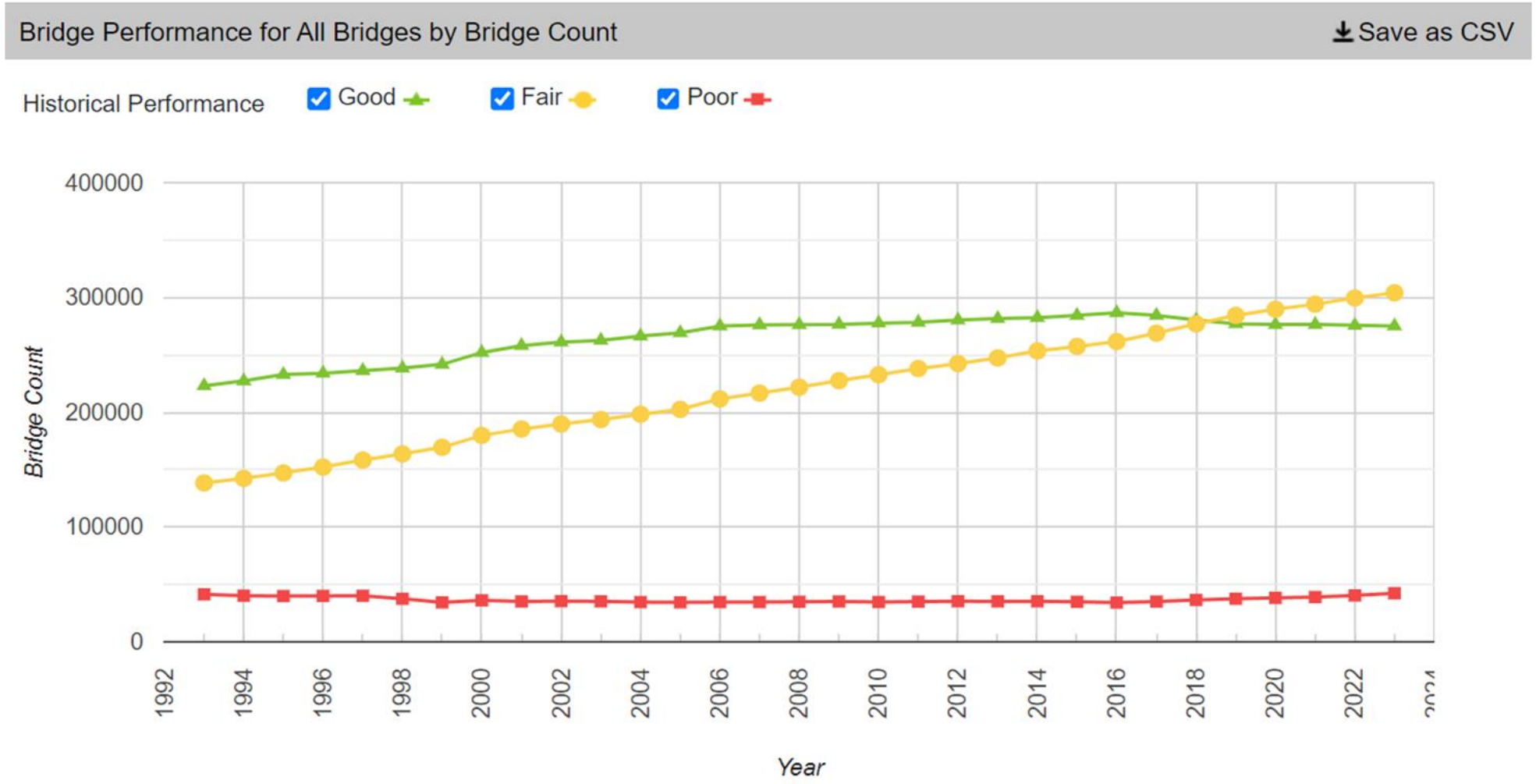
Daily Commutes

- Work Commute
  - Average is 41 miles, to/from
- If there is a bridge every 5 miles, you are crossing a bridge 8 times per day one way and maybe do not even realize it.

Asset Management

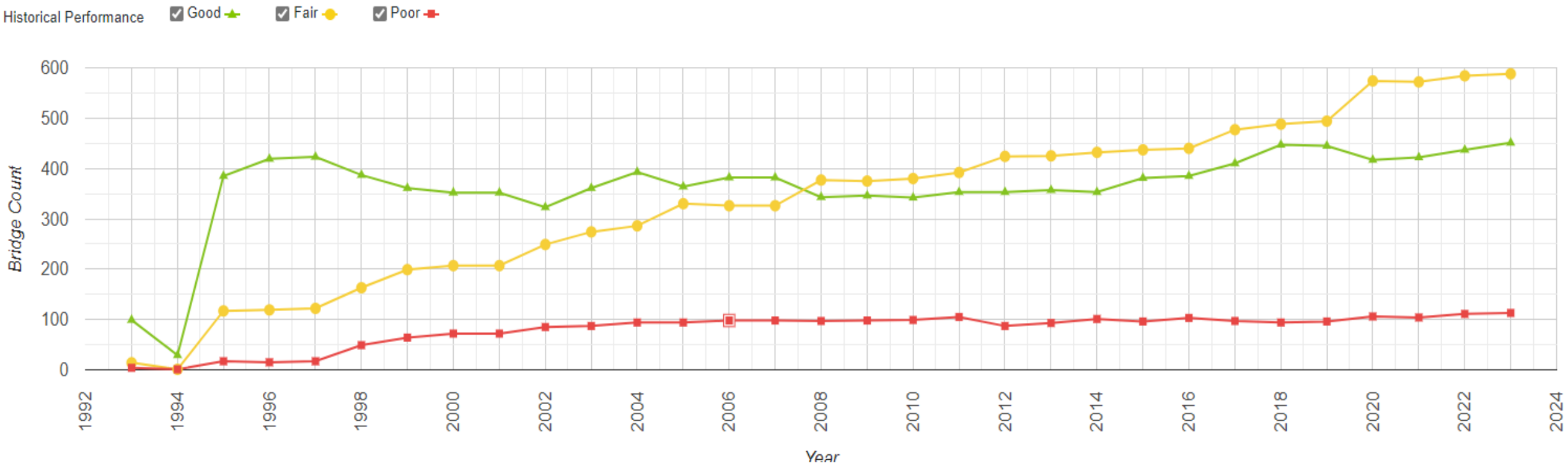
- Approximately 1,152 bridges (=> 20’) owned by a Tribe or BIA
- Bridges are expensive and Large Asset for any agency

All Bridge Conditions in US



Source: https://infobridge.fhwa.dot.gov/Data/Dashboard

Tribal or BIA Owned Bridge Conditions in US

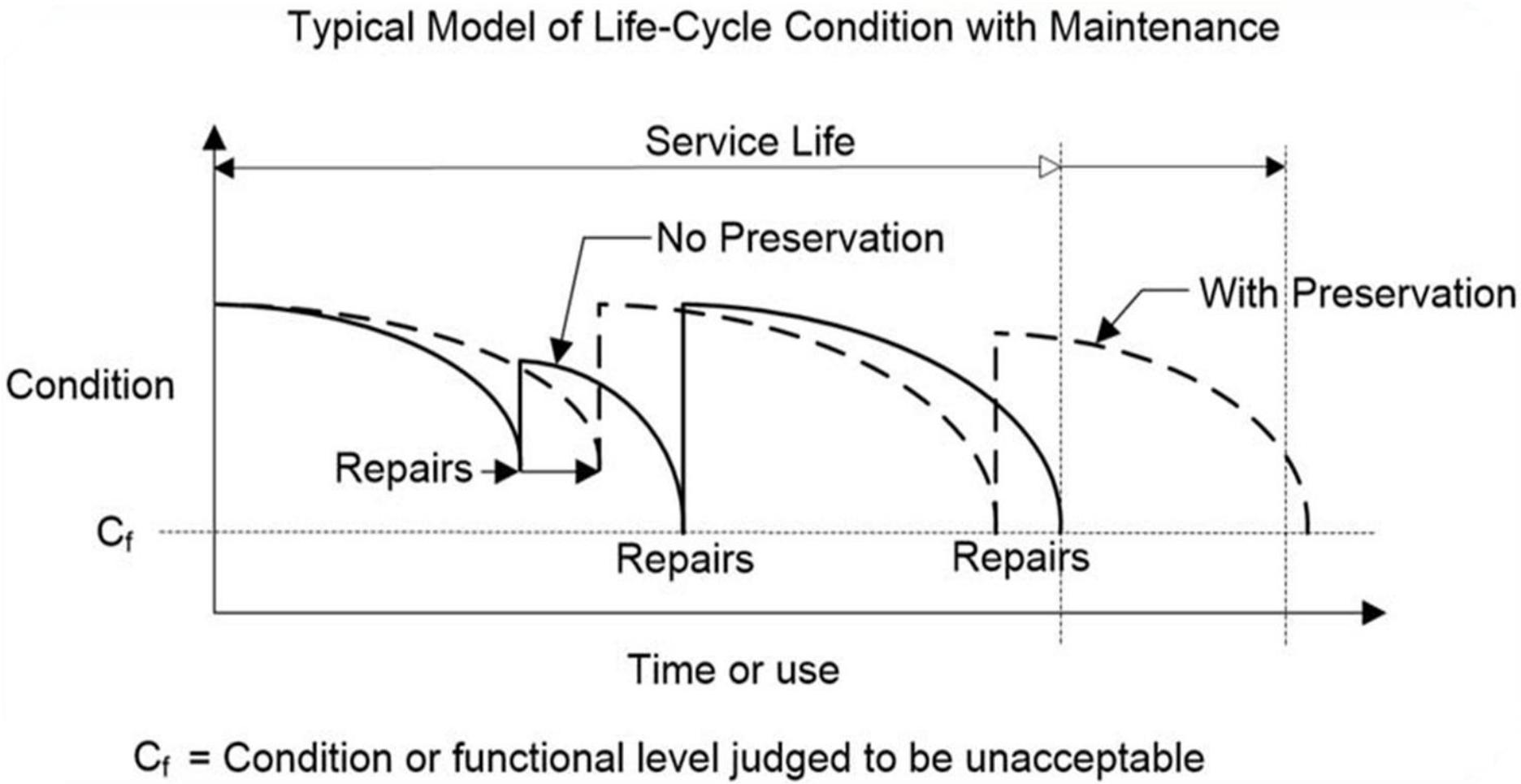


Source: https://infobridge.fhwa.dot.gov/Data/Dashboard

Design Life

- House
  - 50 to 60 years
- Vehicle
  - up to 200K miles
- Roadway
  - 20 to 30 years
- Bridges
  - 75 to 100 years
  - Previously it was 50 years

Example of Life Cycle Cost



Preservation/Maintenance

- Actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements
- Restore the function of existing bridges
- Keep bridges in good condition
- Extend their useable life
- Keeps bridges in service w/o modification to bridge capacity, design type, material, or function

Preservation/Maintenance - Benefits

- Reduce agency costs
  - Extends the useable service life
  - Can avoid or delay major repairs or rehabilitation
- Reduce user costs
  - Detours
    - Closures – repairs or rehabs or early replacement
    - Load carrying issues
- Hopefully avoid a complete Failure

Preservation/Maintenance - Candidates

- Things to consider
  - Bridge condition
    - New, good, and fair
    - What about poor bridges?
  - Bridge material
  - Route or classification of road
  - Load carrying capacity
  - Cost

Preservation/Maintenance - Components

- Deck
- Bearings
- Superstructure
- Substructure
- Bridge/Guard rail
- Approach panels
- Scour/Drainage
- Miscellaneous

Deck

- Material Type
  - Concrete
  - Timber
  - Asphalt
  - Steel – not covered

Deck

- Clean – annually or more if needed
  - Sweep or clear vegetation and debris from the deck
  - Flush or wash the bridge deck
  - Open up drains

Deck – Concrete (Cracks)

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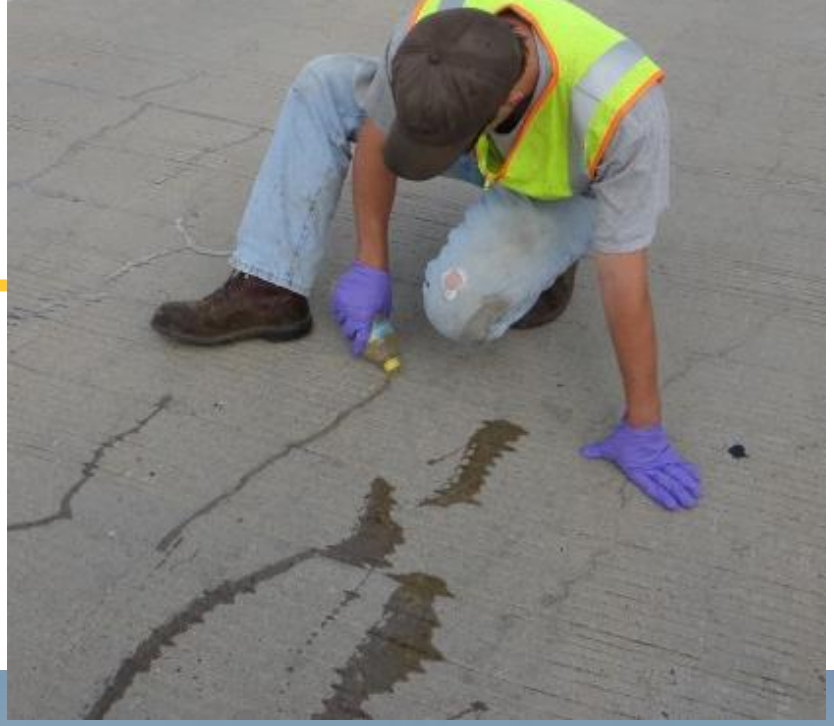

Deck – Concrete (Cracks)

- Prior to crack sealing
  - Delamination survey depending on bridge deck age
  - Look at spall repairs, etc. if needed
- Crack sealers (MNDOTS approved crack sealers)
  - Paulco TE-2501 (MNDOT and NDDOT)
  - Dural 50 LM (MNDOT)
  - TK-9000 (MNDOT)
  - TK Products TK 2110 (MNDOT and NDDOT)

Deck – Concrete (Seal entire deck)

- Silanes (40% or 100%)
- Epoxy Resins
- Healer/Sealers

Deck – Concrete (Silanes)

- Consistency similar to water
- Applied with a spray bar or garden sprayer

Deck – Concrete (Silanes)

- Silanes (MNDOTS approved Silanes)
  - MasterProtect H 440HZ
  - TK - Tri - Silane 590 – 40
  - Certi-Vex Penseal 244 40%
  - Protectosil CHEM-TRETE 40 VOC
  - TK Products TK 590-100 (MNDOT and NDDOT)
  - Protectosil BHN
  - BASF MasterProtect H 1000 (NDDOT)
  - Advanced Chemical Technologies SIL-ACT ATS-100 (NDDOT)
  - Evonik Protectosil 300S (NDDOT)

Deck – Concrete (Epoxy or MMA Resins Overlays)

- Mix components together
- Spread over the deck
- Aggregate placed over and embedded into resin

Deck – Concrete (Epoxy or MMA Resins Overlays)

- Epoxy (polymer) Resins (SDDOT Approved products)
  - CIS PRECISION Epoxy Binder
  - E-Bond 526
  - EP50 – Overlay
  - EPX50
  - Sikadur 22 Lo-Mod FS

Deck – Concrete (Healer Sealers)

- Some chemically bond to concrete, expands when it comes in contact with water to fill cracks

Deck – Concrete (Healer Sealers)

- Products
  - BridgeDECK Protectant (non epoxy or MMA)
  - Various Epoxy/MMA products

Deck – Spall Repair Material

- Material for Spall Repair on concrete (NDDOT Approved Material)
  - Ceratec Pavemend VR
  - SpecChem RepCon V/O
  - Sika SikaQuick VOH
  - BASF MasterEmaco N425

Deck – Joints

- Ideal Deck Joint
  - Watertight
  - Accommodates full range of movement
  - As durable as the deck
  - Low maintenance

Deck – Joints

- Common Problems
  - Poor bond or seal damage allowing water & debris to enter
    - Damages concrete edges and substructure below

Deck – Joints (Abutment/Pier Caps)

- Silanes (MNDOTS approved Silanes)
  - MasterProtect H 440HZ
  - TK - Tri - Silane 590 – 40
  - Certi-Vex Penseal 244 40%
  - Protectosil CHEM-TRETE 40 VOC
  - TK Products TK 590-100 (MNDOT and NDDOT)
  - Protectosil BHN
  - BASF MasterProtect H 1000 (NDDOT)
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Deck – Joints

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Deck – Drains

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Deck

Deck - Timber

- Look for damage and gaps

Deck - Timber

- Add Longitudinal runners to protect deck

Deck – Asphalt over Concrete

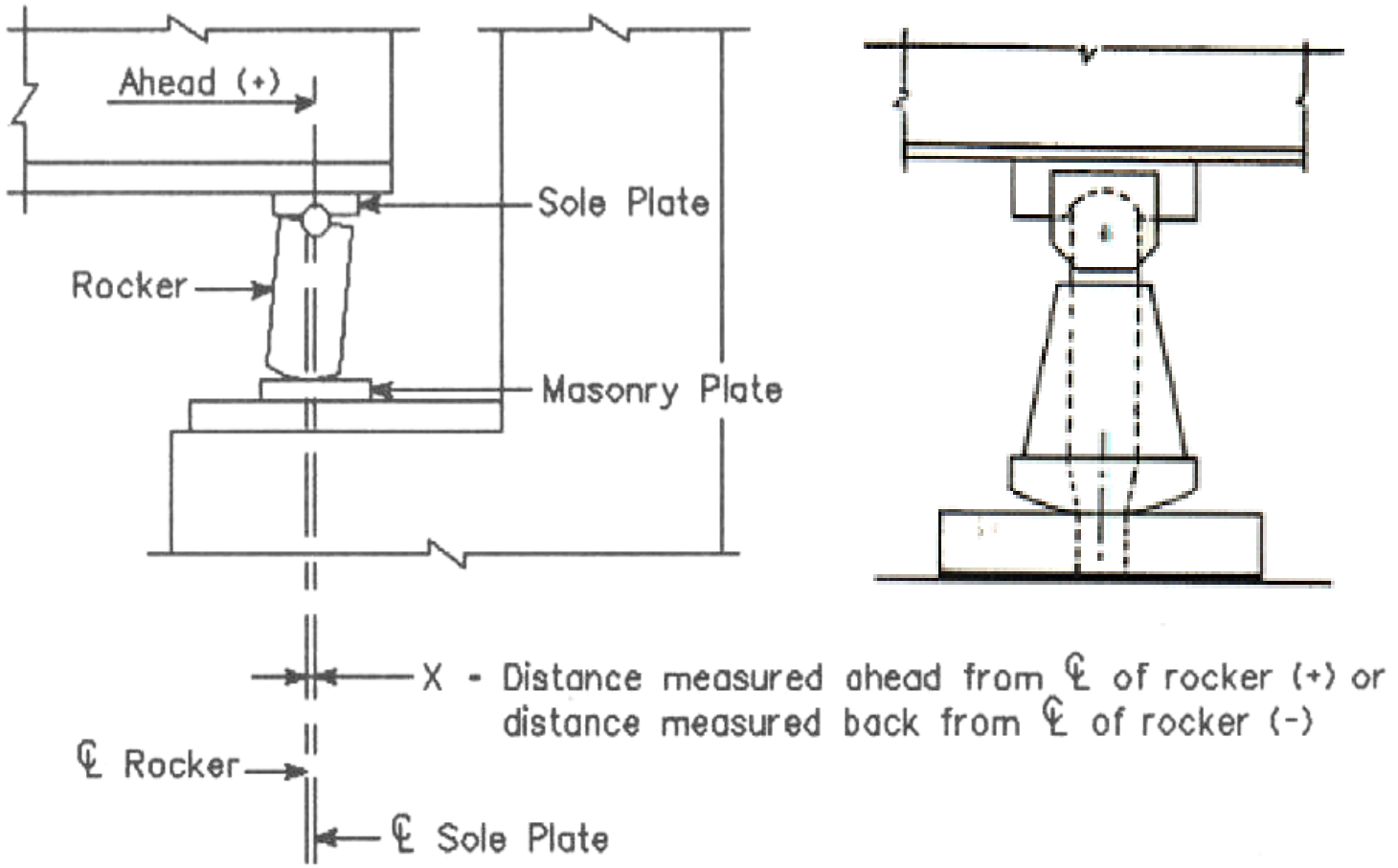
Deck - Asphalt

Deck - Asphalt

- Bonding issues
- Trap chlorides

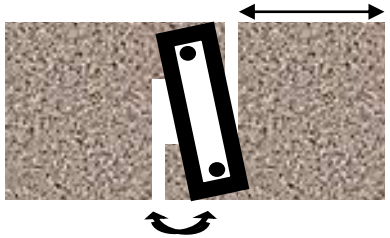
Bearings

- Position is important

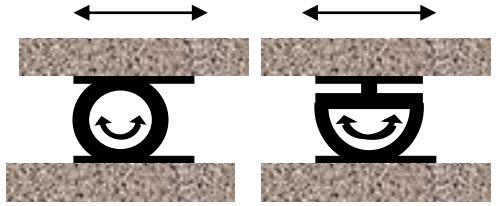


Bearings

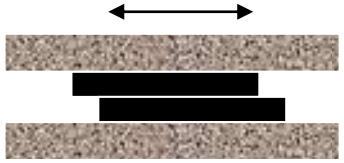
- Type of bearings



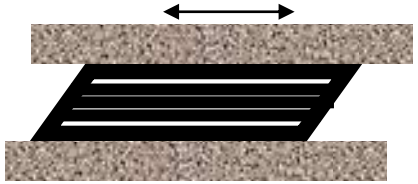
Swinging



Rolling/Rocking



Sliding



Stretching

Bearings

Bearings

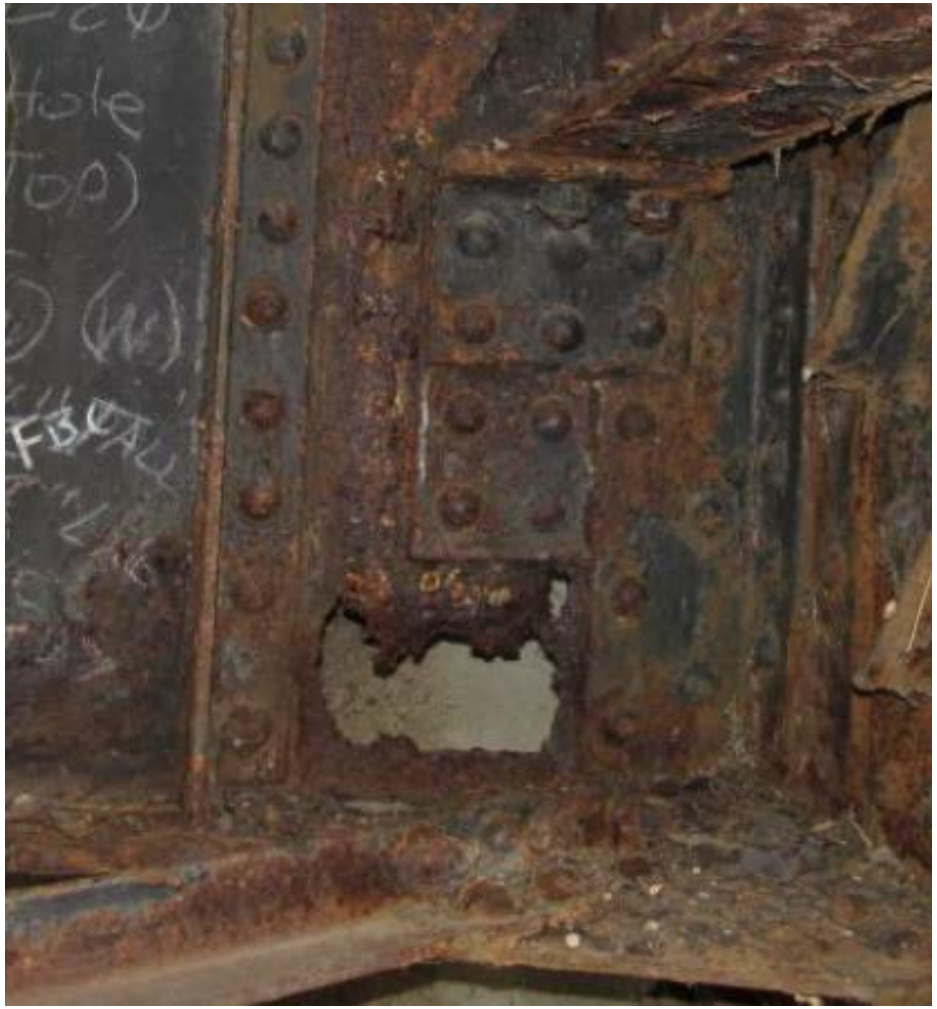
Bearings

- Lubrication of Bearing
  - Ultimate Penetrating & Lubricating Oil
  - LE, Inc. Pyroshield 5100 Syn Open Gear Grease

Superstructure

- Steel
- Concrete
- Timber

Superstructure



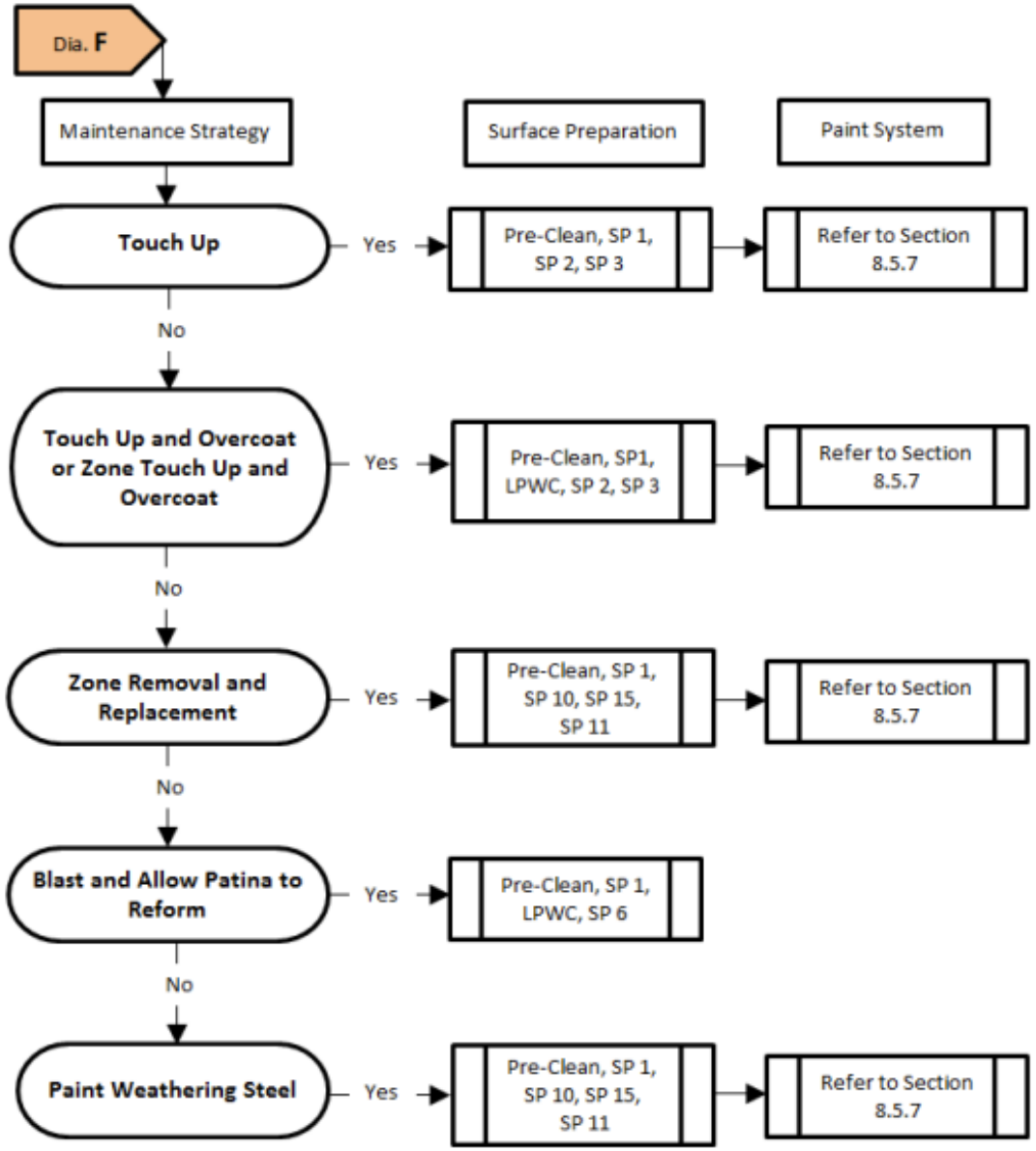
Superstructure

Superstructure

Superstructure

- Painting Steel – Surface Prep

8.5.6 DIAGRAM F: SURFACE PREPARATION AND PAINT SYSTEM



Refer to Section 8.5.8 for the maintenance procedures for each strategy.

Superstructure

- Painting Steel

8.5.7 COATING SYSTEM OPTIONS

Maintenance Painting Strategy	Substrate Condition	1ST Coat (Primer)	2ND Coat	3RD Coat	Finish Coat Option
Touch Up	Pack Rust and Crevice Corrosion Remains	EPS	Epoxy Aluminum	Polyurethane	Acrylic, Waterborne
	Tightly adhered rust, paint and mill scale	Epoxy Aluminum	Polyurethane		Acrylic, Waterborne
Touch Up and Overcoat or Zone Touch Up and Overcoat	Pack Rust and Crevice Corrosion	EPS	Epoxy Aluminum	Polyurethane	Acrylic, Waterborne
	Tightly adhered rust and mill scale	Epoxy Aluminum	Polyurethane		Acrylic, Waterborne
	Adhered existing coating	Compatible tie-coat	Polyurethane		Acrylic, Waterborne
Zone Removal and Replacement*	Near white abrasive blast cleaned	Epoxy Zinc Rich	Epoxy	Polyurethane	Acrylic, Waterborne
		Zinc Rich MCU	MIO MCU	Polyurethane	Acrylic, Waterborne
	Tie-in to Existing Coating	Compatible tie-coat	Epoxy	Polyurethane	Acrylic, Waterborne
			MIO MCU	Polyurethane	Acrylic, Waterborne or MCU
Paint Weathering Steel	Initial Painting, Commercial Blast Cleaned	Corrosion inhibitive epoxy	Epoxy	Polyurethane	Acrylic, Waterborne or MCU
		MIO MCU	MIO MCU	Polyurethane	Acrylic, Waterborne or MCU

*Bridge Structural Steel Coating Systems for removal and replacement are available on the MnDOT Approved Products List (APL) web site for Bridge Structural Steel Coatings.

Superstructure – Painting Steel

Three Coat Systems - Organic

Manufacturer	Primer	Intermediate Coat	Finish Coat	Corrosion Inhibiting Penetrating Sealer *	Paint Supplier's Recommended Caulk	Approval Date
PPG/PMC Amercoat	Amercoat 68 HS	Amercoat 385 Multi-Purpose	Amercoat 450 HSG	-	Sikaflex 1	6/2009
Carboline Co.	Carbozinc 859	Carboguard 893	Carbothane 133 VOC	-	Vulkem	4/2015
Sherwin Williams	Zinc Clad III HS	Macropoxy 646	Acrolon 218 HS	Macropoxy 5000	Loxon H1 Hybrid Sealant or 3M 730 Clear	11/2005
Sherwin Williams	Zinc Clad IV	Recoatable Epoxy B67 Series	Acrolon 218 HS	Macropoxy 5000	Loxon H1 Hybrid Sealant or 3M 730 Clear	3/2001
International Paint	Interzinc 315B	Intergard 475HS	Interthane 870UHS Semi-Gloss	-	NA	4/2010

**This is to be used for pack rust mitigation areas after proper cleaning according to special provision.*

Source: https://www.dot.state.mn.us/products/paint/bridgestructuralsteelcoating.html

Superstructure – Painting Steel

Three Coat Systems - Inorganic

Manufacturer	Primer	Intermediate Coat	Finish Coat	Paint Supplier's Recommended Caulk	Approval Date
PPG/PMC Amercoat	Dimecote D-9H	Amercoat 385 Multi-Purpose	Amercoat 450 HSG	Sikaflex 1	6/2009
Carboline Co.	Carbo Zinc 11 HS	Carboline 893	Carboline 133 HB	Vulkem	12/1995
Sherwin Williams	Zinc Clad II Plus	Macropoxy 646	Acrolon 218 HS	Loxon H1 Hybrid Sealant or 3M 730 Clear	4/2003
Sherwin Williams	Carbo Zinc 11 HS**	Macropoxy 646	Acrolon 218 HS	Loxon H1 Hybrid Sealant or 3M 730 Clear	6/2006
Sherwin Williams	Carbo Zinc 11 HS **	Recoatable Epoxy Primer	Acrolon 218 HS	Loxon H1 Hybrid Sealant or 3M 730 Clear	2/2009
International Protective	Interzinc 22 HS IOZ Silicate	Intergard 475 HS Epoxy	Interthane 870 Polyurethane	NA	4/2006
ICI-Devoe	Catha-Coat 304V	Bar-rust Epoxy 231	Devthane Urethane 379UVA	NA	10/2006

***MnDOT has approved this system based on satisfactory laboratory testing which has shown compatibility of the primer with the topcoats. Contact Allen Gallistel for laboratory testing requirements.*

Source: https://www.dot.state.mn.us/products/paint/bridgestructuralsteelcoating.html

Superstructure – Painting Steel

Moisture Cure Urethane ***

Manufacturer	Primer	Intermediate Coat	Finish Coat	Paint Supplier's Recommended Caulk	Approval Date
Polyval - Xymax Coatings	MonoZinc ME III Moisture Cure Primer	MonoFerro PUR Moisture Cure	Bridge Finish	NA	3/2001
Sherwin Williams	Corthane I GalvaPac Zinc	Corothane I - Iron Ox B	Corothane Iron Ox A HS	Loxon H1 Hybrid Sealant or 3M 730 Clear	4/2003

*** *Systems may be different for overcoating*

Source: https://www.dot.state.mn.us/products/paint/bridgestructuralsteelcoating.html

Superstructure

Superstructure

Superstructure

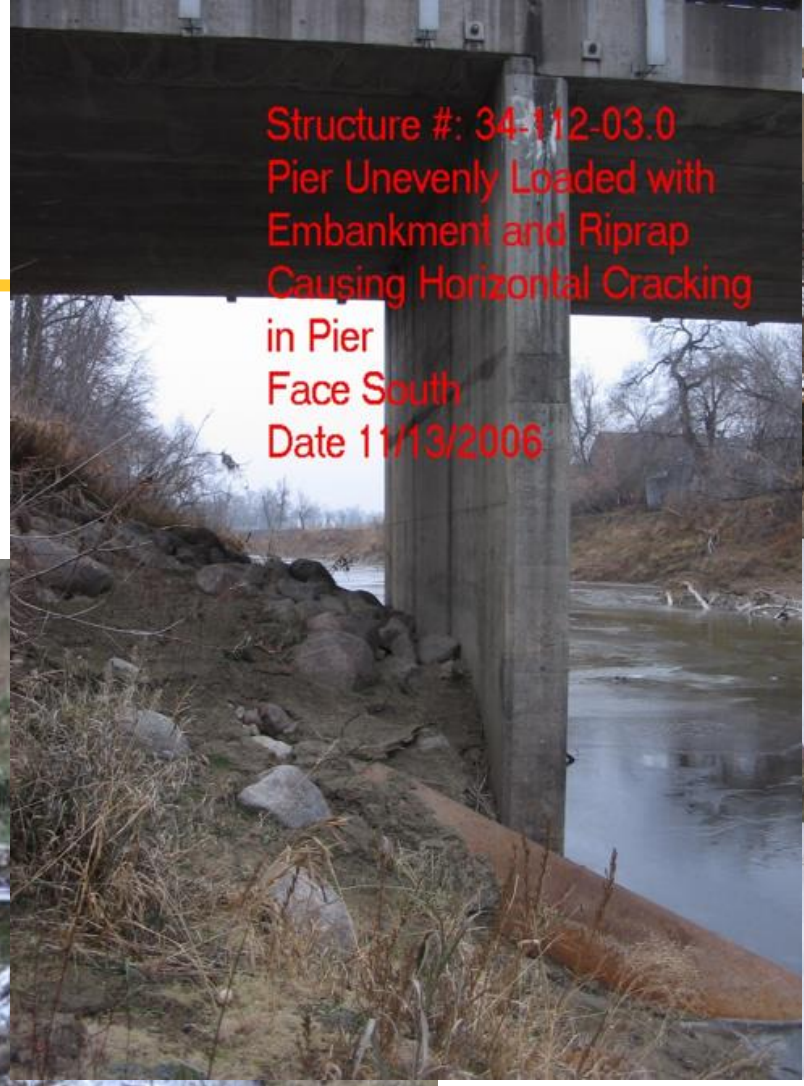
Superstructure

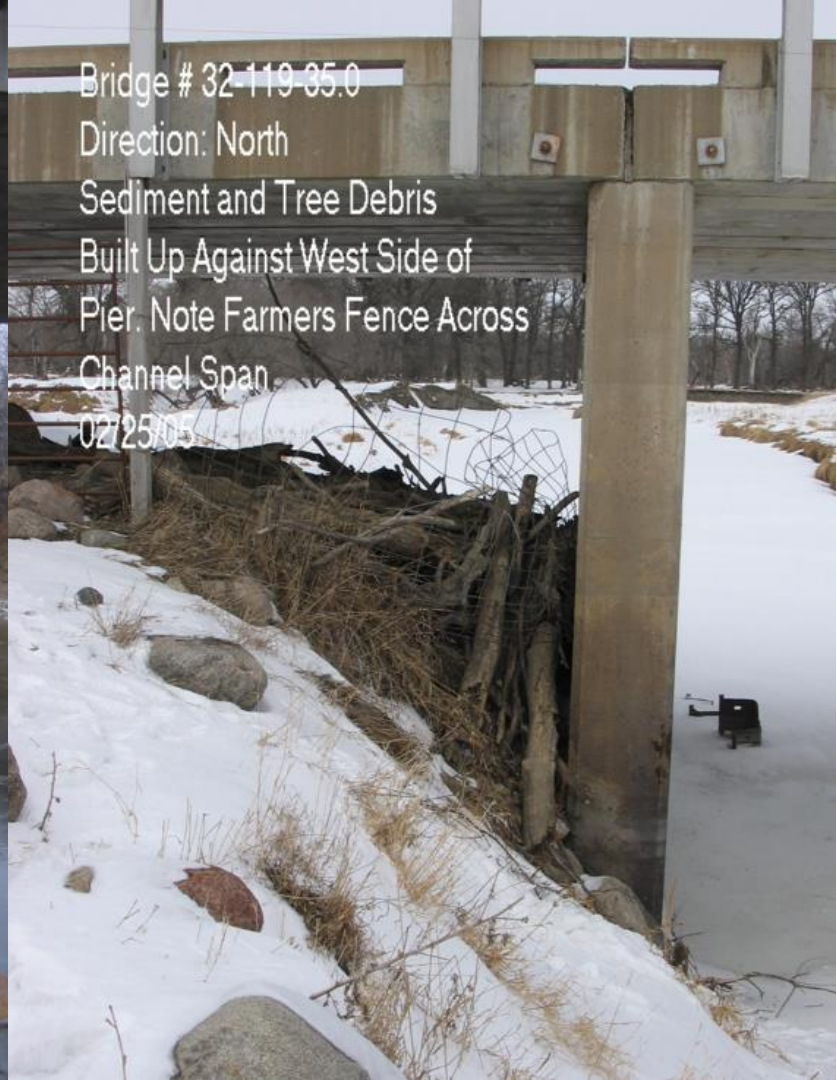
- Treat exposed areas with:
  - Tenino Copper Naphthenate
  - “Roof coatings”

Substructure

- Concrete
- Timber

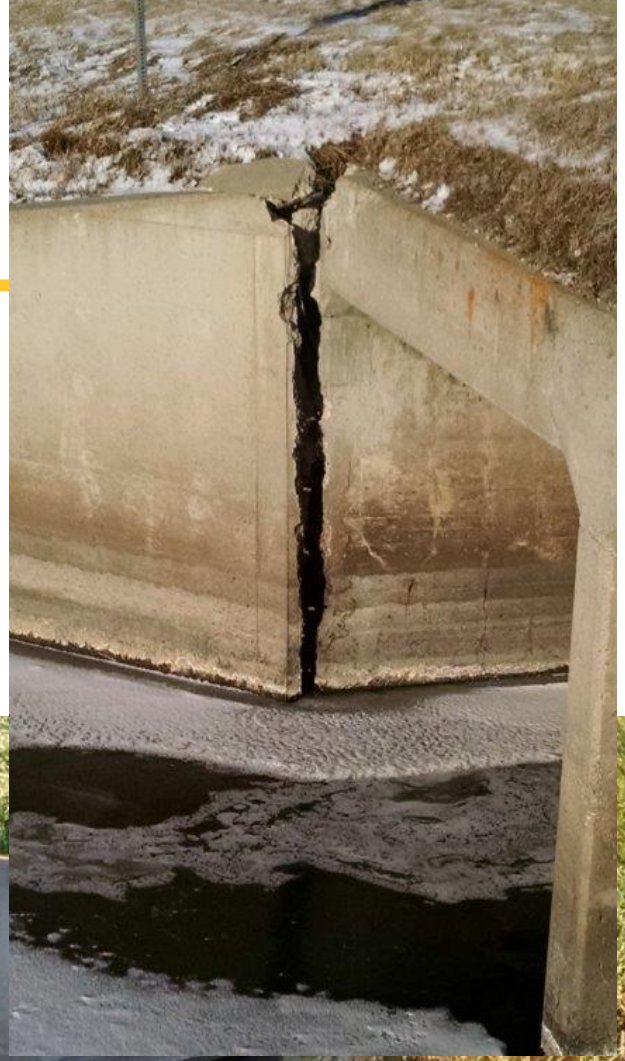
Substructure





Substructure

Substructure



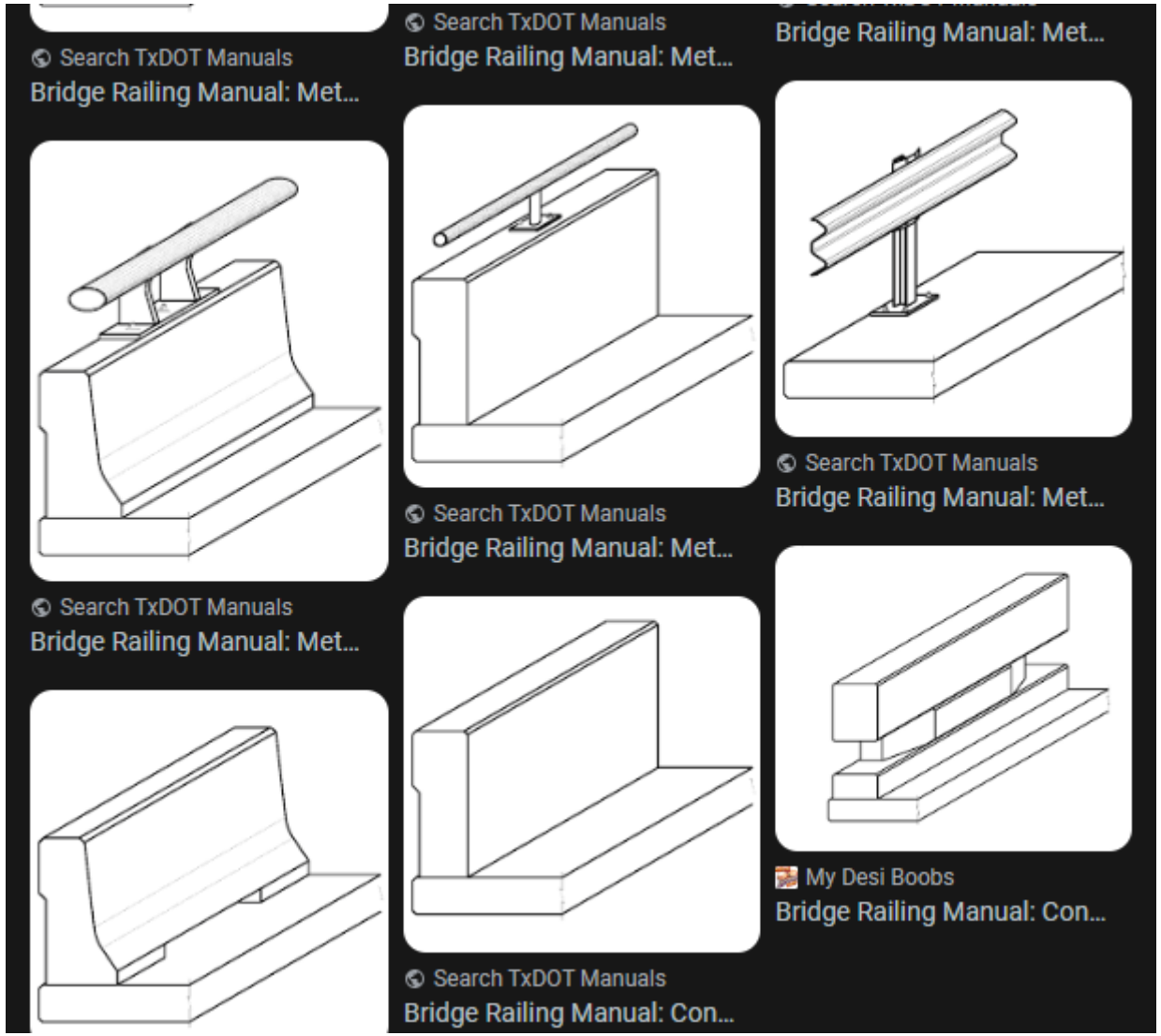
Substructure

Substructure

Bridge Rail & Guardrail

Bridge Rail & Guardrail

Bridge Rail & Guardrail



Bridge Rail & Guardrail

- Guardrail at correct height?
  - MSG system (28”-31”)
  - If >33” or <28”, look at adjusting
  - Older system, <26.5”, adjust to proper height

Bridge Rail & Guardrail

- Damaged rail or non-manufactured holes cut or torch in Guardrail needs to be replaced

Bridge Rail & Guardrail

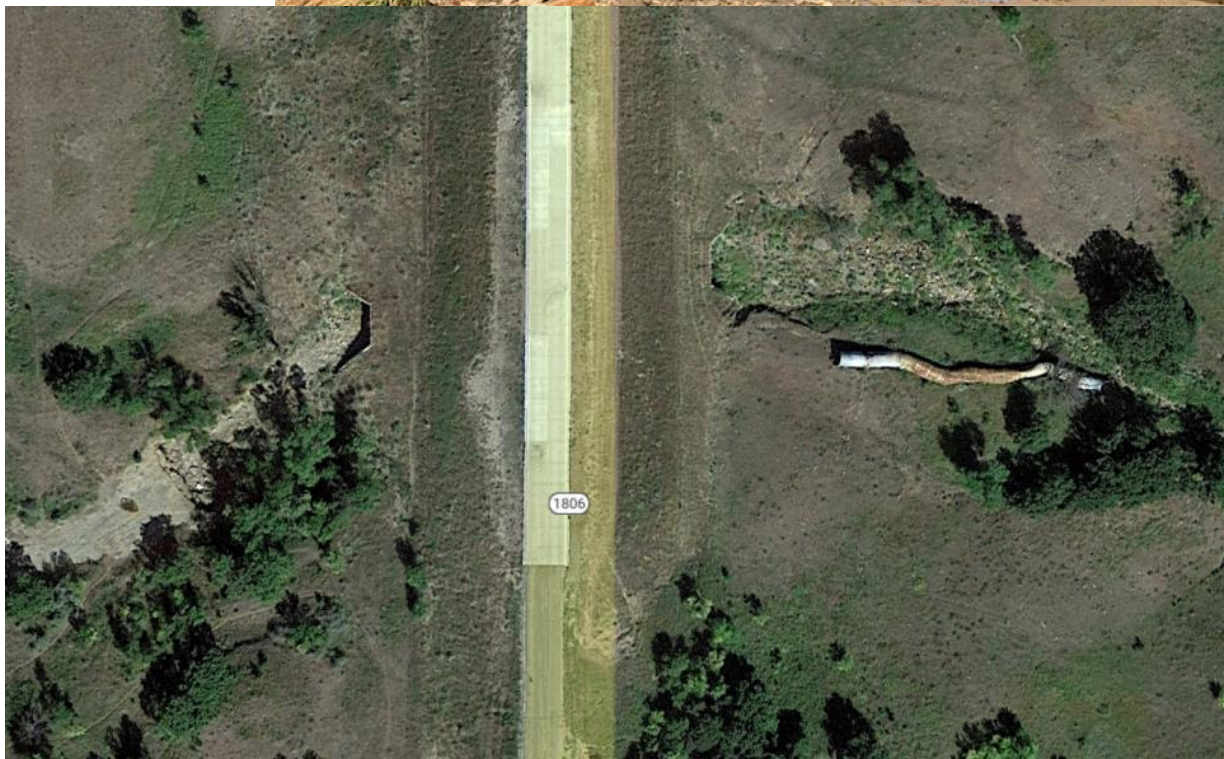
- Deflected more than 9” in 25’ – replace
  - Also look for damaged or missing posts
- Look for damaged or missing bolts at splices

Bridge Rail & Guardrail

- Rail element fully seated into Impact Head?
- Is the rail kinked or bent?
- End post broken, missing, anchor cable missing, steel bearing plate missing or buried?

Approach panels

Scour/Drainage Maintenance



Scour/Drainage Maintenance

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Scour/Drainage Maintenance

Misc. Items

Scheduled Maintenance and Preservation

- Sweep and wash decks
- Clean joints, seal joints, and repair if needed!
- Clean Drains (extend or redirect if needed)
- Seal cracks
- Seal your deck, tops of piers/abutments/columns, splash zones
- Treat exposed Timber cuts and where water may sit
- Paint exposed steel
- Clean and lubricate bearings
- Install and maintain scour countermeasures

Scheduled Maintenance and Preservation

Bridge Maintenance checklist		
No.	**Description**	**Frequency**
1	Debris Removal	As Needed
2	Mechanical Sweeping	Spring and as needed
3	Cleaning of Abutment & Pier Tops	Annually
4	Cleaning of Elastomeric Expansion Joints (4 each)	Spring and as needed
5	Cleaning and Repair of Drainage system (68 Ea.)	Spring, Fall and as needed
6	Cleaning & Washing of Bridge (includes Washing of beams, walkways etc)	Annually
7	Cleaning and Lubrication of Bearings	Annually after No. 4&6
8	Patching of Sidewalks	Annually
9	Repair of Sidewalk Barrier	Annually
10	Patching and crack repair in Jersey Barriers	As Needed
11	Crack Sealing in Pavement & Curblines	Annually
12	Maintenance of Electrical Systems	As Needed
13	Repair of Wearing Surface/Overlays	Every 3-5 years
15	Painting of Steel (Full Bridge)	Every 30 years
14	Spot Painting 1	8 yrs. after No. 10
15	Spot Painting 2 (Painting of Salt Splash Zone and at bearings)	16 yrs. after No. 10
17	Spot Painting 3	24 yrs. after No. 10

Scheduled Maintenance and Preservation

Bridge Component	Bridge Preservation Type	Activity Description	Preventive Maintenance Type	Action Frequency (years)
All	Preventive Maintenance	Sweeping, power washing, cleaning	Cyclical	1-2
Deck	Preventive Maintenance	Deck washing	Cyclical	1
		Deck Sweeping		1
		Deck Sealing/Crack Sealing		4-5
		Thin polymer (Epoxy) overlays		10
		Drainage cleaning/repair		As needed
		Joint cleaning		
		Deck Patching	Condition Based	1- 2
		Chloride extraction		1 -2
		Asphalt overlay with membrane		12-15
		Polymer modified Asphalt overlay		6-12
		Joint seal replacement		10
		Drainage cleaning/repair		1
	Repair or Rehab Element	Rigid concrete overlays	Condition Based	As needed
		Structural Reinforced concrete overlay		
		Deck joint replacement		
		Eliminate joints		
Super	Preventive Maintenance	Bridge approach restoration	Cyclical	2
		Seat and beam ends washing		2
	Repair or Rehab Element	Bridge rail restoration	Condition Based	As needed
		Retrofit rail		
		Painting		
		Bearing restoration (replacement, cleaning, resetting)		
		Superstructure restoration		
		Pin and hanger replacement		
		Retrofit fracture critical members		
Sub	Preventive Maintenance	Substructure Restoration	Condition Based	As needed
		Scour Counter Measure		
		Channel Restoration		

Scheduled Maintenance and Preservation

Description	Frequency
Cyclical Preventative Maintenance	
Sweep Deck & Approach Slabs	Yearly (Spring)
Clean Expansion Joints	Yearly (Spring)
Wash Deck	Yearly (Spring)
Clean Deck Drains	Yearly (Spring)
Clean Beams, Abutments, & Piers	Yearly (Spring)
Clean Bearings	Yearly (Spring)
Lubricate Bearings	Yearly (Spring)
Crack Seal Bridge Deck	3 Years
Apply Deck Surface Treatment	6 Years
Seal Abutments & Pier Tops	6 Years
Seal Concrete in Splash Zone	6 Years

Condition-Based Preventative Maintenance	
Repair Deck Drains	As needed
Repair Concrete on Bridge Deck	As needed
Repair Concrete on Barriers & Curbs	As needed
Repair Bridge Railing	As needed
Repair Expansion Joints	As needed
Repair Concrete Sidewalks	As needed
Repair and Level Approach Slabs	As needed
Repair Bearings	As needed
Repair Spalled Concrete on Beams	As needed
Repair Spalled Concrete on Substructure	As needed
Repair Erosion & Correct Drainage Issues	As needed
Repair Riprap	As needed
Repair Scour	As needed
Repair Slope Protection & Seal Joints	As needed
Remove Debris near Substructure and Abutments	As needed
Remove Trees and Shrubs near Structure	As needed
Spot Painting	As needed
Remove Graffiti	As needed

Resources

- TSP2
- TSP2 Pocket Guides
- Concrete Bridge Deck Preservation Resource Guide
- USFS Timber Bridge Manual
- Bridge Maintenance Manual – MnDOT

Thank you

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