WisDOT Structural Engineers Symposium

Program Agenda
May 23, 2024

8:00 a.m.	Registration
8:30 a.m.	BOS Director's Perspective – *Josh Dietsche*
8:40 a.m.	Bridge Inspection and Maintenance Update – *Jason Lahm*
9:10 a.m.	BOS Initiatives/Policy & Standards Updates – *James Luebke*
9:25 a.m.	Local Bridge Program & Asset Management Updates – *Laura Shadewald*
9:45 p.m.	Best Practices for Constructability – *Carolyn Brugman*
10:00 a.m.	Break/Networking (Beverages and Snacks)
10:20 a.m.	Welcome & Secretary's Office Remarks – *WisDOT Deputy Secretary Christina Boardman*
10:25 a.m.	Structures Cost Estimating – *Fred Schunke*
10:45 a.m.	South Bridge Connector Update/ InfraWorks Overview – *Mark Maday, Trey Horbinski (Jacobs)*
11:20 a.m.	Small Group/Table Discussion – *All*
11:40 a.m.	Geotechnical Updates (WBM preboring updates, drilled shaft projects, needs for borings, etc.) – *Dave Staab*
12:00 p.m.	Lunch/Networking
1:00 p.m.	Consultant Review Updates – *Najoua Ksontini*
1:15 p.m.	Federal Highway Updates – *Derek Soden*
2:00 p.m.	Small Group/Table Discussion – *All*
2:20 p.m.	WisDOT's 1st Design-Build Project from a Structures Perspective – *Bill Dreher (SRF), Vinod Patel (EXP), Brent Freeman (Kraemer)*
2:55 p.m.	Break/Networking (Beverages and Snacks)
3:15 p.m.	Wisconsin Highway Research Program – *James Luebke*
3:30 p.m.	Ratings and Mega Loads – *Alex Pence*
3:45 p.m.	Interactive Survey & Q/A
4:00 p.m.	Adjourn

Conference Location: University of Wisconsin-Madison Union South
1308 West Dayton Street
Madison, WI 53715

For today's presentations, agenda, and proof of attendance, please visit:

http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/research.aspx

Partnerships | People | Process

WisDOT Maintenance Unit

Jason Lahm

BOS Structures and Repair Unit Supervisor/ UAS Pilot

2024 WisDOT Structural Engineers Symposium
Madison, WI

May 23, 2024

Maintenance Unit Topics

- BOS Maintenance Section Organization
- Structures Inspection and Repair (SIR) Unit Organization
- Lift Bridge Unit
- UAS (Drone) Unit

BOS Maintenance Unit Organization

Josh Dietsche
BOS Director

Dave Bohnsack
BOS Chief

Jason Lahm
SIR Unit Supervisor

Thomas Hardinger
North Unit Supervisor

Julie Brooks
South Unit Supervisor

BOS Maintenance Unit Organization

Thomas Hardinger
North Unit Supervisor

- **Brady Rades**
  NER Program Manager
- **Mariah Krueger**
  NC Program Manager
- **Kyle Harris**
  NW – Eu Claire Program Manager
- **Travis McDaniel**
  NW –Superior Program Manager

BOS Maintenance Unit Organization

Julie Brooks
South Unit Supervisor

Scott Reay
SER Program Manager

Mike Williams
SWR – Madison Program Manager

Craig Fisher
SWR – La Crosse Program Manager

BOS Inspection and Repair Unit Organization

Jason Lahm
BOS SIR Unit Supervisor

- Statewide Maintenance and Repair Team
- Statewide Lift Bridge Team
- Statewide Snooper Operation Team
- Statewide Inspection Policy
- Statewide Drone Team
- Statewide Ancillary Structures

Lift Bridge Team

- Jason Lahm, Lift Bridge Team Supervisor
- Jim McDowell, PM Lift Bridge Team
- Lift Bridge Team Members: Emerson H, Mark R, Joel Mass, Max K, Andrew Smith

Why a Lift Bridge Team?

- Build Expertise
- Improved QC/QA Process
- More Efficient Use of State Funds
- Statewide Resource
- Communication Between Owners

UAS (Drone) Team

- Jason Lahm, Drone Team Supervisor (UAS Pilot)
- Steve Doocy, Lead Drone Pilot (UAS Pilot)
- Anthony Stakston, Lead EMILY Boat Captain (UAS Pilot)
- Currently WisDOT has 10 Additional Bridge Inspectors/ UAS Pilots.

Why UAS (Drone) Team?

- Structure Inspection
- Modeling
- Ancillary Structure Inspections
- Mapping
- Public Relations
- Quantity Calculations

Policies

- Personnel
  - 2-person team – Pilot and Inspection TL
  - Pre-flight meeting and form
- All drones use tracked in Aloft
  - Land and Water Based Included
- Drones are used as to supplement the inspection

Unmanned (Drone) Vehicles

Land

(x1)

Sea

(x1)

(x1)

Air

(x8)

(x1)

(x1)

(x4)

(x1)

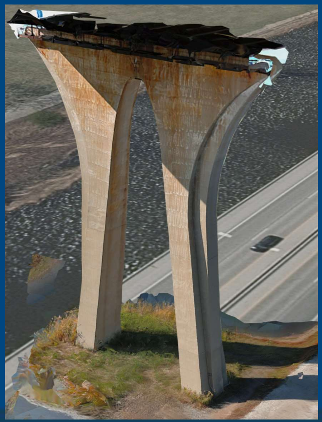
Use Cases

- Structure Inspections
  - Saving Time and Tax dollars
  - No Traffic Disruptions
  - Keeping Employees safe
  - Video and picture records
  - View areas hard to reach
- Modeling
  - Accurate material storage amounts
  - 3D bridge Models









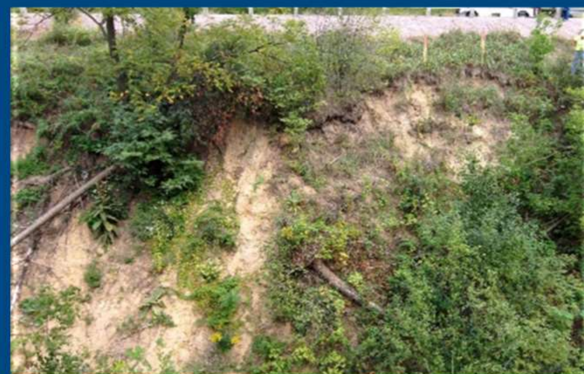
Use Cases

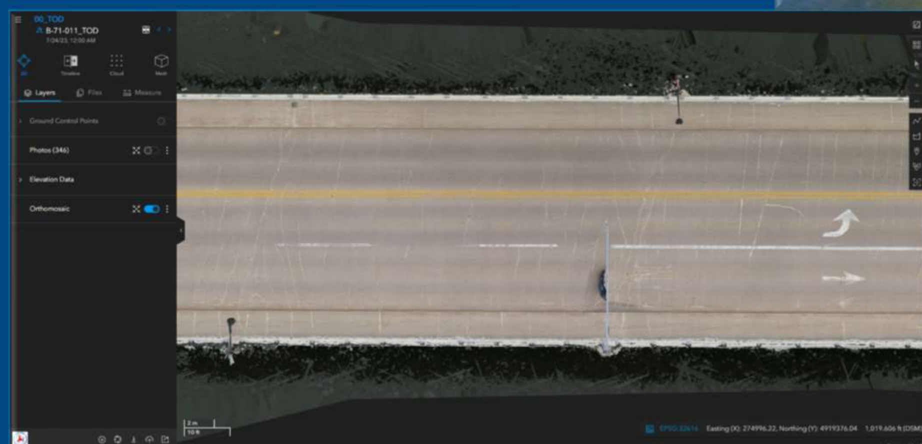
- High Mast Lighting Inspections
  - Very difficult to inspect
  - Inspector needs to climb or rent very expensive equipment
  - Complete a safe inspection
- Mapping
  - Wetland Mitigation Monitoring
- Public Relations
  - Present and Past Project Photos

Use Cases

- Quantity Calculations
  - Deck Cracking
  - Slat Shed Quantity
  - Stockpile Quantities
- Flooding Monitoring
  - Waterway Movement
  - Slope Failures

Use Cases

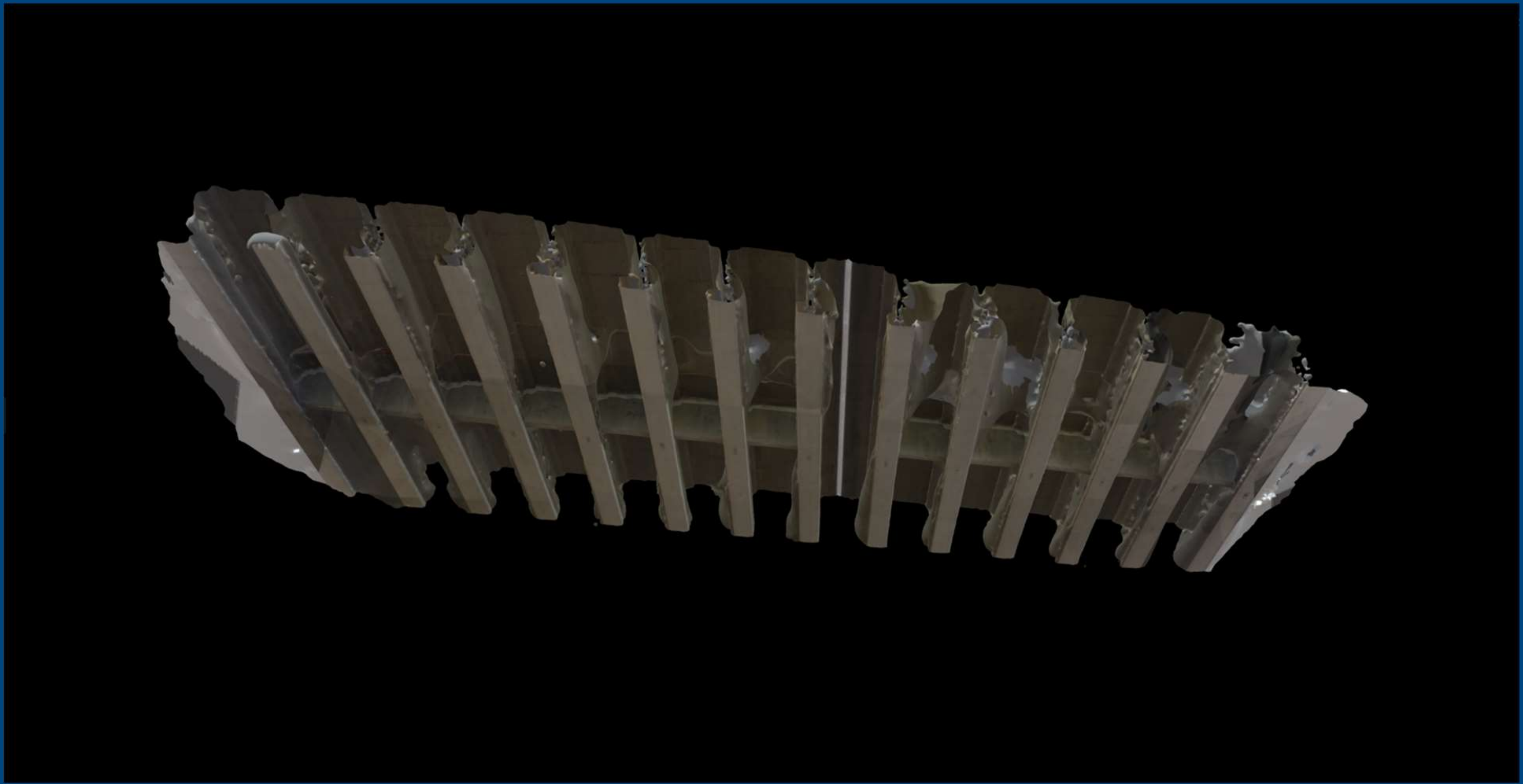



B-71-011_TOD
Layers
Ground Control Points
Photos (346)
Elevation Data
Orthomosaic

Structure Inspection

Structure Inspection

Structure Inspection



Structure Inspection

Top of Deck Cracking (8000' Long Bridge)

Deck Thermal Imaging
Identifying Concrete Delaminations

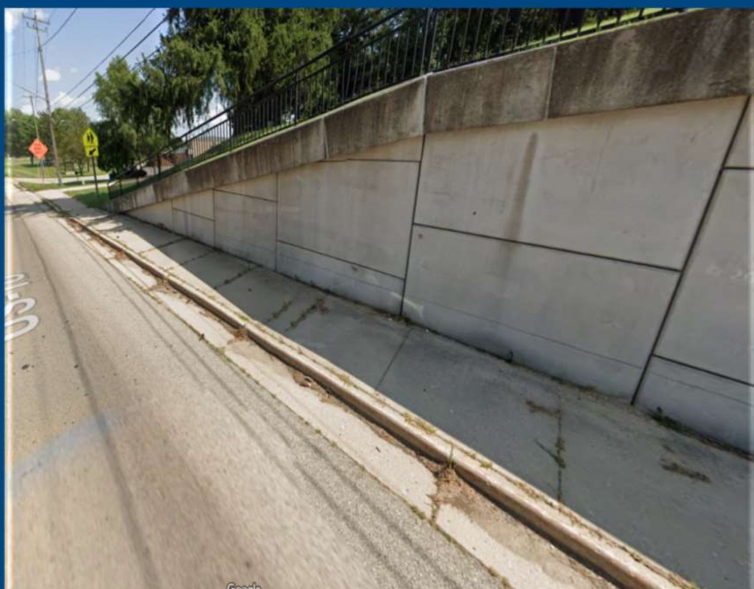
Deck Thermal Imaging

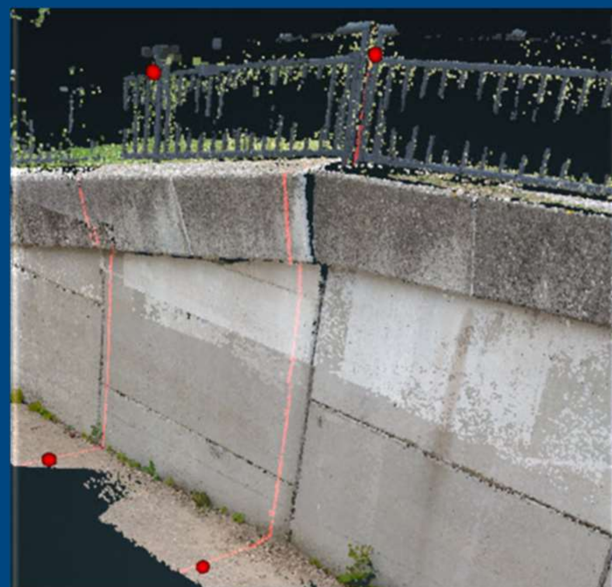
BUREAU OF STRUCTURES

Deck Thermal Imaging

Retaining Wall Inspection

Retaining Wall Movement





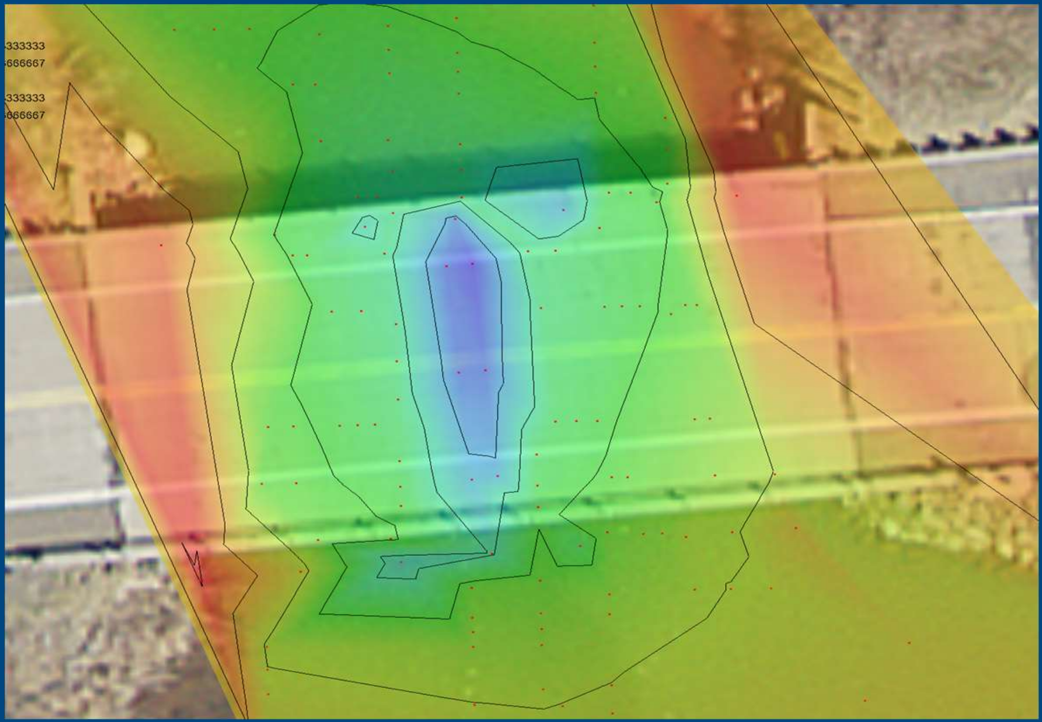
EMILY Boat
Sonar


EMILY Boat

Sonar

EMILY Boat

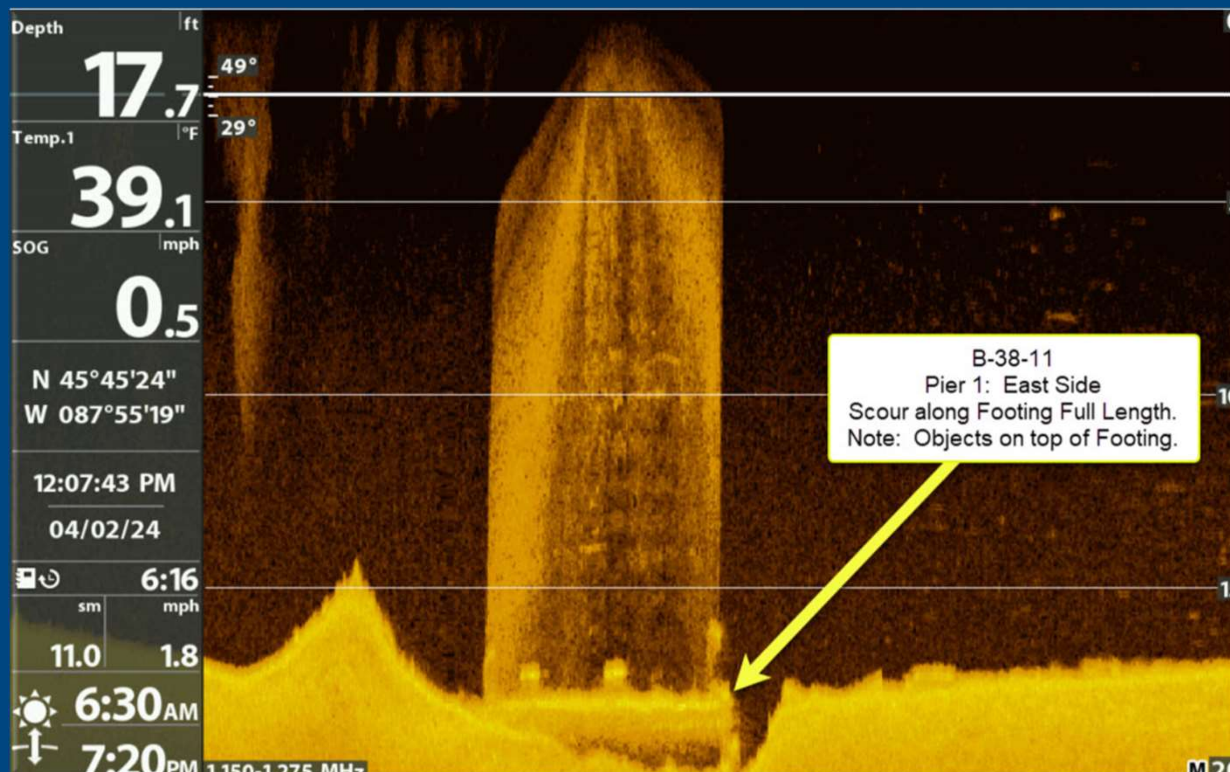
Bathymetric Map from EMILY Boat



EMILY Boat

Sonar Data

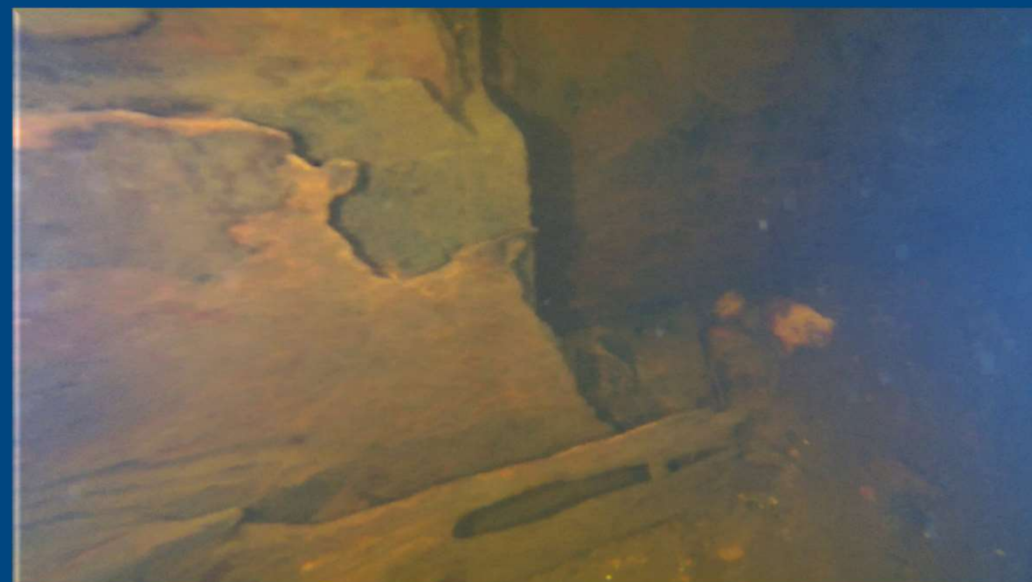
Pier 1
X
Level II
SOLID SHAFT
19.0
Silt w/ Cobbles
No
N/N
N/N
Surface Supplied Air
Pier 1 footing was exposed 1.5 ft max vertically. Concrete surface has scaling up to 1/2 inch maximum from 6 inches above waterline to 1.5 feet below waterline.



Underwater Verification - ROV

Underwater Verification - ROV

Underwater Verification - ROV
Assessment of Mysterious Sonar Data

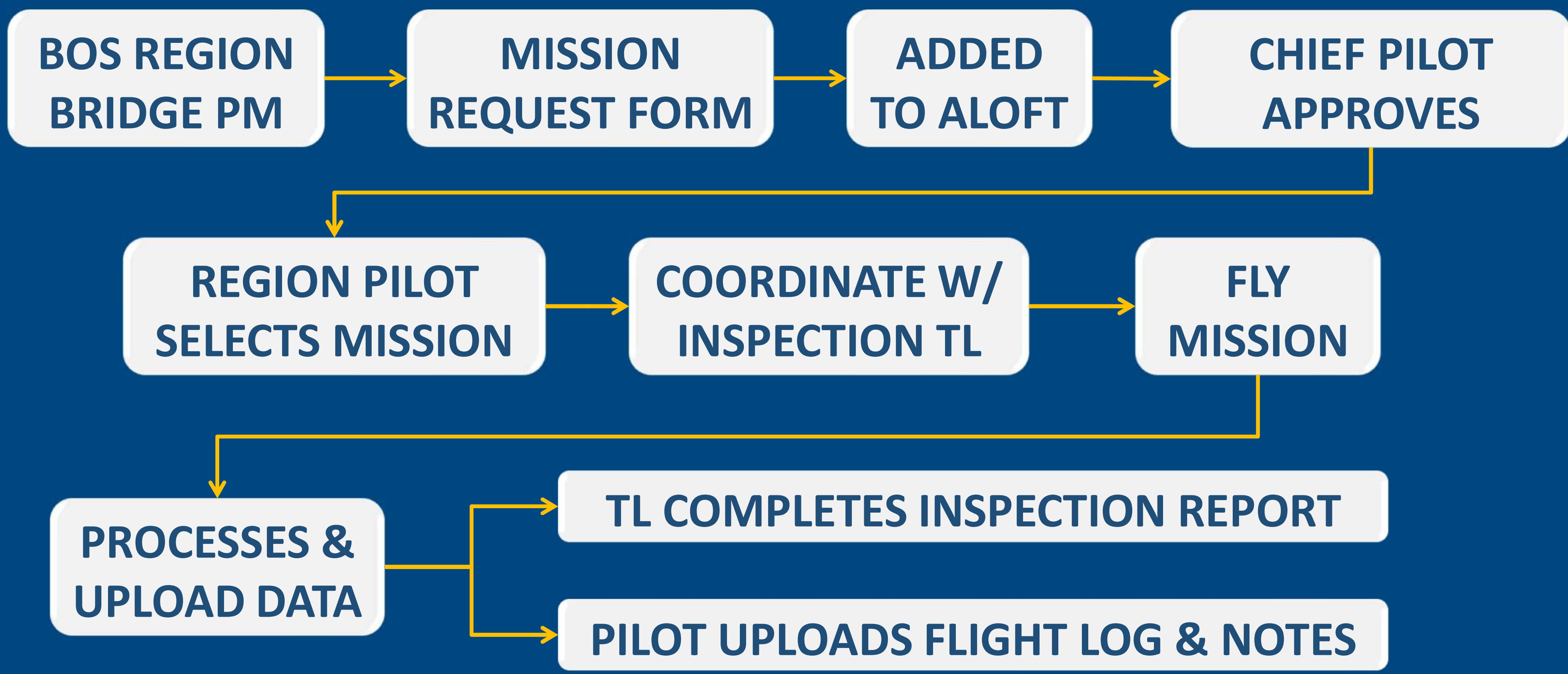


Underwater Verification - ROV

Data

- Raw Photos & Video
- Sonar
  - Point cloud
  - Sonar images
- Processed Data
  - Orthomosaic Images
  - Photogrammetry Images
  - Point Clouds & CADD models
  - Sonar Bathymetry
  - Testing the creation of Digital Twins

Typical Department Mission



BOS Initiatives/Policy & Standards

James Luebke P.E.
Policy and Standards Engineer

WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison WI

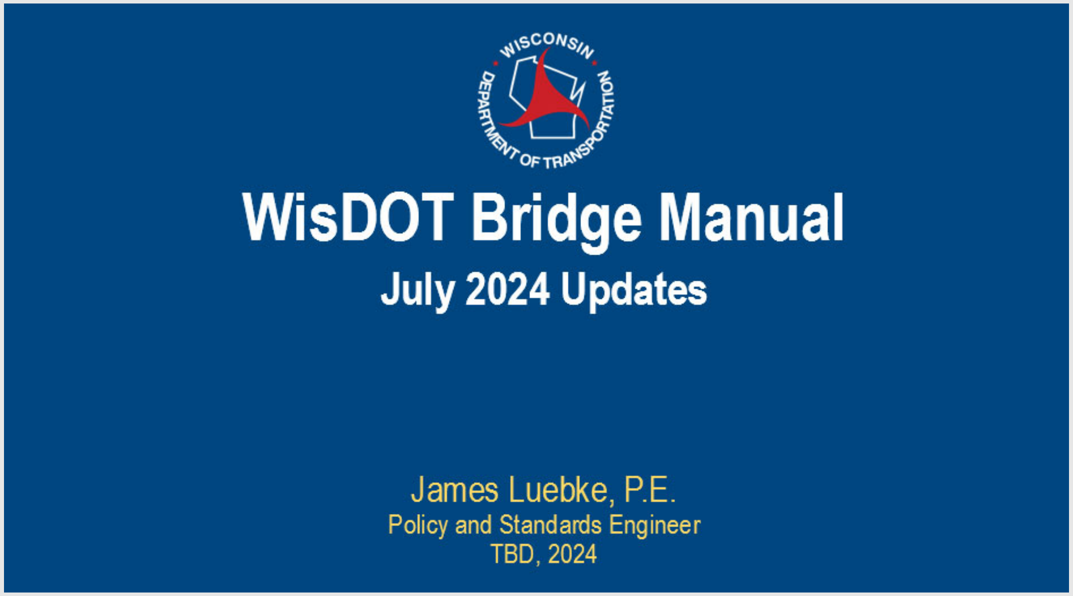
May 23, 2024

Overview

- Bridge Manual Update Webinars
- Concrete Box Culverts
- Other Updates
- What is Next?

Bridge Manual Update Webinars

- Next Update: August 2024

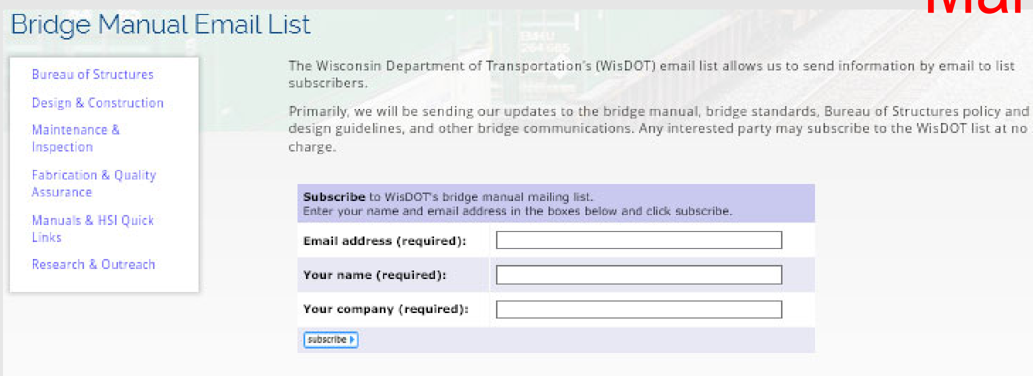


Questions: James.Luebke@dot.wi.gov

Bridge Manual Update Webinars

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/bm-mail-list.aspx

- To be added to email distribution list ➔ Search "WisDOT Bridge Manual Email List"



- To be removed from email distribution list:
  - Send an email to James.Luebke@dot.wi.gov

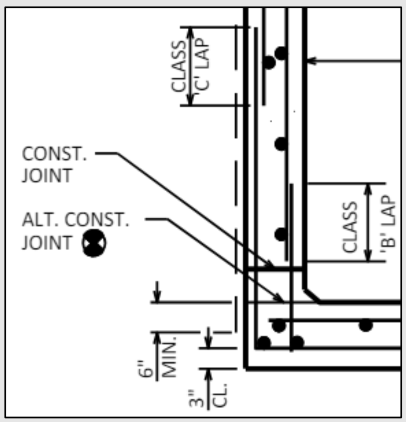
Concrete Box Culverts

<u>Overview:</u>

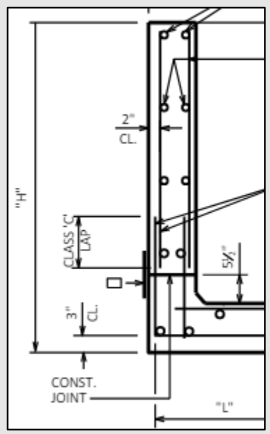
- Details
- Precast Allowances
- ASTM C1577
- Items Under Development

Construction Joints

- Horizontal
  - Barrel (RMW not required)
  - Wing (RMW required)*



Barrel

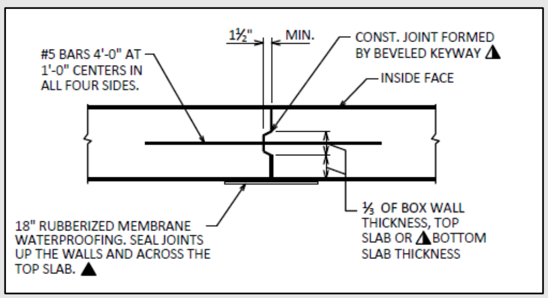


Wing

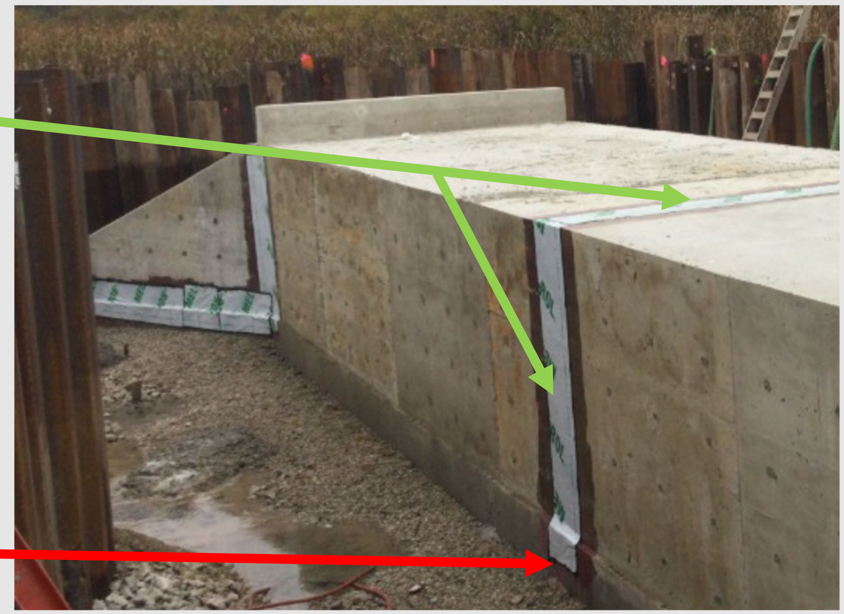
*epoxy coated bars and no alt jt.

Construction Joints

- Vertical
  - Barrel (Top and Sides)
  - Barrel (Bottom)*



IN LIEU OF KEYED CONST. JOINTS IN THE BOTTOM SLAB, THE CONTRACTOR MAY USE 2" DEEP SAW CUTS WITHIN 12 HOURS AFTER POURING. #5 BARS 4'-0" AT 1'-0" CENTERS REQUIRED FOR KEYED CONST. JOINTS AND SAW CUT JOINTS.



Std. 36.03 **(Draft July 2024)**

*#5 bars required (formed jt. and saw cut jt.)

Sheet Waterproofing Membrane

- Sheet Membrane Waterproofing for Asphalt Overlays (516.0600.S)
  - Asphalt Overlays (PMA Overlay Alternative)
- Sheet Membrane Waterproofing for Buried Structures (516.0610.S)
  - Buried Bridge Structures (epoxy bars in top slab)
  - CIP Pedestrian Underpasses
  - *Buried Culvert Structures with low-fills (under development)*

Coarse Aggregates

<u>Breaker Run Substitution:</u>

- Coarse Aggregate #1
  - ➔ AASHTO No. 67
- Coarse Aggregate #2
  - ➔ AASHTO No. 4
- APS 6 Gradations (Std. Spec. 310 & 604)

TABLE 501-4 AGGREGATE MASTER GRADATION LIMITS

SIEVE	FINE AGGREGATE	COARSE AGGREGATE		COMBINED AGGREGATE GRADATION		OPTIMIZED AGGREGATE GRADATION (OAG)
		SIZE NO. 1 AASHTO No. 67[1]	SIZE NO. 2 AASHTO No. 4[1]	STANDARD	100 % PASSING 1-inch sieve	TARANTULA CURVE GRADATION BAND
	(% passing by weight)					(volumetric % retained)
2-inch	__	__	100	100	100	0
1 1/2-inch	__	__	90 - 100	96 - 100	100	<= 5
1-inch	__	100	20 - 55	70 - 99	100	<= 16
3/4-inch	__	90 - 100	0 - 15	55 - 96	95 - 100	<= 20

2023 Std. Spec.

TABLE 501-4 AGGREGATE MASTER GRADATION LIMITS

SIEVE	COMBINED AGGREGATE GRADATION		OPTIMIZED AGGREGATE GRADATION (OAG)
	STANDARD	100 % PASSING 1-inch sieve	TARANTULA CURVE GRADATION BAND
	(% passing by weight)		(volumetric % retained)
2-inch	100	100	0
1 1/2-inch	96 - 100	100	<= 5
1-inch	70 - 99	100	<= 16
3/4-inch	55 - 96	95 - 100	<= 20

2024 Std. Spec.

Precast Allowances

- Historically, Contract plans with CIP design and details with precast allowance
- The designer shall determine if a noted precast allowance is appropriate on a project-by-project basis. This includes the barrel and wingwalls.
- Precast Design:
  - Barrel➔ ASTM C1577, Standards, and STSP
  - Wingwalls ➔ Standards and STSP

Precast Allowances

- Several conditions where a noted allowance for precast may not be suitable for a project:
  - Openings not covered by ASTM C1577 (>12 ft spans or twin cell)
  - Depth of cover is less than 2 ft while supporting traffic loads
  - Pedestrian underpasses
  - Unique hydraulic conditions or other factors

Precast Box Culverts

- ASTM C1577 Includes:
  - Single-cell precast box culverts
  - Standard Openings (3-ft by 2-ft to 12-ft by 12-ft)
  - Design fills (20 ft to 30 feet)
  - Provides wall and slab thicknesses and reinforcing areas

Precast Box Culverts

- ASTM C1577 Includes:
  - Design Criteria (Appendix X1)
    - Span: 12-ft maximum standard opening
    - Load: HL-93 live load without the lane load
    - Materials: f’c=5 ksi, fy=65 ksi
    - Arrangement: A slab thickness of 1⁄12 the span (or greater)

Precast Box Culverts

- ASTM C1577 Special Design *(under development)*:
  - Design Criteria (Appendix X1)
    - Span: Maximum WisDOT allowance
    - Load: HL-93 live load <u>with</u> the lane load (for L>12ft)
    - Materials: Higher strengths (f'c=6 ksi, fy=80 ksi)
    - Arrangement: Crack and deflection control limits

Precast Box Culvert *(Under development)*

- Standards
- Special Provision
- Bridge Manual

Items:

- Fills less than 2-ft
- Construction details (e.g. joint ties)
- Maximum permissible joint opening
- Undercut and backfill notes
- Precast walls

What is Next?

- Bridge Manual Release – End of July 2024
- Bridge Manual Release Webinar – August 2024
- AASHTO LRFD 10th Edition – End of 2024?
- WHRP Implementation

Questions

James Luebke, PE
James.luebke@dot.wi.gov
(608) 266-5098

Local Structures Topics & Updates

Laura Shadewald
Structures Development Chief

WisDOT Structural Engineers Symposium
UW-Madison Union South, Madison, WI

May 23, 2024

Local Structures Topics and Updates

- Trans 212/213 Updates
- Local Structures 6-20 Feet
- Open Railings vs. Parapets

Trans 212/213 Updates

Trans 212/213 Updates

- First Adopted in 1982
- Revised 2-3 times
- Remained static since 1999

WISCONSIN STATE LEGISLATURE

HOME SENATE ASSEMBLY COMMITTEES SERVICE AGENCIES

(7) "Posting" means the placement of regulatory signs at a bridge indicating the safe load-carrying capacity of the bridge.

(8) "Rating" means determining the safe load-carrying capacity of a bridge.

History: Cr. Register, February, 1982, No. 314, eff. 3-1-82; am. (1) and (8), Register, July, 1992, No. 439, eff. 8-1-92; correction in (3) to (eff. 8-1-99.

Trans 212.03 Application of chapter. The bridge inspection and inventory standards in this chapter apply to all highwa railroad traffic and bridges used only by pedestrians, bicycles, and recreational vehicles are excluded from the applicatio

History: Cr. Register, February, 1982, No. 314, eff. 3-1-82.

Trans 212.04 Responsibility for inspection. The responsibility for the continuing inspection program shall be as follo

(1) The department shall inspect highway bridges on the state trunk highway system and all other bridges for which the dep

(2) Each local authority or other authority having jurisdiction over a non-department maintained bridge shall inspect the hi

(3) When the department determines that a local authority or other authority having jurisdiction over a non-departmental m county highway commissioner of the county in which the bridge is located of the inspection failure and shall direct the direction, the county shall perform the bridge inspection or cause it to be performed.

History: Cr. Register, February, 1982, No. 314, eff. 3-1-82; emerg. cr. (3), eff. 8-20-85; cr. (3), Register, April, 1986, No. 364, eff. 5-1-86.

Trans 212.05 Qualification of personnel. Individuals involved in the inspection of bridges as required by this chapter

History: Cr. Register, February, 1982, No. 314, eff. 3-1-82.

Trans 212.06 Frequency of inspections.

(1) State-owned or state-maintained bridges shall be inspected at regular intervals not to exceed 2 years.

(2) Locally owned bridges shall be inspected at regular intervals not to exceed 2 years.

(3) The maximum inspection interval specified in subs. (1) and (2) may be increased from 2 years to no more than 4 years

Trans 212/213 Updates

- Trans 212: Standards for the Inspection of Bridges in WI
  - Propose Update to:
    - Consistent with current inspection standards & procedures
    - Update obsolete language & terminology
    - Ensure compliance with 23 CFR Part 650 Subpart C Final Rule on National Bridge Inspection Standards, effective 2022

Trans 212/213 Updates

- Trans 213: Local Bridge Program
  - Broaden eligibility for funding of local bridges
    - "Sufficiency Rating" – outdated, no longer used nationally
  - Appropriately identify timely bridge improvement work
    - Preserve and extend the life of bridges

Trans 212/213 Updates

- Draft language is almost complete
- Next Steps:
  - Rule Drafting, Analysis and Fiscal Estimate
    - Prehearing materials that are reviewed and approved by DOT
  - Stakeholder outreach
  - Clearinghouse Rules, Public Hearing, Legislative Review
  - Final Rule Published
- Draft rule will be in effect for the next local program cycle Spring 2025

Local Structures 6 – 20ft Program Overview

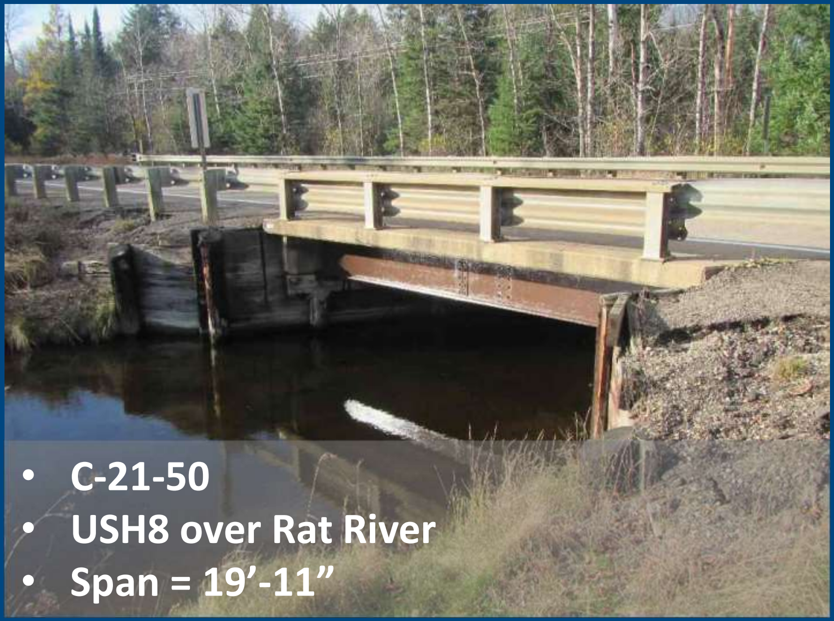
BUREAU OF STRUCTURES

Overview of the Issue

- Structures (local system) under 20ft long…
  - …have no inventory requirements.
  - …have no inspection requirements.
  - …have no load rating requirements.
  - …are **NOT** eligible for federal bridge rehabilitation and replacement funding.

Overview of the Issue

- Bridges and “not bridges” can look and act very similar



NOT A BRIDGE

BRIDGE

Overview of the Issue

- Small structures can still present issues…

- …and require funding to repair or replace.

Wisconsin 2023 – 25 State Budget

- Budget Language
  - *Provides $12,500,000 SEG to JCF's supplemental appropriation in FY24 for assessment of local bridges and culverts and create a biennial DOT SEG appropriation that could receive the funds. Directs the Department to develop a program for counties to assess local bridges and culverts that are less than 20 feet, but greater than six feet in length.*
- State Statute 85.64
  - *The department shall administer a program for counties to inventory and assess the condition of local bridges and culverts that are 20 feet or less in length but greater than 6 feet in length.*

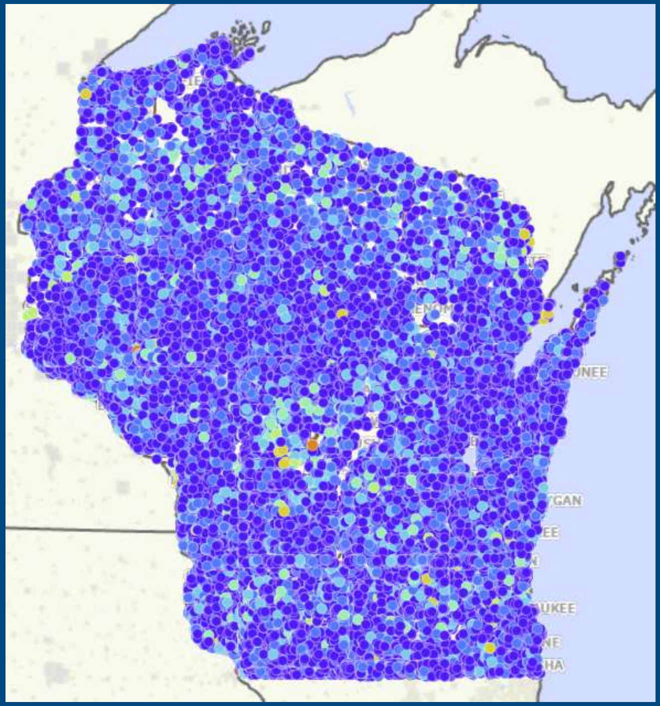
Wisconsin 2023 – 25 State Budget

- Collaborative effort to “develop a program”
  - Wisconsin DOT
  - Wisconsin Towns Association
  - League of Wisconsin Municipalities
  - Wisconsin Counties Association
  - Wisconsin County Highway Association

Size of the Local Inventory

- Approximately 25,000 structures that meet criteria
  - WisDOT GIS mapping
  - Extrapolation from state-owned data
  - Local owner survey

- WisDOT provided information on possible locations



Phased Approach

- Working with local owner representatives on a phased approach:
  - Inventory
  - Inspection
    - Load rating - as needed and pending available funds

Phase 1: Inventory Information

- No qualifications for person collecting this information
- WisDOT Bureau of Structures provided direction/training
- Data uploaded to the Highway Structures Information System (HSIS)
  - Name of person collecting information
  - Date of inventory
  - Owner
  - County
  - Municipality
  - Feature on (roadway name/number)
  - Number of lanes on structure
  - Feature under (if known)
  - Location (Latitude / Longitude)
  - Location description (distance from an intersection)
  - Total structure length
  - Structure type (pipe culvert, box culvert, girder bridge, etc.)
  - Structure material (concrete, steel, etc.)
  - Weight limit (if posted)
  - Concerns identified

Phase 2: Inspection

- Inspections performed by Wisconsin certified bridge inspectors (about 300 in the state)
- Based on National Bridge Inspection (NBI) rating scale (0 – 9)
  - 0 – 2: Severe condition
  - 3 – 4: Poor condition
  - 5 – 6: Fair condition
  - 7 – 9: Good condition
- WisDOT Bureau of Structures provided direction/training

Load Rating

- As deemed necessary and pending availability of funds, perform load ratings to ensure safety
  - Determining if the structure can safely carry legal-weight vehicles
  - Load post as necessary

- Performed by structural engineers

- Contracting and reimbursement mechanism pending availability of funds

Looking Ahead

- Information is being gathered for two reasons:
  - Ensure these structures are safe for the travelling public
  - Support future budget proposals for rehabilitation & replacement funding

- Future funding is not guaranteed, but collecting information on the size, nature, and condition of the small structure inventory is a necessary first step.

Open Railings vs. Parapets

Open Railing vs. Parapet

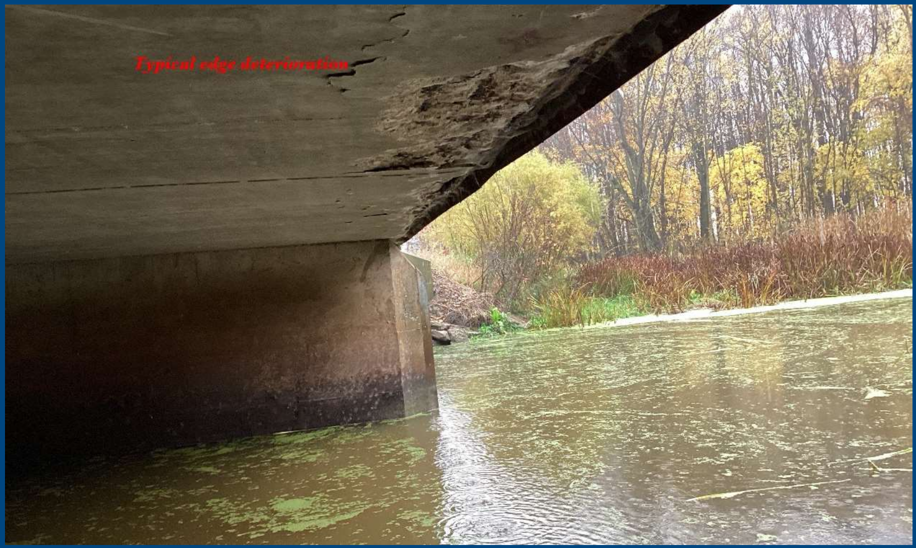
- Parapets preferred/required on state system
- Open railing used more frequently on local structures
- Lots of issues when open railing is used

Open Railing vs. Parapet

- Initial Cost
  - Open Railing: $300-$400/LF
  - Parapet:
    - 32SS: $150/LF
    - 42SS: $185/LF

Open Railing vs. Parapet

- Minimum grade 0.5%
  - 30’ Long Structure = 1.8”
  - 50’ Long Structure = 3”



Open Railing vs. Parapet

- What are we asking?
  - Consider all the options, including parapets
  - Educate the local owners – initial and long-term costs
  - Help us build more sustainable bridges!

Any Questions?

Best Practices for Constructability

Carolyn Brugman, PE

Structures Construction Program Manager

2024 WisDOT Structural Engineers Symposium
UW-Madison Union South, Madison, WI

May 23, 2024

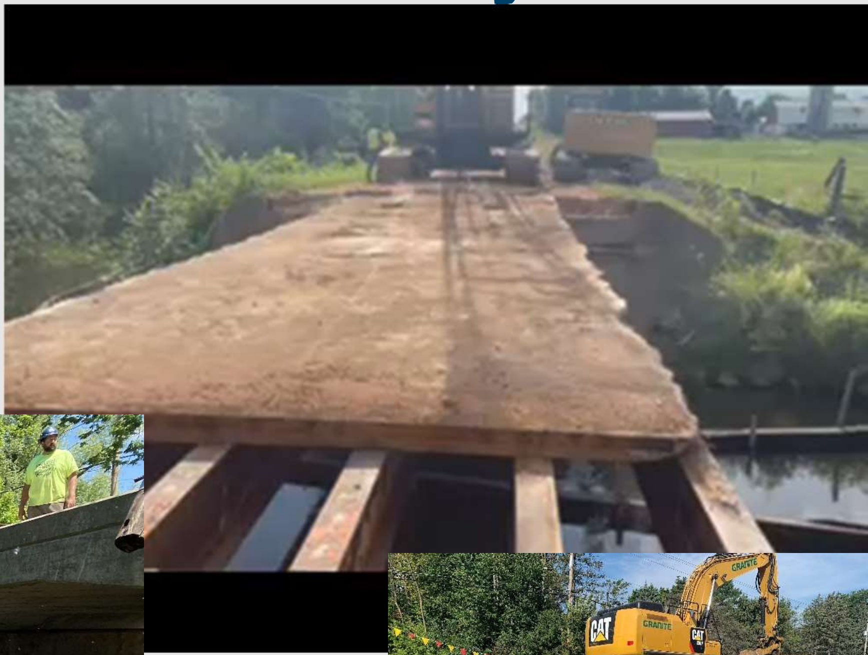
Outline

- Considerations during design to help construction go smoothly
- Construction questions and issues we see that can be addressed during design

Removing Structure over Waterway

Issue

- Selection of the incorrect bid item - Remove Debris, Minimal Debris, or Debris Capture
  - Following DNR initial recommendation without coordination



Removing Structure over Waterway

Solutions

- Select bid item based on structure type - WBM
  - CMM 645.6 contain example removal plans for each item

- Coordinate with DNR and Regional Environmental Coordinator
- Coordinate with BOS on unique structures/situations

Pile Conflicts and Removing Piling

Considerations

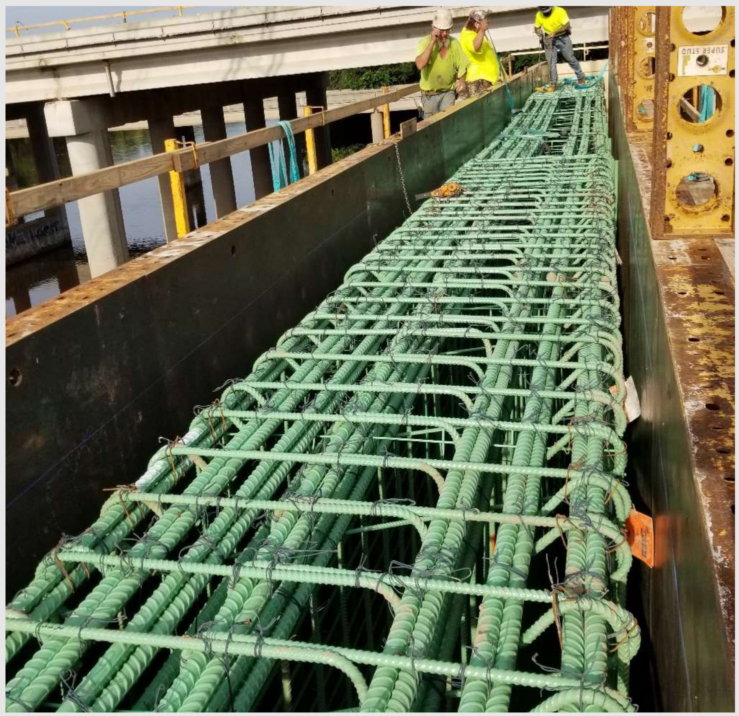
- Verify locations of existing piling vs. proposed
  - Offset proposed substructures from existing
  - Space new piling to avoid existing
  - If neither is possible, include removing existing piling SPV

Rebar Congestion
Issue

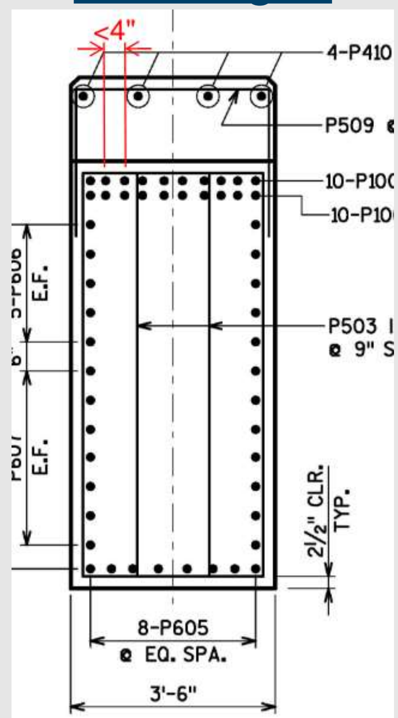
- Tight rebar spacing makes consolidation around rebar difficult
  - Leave enough space for vibrator

Rebar Congestion
Solutions

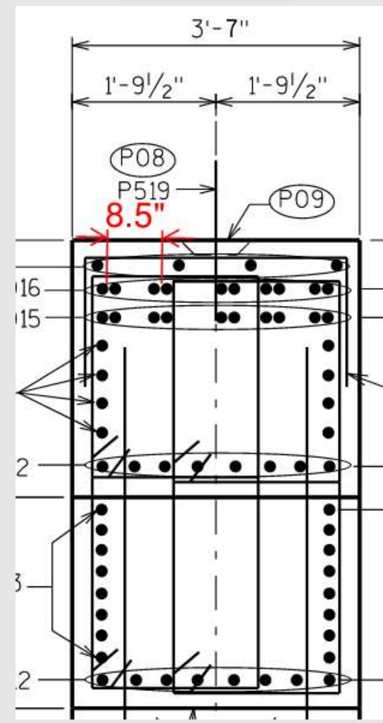
- Stagger lap splices
- Bundle bars
- Multiple rows of rebar
- Upsize members



Too Tight



Better



Small (or Large) Haunches

Include Plan Note

- When haunches less than 1 ¼” or greater than 8” are expected
  - Draws attention to contractor that alternate forming methods may be required

GIRDER HAUNCHES ARE EXPECTED TO BE LESS THAN 1.25” IN SOME AREAS, TRADITIONAL DECK FORMING SYSTEMS MAY NOT BE SUITABLE.

GIRDER HAUNCHES ARE EXPECTED TO BE GREATER THAN 8” IN SOME AREAS, TRADITIONAL DECK FORMING SYSTEMS MAY NOT BE SUITABLE.

Complex Geometry
Considerations

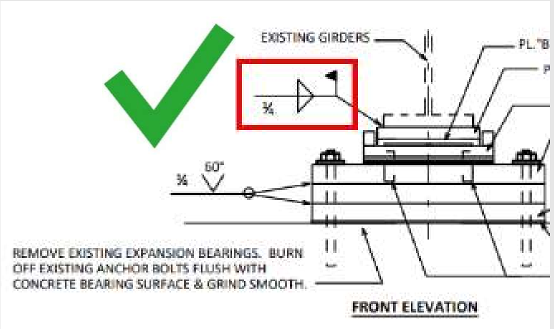
- Tapers
  - Material cost vs. labor cost
- Superelevation Transitions
  - Difficult to get right with finishing machine

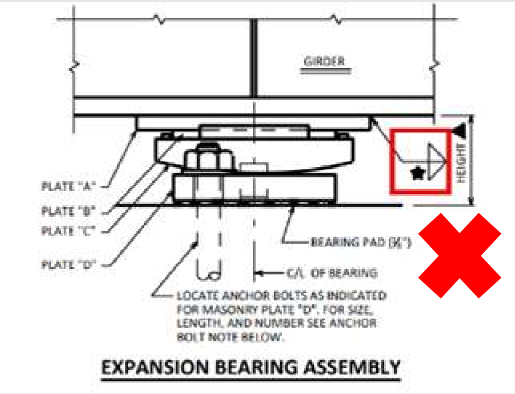
Existing Conditions for Rehabs

- Verify Scope of Work
  - Review inspection reports/scoping notes
  - Secondary maintenance items
- Check most recent inspection reports
- Field verify bearing heights for bearing replacements

Existing Conditions for Rehabs

- Pay attention to existing expansion end diaphragm height for joint replacements
- Field Welding Details for Bearing Replacements



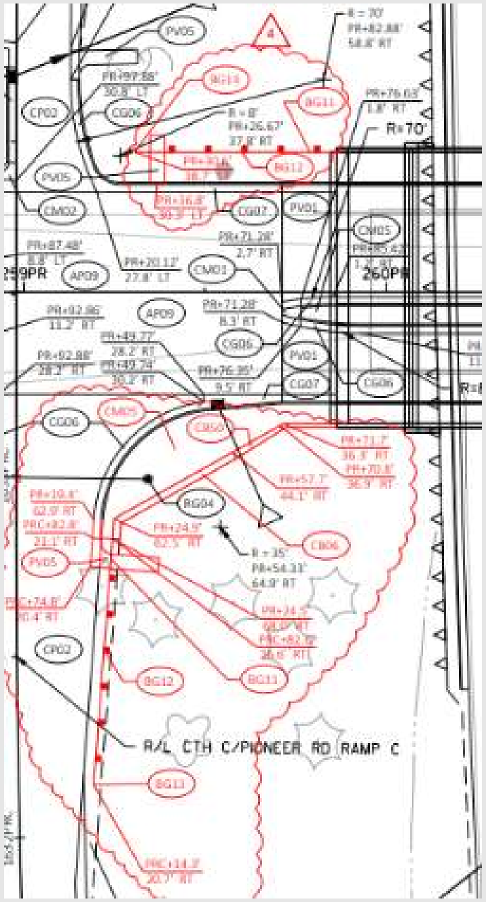


Roadway Design Coordination
Transition from Road to Bridge

- Scope of bridge rehab work (and how this impacts approach road)
  - Replacement of concrete approach needed for redeck/overlay?
  - Pavement replacement directly behind the paving block
- Transition between road and bridge
  - Parapet transitions
  - Curb/sidewalk locations and transitions
  - Grading in Vicinity of Structure

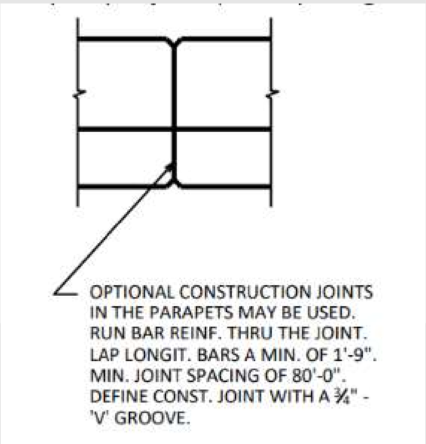
Roadway Design Coordination
(cont.)

- Get updated files from roadway designer frequently
  - Profile
  - Alignments
  - Typical Section/X-Slopes/Transitions
  - Utility (Name & Work Plan)
  - Bridge Layout



Miscellaneous Considerations

- Concrete Overlay Staging
  - Construction joints at crown/grade break
- Temporary Support SPV
  - Calculations to determine necessity
- Parapet Optional Joints
  - Remove optional construction joint if bridge is less than 80' long



Miscellaneous Considerations (cont.)

- Soldier Pile Walls
  - Piles and tiebacks are considered primary members but soldier pile fabricators can be from “Fabricated Bridge Components” or “Primary Members” APL
  - Add note to plans that all welding needs to conform to AWS D1.5
- Box Culverts
  - Consider if inclusion of precast box substitution note is appropriate per WBM

Questions?

Structures Cost Estimating

Fred Schunke
NCR Design QA Engineer

WisDOT Structural Engineers Symposium

May 23, 2024

Lesson Objectives

- Share where structure estimating guidance is in the FDM
- Review commodity trends and share how to adjust historic prices.
- Share some guidance to develop final estimates including updates to the Similar Projects Tool, Bid Express User Guide and plan locations.

BUREAU OF STRUCTURES

FDM 19-5 Estimates

Sections Relevant for Today

- FDM 19-5-5 noted in the Bridge Manual 5.3
- Google WisDOT FDM
- WisDOT Webpages
  - Doing Business > Engineers and consultants > Structure and road resources
  - Listed under Standards and manuals

FDM 19-5 Estimates

Sections Relevant for Today

- FDM 19-5-5.5 Tools and Resources (pg. 13-17)
  - Bid Express
  - Similar Projects Tool
  - Other Tools and Resources
    - Plans, Proposals, Addenda and As-builts

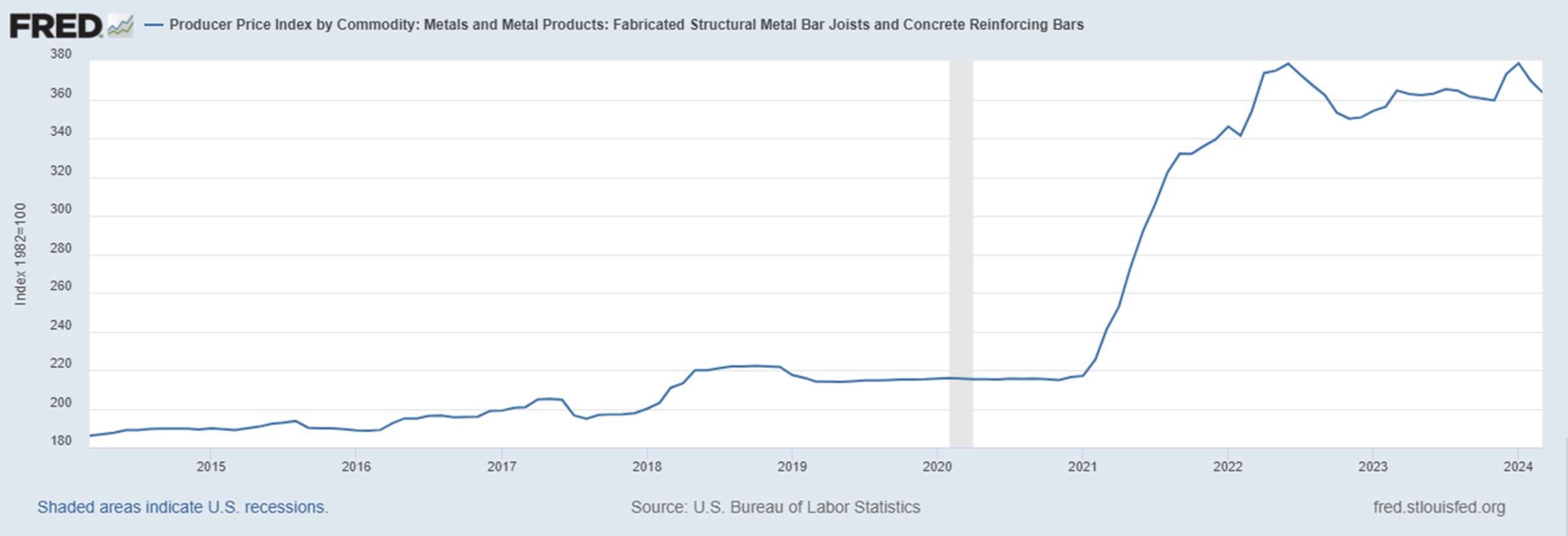
FDM 19-5 Estimates

Sections Relevant for Today

- FDM 19-5-5.6.3 Bid Item Estimating Guidance (pg. 20-21)
  - Concrete Masonry Bridges
  - Concrete Masonry Overlay Decks
- FDM 19-5-5.6.4 Unit Price Guidance (pg. 22)
  - Adjusting Unit Prices
    - WisDOT Chained Fisher Construction Cost Index

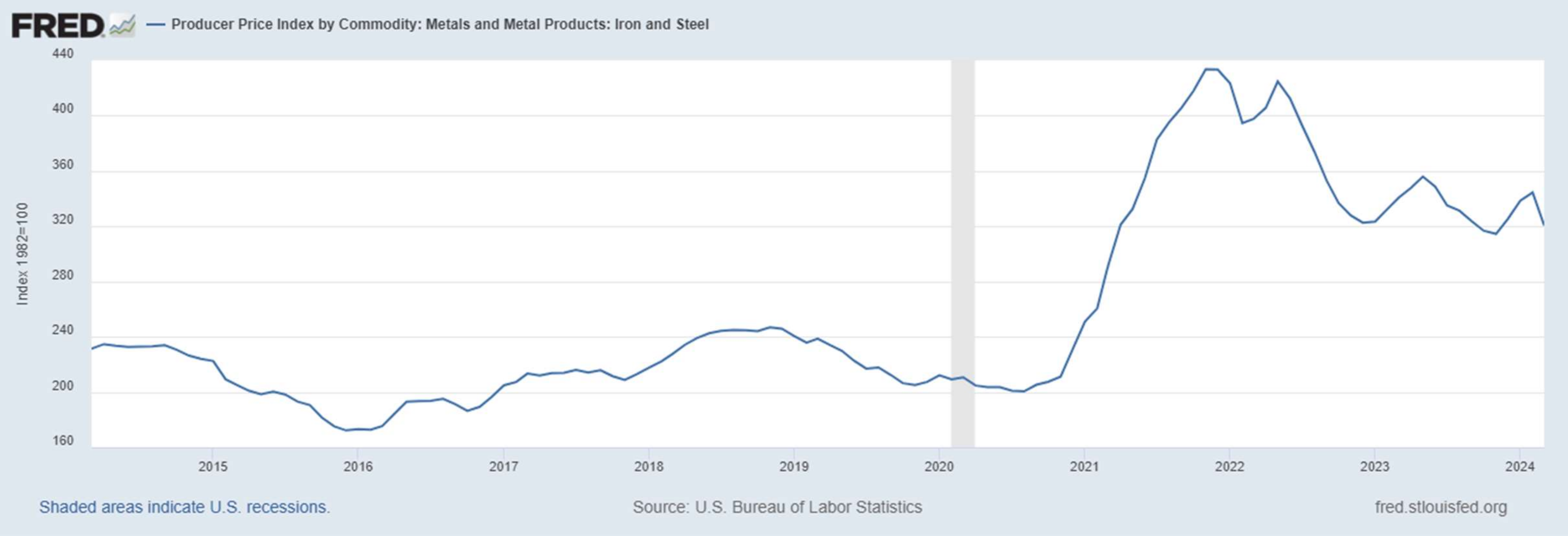
Producer Price Index Commodities

Nationwide Concrete Reinforcing Bars (10 years)



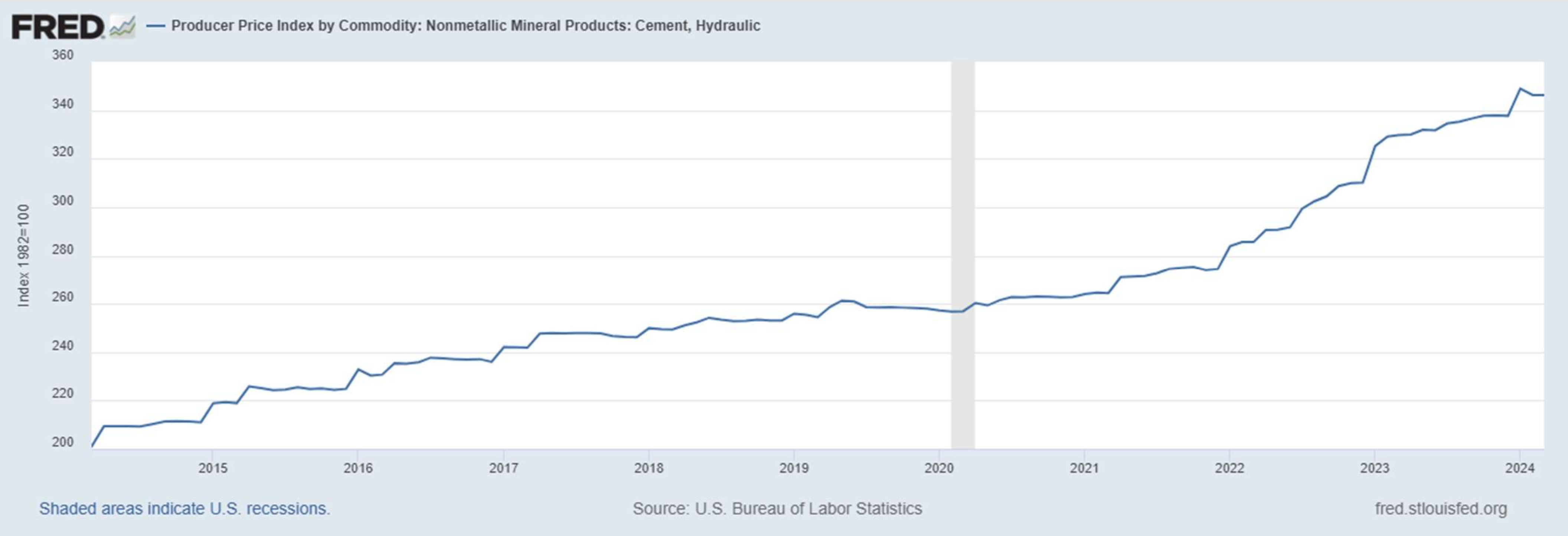
Producer Price Index Commodities

Nationwide Iron and Steel (10 years)

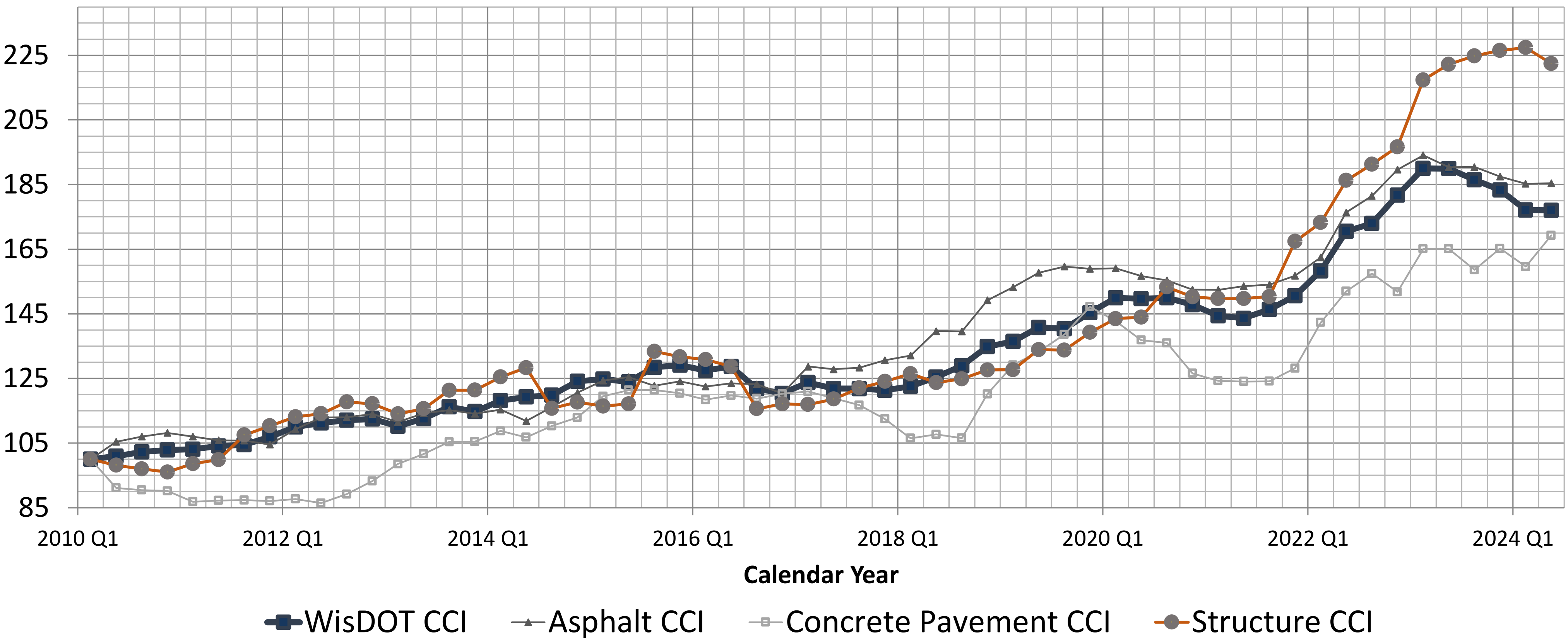


Producer Price Index Commodities

Nationwide Cement (10 years)



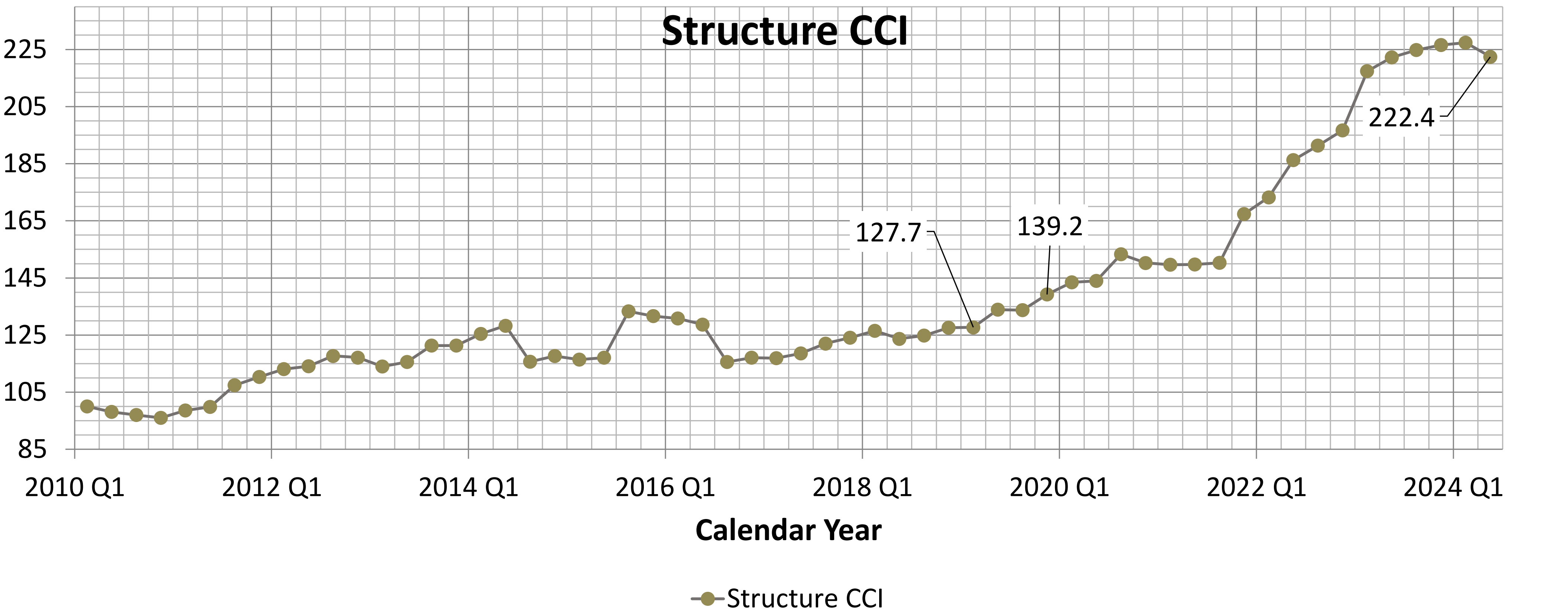
WisDOT Chained Fisher Construction Cost Index



Commodity Links

- **PPI Iron and Steel (WPU101)**
  - PPI Steel Mill Products (WPU1017)
  - **PPI Concrete Reinforcing Bars (WPU1074051)**
- **PPI Cement, Hydraulic (WPU1322)**
  - PPI Construction Sand, Gravel, and Crushed Stone (WPU1321)
  - PPI Construction Machinery and Equipment (WPU112)
- PPI Concrete Pipe (WPU1332)
- PPI Plastic Construction Products (WPU072106)
- Wisconsin's Fuel Cost Adjustment (CFI)
  - PPI No. 2 Diesel Fuel (WPU057303)
  - PPI Asphalt (WPU05810212)
  - Crude Oil Prices

WisDOT Construction Cost Index



WisDOT Construction Cost Index

Adjusting Unit Prices

- Guidance in FDM 19-5-5.6.4 (page 21)
- **Do not forecast prices past the current date**
- Used to convert past prices into current dollars without recent bid history
- Adjusting prices using the WisDOT CCI is approximate
  - But will provide a better estimate
- Recent price trends for bid items will always be more reliable

WisDOT Construction Cost Index

Adjusting Unit Prices

- Use a ratio from past and current index values to convert past prices into current dollars
- $\frac{Current\ Index\ Value}{Past\ Index\ Value} \times Past\ Bid\ Price = Current\ Bid\ Price$
- Example:
  - Jan. to Dec. 2019 price = $166 Total SF Cost
  - Past Index Values = 127.7 to 139.2, using 137
  - Current Index Value = 222.4
  - $\frac{222.4}{137} \times \$166 = \$269\ or\ \$270\ rounded$

WisDOT Construction Cost Index

Adjusting Unit Prices

- Estimator Prices do not need to be adjusted

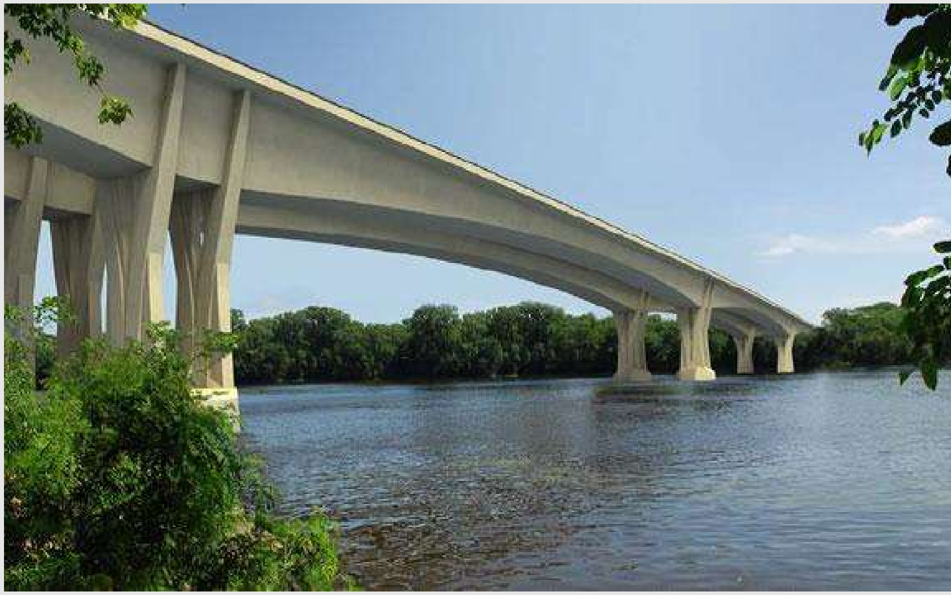
Concrete Masonry Bridges

FDM 19-5-5.6.3 Bid Item Estimating Guidance

- Regression prices should not be used
  - Prices vary for slab-spans, girder and rehabilitated bridges
  - Concrete Masonry Bridges, Removing Structure and Excavation for Structures should be estimated at the **same time** with the same bid data and contractor
    - Each contractor will bid these items differently
    - May need to look at losing bid prices

PS&E Estimates

- Finding similar bridges in the HSI
  - No recent bridges
  - Easy to find similar bridges
- Bid Express, Similar Projects Tool and Let Plans
  - All recent and historic bridges
  - More effort required



Removing Structure Over Waterway

"Average" Price Differences

	Removing Structure Over Waterway Remove Debris	Removing Structure Over Waterway Minimal Debris	Removing Structure Over Waterway Debris Capture
No. of Structures	28	116	11
Minimum	$6,039	$4,289	$41,100
Maximum	$737,500	$2,443,750	$378,461

Removing Structure Over Waterway

"Average" Price Differences

	Removing Structure Over Waterway Remove Debris	Difference	Removing Structure Over Waterway Minimal Debris	Difference	Removing Structure Over Waterway Debris Capture
25th Percentile	$18,738	$25,236	$43,974	$39,231	$83,205
Median	$57,261	$16,071	$73,332	$53,321	$126,653
75th Percentile	$83,607	$40,624	$124,230	$62,470	$186,700

Removing Structure Over Waterway

"Average" Price Differences

	Removing Structure Over Waterway Remove Debris	Difference	Removing Structure Over Waterway Minimal Debris	Difference	Removing Structure Over Waterway Debris Capture
Typical Ranges	$19,000 to $84,000	$16,000 to $41,000	$44,000 to $124,000	$39,000 to $62,000	$83,000 to $187,000
Below Typical	<$19,000	increase 100% decrease 50%	<$44,000	increase 100% decrease 50%	<$83,000
Above Typical	>$84,000	increase 50% decrease 33%	>$124,000	increase 50% decrease 33%	>$187,000

Bid Express User Guide

- Linked in FDM 19-5-5.5.1 Primary Tools pg. 13-14
  - Linked in the Estimating Tools Pages
- Introduction – pg. 2-3
  - Start up
  - Bid Express Overview
- **Looking up bid history and bid tabulations – pg. 4-7**
  - Guidance for what to enter in bid history fields
  - Steps to review and obtain results

Bid Express User Guide

- Tips and Tricks – pg. 8-24
  - Step-by-step guides with screen captures
  - Finding proposal, project or bid information with any project or structure ID
  - Finding structure information
  - Filter and graph Bid Tab Analysis results in Excel
- Appendices – pg. 25-29
  - County and region map
  - County and region codes

Similar Project Tool Updates

- Copy Proposal IDs for BidX Button has been added
- Proposal IDs may be filtered
  - Bridge Replacement or Rehabilitations for structure items
  - Reconstruction or resurfacing/pavement replacements for sidewalk, earthwork and aggregates
  - Broad filters recommended

Similar Project Tool Updates

Bid Tab Analysis Search

Item: 502.0100

☑ Smart Item Search

Description: Any

Proposal Items: 20210608011, 20210608012, 20210608018, 20210511003, 20210511011, 20210511015, 20210511032, 2021051103

County: Any

Unit: Any

Low Bidders: Any

Plans, Proposals, Addenda and As-builts

FDM 19-5-5.5.2 Other Tools and Resources

- Let plans and proposals October 2021 and earlier
  - Plans and Proposals FTP Site
- All addenda and let plans and proposals
  - HCCI Pages
  - Let plans and proposals after October 2021 are in HCCI Pages
- As-builts on DOTView GIS Application in Geoportal
  - WisDOT staff only

Contact Information

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- Proposal Management Chief DTSD-BPD
- Rielly.ODonnell@dot.wi.gov
- (608) 266-3721

Fred Schunke
- Design QA Engineer NCR
- fred.schunke@dot.wi.gov
- (715) 421-8079

SOUTH BRIDGE CONNECTOR

Mark Maday / Jacobs
Trey Horbinski / Jacobs

WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South
Madison, WI
May 23, 2024

Brown County Public Works Department

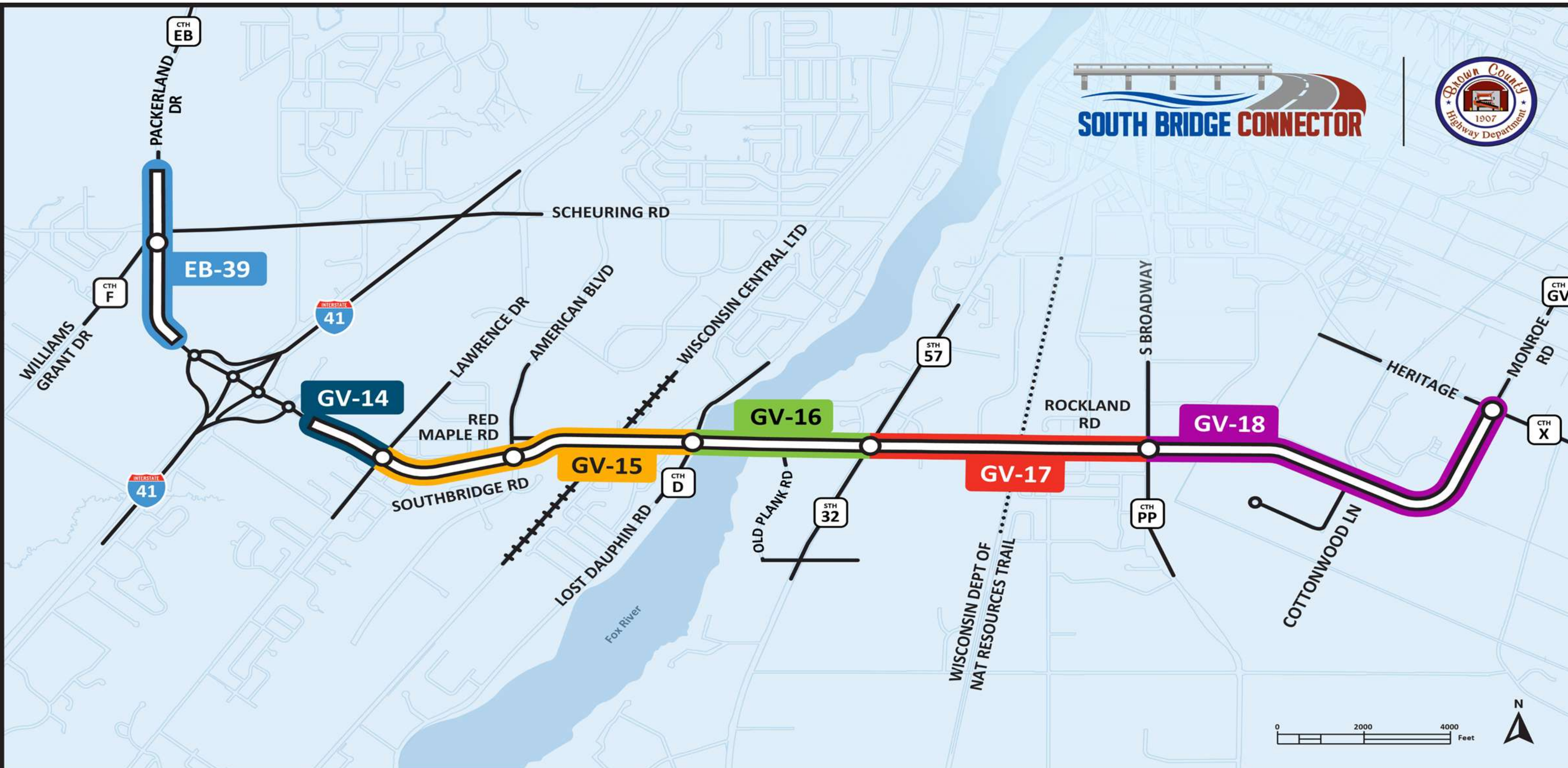
WISCONSIN DEPARTMENT OF TRANSPORTATION

BUREAU OF STRUCTURES

Jacobs

Presentation Outline

- Project Overview
- History / Project Status
- Segment GV-16
- Bridge Alternatives
- Schedule
- Infraworks Demo

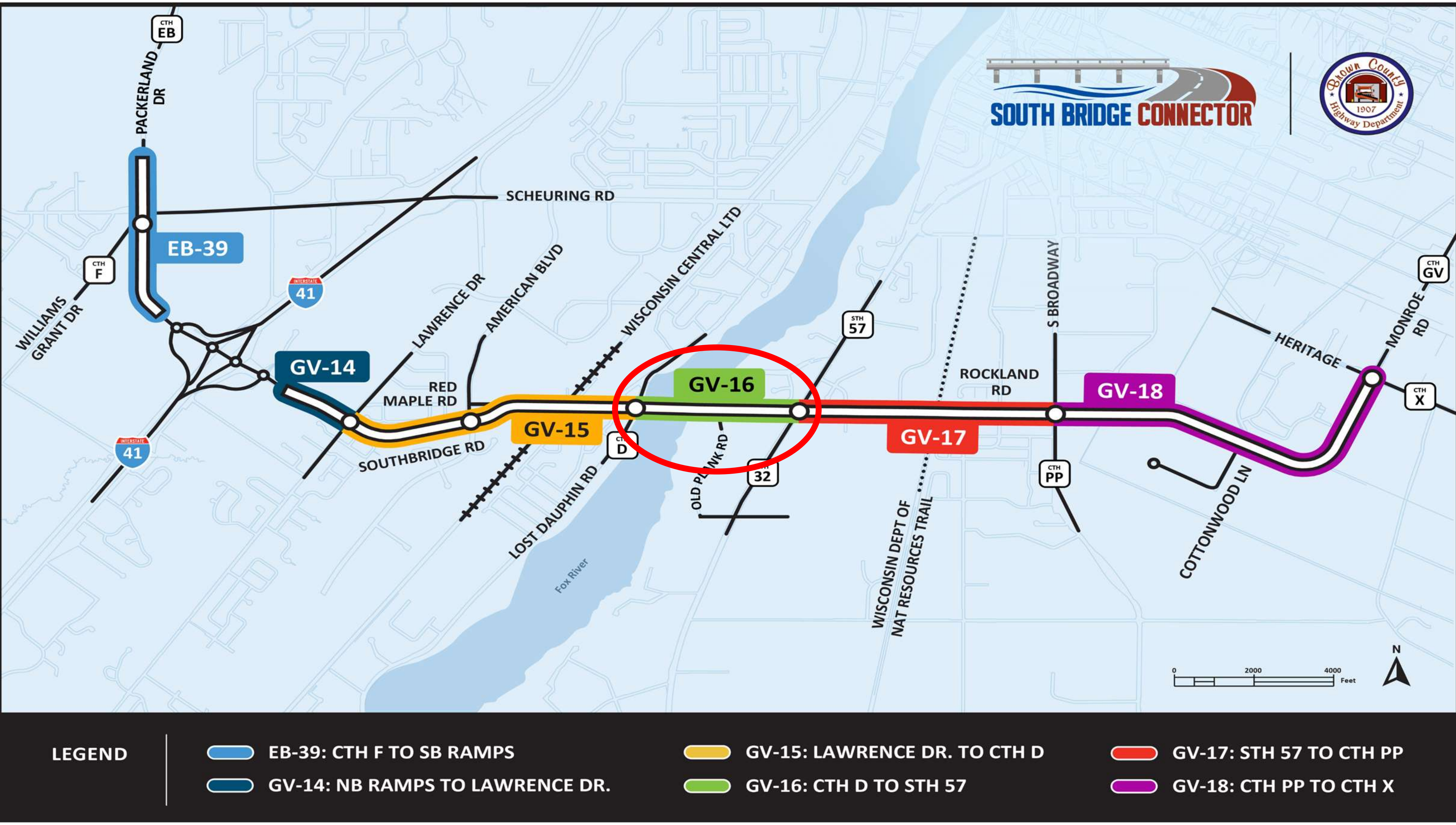


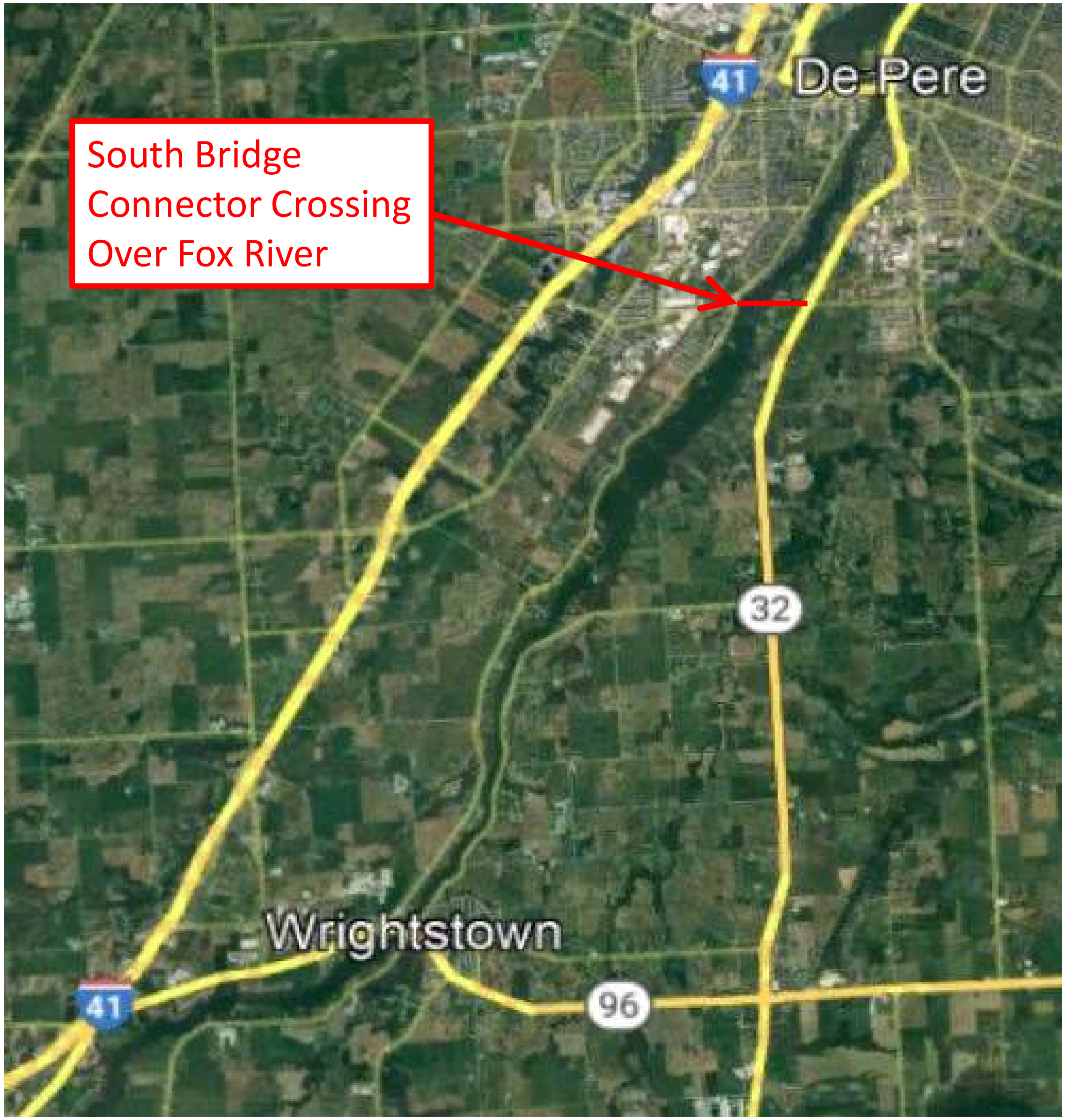
LEGEND

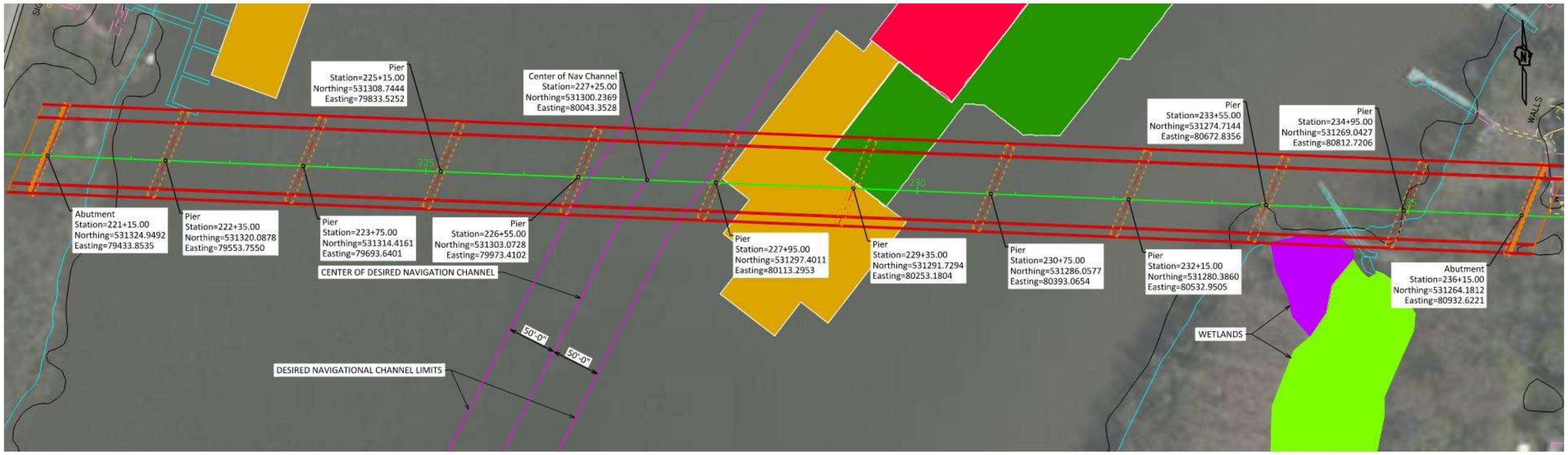
- EB-39: CTH F TO SB RAMPS
- GV-14: NB RAMPS TO LAWRENCE DR.
- GV-15: LAWRENCE DR. TO CTH D
- GV-16: CTH D TO STH 57
- GV-17: STH 57 TO CTH PP
- GV-18: CTH PP TO CTH X

SOUTH BRIDGE CONNECTOR

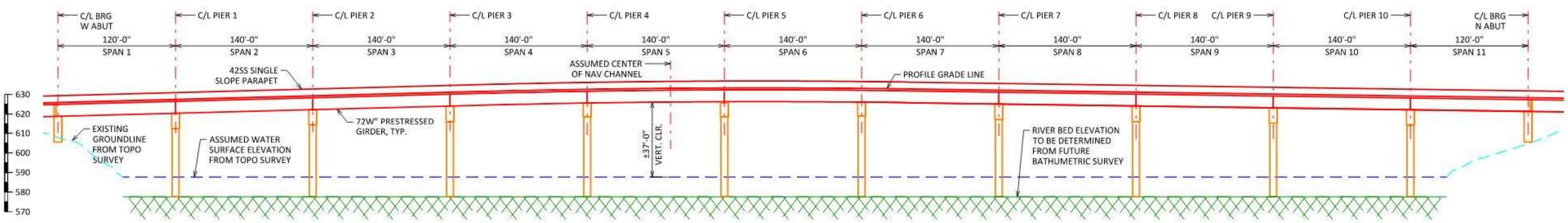
- Tier 1 EIS – ROD Obtained October, 2020
  - https://www.browncountywi.gov/departments/planning-and-land-services/planning/south-bridge-connector/
  - WisDOT Committed Construction of the I-41 / CTH GV Interchange
- $5M Federal Funding For Design / Construction, April 2022
- WisDOT Local Program Committed $50M For Construction
  - Brown County and City of DePere Local Cost Share
- Brown County Project Website:
  - https://www.browncountywi.gov/departments/highway/general-information/south-bridge-connector/


SOUTH BRIDGE CONNECTOR
Brown County Highway Department 1907
CTH EB
PACKERLAND DR
SCHEURING RD
EB-39
CTH F
41
WILLIAMS GRANT DR
GV-14
LAWRENCE DR
AMERICAN BLVD
WISCONSIN CENTRAL LTD
RED MAPLE RD
GV-15
SOUTHBRIDGE RD
CTH D
LOST DAUPHIN RD
Fox River
GV-16
OLD PLANK RD
32
STH 57
GV-17
WISCONSIN DEPT OF NAT RESOURCES TRAIL
ROCKLAND RD
S BROADWAY
CTH PP
GV-18
HERITAGE
MONROE RD
CTH GV
CTH X
COTTONWOOD LN
0 2000 4000 Feet
N
LEGEND
EB-39: CTH F TO SB RAMPS
GV-14: NB RAMPS TO LAWRENCE DR.
GV-15: LAWRENCE DR. TO CTH D
GV-16: CTH D TO STH 57
GV-17: STH 57 TO CTH PP
GV-18: CTH PP TO CTH X


41
De Pere
South Bridge
Connector Crossing
Over Fox River
32
Wrightstown
41
96



PLAN



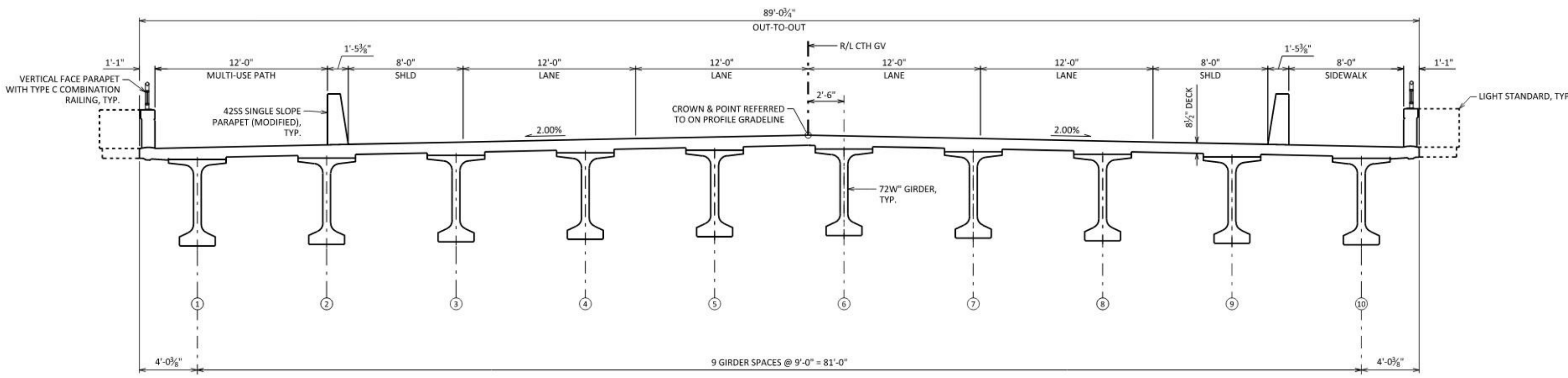
ELEVATION

ALTERNATIVE 1

OVERALL LENGTH = 1500'-0"
SPANS = 120', 140', 140', 140', 140', 140', 140', 140', 140', 140', 120'
PIERS = 10

PROJECT: SOUTH BRIDGE CONNECTOR	PROJECT ID: C9X41200	COUNTY: BROWN			

FILE NAME : C:\USERS\HORBINT\DC\ACCDOCS\JACOBS\US WI_C9X41200_SBC\PROJECT FILES\30 WIP\WORKING\STRC\ALTERNATIVE 1.DWG PLOT DATE : DECEMBER 12, 2023 PLOT BY : HORBINSKI, TREY

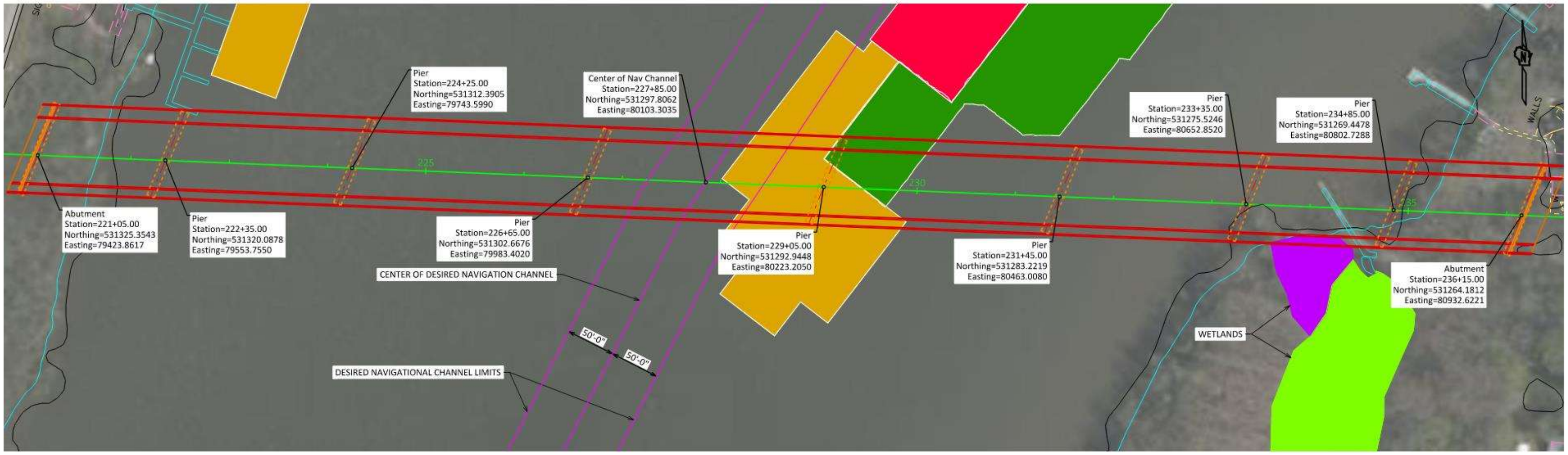


TYPICAL BRIDGE SECTION

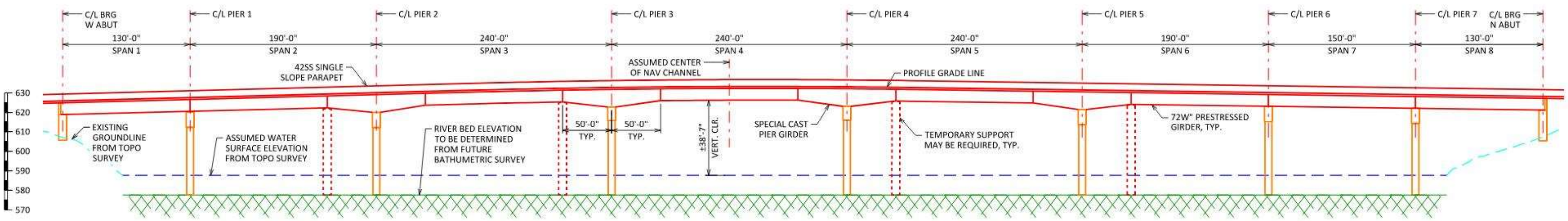
ALTERNATIVE #3

PROJECT: SOUTH BRIDGE CONNECTOR	PROJECT ID: C9X41200	COUNTY: BROWN			

FILE NAME : C:\USERS\HORBINT\DC\ACCDOCS\JACOBS\US WI_C9X41200_SBC\PROJECT FILES\30 WIP\WORKING\STRC\CONCRETE TYP SEC.DWG PLOT DATE : DECEMBER 12, 2023 PLOT BY : HORBINSKI, TREY



PLAN



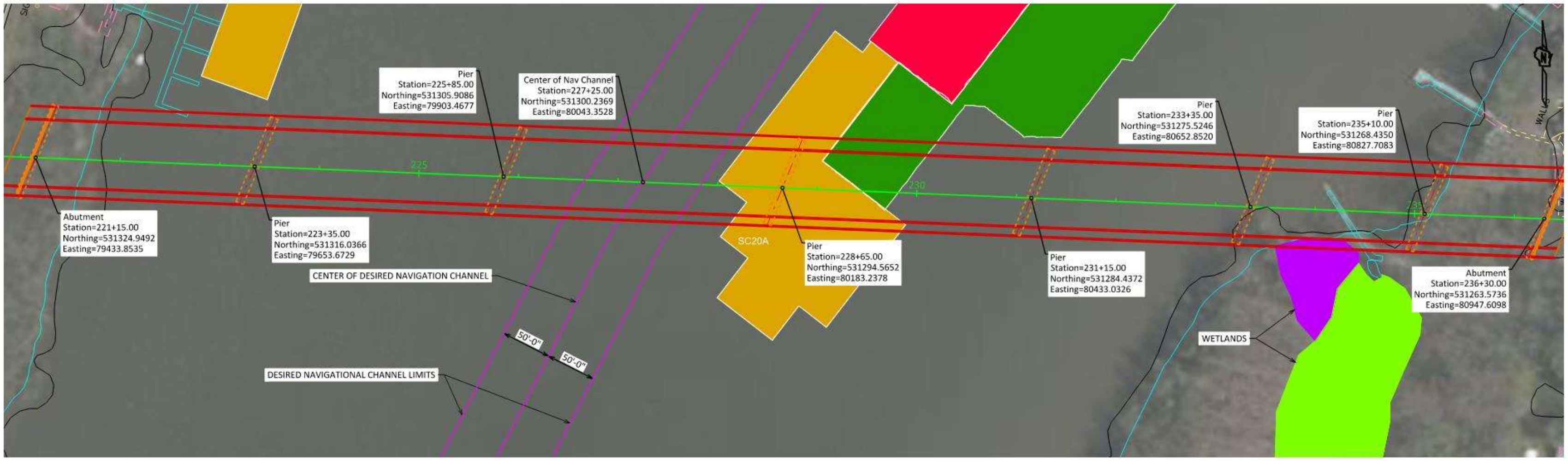
ELEVATION

ALTERNATIVE 2A

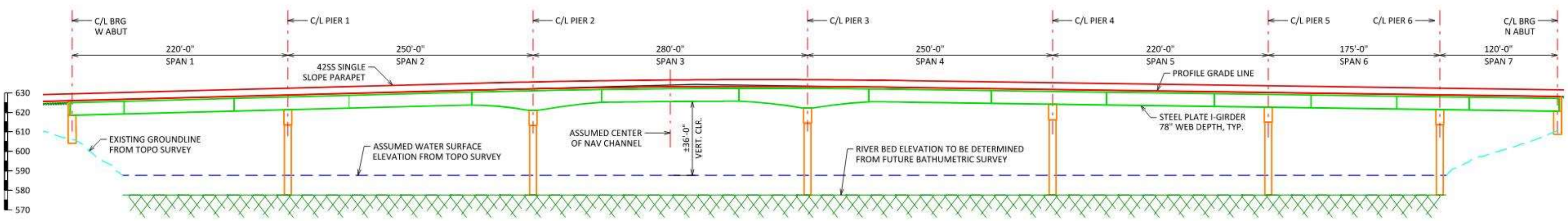
OVERALL LENGTH = 1510'-0"
SPANS = 130', 190', 240', 240', 240', 190', 150', 130'
PIERS = 7
SPECIAL CAST PIER GIRDERS AT PIERS 2, 3, 4 & 5

PROJECT: SOUTH BRIDGE CONNECTOR	PROJECT ID: C9X41200	COUNTY: BROWN			

FILE NAME : C:\USERS\HORBINT\DC\ACCDOCS\JACOBS\US WI_C9X41200_SBC\PROJECT FILES\30 WIP\WORKING\STRC\ALTERNATIVE 2A.DWG PLOT DATE : DECEMBER 12, 2023 PLOT BY : HORBINSKI, TREY



PLAN



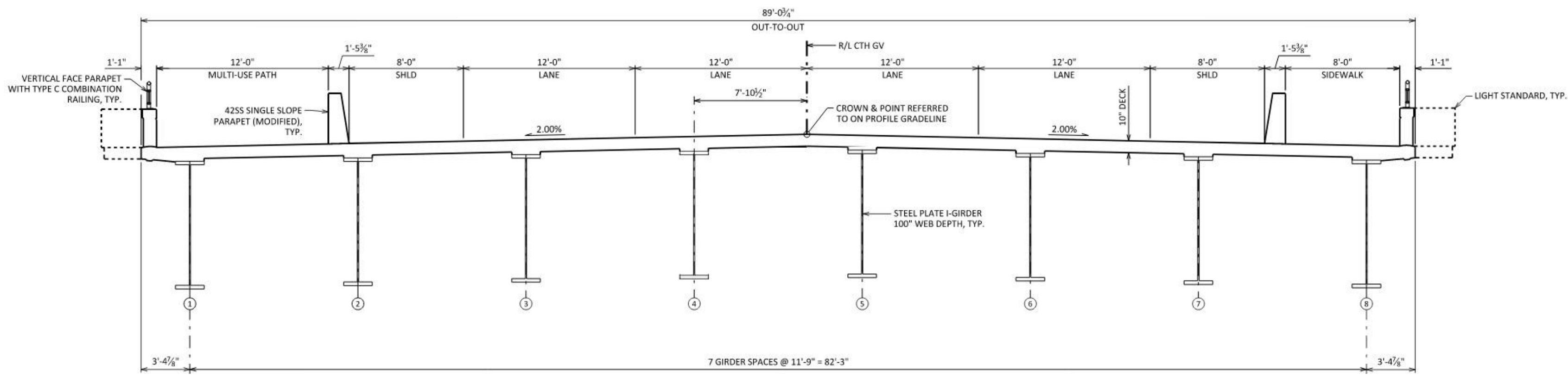
ELEVATION

ALTERNATIVE 3

OVERALL LENGTH = 1515'-0"
SPANS = 220', 250', 280', 250', 220', 175', 120'
PIERS = 6
HAUNCHED GIRDERS AT PIERS 2 & 3

PROJECT: SOUTH BRIDGE CONNECTOR	PROJECT ID: C9X41200	COUNTY: BROWN			

FILE NAME : C:\USERS\HORBINT\DC\ACCDOCS\JACOBS\US WI_C9X41200_SBC\PROJECT FILES\30 WIP\WORKING\STRC\ALTERNATIVE 3.DWG PLOT DATE : DECEMBER 12, 2023 PLOT BY : HORBINSKI, TREY



TYPICAL BRIDGE SECTION

ALTERNATIVE #3

PROJECT: SOUTH BRIDGE CONNECTOR	PROJECT ID: C9X41200	COUNTY: BROWN			

FILE NAME : C:\USERS\HORBINT\DC\ACCDOCS\JACOBS\US WI_C9X41200_SBC\PROJECT FILES\30 WIP\WORKING\STRC\BRIDGELAYOUT_MAM2.DWG PLOT DATE : DECEMBER 12, 2023 PLOT BY : HORBINSKI, TREY

SOUTH BRIDGE CONNECTOR

Segment GV-16 Project Schedule:

- Preliminary Engineering: 2024
- Final Design: 2025 - 2026
- Construction: 2027 - 2028

Brown County Public Works Department

Wisconsin Department of Transportation BUREAU OF STRUCTURES

Jacobs

Autodesk Infraworks

Conceptual Infrastructure Modeling

AUTODESK InfraWorks

Jacobs

Presentation Roadmap

- Software Overview
- Site Modeling
- Bridge Modeling
- Model Enhancements
- Sharing the Model
- Live Demo

Software Overview

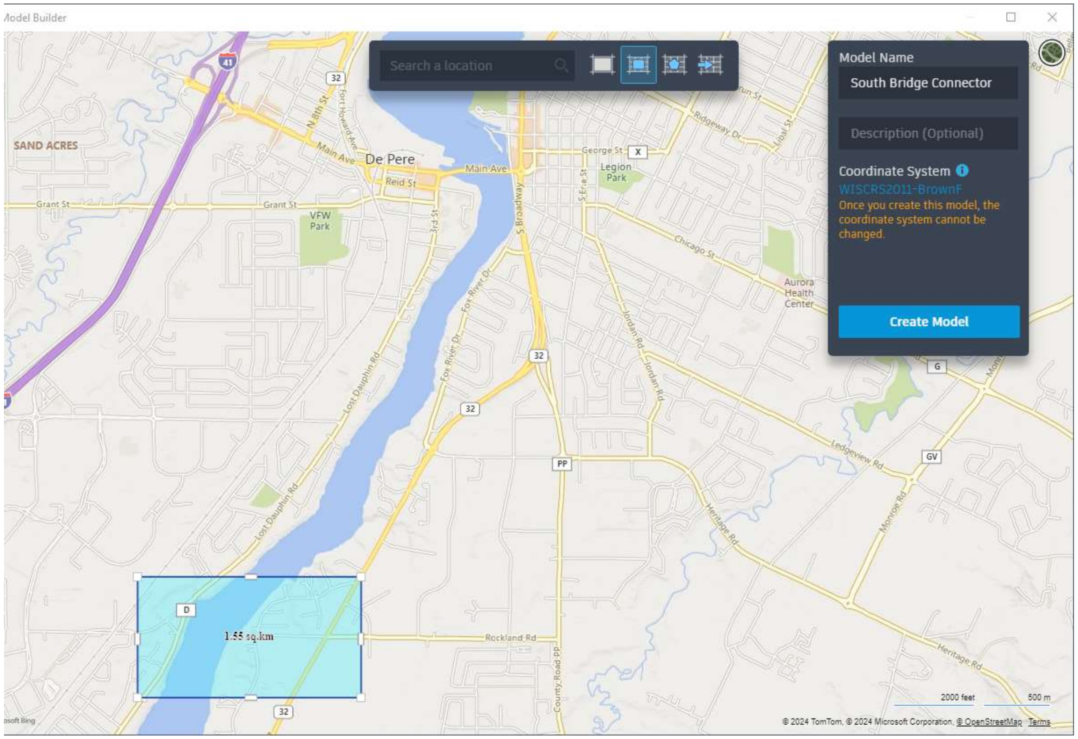
3D Civil Infrastructure	• Conceptual design of roads, structures, drainage
Purchase Options	• Standalone subscription • Bundled – part of Autodesk AEC bundle
Seamless integration with other Autodesk products	• Civil 3D • Revit
Usable "Out-of-the-box"	• Common road and bridge elements preloaded

Creating an Existing Site Model

1 Model builder tool
- Model up to 200 sq km

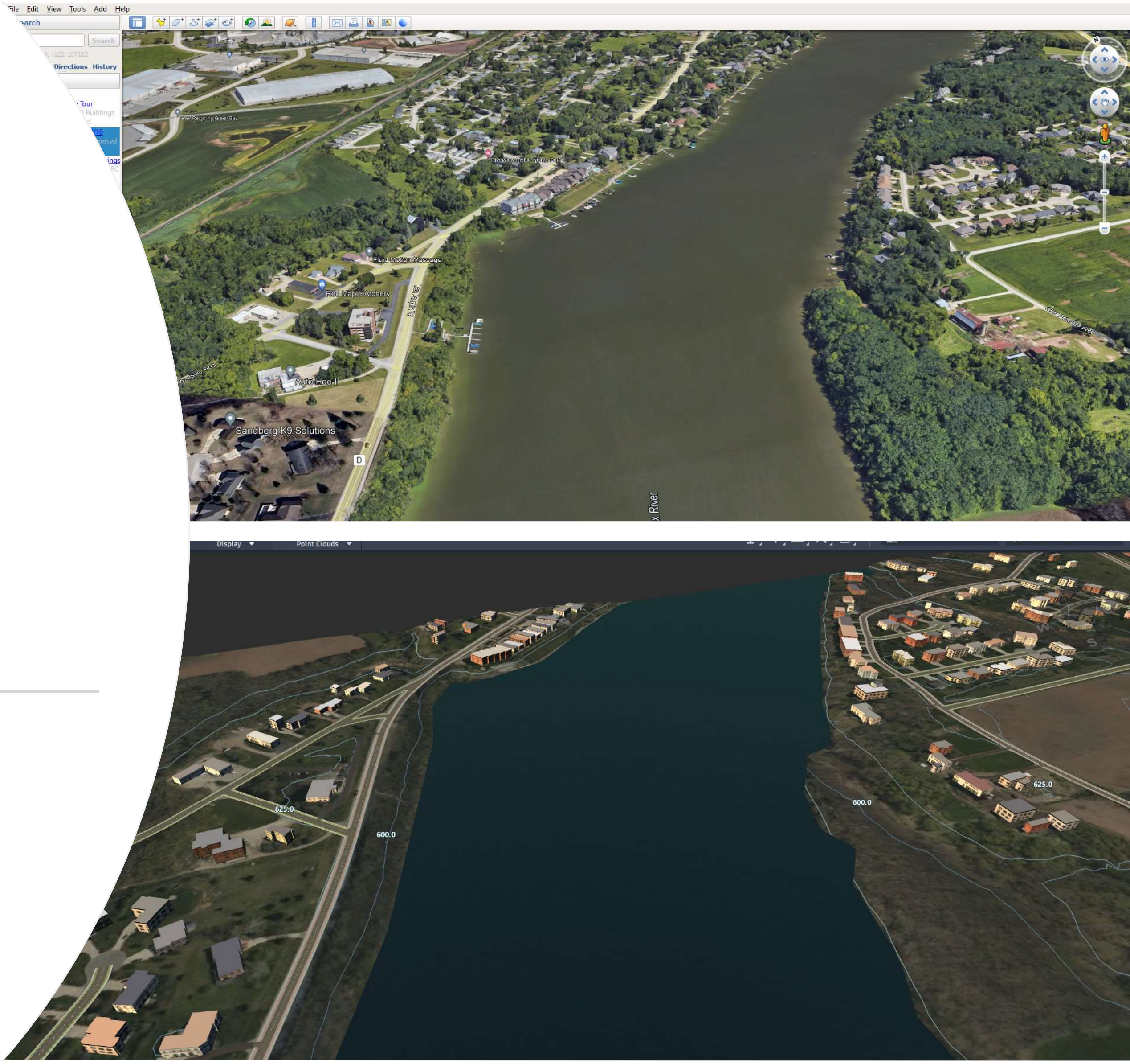
2 Minimize model size
- Improves performance

3 Create Model
- Email when created
- Available in project library



Infraworks Model Builder Tool

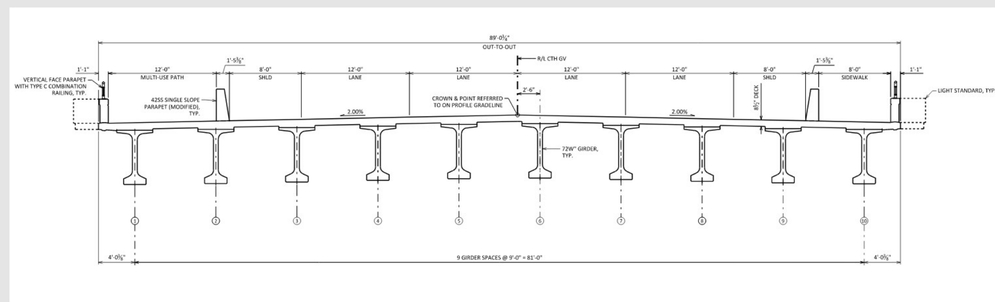
Model Builder Result



Model the Roadway

Create	Bridge alignment and profile in C3D
Import	Alignment and profile into Infraworks
Model	Typical section as road

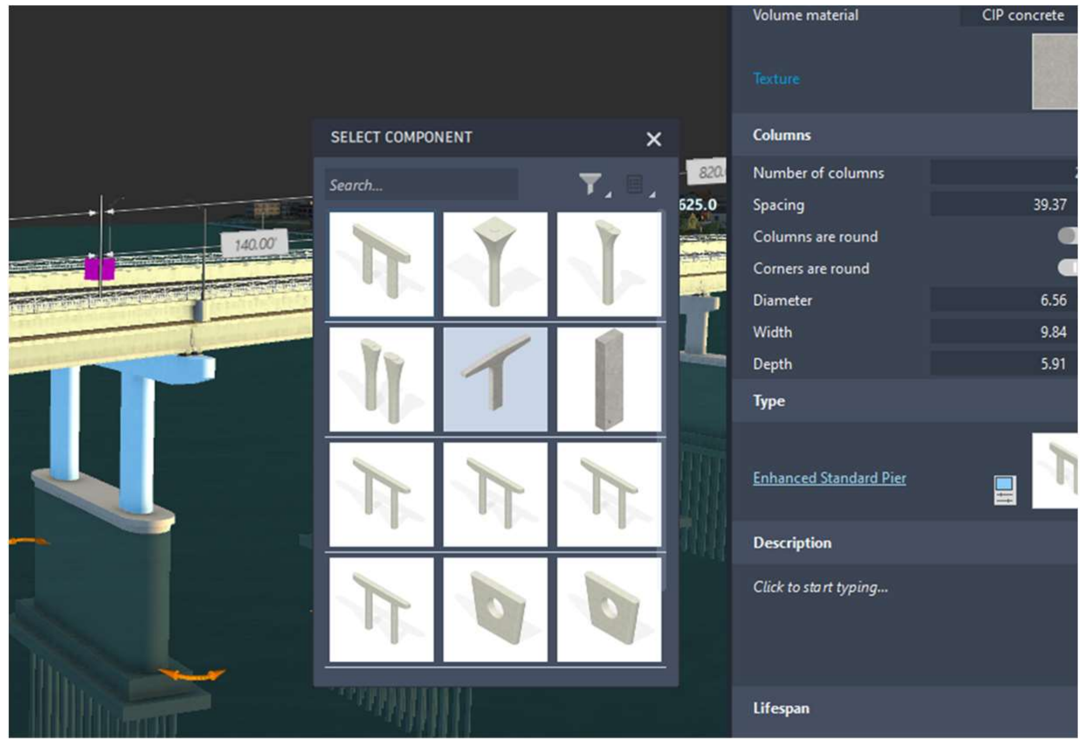
Infraworks Typical Roadway Section



TYPICAL BRIDGE SECTION

Model the Bridge

1. Create new “Proposal”
2. Layout bridge geometry
3. Customize bridge components
   - Girders
   - Piers
   - Foundations



Customizing a Bridge Pier with Default Shapes

Model Enhancements

Realistic water

Foliage

Moving vehicles*

Sun and Sky

Buildings

*with Autodesk 3DS Max

Sharing the Model

Screenshots

Drive-thru Videos

Interactive Presentation

Export as 3D Model

Infraworks Demo

Geotechnical Engineering Update

David Staab, PE
Geotechnical Engineering Unit Supervisor

Structural Engineers Symposium
UW Madison – Union South

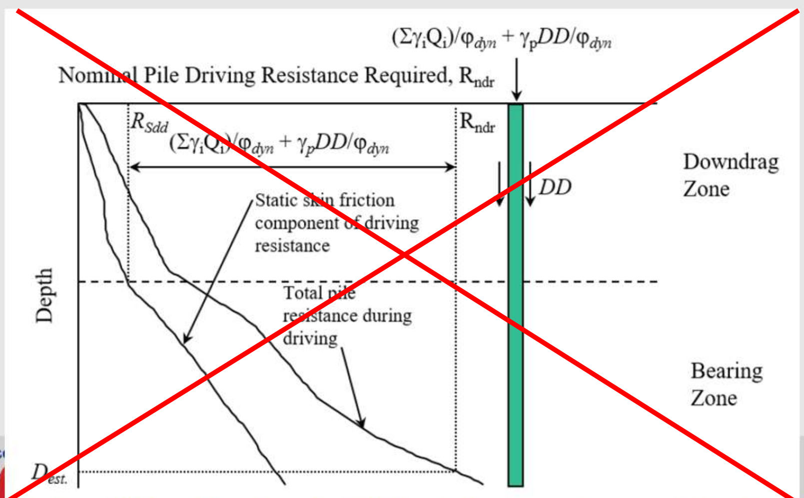
May 23, 2024

Geotechnical Engineering Unit – Staff Updates

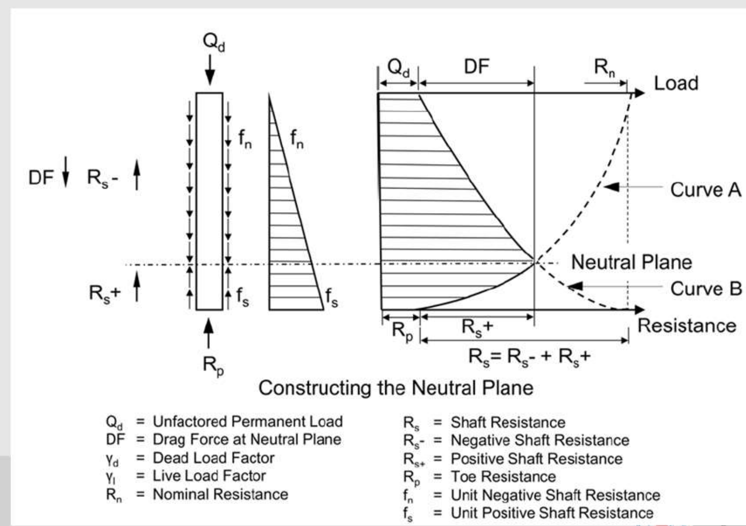
2022	2024
Bob Arndorfer (Retired June 2022)	Dave Staab, Supervisor
Jeff Horsfall (Retired April 2023)	Paulo Florio, Geotech. Eng.
Crystal Goffard	Crystal Goffard, Geotech. Eng.
Dave Staab	Tri Tran, Geotech. Eng.
Dan Reid	Dan Reid, Geologist (Retiring February 2025)

Downdrag Update

- AASHTO Bridge Manual updates to replace “Explicit Method” (3.11.8 and 10.7.1.6.2) with Neutral Plane Method.
- AASHTO Bridge Manual updates expected later in 2024



AASHTO BM, 9 Ed., Fig. C10.7.3.7.1



FHWA GEC 12, Fig. 7-49

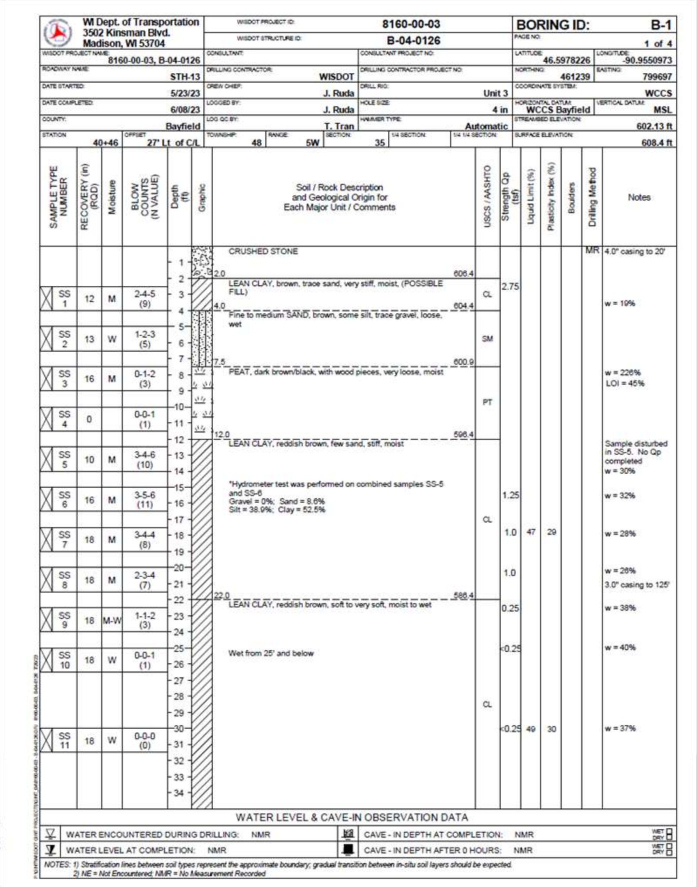
Downdrag Update

- WisDOT Bridge Manual updates to follow AASHTO BM updates.
- Neutral Plane Method has/can be used on WisDOT projects now.
- FHWA GEC 12, Section 7.3.6
- Contact BOS/BTS for assistance.

Geotechnical Data Management

gINT sunsetting in 2026

gINT boring log



WI Dept. of Transportation
3502 Kinsman Blvd.
Madison, WI 53704

WISDOT PROJECT ID: 8160-00-03	BORING ID: B-1		
WISDOT STRUCTURE ID: B-04-0126	PAGE NO: 1 of 4		
WISDOT PROJECT NAME: 8160-00-03, B-04-0126	CONSULTANT:	CONSULTANT PROJECT NO:	LATITUDE: 46.5978226 / LONGITUDE: -90.9550973
ROADWAY NAME: STH-13	DRILLING CONTRACTOR: WISDOT	DRILLING CONTRACTOR PROJECT NO:	NORTHING: 461239 / EASTING: 799697
DATE STARTED: 5/23/23	CREW CHIEF: J. Ruda	DRILL RIG: Unit 3	COORDINATE SYSTEM: WCCS
DATE COMPLETED: 6/08/23	LOGGED BY: J. Ruda	HOLE SIZE: 4 in	HORIZONTAL DATUM: WCCS Bayfield / VERTICAL DATUM: MSL
COUNTY: Bayfield	LOG QC BY: T. Tran	HAMMER TYPE: Automatic	STREAMBED ELEVATION: 602.13 ft
STATION: 40+46 / OFFSET: 27' Lt. of C/L	TOWNSHIP: 48 / RANGE: 5W / SECTION: 35	1/4 SECTION: / 1/4 1/4 SECTION:	SURFACE ELEVATION: 608.4 ft

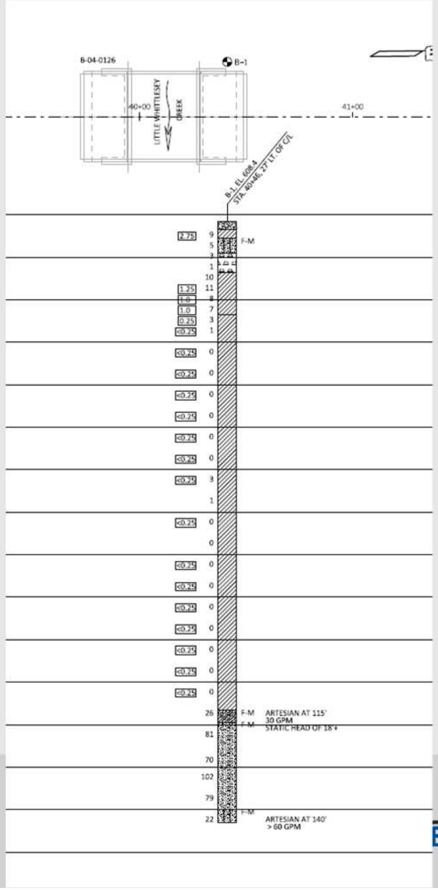
SAMPLE TYPE NUMBER	RECOVERY (in) (RQD)	Moisture	BLOW COUNTS (N VALUE)	Depth (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	USCS / AASHTO	Strength Qp (tsf)	Liquid Limit (%)	Plasticity Index (%)	Boulders	Drilling Method	Notes
				0–2.0	CRUSHED STONE (606.4)						MR	4.0" casing to 20'
SS 1	12	M	2-4-5 (9)	2.0–4.0	LEAN CLAY, brown, trace sand, very stiff, moist, (POSSIBLE FILL) (604.4)	CL	2.75					w = 19%
SS 2	13	W	1-2-3 (5)	4.0–7.5	Fine to medium SAND, brown, some silt, trace gravel, loose, wet (600.9)	SM						
SS 3	16	M	0-1-2 (3)	7.5–12.0	PEAT, dark brown/black, with wood pieces, very loose, moist (596.4)	PT						w = 226% LOI = 45%
SS 4	0		0-0-1 (1)									
SS 5	10	M	3-4-6 (10)	12.0–22.0	LEAN CLAY, reddish brown, few sand, stiff, moist	CL						Sample disturbed in SS-5. No Qp completed w = 30%
SS 6	16	M	3-5-6 (11)		*Hydrometer test was performed on combined samples SS-5 and SS-6 Gravel = 0%; Sand = 8.6% Silt = 38.9%; Clay = 52.5%		1.25					w = 32%
SS 7	18	M	3-4-4 (8)				1.0	47	29			w = 28%
SS 8	18	M	2-3-4 (7)		(586.4)		1.0					w = 26% 3.0" casing to 125'
SS 9	18	M-W	1-1-2 (3)	22.0–	LEAN CLAY, reddish brown, soft to very soft, moist to wet	CL	0.25					w = 38%
SS 10	18	W	0-0-1 (1)		Wet from 25' and below		<0.25					w = 40%
SS 11	18	W	0-0-0 (0)				<0.25	49	30			w = 37%

WATER LEVEL & CAVE-IN OBSERVATION DATA

WATER ENCOUNTERED DURING DRILLING: NMR	CAVE - IN DEPTH AT COMPLETION: NMR
WATER LEVEL AT COMPLETION: NMR	CAVE - IN DEPTH AFTER 0 HOURS: NMR

NOTES: 1) Stratification lines between soil types represent the approximate boundary; gradual transition between in-situ soil layers should be expected.
2) NE = Not Encountered; NMR = No Measurement Recorded

gINT fence log



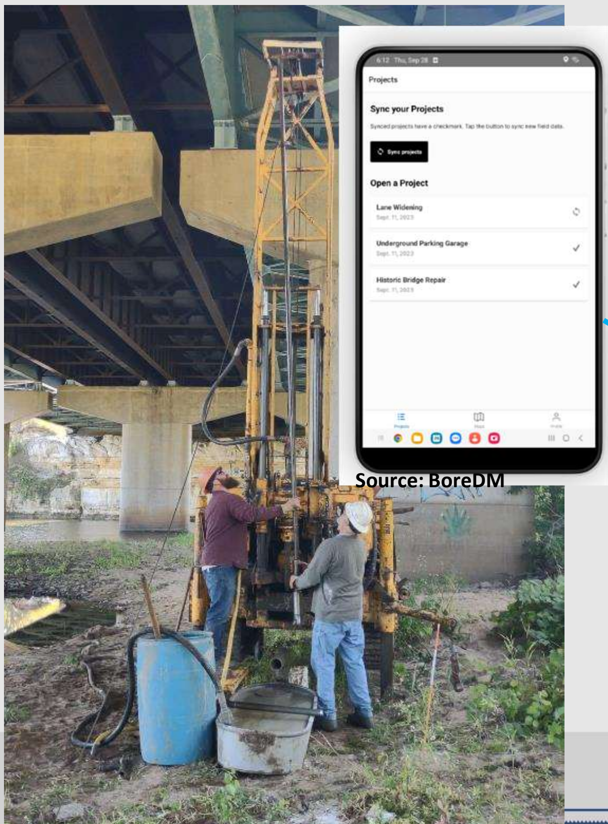
Geotechnical Data Management

gINT replacement

- 4 programs evaluated
- BoreDM selected

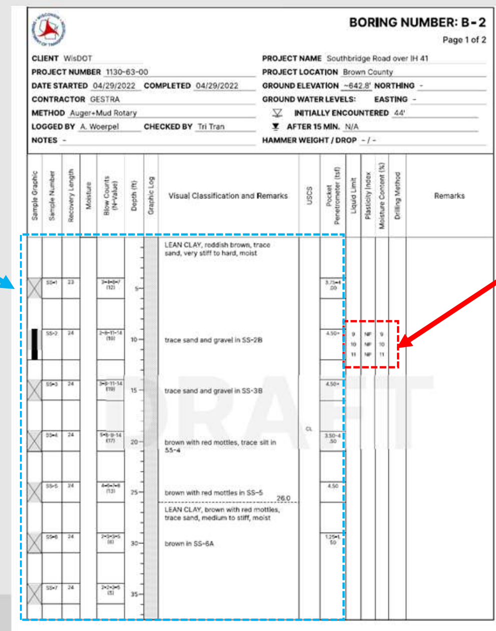
BoreDM for WisDOT

Field data collection

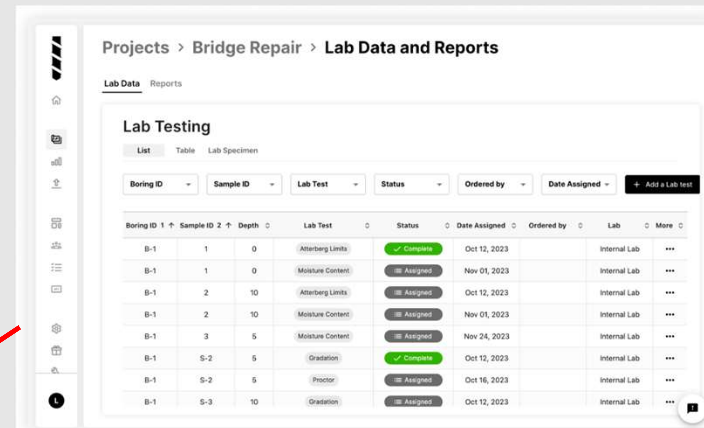


Source: BoreDM

Boring log development (gINT replacement)



Geotechnical lab data



Source: BoreDM

BoreDM for WisDOT

- Centralized storage for all geotechnical information
- Import existing WisDOT gINT files
- Import existing WisDOT PDF logs
- Reduce manual data entry/re-entry points (human error)
- Updated soil boring log heading and format

BoreDM for WisDOT

Designers may appreciate

- DXF export for CAD software (fence diagrams)
- Civil 3D API Connection (in development)

Geotechnical Data Management

DiGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

- Geo-Institute (ASCE) - DiGGS
- DiGGS for geodata is analogous to HTML for transmitting website data
- gINT replacement programs working towards DiGGS compatibility

Source: ASCE Geo-Institute

Geotechnical Data Management

Standard Practice for

Digital Interchange of Geotechnical Data

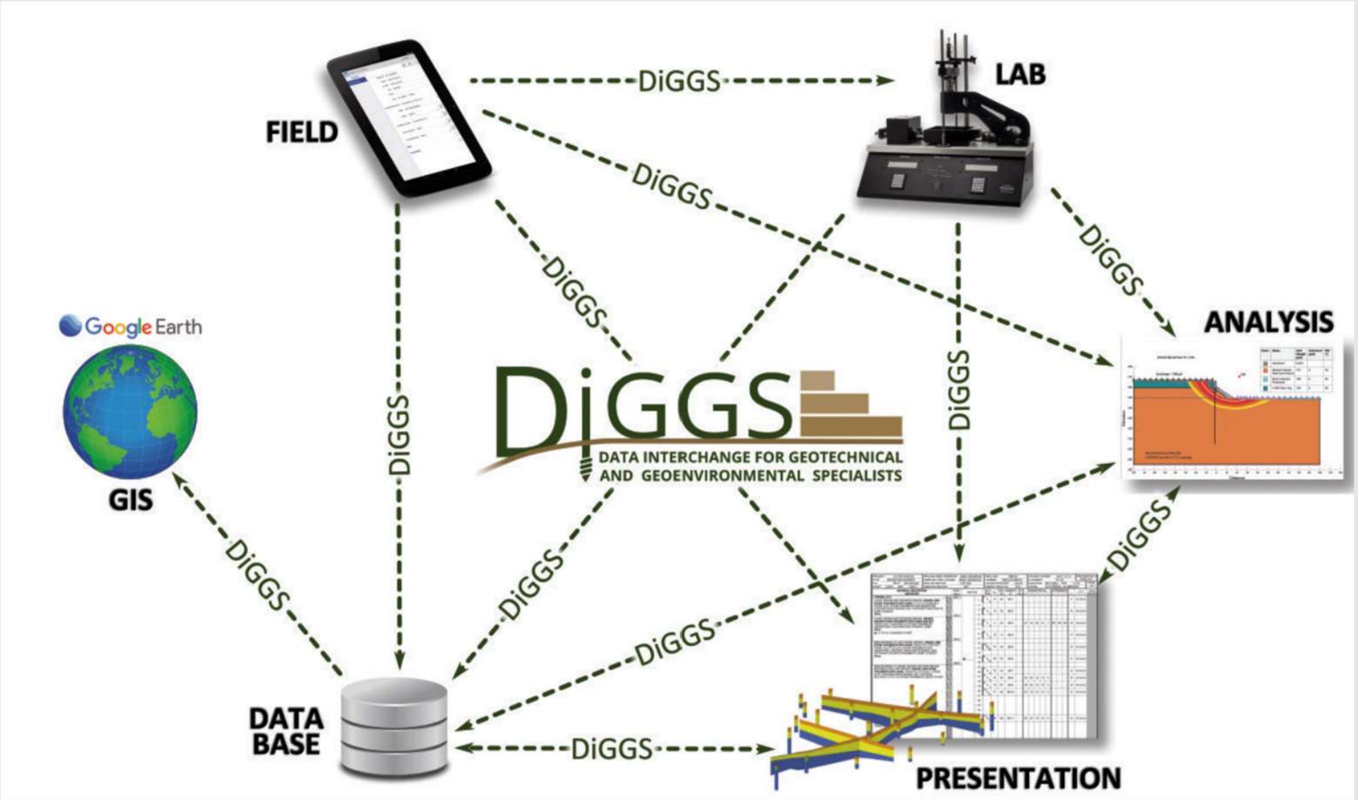
AASHTO Designation: PP 102-20 (2022)[1]

First Published: 2020 **Reviewed but Not Updated: 2022**

Technical Subcommittee: 1b, Geotechnical Exploration, Instrumentation, Stabilization, and Field Testing

4.2. Complete records of all data identified to be recorded and reported by geotechnical standard test procedures, or as specified by the Agency and conducted by the Agency or on the Agency's behalf by contracted geotechnical service providers, shall be transferred to the Agency and by the Agency in a format consistent with the DIGGS schema.

Geotechnical Data Management

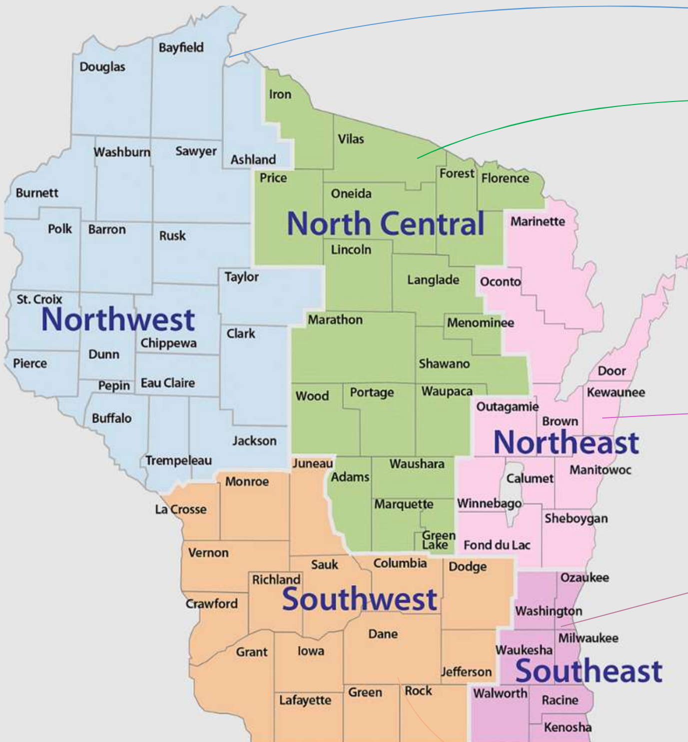


Bachus, et al., Deep Foundations, May/June 2020

WisDOT Geotechnical Data Management

- Data vs. Information
- WisDOT data will be stored and transferred using DiGGS.
- WisDOT consultant geotechnical data?
  - Expect DiGGS requirements
  - Timeframe TBD
  - Coordination, communication & education

WisDOT Geotechnical Data Management



WisDOT Geotechnical Database

Structure borings/soundings

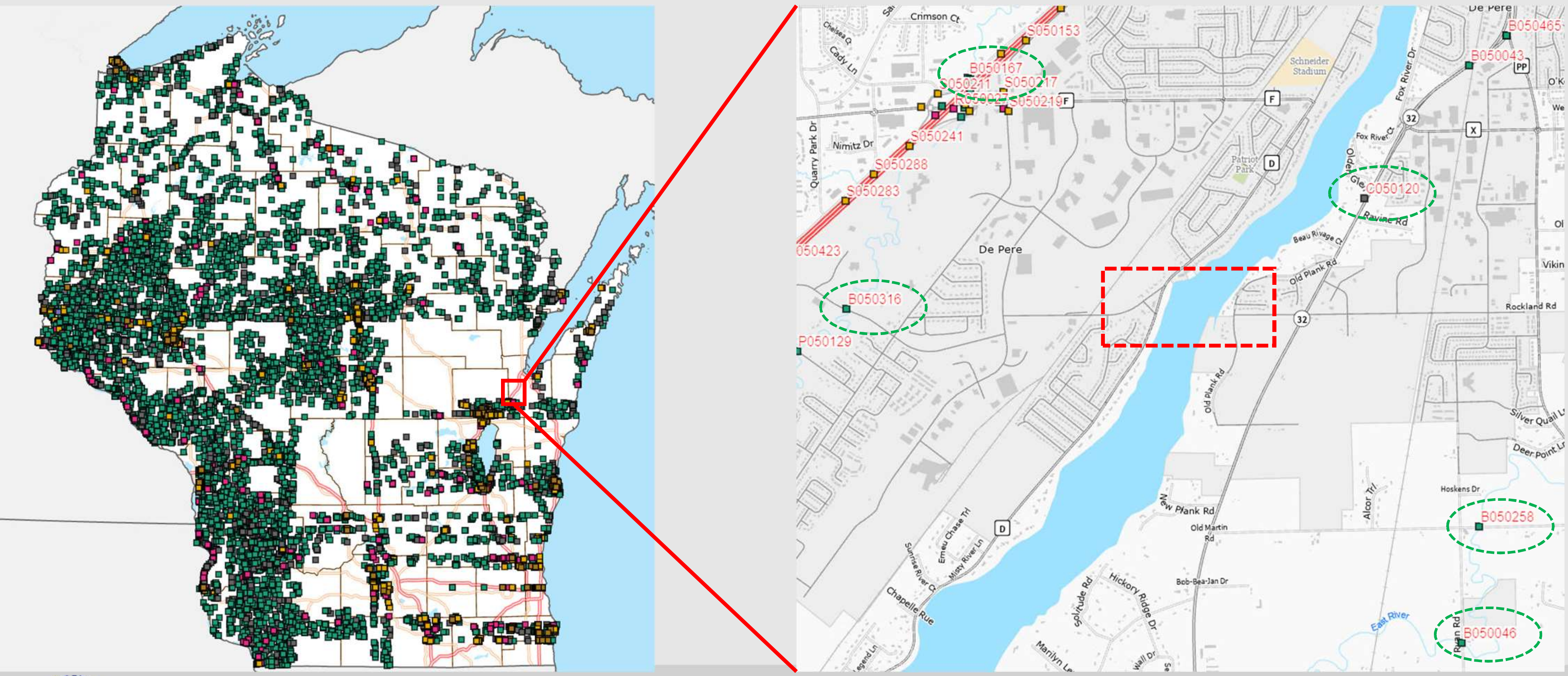
Road borings

Geotechnical lab results

Instrumentation results

Other data

Geotechnical Data Management



Questions?

David Staab, PE
david.staab@dot.wi.gov
608-246-7952

BUREAU OF STRUCTURES

CONSULTANT REVIEW

Najoua Ksontini, P.E.

Consultant Review and Hydraulics Supervisor

2024 WisDOT Structural Engineers Symposium

Consultant Review

CONTACTS

Supervisor

Najoua Ksontini

Preliminary Review

Ruth Coisman

Records Coordinator

Sarah Wright

Final Review

Steve Revello

Emily Kuehne

Max Kulick

Quality Assurance/Quality Control

QA/QC

All consultant firms providing structural design services to the Department must have a QA/QC plan on file with BOS.

The QA/QC plan should be specific to the consultant firm and should document procedures that the firm utilizes to ensure plan quality.

Refer to WisDOT BM 6.5 for items to be included in the QA/QC plan.

When to resubmit QA/QC Plan?

FALL 2024	PROCEDURE CHANGES	STAFF CHANGES

MORE INFORMATION TO COME

Preliminary Plan
REVIEW

HYDROLOGY REPORT
E-submit 60 days prior to preliminary plan submittal [WisDOT BM Chapter 6.5]

NON-STANDARD DESIGNS
contact Ruth ahead of submittal

- not following abutment tables
- 3-sided structures
- <0.5% grade [state system]
- high skew
- lack of freeboard
- shallow foundations
- open railing [state system]
- high level aesthetics
- doing something weird

PRIORITIZING
let Najoua know ahead of time, but we can’t accommodate everyone’s schedule

DNR INITIAL CONCURRENCE LETTER
include with preliminary plan submittal

SIZING REPORT
include scour calculations [WisDOT BM Chapter 8 Appendix A]

Final Plan

REVIEW

ON-TIME SUBMITTAL IMPROVEMENT FORM
when final plans submitted <2 months prior to PS&E

GEOTECH REPORT
include with final plan submittal, make sure it is latest and greatest

PRELIMINARY PLAN
include responses to preliminary plan comments

RATING SPREADSHEET
no longer required

LOAD RATING SUMMARY FORM
complete FAST Act Emergency Vehicles when:

[WisDOT BM Chapter 45]

HL-93 INVENTORY < 0.9

HS-20 INVENTORY < 20

UPDATES

- Final Consultant Performance Evaluation Report ★★☆
  BOS no longer completing

REMINDERS

- don’t count on BOS to be your QA/QC
  include plan initials for both preliminary and final plans
- preliminary plan review status
  contact Ruth and Najoua, not consultant reviewers
- Removing Structure bid items
  [WisDOT BM 6.3.3.8]

Thank You!

Questions?

FHWA Updates

WisDOT Structural Engineers Symposium

Derek Soden, Principal Structural Engineer

May 23, 2024

U.S. Department of Transportation
Federal Highway Administration

Disclaimer

Except for the statutes and regulations cited, the contents of this presentation do not have the force and effect of law and are not meant to bind the States or the public in any way. This presentation is intended only to provide information regarding existing requirements under the law or agency policies.

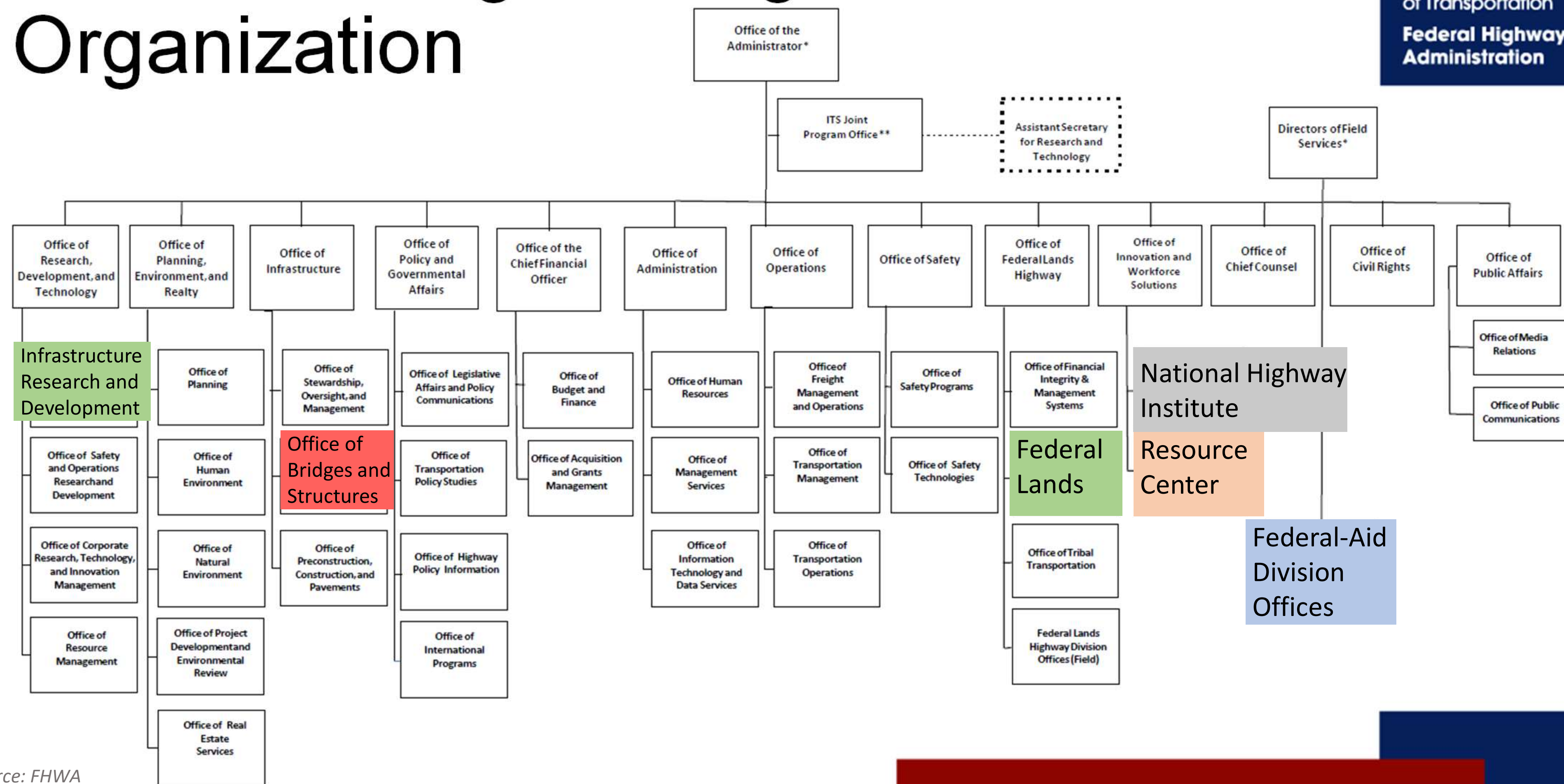
Unless otherwise noted, FHWA is the source for all images in this presentation.

U.S. Department of Transportation
Federal Highway Administration

Agenda

- FHWA Structural Engineering Organization
- Bridge and Tunnel Safety and Funding Programs
- Recent Bridge Issues
  - Fern Hollow Bridge, NTSB Final Report

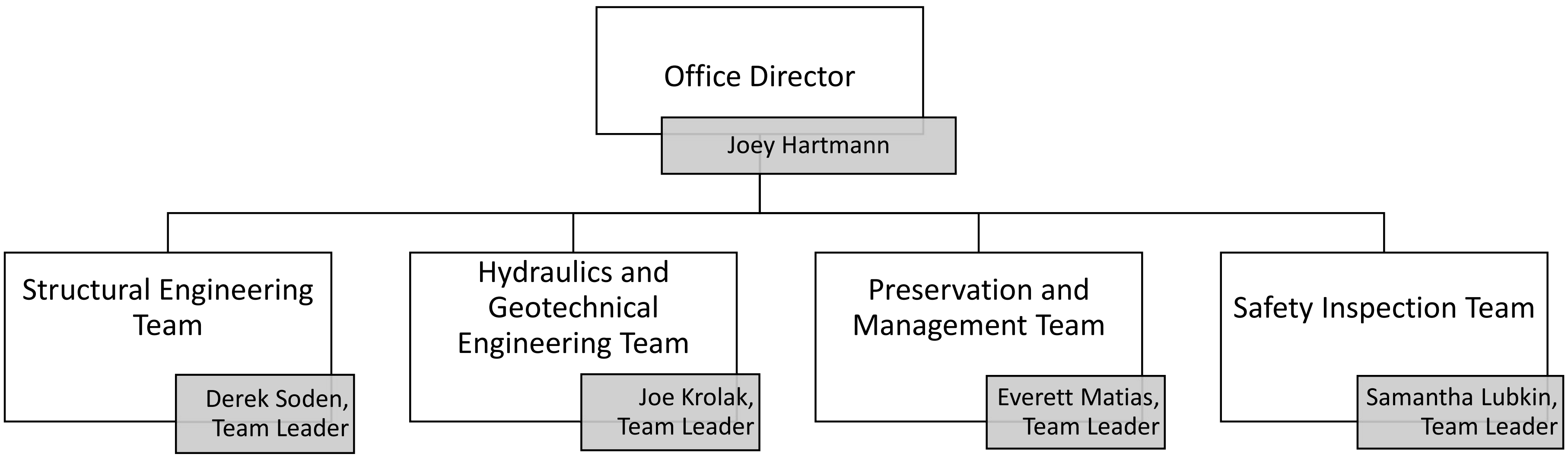
Structural Engineering in the FHWA Organization



U.S. Department of Transportation
Federal Highway Administration

Source: FHWA

FHWA Office of Bridges and Structures



Bridge and Tunnel Safety and Funding Programs

- National Bridge Inspection Standards – 2022 Final Rulemaking
- Bridge Formula Program
- Bridge Investment Program

2022 NBIS Rulemaking

- Published in the Federal Register May 6, 2022 (87 FR 27396)
- Became effective June 6, 2022
  - Load rating provisions effective as of that date
- Incorporation of the Specifications for the National Bridge Inventory (SNBI)
  - Replaces the 1995 "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges"
  - Full implementation by 2028[1]

[1] See FHWA's May 25, 2022 Memorandum "Implementation of the Specifications for the National Bridge Inventory" for more information

BFP: Bridge Formula Program

Purpose	Bridge replacement, rehabilitation, preservation, protection, and construction
Funding	**$27.5 B** (FY 22-26), apportioned to the States, **$5.5 B** per Fiscal Year

Eligible projects	• Highway bridge projects on public roads including:
	  • Replacement, Rehabilitation, Preservation, Protection, or Construction
	• BFP funding may be used on:
	  • Any highway bridge that is listed in the National Bridge Inventory (NBI), or
	  • Any new highway bridge that upon the completion of construction would meet the definition of a highway bridge and would be required to be reported to the NBI

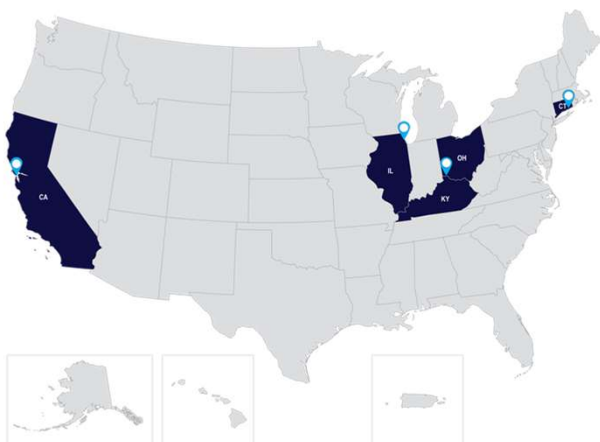
Ineligible Projects	• NBIS bridge inspections • Load rating and posting of bridges • Non-highway bridge projects
Other Key Provisions	• 100 percent Federal share for costs reimbursed with BFP funds under this program for an off-system highway bridge owned by a county, town, township, city, municipality or other local agency, or federally-recognized Tribe

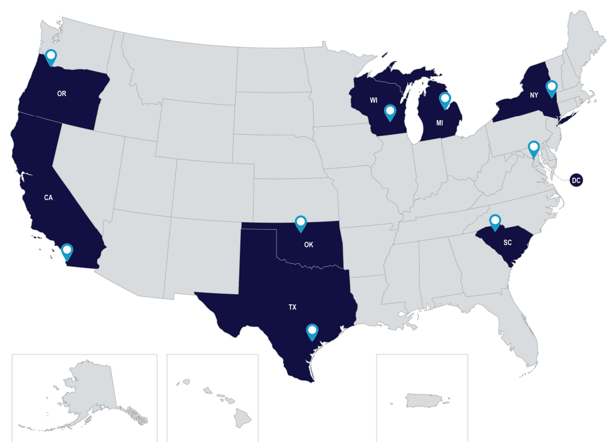
See FHWA's Jan. 14, 2022, BFP Implementation Guidance for additional information.

BIP: Bridge Investment Program (discretionary grants)

Purpose	Improve bridge (and culvert) condition, safety, efficiency, and reliability
Funding	**$12.5 B** (FY 22-26), including— • $3.3 B (FY 22-26) in Contract Authority from the Highway Trust Fund (HTF); and • $9.2 B (FY 22-26) in advance appropriations from the General Fund (GF)
Eligible entities	• State, MPO (w/ pop. >200K), Local government, Special purpose district/public authority with a transportation function, Federal land management agency, or Tribal government
Eligible projects	• Project to replace, rehabilitate, preserve or protect **one or more bridges on the NBI** • Project to replace or rehabilitate culverts to improve flood control and improve habitat connectivity for aquatic species
Other key provisions	• **Large Bridge Projects (>$100M)** are eligible for up to 50% of project costs and have the option for multi-year funding agreements • **Bridge Projects (≤$100M)** are eligible for up to 80% of project costs • Sets aside of $20M per FY for **Planning grants** • Sets aside of $40M per FY for Tribal transportation bridges

FY 2022 Bridge Investment Program





<u>Large Bridge Projects</u>
- $2.1 billion
- 4 Projects in 5 States
  - Brent Spence Bridge (KY, OH)
  - Golden Gate Bridge (CA)
  - Gold Star Mem. Bridge (CT)
  - Calumet River Bridges (IL)

<u>Bridge Projects</u>
- $296 million
- 9 Projects in 9 States

<u>Planning Grants</u>
- $20 million (statutory set-aside)
- 24 Projects in 24 States, including:
  - Interstate Replacement Bridge (OR)
  - Cape Cod Bridges (MA)
  - East River Bridges (NY)

Review and Selection Process

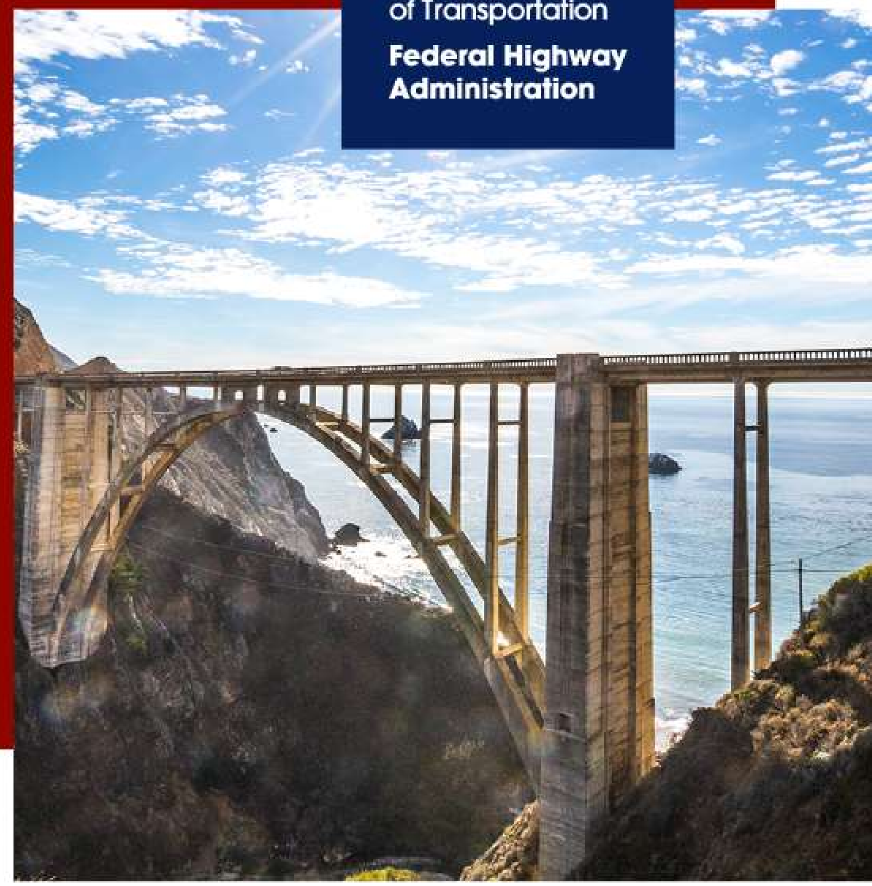
U.S. Department of Transportation
Federal Highway Administration

- Application Intake and Eligibility Review – Large Bridge Projects
  - Applications submitted before the applicable application deadline will be considered for the current review cycle
    - November 27, 2023, for FY23/24 Funding Cycle
    - August 1, 2024, for FY25 Funding Cycle
    - August 1, 2025, for FY 26 Funding Cycle
- Application Intake and Eligibility Review – Bridge Projects
  - Applications submitted before the applicable application deadline will be considered for the current review cycle
    - March 19, 2024, for FY23/24 Funding Cycle
    - November 1, 2024, for FY25 Funding Cycle
    - November 1, 2025, for FY 26 Funding Cycle

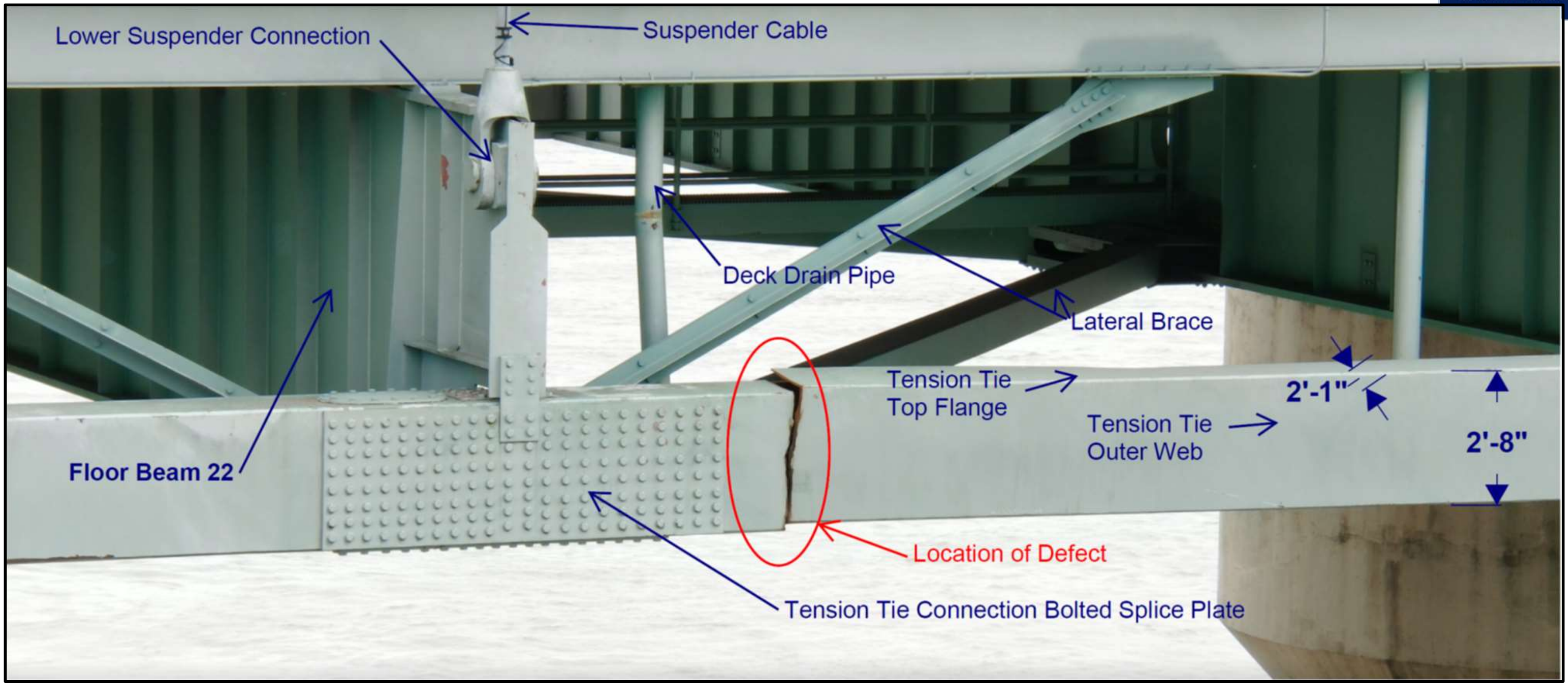
Recent Bridge Issues

- Hernando DeSoto Bridge (2021)
- Fern Hollow Bridge (2022)
- Washington Bridge (2023)
- Francis Scott Key Bridge (2024)

U.S. Department of Transportation
Federal Highway Administration



Hernando de Soto Bridge – Tie Girder Fracture (2021)



Source: Michael Baker International

December 13, 2021 FHWA Memo

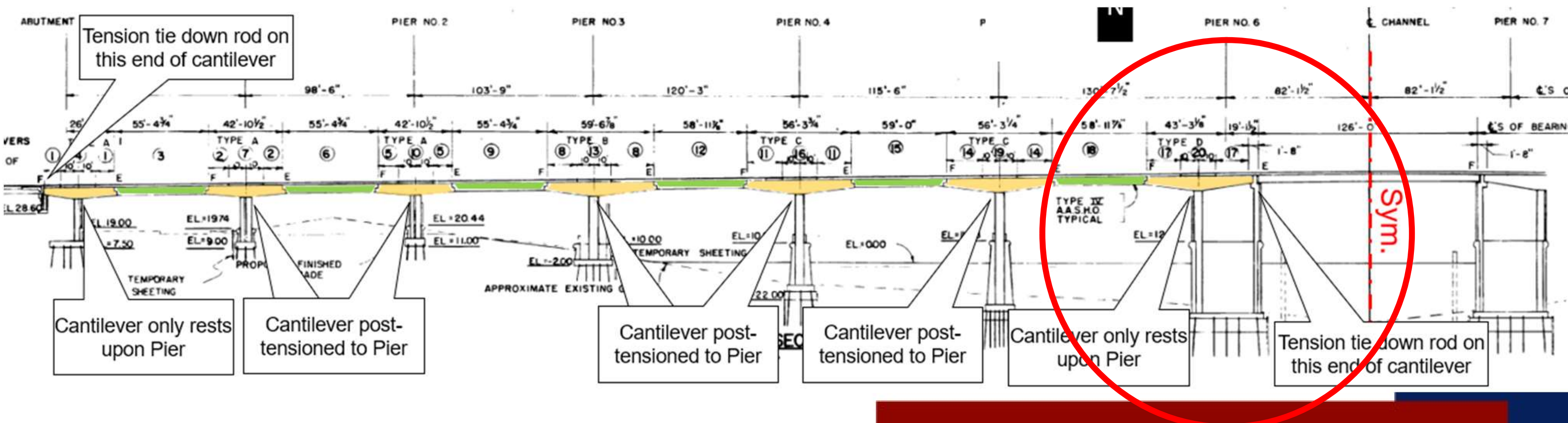
U.S. Department of Transportation
Federal Highway Administration

- Non-Destructive Testing of Fracture Critical Members Fabricated from AASHTO M244 Grade 100 (ASTM A514/A517) Steel
- *Requires* that State DOTs:
    - Identify bridges with fracture critical members fabricated from T-1 steel without requirements to meet the provisions of the AASHTO/AWS FCP and document them in the FCM inspection procedures[1]
    - Supplement hands-on inspection of T-1 FCMs with Non-Destructive Evaluation verifying the soundness of butt welds in tension[2]
        - Unless previous verification has been documented
        - Previous verification needs have been performed a minimum of 48 hours after original welding ($\leq$ 2" thick, 72 hours for $>$ 2" thick)
        - Complete testing by March 31, 2024
    - Classify rejectable indications (using AASHTO/AWS criteria) as critical findings[3]
    - By March 31, 2022, Report an inventory of bridges with T-1 FCMs and actions taken to perform verification and follow up on findings[4]
        - Update reporting data at six-month intervals

[1] 23 CFR 1.36, 23 CFR 650.313
[2] 23 CFR 1.36, 23 CFR 650.313
[3] 23 CFR 1.36, 23 CFR 650.313
[4] 23 CFR 1.36, 23 CFR 650.315

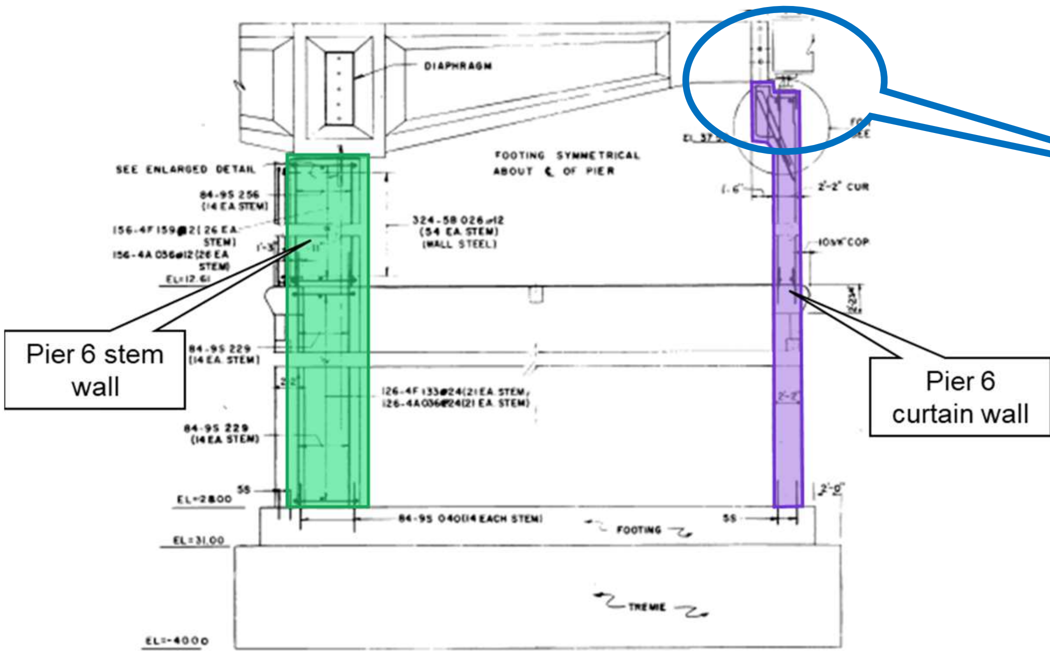
Washington Bridge Closure (2023)

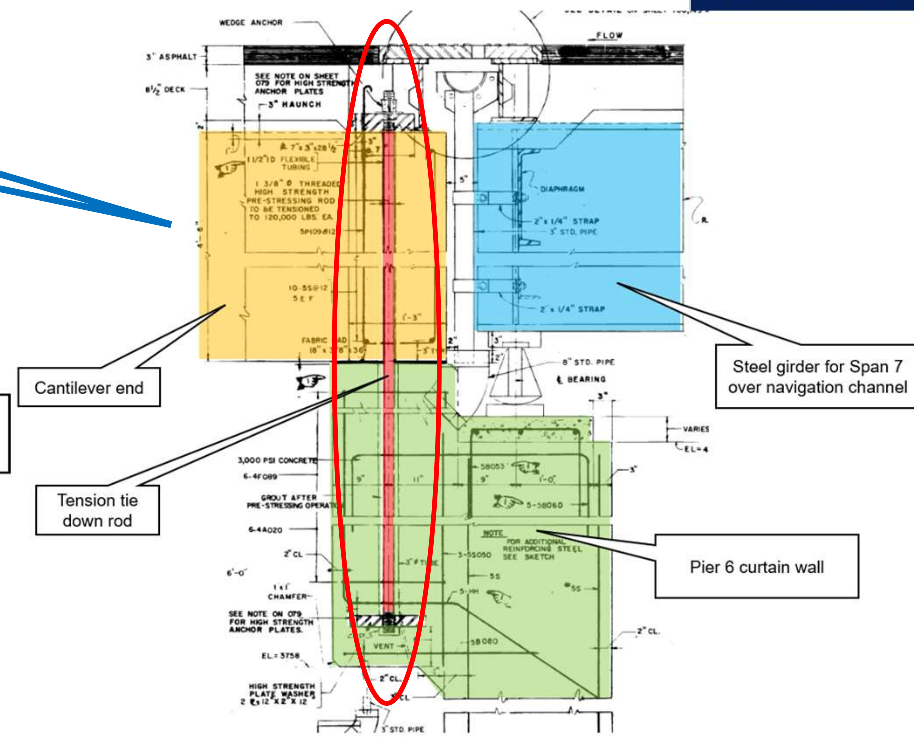
- Carries I-195 over the Seekonk River in Providence, Rhode Island
- Emergency closure, December 2023
- Bridge Details
  - 13 spans, 1,904' total length
  - Prestressed concrete cantilever and drop-in spans, with one steel span



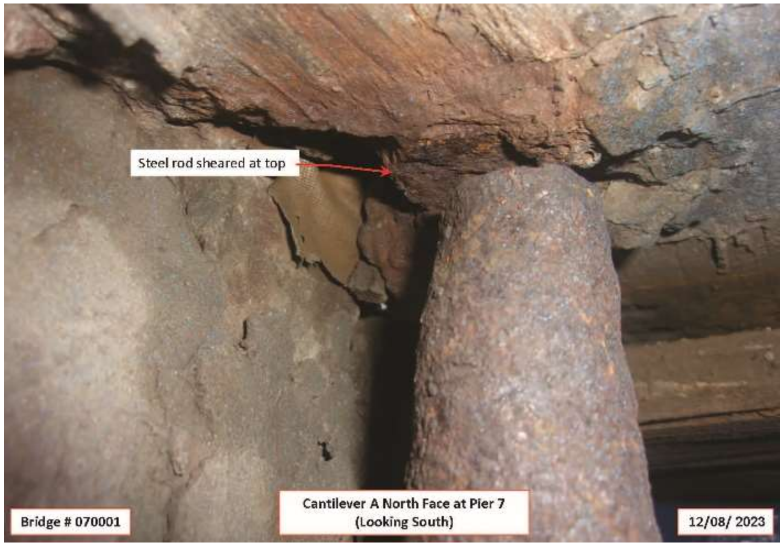
Washington Bridge Details

U.S. Department of Transportation
Federal Highway Administration





Tie Rod Conditions, December 2023



Fern Hollow Bridge Collapse

- January 28, 2022
- Pittsburgh, Pennsylvania
  - Forbes Avenue over Nine Mile Run in Frick Park
- 6 injuries (2 serious)
- 3-span rigid (K) frame 442'-8" in length
  - Constructed 1972-1973
- Fracture Critical (NSTM) Bridge
- Poor Condition (annual inspections)
- Posted at 26 tons

NTSB Report and Docket

The main accident page and link to final report is at:

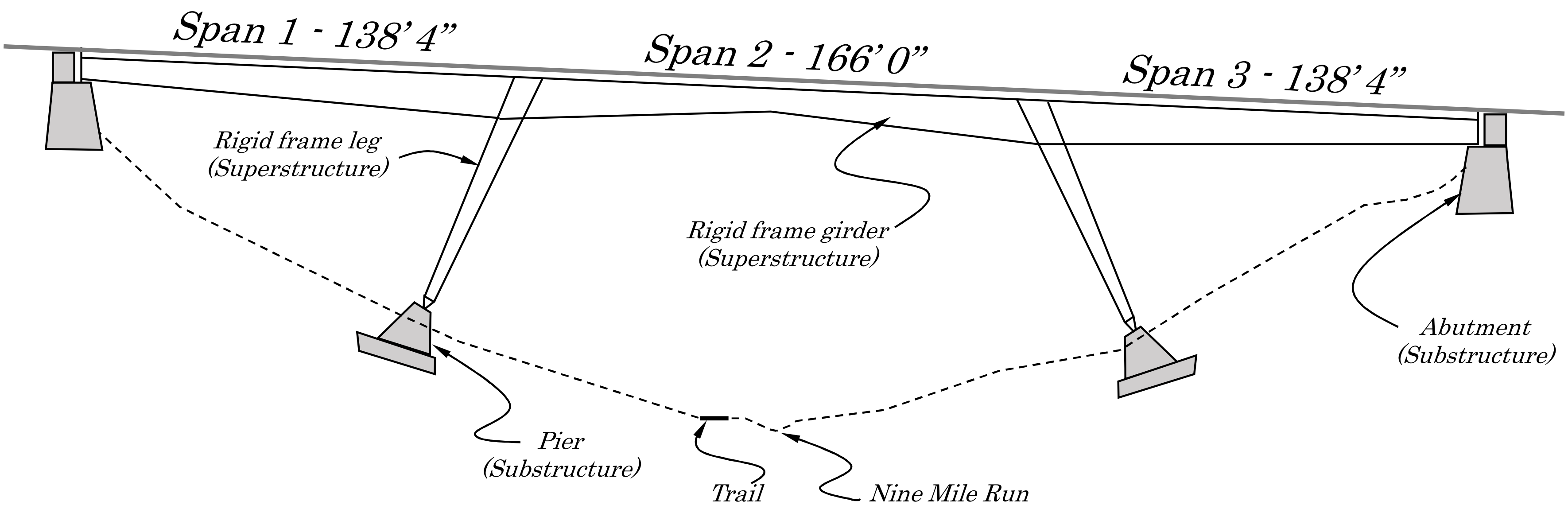
https://www.ntsb.gov/investigations/Pages/HWY22MH003.aspx

The docket is at:

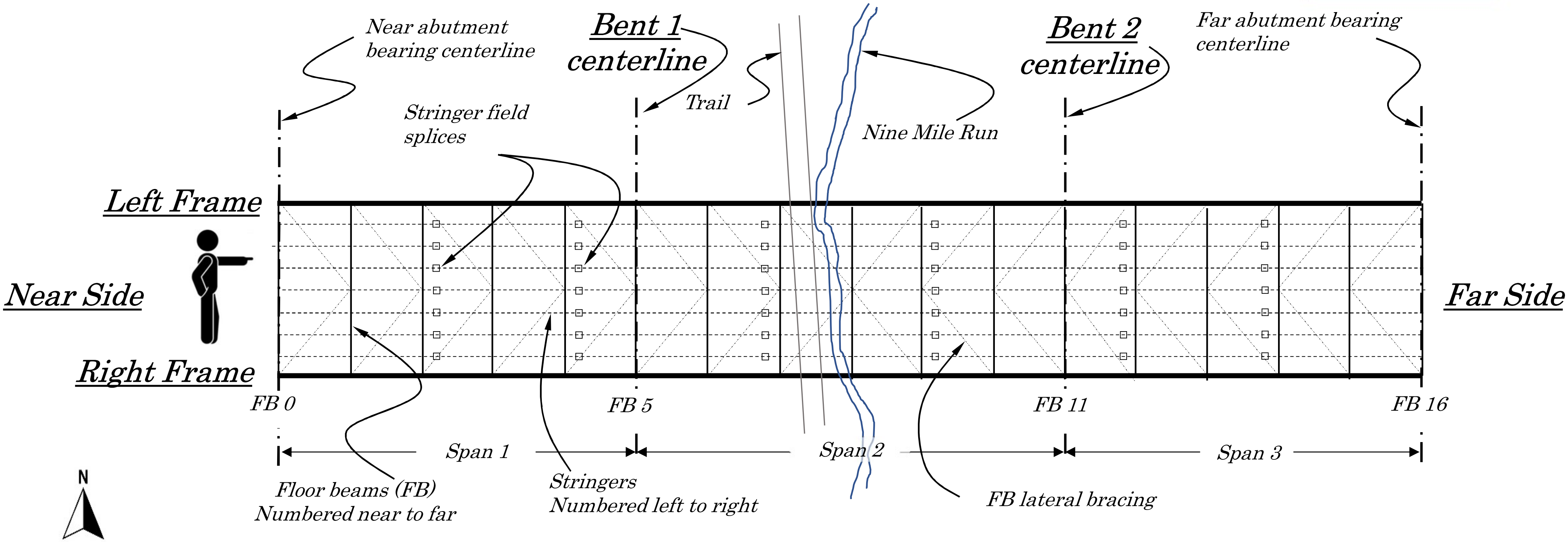
https://data.ntsb.gov/Docket/?NTSBNumber=HWY22MH003

- “Forbes Avenue over Fern Hollow Bridge Collapse Investigation – Assessment of Bridge Inspection and Load Rating”
- “Materials Laboratory Factual Report 23-036,” Appendix A and Appendix B

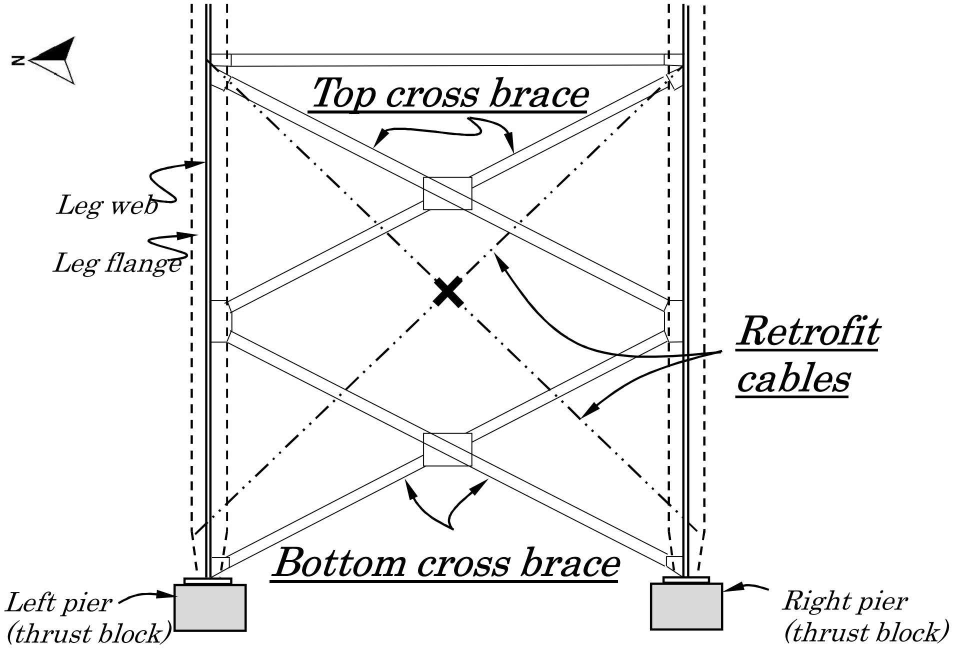
Bridge Description

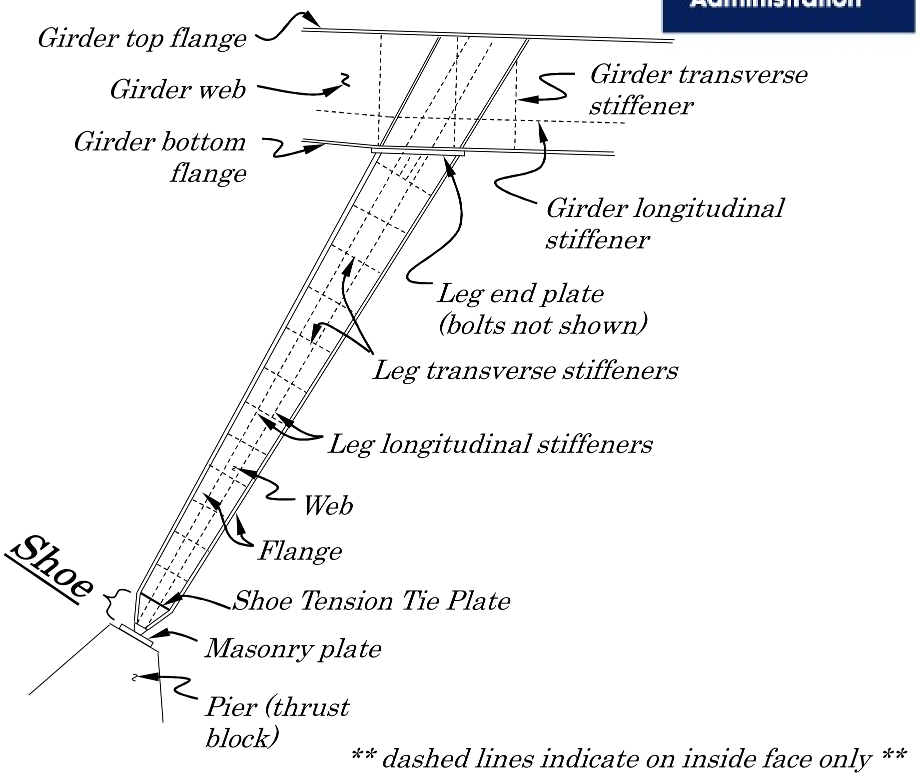


Bridge Description

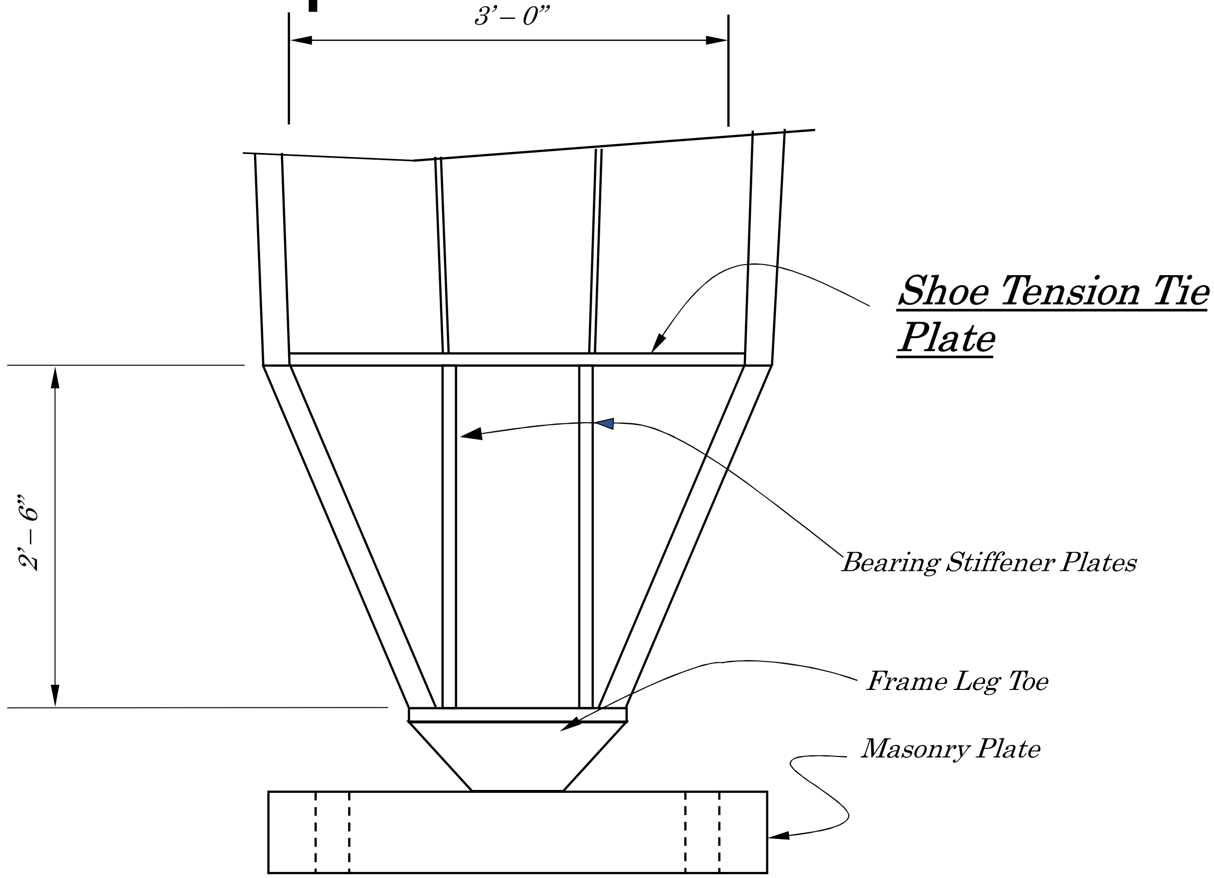


Bridge Description

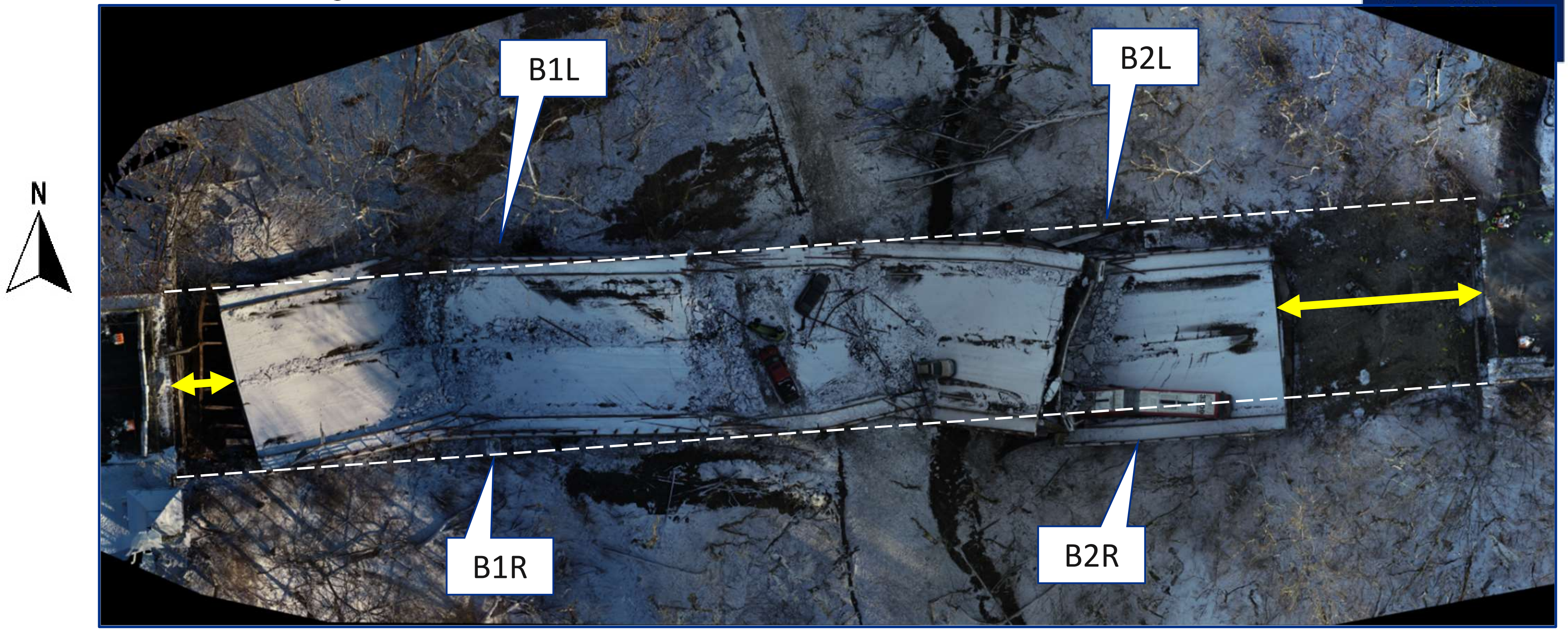




Bridge Description

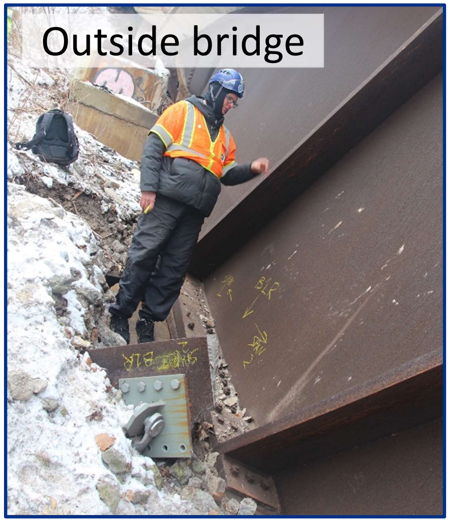


January 29, 2022



Source: NTSB

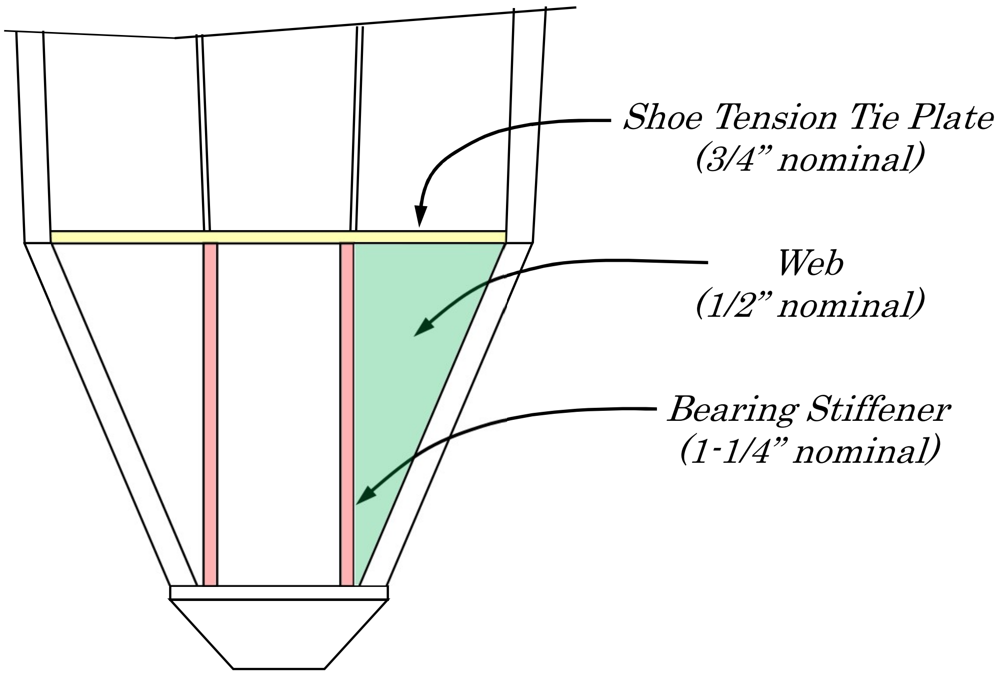
Leg B1R

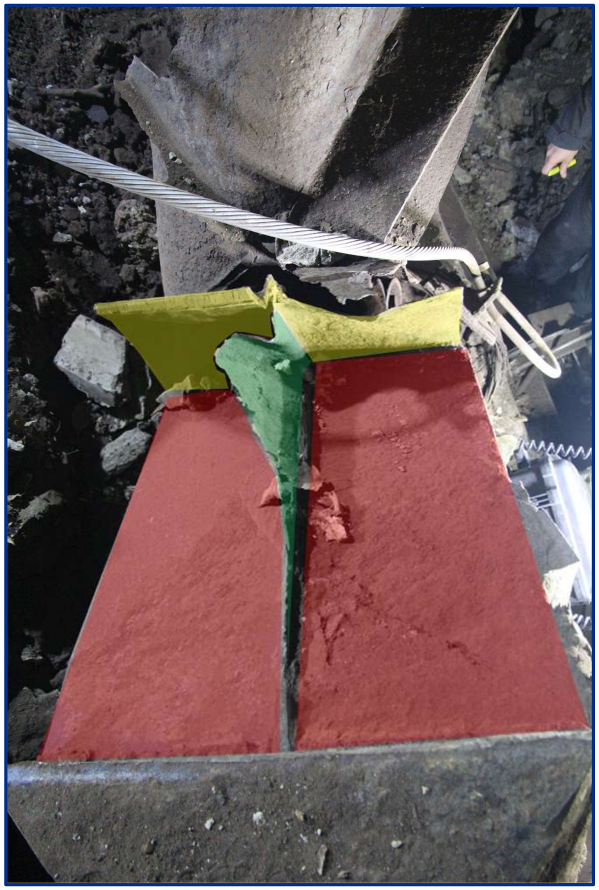


~20 ft of downhill flange was missing, wasn't recovered until rest of super was removed

All images source: NTSB

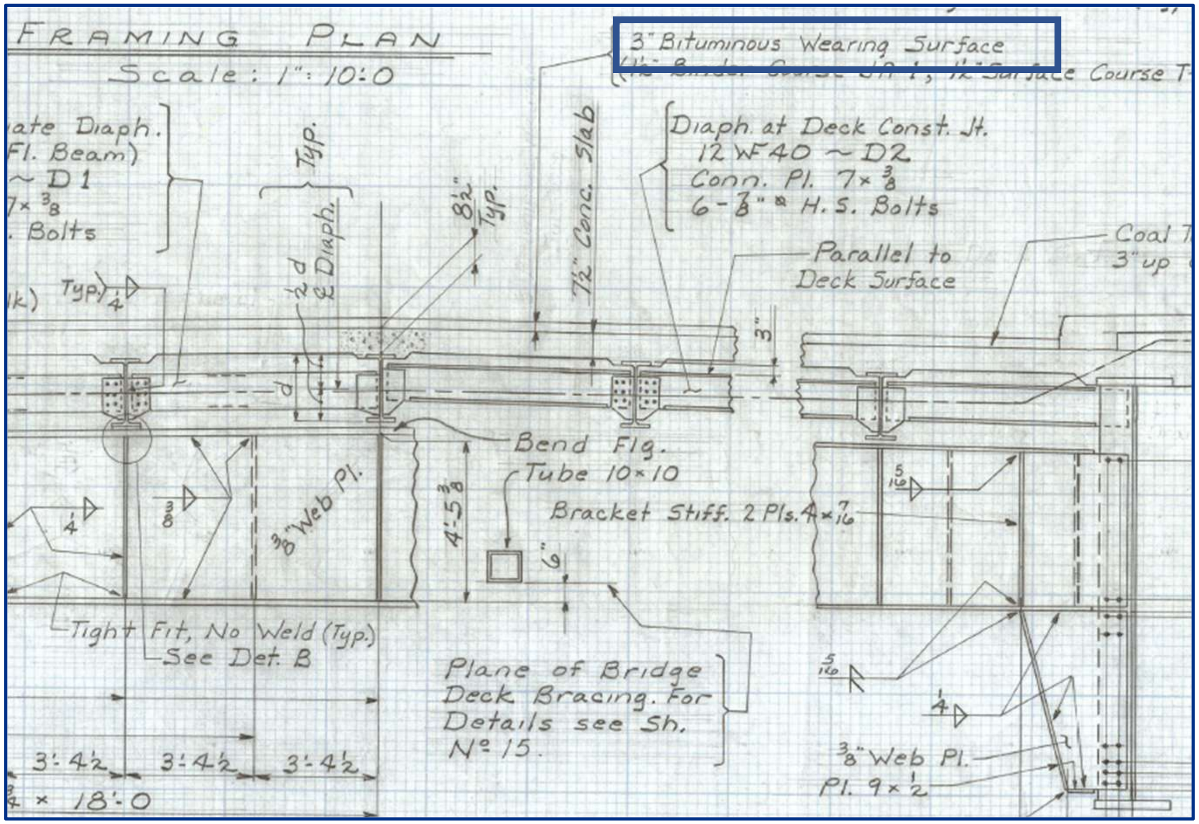
Leg B1R





All images source: NTSB

Wearing Surface



Source: City of Pittsburgh

Wearing Surface

U.S. Department of Transportation
Federal Highway Administration

All images source: NTSB

Remaining Section Measurements

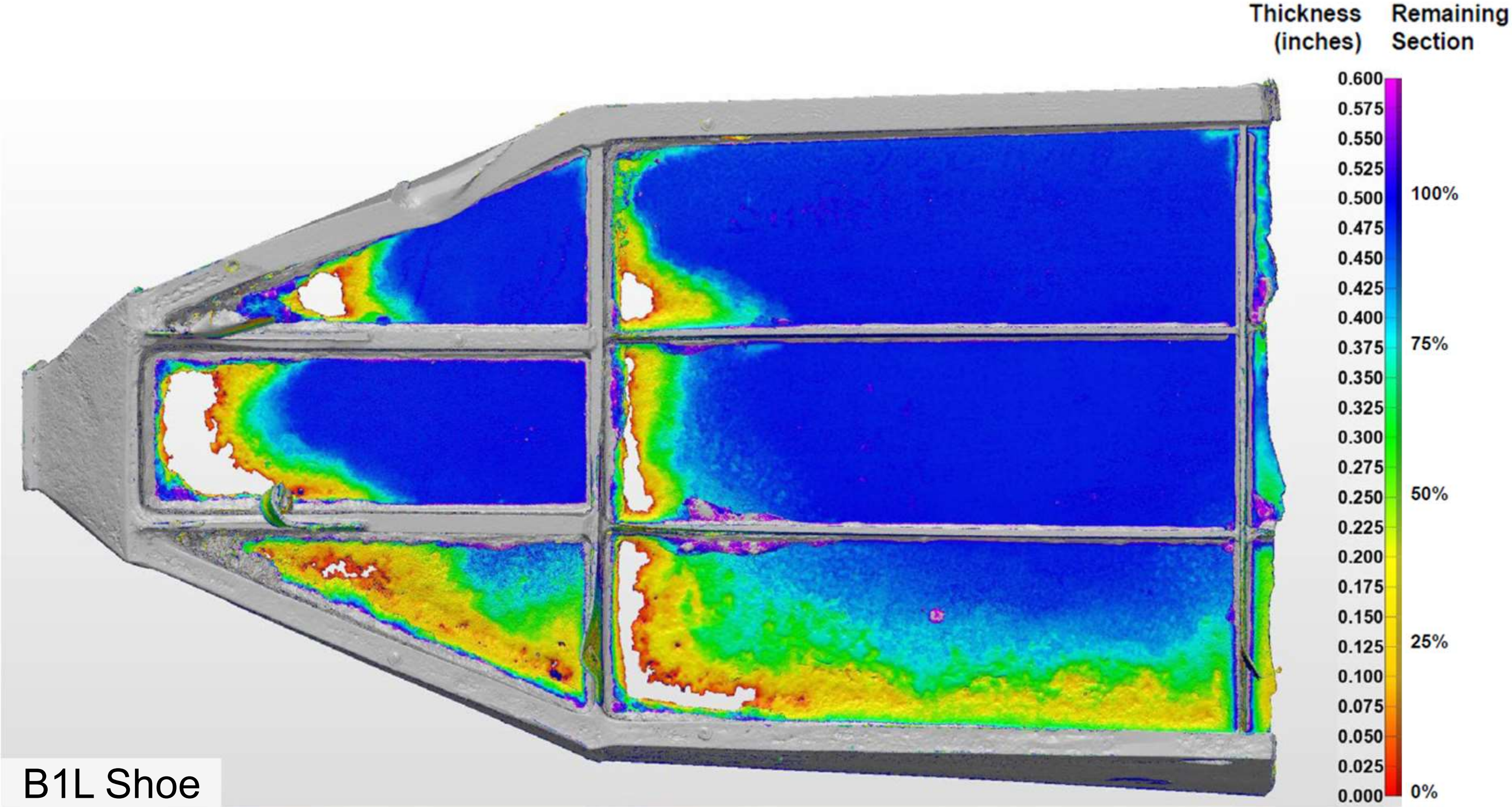
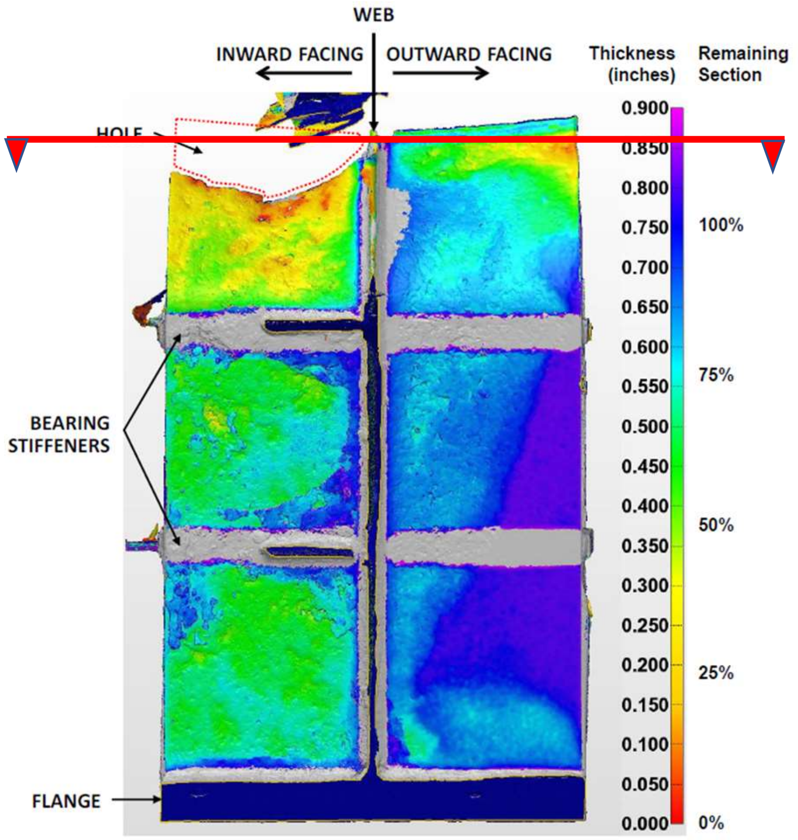


Image Source: NTSB

Remaining Section Measurements



$2.2in^2$ remaining effective area in the tie plate

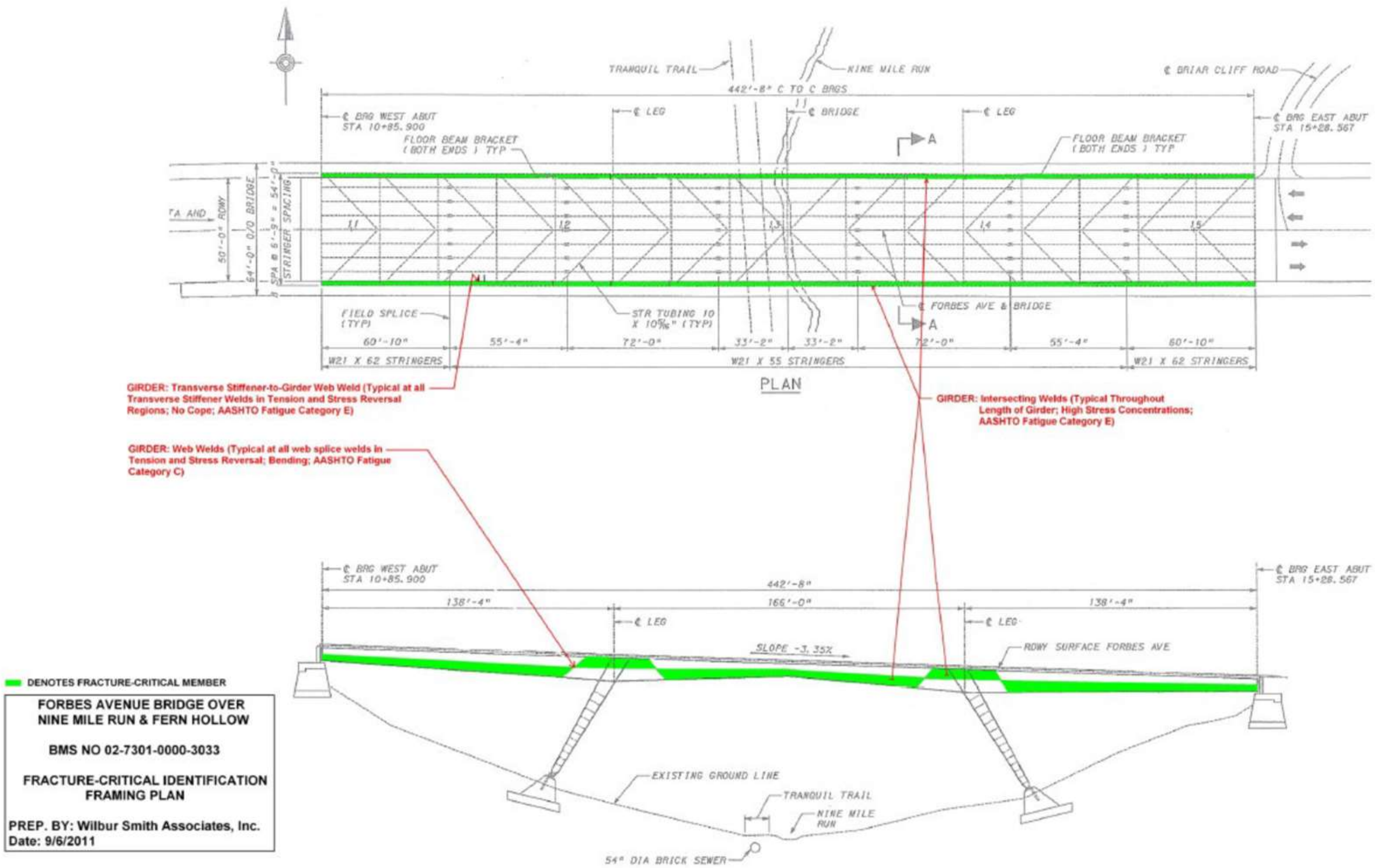
Images Source: NTSB

U.S. Department of Transportation
Federal Highway Administration

Inspection Investigations

- Reviewed all inspection reports going back to 2005.
- Assessed inspection procedures and quality. Significant findings included issues related to:
    - Fracture Critical Member (FCM) inspection procedures,
    - Section loss measurements and documentation, and
    - Condition assessment.
- Assessed inspector recommendations. Significant findings included issues related to:
    - Load re-rating, and
    - Maintenance prioritization.

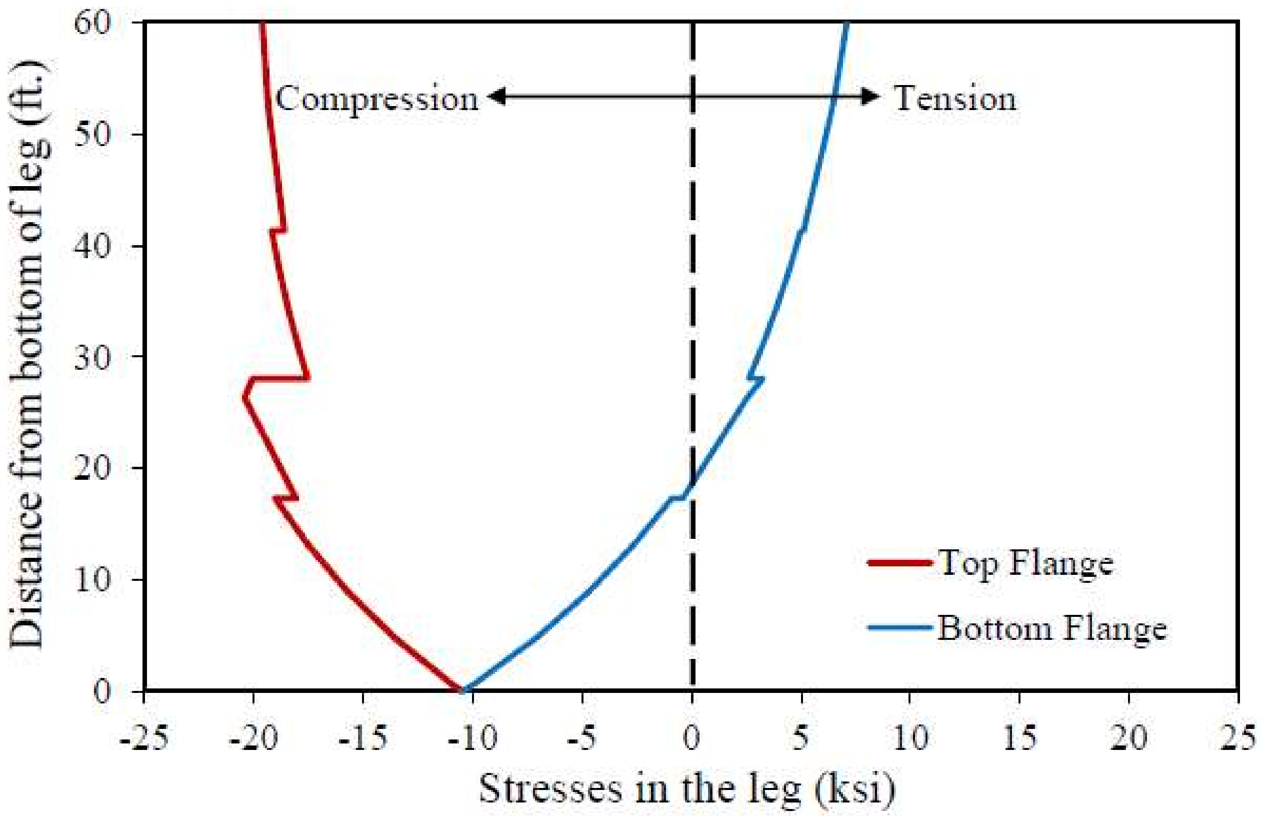
FCM Inspection Procedures- Identification



- Girders highlighted to indicate zones of tension.
- No portion of the legs are highlighted.

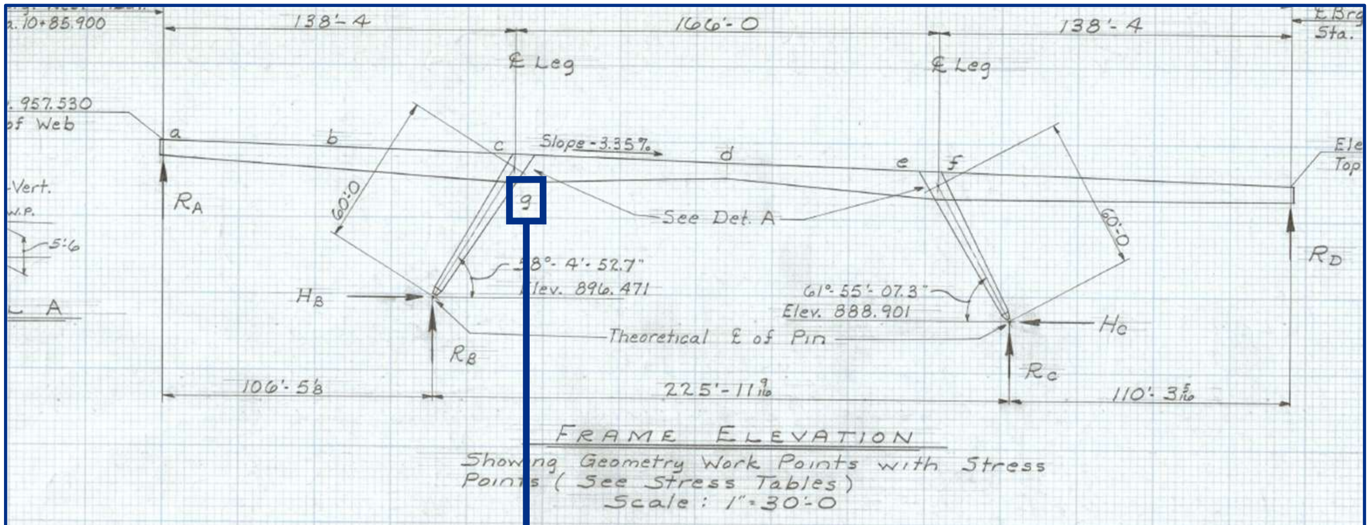
Sources: PennDOT and City of Pittsburgh

FCM Inspection Procedures- Identification



- FHWA independent analysis.
- Analysis shows the upper $^2/_3$ of the leg is partially in tension.

FCM Inspection Procedures- Identification



FRAME REACTION & SHEAR STRESS TABLE

Reaction or Shear	Force in Kips D.L.	L.L.+I	S	Total	Max. Unit Shear Stress in K/Sq.In. Actual	Allow.
V_a	234	92	11	337	12.5	17.0
V_c	492	153	19	664	6.2	17.0
V_e	454	137	16	607	5.7	17.0
V_g	50	59	9	118	1.7	17.0
R_A	234	133	14	381		
H_B	589	129	18	736		
R_B	1059	266	34	1359		

FRAME THRUST & MOMENT STRESS TABLE *

Location	Thrust in Kips D.L.	L.L.+I	S	Total	Moment in Ft. Kips D.L.	L.L.+I	S	Total	Unit Axial Stress in KSI Actual	Allow.	Max. Unit Bending Stress in KSI Actual	Allow.
b	—	—	—	—	6858	3108	389	10355	—	—	25.5	27.0
d	594	81	18	693	3770	2460	297	6527	5.4	21.1	19.7	27.0
e	619	131	17	767	-17039	-4980	-609	-22628	3.0	21.6	22.3	27.0
f	—	—	—	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
g	1177	177	28	1382	3001	3619	522	7142	7.3	19.3	14.4	27.0

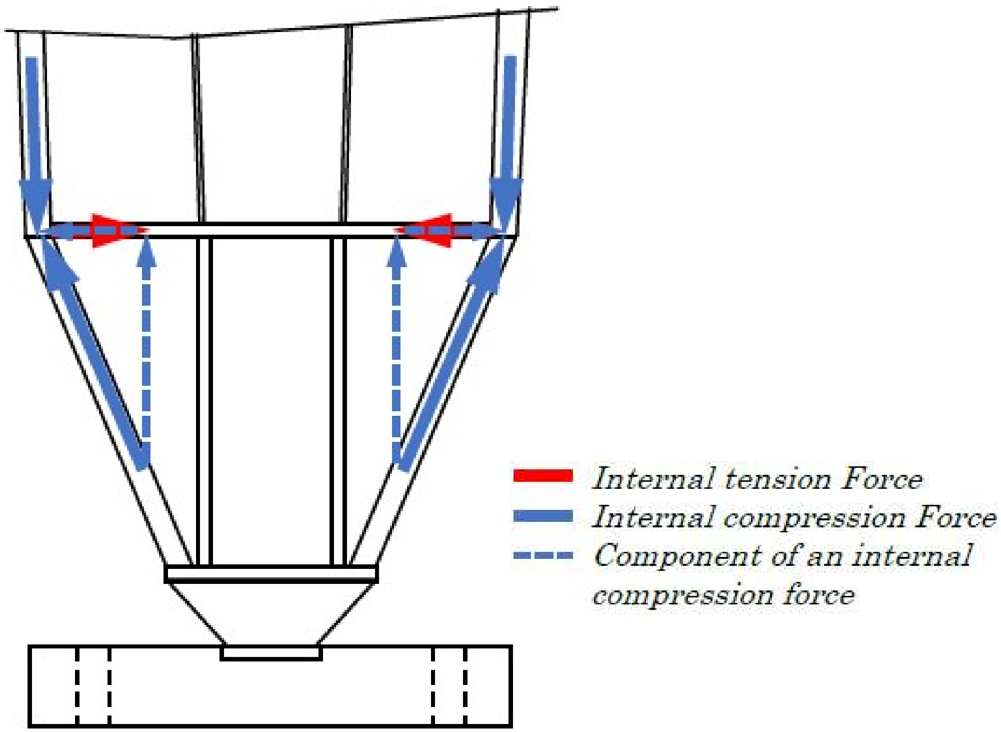
* Wind & temperature Stresses have been investigated & do not govern.

Source: City of Pittsburgh

Design plans show 14.4 ksi bending stress exceeds 7.3 ksi axial stress at top of leg. This implies tension.

FCM Inspection Procedures- Identification

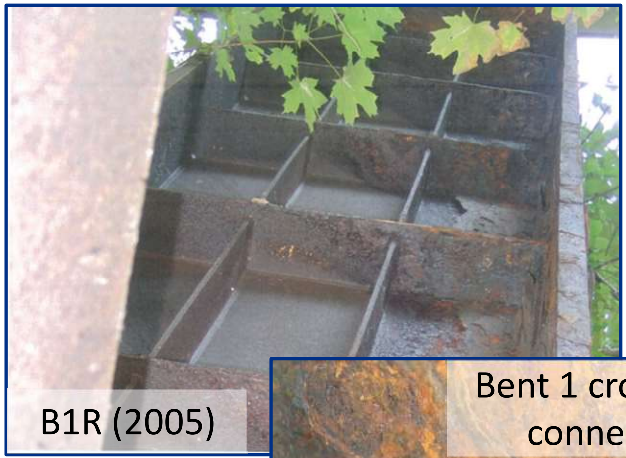
U.S. Department of Transportation
Federal Highway Administration

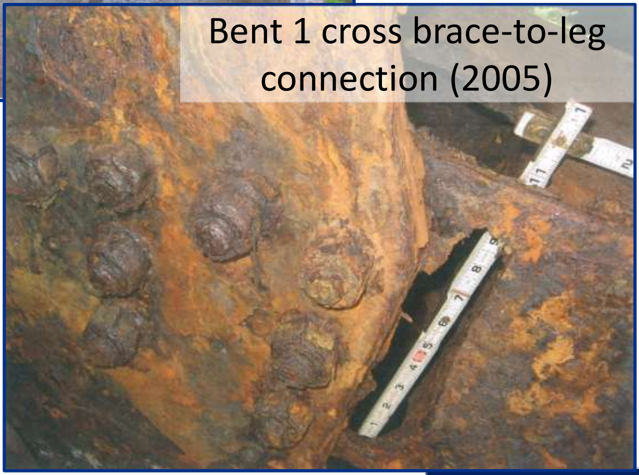


- Change in flange angle results in balancing tension force.
- The base of the leg is globally in compression, but the tie plate element is in axial tension.

Section Loss - History

- As far back as 2005, the leg stiffeners/webs, and cross braces had documented section loss including areas of 100% section loss.
- Cross brace connections deteriorated rapidly from 2005-2021, including the failure of the connections for Bent 1 bottom brace in 2018.


B1R (2005)


Bent 1 cross brace-to-leg connection (2005)

All images sources: PennDOT and City of Pittsburgh

Section Loss- Measurement and Documentation

U.S. Department of Transportation
Federal Highway Administration

- Documentation focused on the growing areas of 100% section loss.
- No indication that cleaning of the steel had been performed based on photos.
- No reviewed report included measurement of tie plate section loss.
- Unclear whether all areas of section loss were accessed and measured on the legs.
- Loss, when reported, was primarily estimate of depth or percent.

Section Loss- Measurement and Documentation

AASHTO MBE Article 4.8.1.2- Cleaning.

"*Metal structures with heavy plate corrosion will require chipping with a hammer or other means to remove corrosion down to the base metal in order to measure the remaining section.*"

AASHTO MBE Article 4.8.3.1- Steel Beams, Girders, and Box Sections.

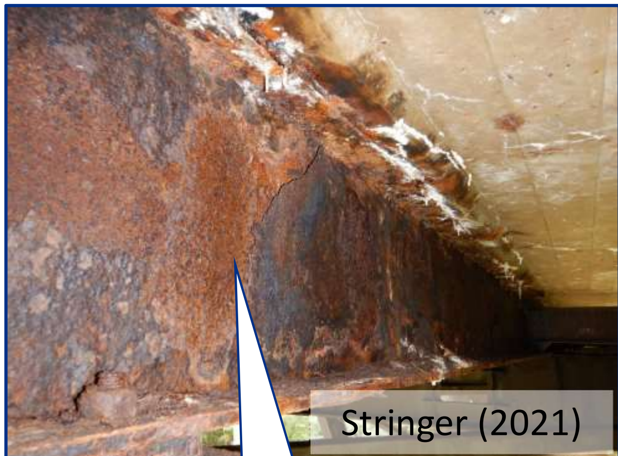
"*Structural steel members should be inspected for loss of section due to corrosion. Where a build-up of rust scale is present, a visual observation is usually not sufficient to evaluate section loss. Hand scrape areas of rust scale to base metal and measure the remaining section using calipers, ultrasonic thickness meters, or other appropriate method. Sufficient measurements should be taken to allow the evaluation of the effect of the losses on member capacity*…

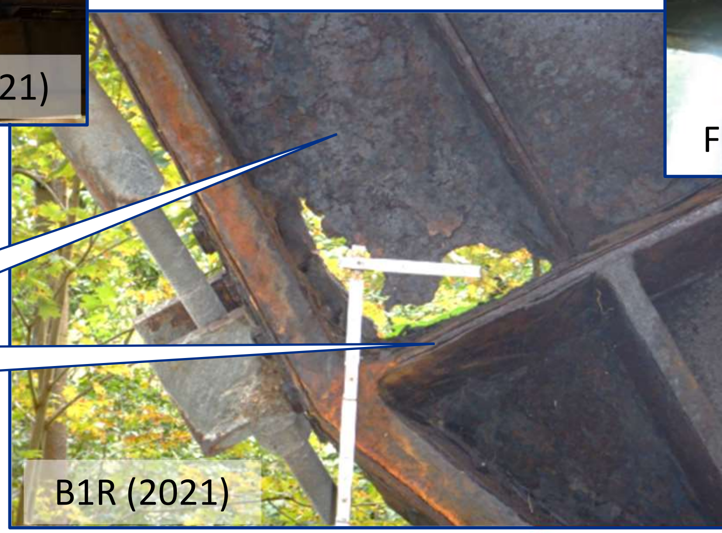
Inspect uncoated weathering steel structures for details or conditions that promote continuous wetting of uncoated steel; bridge geometrics that result in salt spray reaching the uncoated steel; pitting of the surface of the steel indicating unacceptable degradation of the steel."

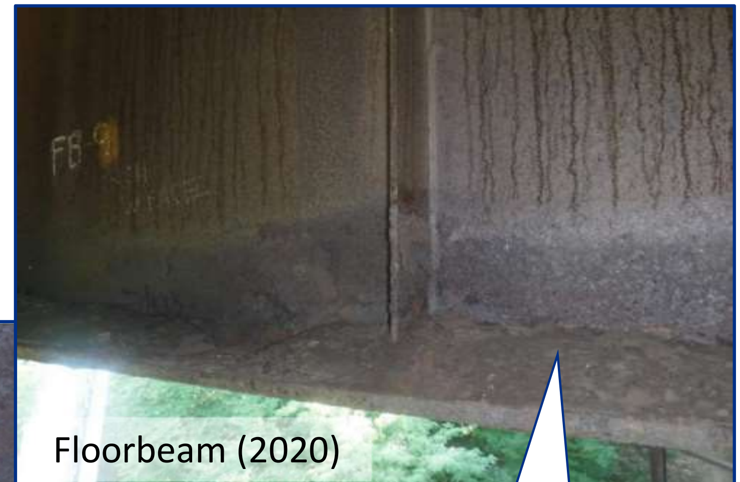
AASHTO Manual for Bridge Evaluation, 3rd Edition [23 CFR 650.317(a)]

Section Loss- Measurement and Documentation

???
Cleaning
???


Stringer (2021)


B1R (2021)


Floorbeam (2020)

Laminar corrosion clearly present

Rust flake accumulation on flange

All images sources: PennDOT and City of Pittsburgh

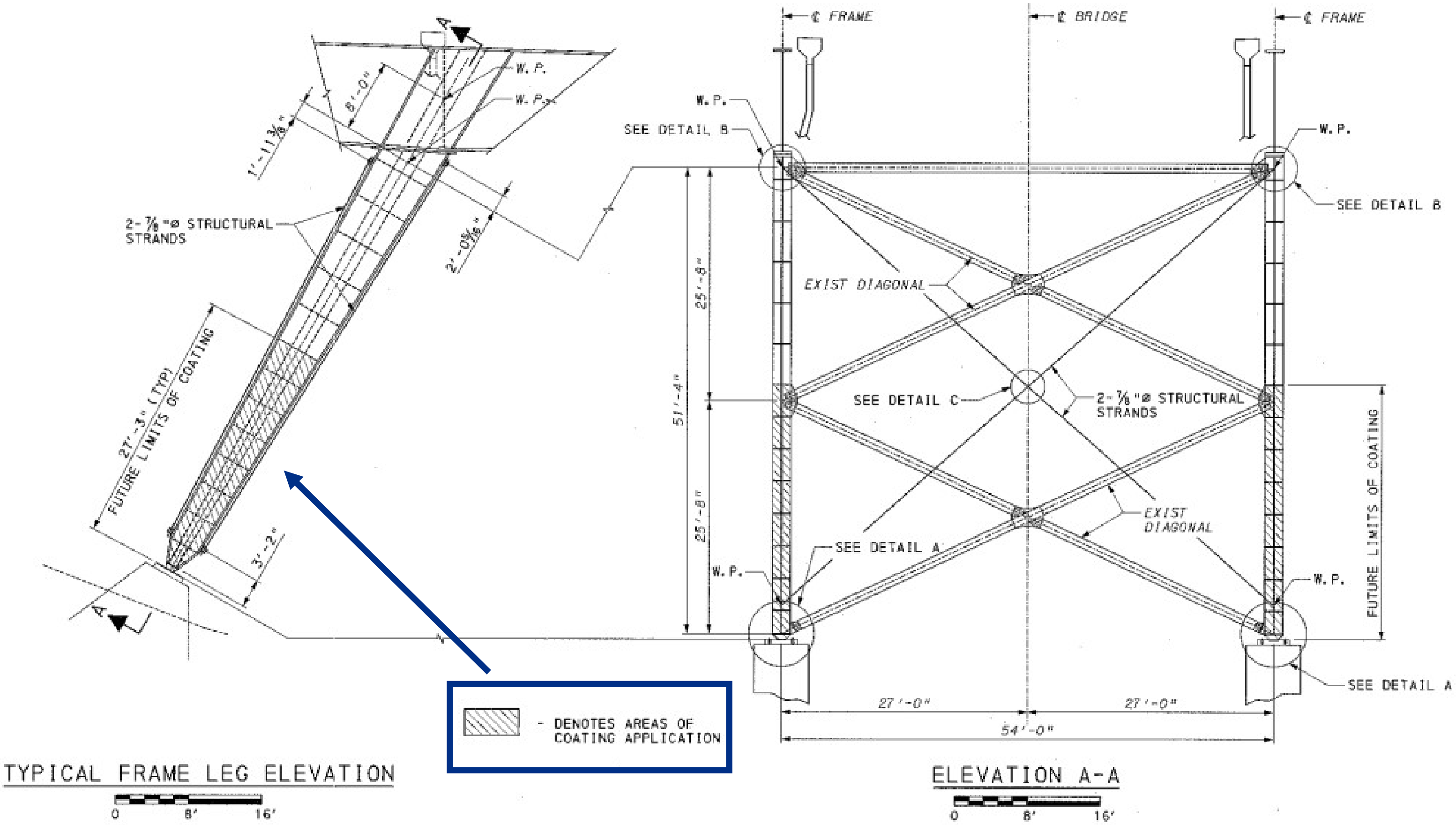
Section Loss- Measurement and Documentation

U.S. Department of Transportation
Federal Highway Administration

Web hole above B1R tie plate, 2013 vs 2021

All images sources: PennDOT and City of Pittsburgh

Maintenance and Rehabilitation History

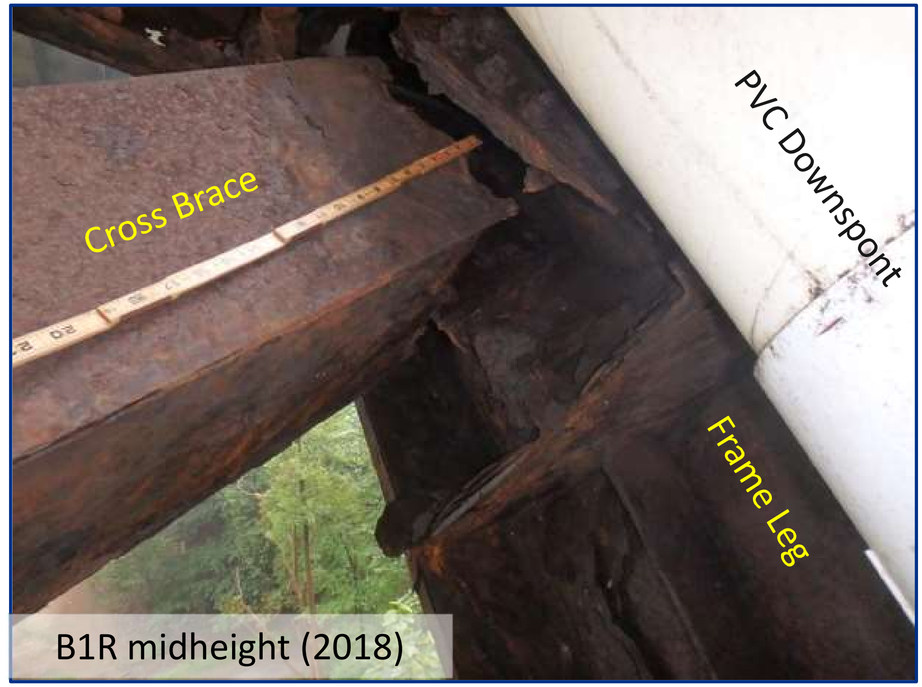


Source: City of Pittsburgh

2009 Rehabilitation

- Install cable braces.
- Install PVC downspouts.
- Zone paint legs.

Maintenance and Rehabilitation



All images sources: PennDOT and City of Pittsburgh

Maintenance and Rehabilitation

- Lower cross brace was removed in December 2018/January 2019.

- Load rating analysis assumptions indicated that the rating assumed full loss of cross braces.

Comments/Assumptions*: Ratings assume full loss of the original column cross frames and 1/16" loss in the stringer flange as well as to the near half

Sources: PennDOT and City of Pittsburgh

Maintenance Recommendations

- PennDOT includes maintenance recommendations in inspection reports.
- Inspectors recommend maintenance actions and assign a priority to them based on PennDOT Publication 100A.

Coding:

		Short Definition	Action Timeframe
0	**CRITICAL**	Immediate response required	(within 7 days)
1	**HIGH PRIORITY**	As soon as work can be scheduled	(within 6 months)
2	**PRIORITY**	Review work plan and re-prioritize schedule.	(routine inspection interval)
3	**SCHEDULE**	Add to scheduled work.	(Add to schedule)
4	**PROGRAM**	Add to programmed work	(when funds are available)
5	**ROUTINE**	As per existing maintenance schedule.	(within the next work cycle)

Notes:

1) The District Bridge Engineer (and owner for non-PennDOT bridges) must be advised of conditions that warrant a Priority code 0 or 1 Flexaction work candidate, and must accept this coding before Item 1A07, Inspection Status, is changed to Approved. See Publication 238 Sections 2.13 and 2.14 for specific guidance and required actions for Priority Codes 0 and 1.

Source: PennDOT Publication 100A

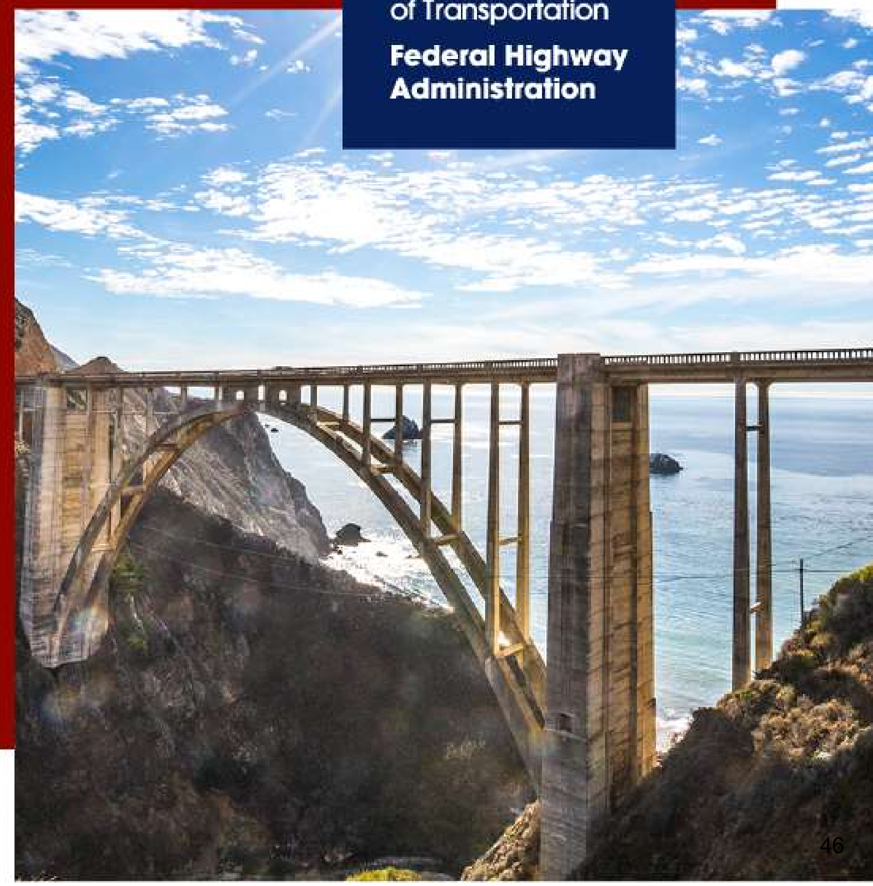
Fern Hollow Bridge Maintenance Recommendations

Recommended Maintenance Item Description	Priority	First Year Identified	Additional Years Identified	Documented Completion
Repair/replace stiffeners and web on frame legs	2	2007	2009-2021	
Repair cross bracing on both frame legs	2	2005	2007-2021	
Re-tension cables on legs	2	2009	2011-2014	7/25/2014
Extend PVC "weepholes" in deck to drain below superstructure	2	2005	2007-2021	
Paint superstructure areas exposed to leakage, primarily the frame legs[a]	2	2007	2014-2021	
Drill crack arrest holes in FB/girder connection plate cracks	2	2015	2016-2021	
Clean and flush deck scuppers (drains)[b]	2	2017	2018-2021	
Repair/replace lower cross frame at Bent 1 which is nearly severed at connections.	1	2017	3/2018	1/4/2019 cross frame was removed
Remove or replace defective light pole on deck.	0	2009		By 2011 inspection, all light poles were replaced.
Repair/replace lower cross frame at Bent 1 which has become severed. (priority raised to 0)	0	9/2018		1/4/2019 cross frame was removed
Add "bridge" placards to all postings	0	2015		Before 2016 inspection
Add "distance ahead" placards to all postings	0	2020		9/11/2020

Load Rating Investigations

- Review of historical load rating records
- Evaluation of load rating analyses
- Independent FHWA analyses

U.S. Department of Transportation
Federal Highway Administration



Historical Load Rating Records

- June 2000 – Evaluated floor beams and stringers
  - Did not evaluate rigid frame girders or legs
  - AASHTO H-20 and HS-20 and PennDOT ML80 live loads
- September 2003 – Supplemental live load analysis
  - PennDOT TK527 live load
- October 2013 – Most recent load rating
  - Evaluated floor beams, stringers and rigid frame girders and legs
  - Based on inspection recommendation to: *perform an analysis of the stability of the structure assuming that the cross braces are nonfunctional*

2014 Load Rating

- Load Factor Rating (LFR) method
- Considered section losses noted in inspection reports
  - Equivalent sections (i.e., “smeared” losses)
- Excluded the contribution of the leg cross braces
  - Weak axis unbraced length = full height of leg
- Included weight of 3” wearing surface

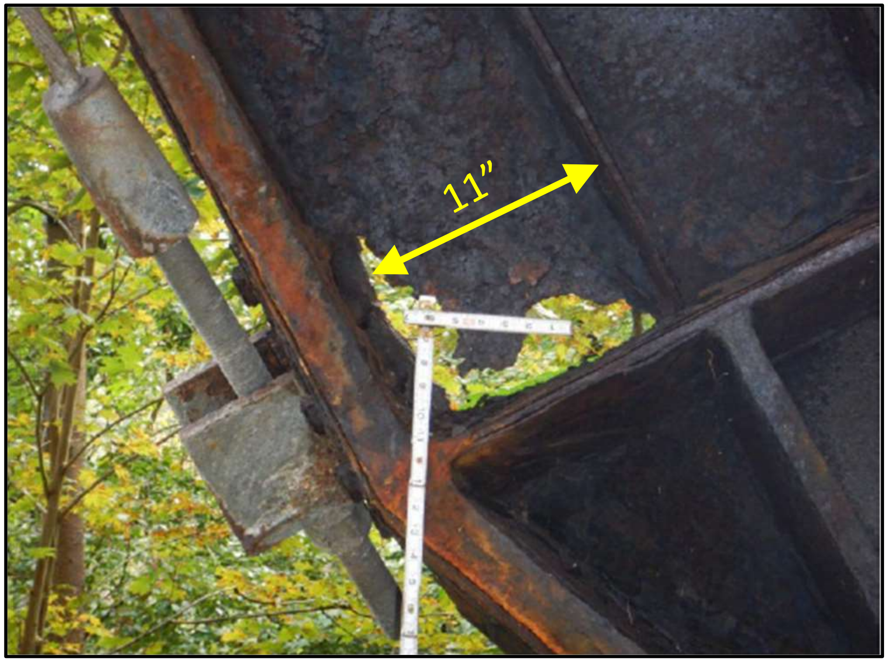
All images source: NTSB

Equivalent Section Loss

- Based on worst-case observation, an 11” wide hole
- Applied as a generalized 11” wide void along entire plate length
- Based on average plate width of 3’-0”, section thickness was reduced proportionately:

$$\frac{0.5"}{36"} = \frac{t_{eff}}{36" - 11"} \rightarrow t_{eff} = \frac{25"}{36"}(0.5") = 0.347"$$

- Flange losses similarly modeled
- Appropriate for global analyses, not for consideration of local effects



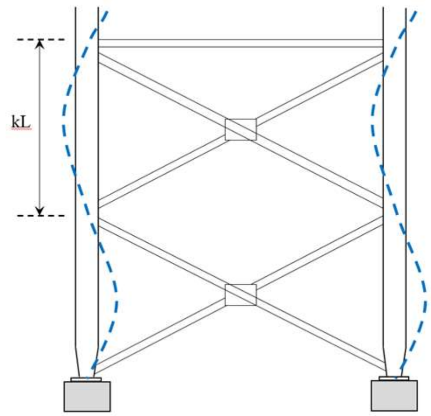
Sources: PennDOT and City of Pittsburgh

Effective Length Factor

- Euler Buckling Load:

$$P_{cr} = \frac{\pi^2 EI}{(kL)^2}$$

- As designed, assumed, buckled shape in the weak-axis direction:



Sources: PennDOT and City of Pittsburgh

U.S. Department of Transportation
Federal Highway

Effective Length Factor

- From the Load Rating calculations

See Section 10.54

As per 10.54.1.2, K = 0.75

Lc in strong direction

Lc in weak direction = 25'-8" = 308", However use 624" for case considering section losses

Sources: PennDOT and City of Pittsburgh

- From AASHTO Standard Specifications for Highway Bridges*

10.54.1.2 Effective Length

The effective length factor K shall be determined as follows

(a) For members having lateral support in both directions at its ends

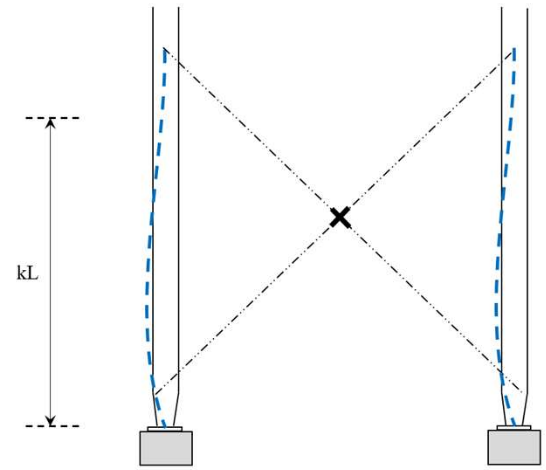
K = 0.75 for riveted, bolted, or welded end connections;

K = 0.875 for pinned ends.

(b) For members having ends not fully supported laterally by diagonal bracing or an attachment to an adjacent structure, the effective length factor shall be determined by a rational procedure.**

** AASHTO Manual for Bridge Evaluation, 3rd Edition, Article 6B.1.1 [23 CFR 650.317(a)]*

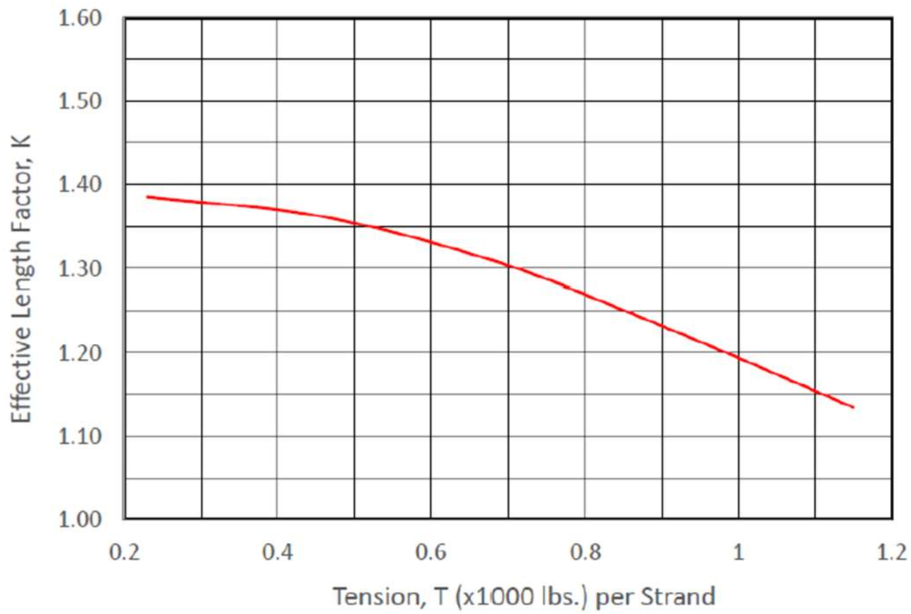
- Assumes translation- and rotational restraint that the cable bracing could not provide:



Effective Length Factor

U.S. Department of Transportation
Federal Highway Administration

- Relationship between cable tension and k factor:



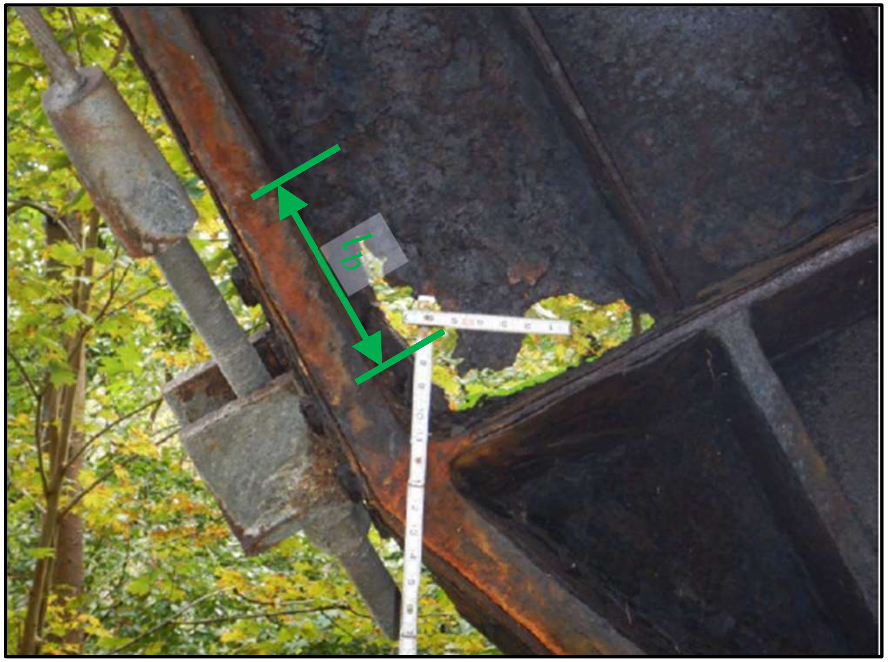
Summary of Leg Ratings (Sectional Analysis)

U.S. Department of Transportation
Federal Highway Administration

Scenario	HS-20 Operating Rating Factor (per MBE LFR)	HS-20 Operating Rating (tons) (per MBE LFR)
As-Designed Assumes both cross braces effective between legs (*k*=1.0) and 3-inch wearing surface	2.89[2]	104
Modified As-Designed Assumes both cross braces effective between legs (*k*=1.0) and 5.6-inch wearing surface	2.62[2]	94
2014 Load Rating Assumes cross braces ineffective, cable braces effective (*k*=0.75), 3-inch wearing surface, section loss distributed evenly across frame leg.	0.92	33[3]
Existing Condition at Collapse 1 Assumes cross braces ineffective, cable braces tightened to approximately 1000 lbf tension (*k*=1.2), 5.6-inch wearing surface and section loss distributed evenly across frame leg.	0.17	6
Existing Condition at Collapse 2 Assumes cross bracing ineffective, cable braces tightened to approximately 200 lbf tension (*k*=1.4), 5.6-inch wearing surface and section loss distributed evenly across frame leg.	-0.66[6]	N/A

Local Effects – Flange Buckling

- Analysis to determine unbraced length of the flange plate that results in plate buckling controlling over global buckling.
- f_{cr} for global buckling of the leg, using the upper bound value of k was 11.5ksi
- For flange buckling to control, l_b would need to be at least 96”
- Result: flange buckling was not a controlling limit state



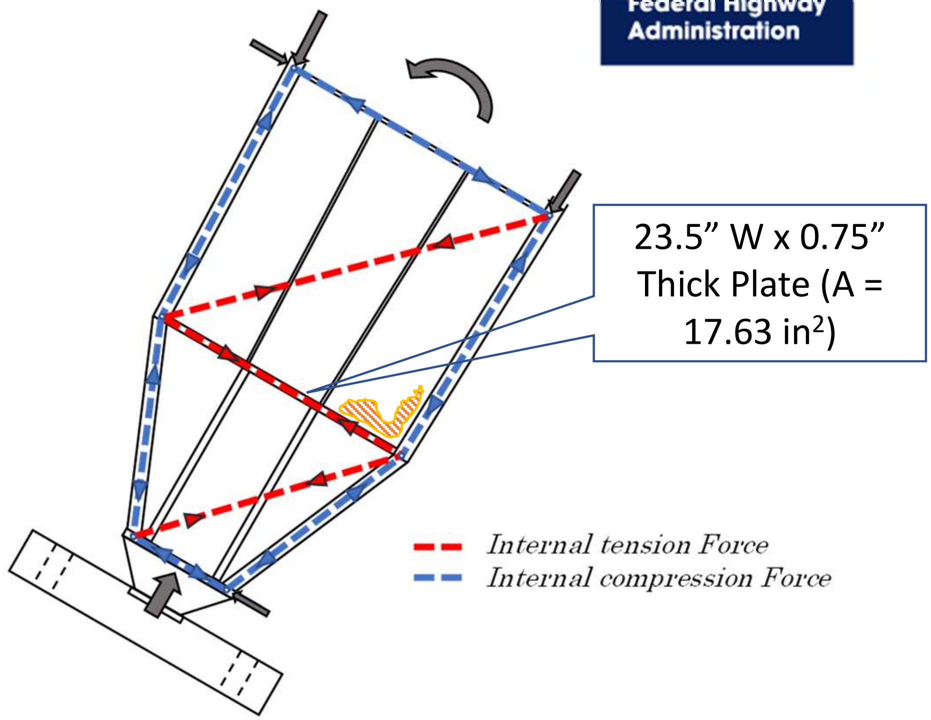
Sources: PennDOT and City of Pittsburgh

Local Effects: Tension Tie Plate Tension

- Strut-and-tie model of the lowest panel of the leg and the shoe
- Demonstrates that the geometry of the shoe puts the plate into tension
  - Region of the web with corrosion holes is largely in a compression stress field
- FHWA analysis established remaining section required to control rating:

Asphalt	k factor	Operating R.F.	Equiv. $A_{remaining}$
5.6”	0.75	0.92	$6.97in^2$
5.6”	1.2	0.17	$6.71in^2$
5.6”	1.4	-0.66	N/A
5.6	1.2	0.08 (3 Tons)	$6.59in^2$

- Measured remaining area: as little as $2.2in^2$



U.S. Department of Transportation
Federal Highway Administration

NTSB Recommendations

NTSB Finding of Probable Cause

U.S. Department of Transportation
Federal Highway Administration

"…was the failure of the transverse tie plate on the southwest leg of the bridge, a fracture-critical member (nonredundant steel tension member), due to corrosion and section loss resulting from the City of Pittsburgh's failure to act on repeated maintenance and repair recommendations from inspection reports. Contributing to the collapse were the poor quality of inspections, the incomplete identification of the bridge's fracture-critical members (nonredundant steel tension members), and the incorrect load rating calculations for the bridge. Also contributing to the collapse was insufficient oversight by the Pennsylvania Department of Transportation of the City of Pittsburgh's bridge inspection program."

NTSB February 21, 2024, Highway Investigation Report 24-02, pg. 103.

NTSB Recommendations for FHWA

U.S. Department of Transportation
Federal Highway Administration

1. Require one time review of NSTM inspection procedures for steel frames to ensure that all fracture critical members are identified and inspected.
2. Update the BIRM to address the identification of localized tension zones in members partially or fully in tension.
3. Update the BIRM to include information on the selection, frequency of use, and application of NDE approaches to measuring asphalt wearing surface thickness.

NTSB Recommendations for FHWA

U.S. Department of Transportation
Federal Highway Administration

4. Establish a process for targeted reviews of safety issues identified in this investigation, including
   a) Bridge owners' determinations that a new load rating is required
   b) Appropriateness of assumptions used in the load rating of deteriorated structures
5. Incorporate the findings of this investigation into bridge inspection training courses and use the Fern Hollow Bridge as a case study.

U.S. Department of Transportation

Federal Highway Administration

WISDOT'S 1^{ST} DESIGN-BUILD PROJECT

WIS-130 Bridges over the Wisconsin River

May 23, 2024


Photo by SRF

KRAEMER NORTH AMERICA | HOFFMAN CONSTRUCTION | SRF | exp. | AMERICAN ENGINEERING TESTING | WISCONSIN DEPARTMENT OF TRANSPORTATION

Introductions

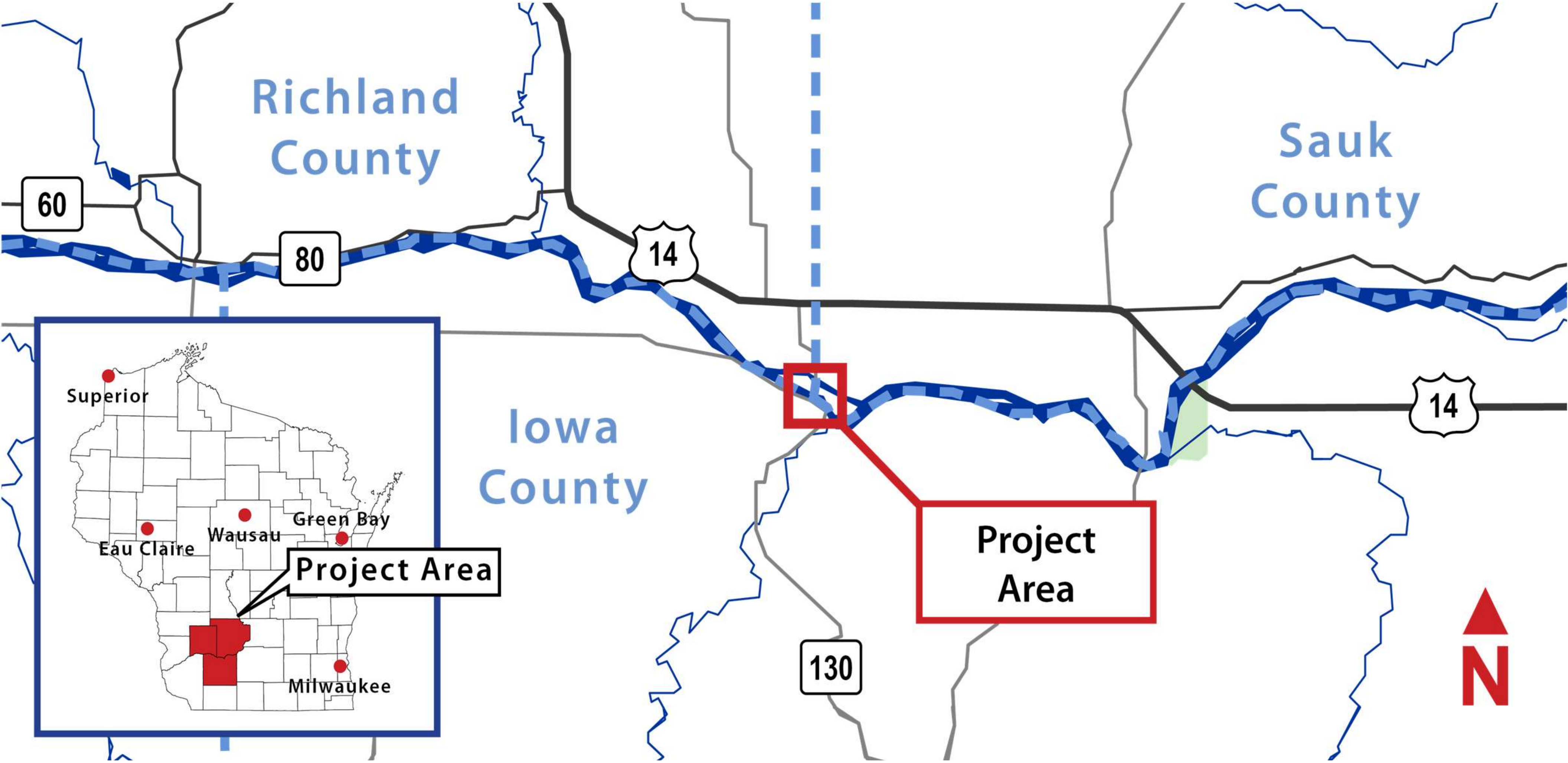
Laura Shadewald, PE
Structures Development Chief

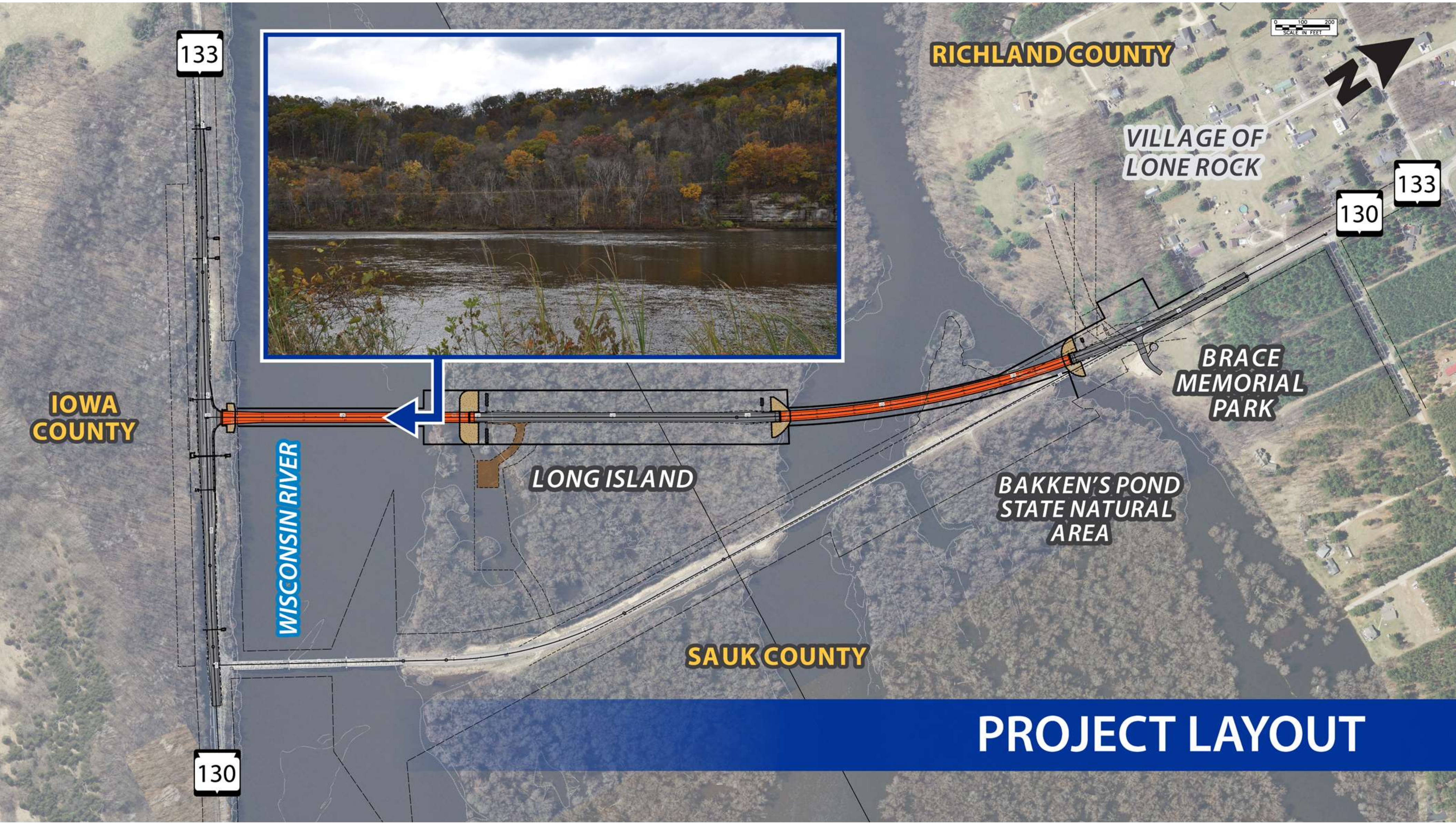
Brent Freeman, PE
DB Project Manager

Bill Dreher, PE
DB Bridge Design Engineer

Vinod Patel, PE, SE
DB Lead Bridge Design Engineer

Project Location





133
RICHLAND COUNTY
VILLAGE OF
LONE ROCK
133
130
IOWA
COUNTY
BRACE
MEMORIAL
PARK
WISCONSIN RIVER
LONG ISLAND
BAKKEN'S POND
STATE NATURAL
AREA
SAUK COUNTY
130
PROJECT LAYOUT

Project Need

Existing Truss Bridges

- Built in early 1930s / 1940s
- End of design life
- Structurally deficient
- Functionally obsolete
- Bridges get struck by large trucks
- Poor intersection geometry

Photo by SRF

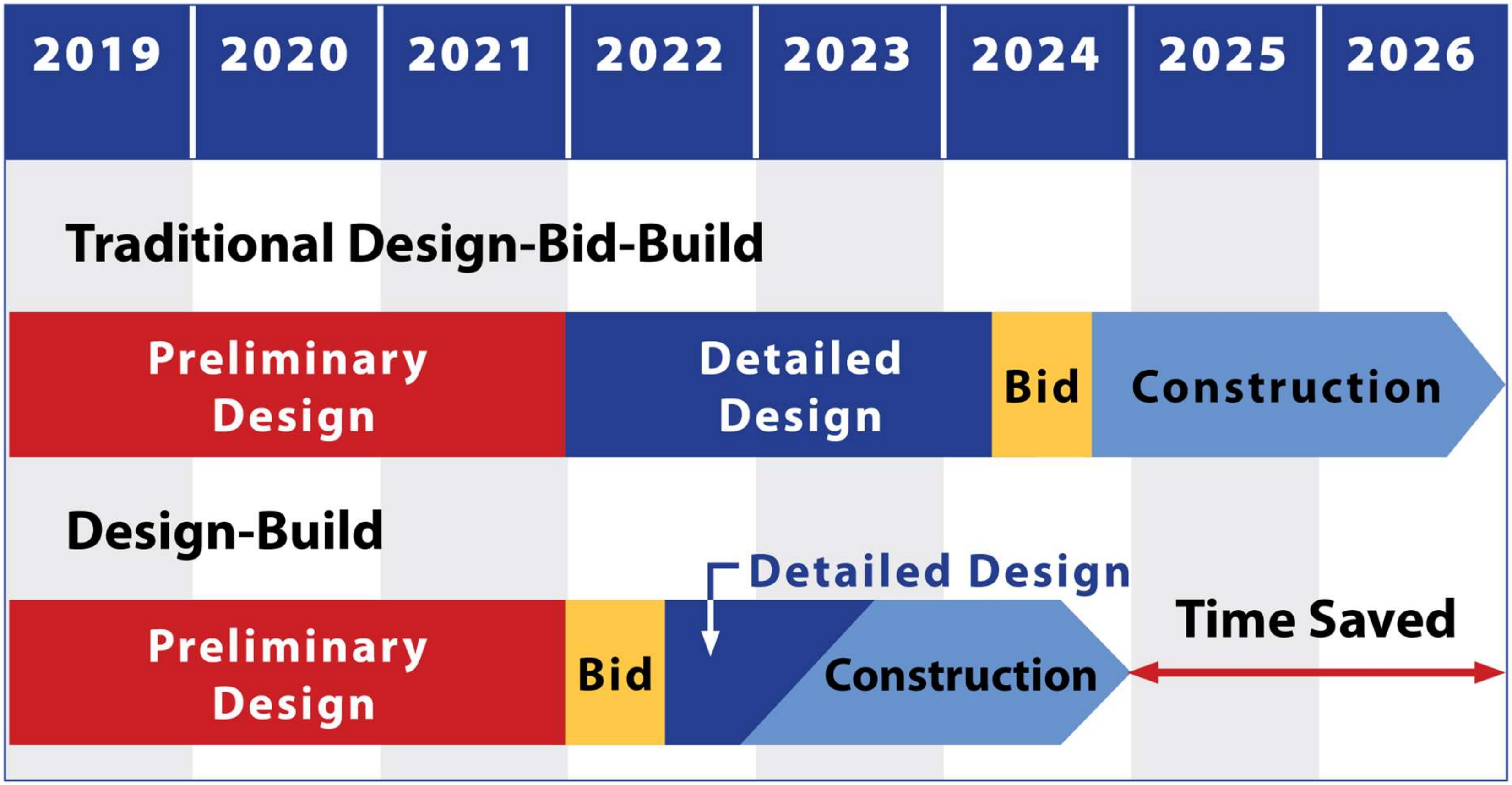
Photo by SRF

Why Design-Build Delivery was Chosen

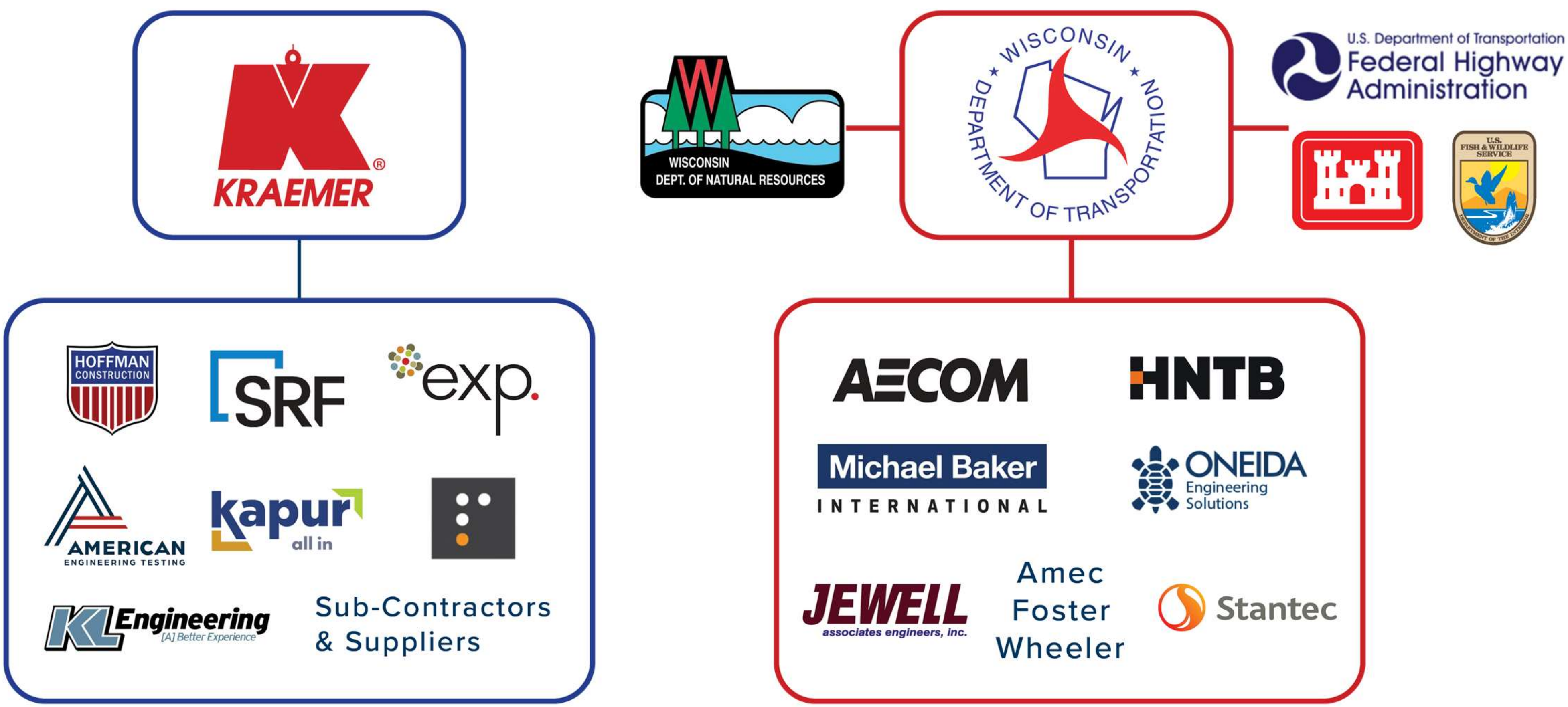
- Environmental document & preliminary design complete
- Desire for an accelerated schedule to address pressing needs through accelerated procurement
- Well-defined scope, yet flexible enough to allow for efficiencies and innovation
- Appropriate size and complexity
- Minimal utility conflicts
- Minimal real estate
- No concern with contractor interest or lack of proposers

Time Saved with Design-Build

Traffic on New Bridges Two Years Early!



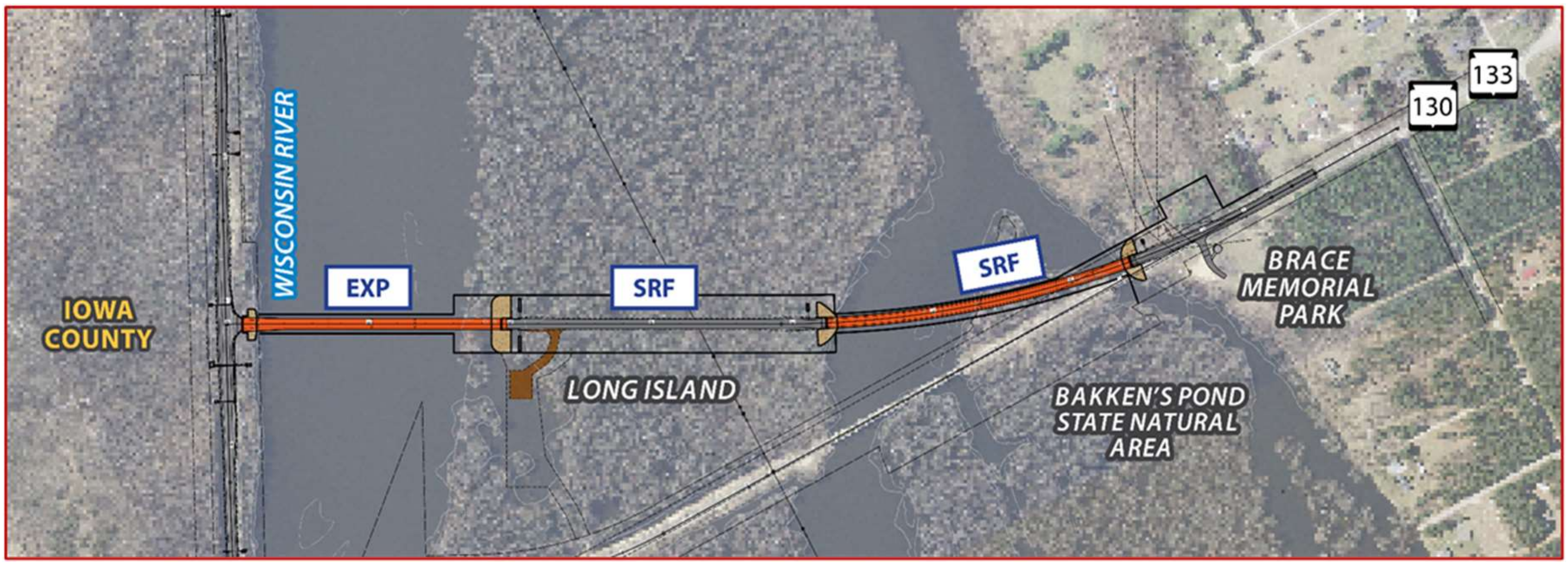
Project Team



D-B Team

KRAEMER
HOFFMAN CONSTRUCTION

SRF
exp.
AMERICAN ENGINEERING TESTING



Creating the D-B Team

- Teaming
  - SRF Internal discussions in 2019
  - KNA and SRF contact in late 2020
    - WisDOT industry review workshops
  - WisDOT D-B projects announced to industry in summer 2021
    - SRF and KNA immediately teamed
      - Desired major river crossing and WisDOT experience – added EXP
    - Request for Qualifications issued November 2021, Statements of Qualifications due January 2022
    - Request for Proposals issued February 2022, Technical and Price Proposals due May 2022


Photo by HNTB

Request for Qualifications (RFQ)

- Statement of Qualifications (SOQ)
  - Know & Understand the Project Goals
  - Select the Right Team
  - Experience
    - Scope of work –and– as teammates
  - KNA and SRF – long history as DB teammates
  - EXP major river crossings design experience
  - AET added for geotechnical and environmental
  - Added Hoffman as a major contractor partner – grading/earthwork subcontractor

Request for Proposals (RFP)

- Process
  - Pursuit Schedule – 3 months to develop technical and price proposals
  - Instructions to Proposers (ITP) , RFP Books 1 to 3, and RID review
  - DB Team Meetings
  - Requests for Clarifications, Q&A
  - One-on-One Meetings with DOT
  - SOQ Modifications (if necessary)
  - Alternate Technical Concepts (ATC) development and review, and finalizing
  - Design Concepts development and review, and finalizing
  - Estimating
    - Subcontractors and Suppliers outreach and coaching, including all our DBEs
  - Technical Proposal development, review, finalize
  - Final Price Proposal

Alternate Technical Concept (ATC)

Objective: Benefit from DB's Innovative Solutions and Construction Means & Methods

Reduce Cost & Construction Duration

Reduce Impacts

Improve Constructability

Maintain Quality & Safety

Other Considerations:

- Durability
- Life-cycle Maintenance
- Aesthetics
- Construction Safety

ATC
D-B Mechanism to get DOT's Pre-approval

ATC’s

- Summary of ATC’s

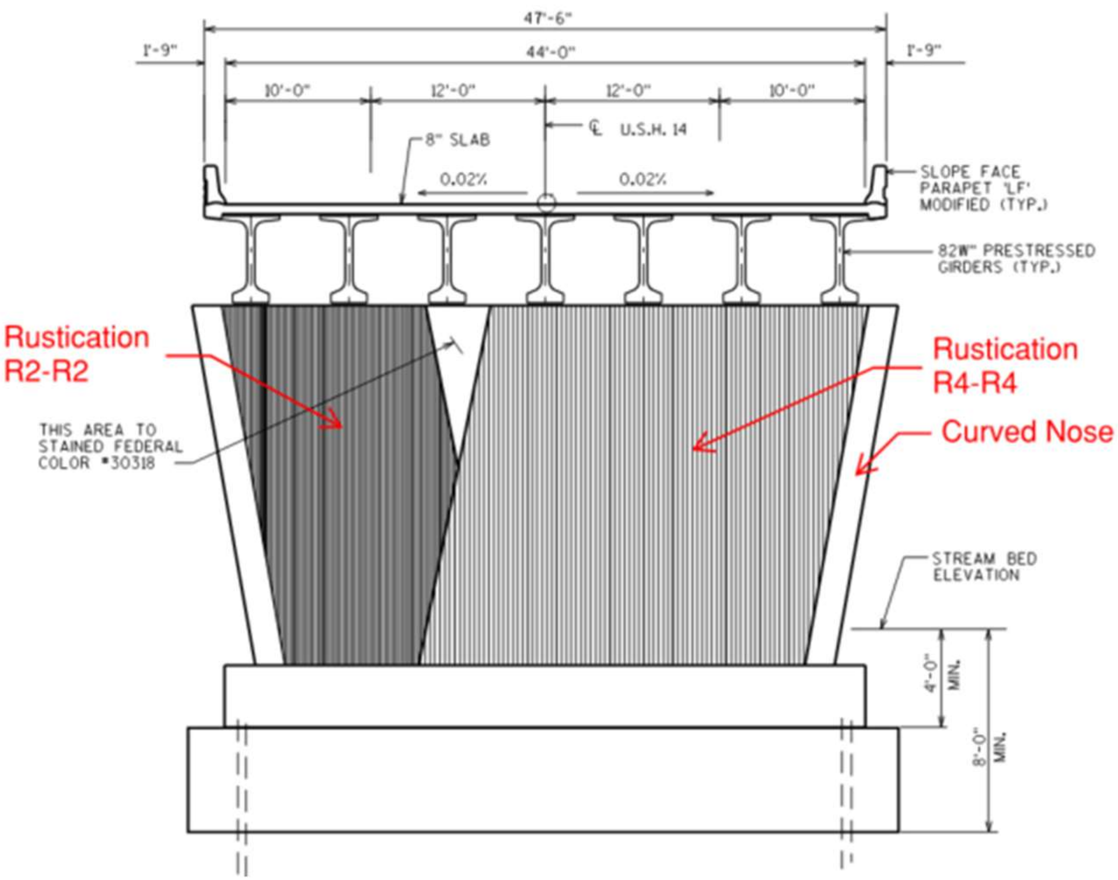
Kraemer North America					
	Resubmitted Final ATC Responses		- From 4/8/22 Submital Deadline	Incorporated in Design-Builder's Proposal	
#	Subject	Date Received	Response - WisDOT		Notes
ATC 2	Longer Continuous Span	3/16/2022	The submitted ATC is Approved.	YES	Used at South bridge
ATC 3	Reinforced Soil Slopes	3/16/2022	The submitted ATC is Approved.	NO	
ATC 5	Alternate Pier Types	3/17/2022	The submitted ATC is Approved.	YES	
ATC 6	Shorter South Bridge, Optimize Pier Location	3/19/2022	The submitted ATC is Conditionally Approved. Condition: The required permits for the Project are obtained based on the associated natural resource impacts of this ATC.	YES	
ATC 7	South Bridge-Alternate Span Configuration	3/19/2022	The submitted ATC is Approved.	NO	
ATC 8	North Bridge-Alternate Span Configuration	3/19/2022	The submitted ATC is Approved.	YES	
ATC 13	MSE Walls	3/25/2022	The submitted ATC is Approved.	YES	

ATC – Bridge Piers and Girders

- North Bridge
  - Three piers eliminated with increase to 72W girders from 45Ws
    - Required roadway profile grade raise
  - Savings per pier estimated at $217k (before design optimization)
  - Pier type change to hammerhead style from reverse trapezoid – estimated at $100k per pier (before final rebar detailing) and one week saved on schedule per pier
- South Bridge
  - One pier eliminated with shorter bridge, alternate span configuration and girder design modifications - $217k saved
  - Pier type change to hammerhead design at $100k per pier (before final rebar detailing) and one week saved on schedule per pier

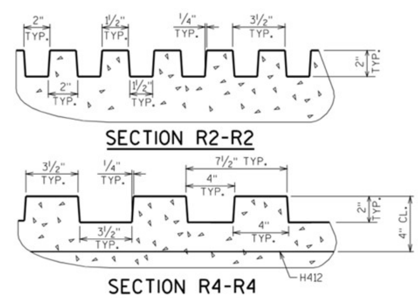
- Overall savings from changes to piers amounted to over $2,000,000 and 12 weeks construction schedule savings

Bridge Piers - RFP

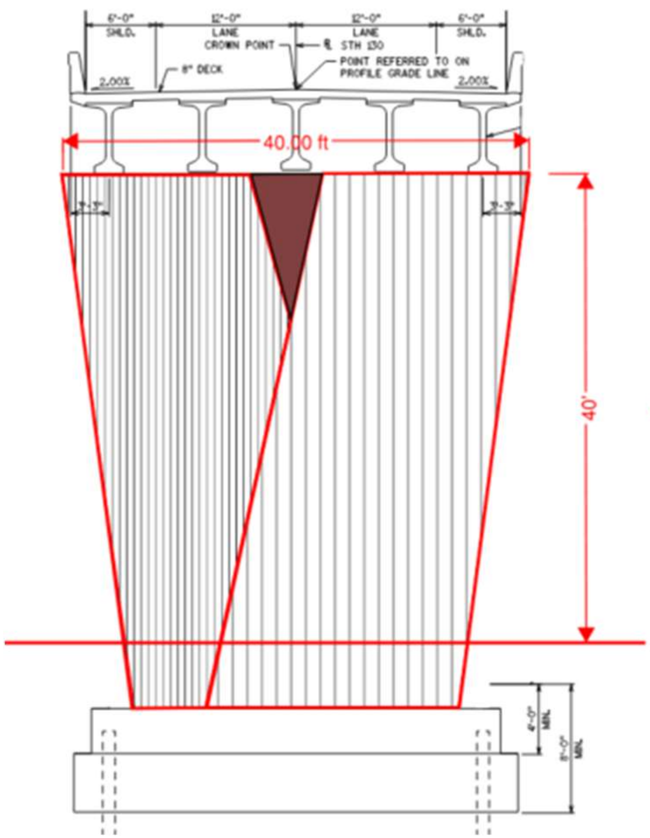


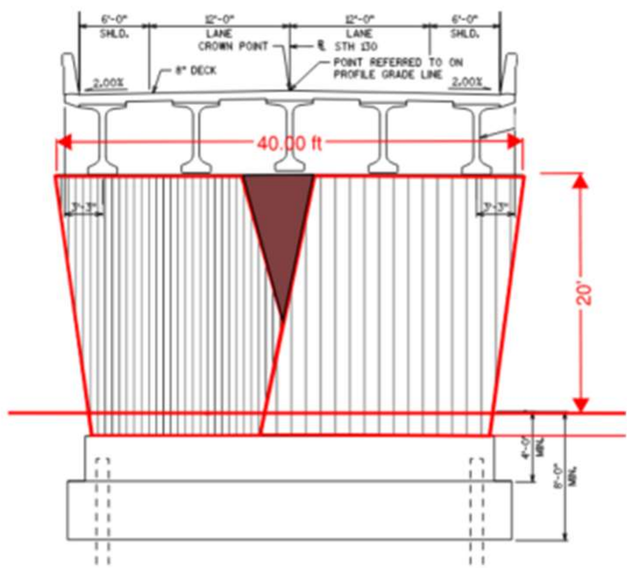
RFP Requirements

- Trapezoidal Piers similar as the US 14 Bridge
- Vertical Rustication on both faces
- Slanted Curved Noses with Rustication



Bridge Piers - RFP





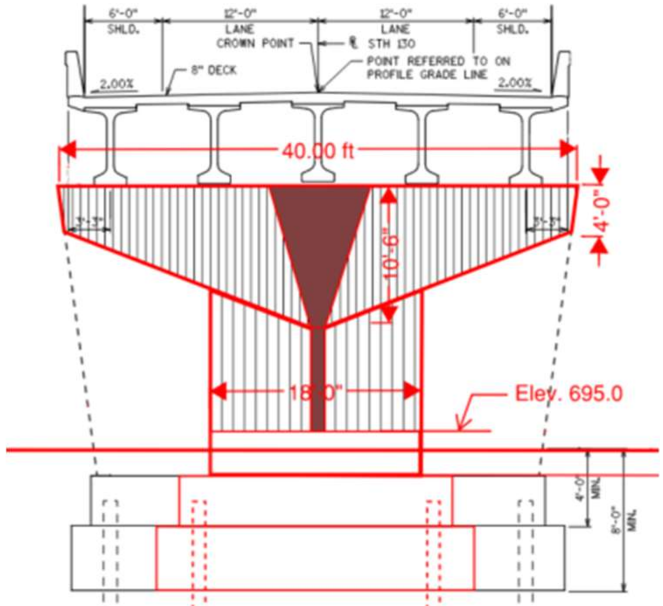
Visual Disparity

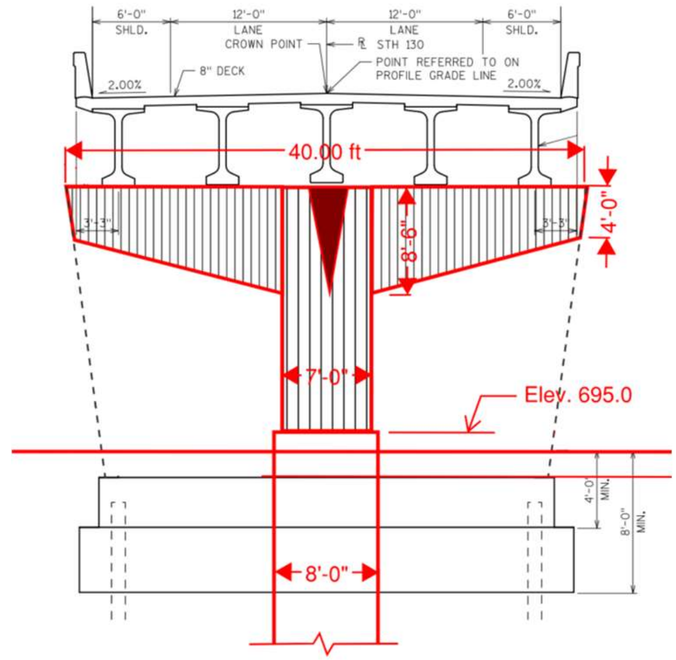
- US 14
  - All piers same height – 24′
  - Uniform width @ water level
- WIS-130
  - Pier height varies from 40′ to 20′
  - Width @ water level varies from 26′ to 33′

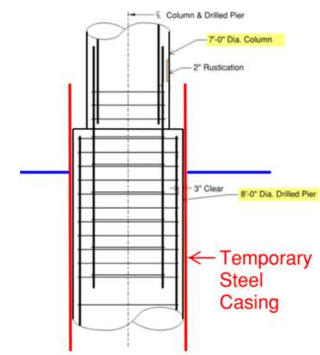
Potential for Improvements

- Reduce Materials / Visual Mass
- Reduce cost
- Reduce construction time
- Reduce footprint / wetland impacts
- Reduce scour potential

Bridge Piers – ATC #5







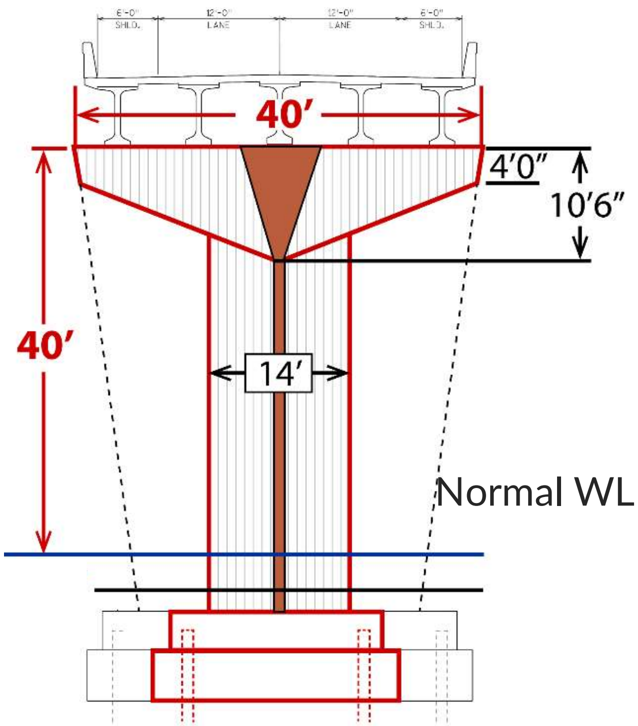
ATC #5A

- Hammerhead Pier w/Oblong Shaft
- Pile supported footing
- Construct with Cofferdam

ATC #5B

- Hammerhead Pier w/Round Shaft
- Single Drilled Shaft Foundation
- Shaft transition above Design Water Level
- Construct with Temporary Casing

Bridge Piers – Final ATC



Benefits

- Compact size
- Smaller footprint / cofferdam & seal
- Less impacts to sensitive wetlands
- Less cost
- Less time to construct
- Better visual quality
- More openness for river users – greater visibility of surrounding natural beauty
- Structural benefits –
  - Lesser scour depth
  - Less ice force

Bridge Piers – Renderings / Photo

RFP Base Case

ATC

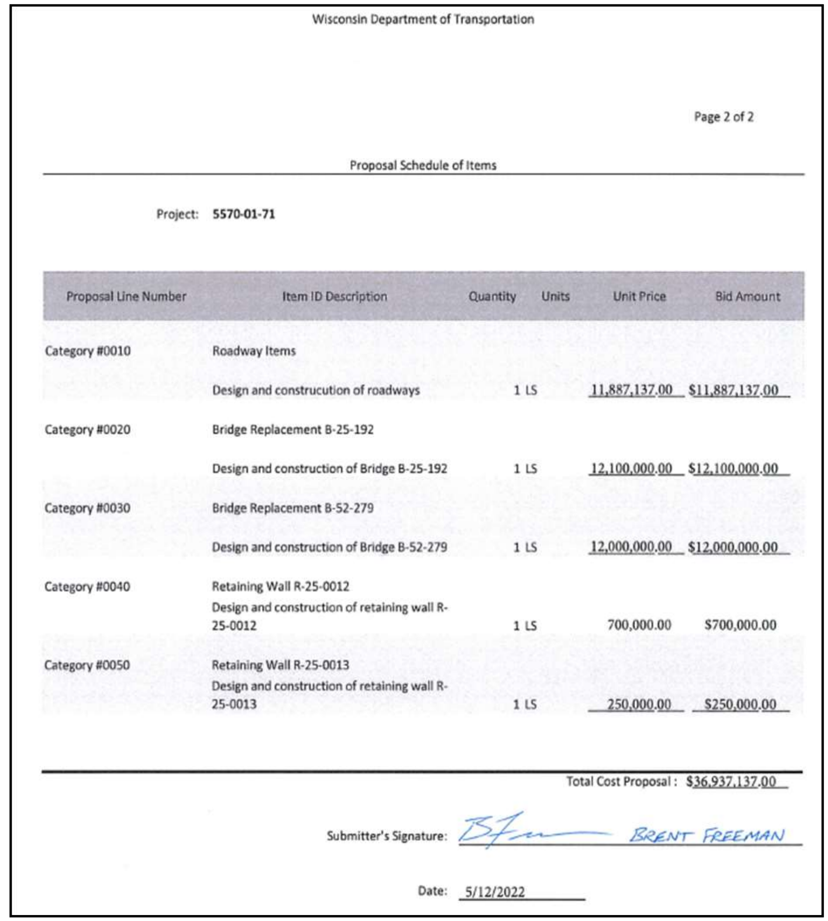
Photo of As-Built Pier

Technical Proposal

- Executive Summary
- Narratives
  - Design Features
  - Environmental Compliance Plan
  - Mobility with the Project Corridor
  - Conceptual Designs
- Appendices
  - Organizational Chart
  - ATCs Documentation
  - Progress Schedule
  - Roll Plot of Conceptual Design of Project
  - Proposer Information, Certifications, and Documents (the legal stuff)

Price Proposal

- Bid Certification
- Bid Bond
- Bid Form
  - Standard Form with Lump Sum Prices for each of the five bid items
    - one for each structure and one for the roadway/all other work
- DBE certifications and commitments
- Above is what actually gets submitted. The effort to get to that point requires many more bullet points!



Wisconsin Department of Transportation

Page 2 of 2

Proposal Schedule of Items

Project: **5570-01-71**

Proposal Line Number	Item ID Description	Quantity	Units	Unit Price	Bid Amount
Category #0010	Roadway Items				
	Design and construcution of roadways	1	LS	11,887,137.00	$11,887,137.00
Category #0020	Bridge Replacement B-25-192				
	Design and construction of Bridge B-25-192	1	LS	12,100,000.00	$12,100,000.00
Category #0030	Bridge Replacement B-52-279				
	Design and construction of Bridge B-52-279	1	LS	12,000,000.00	$12,000,000.00
Category #0040	Retaining Wall R-25-0012				
	Design and construction of retaining wall R-25-0012	1	LS	700,000.00	$700,000.00
Category #0050	Retaining Wall R-25-0013				
	Design and construction of retaining wall R-25-0013	1	LS	250,000.00	$250,000.00

Total Cost Proposal : $36,937,137.00

Submitter's Signature: BRENT FREEMAN

Date: 5/12/2022

Design Refinements/Challenges

- South Bridge
  - South abutment design
  - Pier 1 foundation design
  - Bridge configuration
  - Retaining walls

- North Bridge
  - Drop girder line
  - South abutment design

Design Refinements/Challenges

- South Bridge: South Abutment (background)
  - Underlying bedrock slopes down from South to North and West to East
  - Located mid slope of steep slope between river and two-lane STH 133.
  - Tall abutment body
  - Permanent tieback and deadman system required
  - Curved wingwalls
  - Retaining walls tied into wing walls
  - Tough Access
  - Complex temporary shoring required
  - Construction completed during full closure of STH 133

Design Refinements/Challenges

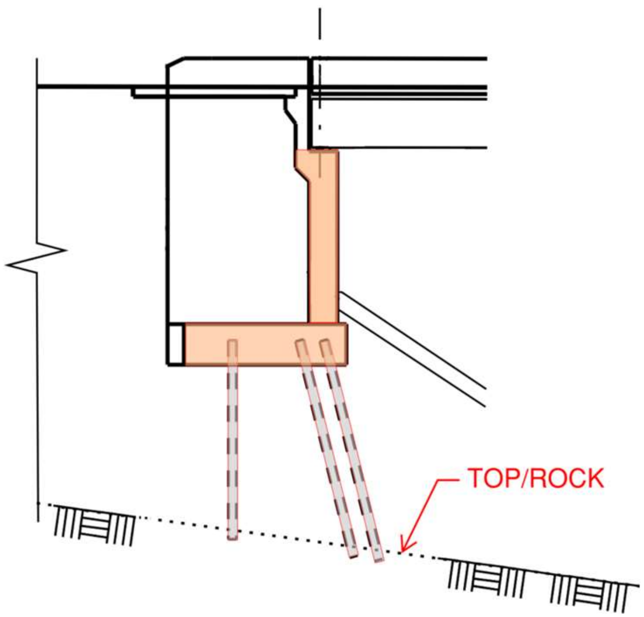
- South Bridge: South Abutment Design – Contractor Considerations
  - Schedule constraints
    - Completion tied in with STH 133 roadway improvements, which were completed under full closure of STH 133 in 120 calendar days
  - No access from existing STH 133 prior to our improvements, when road was open to traffic
  - Access from river to begin work early
  - Complex, multi-staged and tied back temporary shoring system
    - Required for construction sequencing
  - Pre-bored and driven piles into rock
    - Tried to limit pre-boring where possible
  - Wingwalls completed as soon as possible after body constructed
    - MSE Walls tied in to wing walls
  - Parapets tied into roadway barrier that sit on moment slabs over MSE walls

Design Refinements/Challenges

- South Bridge: South Abutment Design – Contractor Considerations
  - Complex, multi-stage temporary shoring – required temporary tiebacks

Design Refinements/Challenges

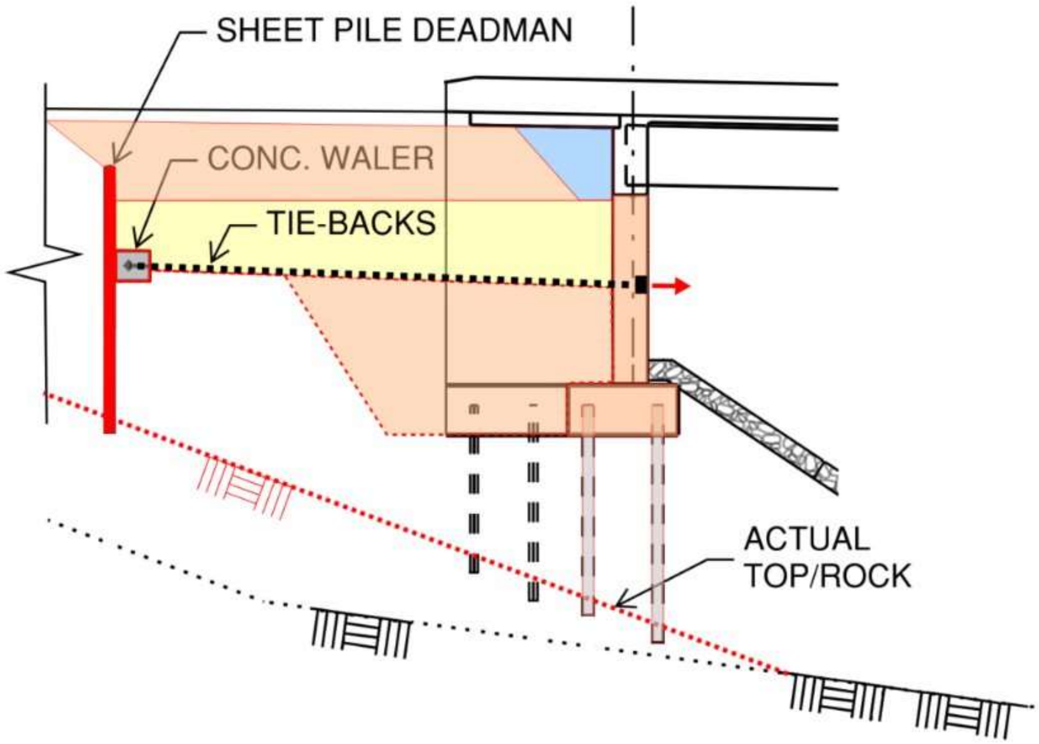
South Bridge – South Abutment
Bid Proposal Design



- Rock profile – mild slope
- Conventional semi-retaining abutment
- ± 33 ft. height
- Battered piles

Design Refinements/Challenges

South Bridge – South Abutment
Final Design



- Additional borings
- Rock profile – steep slope
- Concerns with driving battered piles
- Issues with Global Stability
- Semi-retaining abutment with tie-backs
- All vertical piles
- Sheet pile deadman with concrete waler

Design Refinements/Challenges

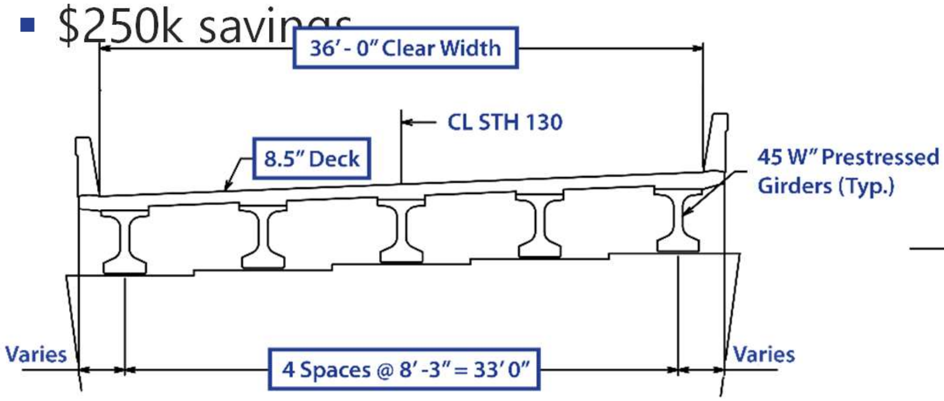
South Bridge – South Abutment
<u>As-built Abutment</u>



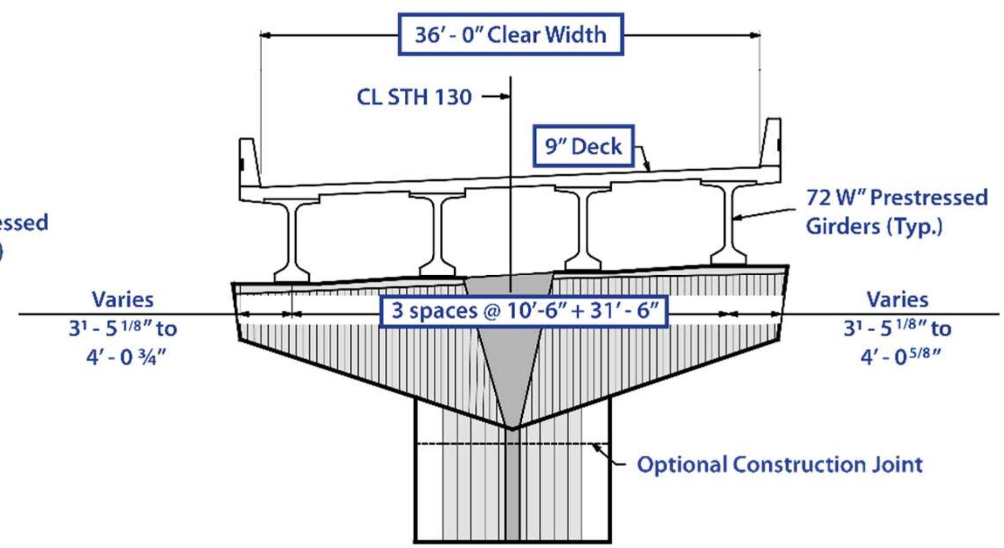

Design Refinements/Challenges

North Bridge - Reduce Number of Girder Lines

- Debond strands (2 of 46) vs. increased concrete strength (8.5 ksi)
- Fabrication, transport, setting girders
- Less deck forming (# of bays)
- More strands, thicker deck
- $250k savings



RFP Cross Section



Revised Cross Section

Field Design Changes

- South Bridge
  - Pier 1 Foundation Re-design & South Abutment NCR Changes
  - Pier 2 Seal Revision

- North Bridge
  - Pier Spread Footing Seal & Rock Excavation Revisions
  - Pier Cap Rebar Detail Modification
  - Pier Cap Rebar Bar# 613 Revision
  - Girder #5 Stirrups Revised Bottom Leg
  - Deck Modular Joint Blockout and Deck Rebar Mods

Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions
  - Spread footings on concrete seals
  - 500-year scour will expose the sandstone bedrock.
  - Long-term degradation of the bedrock = 0.75 feet
  - Seals embedded 1′ minimum into sound rock

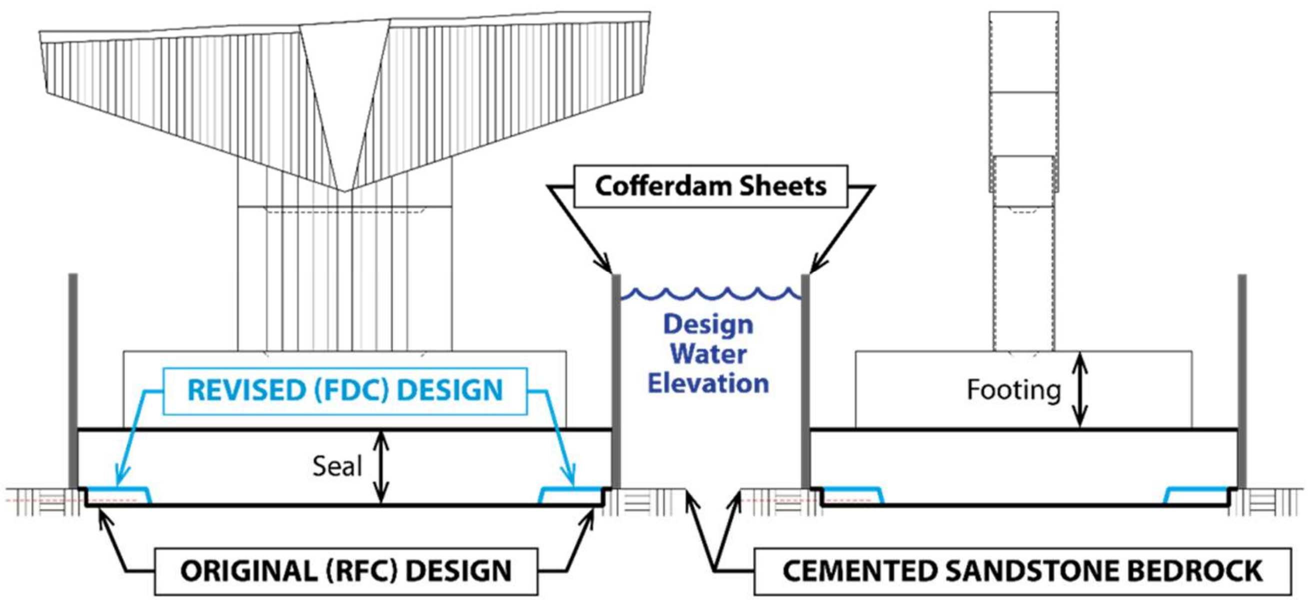
Photo by KNA

Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions – Contractor Considerations
  - Make all cofferdams same size with thickness as needed
  - Subsurface information from WisDOT
  - Boring locations did not line up with the revised pier layout
  - No new borings
  - Rock excavation limited to 4.5′ from edge of seal resulting in reduced seal bearing area

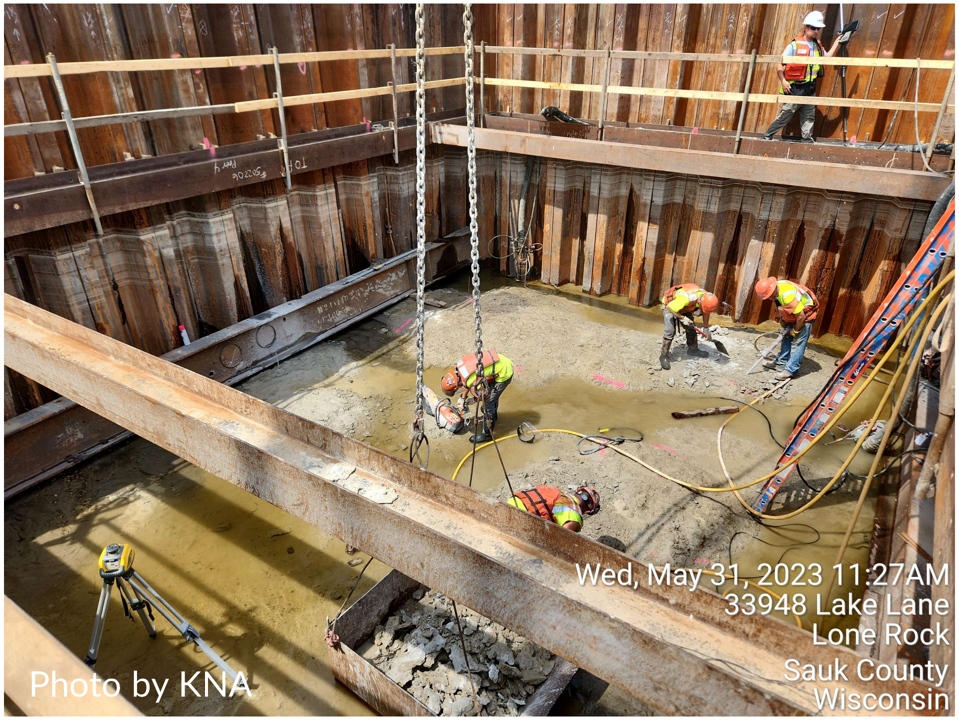
Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions – Designer Considerations



Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions



Field Design Changes

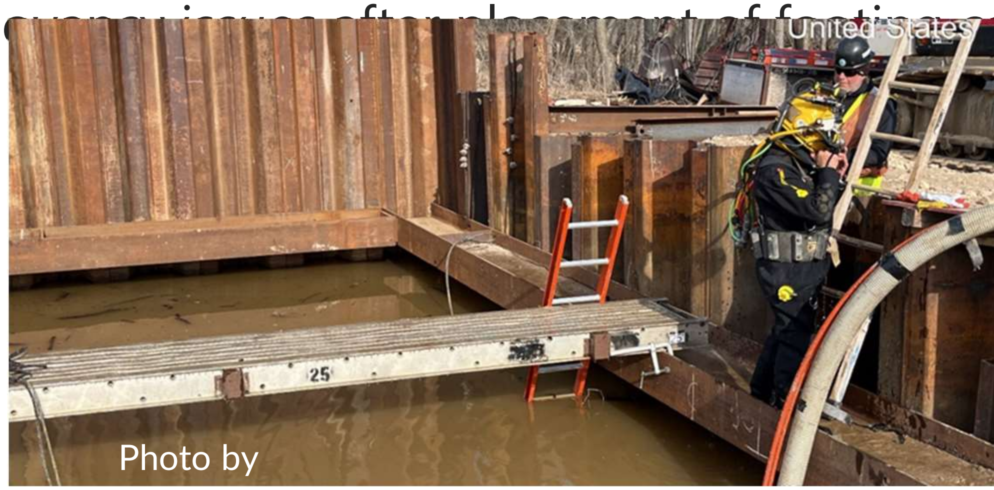
- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions
  - Nominal bearing resistance increased from 10 ksf to 30 ksf
  - Rock elevations estimated during design
  - Excavation provided accurate rock elevations (higher than estimated)
  - Hydrostatic Pressure
    - Higher rock led to thinner seals
    - Keep top of footing below ‘normal water’
    - Footing elevation changes would affect thermal model and pier design
  - Epoxy anchors
  - Reduced design water elevation

Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions
  - Hydrostatic Pressure
    - Hydraulic conductivity of sandstone
    - Any significant seepage through bedrock would be through joints or fractures
    - Uplift force would be hydrostatic pressure acting over the area of the fractures within the seal footprint
    - Assume 50% of seal footprint subjected to full hydrostatic pressure

Field Design Changes

- North Bridge: Pier Spread Footing Seal & Rock Excavation Revisions
  - Hydrostatic Pressure
    - Excavation inspected by diver to ensure no significant joints or fractures
    - Buoyancy forces develop shortly after dewatering. Wait at least 24 hours to confirm no seal uplift
    - No buoyancy issues after placement of footing concrete



DB – Owner's Perspective

- A learning process!
- Preferences vs. Contractual Requirements
- Submittal & Review Processes
- Different contract documents
- Teamwork!


Photo by HNTB

Thank

You!

Wisconsin Highway Research Program

James Luebke P.E.

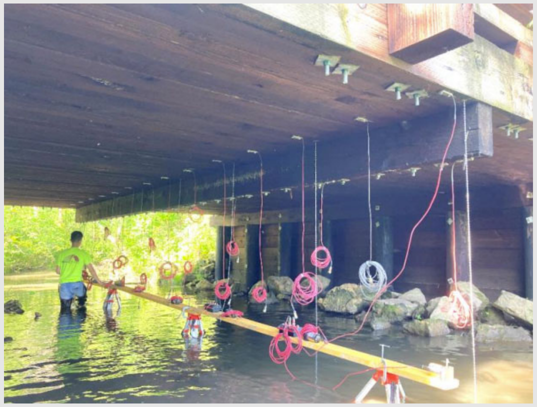
Policy and Standards Engineer

WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison WI

May 23, 2024

Overview

- WHRP
- Recently Completed Projects
- Active Projects



Wisconsin Highway Research Program (WHRP) Overview

- Established in 1998
- Collaboration with the University of Wisconsin - Madison
- Four research areas
  - Flexible Pavements
  - Rigid Pavements
  - Geotechnics
  - Structures
- GOAL: Practical research → implementable results

WHRP

- Better Ways to Design, Build and Reconstruct

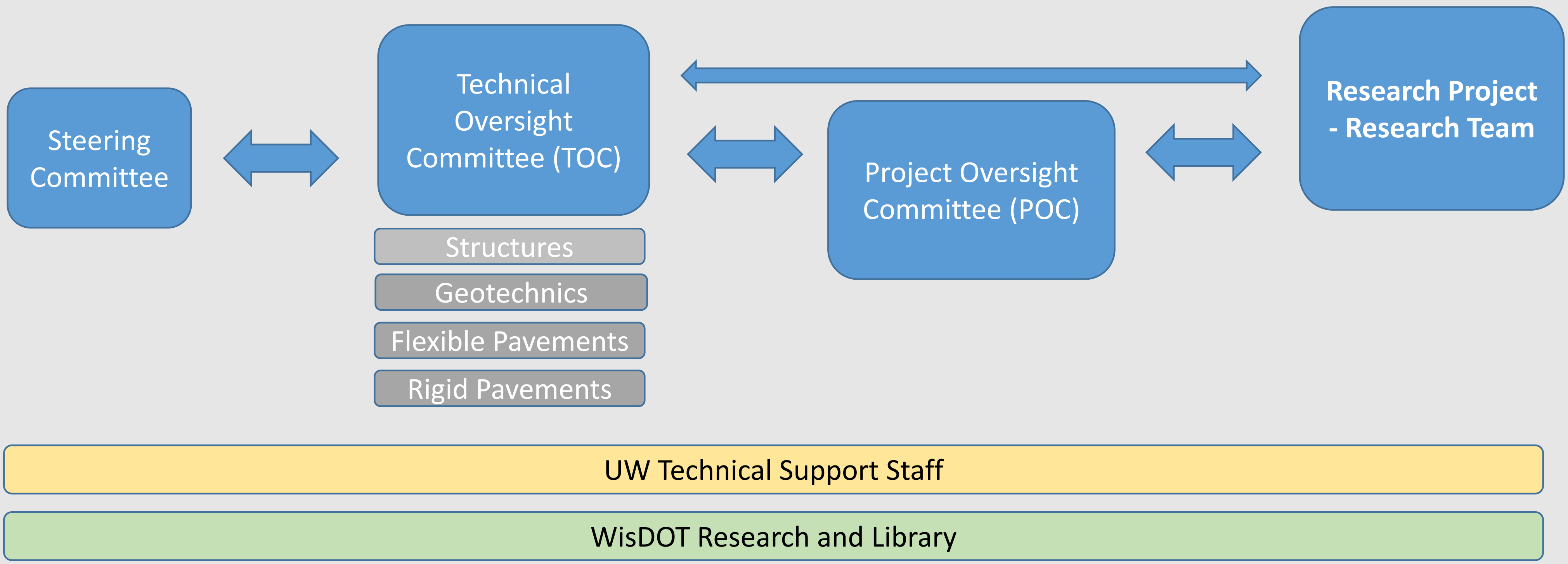
- Selected and overseen by WisDOT, Academia, Industry, Consulting Engineers, and the FHWA.

- Structures Area – 1 to 2 projects/Year

WHRP Funding

- WHRP project funding is approximately $1 million annually
- Projects are funded by:
  - 80% FHWA federal funds (SPR, Part B Research), and
  - 20% WisDOT state funds

WHRP Organization



WHRP Process

Typical 2-year project

1. Ideas — Summer Year 1
2. RFPs — Fall Year 1
3. Proposals — Winter Year 1
4. Project — Fall Year 2 – Fall Year 4
5. Implement — Spring Year 5+

Wisconsin Highway Research Program (WHRP)

- Research and Library
- **Research**
  - Wisconsin Highway Research Program (WHRP)
  - Policy Research Program
  - Pooled Fund Research
  - For Researchers
  - Program Documents and Events
  - Find Research Reports
- **Library**
  - Archives
  - History
  - Partners
  - Reading Room
  - Resources

The Wisconsin Highway Research Program was established in 1998 by the Wisconsin Department of Transportation in collaboration with the University of Wisconsin-Madison to discover better ways to design, build and reconstruct the state's highways. WHRP research projects are selected and overseen by collaborative committees that include WisDOT, academia, industry, consulting engineers and the Federal Highway Administration. Through rigorous testing of innovative materials and methods, WHRP research leads to improved performance and service life of Wisconsin's highways.

WHRP

Strategic plan

Steering Committee

Technical Oversight Committee member lists

Outreach

Project details, final reports and technical briefs

- Flexible Pavements
- Rigid Pavements
- Structures
- Geotechnics

Having trouble finding a project? Try our search tool.

Wisconsin Highway Research Program contact Shari Krueger
608-261-6064
shari.krueger@dot.wi.gov

Website: https://wisconsindot.gov/Pages/about-wisdot/research/whrp.aspx

Structures - Technical Oversight Committee (TOC)

Structures

James Luebke, Chair
WisDOT Bureau of Structures

Joe Balice (non-voting)
Federal Highway Administration

Ruth Coisman
WisDOT Bureau of Structures

Jared Marugg
Kraemer North America

Travis McDaniel
WisDOT Bureau of Structures

Tadd Owens
CORRE

Dave Pantzlaff
Ayres Associates

Jose Pincheira
University of Wisconsin – Madison

Laura Shadewald
WisDOT Bureau of Structures

Andrew Smith
WisDOT Bureau of Structures

Anthony Stakston
WisDOT Bureau of Structures

Habib Tabatabai
University of Wisconsin – Milwaukee

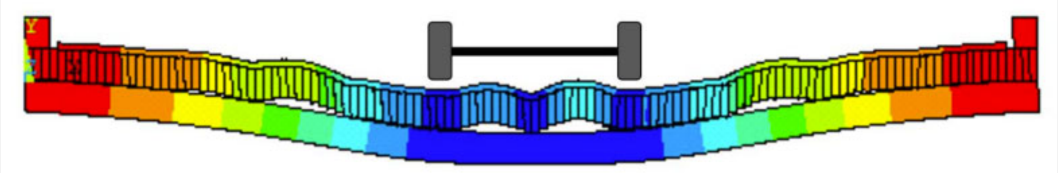
Baolin Wan
Marquette University

Recently Completed Projects

- Analytical and Testing Methods for Rating Longitudinal Laminated Timber Slab Bridges
- Optimizing Bridge Abutment Slope Protection at Stream Crossings
- Improving Bridge Concrete Overlay Performance

Timber Slab Bridges

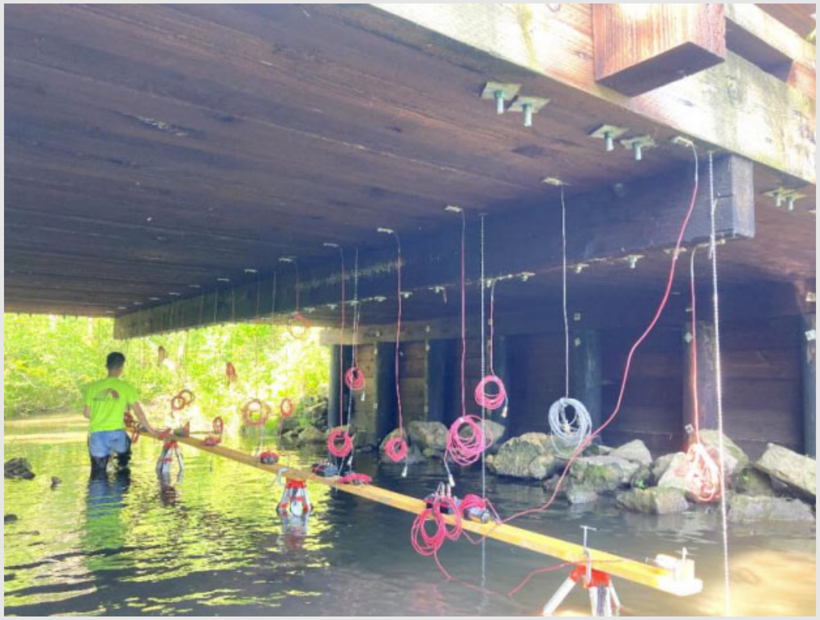
- Objective: Develop a more accurate and reliable determination of wheel load distribution
- Research Benefit: Avoided new or lower weight postings (70+/-)



0092-20-01 Analytical and Testing Methods for Rating Longitudinal Laminated Timber Slab Bridges (12/21)

Timber Slab Bridges

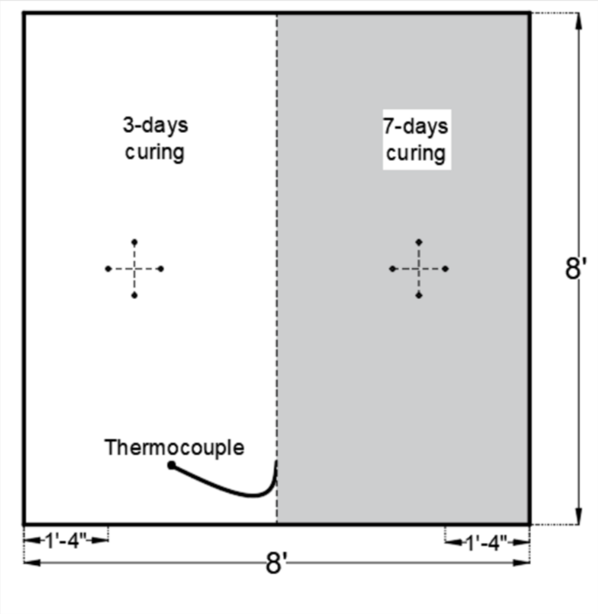
- Field Tested 10 Bridges
- Developed 3D FE models
- Parametric Study
- Validated New Equation - Equivalent Strip Width



0092-20-01 Analytical and Testing Methods for Rating Longitudinal Laminated Timber Slab Bridges (12/21)

Improving Bridge Concrete Overlay Performance

- Experimental Work – Slab Tests:
  - (2) cure durations (3 and 7 day)
  - (7) different overlay mixes



Improving Bridge Concrete Overlay Performance

Mixture	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6	Mix 7
Designation	E-IL	FRC	CR-15	FRC-15	FA	LMC	E-I
Description	Grade E	Grade E, PVA Fibers	Grade E Reduced Cement	Grade E Reduced Cement PVA Fiber	Grade E 15% Fly Ash	Latex Modified Mix	Grade E
Cement Type	IL	IL	IL	IL	IL	IL	I
Sand, dry (lbs)	1405	1405	1405	1405	1405	1405	1405
Gravel, dry (lbs)	1405	1405	1405	1405	1405	1405	1405
Cement	823	823	700	700	700	659	823
Water-Cement Ratio	0.324	0.324	0.324	0.324	0.324	0.324	0.324
Water reducer (oz)	To meet slump requirement						
Air Entrainment (oz)	To meet air content requirement						
PVA fiber (lbs)		1.5		1.5			
Fly Ash (lbs)					123		
Latex (lbs.)						139	

Improving Bridge Concrete Overlay Performance

- Summary and Conclusions
  - Heat-of-hydration (calorimetry) tests indicated that Type IL cement can generate higher peaks of heat flow compared Type I.
  - Reduction of cement content resulted in reduced heat flow for both IL and OPC.
  - Replacing cement with fly ash (0, 10%, 15%, and 20% replacement) resulted in progressively smaller heat flow peaks.

Improving Bridge Concrete Overlay Performance

- Recommendations:
  - Modifications to the Mix Design
  - Increase Concrete Cure
  - Perform Deck Repairs Before Placing the Overlay

Optimizing Bridge Abutment Slope Protection at Stream Crossings

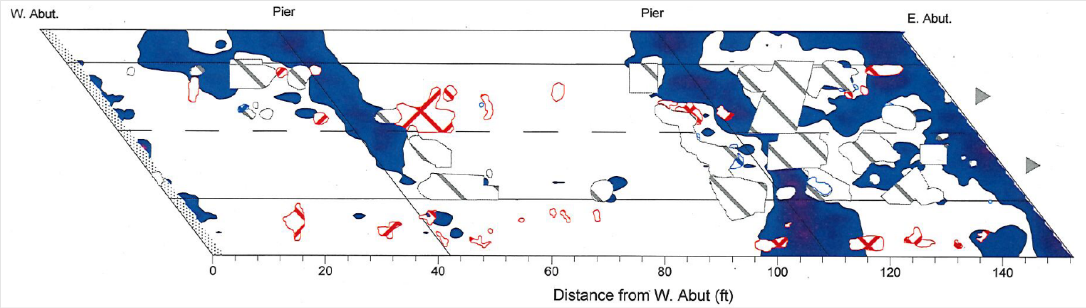
- Develop guidance for identifying performance issues associated with slope protection.
- Develop guidance with life-cycle cost considerations.

Active Projects

- Bridge Deck Thermography Verification and Policy
- Vertical and Overhead Concrete Patches
- State of Practice for Specifying and Repairing MSE Walls
- Investigation of MSE Wall Corrosion in Wisconsin (Geotech)
- Investigation of Removing Existing Abutment Exp. Joints (Pre-Contract)

Bridge Deck Thermography

- Specifications IRT data collection.
- State-wide policies on using IRT
- Guidelines on the IRT's accuracy



PI: AECOM
PM: Philip Meinel
Completion: 10/2024

Vertical and Overhead Concrete Patches

- Investigate and provide material selection guidance and repair strategies for concrete surface repairs.
- Develop patch-repair material installation specifications, installation inspection requirements, and acceptance criteria.
- Investigate the performance of minor to intermediate patch repairs

PI: WJE
PM: Andrew Smith
Completion: 10/2025

Investigation of MSE Wall Corrosion in WI

Figure: FHWA-HIF-24-002

PI: Geocomp, Inc
PM: Steven Doocy
Completion: 10/2025

State of Practice for Specifying and Repairing MSE Walls

- Identify best practices for MSE wall usage
- Recommendations to maximize MSE wall service life
- Prepare recommendations for specific retrofit solutions.

PI: Applied Research Associates, Inc.
PM: Ruth Coisman
Completion: 2/2026

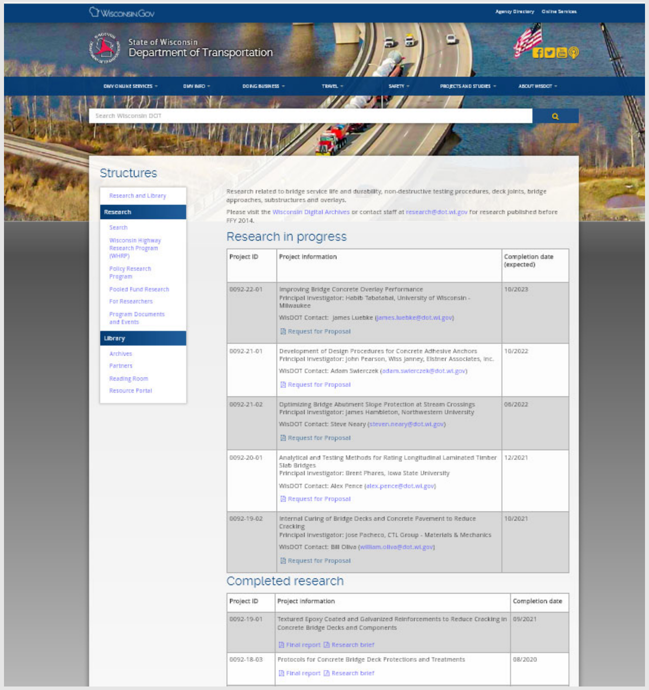
Investigation of Removing Existing Abutment Expansion Joints

- Examine WisDOT's practice of removing existing expansion joints at substructures.
- Define practical limits of substructure conversions.
- Prepare recommendations for converting substructures.

PI: TBA
PM: Laura Shadewald
Completion: 10/2026

WHRP Reports:

- https://wisconsindot.gov/Pages/about-wisdot/research/structures.aspx



Questions

James Luebke, PE
James.luebke@dot.wi.gov
(608) 266-5098

Load Ratings & Mega-Loads

Alex Pence
Supervisor – Automation & Load Ratings

BOS Symposium

May 23, 2024

Topic 1: Load Rating FAQs

- Emergency & Posting Vehicle Evaluations
- Where to Find Recent Load Ratings
- Low Load Ratings on Good Bridges
- Wis-SPV Ratings
- Prestressed Girder Shear
- Culvert Ratings

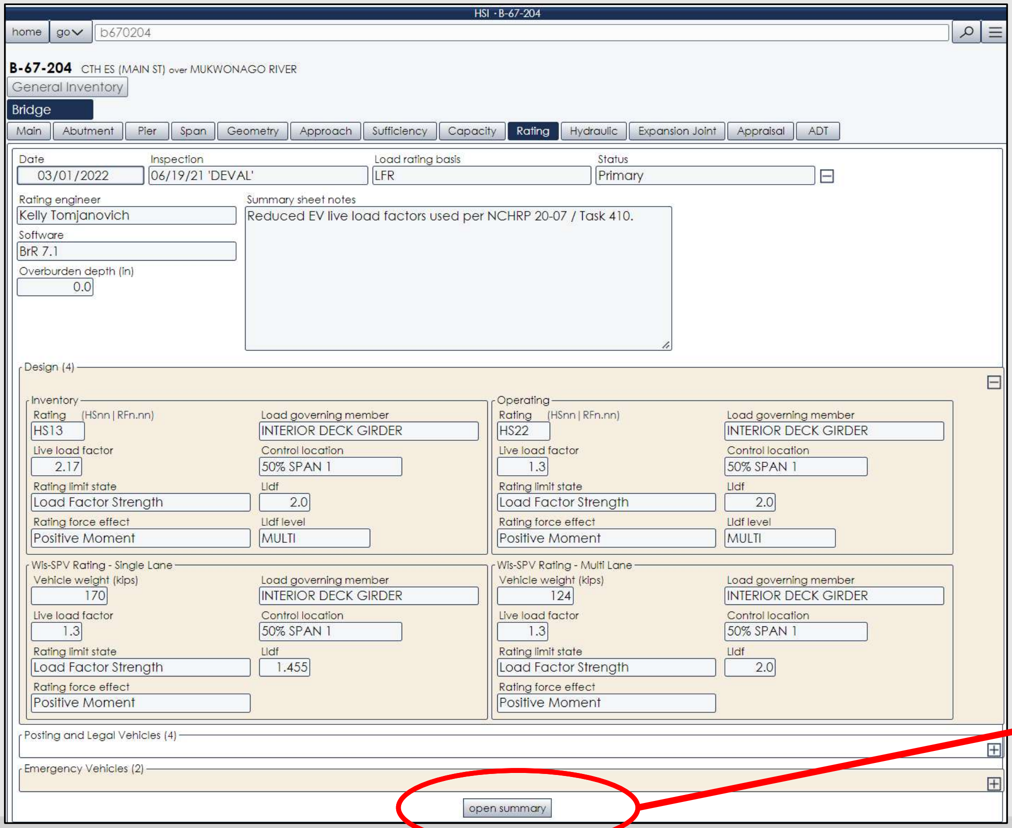
Emergency & Posting Vehicle Evaluations

When do posting / emergency vehicles need to be analyzed?

Vehicles	Inventory Rating	Operating Rating
Emergency Vehicles	HS20 RF < 1.0 HL93 RF < 0.9	---
SHVs	---	HS20 RF < 1.3 HL93 RF < 1.0
Other Posting Vehicles	---	HS20 RF < 1.0 HL93 RF < 1.0

Where to Find Recent Load Ratings?

HSIS Rating Tab


HSI - B-67-204

home | go | b670204

B-67-204 CTH ES (MAIN ST) over MUKWONAGO RIVER

General Inventory

Bridge

Main | Abutment | Pier | Span | Geometry | Approach | Sufficiency | Capacity | Rating | Hydraulic | Expansion Joint | Appraisal | ADT

Date	Inspection	Load rating basis	Status
03/01/2022	06/19/21 'DEVAL'	LFR	Primary

Rating engineer: Kelly Tomjanovich

Software: BrR 7.1

Overburden depth (in): 0.0

Summary sheet notes: Reduced EV live load factors used per NCHRP 20-07 / Task 410.

Design (4)

Inventory

Rating (HSnn | RFn.nn)	HS13
Load governing member	INTERIOR DECK GIRDER
Live load factor	2.17
Control location	50% SPAN 1
Rating limit state	Load Factor Strength
Lldf	2.0
Rating force effect	Positive Moment
Lldf level	MULTI

Operating

Rating (HSnn | RFn.nn)	HS22
Load governing member	INTERIOR DECK GIRDER
Live load factor	1.3
Control location	50% SPAN 1
Rating limit state	Load Factor Strength
Lldf	2.0
Rating force effect	Positive Moment
Lldf level	MULTI

Wis-SPV Rating - Single Lane

Vehicle weight (kips)	170
Load governing member	INTERIOR DECK GIRDER
Live load factor	1.3
Control location	50% SPAN 1
Rating limit state	Load Factor Strength
Lldf	1.455
Rating force effect	Positive Moment

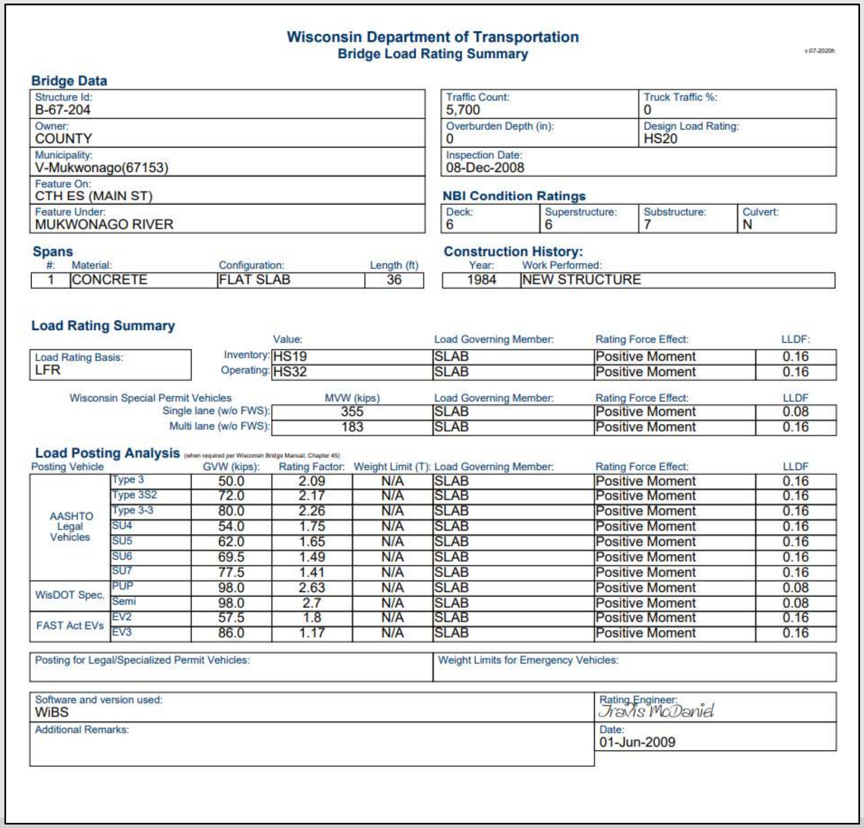
Wis-SPV Rating - Multi Lane

Vehicle weight (kips)	124
Load governing member	INTERIOR DECK GIRDER
Live load factor	1.3
Control location	50% SPAN 1
Rating limit state	Load Factor Strength
Lldf	2.0
Rating force effect	Positive Moment

Posting and Legal Vehicles (4)

Emergency Vehicles (2)

open summary


Wisconsin Department of Transportation
Bridge Load Rating Summary

v.07-2020h

Bridge Data

Structure Id: B-67-204	Traffic Count: 5,700 / Truck Traffic %: 0
Owner: COUNTY	Overburden Depth (in): 0 / Design Load Rating: HS20
Municipality: V-Mukwonago(67153)	Inspection Date: 08-Dec-2008
Feature On: CTH ES (MAIN ST)	
Feature Under: MUKWONAGO RIVER	

NBI Condition Ratings

Deck:	Superstructure:	Substructure:	Culvert:
6	6	7	N

Spans

#:	Material:	Configuration:	Length (ft)
1	CONCRETE	FLAT SLAB	36

Construction History:

Year:	Work Performed:
1984	NEW STRUCTURE

Load Rating Summary

Load Rating Basis: LFR

	Value:	Load Governing Member:	Rating Force Effect:	LLDF:
Inventory:	HS19	SLAB	Positive Moment	0.16
Operating:	HS32	SLAB	Positive Moment	0.16

Wisconsin Special Permit Vehicles	MVW (kips)	Load Governing Member:	Rating Force Effect:	LLDF
Single lane (w/o FWS):	355	SLAB	Positive Moment	0.08
Multi lane (w/o FWS):	183	SLAB	Positive Moment	0.16

Load Posting Analysis (when required per Wisconsin Bridge Manual, Chapter 45)

Posting Vehicle		GVW (kips):	Rating Factor:	Weight Limit (T):	Load Governing Member:	Rating Force Effect:	LLDF
AASHTO Legal Vehicles	Type 3	50.0	2.09	N/A	SLAB	Positive Moment	0.16
	Type 3S2	72.0	2.17	N/A	SLAB	Positive Moment	0.16
	Type 3-3	80.0	2.26	N/A	SLAB	Positive Moment	0.16
	SU4	54.0	1.75	N/A	SLAB	Positive Moment	0.16
	SU5	62.0	1.65	N/A	SLAB	Positive Moment	0.16
	SU6	69.5	1.49	N/A	SLAB	Positive Moment	0.16
	SU7	77.5	1.41	N/A	SLAB	Positive Moment	0.16
WisDOT Spec.	PUP	98.0	2.63	N/A	SLAB	Positive Moment	0.08
	Semi	98.0	2.7	N/A	SLAB	Positive Moment	0.08
FAST Act EVs	EV2	57.5	1.8	N/A	SLAB	Positive Moment	0.16
	EV3	86.0	1.17	N/A	SLAB	Positive Moment	0.16

Posting for Legal/Specialized Permit Vehicles:

Weight Limits for Emergency Vehicles:

Software and version used: WiBS

Rating Engineer: Travis McDaniel

Additional Remarks:

Date: 01-Jun-2009

BUREAU OF STRUCTURES

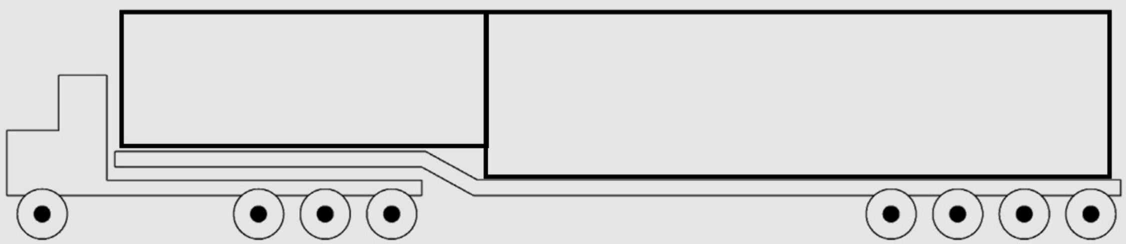
Low Load Ratings on Good Bridges

- Impacts
  - Legal Weight Limit Restrictions
  - OSOW Freight Restrictions
  - Reduced Service Life
  - Inspection Frequency (Inv RF < 1.0)

- Design Phase
  - Consider cost/benefit of refined analysis, alternate methods, or strengthening
  - Reach out to BOS Rating Unit to discuss

Wis-SPV Ratings

- Wisconsin Bridge Manual Section 45.12
  - Target MVW > 190 kips w/ Single-Lane Loading
    - Plus FWS for new designs
  - Report ratings w/o FWS on plans and load rating summary sheet
  - Consider <u>Interior</u> Girders or Slab Strips only
  - For rehab or in-service bridge ratings, contact BOS if MVW < 190 kips
    - Below 170 kips can restrict annual permits



Prestressed Girder Shear

45.6.1 Prestressed Concrete

For bridges designed to be continuous over interior supports, the negative capacity shall come from the reinforcing steel in the concrete deck. Conservatively, only the top mat of steel deck reinforcing steel should be considered when rating for negative moment. If this assumption results in abnormally low ratings for negative moment, contact the Bureau of Structures Rating Unit for consultation.

Elastic gains in prestressed concrete elements shall be neglected for a conservative approach.

Shear design equations for prestressed concrete bridges have evolved through various revisions of the AASHTO design code. Because of this, prestressed concrete bridges designed during the 1960s and 1970s may not meet current shear capacity requirements. Shear capacity should be calculated based on the most current AASHTO code, either LFR or LRFR. Shear should be considered when determining the controlling ratings for a structure. If shear capacities are determined to be insufficient, the load rating engineer of record should contact the Bureau of Structures Rating Unit for consultation. If an existing bridge was designed using the Simplified Procedure for shear, the Simplified Procedure **LRFD [5.8.3.4.3]** (7^{th} Edition - 2014) may be considered for shear ratings.

Concrete Bridge
Shear Load Rating Synthesis Report

Publication No. FHWA-HIF-18-061
Federal Highway Administration
Office of Infrastructure

November 2018

U.S. Department of Transportation
Federal Highway Administration

U.S. Department of Transportation
Federal Highway Administration

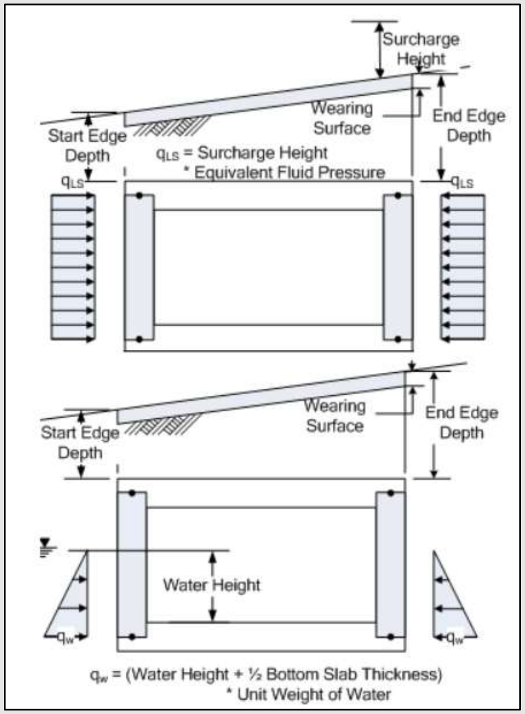
CONCRETE BRIDGE SHEAR LOAD RATING GUIDE AND EXAMPLES
USING THE MODIFIED COMPRESSION FIELD THEORY

Publication No: FHWA-HIF-22-025
Office of Bridges and Structures
April 2022

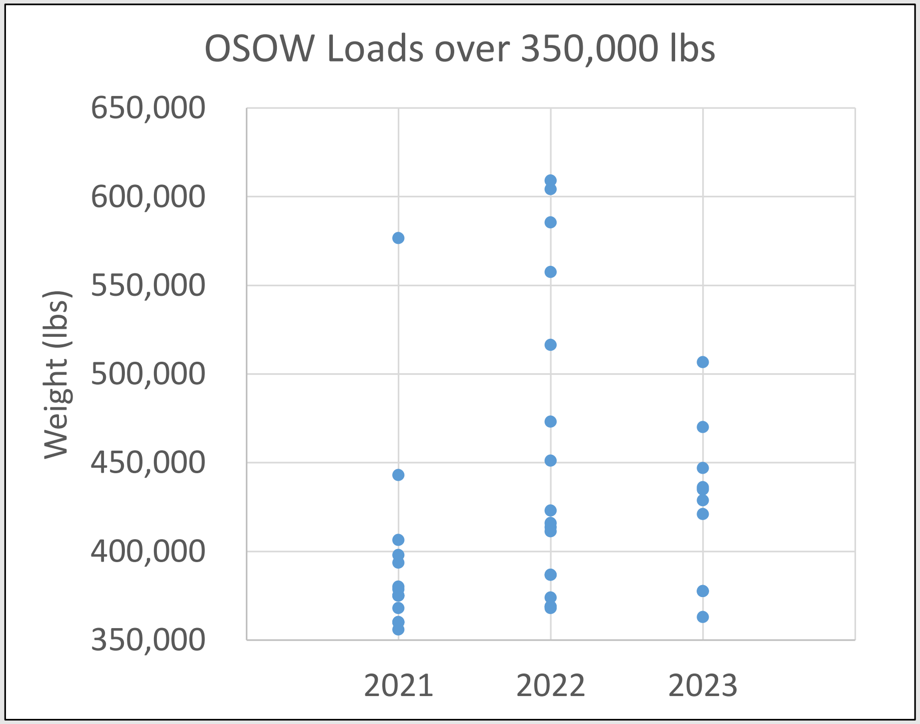
Culvert Load Ratings

- Bridge Manual Ch. 45 Update (July 2023)

- 3 Methods
  - Calculated
    - Ideal method; required for most concrete boxes
  - Assigned
    - Requires stamped plans/calcs with design load & fill depth
    - Must meet minimum original design standards
  - Field Evaluation & Engineering Judgment
    - Use when Calculated or Assigned cannot be used
    - Bridge Manual has recommended ratings and postings based on condition



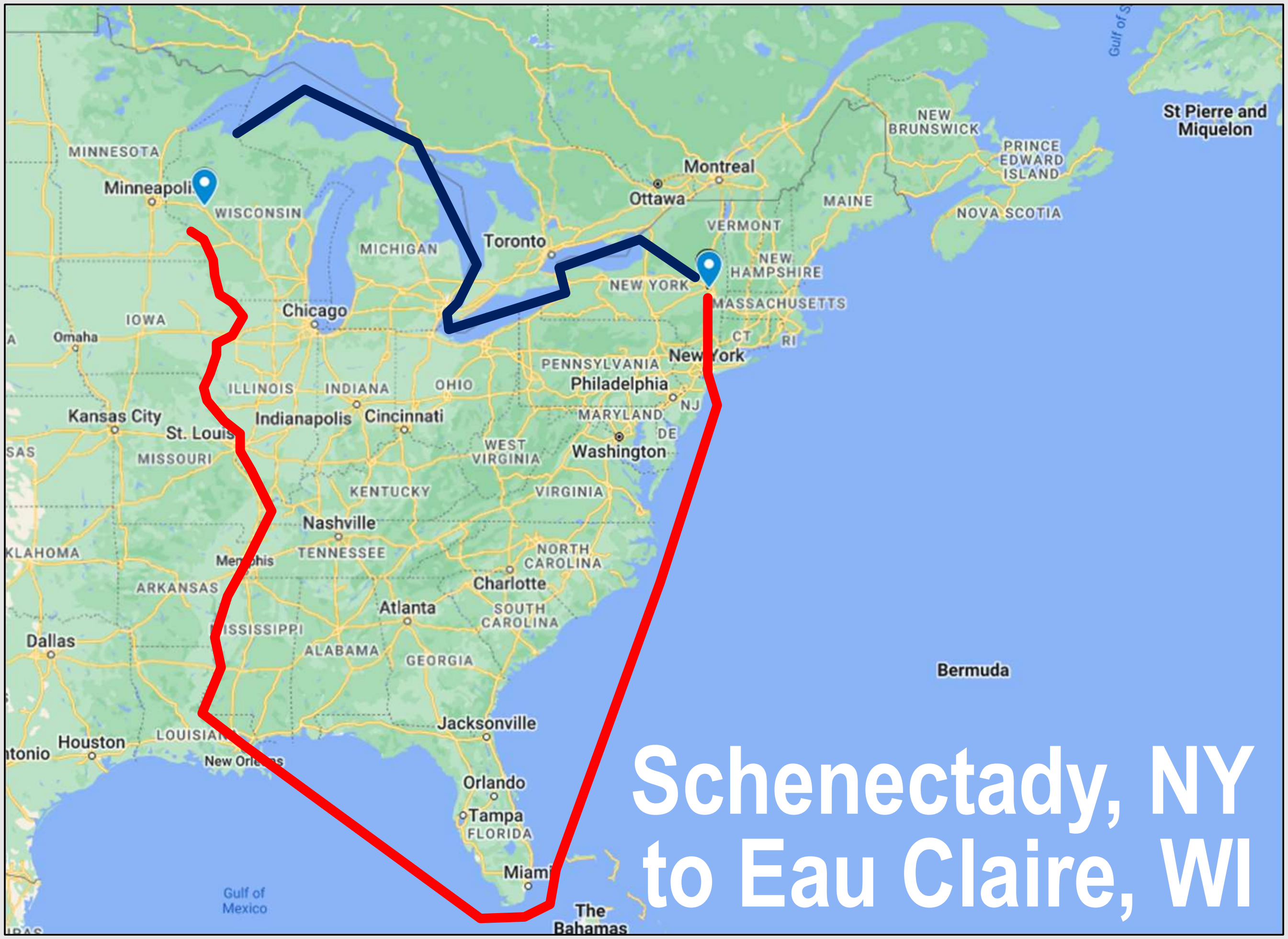
Topic 2: Mega-Loads in Wisconsin



BUREAU OF STRUCTURES

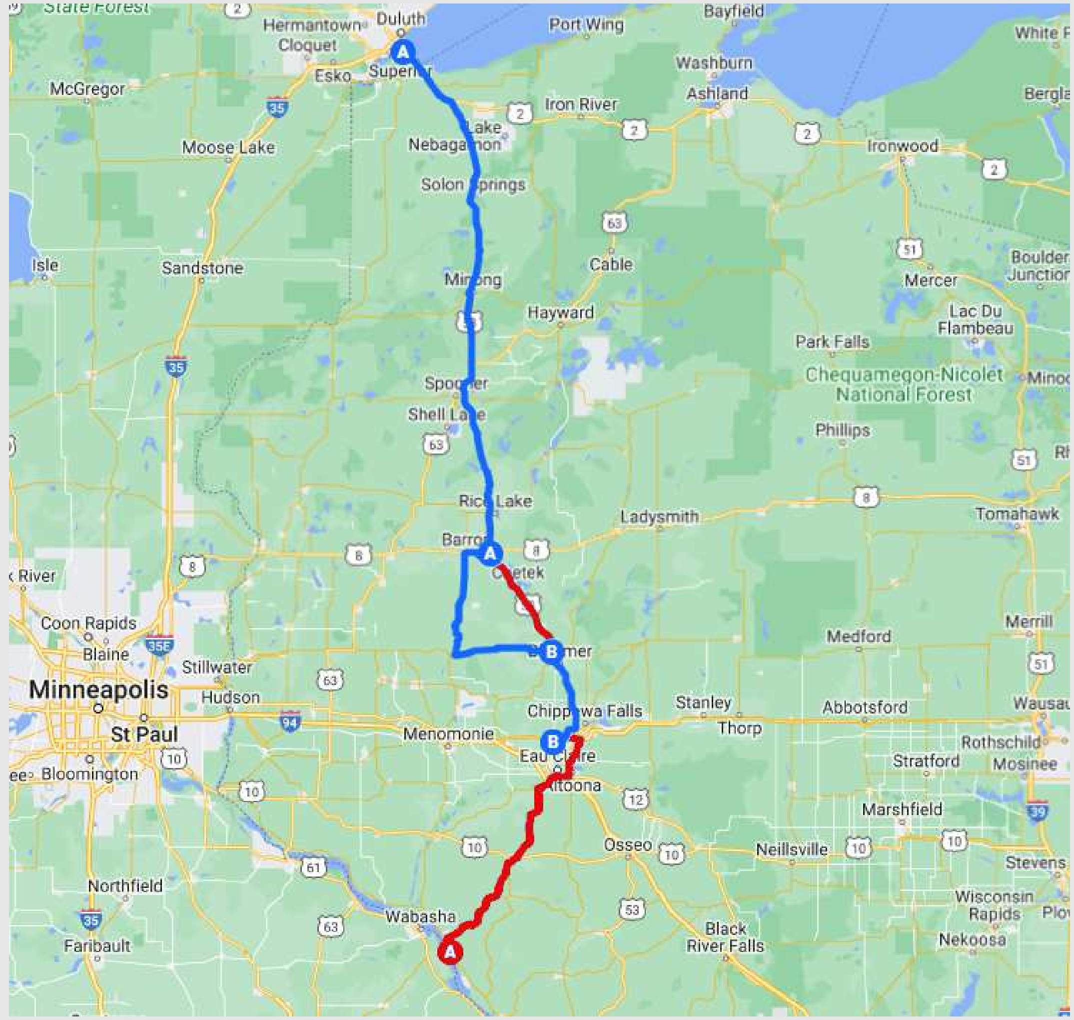
1.4M-Lb Mega-Load: Xcel Energy Generator

- 658,000-lb generator
- Converts natural gas turbine output into electricity
- Green Energy initiative
- Destination: Eau Claire, WI (Xcel Energy)
  - Originally could not get rail clearance
  - Planned to travel by barge
- Schedule: Summer 2024

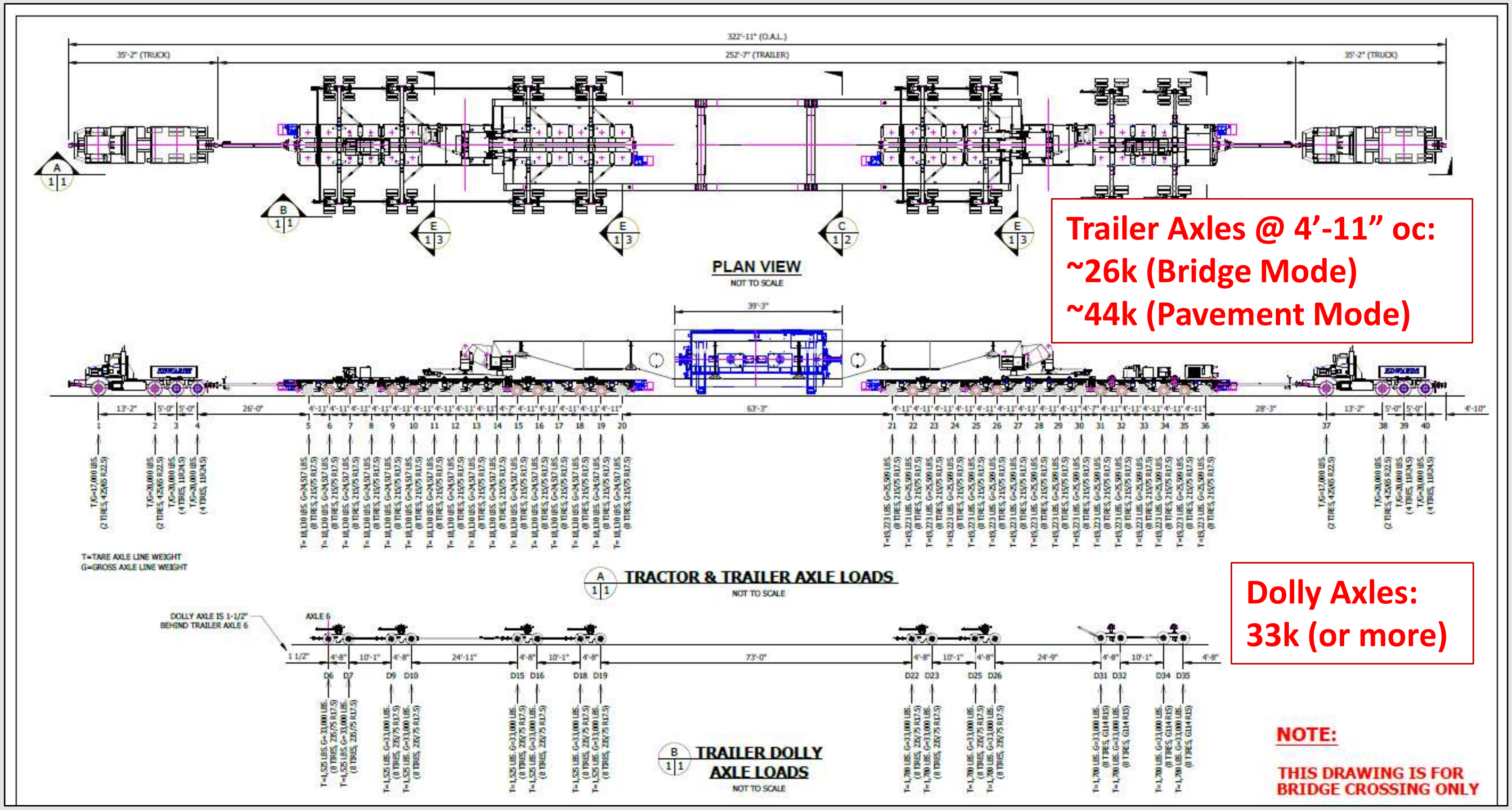

Schenectady, NY
to Eau Claire, WI
MINNESOTA
Minneapolis
WISCONSIN
MICHIGAN
Toronto
Ottawa
Montreal
VERMONT
MAINE
NEW BRUNSWICK
PRINCE EDWARD ISLAND
NOVA SCOTIA
St Pierre and Miquelon
NEW HAMPSHIRE
NEW YORK
MASSACHUSETTS
CT
RI
New York
IOWA
Omaha
Chicago
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
Philadelphia
NJ
MARYLAND
DE
Washington
Kansas City
St. Louis
MISSOURI
Indianapolis
Cincinnati
WEST VIRGINIA
VIRGINIA
KENTUCKY
Nashville
TENNESSEE
NORTH CAROLINA
Charlotte
SOUTH CAROLINA
ARKANSAS
Atlanta
ALABAMA
GEORGIA
Dallas
Jacksonville
Houston
Orlando
Tampa
FLORIDA
Miami
The Bahamas
Bermuda
Gulf of Mexico

Routes through Wisconsin

- From Alma (Mississippi)
- From Superior (Great Lakes)
  - First Attempt
  - Detour for Denied Bridges



Load Configuration

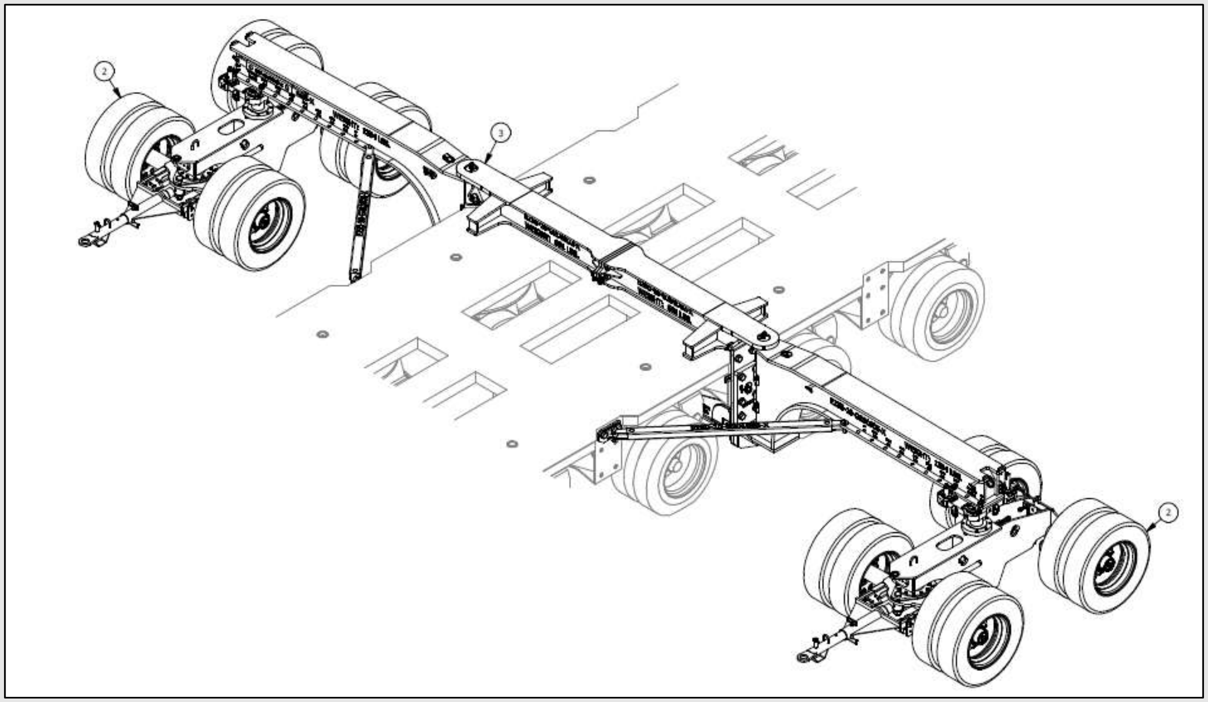


Trailer Axles @ 4'-11" oc:
~26k (Bridge Mode)
~44k (Pavement Mode)

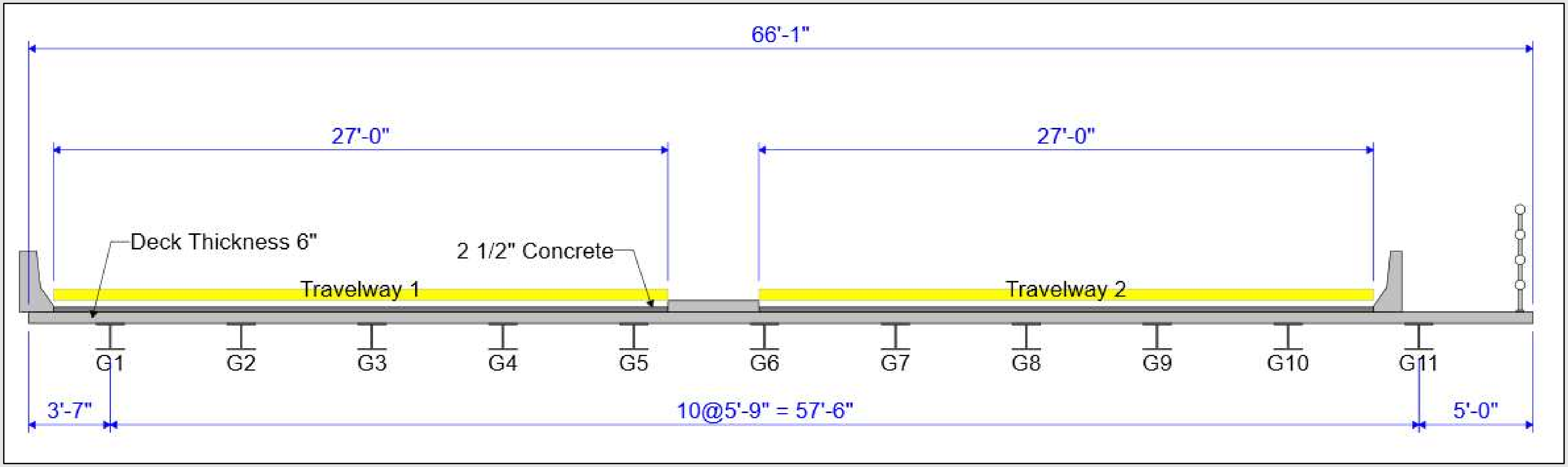
Dolly Axles:
33k (or more)

Load Configuration

- 1,482,422 lbs
- 40 axles
- 2 trailers
- 2 trucks
- 322’-11” length
- 9’-10” wide “pavement mode”
- 31’-2” wide “bridge mode”

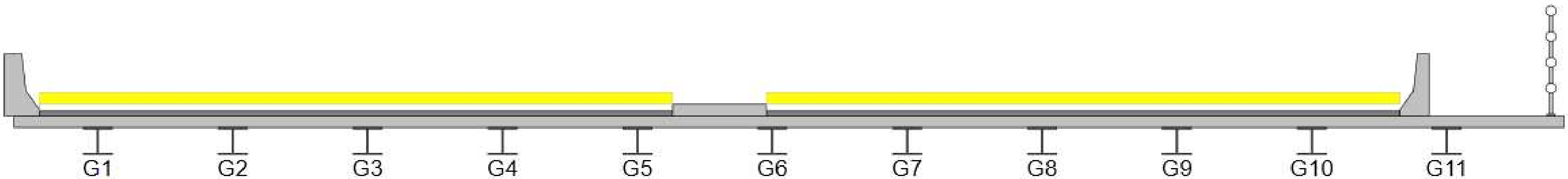


Example Bridge w/ Non-Standard Gage (NSG) Vehicle Analysis



AASHTO Std Spec (LFD/LFR)

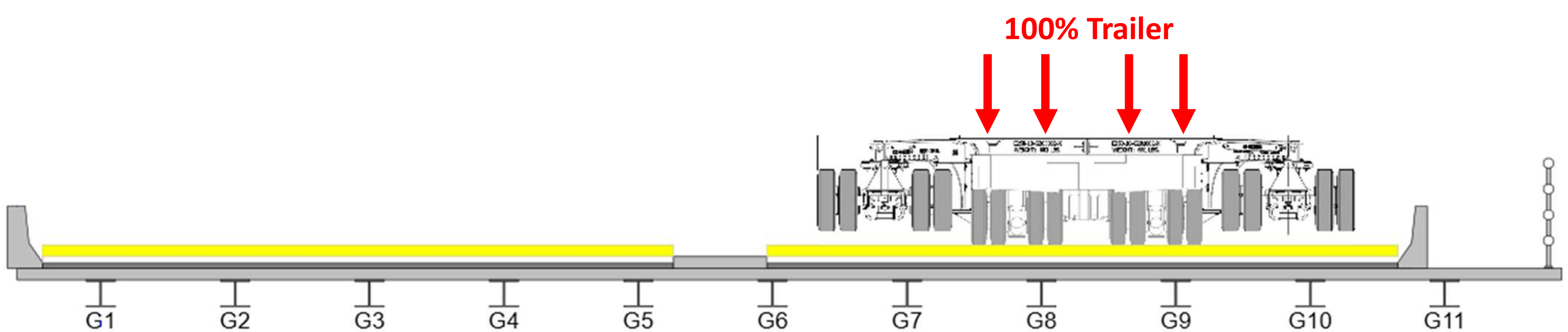
Standard Truck Axle Live Load Distribution



57%	41%	41%	41%	41%	41%	41%	41%	41%	41%	52%

NSG + Vehicle Path Distribution Factors

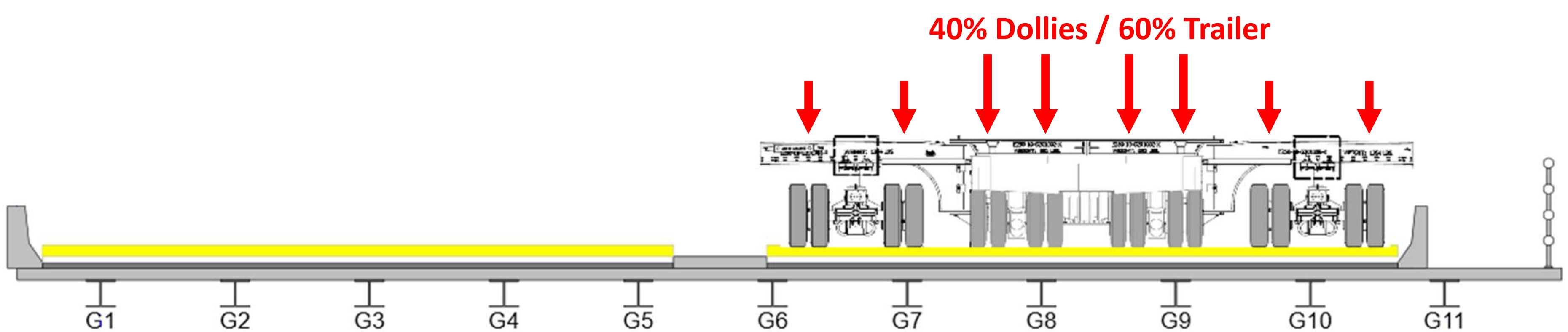
Roadway Configuration (Dollies Lifted)



0%	0%	0%	1%	4%	10%	18%	31%	28%	16%	6%

NSG + Vehicle Path Distribution Factors

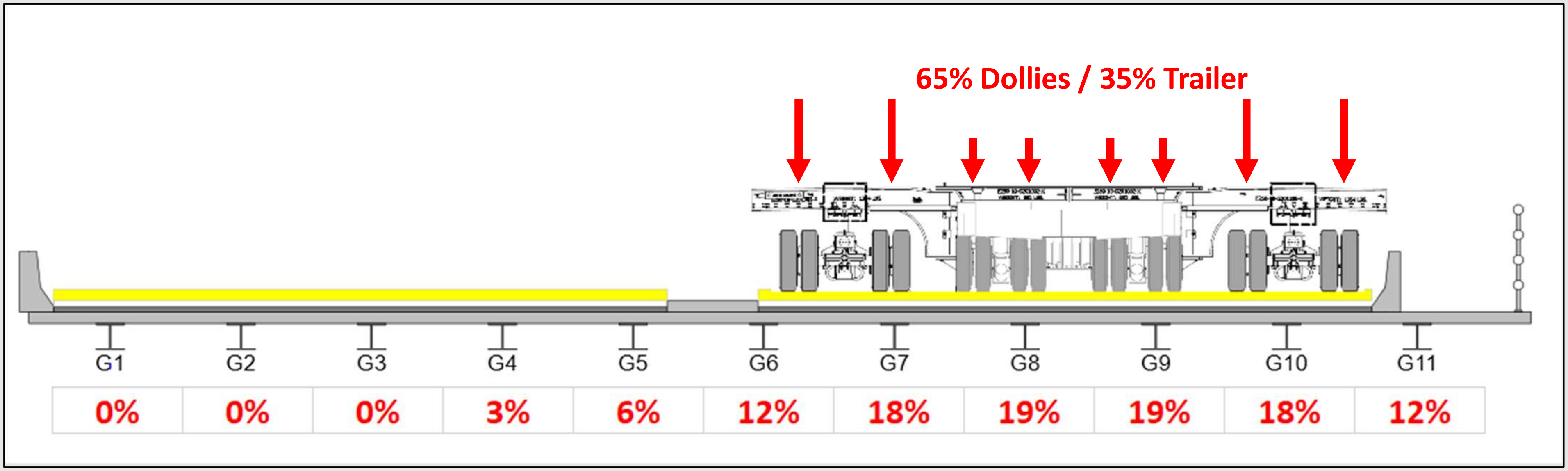
Balanced Load on Dollies, Minimum Width



0%	0%	0%	2%	6%	11%	18%	24%	23%	16%	10%

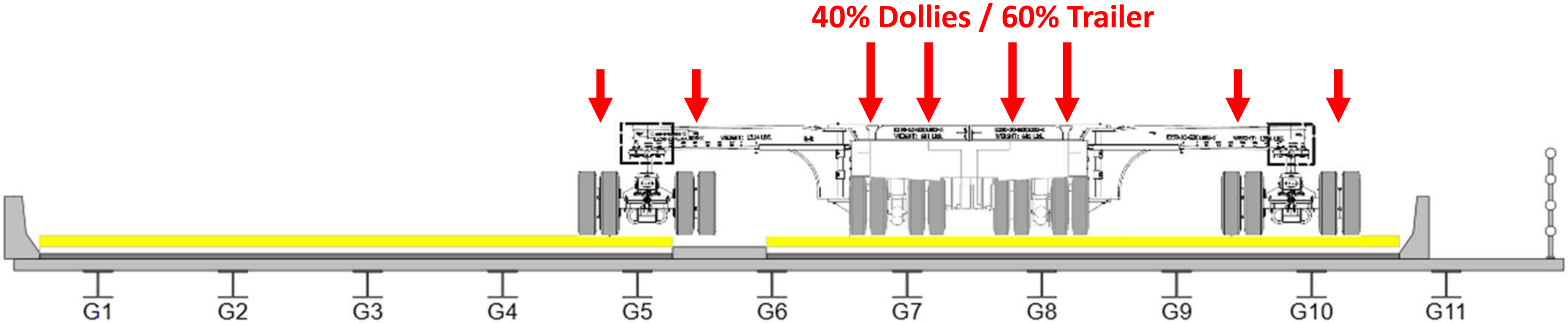
NSG + Vehicle Path Distribution Factors

Maximum Load on Dollies, Minimum Width



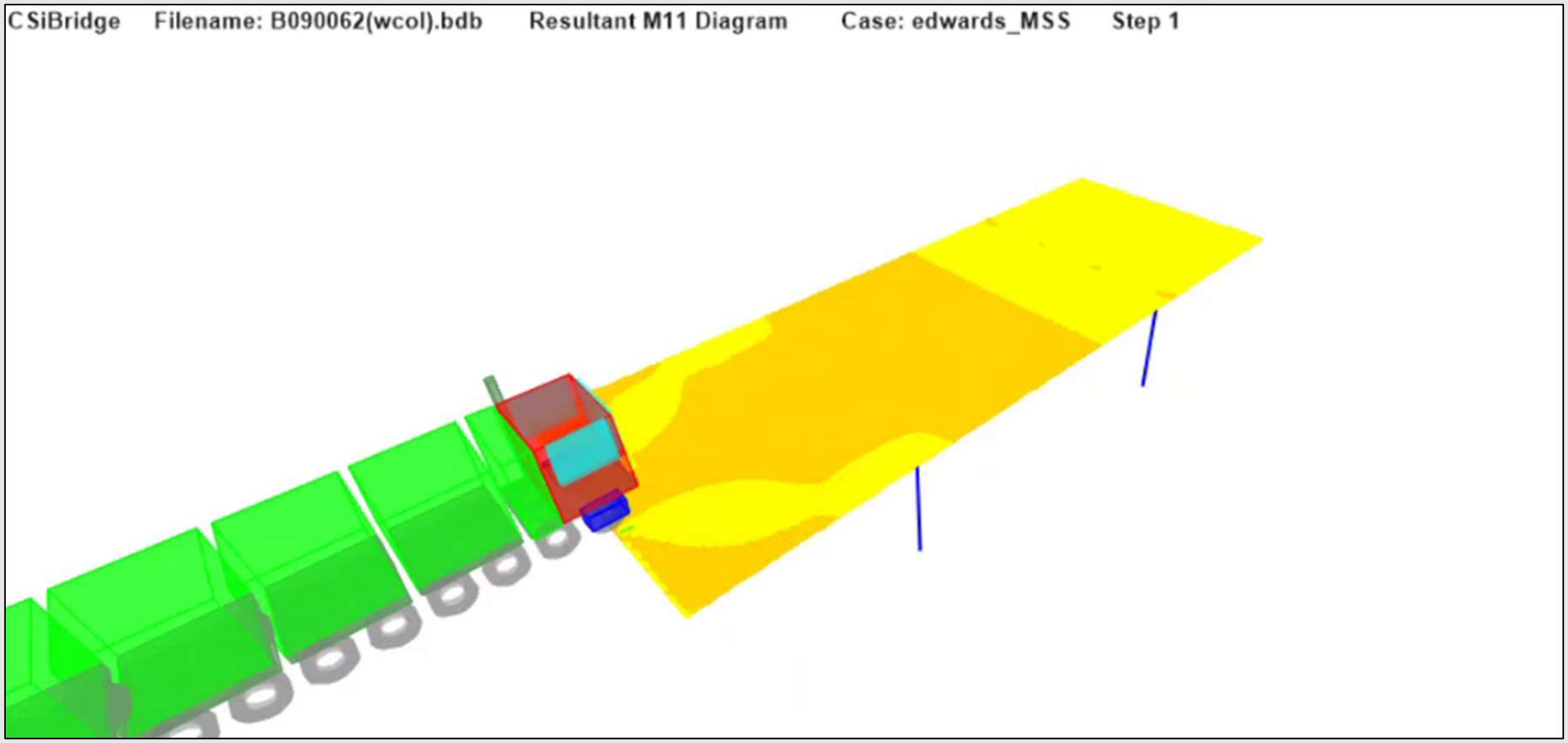
NSG + Vehicle Path Distribution Factors

Balanced Load on Dollies, Maximum Width



G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
0%	0%	2%	6%	10%	15%	21%	21%	16%	10%	5%

3D Analysis for Slabs

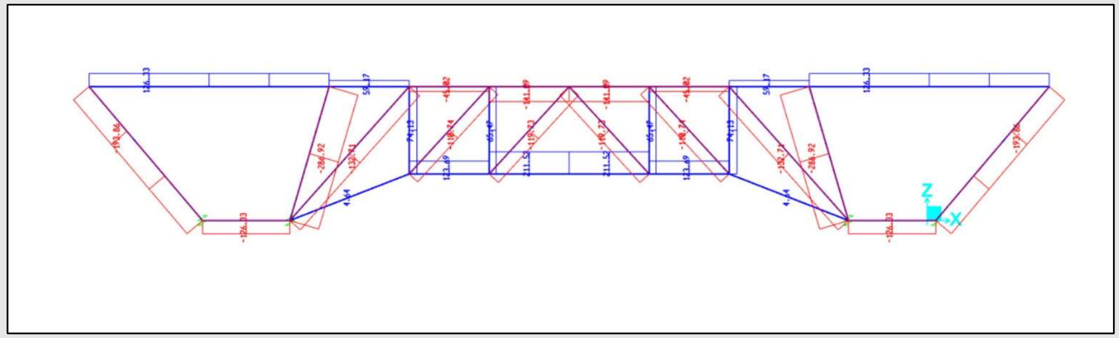


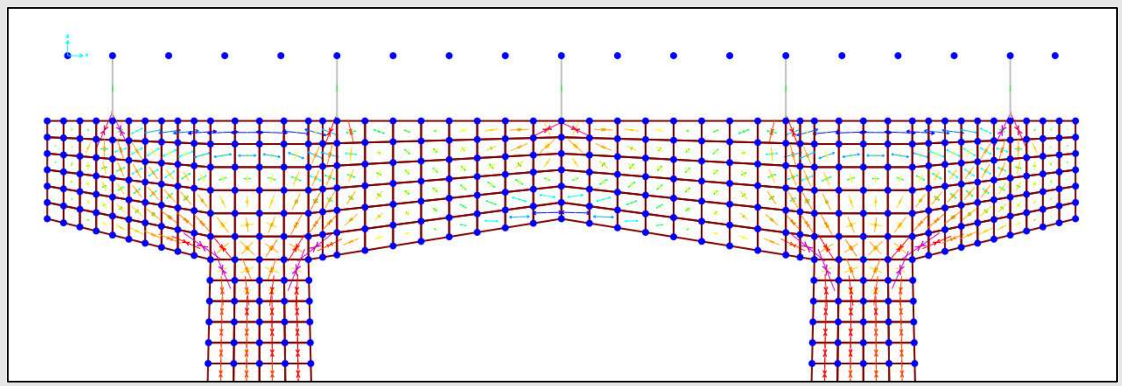
Analysis Refinement Options

- Steel Girder – Positive Moment
  - Elastic vs. Plastic
- Prestressed Girder – Shear
  - LFR vs. LRFR, General vs. Simplified, Ignore
- Deck Reinforcement – Negative Moment
  - Top Mat only vs. Top & Bottom
- Moment Redistribution
  - Decrease Negative Moment, Increase Positive Moment
- LRFR instead of LFR
  - Usually better for PS girder shear
  - Allows lower LL factor for escorted permit loads

Other Rating Checks

- Inspection Report Review
- Culverts
- Pier Caps
  - Traditional Beam Analysis
  - FEA / Strut-and-Tie





Permit Fees

- Bridge Review
  - $10 per hour → $10 flat fee?
  - Unchanged since 1983
- Other Special Investigation
  - Opened Project ID
  - Tracking Actual Costs
  - BOS + Consultant Resources

Trans 250.05 Special investigation fees.

(1) The department shall charge the following special investigation fees:

(a) For each single trip permit for a width exceeding 16 feet, a region review fee of $10 for each region through which the load is routed to cover the costs incurred by the region office in reviewing the adequacy of the route for the proposed move.

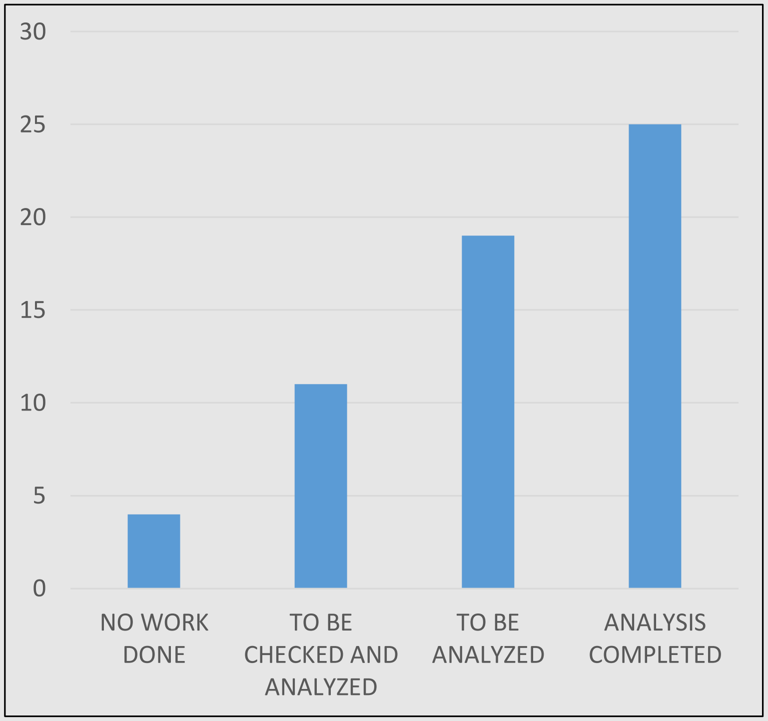
(b) For each single trip permit for a gross weight exceeding 150,000 pounds, a bridge review fee of $10 per hour for each employee-hour or fraction thereof required to review the adequacy of the bridges to support the proposed load to cover the costs incurred by the department for this review.

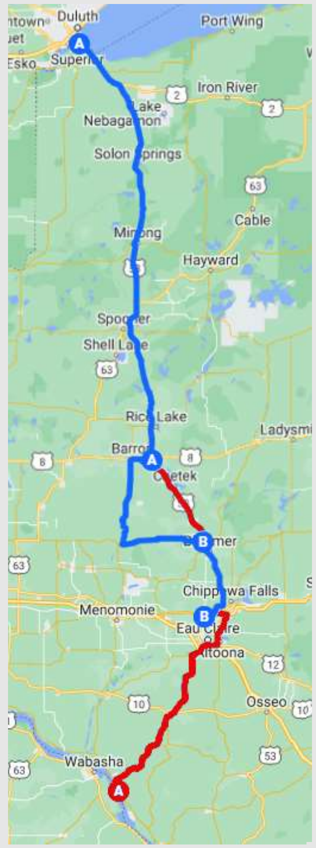
(c) For any other special investigation deemed necessary by the department because of the size or weight of the load or of the route to be travelled, the actual cost incurred by the department in making the investigation.

(2) The fees under sub. (1) shall be charged regardless of whether the special investigation is conducted before or after a permit application is received and regardless of whether a permit is issued or denied.

History: Cr. Register, September, 1983, No. 333, eff. 10-1-83; correction in (1) (a) made under s. 13.92 (4) (b) 6., Stats., Register February 2013 No. 686.

Progress





- Alma – Eau Claire (27)
  - 7 approved
  - 1 denied
  - 19 incomplete
- Superior – Eau Claire (49)
  - 24 approved
  - 2 denied
  - 23 incomplete
    - 7 removed from route
- Superior – Eau Claire Detour (14)
  - 14 incomplete
- **Most Recent Route (50)**
  - **Evaluation ~85% complete**

Hold Up!

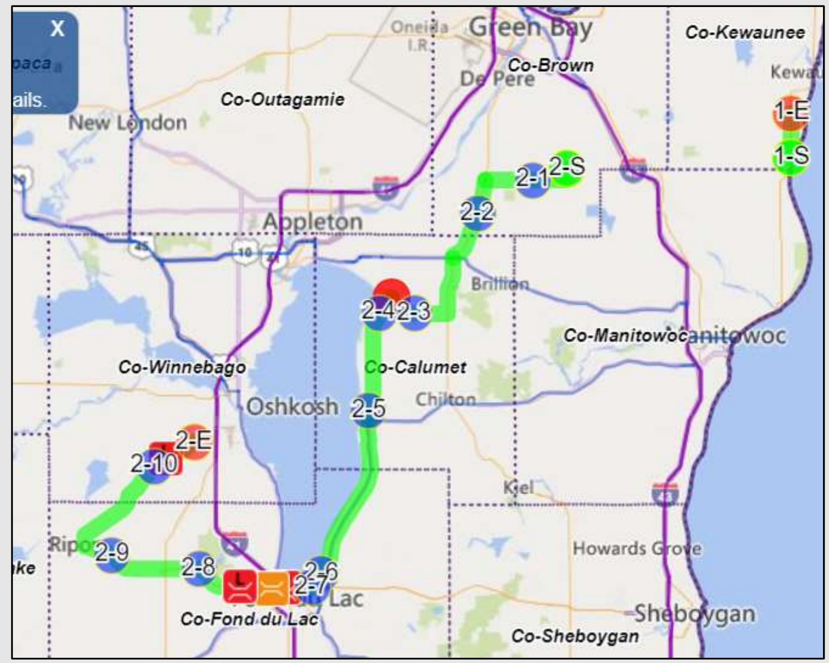
Letter to WisDOT

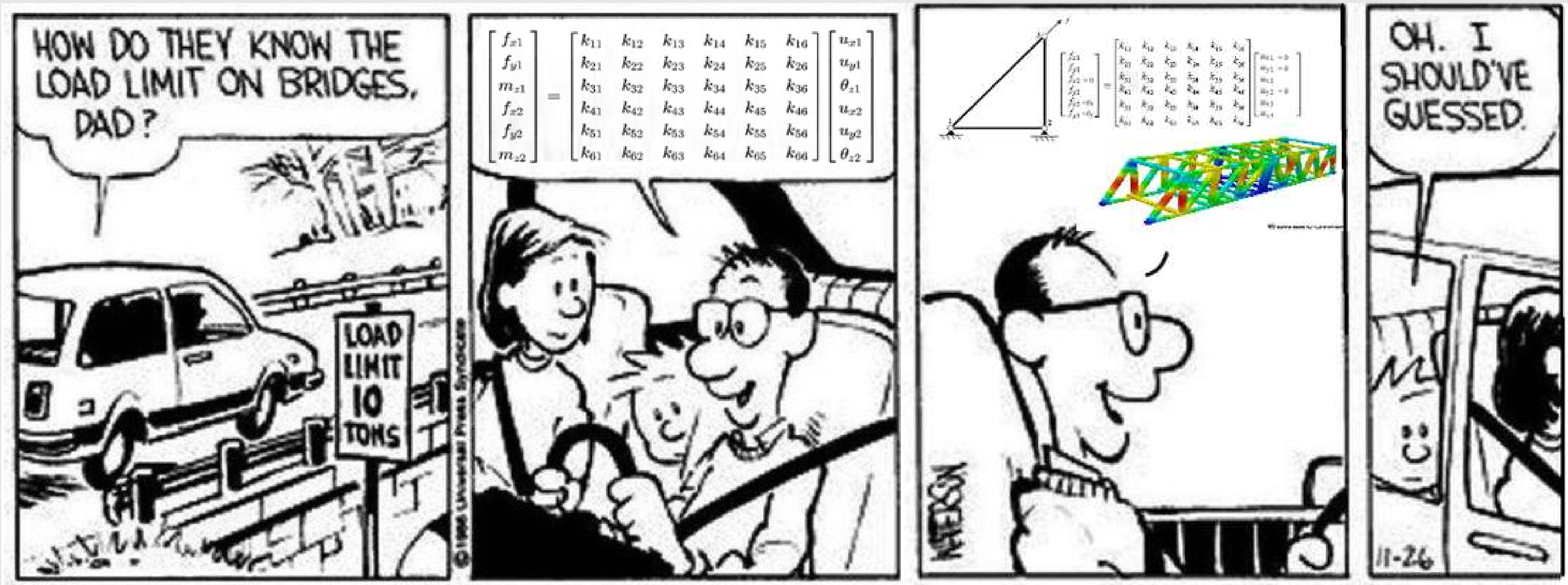
"Notification to terminate the Superior to Eau Claire permitting efforts. There was a design change made to this specific generator that enabled it to fit within the needed rail clearance envelope."

"We look forward to partnering with the State of Wisconsin as the rail siding to the project site will still require road transit, in a much smaller-scope (under 10 miles)."

Another Mega-Load!

- Kewaunee Power Station
  - Traveling to Oshkosh, then via rail to Utah
    - October 2024
  - 780,200 lbs
    - Not over a million, but still…
  - 22 axles
  - 219’-6” length
  - 16’-0” width
  - 14 bridges
    - Not 50, but still…




HOW DO THEY KNOW THE LOAD LIMIT ON BRIDGES, DAD?
LOAD LIMIT 10 TONS
$\begin{bmatrix} f_{x1} \\ f_{y1} \\ m_{z1} \\ f_{x2} \\ f_{y2} \\ m_{z2} \end{bmatrix} = \begin{bmatrix} k_{11} & k_{12} & k_{13} & k_{14} & k_{15} & k_{16} \\ k_{21} & k_{22} & k_{23} & k_{24} & k_{25} & k_{26} \\ k_{31} & k_{32} & k_{33} & k_{34} & k_{35} & k_{36} \\ k_{41} & k_{42} & k_{43} & k_{44} & k_{45} & k_{46} \\ k_{51} & k_{52} & k_{53} & k_{54} & k_{55} & k_{56} \\ k_{61} & k_{62} & k_{63} & k_{64} & k_{65} & k_{66} \end{bmatrix} \begin{bmatrix} u_{x1} \\ u_{y1} \\ \theta_{z1} \\ u_{x2} \\ u_{y2} \\ \theta_{z2} \end{bmatrix}$
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WATTERSON
OH. I SHOULD'VE GUESSED.
11-26