

WisDOT Structural Engineers Symposium

Program Agenda
May 24, 2022

8:00 a.m.	Registration	11:45 a.m.	Standard Bridge Plans Update – <i>Aaron Bonk</i>
8:30 a.m.	Welcome and Opening Remarks – <i>WisDOT Secretary Craig Thompson</i>	12:00 p.m.	Lunch/Networking
8:40 a.m.	WisDOT Division of Transportation System Development Welcome – <i>Scot Becker</i>	1:00 p.m.	Structures-Related Asset Management – <i>Philip Meinel, Dominique Bechle</i>
8:50 a.m.	BOS Director’s Perspective – <i>Josh Dietsche</i>	1:25 p.m.	Bridge Load Ratings & Structural Reviews – <i>Alex Pence</i>
9:05 a.m.	Geotechnical Updates: Downdrag, Pre-boring, & Pile Tips – <i>Dave Staab</i>	2:00 p.m.	Small Group/Table Discussion – <i>All</i>
9:35 a.m.	Consultant Review Update – <i>Najoua Ksontini</i>	2:15 p.m.	St. Croix Bridge Inspection – <i>Drew Garceau, Jon Wittrock (Collins Engineers)</i>
9:50 a.m.	Policy and Standards Update – <i>James Luebke</i>	2:50 p.m.	Break/Networking (Beverages and Snacks)
10:10 a.m.	Break/Networking (Beverages and Snacks)	3:10 p.m.	Wisconsin Tub Girder Retrofits – <i>Andrew Smith</i>
10:30 a.m.	IH 39/IH 43 Interchange Flyover Bridges – <i>Mike Arnold, Nick Rice, Isaac Groshek (AECOM)</i>	3:25 p.m.	Wisconsin Highway Research Program – <i>James Luebke</i>
11:05 a.m.	Small Group/Table Discussion – <i>All</i>	3:40 p.m.	Interactive Survey & Q/A
11:20 a.m.	AutoCAD Transition Update – <i>Dan Monroe, Adam Swierczek</i>	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-rsrcs/strct/research.aspx>

Geotechnical/Structural Topics

Downdrag Updates Pre-Boring/Pile Tips Guidance

David Staab, PE
Geotechnical Engineer, Bureau of Technical Services


Structural Engineers Symposium
UW-Madison Union South, Madison, WI
May 24, 2022



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Outline

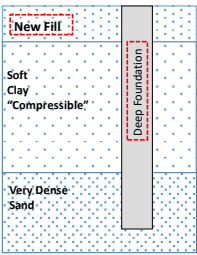

- Downdrag
 - AASHTO Explicit Method
 - FHWA Neutral Plane Method
 - AASHTO & WisDOT Bridge Manual Updates
- When to use Pre-Boring or Pile Tips
 - Use of pre-boring vs. pile tips
 - Pre-boring guidance
 - Pile tip guidance



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“Downdrag”

- Pile driven through weak/compressible layer to a stronger/less compressible layer
- New fill placement occurs.
- New fill causes soft clay layer to settle.
- Differential movement occurs between settling soil and deep foundation.
- How is pile evaluated?

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Current AASHTO Downdrag Guidance

- AASHTO (Explicit) METHOD (LRFD Articles 3.11.8 & 10.7.3.7)
- Check settlement. Downdrag occurs where settlement is 0.4 in. or greater.
- Treats drag load as a top load on pile **with load factor**.
- Geotechnical resistance available to resist structure loads & drag load is estimated by considering positive side resistance and toe resistance below lowest layer contributing to downdrag.

AASHTO BM - Figure C10.7.3.7-1

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Current AASHTO Downdrag Guidance

- **NOT ONLY IS PILE RESISTANCE LOST (in negative skin friction zone), BUT LOAD IS ADDED (factored downdrag load to top of pile)****
- Drag force considered in **GEOTECHNICAL strength** limit state & **STRUCTURAL** strength limit state.
- Often **INEFFICIENT** pile design results limited by **GEOTECHNICAL** strength limit state (relatively low pile resistance, additional piles, etc.).

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Neutral Plane Method

- More accurately describes deep foundation behavior subject to downdrag effects
- Current Guidance
 - FHWA (GEC 12 – *Design and Construction of Driven Pile Foundations*)
 - MnDOT (*Geotechnical Manual – App. F*)
 - AASHTO LRFD BM - Neutral Plane Method acceptable alternative
- AASHTO revising LRFD Bridge Manual (in-progress)
 - Adopt Neutral Plane Method
 - Delete Explicit Method

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- DOWNDRAW - Downward soil movement around and relative to a deep foundation element.
- NEGATIVE SIDE FRICTION – Side friction above neutral plane caused by downward soil movement (downdrag).
- DRAG FORCE – Internal axial compressive force on pile from cumulative negative side friction.
- NEUTRAL PLANE – Location along the pile where side friction changes from negative to positive side friction.
- POSITIVE SIDE FRICTION– Side friction below the neutral plane that resists compressive load.

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Neutral Plane Method

- For LRFD pile design, downdrag effects are evaluated in the
 - STRUCTURAL strength limit state – is the pile section adequate?
 - GEOTECHNICAL service limit state – is settlement acceptable?
- The reason downdrag effects are not considered in the geotechnical strength limit state is because at geotechnical failure (geotechnical strength limit state), all side resistance is positive side friction (and negative side friction/drag force is therefore zero).

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Neutral Plane Method

- STRUCTURAL strength limit state – is the pile section adequate to resist permanent pile loads & drag loads?
- Check:
 - Known or estimated
 - Static Pile Analysis Software

$$1.25 \cdot (\text{Permanent Dead Load, } Q_D) + 1.1 \cdot (\text{Drag Force, DD}) < \text{Factored Pile Structural Resistance}$$

- AASHTO load factor for strength limit state
- Load Factor from MnDOT for Unified Method (in GEC 12 & proposed AASHTO updates)
- New WisDOT policy for Downdrag Analysis ONLY

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Pile Structural Resistance – Downdrag ONLY

- For CIP piles, structural resistance FOR DOWNDRAG ONLY includes
 - Concrete area ($f'_c = 3.5$ ksi), plus
 - 50% of the steel area ($f_y = 45$ ksi)
 - (For axial compression resistance, WisDOT policy neglects the steel area, as shown in WisDOT BM, Table 11.3-5; **this remains unchanged**)

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Pile Structural Resistance – Downdrag ONLY

- New Table!
- Official guidance forthcoming in updates to WisDOT Bridge Manual & Geotechnical Manual...stay tuned
- NP may be used now – discuss with BTS

CIP Pile Size	Shell Thickness (in.)	Nominal (Structural) Resistance (P_n) - Including Full Concrete & Half Steel Area (tons) ^{1, 2, 3}	Factored (Structural) Resistance (P_r) - Including Full Concrete & Half Steel Area ($\phi_{concrete} = 0.5$, $\phi_{steel} = 0.7$) (tons) ⁴
10.75	0.219	205.8	127.7
10.75	0.25	215.5	132.3
10.75	0.365	251.3	149.1
10.75	0.5	292.2	168.3
12.75	0.25	285.8	175.0
12.75	0.375	332.3	199.8
12.75	0.5	377.8	221.2
14	0.25	334.4	209.8
14	0.375	385.7	233.9
14	0.5	436.0	257.5
16	0.375	478.8	293.8
16	0.5	536.8	321.0

Notes:
 1. Based on minimum concrete compressive strength (f'_c) of 3.5 ksi.
 2. Based on minimum steel yield strength (f_y) of 45 ksi.
 3. $P_n = C_1 f'_c A_c + f_y 0.5 A_{st}$, where $C_1 = 0.85$ for filled tubes, per AASHTO Table 6.9.5.1-1.
 4. $P_r = \phi P_n$.

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Neutral Plane Method – Final Comments

- Downdrag analysis typically completed by the Geotechnical Engineer, but Structural Engineer provides input (unfactored loads, etc.)
- Geotechnical Strength Limit State is still checked (DL + LL) but does not include drag loads.
- Geotechnical Service Limit State is checked for settlement.

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Pile Tips and Pre-Boring Discussion



- Geotechnical Manual Section 7-3.2.3.3
- Pile Tips
 - **Reduce risk of pile damage & improve alignment** when driving through or into dense material with cobbles/boulders
 - Piles driven into sloping bedrock
 - **Note:** tips can affect (reduce) side resistance resulting in longer pile lengths (if not driven to hard bearing layer)



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Pile Tips (Points)


- Consider using pile tips if:
 - **Pile damage is likely without using pile tips**
 - Scattered cobbles or boulders are fairly common in glacial deposits, but may not justify using pile tips
 - **Pile alignment may be compromised without pile tips**
 - **Piles need to "bite" into hard sloping bedrock**
 - **Judgement required - discuss with geotechnical engineer**
 - **Larger H-piles generally drive better in tough conditions**
- Pile points on Approved Products List (APL)



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Pre-Boring


- Pre-Boring
 - **Achieve minimum 10-foot pile penetration**
 - **Shallow obstructions, cobbles/boulders that may limit pile penetration, affect alignment or damage pile**
 - **Shallow rock where minimum pile penetration cannot be achieved**
 - Minimum 3-ft penetration into rock
 - **Displacement piles used in new embankments with ≥ 10 ft of new fill**
 - Pre-bore to base of new fill



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Pre-boring – Unconsolidated Material


- Section 550.3.9.2 of Standard Specifications
- Pre-boring
 - Round piles: pre-bore hole approximately pile diameter
 - Other shapes: pre-bore hole to largest diagonal dimension
 - Enlarge holes if obstructions encountered
- Temporary casing if borehole unstable
- Pile driving may occur at bottom of pre-bore if pile is not within very dense soil or bedrock
- Backfill around pile with sand or other engineer-approved material



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Pre-boring – Rock (Consolidated Material)


- Section 550.3.9.3 of Standard Specifications
- Pre-boring
 - Round piles: pre-bore hole at least 1 inch larger than pile diameter
 - Other shapes: pre-bore hole at least 1 inch larger than diagonal dimension
 - Enlarge holes if obstructions encountered
- Temporary casing into top of rock/consolidated material may be needed to maintain stability or prevent introduction of unconsolidated material
- Clear materials from bottom of hole
- FIRMLY SEAT pile into rock/consolidated material (pile driving may damage pile)
- Cement grout backfill (W/C = 0.4) around pile within rock zone (or other engineer-approved material) - look for upcoming spec. updates!
- Remove casing and backfill upper part with sand or engineer-approved material



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Pre-boring – Rock (Consolidated Material)

- Minimum pile penetration typically 10 ft
- 3 ft is typically the minimum distance into rock
- Extend pre-bore depth if upper rock is highly weathered or contains soil seams
- Field judgement needed to assess pre-boring depth




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Seating Pile After Pre-boring

- Rock (Consolidated Material)
 - Method to ensure pile tip is in firm contact with competent bedrock surface
 - Ensure no loose material below pile tip and rock surface
 - Do not use pile driving hammer – possible pile damage

- Unconsolidated Material
 - Drive pile with pile driving hammer to driving criteria



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Pre-boring - “Firmly Seating” Pile Tip to Rock



Cat 345
Excavator




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Pre-boring – Rock (Consolidated Material)

Plan Language

“[Piers/Abutments] to be supported on [pile type/size] piling seated in pre-bored holes cored [x] feet minimum into rock. Pile driving is not required. The factored axial resistance of the piles in compression used for design is [xxx] tons multiplied by a resistance factor of 0.5. Estimated [xx’-xx”] long.”



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Pre-boring – Shallow Rock at Piers

- Shallow Rock
- Pre-boring required for some piles for uplift resistance
- Certain piles pre-bored and socketed into rock
- Other piles driven with pile tips

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Pre-boring – Shallow Rock at Piers

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Pre-boring – Shallow Rock at Piers

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Pre-boring – Rock (Consolidated Material)

- Water crossing
- Shallow rock, but with highly weathered/soil seams
- Spread footings considered but scour concerns
- Pre-bored piles
- Extended pre-boring from 10 ft to 15 ft due to highly weathered zones

The geotechnical log displays soil and rock profiles with various test results and descriptions. A red dashed box highlights the 'Bottom of Abutment' at approximately 15 feet depth. A blue line indicates the 'Recommended pre-boring depth' extending to about 18 feet. The log includes columns for depth, soil type, and test results.

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Pre-Boring and Pile Tips

- Tough site for driven piles
- Pre-bore through cobble/boulder layer (north half) with casing
- Drive H-piles (12x53s) with tips to bedrock
- Backfill around piles with cement grout

The diagram shows a plan view of pile tips and abutments. Red dashed boxes highlight 'B.O. Abutments' and 'Pile Tip' locations. The diagram includes dimensions and labels for various structural elements and soil layers.

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Pre-boring – Lateral Loads

- Pre-boring battered piles is generally not feasible
- If large lateral loads need to be resisted (i.e., battered piles) and pre-boring required, evaluate lateral resistance of vertical piles (e.g., p-y analysis)
- May need larger pile section to resist lateral loads
- May need deeper pre-bore for sufficient geotechnical resistance


The diagram illustrates pile configurations and lateral load considerations. It shows various pile types and their orientations, along with annotations for lateral load resistance and pre-boring requirements.

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Thank You,
Questions?




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



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Consultant Review – Update

Najoua Ksontini, P.E.
Consultant Review and Hydraulics Supervisor



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University of Wisconsin-Madison Union South, Madison, WI
May 24, 2022



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- **Overview**
 - BOS Consultant Review staff and contact information
 - Updates on Consultant QA/QC requirements
 - Plan submittal requirements – refresher
 - BOS vs. Consultant Design delivery





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Consultant Review Unit Contacts

- Ruth Coisman: coordinates preliminary plan reviews.
Ruth.Coisman@dot.wi.gov, 608-246-3865
- Steve Revello: coordinates final plan reviews.
Steven.Revello@dot.wi.gov, 608-266-5095
- Emily Kuehne: reviews structure plans, SE Region liaison, IH 43 project liaison.
Emily.Kuehne@dot.wi.gov, 608-266-5089





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Consultant Review Unit Contacts

- Max Kulick: reviews structure plans, NC Region liaison, Lake IC Planning Study liaison.
Max.Kulick@dot.wi.gov, 608-261-6108
- Sarah Lamson-Wright: coordinates submittals and design data records.
Sarah.Lamsonwright@dot.wi.gov, 608-246-3873
- Najoua Ksontini: Unit Supervisor.
Najoua.Ksontini@dot.wi.gov, 608-266-2657






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Consultant Review Resources

- Aaron Bonk: BOS Design Section Chief.
Aaron.Bonk@dot.wi.gov, 608-261-0261
- James Luebke: BOS Policy and Standards.
James.Luebke@dot.wi.gov, 608-266-5098
- Additional BOS and BTS specialty experts: Geotechnical, Steel Fabrication, Load Rating, etc..
- Consultant staff on-site and remote through staffing contracts.

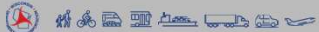




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BOS QA/QC requirements

- All consultant firms providing structural design services to the Department must have a Quality Assurance/Quality Control (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 Bridge Manual Section 6.5 for items to be included in the QA/QC plan.







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BOS QA/QC requirements

- In addition to the QA/QC plan, a QA/QC verification summary sheet is required as part of every final structure plan submittal:
 - The QA/QC verification summary sheet should demonstrate that the QA/QC procedures were followed for that structure design and plan preparation.
 - The QA/QC verification summary sheet shall include the signoff or initialing by each individual that performed the tasks (design, checking, plan review, technical review, etc.) as documented in the QA/QC plan and procedures.








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BOS QA/QC requirements

- In 2019, BOS established additional requirements for consultant firms' QA/QC plans:
 - Identification of a lead QA/QC Structures Program contact
 - Identification of the QA/QC plan implementation date
 - A statement indicating that an independent design and independent plan check will be performed by an individual other than the designer and the drafter respectively
 - Provisions for periodic reviews and updates of the QA/QC plan








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BOS QA/QC requirements

- Consultant Firms are expected to submit to BOS an updated QA/QC plan if they have changes to their Firm's Structures Program contact or changes to their processes and procedures.
- BOS will periodically review consultants' QA/QC plans and verification summary sheets to ensure compliance with BOS requirements.
- BOS will request updated QA/QC plan as needed.

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BOS QA/QC requirements

- The list of "BOS Eligible Structural Consultants" can be accessed through the BOS web site: [BOS Eligible Structure Consultants list.xlsx \(wisconsindot.gov\)](#)

The screenshot shows a web page with a sidebar on the left containing navigation links like 'Home', 'About Us', and 'Contact Us'. The main content area is titled 'Plan Submittal' and lists requirements for design and construction. A callout box highlights the 'BOS Eligible Structure Consultants (January 2022)' list, which includes names like 'AECOM', 'ARCADIS', and 'BURNS & MCDONNELL'. An arrow points from this callout to the 'BOS Eligible Structure Consultants' link in the main text.

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Plan Submittal Requirements

Preliminary Plan Review Timelines

- Allow for about 60 days for preliminary plan review.
 - Always provide responses to preliminary plan review comments if you do not agree with incorporating them into final plans.
- Priority of reviews are first in/first out, however, we may consider PS&E dates as well.
- Region PM and/or Consultant are responsible for communicating with BOS when an expedited review is needed.

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Plan Submittal Requirements

Final Plan Review Timelines

- All final structure plans for all structure types are to be submitted to BOS a minimum of two months prior to PS&E date
- Final structure plans must be complete, checked, signed, sealed, and dated when submitted. BOS will not accept 90% plans or draft structure plans
 - Consultants are responsible for thoroughly checking their final structure plans prior to submittal to BOS

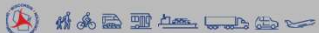

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BOS vs. Consultant Design Delivery

- BOS Design delivery accounts for about 20% of the State Let Program.
- We expect that the additional BIL funding will require increase needs for consultant resources to address additional design demands.


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Questions?

Najoua Ksontini
Najoua.Ksontini@dot.wi.gov
 608-266-2657



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Policy and Standards Update

James Luebke
Structural Engineer, Bureau of Structures

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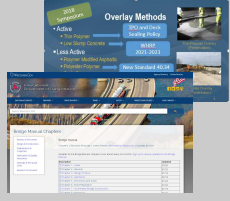



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Overview

- Major Updates
 - Standards
 - Chapters
- Other Updates
- What's Next?

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Deck Treatments

2018 Symposium

Overlay Methods

- Active
 - Thin Polymer → TPO and Deck Sealing Policy
 - Low Slump Concrete → WHRP 2021-2023
- Less Active
 - Polymer Modified Asphaltic → New Standard 40.34 and SPV Revisions
- Not Active
 - Asphaltic with Membrane → Under Review





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Overlays Polyester Polymer Concrete Usage

- Decks in Good Condition
 - NBI rating ≥ 7
 - Distressed areas $< 5\%$
 - Deck age < 15 years*
- General Criteria
 - Traffic Restrictions
 - High Traffic (AADT $> 20,000$)
 - Remaining life > 20 years

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Deck Protection

- Deck sealing has been found to be a cost-effective tool in preserving decks (WHRP)
- Earliest TPO placement - the following construction season
- Apply as early as possible and re-applied thereafter (see Table 40.5-3 Deck Sealing Frequency)

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Deck Protection

Roadway ADT	Deck Sealing Frequency
ADT $< 2,500$	4 – 5 years
$2,500 \leq$ ADT $< 6,500$	4 years
$6,500 \leq$ ADT $< 15,000$	3 years
ADT $\geq 15,000$	2 years*

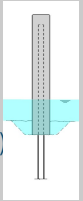
Table 40.5-3
Deck Sealing Frequency

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Pile Encased Piers

- Pier Type Selection Guide
- Bid Item Consistency
- Improve Site Conditions (Construction and Environmental)
- Avoid Costly Repairs



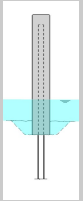
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Pile Encased Piers

- Certain cases may still require a cofferdam for protection and/or to address environmental concerns.
- Guidance based on normal (or observed) water level
- Other factors (e.g. velocity and water elevation) should be considered when selecting pier types




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Pile Encased Piers



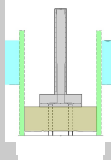
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Pile Encased Piers

- New Std. 13.09 – Pile Encased Pier (Types) 7/19
- Pier Types
 - Type 1 ($H \leq 5$ ft) – No Additional Bid Items
 - Type 2 ($5 \text{ ft} < H \leq 10$ ft) – Cofferdam + Underwater Inspection
 - Type 3 ($H > 10$ ft)
 - Alternative ($H > 10$ ft) – Solid Wall Pier (Spread footing on piles)

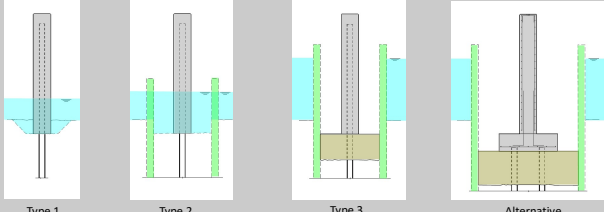


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Pile Encased Piers



Type 1 Type 2 Type 3 Alternative

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Removing Old Structure

- WBM - New Section 6.3.3.8 - Removing Old Structure and Debris Containment. 1/19
- 2022 Standard Specification – New Bid items 1/21
- CMM – 645 Erosion Control 2021


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Removing Old Structure

- Consistency – Bid Items and Environmental Expectations
- Three Over Waterway Bid Items:
 - Removing Structure Over Waterway Remove Debris (structure)
 - Removing Structure Over Waterway Minimal Debris (structure)
 - Removing Structure Over Waterway Debris Capture (structure)




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Removing Structure Over Waterway...

	<u>Example</u>	<u>Bid Item Usage +/-</u>
Remove Debris (structure) ➡	Slab Spans	17%
Minimal Debris (structure) ➡	Deck Girders	75%
Debris Capture (structure) ➡	Deck Girders Over Sensitive Wetland*	8%

* Consult with DNR, Region, and BOS

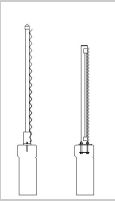


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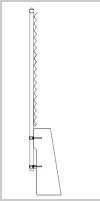
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Fencing Details


- Top-Mount
 - RDS ≤ 45 mph
- Side-Mounted
 - New Standard 30.12 7/21
 - RDS > 45 mph (when warranted)



Top-Mount
Chain Link (Std. 30.11)
Tubular Railing Screening (Std. 30.15)



Side-Mount
Chain Link (Std. 30.12)






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Metal Buried Structures

- Added guidance based on WHRP. Rigid reinforced concrete structures are still recommended over metal structures, especially for higher volume roadways 7/20



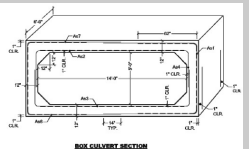



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Precast Box Culverts

- Updated guidance on the use of precast box culverts and precast aprons. 1/21



BOX CULVERT SECTION

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Culverts

- Precast Box Culvert Substitutions - May Not Be Suitable:
 - Not covered by ASTM C1577
 - Depth of Cover < 2.0 ft (Traffic)
 - Pedestrian Underpasses
 - Performance Concerns
- When Suitable - Provide Precast Allowance Note

DESIGNER NOTES

IF PRECAST ELEMENTS ARE ALLOWED, INCLUDE THE FOLLOWING NOTE ON THE EXHIBIT SHEET:

THE CONTRACTOR MAY FURNISH ALLOWABLE PRECAST ELEMENTS IN LIEU OF THE CAST-IN-PLACE BOX CULVERT WITH THE ACCEPTANCE OF THE SHOULDER DRAWINGS BY THE STRUCTURES MAINTENANCE SECTION. THE PRECAST CONCRETE BOX CULVERT SHALL CONFORM TO PRECAST DETAILS IN CHAPTER 36 STANDARDS OF THE CURRENT WISCONSIN DOT BRIDGE MANUAL. PAYMENT FOR THE PRECAST CULVERT SHALL BE BASED ON THE QUANTITIES AND PRICES BID FOR THE ITEMS LISTED IN THE TOTAL ESTIMATED QUANTITIES.





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Other Updates

- Archived 36-inch PS Girder 7/21
- Noise walls not allowed on bridges (for most situations) 7/19
- Chapter 39 – Sign Structures (LRFD) 1/20
- Chapter 41 – Structure Asset Management 1/19
- Chapter 42 – Bridge Preservation 1/19
- Chapter 43 – Structures Asset Management: Maintenance Work 7/20



19

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What's Next?

- Open Rail Meeting MASH TL-3
- HMA Overlay + Membrane (Policy and Specifications)
- Timber Design and Rating Guidance (WHRP Findings)

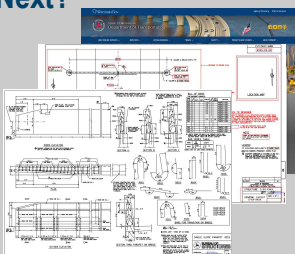




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2022 WisDOT Structural Engineers Symposium

What's Next?


- AutoCAD Transition
 - Insert Sheets
 - LRFD Standardized OSS Plans
 - Standard Drawings (internal)

21

Questions

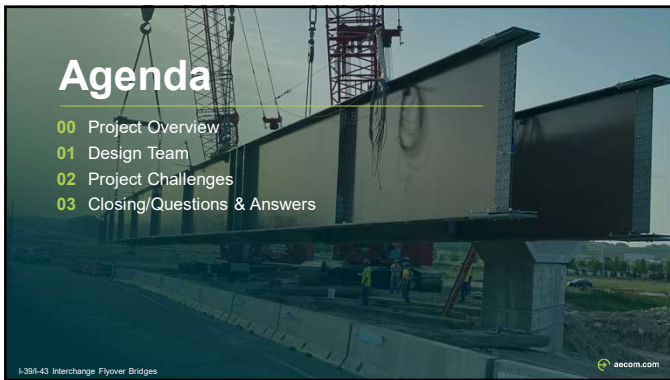
James Luebke, PE
 WisDOT, Bureau of Structures
James.luebke@dot.wi.gov
 (608) 266-5098



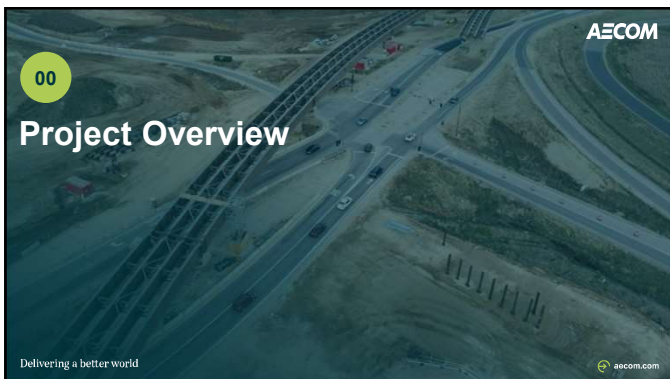
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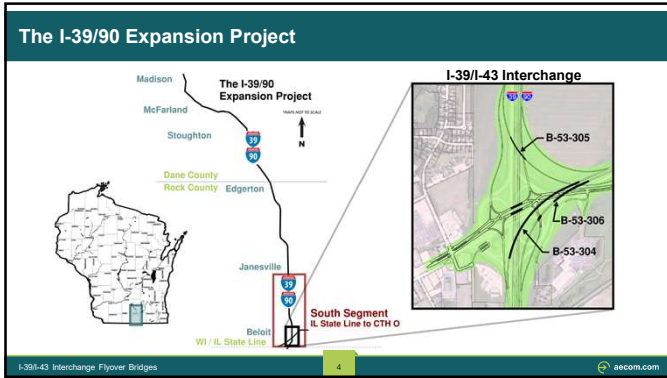
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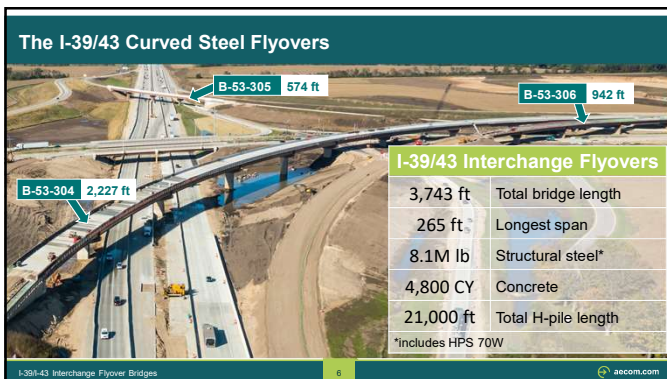
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5



6

Superstructure Width

"Future Proof" Piers

- Cost-Saving Measure
- Accommodates future widening from 1 lane to 2 lanes



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01


Design Team

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8

Interchange Structures Design Team



- WisDOT SW Region
- I-39 Corridor Team PM: Steve Marshall
- BOS Liaison: Brandan Burger
- Consultant PM: Mike Preboske
- Structures Lead: Kevin Hagen
- Milwaukee: Mike Arnold
- Middleton: Nick Rice
- Stevens Point: Isaac Groshek
- Independent experts: AECOM
- WisDOT Bureau of Structures 


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02

AECOM

Project Challenges

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I-39/I-43 Interchange Reconstruction

CHALLENGES

- 1 – Foundation Design
- 2 – Pier Detailing
- 3 – HLMR Bearing Design
- 4 – Lateral Wind Bracing




I-39/I-43 Interchange Flyover Bridges **11** 

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02.1

AECOM

Foundation Design

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Foundation Design

- Variable bedrock elevation
- Pile length varies 25 - 115 feet within one structure
- Nearby structure used shallow foundations
- Pile pre-boring required

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Foundation Design

Pile Dynamic Analysis (PDA) & Static Pile Load Testing

- Advance contract
- Allowed use of $\Phi=0.8$ for pile design
- Cost savings = \$700,000
- Reaction frame piles incorporated into future footings

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02.2 Pier Detailing

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aecom.com

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Eccentric Loading from Superstructure

- Large **eccentricity** from superstructure loading
- Sustained **tension** at outside face of column
- Determine effect of eccentricity on load path

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Load Path due to Large Eccentricity

- 3D Finite element modeling (CSIBridge)
 - Shell elements
 - Creates "map" of forces
- Results
 - Continuity of **tensile** forces
 - **Compressive** arching

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Pier Cap Design Methodology

- WisDOT Policy Item: Chapter 13
 - Strut-and-Tie Method (STM)
 - AASHTO LRFD 8th Edition
- Strut-and-Tie Method (STM)
 - D-Regions
 - Truss model

Create tension load-path with vertical tie over column


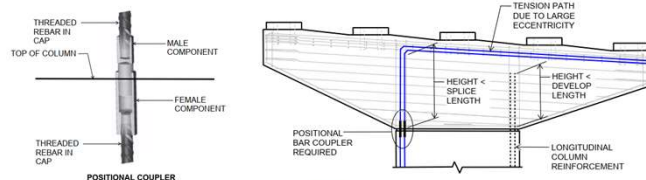
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Positional Bar Couplers

Bar Couplers

- Provide continuous load path
- Eliminate need for full lap
- Rotate coupler instead of bar

Labels in diagram: THREADED REBAR IN CAP, TOP OF COLUMN, MALE COMPONENT, FEMALE COMPONENT, THREADED REBAR IN CAP, POSITIONAL COUPLER, POSITIONAL BAR COUPLER REQUIRED, TENSION PATH DUE TO LARGE ECCENTRICITY, HEIGHT < SPLICE LENGTH, HEIGHT < DEVELOP LENGTH, LONGITUDINAL COLUMN REINFORCEMENT.

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Effect of Eccentricity on Pier Footing

Loading

- Longitudinal / Transverse / Vertical

Pile Demand

- Maximum at corners
- Sustained uplift



Labels in diagram: HP 14X73 STEEL PILING (TYP), LONGITUDINAL LOADING (WIND, BRAKING, TEMPERATURE), TRANSVERSE LOADING (WIND ONLY), PIER COLUMN, MAXIMUM UPWARD LOADING, MAXIMUM DOWNWARD LOADING, VERTICAL LOADING (DEAD, LIVE), PIER FOOTING, FOOTING PLAN.

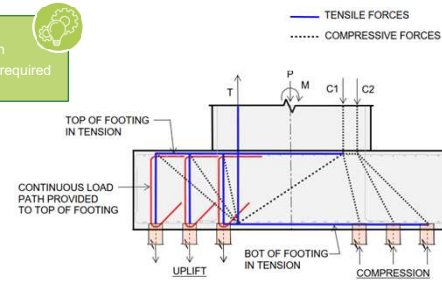
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20

Effect of Eccentricity on Pier Footing

Pile uplift considerations

- Provide continuous load path
- Top & bottom reinforcement required
- Pile uplift detail



Labels in diagram: TENSILE FORCES, COMPRESSIVE FORCES, TOP OF FOOTING IN TENSION, CONTINUOUS LOAD PATH PROVIDED TO TOP OF FOOTING, UPLIFT, BOT OF FOOTING IN TENSION, COMPRESSION, P, M, C1, C2.

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02.3

HLMR Bearing Design

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High Load Multi-Rotational (HLMR) Bearings

Bearing Type


- Demand requires HLMR
- Disc or pot bearings allowed

Design & Plans

- Specify Loads, Movements, & Rotations
- Estimate dimensions

Construction

- Manufacturer responsible for design
- Shop drawing review



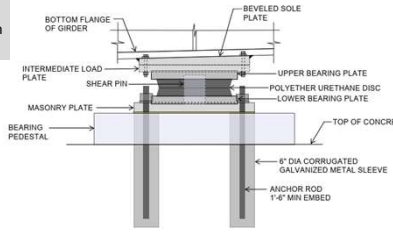
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Fixed Disc Bearings

Fixed Bearing

- Rotation in all degrees of freedom
- Fixed in translation



FIXED DISC BEARING

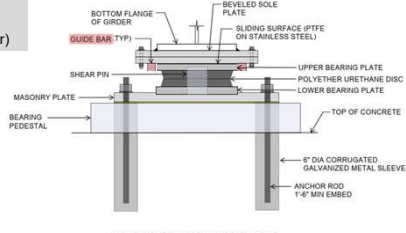
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24

Guided Expansion Disc Bearings

Expansion Bearing

- Rotation in all degrees of freedom
- Uni-directional translation (guide bar)



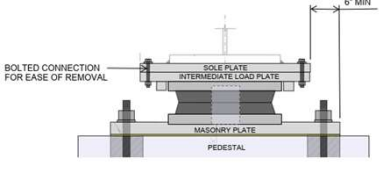
GUIDED EXPANSION DISC BEARING

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25

Preliminary Bearing Sizing

- Bearing sizes estimated using tables from DS Brown
 - Vertical Capacity (Service)
 - Horizontal Capacity (% of Vertical)
- Masonry Plate Size
 - provided by designer
 - confirmed by supplier
 - Minimum width = sole plate + 6"

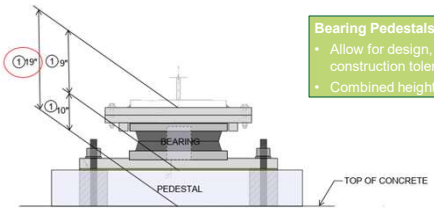


MINIMUM MASONRY PLATE WIDTH

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26

Pedestal & Bearing Height



Bearing Pedestals

- Allow for design, fabrication, and construction tolerances
- Combined height based on past experience

PEDESTAL AND BEARING HEIGHT

① ASSUMED FOR DESIGN. BEARING AND PEDESTAL HEIGHT DETERMINED BY BEARING MANUFACTURER.

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27

Orientation of Expansion Bearings

Thermal Movement

- Without restraint, varying movement at each bearing
- With restraint, force induced

Thermal Analysis (with & without restraint)

- Determine movements (or) forces

Final Bearing Orientation

- Guide movement tangent to girder centerline
- Induced transverse forces relatively minor

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Design for Future Bridge Jacking

- Additional space provided for future bearing replacement
 - Jack width + 4"
 - Jack height + stroke length < 19"
- Jack sizes determined with Enerpac Quick Selection Chart

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AECOM

02.4

Lateral Wind Bracing

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Wind Loading on Bridges

Deck = "shear diaphragm"

IN-SERVICE
FLANGE LOADING SPAN: BETWEEN CROSS-FRAMES

DURING CONSTRUCTION
FLANGE LOADING SPAN: BETWEEN SUBSTRUCTURES

Resisting Wind Loads During Construction

- Engage flanges in lateral bending
- Prevent global buckling

Extended Duration Without Deck

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Industry Guidance on Wind Loading

GUIDE SPECIFICATIONS FOR WIND LOADS ON BRIDGES DURING CONSTRUCTION

AASHTO 1ST EDITION • 2017

Wind pressure output, P_z

Application of Wind Loading During Construction

$$P_z = (2.56 \times 10^{-6}) V^2 R^2 K_z G C_D$$

Reduction Factor, R_z

Superstructure Construction Duration

Source: AASHTO

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Evaluation of Need for Bracing

- 2-D Modeling
- L/150 Deflection Limit
- Evaluation Stress Checks

Bridge	Steel Cost (vert. loads)	Estimated Correction Cost	
		Option 1: Flange Upsize (no bracing)	Option 2: Lateral Bracing (no flange upsize)
B-53-304	\$8.6 M	\$5.8 M	\$0.5 M
B-53-305	\$1.4 M	\$0.1 M	\$0.1 M
B-53-306	\$2.9 M	\$1.2 M	\$0.2 M

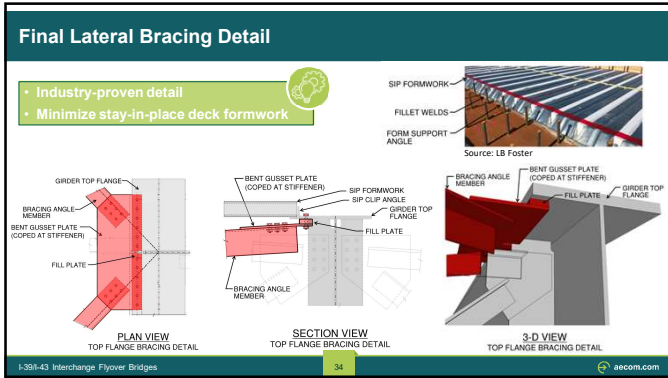
Lateral Bracing Option

- Potential total savings > \$6 M

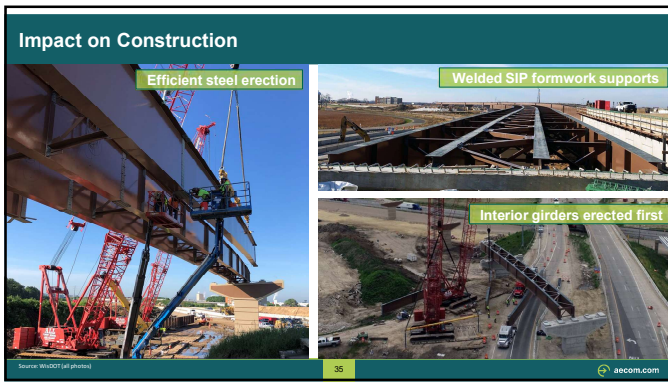
PLAN VIEW
DECK NOT PRESENT

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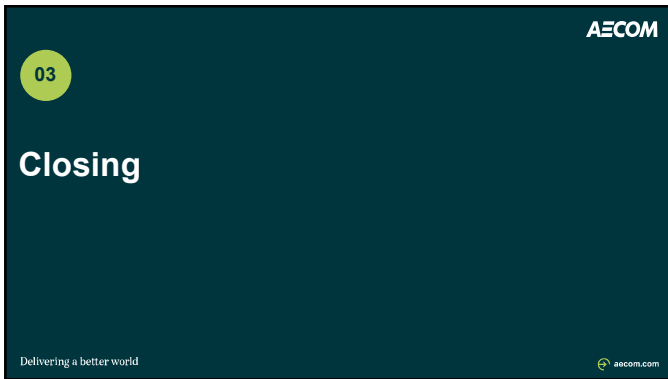
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34



35



36

Project Conclusions

CHALLENGES

- Cost-effective foundation design
- Specialized pier detailing
- HLMR bearing design
- Lateral wind bracing

COST SAVING MEASURES

- Static Load Testing
- Decreased superstructure width
- HPS 70W steel
- Proven lateral bracing details

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Q+A

Questions and answers

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Thank you

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2022 WisDOT Structural Engineers Symposium



Intro to BOS AutoCAD Civil 3D

Adam Swierczek, PE **Dan Monroe, PE**
Structures Design Engineer Structures Design Engineer

WisDOT Structural Engineers Symposium
Madison, WI
May 24, 2022



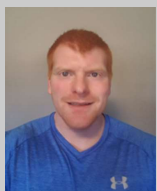


1

2022 WisDOT Structural Engineers Symposium

Introduction

Dan Monroe, PE

- WisDOT Bureau of Structures (BOS)
- Structures Design Engineer
- Autodesk Migration Team




2

2022 WisDOT Structural Engineers Symposium

Introduction

Adam Swierczek, PE

- WisDOT Bureau of Structures (BOS)
- Structures Design Engineer
- Creator of BOS CADD User Group
- Autodesk Migration Team






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2022 WisDOT Structural Engineers Symposium

Agenda

- History of CAD in BOS
- Migration Timeline
- Integration with Current WisDOT Civil 3D Template
- Introduction to WisDOT Structures Civil 3D Template
 - Quick Demo: Set up a structures sheet
- Insert Sheets
 - Quick Demo: How to use an insert sheet
- Future Developments
- Resources




4

2022 WisDOT Structural Engineers Symposium

History of CAD in BOS

- MicroStation for last 30+ years
 - Latest version used is v8i SS10
 - Significant changes in latest version of MicroStation
 - Support of SelectSeries has ended
- BOS has scaled up sheet borders to match details
 - New to Paper Space concept
- Moving to AutoCAD Civil 3D
 - Same platform as Roadway




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2022 WisDOT Structural Engineers Symposium

Migration Timeline

- Develop tools and settings
 - May 2020-August 2021: Preliminary Setting and pilot Projects
 - September 2021: Finalize content and published with WisDOT Civil 3D Package
- Civil 3D Training
 - Begin November 2021
 - C3DKB [documentation](#) added February 2022
- Begin Plans Production
 - February 2022
- Structures Insert Sheets Converted
 - Planned to be released with July 2022 Bridge Manual update




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2022 WisDOT Structural Engineers Symposium

Civil 3D Benefits

- Better integration with Roadway
 - Reference files no longer need to be converted between C3D and MicroStation
- WisDOT tools for Civil 3D
 - MDU has developed many tools that are also useful for structures plans
- Dynamic Blocks and Insert Sheets
 - Dynamic blocks in Civil 3D allow for more intuitive insert sheets and more useful blocks
- End of SelectSeries Support
 - MicroStation SelectSeries is no longer supported, and many of tools for MicroStation would not work with the next version




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2022 WisDOT Structural Engineers Symposium

Civil 3D Roadblocks

- Training Required
 - C3D is quite different in some ways than MicroStation, and our staff need training to use it efficiently.
 - We did not take advantage of Sheet Models in MicroStation, but we will use Paper Space in Civil 3D
- Converting MicroStation Drawings
 - The built-in tool for converting MicroStation Drawings is not very good, and many tedious changes need to be made before the drawings can be used
- Missing Tools
 - Some of our custom drafting tools developed for MicroStation will need to be converted to work with Civil 3D

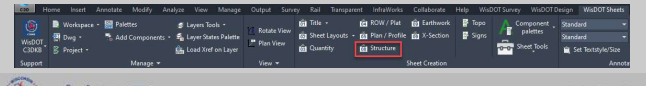



8

2022 WisDOT Structural Engineers Symposium

Integration with Current WisDOT Template

- Structures package works within WisDOT C3D
- Familiar interface for users
- Allows for support through WisDOT MDU
- New Components
 - Layouts
 - Structures blocks
 - DGN to DWG conversion tool
 - B_ & H_ layers
 - Linetypes


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2022 WisDOT Structural Engineers Symposium

Intro to WisDOT Structures Template

- 2 Start-up templates
 - **Decimal Feet for inputs**
 - Assumes length of 1 means 1 FOOT
 - Used for coordinate correct or coordination files (XREFs)
 - **Architectural for inputs**
 - Assumes length of 1 means 1 INCH
 - Used for precision length input (most plan sheets in BOS)

***Most content functions in either template, but may need to be scaled by a factor of 12*




BUREAU OF STRUCTURES

10

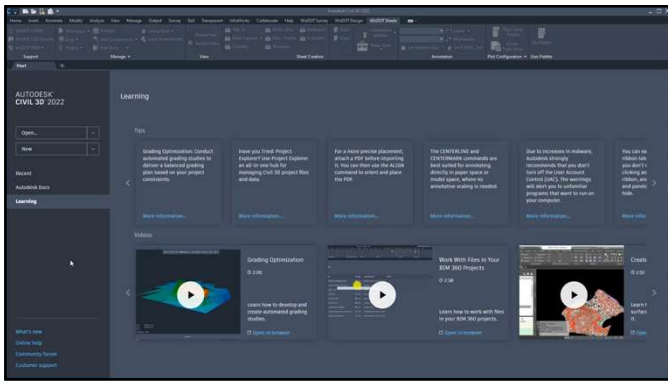
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Structures Template Demo



BUREAU OF STRUCTURES

11



AUTODESK CIVIL3D 2022

Learning

Grading Optimization: Learn how to develop and create automated grading solutions.

Work With Files in Your BIM 360 Projects: Learn how to work with files in your BIM 360 projects.

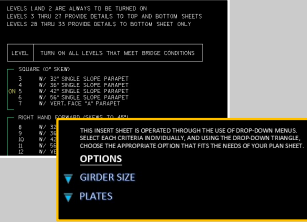
BUREAU OF STRUCTURES

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Structures Insert Sheets

- MicroStation (old)
 - Toggled Levels to change linework
 - No longer being updated
- AutoCAD (new)
 - Series of coincident dynamic blocks to change linework
 - Will be published with July 2022 Bridge Manual Release





LEVELS (AND 2 ARE ALWAYS TO BE TYPED IN)
LEVELS 3 THRU 29 PROVIDE DETAILS TO TOP AND BOTTOM SHEETS
LEVELS 28 THRU 25 PROVIDE DETAILS TO BOTTOM SHEET ONLY

LEVEL	TURN ON ALL LEVELS THAT MEET BRIDGE CONDITIONS
3	W/ 3" SINGLE SLOPE PARAPET
4	W/ 3" SINGLE SLOPE PARAPET
5	W/ 4" SINGLE SLOPE PARAPET
6	W/ 4" SINGLE SLOPE PARAPET
7	W/ 4" SINGLE SLOPE PARAPET
8	W/ 4" SINGLE SLOPE PARAPET
9	W/ 4" SINGLE SLOPE PARAPET
10	W/ 4" SINGLE SLOPE PARAPET
11	W/ 4" SINGLE SLOPE PARAPET
12	W/ 4" SINGLE SLOPE PARAPET
13	W/ 4" SINGLE SLOPE PARAPET
14	W/ 4" SINGLE SLOPE PARAPET
15	W/ 4" SINGLE SLOPE PARAPET
16	W/ 4" SINGLE SLOPE PARAPET
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24	W/ 4" SINGLE SLOPE PARAPET
25	W/ 4" SINGLE SLOPE PARAPET
26	W/ 4" SINGLE SLOPE PARAPET
27	W/ 4" SINGLE SLOPE PARAPET
28	W/ 4" SINGLE SLOPE PARAPET
29	W/ 4" SINGLE SLOPE PARAPET

THIS INSERT SHEET IS OPERATED THROUGH THE USE OF DROP-DOWN MENUS. SELECT BRIDGE CRITERIA INDIVIDUALLY AND USING THE DROP-DOWN MENUS, CHOOSE THE APPROPRIATE OPTION THAT FITS THE NEEDS OF YOUR PLAN SHEET.

OPTIONS



- ▼ GIRDER SIZE
- ▼ PLATES



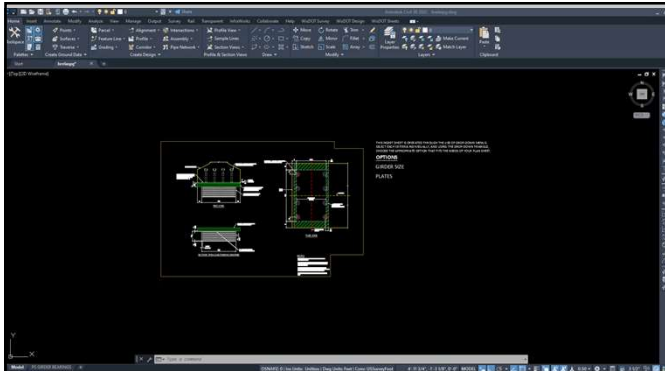
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Insert Sheet Demo


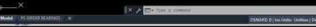


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OPTIONS

- ▼ GIRDER SIZE
- ▼ PLATES




15

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Future Developments

- Migration to AutoCAD Civil 3D is still a work-in-progress
- Continue developing tools to help draft more efficiently and improve consistency
- Incorporate Civil3D capabilities into typical structure plans
 - Substructures in 3D, placed in globally correct location
 - Auto-populated Top of Deck elevations




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Resources

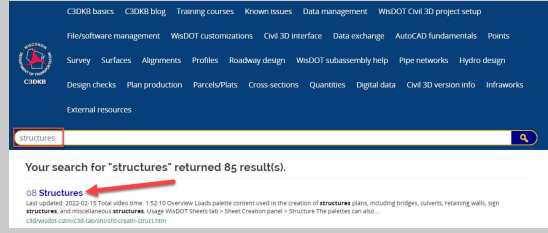
- Internet Search
 - Autodesk website
 - Autodesk forums
 - Bloggers
- YouTube videos
- WisDOT Civil 3D Knowledge Base



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Civil 3D Knowledge Base (C3DKB.dot.wi.gov)



Your search for "structures" returned 85 result(s).

08 Structures

Last updated: 2022-05-17 Total index time: 1:22:10 Overview Leads palette content used in the creation of structures plans, including bridges, culverts, retaining walls, sign structures, and miscellaneous structures. Usage: WisDOT Sheets Lab > Sheet Creation panel > Structure The palette can also...




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Civil 3D Expectations

- BOS is not requiring consultants to move to Civil 3D
- BOS MicroStation content is no longer being updated
- Content available in Civil 3D should be treated similar to Insert Sheets
 - Content is provided to help with plan production efficiency
 - Content does not alleviate the responsibility for plan correctness



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Questions?



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2022 WisDOT Structural Engineers Symposium



Standard Bridge Plans Update

Aaron Bonk, PE
Chief Structures Design Engineer

2022 WisDOT Structural Engineers Symposium
Madison, WI
May 24, 2022



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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - Pilot Project Implementation
 - Next Steps
- Questions?






2

2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - Pilot Project Implementation
 - Next Steps
- Questions?







3

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Standard Bridge Plans Initiative Background

- Initiative Intent
 - Be more efficient in the delivery of the local program (i.e., more dollars into construction by streamlining design, project oversight, etc.)
- Initiative Timeline
 - Spring 2019 – WisDOT discussions with other state DOT's
 - Fall 2019 – WisDOT seeks/receives STIC grant from FHWA
 - 2020 – BOS staff begin tool development
 - 2021 – Tool finalization and pilot project work
 - 2022 – Tool updates ongoing...








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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - Pilot Project Implementation
 - Next Steps
- Questions?

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Standard Bridge Plans Overview

- What structure types are included?
 - Single span concrete slab bridges
 - This structure type accounts for approximately half of local bridge replacements





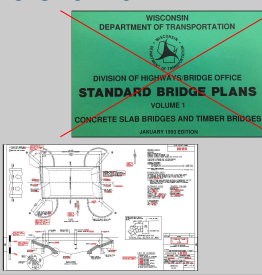


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Standard Bridge Plans Overview

- What the Standard Bridge Design Tool **is not**...
 - Not a replacement for needing a structural engineer to lead design efforts
 - Not a catalog of 100% complete plans
 - Designer still required to perform structure type alternatives analysis, TSL design, H&H analyses, and partial foundation design



WISCONSIN DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS BRIDGE OFFICE
STANDARD BRIDGE PLANS
VOLUME 1
CONCRETE SLAB BRIDGES AND TIMBER BRIDGES
JANUARY 1992 EDITION

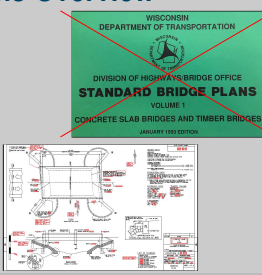
BUREAU OF STRUCTURES

7

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Standard Bridge Plans Overview

- What the Standard Bridge Design Tool **is**...
 - Website-based user interface
 - User interface requires 7 different inputs (multiple options for each)
 - Output of tool is a CADD file that requires relatively minimal updating to finalize the full set of bridge plans for project submittal



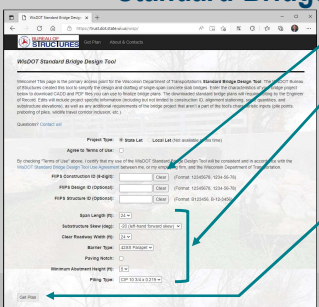
WISCONSIN DEPARTMENT OF TRANSPORTATION
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STANDARD BRIDGE PLANS
VOLUME 1
CONCRETE SLAB BRIDGES AND TIMBER BRIDGES
JANUARY 1992 EDITION

BUREAU OF STRUCTURES

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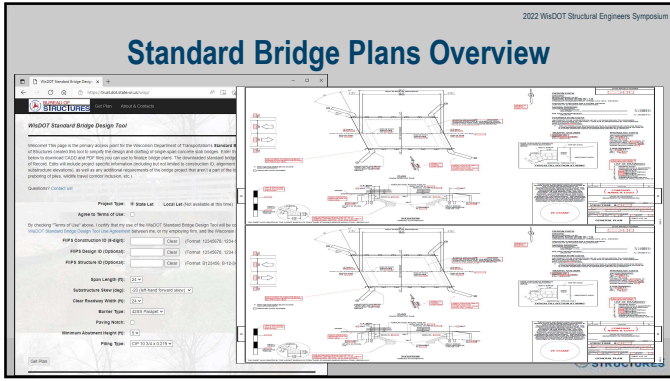
Standard Bridge Plans Overview



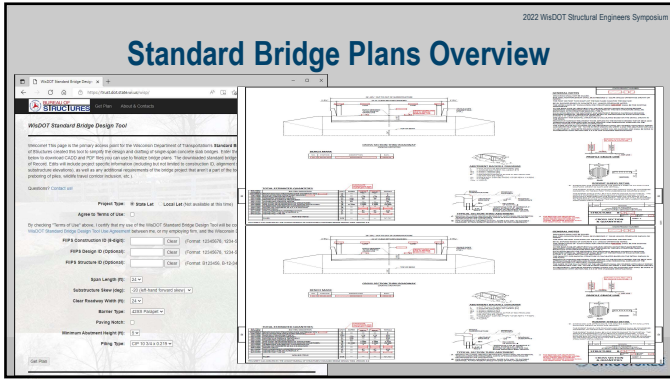
- Currently requires 'activated' project ID
- 7 different inputs
 - Span – Skew – Clear width – Barrier type – Paving notch – Minimum abutment height – Piling type
- "Get Plan" retrieves ZIP file containing CADD file and PDF duplicate

BUREAU OF STRUCTURES

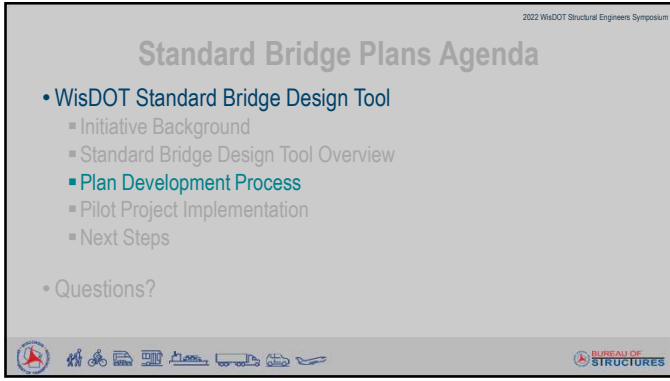
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10



11




12

2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - **Pilot Project Implementation**
 - Next Steps

- Questions?





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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Pilot Projects

- 10 Pilot Projects Initially Identified by WisDOT
 - Designs in 2021 and 2022
 - PS&E's ranging from 8/1/21 through 11/1/22

- 5 Additional "Pilots" Identified
 - Designs in 2022 through 2024


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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - Pilot Project Implementation
 - **Next Steps**

- Questions?



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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Next Steps

- Candidate Project Identification
 - BOS reviews local program applications and screens for candidates
 - Working to identify mechanism for potential use on state system and locally let projects
- Tool Updating
 - Updating tool to align with new C3D standards
 - Updating to clean up identified plan issues identified in pilot projects
 - Will perform additional QC on tool when updates are completed




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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans Agenda

- WisDOT Standard Bridge Design Tool
 - Initiative Background
 - Standard Bridge Design Tool Overview
 - Plan Development Process
 - Pilot Project Implementation
 - Next Steps
- Questions?




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2022 WisDOT Structural Engineers Symposium

Standard Bridge Plans


Questions?



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Structures Related Asset Management
Structures Certification

Philip Meinel – BOS Structures Asset Management Unit
Dominique Bechle – BOS Design Unit



1




2

What is Bridge Asset Management?

The concept behind bridge asset management is to use **bridge inventory data and condition data** combined with **preservation policy** in order to systematically determine bridge rehabilitation, preservation, and replacement needs at a **network level**.

Also refer to: [FDM 3-5-1](#) and [MAP-21 / 23 U.S.C. 101\(a\)\(2\)](#)



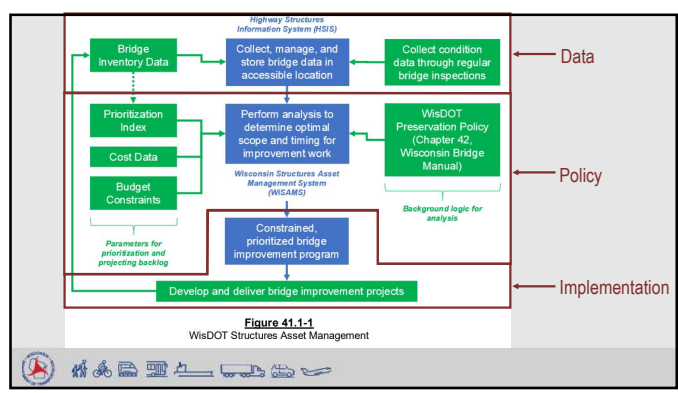
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Core Principles of Asset Management

- Policy-Driven
- Performance-Based
- Analysis of Options and Tradeoffs
- Quality Information
- Monitored for Clear Accountability and Feedback



4

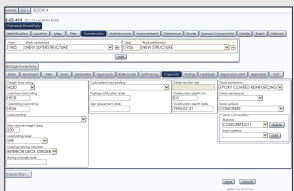


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Bridge Data

Highway Structures Information System (HSIS)

- Collect and store bridge inventory data
- Collect and store inspection data
- Web-based database



Easy for computer applications to access information

Easy for stakeholders to access information



6

Bridge Preservation Policy

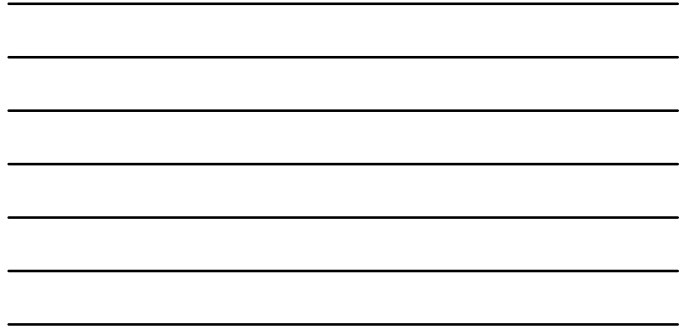
Bridge Preservation Policy Guide (2016)

Became Bridge Manual Ch. 42 (2019)

WisDOT Bridge Manual Chapter 42 - Bridge Preservation

Table of Contents	
42.1 Overview	2
42.2 WisDOT Goals and Strategies for Bridge Preservation	3
42.3 Goals for WisDOT Bridge Preservation Program	3
42.2 Strategies to Achieve WisDOT Bridge Preservation Goals	3
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42.4.1 Condition Based Strategies	6
42.4.2 Condition Based Strategies, Goals and Performance Measures	6
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42.4.4 Preservation Program Benefits	8
42.5 Bridge Preservation Activities, Eligibility and Need Assessment Criteria	9
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42.5.2 Identification of Preservation Needs	14
42.5.3 Funding Resources and Budgeting	15
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Bridge Preservation Policy

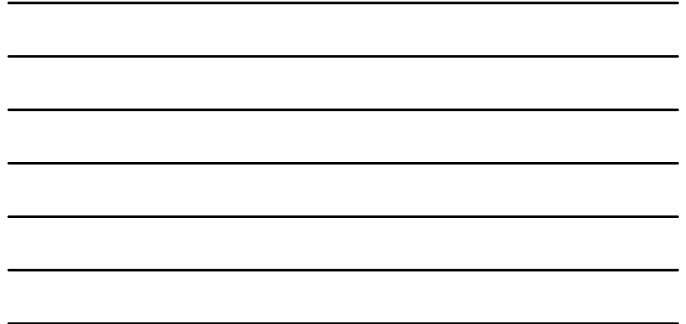
Performance Measures

Performance Measure	How we measure it	Current Report period	Goal	Unit	Trend	Comments	Date last reported
State Bridge Condition (calendar year 2021)	Percent of state bridges rated fair or better (percent)	83.7	85.8	%	↑	The department's focus on safe infrastructure continues to contribute to overall system quality, as state bridge condition consistently meets 70 and 80 goals, increasing to a 71 percent match rate.	7/2021

Objective	Target/Goals	Performance Measure
Maintain bridges in good or fair condition	95% of bridges	Percentage of bridge in good or fair condition (NBI rating 5 or higher)
Maintain bridge decks in good or fair condition	95% of bridge decks	Percentage of bridge decks in good or fair condition (NBI Rating 5 or higher)
Maintain effective expansion joints that do not leak	85% of bridges with wing wall joints that are effective in stopping leakage	Percent of a bridges with 85% of their wing wall expansion joints in condition state 2 or better (effective joint)
Maintain coated steel surfaces in condition state 2 or better	90% of coated steel surfaces	Percentage of coated steel surfaces in condition state 2 or better (effective)
Maintain bearings in condition state 2 or better	95 % of bearings in condition state 2 or better	Percentage of bearings in condition state 2 or better
Seal eligible concrete decks (NBI rating 4 or higher) with sealant every 3-5 years	Seal 50% eligible concrete decks	Number of decks sealed (i.e. # of deck area) each year during a 5-year period

Table 42.4-1
Objectives and Performance Measures

8



Bridge Preservation Policy

- Defines policy on when to choose one treatment versus another
- Bridge Deck Example:**

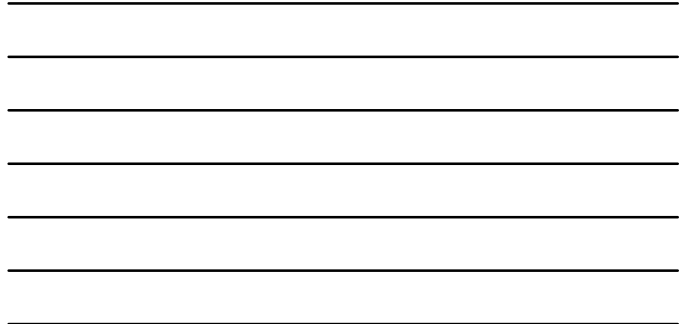
Table 2 - Bridge Preservation Activities

Winter Component	Bridge Preservation Type	Activity Description	Preventive Measure RPE	Active Priority (2021)
Deck	Preventive Maintenance	Preventing ground water seepage	CR-10	1-3
		Deck Sealing	CR-10	4
		Deck Repaving/Deck Overlay	CR-10	4-5
		Deck Resurfacing	CR-10	4
		Deck Rehabilitation	CR-10	4
	Repair or Replace Elements	Deck Rehabilitation	CR-10	1-3
		Deck Repaving/Deck Overlay	CR-10	1-3
		Deck Resurfacing	CR-10	1-3
		Deck Rehabilitation	CR-10	1-3
		Deck Rehabilitation	CR-10	1-3

Table 3 - Concrete Deck/Slab Eligibility Matrix

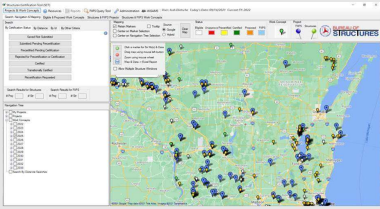
NBI Item 55	Deck Element Distress Area (sq ft)	Preservation Activity	Benefit to Deck from action	Application Frequency (in years)
Concrete Deck/Slab	1-7	Deck Sealing/Walsh	Seal Cracks	1 to 2
		Crack Sealing	Seal Cracks	1 to 2
		Deck Sealing	Seal Cracks	3 to 5
		Polymer Modified Asphalt Overlay	Seal Cracks	12 to 15
		Polymer Overlay	Seal Cracks	10 to 12
	8-10	Deck Sealing/Walsh	Seal Cracks	1 to 2
		Crack Sealing	Seal Cracks	3 to 5
		Deck Sealing	Seal Cracks	3 to 5
		Deck Sealing	Seal Cracks	3 to 5
		Deck Sealing	Seal Cracks	3 to 5
11-15	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
16-20	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
21-25	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
26-30	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
31-35	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
36-40	Deck Sealing/Walsh	Seal Cracks	1 to 2	
	Crack Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	
	Deck Sealing	Seal Cracks	3 to 5	

9



Structures Certification Tool

- SCT facilitates
 - Delivery of structure work concepts
 - Creation and review of structure projects
 - Structures certification
 - Tracking of structure projects (through FIIPS)



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Project Initiation

- PY8-PY7, LC 00-10
 - Development of Projects with Structures Work (WISAMS List)
 - Annually in February and August
 - Work Concept Review
 - Priority Review
 - Coordination with Region Planning
 - Create Projects in SCT
 - Pre-Certification (BOS Development)

Project Initiation

Project Year 8	PY7
LC00	

Development of Structures Projects
(Section 41.3.1.2)

During the Project Initiation phase and past LC10 into the Project Definition phase, Regional staff will work with BOS to:

- Opportunity to review BOS structure improvement work recommendations.
- Provide input and collaborate on priority.
- Use list of eligible structures improvement work to develop transportation improvement projects.

BOS uses WISAMS to deliver a prioritized list of eligible primary structures improvement work concepts to Regional Programming (Section 41.2.1)

Eligible Structures Work Concepts

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	Project Initiation		Project Definition		Project Delivery and Execution
	Project Year 8	PY7	LC00	PY6	LC11
<p>Long-Range Planning (Section 41.3.1.1)</p> <p>Collaboration between BOS and Region on identifying possible future structure improvement and replacement needs. Focus will be on large bridges/projects in order to better anticipate future budget needs.</p> <p style="font-size: x-small;">BOS uses WISAMS to deliver a prioritized list of eligible primary structures improvement work concepts to Regional Programming (Section 41.2.1)</p> <p style="font-size: x-small;">Eligible Structures Work Concepts</p>	<p>Development of Structures Projects (Section 41.3.1.2)</p> <p>During the Project Initiation phase and past LC10 into the Project Definition phase, Regional staff will work with BOS to:</p> <ul style="list-style-type: none"> • Opportunity to review BOS structure improvement work recommendations. • Provide input and collaborate on priority. • Use list of eligible structures improvement work to develop transportation improvement projects. 		<p>Structures Project Certification (Section 41.3.1.3)</p> <p>During the Project Definition phase, starting at approximately PY6, BOS to perform the following work:</p> <ul style="list-style-type: none"> • Review primary structures improvement work concept. • Identify secondary structures improvement work. • Develop a cost estimate for identified structures improvement work. <p style="font-size: x-small;">Structure Certification is REQUIRED before a project can move to PY6, LC11, and into the Project Delivery phase. Structure Certification addresses:</p> <ul style="list-style-type: none"> • Primary structure improvement work concept • Secondary structure improvement work • Cost estimate for structures work • Structure design resources (BOS or consultant) <p style="font-size: x-small;">See Section 41.3.1.4 for more information.</p>		<p>Project Delivery phase and Project Execution phase to proceed per direction in the WisDOT Facilities Development Manual (FDM).</p> <p>Structures Re-Certification</p> <p>After Structure Certification is complete, any changes related to the scope of structures improvement work is subject to re-certification.</p> <p style="font-size: x-small;">Phase of structure asset management process per Chapter 41 of the WisDOT BOS Bridge Manual.</p>
Bridge or Structure Certification Document (BOSCD)					

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Project Definition

- PY6-PY5, LC 10/11
 - Certification Phase

Step 1:
Design Supervisors assign Structures Certification Liaison

Structure Certification (Section 41.3.1.3)
During the Project Definition phase, starting at approximately PY6, BOS to perform the following work:

- Review primary structures improvement work concept.
- Identify secondary structures improvement work.
- Develop a cost estimate for identified structures improvement work.

Structure Certification is **REQUIRED** before a project can move to PY5, LC11, and into the Project Delivery phase. Structure Certification addresses:

- Primary structure improvement work concept
- Secondary structure improvement work
- Cost estimate for structures work.
- Structure design resources (BOS or consultant)

See Section 41.3.1.4 for more information.

Bridge or Structure Certification Document (BOSCD)

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Project Definition

- PY6-PY5, LC 10/11
 - Certification Phase

Step 2:
Structures Certification Liaison Review

- Verifies primary scope of work (concrete overlay, deck replacement, etc.)
- Evaluates bridges for recommended secondary scope of work (parapet repair, bearing replacement, etc.)
- Develops refined construction cost estimate

Structure Certification (Section 41.3.1.3)
During the Project Definition phase, starting at approximately PY6, BOS to perform the following work:

- Review primary structures improvement work concept.
- Identify secondary structures improvement work.
- Develop a cost estimate for identified structures improvement work.

Structure Certification is **REQUIRED** before a project can move to PY5, LC11, and into the Project Delivery phase. Structure Certification addresses:

- Primary structure improvement work concept
- Secondary structure improvement work
- Cost estimate for structures work.
- Structure design resources (BOS or consultant)

See Section 41.3.1.4 for more information.

Bridge or Structure Certification Document (BOSCD)

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Project Definition

- PY6-PY5, LC 10/11
 - Certification Phase

Step 3:
Determine Design Resourcing

- Estimate Design Level of Effort
- BOS or Consultant

Structure Certification (Section 41.3.1.3)
During the Project Definition phase, starting at approximately PY6, BOS to perform the following work:

- Review primary structures improvement work concept.
- Identify secondary structures improvement work.
- Develop a cost estimate for identified structures improvement work.

Structure Certification is **REQUIRED** before a project can move to PY5, LC11, and into the Project Delivery phase. Structure Certification addresses:

- Primary structure improvement work concept
- Secondary structure improvement work
- Cost estimate for structures work.
- Structure design resources (BOS or consultant)

See Section 41.3.1.4 for more information.

Bridge or Structure Certification Document (BOSCD)

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Project Definition

- PY6-PY5, LC 10/11
 - Certification Phase

Step 4:
Bridge or Structure Certification Document (BOSCD)

- BOSCD required as projects enter PY4 (LC11)
- Re-certification required for changes in scope

Project Definition

PY6 PY5

LC10

Structures Project Certification
(Section 41.3.1.3)

During the Project Definition phase, starting at approximately PY6, BOS to perform the following work:

- Review primary structures improvement work concept.
- Identify secondary structures improvement work.
- Develop a cost estimate for identified structures improvement work.

Structure Certification is REQUIRED before a project can move to PY5, LC11, and into the Project Delivery phase. Structure Certification addresses:

- Primary structure improvement work concept
- Secondary structure improvement work
- Cost estimate for structures work.
- Structure design resources (BOS or consultant)

See Section 41.3.1.4 for more information.

Bridge or Structure Certification Document (BOSCD)

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Project Delivery and Execution

- PY4-Construction, Life Cycle 12+
 - Re-certification if any changes
 - Scope (primary or secondary)
 - Structures construction cost estimate
 - PS&E or let date
 - Advanceable date
 - Structures design resourcing

Project Delivery and Execution

PY4 – PY1

LC11

Project Delivery phase and Project Execution phase to proceed per direction in the WisDOT Facilities Development Manual (FDM).

Structures Re-Certification

After Structure Certification is complete, any changes related to the scope of structures improvement work is subject to re-certification.

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Structure Certification Roles and Responsibilities

Bureau of Structures

- Maintenance Section
 - Bridge Inspections
 - Scope Input
- Development Section
 - Preservation Policy
 - Maintain WISAMS & SCT Applications
 - Review and Pre-Certify Projects
 - Performance Measures
- Design Section
 - Design or Oversight
 - Structure Certification Liaisons


Region

- Planning and Scoping
 - Initiate Structures Projects
 - Coordinate with Pavements, Safety, Operations, Traffic Control, etc.
- PDS
 - Guide Projects from Certification through Construction
 - Re-Certification, if Necessary

Scoping question in design?
Where do you go first?
BOSCD

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BOSCD
Bureau of Structures Certification Document




FIIPS Design ID	7170-00-05	Certification Date	01/14/2022
FIIPS Construction ID	7170-00-75	SCT Project No.	3968
FIIPS EPS&E Date	11/01/2022	SCT Adv. FY	2023
FIIPS PS&E Date	05/01/2028	SCT FY	2029
FIIPS Let FY	2029		

Structure ID	B-06-0157	Region	NW	Feature On	STH 25
County	BUFFALO	Municipality	NELSON	Feature Under	MISSISSIPPI RIVER SLOUGH

BOS Certification Liaison:

Name	Philip Meinel	Phone Number	608-261-2590
Email	philip.meinel@dot.wi.gov		


Primary Work Concept:
(94) REPLACE OR REPAIR APPROACH SLABS




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Resources

- [Wisconsin Bridge Manual](#)
 - Chapter 41: Structures Asset Management
 - Chapter 42: Bridge Preservation
- Bureau of Structures
 - Bridge Management Unit / Development Section
 - Design Section




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2022 WisDOT Structural Engineers Symposium

Load Ratings & Structural Reviews



Alex Pence, PE, SE
 Bridge Automation & Ratings Unit Supervisor
 WisDOT Structural Engineers Symposium
 Madison, WI
 May 24, 2022



1

Load Rating Fundamentals

- Why calculate load ratings?
 - Safety
 - Weight Limit Postings
 - NBIS Compliance
 - Determine Rehab/Replacement Needs
 - OSOW Evaluation

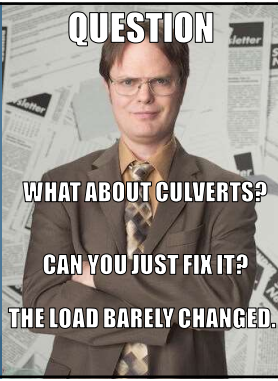
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3

Load Rating Fundamentals


- When is a load rating required?
 - New Bridges
 - Existing Structures
 - Deterioration / Damage
 - Load Changes
 - Rehabs



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Load Rating Fundamentals


- Load Rating Methods
 - Calculations
 - LRFR, LFR, ASR
 - Assigned
 - Field Evaluation & Documented Engineering Judgment
 - Load Testing



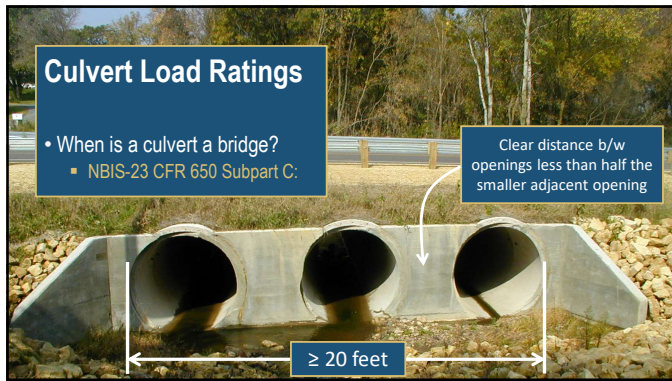
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Load Rating Fundamentals

Rating Software	
Steel Girders / Floor Systems	AASHTOWare BrR, SIMON
Prestressed Conc Girders	In-House, BrR
Reinf Conc Slabs	In-House, BrR
Steel Trusses	BrR
Concrete Box Culverts	BrR
Finite Element Analysis	CSI Bridge, RISA
Other	LEAP/OpenBridge, MDX, Midas Mathcad / Excel



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7

Culvert Load Ratings

2022 WisDOT Structural Engineers Symposium

$q_u = (\text{Water Height} + \frac{1}{2} \text{ Bottom Slab Thickness}) \cdot \text{Unit Weight of Water}$

- Working w/ FHWA to Update Policy
- Methods
 - Calculated:
 - Ideal when practical; required for some
 - Assigned:
 - As-Built Available, Current Conditions = Original Design
 - OK if Designed for via LFD for HS20 or via LRFD for HL93
 - Sometimes OK if designed via ASD or for < HS20
 - Field Evaluation & Engineering Judgment
 - Unknown construction details
 - Deterioration effects that cannot be analyzed
- Types:
 - Priority: Concrete Boxes with Fill Depth < 10'
 - May require future calculated ratings for others

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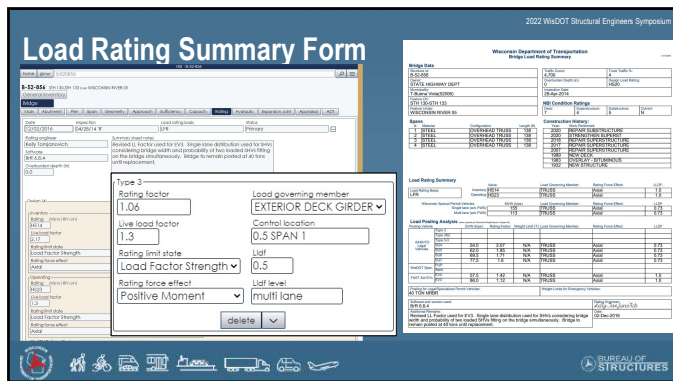
Culvert Load Ratings

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- New Culverts
 - Concrete Boxes – calculate ratings
 - Other Types / Empirical Designs
 - Design Load and Design Fill Depth on Stamped Plans
- Rehab
 - Fill Depth Changes (outside design min/max)
 - Extensions
 - May have two different methods
 - Report both ratings on plans
- In-Service
 - Working w/ FHWA for specific criteria and values to use for Assigned / FEEJ
 - Consult BOS on deterioration concerns

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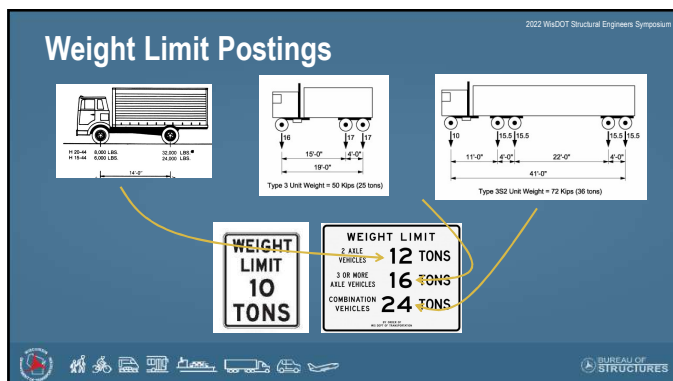
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Weight Limit Postings

Type 3 Unit Weight = 50 Kips (25 tons)

Type 3S2 Unit Weight = 72 Kips (36 tons)

Type 3-3 Unit Weight = 80 Kips (40 tons)

PUP Unit Weight = 98 Kips (49 tons)

Semi Unit Weight = 98 Kips (49 tons)

WEIGHT LIMIT 10 TONS

BUREAU OF STRUCTURES

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2022 WisDOT Structural Engineers Symposium

Weight Limit Postings

Type 3 Unit Weight = 80 Kips (40 tons)

Type 3S2 Unit Weight = 72 Kips (36 tons)

Type 3-3 Unit Weight = 80 Kips (40 tons)

PUP Unit Weight = 98 Kips (49 tons)

Semi Unit Weight = 98 Kips (49 tons)

WEIGHT LIMIT 10 TONS

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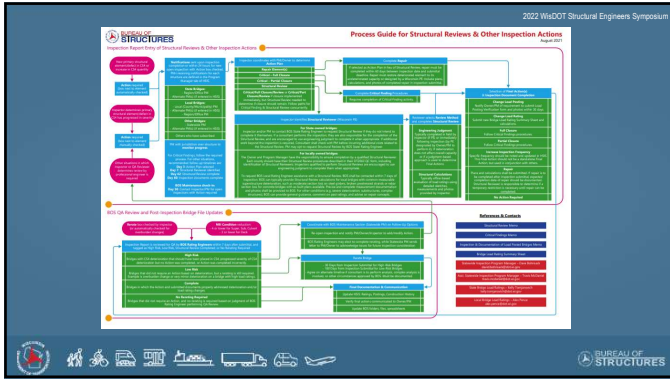
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FAST Act – Emergency Vehicles

- Increased allowable weight limits on Interstate and within one-mile access
 - 86,000 lbs gross
 - 24,000 lbs single steering axle
 - 33,500 lbs single drive axle
 - 62,000 lbs tandem axle
 - 52,000 lbs tandem rear drive axle
- Wisconsin:
 - Emergency Vehicles already could exceed standard weight limits *everywhere*

BUREAU OF STRUCTURES

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Structural Reviews

- If CS4 Quantity triggers a required **Action**, options are:
 - Critical Finding
 - Repair Elements
 - Structural Review
- Must be completed within 60 days of inspection

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Structural Reviews

- Engineering Judgment
 - Deterioration / Damage does not affect overall load rating
 - Conservative Posting / Restriction in lieu of calculations
- Structural Calculations
 - Submit calculations and load rating summary form
 - Consult with BOS – we may be able to assist with routine calculations

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Structural Reviews

- Final Actions
 - Change Load Posting
 - Change Load Rating
 - Full Closure
 - Partial Closure
 - Increase Inspection Frequency
 - Repair
 - No Action Required

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Repairs (as Action Plan)

Complete Repair

If selected as Action Plan in lieu of Structural Review, repair must be completed within 60 days between inspection date and submittal deadline. Repair must restore deteriorated element to its undeteriorated capacity or designed by a Wisconsin PE. Include plans, calculations, and photos of completed repair in inspection submittal.

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Repairs (as Final Action)

Repair

Plans and calculations shall be submitted. If repair is to be completed after inspection submittal, expected completion date of repair should be documented. Structural Reviewer is responsible to determine if a temporary restriction is necessary until repair can be completed.

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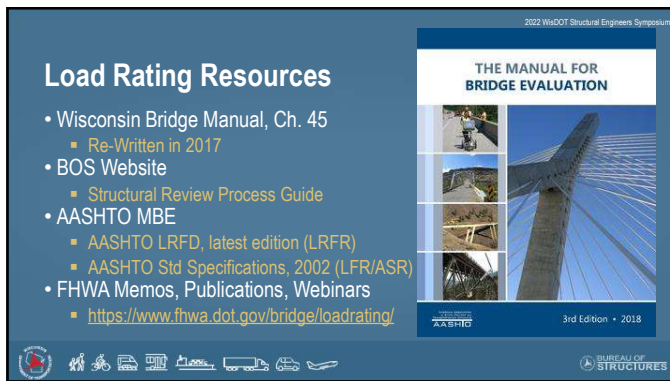
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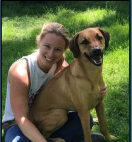

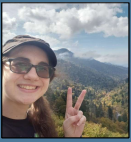

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BOS Load Rating Contacts 2022 WisDOT Structural Engineers Symposium

<https://stateempdir.wi.gov/>

			
Kelly Tomjanovich, PE	Andrew Smith, PE	Sam Wandeloski, EIT	Alex Pence, PE
State System QA/QC Structural Reviews OSOW Permits	Complex Analysis Research Repairs Structural Reviews	Local System OSOW Permits	Supervisor

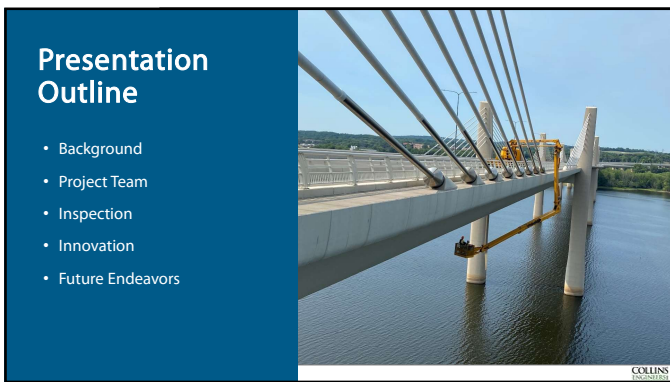
Icons: Pedestrian, Bicycle, Bus, Light Rail, Truck, Car, Boat, Airplane

BUREAU OF STRUCTURES

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1



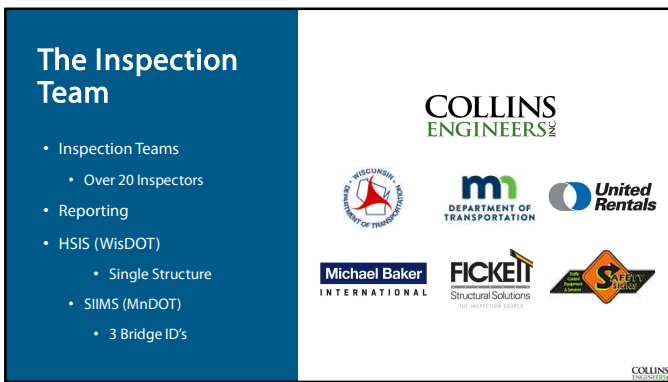
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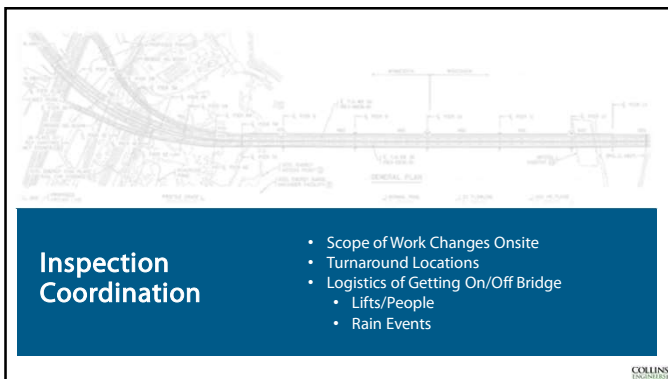
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5



6



Inspection— Coordination

- Inspection Guide (786 Pages)
- Traffic Control
 - Lane Closures & Attenuator Trucks
 - Time Restrictions
- Inspection Tools
- Field notes
- Portable Lavatory

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Inspection— Equipment

- Reach-All Vehicle – WisDOT
- 100' JLG Lift – United Rentals
- Rope Access – Collins
- UAS - Collins
- Confined Space
- Air Monitor/Tripod/Harnesses

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Inspections—Wearing Surface/Joints

- Access
- Measurements



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Inspections–Box Girders (Exterior)

- Reach-All Vehicle
- Walkway
- Pedestrians
- TMA

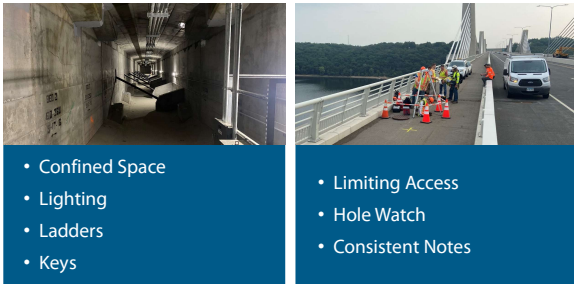


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Inspections–Box Girders (Interior)

- Confined Space
 - Lighting
 - Ladders
 - Keys
- Limiting Access
 - Hole Watch
 - Consistent Notes



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Inspections – Box Girders (Interior)

- Confined Space
- Limiting Access
- Hole Watch
- Consistent Notes
- Lighting

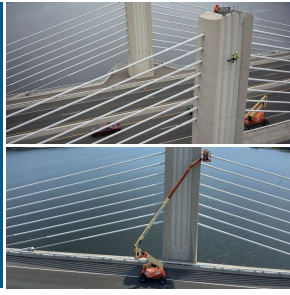


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Inspections – Towers

- Interior
 - Fall Protection
- Exterior
 - JLG
 - Rope Access
 - UAS



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13

Inspections–Cables

- 100 ft Manlift
- Lane Closure/TMA
- Storage/Operation
- Cable Anchorages
 - UAS



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Inspections – Bearings/Substructure

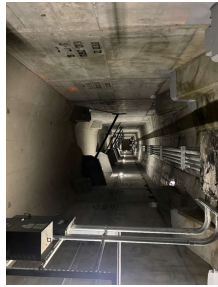
- UAS
- Reach-All
- Exterior
- Boat

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15

Reporting

- Prestressed Concrete Crack Mapping
- 100 Pages of Crack Tables
- Inspection Teams
- Access
- Gear/Ladders
- Note Taking



16

Innovation

- UAS Use
 - Certified Pilots
 - Airspace Clearance
 - Plan Flight
- Collect Data
 - Pre-Program Flights
 - Autonomous



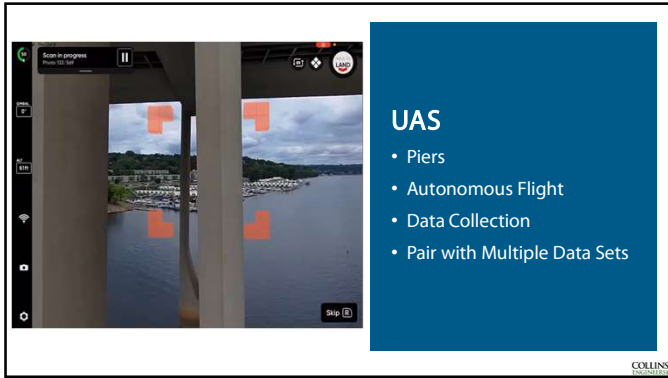
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UAS

- Multiple UAS deployed
- Photo & Video Documentation
- Supplement Inspectors
- Digital Twin Model



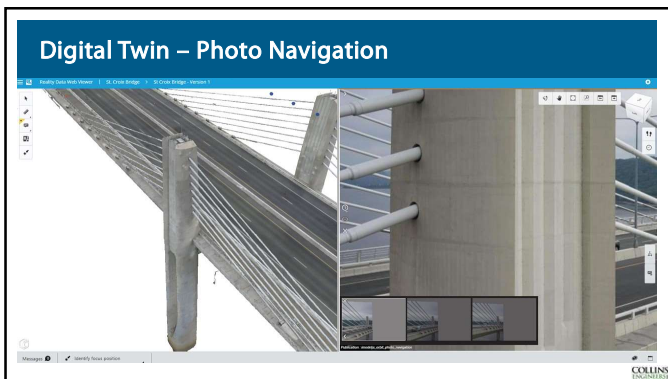
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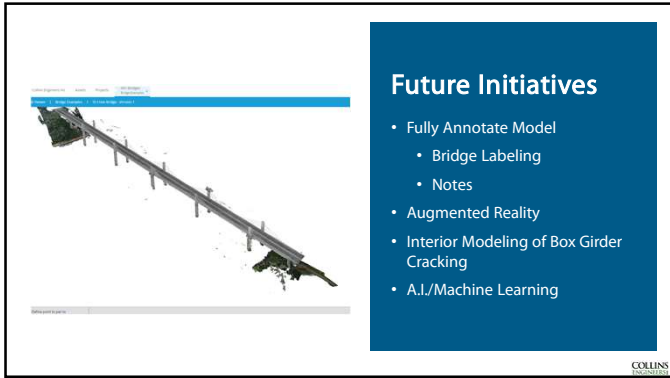
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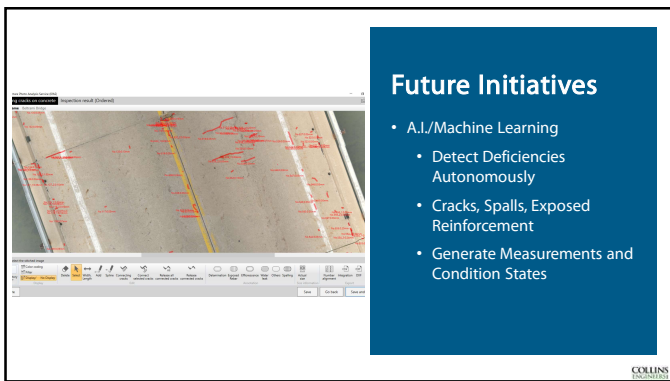
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Wisconsin Tub Girder Retrofits

Andrew Smith
WisDOT Engineer

2022 WisDOT Structural Engineers Symposium
University of Wisconsin-Madison Union South, Madison, WI
May 24, 2022




1

Steel Tubs in Wisconsin


Most Wisconsin tubs entered service as **Fracture Critical** because of 2-girder system (i.e. not load path redundant)


Require hands-on fracture critical inspection every two years



2


FCM





FHWA Review

SRM



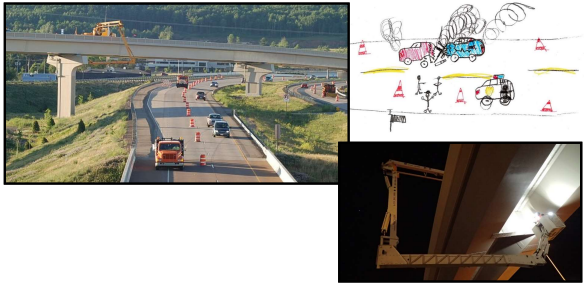
Fracture Critical Requirements	FCM Classification	SRM Classification	Redundancy Basis
Material	X	X	Load Path
Fabrication	X	X	Load Path
Inspection (shop)	X	X	Load Path
Inspection (in-service)	Hands-on	Routine ¹	Load Path (<i>default</i>) Structural (<i>optional</i>)

¹ walk through of each tub girder required at 48-month interval

FHWA considering Interval Redundancy

3

Fracture Critical Inspections



4

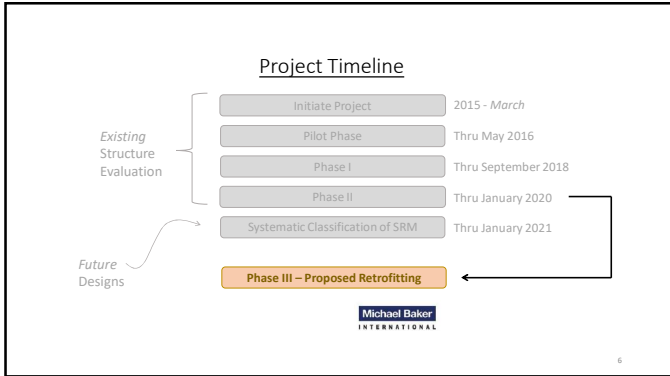


But not all shall pass!

- 4 twin tub girder bridges in Inventory did not satisfy AASHTO SRM Guide Spec
- Lack of stiff intermediate diaphragms
- Unusually long end spans
- Lack of shear studs in negative moment regions

5

Project Timeline



Phase	Timeline
Initiate Project	2015 - March
Pilot Phase	Thru May 2016
Phase I	Thru September 2018
Phase II	Thru January 2020
Systematic Classification of SRM	Thru January 2021
Phase III - Proposed Retrofitting	

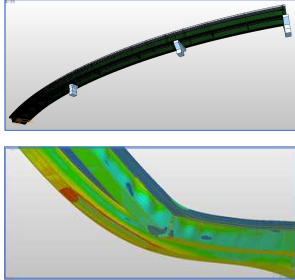
Existing Structure Evaluation

Future Designs

Michael Baker INTERNATIONAL

6

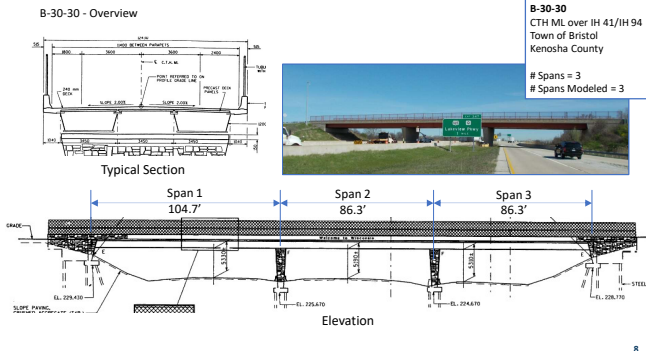
- Based on *AASHTO Guide Specs for Analysis and Identification of Fracture Critical Members and System Redundant Members*
- Create Midas model for existing bridge conditions (no failure included)
- Determine live load cases that cause highest +M
- Fracture tub girder at location(s) of highest +M
 - 1 fracture in an end span
 - 1 fracture in an interior span
- Determine bridge failure mechanisms
- Add retrofit(s) to model to address failures and satisfy *Guide Specs*
- Check performance of retrofit, modify as req'd



7

7

B-30-30 - Overview



B-30-30
CTH ML over IH 41/IH 94
Town of Bristol
Kenosha County

Spans = 3
Spans Modeled = 3

Typical Section

Elevation

Span 1
104.7'

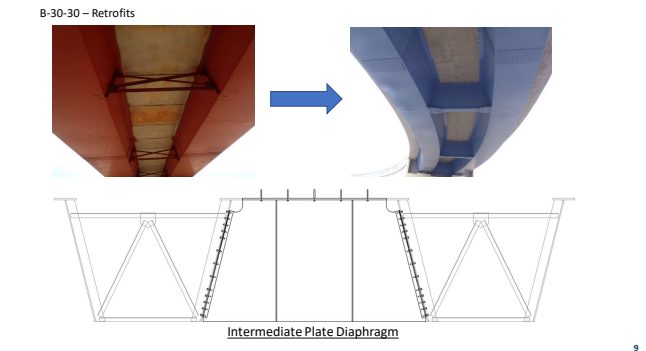
Span 2
86.3'

Span 3
86.3'

8

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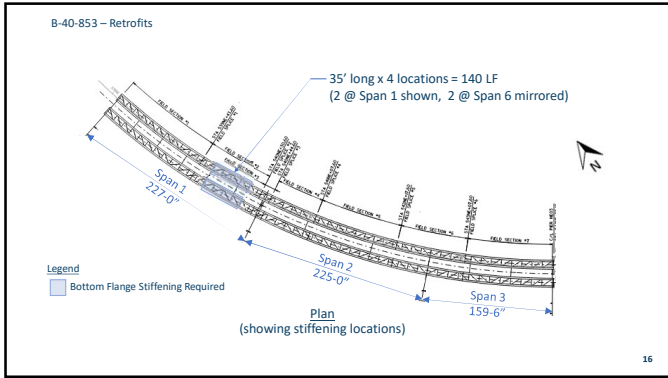
B-30-30 - Retrofits



Intermediate Plate Diaphragm

9

9




16

Next Steps


- ✓ Submit to and gain conditional approval from FHWA
- Cost consideration / Regional input
- Develop detailed design drawings
 - Ready to pull from "shelf" as funding allows

Submit final plans for review



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Questions?



18

2022 WisDOT Structural Engineers Symposium



Wisconsin Highway Research Program

James Luebke
Structural Engineer, Bureau of Structures

Structural Engineers Symposium
UW-Madison Union South, Madison, WI
May 24, 2022






1

2022 WisDOT Structural Engineers Symposium

Wisconsin Highway Research Program

- What is the WHRP?
- Recently Completed Projects
- In-Progress Projects






2

2022 WisDOT Structural Engineers Symposium

Wisconsin Highway Research Program

- 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

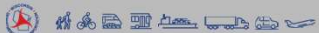




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2022 WisDOT Structural Engineers Symposium

Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

- Textured Epoxy-Coated:
 - Standard Epoxy Coating to Mitigate Corrosion + Rough Surface for Concrete bond
 - Standard Smooth Power Spray Immediately followed by Second Power Spray for Texture (+/-6.4% thicker coat).
 - No ASTM Standard – Feels like 180-grit






7

2022 WisDOT Structural Engineers Symposium

Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

- Laboratory Studies:
 - Shrinkage Cracking
 - Bond
 - Cyclic Load
 - Static Load Testing
 - "Short" Beams

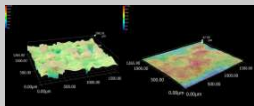
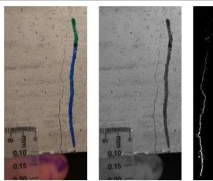
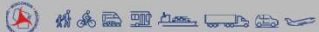




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2022 WisDOT Structural Engineers Symposium

Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

- Image Analysis:
 - Cracks - ImageJ Software
 - Surface Roughness – Optical Microscope

9

2022 WisDOT Structural Engineers Symposium

Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

• Results:

Figure 32 - Synthesis of results for bond, static load, and small beam test programs.

BUREAU OF STRUCTURES

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2022 WisDOT Structural Engineers Symposium

Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

• Field Test:

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Textured Epoxy Coated and Galvanized Reinforcements to Reduce Cracking in Concrete Bridge Decks and Components

• Recommendations:

- Textured epoxy and hot-dipped galvanized bars provided superior crack control performance in laboratory tests
- Recommended as an alternative.
- TPC and Galvanized bars in precast concrete girders is neither encouraged nor discouraged.

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2022 WisDOT Structural Engineers Symposium

Protocols for Concrete Bridge Deck Protections and Treatments

PI: Minnesota State University, Mankato
 PM: Ryan Bowers
 Completed: 8/2020



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Protocols for Concrete Bridge Deck Protections and Treatments

- Findings:
 - The “do nothing” treatment plan - Highest Cost
 - Sealing frequency - determined based on the AADT
 - Deck Seals Followed by TPO – Most Cost Effective



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2022 WisDOT Structural Engineers Symposium

Protocols for Concrete Bridge Deck Protections and Treatments

- WBM Implementation:


Deck Protection

 - Deck sealing has been found to be a cost-effective tool in preserving decks (WHRP)
 - Earliest TPO placement - the following construction season
 - Apply as early as possible and re-applied thereafter (see Table 40.5-3 Deck Sealing Frequency)

Deck Protection

Roadway AADT	Deck Sealing Frequency
AADT < 2,500	4 - 5 years
2,500 -> AADT < 5,000	2 years
5,000 -> AADT < 10,000	2 years
AADT > 10,000	2 years


Table 40.5.3
Deck Sealing Frequency






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2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin



PI: Simpson Gumpertz & Heger Inc.
PM: Steve Neary
Completed: 5/2019








16

2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin

- History:
 - 1980 – Experimental Culvert Pipe - Project Initiated
 - 1981 – Installed aluminum and aluminized steel pipes
 - 1988 - Corrosion Evaluation of Experimental Metal Culvert Pipe in WI
 - 1993/1994 - Aluminum culvert pipes collapsed
 - 2003 - Experimental Culvert Pipe – Final Report
 - 2005 - WBM "Aluminum box culverts are not permitted by the BOS"








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2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin

- Key Findings:
 - Once environmental conditions are met, aluminum culverts will provide a minimum service life of 50 to 75 yrs when not influenced by other corrosion mechanisms, such as contact with chloride-based roadway deicing salts

18

2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin

- Recommendations:
 - Develop updates to allow use of aluminum culverts where sites allow.
 - Buried aluminum culverts can be subject to soil-side corrosion
 - Specify use of an impermeable isolation membrane in the backfill above aluminum culverts.

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2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin

- WBM Implementation:

Shorter Spans (Less than 7 ft +/-)

 - See FDM 13-1
 - Corrugated Pipes and Arches

Longer Span (Greater than 7 ft +/-)

 - See WBM 36.13.3 Structural Plate Structure (Pipe, pipe arch, box culverts)

20

2022 WisDOT Structural Engineers Symposium

Performance and Policy Related to Aluminum Box Culverts and Pipe Culverts in Wisconsin


- WBM Implementation:
 - 36.13.3 – Metal Buried Structures
 - Site requirements (pH, resistivity, sulfates, etc.)
 - Provide an impervious isolation membrane
 - RC concrete structures are still recommended over metal structures, especially for higher volume roadways




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2022 WisDOT Structural Engineers Symposium

Analytical and Testing Methods for Rating Longitudinal Laminated Timber Slab Bridges

PI: Iowa State University
PM: Alex Pence
Completed: Soon



22

2022 WisDOT Structural Engineers Symposium

Analytical and Testing Methods for Rating Longitudinal Laminated Timber Slab Bridges

• Research Objectives:

- Develop refined wheel load distribution widths for laminated timber deck slab
- Evaluate effectiveness of retrofit techniques
- Provide policies and practices for load rating and proof loading.







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2022 WisDOT Structural Engineers Symposium

Improving Bridge Concrete Overlay Performance

• Research Objectives

- Evaluate WisDOT's current low-slump concrete overlay specifications
- Provide guidance for maintaining low-slump concrete overlays
- Recommend changes to the WisDOT Bridge Manual and Standard Specifications

10/2023 Expected Completion






24

2022 WisDOT Structural Engineers Symposium

Development of Design Procedures for Concrete Adhesive Anchors

- Research Objectives:
 - Provide simplified design guidance
 - Examine and summarize policies and guidelines
 - Develop recommendations and guidelines

10/2022 Expected Completion



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Where to find WHRP reports:

- <https://wisconsin.gov/Pages/about-wisdot/research/structures.aspx>





26


Questions



James Luebke, PE
Structures TOC - Chair
WisDOT, Bureau of Structures
James.luebke@dot.wi.gov
(608) 266-5098



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2022 WisDOT Structural Engineers Symposium

WISCONSIN DEPARTMENT OF TRANSPORTATION

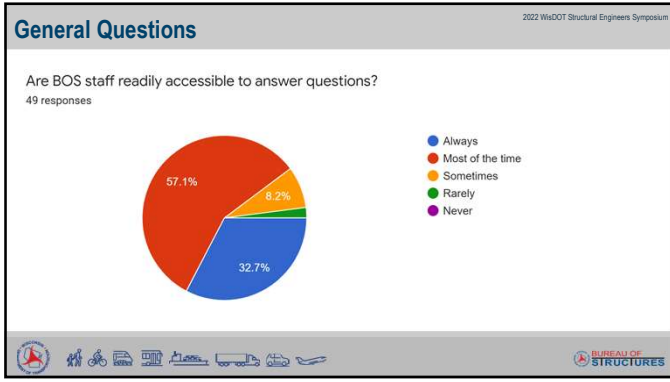
Interactive Survey Results

Laura Shadewald, PE
Structures Design Supervisor

2022 WisDOT Structural Engineers Symposium
Madison, WI
May 24, 2022

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1



2022 WisDOT Structural Engineers Symposium

General Questions

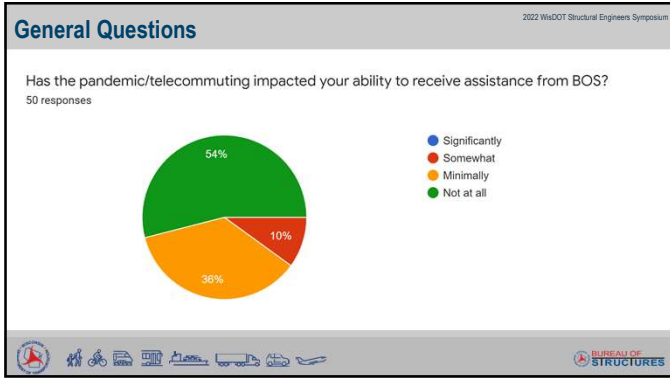
Are BOS staff readily accessible to answer questions?
49 responses

- Always
- Most of the time
- Sometimes
- Rarely
- Never

Response	Percentage
Always	32.7%
Most of the time	57.1%
Sometimes	8.2%
Rarely	0%
Never	0%

BUREAU OF STRUCTURES

2



2022 WisDOT Structural Engineers Symposium

General Questions

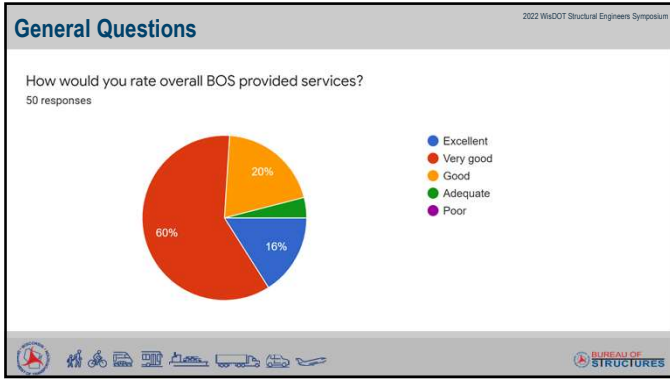
Has the pandemic/telecommuting impacted your ability to receive assistance from BOS?
50 responses

- Significantly
- Somewhat
- Minimally
- Not at all

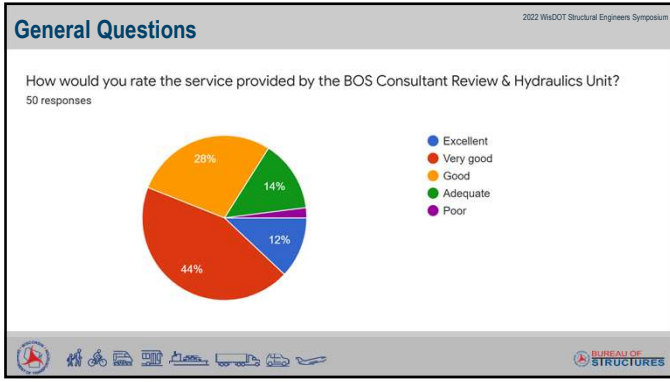
Response	Percentage
Significantly	10%
Somewhat	36%
Minimally	54%
Not at all	0%

BUREAU OF STRUCTURES

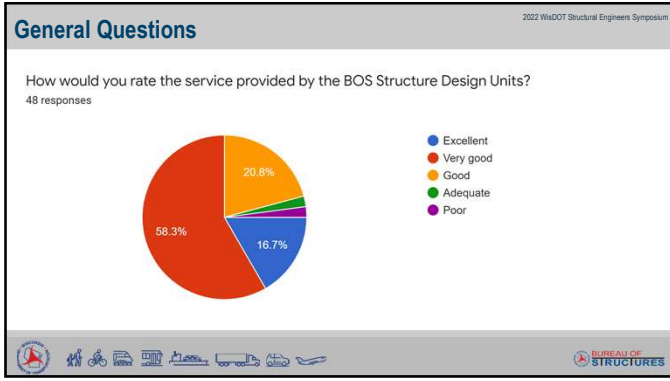
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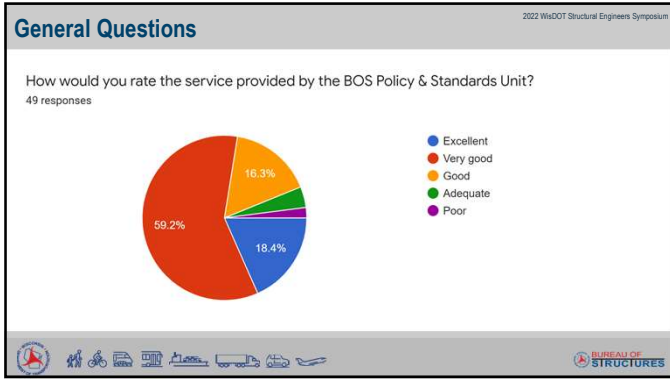
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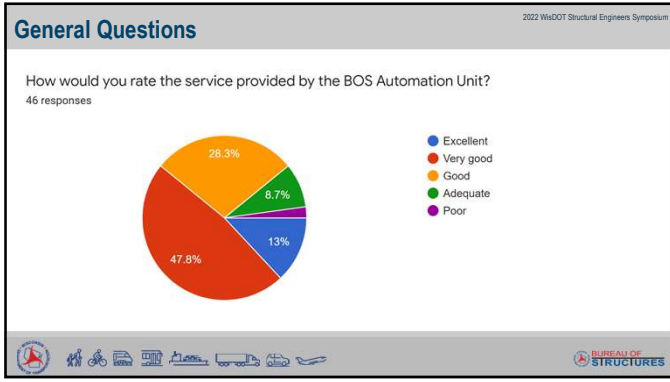
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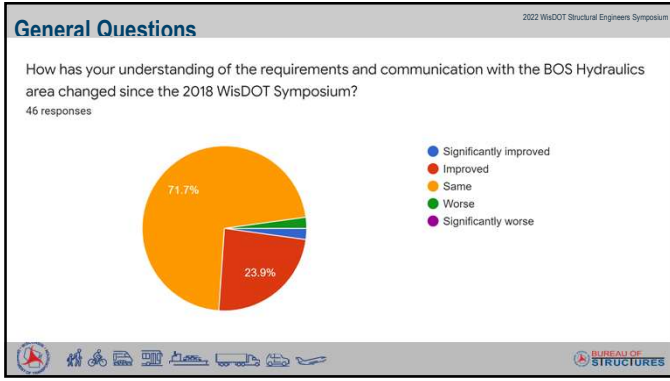
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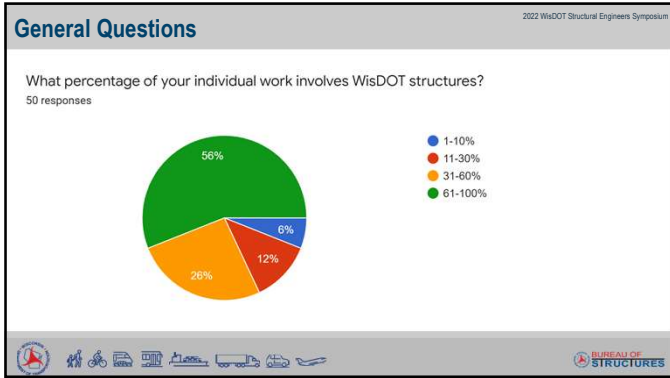
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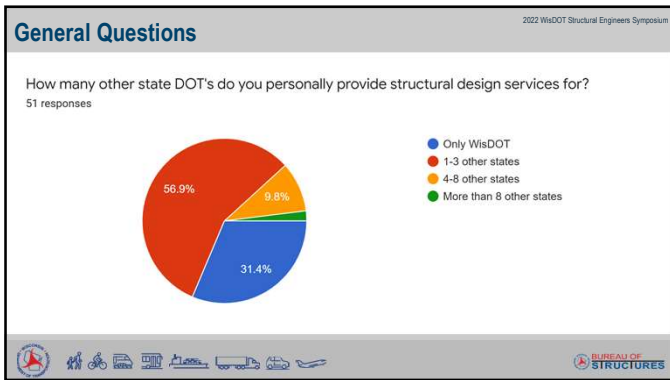
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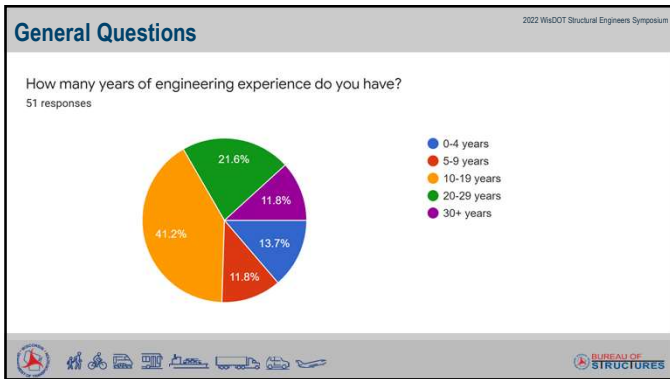
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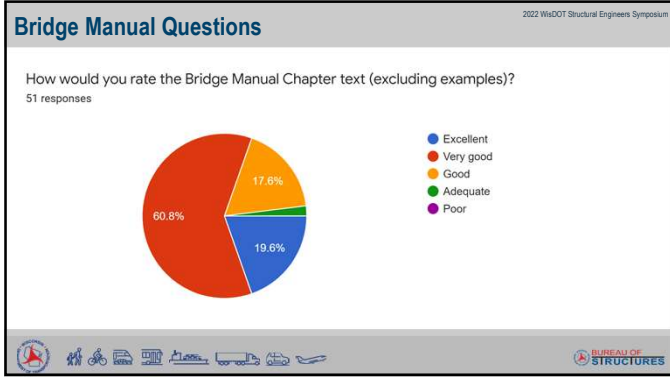
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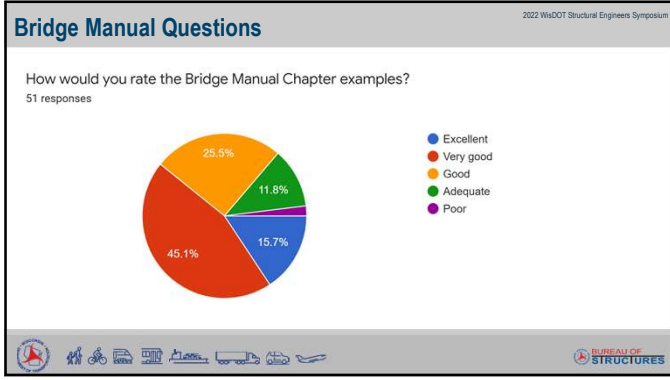
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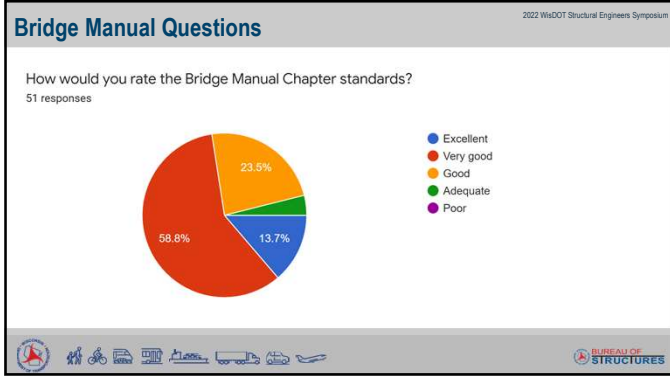
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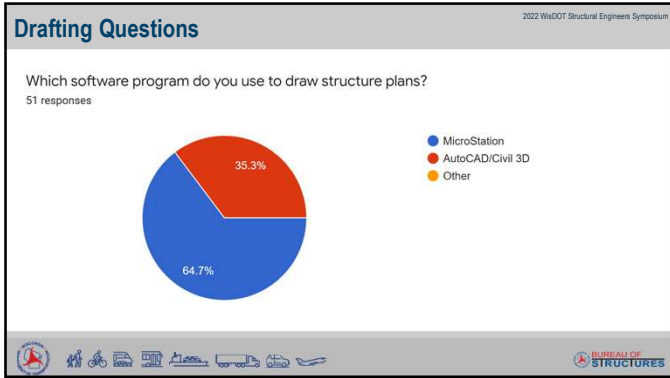
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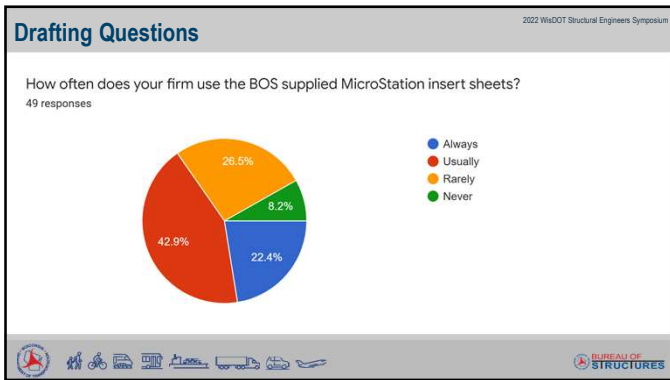
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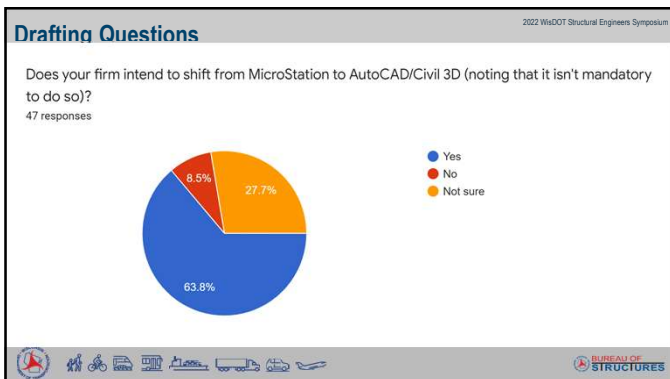
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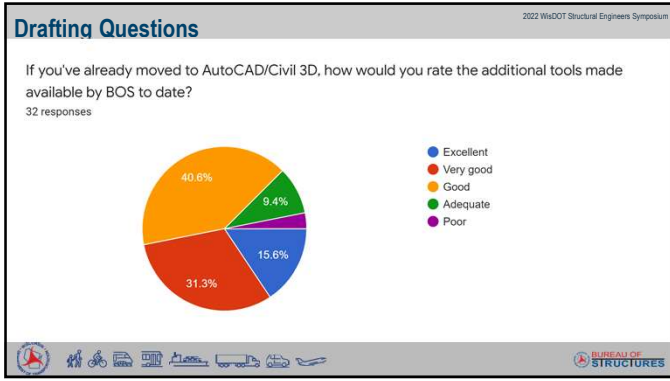
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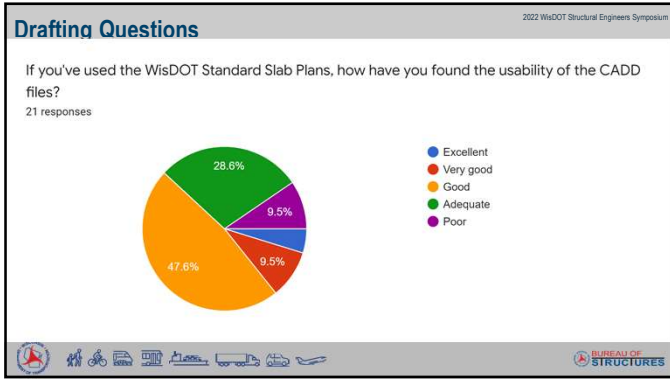
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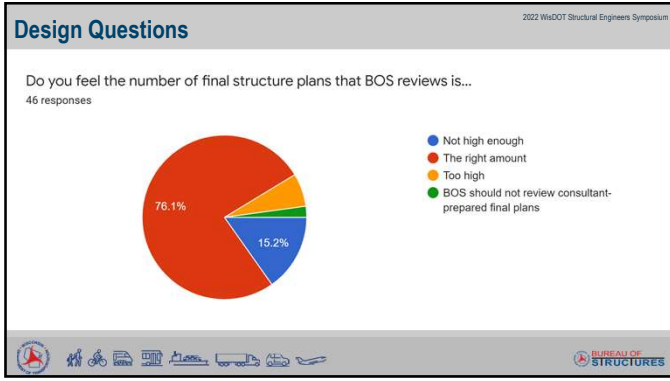
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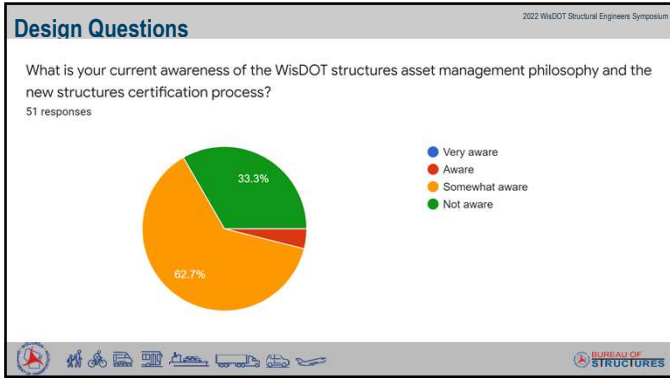
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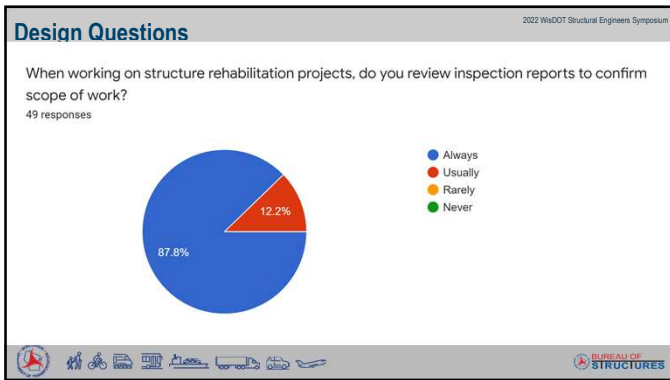
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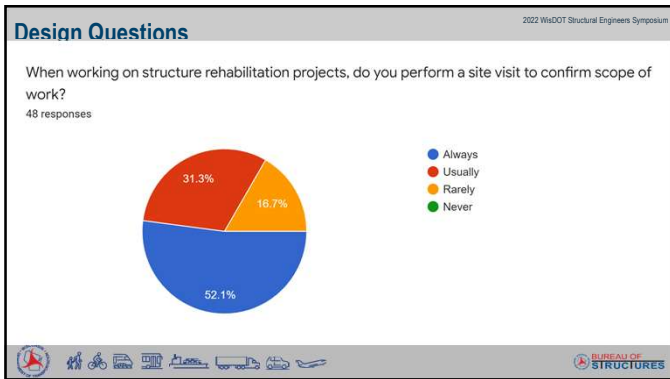
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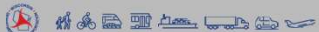



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2022 WisDOT Structural Engineers Symposium

Interactive Survey Results

Additional Questions?

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