WisDOT Structural Engineers Symposium
Program Agenda
June 7, 2016

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

For today’s presentations, agenda, and proof of attendance, please visit:
http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/design-policy-memos.aspx

7:30 a.m.  Registration

8:00 a.m.  Welcome & Secretary’s Office Remarks – Mark Gottlieb, WisDOT Secretary

8:10 a.m.  BOS Director’s Perspective – Scot Becker, BOS Director

8:20 a.m.  Consultant Review Topics – Najoua Ksontini, Design Supervisor; Dan Breunig, Consultant Review Engineer; Matt Allie, Hydraulic Design Engineer

9:20 a.m.  Structures Estimating – Fred Schunke, WisDOT Estimating Engineer

9:35 a.m.  Design & Construction of Post-Tensioned Integral Pier Caps – Randy Thomas, CH2M

10:00 a.m. Break (Beverages and Snacks)

10:20 a.m. Bridge Management – Philip Meinel, Development Engineer; Josh Dietsche, Development Supervisor; Bria Lange, Development Engineer

10:55 a.m. Automation, Policy, and Standards – Dave Kiekbusch, Development Supervisor; James Luebke, Development Engineer; Andrew Smith, Development Engineer

11:55 a.m. Lunch

1:00 p.m. South 1st Street Bascule Bridge – Michael Delemont, AECOM

1:25 p.m. Construction Topics – Bill Dreher, Design Chief; Joe Balice, FHWA Division Bridge Engineer

2:05 p.m. Ancillary Structures – Ben Koeppen, Maintenance Engineer; Anthony Stakston, Regional Ancillary Structure Inspection Engineer; Vu Thao, Design Engineer

2:35 p.m. Break (Beverages and Snacks)

2:55 p.m. Research Updates – Bill Oliva, Development Chief

3:10 p.m. Accelerated Bridge Construction – James Luebke, Development Engineer; Bill Oliva, Development Chief

3:35 p.m. Interactive Survey & Q/A

4:00 p.m. Adjourn
BOS Director’s Perspective

Scot Becker
Wisconsin DOT
June 7, 2016
Welcome to the 2nd Transportation Structural Symposium

BOS Accomplishments / Looking Forward

National Trends and Challenges
Fun Facts – The last 2 years Since our First Symposium

- How many bridges were built? Other structures?
- How many bridges were designed? Other structures?
- How many bridges were rated by BOS?
- How many bridges were inspected?
Progress of St. Croix
Drones Pilot for Bridge Inspection
Today’s Agenda

- Consultant Presentations
- Bureau Items

WisDOT Perspective

- Lessons Learned

5- WiSAMS

Highway Structures Information System (HSIS)

- Inventory & Other Data
- Review & Manage Bridge Data
- Perform Network Analysis
- Wisconsin Structures Asset Management (WISAM)
- Provide Report with Recommended Work Actions, Optimal Year to Perform, and Cost Estimate
- WisDOT Preservation Policy
- Cost Data
- Regional Planning/PDS
- Develop and Perform Bridge Projects
- Inspect Bridges
- Regional Maintenance
- Condition Data

Project Debriefing
WisDOT BM Chapter 7-ABC
WisDOT Experience
Next ABC - Bridge Project
BOS Accomplishments - Looking Forward

- New Improved Bureau Web Site
- Bridge Aesthetics
- Fiber Reinforced Polymer (FRP) Policy
- Timeliness Initiative
- Implementation of Bridge Preservation Policy & Updated WisDOT/FHWA PM Agreement
BOS Looking Forward

- Ancillary Structures Program
- WiSAM (Wisconsin Structures Asset Management)
- Fabrication Phase II Project
- MASH Research and Implementation
- Accelerated Bridge Construction Program Development
National Trends and Challenges

- New 3 year frequency of LRFD Manual Versions with no interims
  - Wisconsin led this effort
- Interstate Truck Weight Exceptions – FAST Act
- LRFD Sign Structures
- National Tunnel Inspection Program
- Bridge Information Modelling
Wisconsin Transportation Structures Program

- We want your Feedback and Input
- BOS - How are we doing?
- 3rd Symposium?
- Innovations?
Once Again Welcome!
Consultant Review Reports and Consultant Performance

Najoua Ksontini
Supervisor - Consultant Review and Hydraulics
Bureau of Structures
June 7, 2016
Goals of Presentation

- Provide an overview of some consultant review business metrics
- Discuss consultant performance and plan submittal timeliness
Consultant Review Metrics

- BOS provides reviews for all bridge, culvert, and retaining wall preliminary plans and some sign structure preliminary plans
- BOS provides QA reviews for some, not all submitted final structure plans
Consultant Review Metrics

Preliminary Plans Reviewed
(Bridges and Culverts)

<table>
<thead>
<tr>
<th>Year</th>
<th>Reviewed</th>
<th>Submitted</th>
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<tbody>
<tr>
<td>2011</td>
<td>217 (89%)</td>
<td>244</td>
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<tr>
<td>2012</td>
<td>155 (94%)</td>
<td>165</td>
</tr>
<tr>
<td>2013</td>
<td>201 (69%)</td>
<td>293</td>
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<tr>
<td>2014</td>
<td>201 (94%)</td>
<td>214</td>
</tr>
<tr>
<td>2015</td>
<td>220 (97%)</td>
<td>226</td>
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</table>

- Preliminary Plans Reviewed
- Preliminary Plans Submitted
Consultant Review Metrics

Final Plans Reviewed
(Bridges and Culverts)

<table>
<thead>
<tr>
<th>Year</th>
<th>Final Plans Reviewed</th>
<th>Final Plans Submitted</th>
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<tbody>
<tr>
<td>2011</td>
<td>71 (29%)</td>
<td>244</td>
</tr>
<tr>
<td>2012</td>
<td>62 (38%)</td>
<td>165</td>
</tr>
<tr>
<td>2013</td>
<td>74 (25%)</td>
<td>293</td>
</tr>
<tr>
<td>2014</td>
<td>79 (37%)</td>
<td>214</td>
</tr>
<tr>
<td>2015</td>
<td>87 (38%)</td>
<td>226</td>
</tr>
</tbody>
</table>
Consultant Review- Reviewers

- BOS utilizes a mix of in-house staff and consultant staff to perform preliminary and final plan reviews.
- Currently BOS has seven staffing contracts providing for consultant review services on a part-time or as needed basis.
  - 3 staffing contracts for preliminary plan review services
  - 2 staffing contracts for final plan review services
  - 2 staffing contracts for sign structure plan review services
Consultant Plan Submittal Timeliness and Performance

- BOS tracks and compiles consultant plan submittal timeliness and performance data
- Consultant performance data is based on the consultant evaluations completed by BOS reviewers for each preliminary and final plan review.
Plan submittal Timeliness

Preliminary Plan Submittals - On Time vs. Late*

*Late = received less than 3 months prior to PSE date

<table>
<thead>
<tr>
<th>Year</th>
<th>Late</th>
<th>On Time</th>
<th>Total</th>
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</thead>
<tbody>
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<td>73</td>
<td>347</td>
<td>420</td>
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<tr>
<td>2012</td>
<td>47</td>
<td>233</td>
<td>280</td>
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<td>2013</td>
<td>106</td>
<td>354</td>
<td>460</td>
</tr>
<tr>
<td>2014</td>
<td>64</td>
<td>348</td>
<td>412</td>
</tr>
<tr>
<td>2015</td>
<td>31</td>
<td>288</td>
<td>319</td>
</tr>
</tbody>
</table>
Plan submittal Timeliness

Final Plan Submittals - On Time vs. Late*

*Late = received less than 2 months prior to PSE date

<table>
<thead>
<tr>
<th>Year</th>
<th>Late</th>
<th>On Time</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>184</td>
<td>222</td>
<td>420</td>
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<td>2012</td>
<td>117</td>
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<td>105</td>
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<tr>
<td>2014</td>
<td>119</td>
<td>293</td>
<td>412</td>
</tr>
<tr>
<td>2015</td>
<td>54</td>
<td>265</td>
<td>319</td>
</tr>
</tbody>
</table>
Consultant Performance Ratings

- The consultant evaluation rating uses a scale of 1 through 5, with a rating of 3 reflecting a satisfactory performance that meets expectations.
- Data from 2013 through 2015, showed BOS had completed consultant evaluation ratings for 45 consultant firms.
- The compilation of the data results in a single average rating for each of the consultant firms.
Consultant Performance Ratings

Consultant Performance Average Ratings
2013-2015

<table>
<thead>
<tr>
<th>Range</th>
<th>Number</th>
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<tbody>
<tr>
<td>Less than 2</td>
<td>1</td>
</tr>
<tr>
<td>2.0-2.19</td>
<td>1</td>
</tr>
<tr>
<td>2.2-2.39</td>
<td>0</td>
</tr>
<tr>
<td>2.4-2.59</td>
<td>1</td>
</tr>
<tr>
<td>2.6-2.79</td>
<td>5</td>
</tr>
<tr>
<td>2.8-2.99</td>
<td>13</td>
</tr>
<tr>
<td>3.0-3.19</td>
<td>15</td>
</tr>
<tr>
<td>3.2-3.39</td>
<td>10</td>
</tr>
<tr>
<td>3.4-3.59</td>
<td>0</td>
</tr>
</tbody>
</table>
Questions?
Recent and Upcoming Changes to Consultant Review Process

Najoua Ksontini
Supervisor - Consultant Review and Hydraulics
Bureau of Structures
June 7, 2016
Goals of Presentation

- Discuss implementation of the On-Time Plan Submittal Improvement form
- Discuss upcoming improved documentation of review processes and expectations
- Discuss changes to consultant review evaluations
On-Time Plan Submittal Improvement Form

- Policy was set forth in a memo dated March 2nd, 2016.
- Form is intended to gather information about the reasons for past-deadline final structure plan submittals.
- BOS will categorize those reasons and will be able to provide suggestions to Region and consultant staff about process improvements.
On-Time Plan Submittal Improvement Form

- Form is required when:
  - Final structure plans are submitted past due date (i.e. 2-month prior to PS&E date), or
  - Each time a revised final structure plan is submitted after the due date, unless the revised submittal is in response to a BOS QA review.

- Form is **not** required for structure addenda and post-let revision submittals
On-Time Plan Submittal Improvement Form

- Form is available on the BOS web site and would need to be E-submitted along with the plan submittal
- Form should include a detailed description of the reasons that caused the past due date submittal and what could have been done differently to achieve the required two-month window prior to PSE
Several policy items related to consultant plan submittals and review processes are currently provided in BOS design policy memoranda that are found on the BOS web site.

BOS will incorporate these policies in Chapter 6 of the Bridge Manual.
The documentation in the Bridge Manual will cover:

- Consultant preliminary structure plan submittal expectations and review process
- Consultant final structure plan submittal expectations and review process
- Structure plan addenda submittal expectations and process
- Structure plan post-let revision submittal expectations and process
Consultant Evaluations

- Currently, BOS provides consultant performance evaluations for all preliminary and final plan reviews
- Evaluations are returned to design consultants and Region contacts when reviews are complete
Consultant Evaluations
How are they used?

- Consultant evaluation “average scores” are incorporated by Region Project Managers or Local Program Management Consultants into the consultant contract close-out evaluation
- Consultant evaluation “average ratings” are used by BOS to develop a consultant performance ranking
Consultant Evaluation- Preliminary Review

<table>
<thead>
<tr>
<th>Project ID.</th>
<th>Structure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway:</td>
<td>County:</td>
</tr>
<tr>
<td>Project Name:</td>
<td>Region:</td>
</tr>
<tr>
<td>District Contact:</td>
<td></td>
</tr>
<tr>
<td>Consultant:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of Structure:</th>
<th>Grade Separation</th>
<th>Retaining Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Crossing</td>
<td>Rehabilitation</td>
<td>Other</td>
</tr>
</tbody>
</table>

Average Rating: __________

1 = Unacceptable Performance  2 = Below Average  3 = Satisfactory  4 = Above Average Performance  5 = Outstanding
(See rating system in FDM 8.25.5)

Preliminary Submittal

<table>
<thead>
<tr>
<th>Reviewer: __________</th>
<th>Date: __________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours: __________</td>
<td></td>
</tr>
</tbody>
</table>

1. Completeness and clearness Preliminary plan submittal
2. Hydrologic and Hydraulic Calculations
3. Preliminary Structure selection
4. Preliminary Plan details and Engineering
5. Plans submitted with sufficient lead-time for review

Preliminary Submittal Comments:
_________________________________________________________________________________________
Consultant Evaluation - Final Plan Review

<table>
<thead>
<tr>
<th>Project ID.</th>
<th>Structure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway:</td>
<td>County:</td>
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<td>Project Name:</td>
<td>Region:</td>
</tr>
<tr>
<td>District Contact:</td>
<td>Consultant:</td>
</tr>
</tbody>
</table>

**Type of Structure:**
- [ ] Stream Crossing
- [ ] Rehabilitation
- [ ] Grade Separation
- [ ] Other
- [ ] Retaining Wall

**Average Rating:**
1 = Unacceptable Performance  2 = Below Average  3 = Satisfactory  4 = Above Average Performance  5 = Outstanding
*See rating system in FDM 8.25-5*

**Final Submittal**

*Reviewer(s): ____________________________________________ Date: ___________________________

*Hours: ________________

1. Preliminary Plan Review Comments Addressed  
2. Bidability  
3. Quality of Final Design Thoroughness  
4. Constructability/Plan Detail Thoroughness  
5. Completeness of Final Structures Plans Submittal  
6. Plan Submitted on Time – 2 Months prior to PS&E (1 if not on time, 2 if with late with justification, 3 if on time)  
   - [ ] 1
   - [ ] 2
   - [ ] 3
   - [ ] NA
7. Final Review Comments Addressed Appropriately/Thoroughly  

**Final Plan Submittal Comments:**
Consultant Evaluations -
Upcoming Changes

- In the future, BOS will not provide performance evaluations for preliminary plans for “minor” rehabilitation work.
- Minor work may include polymer overlays, painting, slope repairs, etc..
- Preliminary plans for this type of work will still be reviewed and comments will be provided.
- BOS will indicate when an evaluation is not provided.
Consultant Evaluations - Upcoming Changes

- In the future, average rating for final review evaluations will reflect a weighted average that places more weight on the more significant aspects of the submittal such as design and plan quality.
Contacts and resources

- Questions regarding structure plan submittals and review processes should be directed to:
  - Najoua Ksontini [Najoua.Ksontini@dot.wi.gov](mailto:Najoua.Ksontini@dot.wi.gov)
    (608) 266-2657
Questions?
Common BOS Review Comments

Dan Breunig
Consultant Review Engineer
Comments largely related to detailing and constructability concerns, but design errors are important

- **80% Constructability Comments**
  - Dimension errors
  - Bar steel callout errors
  - Not enough information to build

- **10% Bidability Comments**
  - Incorrect bid items
  - Work detailed in plans but no bid item for work

- **10% Design Comments**
  - Insufficient designs or overly conservative designs
Geotechnical Reports and Piling Design

- Several examples of misunderstandings of how to interpret the geotechnical reports and translate that to a modified gates piling design.
- Some borings are not going deep enough, and skin friction piles cannot develop enough resistance within the boring depth. Has resulted in designs with too many piles, not driven deep enough, and driven to a resistance less than the pile’s maximum driving resistance.
- Incorrect subsurface exploration border sheet.
Most Common Review Comments

- Ratings – Different programs, different results
  - Several different design/rating programs are used in the design community.
  - BOS has access to many of these, but uses an in-house program to actually rate structures (culverts, prestress, steel, slabs).
  - Occasionally, design changes are requested in order to satisfy BOS’ in-house software.
Other Common Review Comments

- Drafting Program Errors – incorrect dimension scales - dimensions all off by a constant factor.
- Design computations somehow not making it through to the final plan, typically due to a drafting error or error in an automated process.
- Construction Joint Locations and Bar Couplers
  - For staged construction and widenings, it is preferable to lap transverse deck bars rather than use bar couplers. Saves $$$ and reduces bar congestion.
SSR Training Resources

Matt Allie
Hydraulic Design Engineer
WisDOT Bureau of Structures
Outline

- Objective
- Background
- Resources
- Support
Objective

- Provide comprehensive SSR resources for:
  - Region – when submitting structure for BOS design
  - Consultants – when submitting preliminary structure plans for BOS review or design

- SSRs are most valuable when containing complete and accurate information
Background

- Previously, SSR training presentations given at WisDOT Region offices
- SSR forms updated in 2012
- Update and expand upon SSR training materials
- Recommended by the BOS Timeliness Initiative Final Report
Resources

Check Lists
- Consultant Preliminary Plan
- Separation Structure
- Retaining Wall
- Sign Structure
- Rehabilitation
- Stream Crossing

Training Resources

Blue Sheets (commented SSR forms elaborating on requested information)
- Separation Structure Survey Report
- Rehabilitation Structure Survey Report
- Stream Crossing Structure Survey Report (Bridge)
- Stream Crossing Structure Survey Report (Box Culvert)

Structure Survey Report Training Videos
- Module 1 - Introduction to BOS and Scheduling
- Module 2 - Structure Types
- Module 3 - Structure Aesthetics and Costs
- Module 4 - Grade Separation SSR
- Module 5 - Survey for Stream Crossing Structures
- Module 6 - Stream Crossing SSR - Bridge
- Module 7 - Stream Crossing SSR - Box Culvert
- Module 8 - Rehabilitation SSR
- Module 9 - Retaining Walls, Sign Structures and Ancillary Structures
- Module 10 - Consultant Preliminary Structure Plans Review and Approval

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Submittal Checklists

E-SUBMIT CHECKLIST
CONSULTANT PRELIMINARY PLANS AND STRUCTURE SURVEY REPORT SUBMITTAL

1. STRUCTURE SURVEY REPORT
   - Complete Structure Survey Report
   - SSR Workshop Manual and Videos
   - Bridge Manual Chapter 6.7.1 - Bridge Manual Chapter 6.5

2. PRELIMINARY SUBMITTAL
   - PDF Files:
     - Project Location Map
       - structure location and number
       - other proposed structures within project limits
     - Preliminary Roadway Plans
       - existing and proposed profile grade line
       - horizontal and vertical curve data (grades to nearest thousandth)
       - structure location, typical section, super transition locations
     - Preliminary Structure Plans
       - dimensions, plan view, elevation view, section through roadway, subsurface information
     - Geotechnical Report
       - boring logs and foundation recommendations
       - if report is not included with submittal, state on SSR who is doing this work
     - Labeled Photographs
       - existing structures, utilities, buildings, etc.
     - Other Documentation
       - summary of design considerations and alternatives evaluated; see Bridge Manual Section 6.2.2.2
       - existing and proposed contours, if available

3. ADDITIONAL SUBMITTAL FOR STREAM CROSSINGS
   - PDF Files:
     - Contour Map
       - labeled contours, location of new and/or existing structure(s), proposed contours, proposed riprap limits, north arrow, stream direction and scale 1"=20'
     - Hydraulic Report
       - discussion of hydraulic, nature of previous flooding, scour information, design considerations and alternatives considered; see Bridge Manual Chapter 8 Appendix 8-A, for example
     - Hydraulic Model
       - existing conditions and proposed conditions hydraulic model (preferably HEC-RAS); see Bridge Manual Section 8.3.2
     - FEMA Floodplain Map
       - location of structure(s) relative to any mapped floodplain
     - DNR Initial Review Letter

4. SUBMITTAL
   - E-Submit
     - E-Submit Help
     - E-Submit
     - SUPPORTING DOCUMENTATION
     - if necessary and SUPPORTING DOCUMENTATION are submitted using the E-Submit process (as "PRELIMINARY")
### Stream Crossing Structure Survey Report

**Design Project ID:**

**Construction Project ID:**

**Highway (Project Name):**

**Final Plan Due Date:**

**Preliminary Plan Due Date:**

**FSM Date:**

**Listed Date:**

**New Structure Number:**

**Existing Structure Number:**

**Station:**

**Traffic Forecast Data:**

**Feature On:**

**Waterway:**

**Region Contact:**

**Consultant Contact:**

---

### Instructions for Structure Survey

1. Small County Map on which the location of proposed structure is shown in red, any highway realignment in green, and Location Map of scale not less than 1" = 200' showing the structure location and number.

2. Plan and Profile Sheet on proposed reference line of highway showing: (a) Ground line; (b) Finished grade line; (c) Profile grade line elevations at least every 100 feet for 1,000 feet each side of the structure; (d) Vertical curve control points; (e) Horizontal curve control points; (f) Curve data, including full SC and runoff distance.

3. Contour Map of the site drawn to a scale of not less than 1" = 20' with one-foot contours and showing: (a) Existing highway and structure; (b) Proposed highway alignment and ROW; (c) Natural levees; (d) Buildings; (e) Above and below ground facilities; (f) Recommanded channel changes; (g) Direction of stream flow; (h) Station at ends of existing structure; (i) Location of river cross sections or individual survey shots; (j) Proposed structure and extent of pipes for report submitted with preliminary plans; (k) Other features that influence design.

4. Typical Roadway Cross Section of proposed approaches showing: (a) Dimensions; (b) Slopes; (c) Type and width of surfacing or pavement; (d) Sidewalks, curbs & gutters; (e) Subgrade and pavement thickness; (f) Clear zone width.

5. Stream Cross Sections at upstream and downstream face of existing bridge and at one structure length upstream and downstream. Water and streambed elevations to be taken at structure and water surface elevations 1500 feet upstream and downstream of existing bridge.

6. Labeled Photographs of (a) Existing structure; (b) Upstream and downstream structures; (c) Buildings within 100 feet of the proposed structure; (d) Undisturbed panoramic view looking upstream and downstream from location of proposed structure, showing stream and floodplain; (e) Any noteworthy details on existing structure or surrounding site (i.e. downstream obstructions); (f) Air photo mosaics referenced to contour map DGN if available.

7. Attach a copy of the regulatory floodplain map (FEMA map) depicting the site.

8. Report submitted with preliminary plans – Hydraulic Report (See Bridge Manual Chapter 8) which may contain: (a) USGS quadrangle sheet showing proposed location, highway alignment and reach of river; (b) All available flood history; high water marks with date of occurrence, nature of flooding, damages, scour information, and factors affecting water stages; (c) Navigation clearance; (d) Discussions of alternatives considered; factors influencing selection.

9. Attach a copy of DNR initial concurrence letter.
SSR Training Manual

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Training Videos

Introduction to BOS and Scheduling
A Structure Report Training Video
Presented by the Bureau of Structures Design Section

WisDOT - SSR Training Video 1 - Introduction to BOS and Scheduling

Uploaded on Feb 11, 2016
An introduction to the Bureau of Structures organizational structure, support services offered by BOS, structures project schedule and coordination of geotechnical work. SSR and Submittal Information: http://wisconsindot.gov/Pages/doing-b...
Support

- BOS continues to provide support for filling out SSR forms and using training materials
- Please direct inquiries to Najoua Ksontini

Questions?
Cost Estimating for Structures

1. How do they know the load limit on bridges, Dad?

2. They drive bigger and bigger trucks over the bridge until it breaks.

3. Then they weigh the last truck and rebuild the bridge.

4. Oh, I should've guessed.

5. Dear, if you don't know the answer, just tell him!
Estimating Engineer

- Estimating Engineer for WisDOT since January 2015

- What estimating engineer does.
  - Review estimate development processes and find ways to improve estimate accuracy.
  - Develop updated training materials, make presentations like this, and join any meetings when project estimates are discussed.
    - Organize and run quarterly Estimating User Group meetings.
      - Members are from Planning, Design, Program Control, and Bureau of Structures.
  - Review the bids and estimates for a Letting to prepare for the awards meeting, and reviewing estimate documentation and major items in PS&E estimates before the Letting.
Topics being Discussed

- Engineering Estimate Accuracy (EEA) Performance Measure
- Construction Cost Index
- Estimator Files
- Bid items that cause inaccurate estimates
- Mobilization
- Bascule Bridge Projects
- Lump sum bid items
- Special Provision Items (SPVs)
FHWA/WisDOT Stewardship Agreement (Sept 2010) goal
- 50% of estimates should be within 10% of low bid

WisDOT goal
- 60% of estimates within 10% of low bid
- 75% of estimates within 15% of low bid
- Goals tracked in Estimate accuracy report

WisDOT external MAPSS measurement—
http://wisconsindot.gov/Pages/about-wisdot/performance/mapss/measures/accountability/on-budget.aspx
Engineering Estimate Accuracy (EEA) Performance Measure

- Estimate results for last six years
- Includes breakdown by region, number of bidders, funding category, and work type.
- Structure projects make up 30% of the entire program since 2011.
- Available on online:
**Bridge Project Estimates within 10%**

% of Proposals within 10% of the Low Bid
-By Proposal Type and FY-

<table>
<thead>
<tr>
<th></th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
<th>FY15</th>
<th>FY16*</th>
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<tbody>
<tr>
<td>Total</td>
<td>38%</td>
<td>47%</td>
<td>45%</td>
<td>48%</td>
<td>44%</td>
<td>42%</td>
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<tr>
<td>Structure</td>
<td>47%</td>
<td>56%</td>
<td>45%</td>
<td>53%</td>
<td>39%</td>
<td>46%</td>
</tr>
<tr>
<td>Target¹</td>
<td>50%</td>
<td>50%</td>
<td>50%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
</tbody>
</table>

* Data through May 2016 Bid Letting

¹ The performance measure target was 50 percent for FY09-FY13. As part of WisDOT’s continued efforts to strive for continuous improvement, the target was increased to 60 percent in FY14.
Construction Cost Index (CCI)

- The Chained Fisher Construction Cost Index
  - Accounts for changes in type and usage of items
  - Eliminates issue of updating the base period
    - Able to accommodate usage for the current year and base year
  - Performs better than fixed-weight indices when prices and quantities are volatile

- The Federal Highway Administration (FHWA) uses a Chained Fisher approach—
Construction Cost Index

<table>
<thead>
<tr>
<th>Year</th>
<th>WisDOT CCI</th>
<th>Asphalt CCI</th>
<th>Concrete CCI</th>
<th>Earthwork CCI</th>
<th>Structure CCI</th>
</tr>
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<tbody>
<tr>
<td>2010 Q1</td>
<td>95</td>
<td>93</td>
<td>96</td>
<td>97</td>
<td>95</td>
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<td>2011 Q1</td>
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<td>105</td>
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<td>105</td>
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<td>2013 Q1</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>2014 Q1</td>
<td>115</td>
<td>115</td>
<td>115</td>
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<td>115</td>
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<tr>
<td>2015 Q1</td>
<td>120</td>
<td>120</td>
<td>120</td>
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<tr>
<td>2016 Q1</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
</tr>
</tbody>
</table>

Average Annual Inflation Variance

- WisDOT CCI: 5.02% 0.98
- Asphalt CCI: 3.69% 0.91
- Concrete CCI: 6.25% 0.77
- Earthwork CCI: 7.49% 0.74
- Structure CCI: 5.74% 0.77
Construction Cost Index

- The CCI does not include SPVs items.
  - If enough is spent on special provision items instead of standard items, there will be a dip in the index.
- The CCI does not include Lump Sum items such as Mobilization and Traffic Control Project.
- The WisDOT CCI is consistent with other states.
A lot of you are using Estimator for estimating your structures.

We have made a user guide to merge Estimator files.


Recommend sharing your Estimator files with project designers along with this user guide.

- Decrease the chances for errors from reentering items.
- Decrease the workload with reentering items.
## Bid items that cause inaccurate estimates

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Item Description</th>
<th>1% or greater</th>
<th>10% or greater</th>
<th>Occurrences</th>
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<tbody>
<tr>
<td>502.0100</td>
<td>Concrete Masonry Bridges</td>
<td>59%</td>
<td>7%</td>
<td>295</td>
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<tr>
<td>203.0600.S</td>
<td>Removing Old Structure Over Waterway With Minimal Debris</td>
<td>43%</td>
<td>5%</td>
<td>182</td>
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<tr>
<td>206.1000</td>
<td>Excavation for Structures Bridges</td>
<td>15%</td>
<td>0%</td>
<td>461</td>
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<tr>
<td>203.0200</td>
<td>Removing Old Structure</td>
<td>14%</td>
<td>1%</td>
<td>463</td>
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<tr>
<td>509.2500</td>
<td>Concrete Masonry Overlay Decks</td>
<td>46%</td>
<td>3%</td>
<td>71</td>
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<tr>
<td>505.0605</td>
<td>Bar Steel Reinforcement HS Coated Bridges</td>
<td>12%</td>
<td>0%</td>
<td>258</td>
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<tr>
<td>517.1800.S</td>
<td>Structure Repainting Recycled Abrasive</td>
<td>9%</td>
<td>1%</td>
<td>77</td>
</tr>
<tr>
<td>504.0100</td>
<td>Concrete Masonry Culverts</td>
<td>25%</td>
<td>5%</td>
<td>56</td>
</tr>
</tbody>
</table>

Data includes July 2013 to March 2016
Concrete Masonry: New vs. Rehabilitated Structures

Includes statewide low bids of Concrete Masonry (502.0100) from January 2014 to March 2016
Concrete Masonry Bridges

Concrete Masonry Bridges is about $100 to $200 more expensive on Rehabilitated Structures

- Lower production rates (higher costs) when work is on the superstructure only.
- Formwork may be more difficult to complete against existing beams, especially when preserving existing concrete girders.
- Staged construction increase costs.

Prices seem to have lowered since the cement shortage, but can vary according to contractor bidding.

- Most recent prices show certain contractors bid around $500/CY and others bid $600/CY.
- It is difficult to always know who is going to bid on your project but the large complex projects will often include Kraemer North America, Lunda and Zenith Tech.
# Earthwork Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Estimate</th>
<th>Bid</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>205.0100</td>
<td>Excavation Common</td>
<td>$148,449,667</td>
<td>$140,538,768</td>
<td>5%</td>
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<tr>
<td>208.0100</td>
<td>Borrow</td>
<td>$32,900,927</td>
<td>$23,043,401</td>
<td>30%</td>
</tr>
<tr>
<td>206.1000</td>
<td>Excavation for Structures Bridges (structure)</td>
<td>$8,605,129</td>
<td>$18,708,900</td>
<td>-117%</td>
</tr>
<tr>
<td>206.2000</td>
<td>Excavation for Structures Culverts (structure)</td>
<td>$3,567,601</td>
<td>$4,441,862</td>
<td>-25%</td>
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<tr>
<td>206.3000</td>
<td>Excavation for Structures Retaining Walls (structure)</td>
<td>$1,508,045</td>
<td>$3,218,972</td>
<td>-113%</td>
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</tbody>
</table>

Data includes July 2013 to March 2016

- Contractors will bid cubic yard earthwork items at a low cost and increase their prices for related lump sum items.
- The total amounts for earthwork is closer when total project costs are considered.
- Designers need to evaluate the total project cost and should not get worried about larger lump sum items or low bids for earthwork.
- The department has a comprehensive Unbalanced bid Analysis that is detailed in CMM 2.10.2.1
  - [http://wisconsindot.gov/rdwy/cmm/cm-02-10.pdf#cm2-10.2.1](http://wisconsindot.gov/rdwy/cmm/cm-02-10.pdf#cm2-10.2.1)
Mobilization

- Roadway Designers use a percentage of the total estimate.
  - The mobilization tool on the estimating page allows designers to get more specific percentages.

### Structures

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
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<tbody>
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<td>Sample Size</td>
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<td>84</td>
<td>72</td>
<td>55</td>
<td>69</td>
<td>81</td>
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<tr>
<td>1st Quartile</td>
<td>5.6%</td>
<td>5.0%</td>
<td>6.0%</td>
<td>5.7%</td>
<td>6.7%</td>
<td>6.1%</td>
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<tr>
<td>Median</td>
<td>7.8%</td>
<td>6.7%</td>
<td>7.5%</td>
<td>7.9%</td>
<td>8.3%</td>
<td>8.7%</td>
</tr>
<tr>
<td>3rd Quartile</td>
<td>9.9%</td>
<td>8.8%</td>
<td>9.3%</td>
<td>10.6%</td>
<td>10.9%</td>
<td>10.6%</td>
</tr>
<tr>
<td>High Outlier Bound</td>
<td>20.8%</td>
<td>18.0%</td>
<td>17.3%</td>
<td>22.4%</td>
<td>21.0%</td>
<td>22.1%</td>
</tr>
<tr>
<td>Trimean</td>
<td>7.8%</td>
<td>6.8%</td>
<td>7.6%</td>
<td>8.0%</td>
<td>8.5%</td>
<td>8.5%</td>
</tr>
</tbody>
</table>
Mobilization

- Structure engineers typically don’t dictate to the roadway designers what percentage to use.
- Could provide recommendations on projects.
  - The project designer should be made aware of project requirements that would increase mobilization costs.
- Specialty bridge projects such as bascule bridge projects, should be using higher than average mobilization prices.
Mobilization: Factors that increase costs

- Complex Design or Construction
- Barges required
- Very large cranes required
- Tall piers
- Long girders
- Staging or number of Mobilizations
- Over freeways and railroads
- Limited work area, such as an urban environment
Bascule Bridges

- WisDOT needs to do a better job estimating these types of projects.

<table>
<thead>
<tr>
<th>Proposal #</th>
<th>Project #</th>
<th>Estimate</th>
<th>Bid</th>
<th>Accuracy</th>
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</thead>
<tbody>
<tr>
<td>20110809017</td>
<td>4998-02-71</td>
<td>$13,299,135</td>
<td>$13,477,696</td>
<td>1.3%</td>
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<tr>
<td>20120710015</td>
<td>4140-23-71</td>
<td>$3,441,312</td>
<td>$4,811,300</td>
<td>28.5%</td>
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<tr>
<td>20130611009</td>
<td>4065-15-71</td>
<td>$5,650,016</td>
<td>$4,639,146</td>
<td>-21.8%</td>
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<tr>
<td>20140408014</td>
<td>1302-00-71</td>
<td>$1,303,408</td>
<td>$1,367,058</td>
<td>4.7%</td>
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<tr>
<td>20150512040</td>
<td>4990-03-71</td>
<td>$1,377,089</td>
<td>$1,534,911</td>
<td>10.3%</td>
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<tr>
<td>20150714022</td>
<td>9995-03-60</td>
<td>$1,751,571</td>
<td>$2,808,515</td>
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<tr>
<td>20150811009</td>
<td>4140-20-74</td>
<td>$2,367,450</td>
<td>$3,616,663</td>
<td>34.5%</td>
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<tr>
<td>20160510027</td>
<td>9210-17-60</td>
<td>$1,140,848</td>
<td>$1,750,825</td>
<td>34.8%</td>
</tr>
</tbody>
</table>
Bascule Bridges

- BPD has started to look into these types of projects more closely.
- WisDOT needs to monitor the number of bascule bridge projects each year.
  - There are only a few contractors for this type of work.
- Industry has stated that the provisions for these specialty bridges are so stringent, that the cost of the items continue to rise.
Lump Sum Items

- Many of the following points come directly out of AASHTO: Practical Guide to Cost Estimating.

- Lump sum items should only be used when an item of work can be easily defined but not all the components or details can be clearly determined.

- The more breakdown of a lump-sum item there is, the greater the likelihood that an accurate lump-sum estimate can be developed.
  - Easier to verify estimate prices with similar items.
  - Use units that reduce risk from the contractor.
Lump Sum Items

- Using lump-sum items typically transfers the unknowns to the contractor.
  - Girder Surface Repair in linear feet or square instead of each unit. Contractor is then paid for work completed instead of bidding higher price when amount of repair is not
- We need to do a better job of balancing risk between the contractor and the DOT.
  - Risk = Cost
    - Try not to be prescriptive for the means of construction and materials. Specify the requirements for the final item.
- Most lump-sum items are very different from one project to another. Using past bid history is often not a good indicator for future bid price of lump-sum items.
Why we should avoid SPVs

- Bid history is difficult to obtain. Estimate prices are less accurate.
- Contractors have to interpret the SPVs, increasing risk and cost.
- Non-standard items may be in short supply and are more expensive.
- Old special provision items may not reflect changes to General Requirements in the Standard Specifications.
- New special provision items may not have been approved by tech committees.
- WisDOT spends about 25% of its program on special provision items and that is too much.
Why we should avoid SPVs

- If the result for a task is the same for an SPV and a standard bid item, then use the standard bid item.
  - The bid item is consistent for all projects.
  - Bid history is much easier to find.
  - Experience with common items reduces costs and risk.
  - Standard bid items are more available.
- If you must use an SPV, use SPV libraries maintained by the Bureau of Structures.
Feel free to contact us with your ideas to improve WisDOT Estimates.

Thank You!

Fred Schunke, PE
Estimate Engineer
Phone: (608) 266-9626

Scott Lawry, PE
Proposal Mngmt. Chief
Phone: (608) 266-3721

Website:
WisDOT Employees -
http://dotnet/consultants/estimates/index.shtm

Consultant –
https://trust.dot.state.wi.us/extntgtwy/consultants/estimates/index.shtm
Design and Construction of Post-Tensioned Integral Pier Caps

Randy Thomas, PE
Senior Structural Engineer
CH2M
Learning Outcomes

Today’s talk is on the design and construction of post-tensioned concrete integral pier caps used for steel I-girder bridges on the Zoo IC Project. At the end of the session, you will be familiar with:

- Fundamental design parameters
- Benefits of a collaborative design approach
- Design and detailing considerations affecting constructability and quality of finished product
Presentation Outline

- Introduction
- Case Study: Zoo IC Project
- Design & Detailing Considerations
- Closing
- Questions
Introduction
Definition of Integral Pier Cap

- Cap resides entirely or mostly within the depth of the girder framing
- Integrally connected into girder framing system
- Can be any material (steel, concrete, PT concrete)
Why consider an integral pier cap?

- If site geometry is restrictive
  - Clear span prohibitively long/expensive
  - Pier cap overhangs roadway
  - Project economics and/or roadway geometrics favor a shallow superstructure
- Eliminate joints & bearings
  - As compared to using an inverted Tee Pier
- Common applications
  - Heavily skewed ramps
  - Low level viaducts
Integral Cap Type Selection

- **Steel**
  - Box beam likely required – complicated connections
  - Non-redundant for NBIS condition inspections

- **Mildly Reinforced Concrete**
  - Concern for cracking and corrosion
  - Tends to sag over time (creep)

- **Post-Tensioned Concrete**
  - Internally redundant
  - Small deflections / no sag
  - Clean look, similar to adjacent conventional piers
  - Concern for corrosion of hidden elements – can be mitigated through proper detailing
Construction Sequence

1. Form, pour, and strip columns

2. Build falsework
Construction Sequence

3. Erect structural steel

4. Tie rebar
Construction Sequence

5. Place ducts

6. Set side forms
Construction Sequence

7. Pour concrete

8. Strip forms
Construction Sequence

9. Push strand

10. Jack strand
Construction Sequence

11. Grout tendons and cast pour-backs

12. Pour deck and parapet
Case Study: Zoo IC Project
Zoo Interchange Project

- 2 Steel I-girder bridges with integral pier caps
- 2 designers
  - BOS
  - CH2M
- 2 construction lets
  - Zoo Core1 FPSE May 2014
  - Zoo Core2 FPSE May 2015
- 2 design schedules
  - Prelim: Concurrent
  - Final: Staggered
Bridge B-40-852 (SW Ramp)

- 3-lane, 3-span, 550-ft long
- 1900-ft radius curve
- 84-in webs
- 1 straddle pier
- Designed by BOS
Bridge B-40-787 (WN/WS Gore)

- 3-lane, 5-span, 750-ft long, 1450-ft radius curve, tapered
- 1 straddle pier, 2 hammerheads, 69-in webs
- Designed by CH2M as part of Forward 45
The Zoo structures design team recognized the potential for collaborative design early in the process.

**Preliminary Plans (Jan 2013)**
- Integral cap locations identified, specifics TBD

**Design Workshop (May 2013)**
- Review example CH2M designs
- Establish design criteria, fundamental design decisions, design methodology/tools

**Final Plans Esubmit – staggered by 1 year**
- B-40-852: Feb 2014 (May 2014 FPSE)
- B-40-787: Feb 2015 (May 2015 FPSE)
Facilitating Collaborative Design

- Forward 45 advanced the final design of B-40-787 PT integral straddle pier, to match B-40-852 schedule and capture synergies
- Design teams co-located at Barstow project office in Waukesha
- Over-the-shoulder reviews
  - No direct responsibility for checking each other’s work
  - Provide opinion/advice
  - Identify common or similar elements of design
  - Adopt consistent design approach (evolves over time)
  - Trouble shoot together
Benefits of Collaborative Design

- Design Efficiencies - 2 birds with 1(+) stone
  - Selection of analysis tools
  - Approach to detailing
  - Special provisions

- “Incidental” Quality Control
  - 2 design teams offer a degree of independent thought
  - Qualitative comparisons – Why are things different?
  - Quantitative comparisons – proportional gut check on size, qtys

- Consistency
  - End products look very similar (uniformity within interchange)

- Constructability
  - Lessons learned during bidding/construction of 1st bridge can be applied to 2nd bridge in real time
Fundamental Design Parameters

- **Prestress Type**
  - HS Bars: good for short, straight tendons; lower PS losses; shallow blockout
  - HS Strand: higher capacity; easy to curve tendons; higher PS losses; deeper blockout

- **Depth of Cap**
  - Aesthetics, structural depth, tendon pathways

- **Articulation**
  - Bearings, hinges, pins?
  - Accommodate PT shortening, cap torsion

- **Design Methodology/Tools**

- **Corrosion Protection Measures**
Outcomes of Design Workshop

- PS Type: TBD during final design case-by-case
- Increase vertical clearance to 17’-0” (normally 16’-9”)
  - Protect against vehicle collision/repairs
- Articulation
  - Straddle: Use pin detail (rebar cluster)
  - Hammerhead: Use hinge detail (rebar row)
  - Rotational release alleviates constraint forces
- Analysis platform: 3D FEM (LARSA 4D)
  - Irregular geometry; integral framing; staging analysis; time-dependent material effects
- Design PT for zero tension (AASHTO allows LL tension)
  - Section remains uncracked; more difficult for salt to penetrate
  - Keep cap “clamped” tightly at girder/cap interface
Corrosion Protection Measures

- Cap replacement would require major construction
  - Severe traffic impacts
  - Expensive
- Pier Cap
  - Stainless steel rebar
- PT Anchorage
  - Galvanized or plastic fittings
  - Grouted anchor end caps
  - Pour-back
  - Exterior surface protection
- Girders
  - Zinc Metalized
- Exposed to salt spray
Design and Detailing Considerations
Design and Detailing Considerations

- Holes thru girder webs
  - Lesson Learned: Leave ample room for construction tolerance (7” hole for 4” or 5” duct)
    (1 7/8” hole for #6 rebar)
  - Offsets unique for each girder - Double check all dims!
Design and Detailing Considerations

- Duct layout dimensions
  - Clearly distinguish between CL duct and c.g. strand (vertical offset)
  - Craft labor will measure from bottom cap form to bottom of duct, in fractional inches. Requires clear communication between design, fabrication & construction.
Design and Detailing Considerations

- Cap connection to columns

Rebar Hinge Detail

Rebar Pin Detail
Design and Detailing Considerations

- End Anchorages
  - Ensure adequate real estate for anchor hardware and rebar spiral
  - Ensure shape of jacking pockets provides adequate room for common jacks
Design and Detailing Considerations

- Recommend locating X-frames 10’ from face of cap
  - Provides room for formwork
  - Avoids large stresses in x-frames and/or lateral flange bending due to PT shortening (we want PT force in the cap, not the steel)

Looking up at underside of cap
Feedback from Construction Eng

- Concrete Mix for Pier Cap – dense reinforcement
  - Use 6” to 8” slump and ¾” max aggregate
  - Consider requiring super-plasticizer
- PT duct splices
  - Spec should specify heat shrink seal (don’t want duct tape!)
Feedback from Construction Eng

- Qualifications for supervisor of stressing operations
  - Spec is not clear how the qualifications of the “qualified individual” will be assessed/approved; suggest requiring PTI certification
Surface treatment on pour backs
- Suggest using a stainable or custom pigmented sealing product over the non-shrink grout

Duct Grout
- Include testing for chloride levels (ASTM C1152)
- Consider adding specific content requirements for the contractor’s Grouting Plan
Closing
Parting Thoughts

- B-40-787 is currently under construction. Despite its complex geometry, parts are fitting together nicely.
- A collaborative approach can contribute to higher quality, more efficient designs.
- Feedback from the field is essential for improved designs moving forward.
Questions
Wisconsin Structures Asset Management System (WiSAMS)

Philip Meinel
Structures Asset Management Engineer
BOS – Development – Bridge Management Unit
Bridge Management History

- National issue
  - Early 1990s

- Goals:
  - Database for inventory and inspection data
  - Deterioration modeling
  - Network-level asset management/planning

(Re-branding)
Bridge Management History

- “Pooled-fund” software
  - Pros: Collaboration, eliminate duplication of effort
  - Cons: Can be slow developing…hard to please everyone

- WisDOT moves forward in parallel with BrM
  - HSIS database - 2003
  - WiSAMS planning tool - 2015
Structure Asset Management

Implementation

Policy

Data
Structure Asset Management

Implementation
• Wisconsin Structures Asset Management System (WiSAMS)

Policy – WisDOT Bridge Preservation Policy
• Bridge Preservation Policy Guide

Inventory and Condition Data
• Highway Structure Information System (HSIS)
HSI Database

- Major upgrade 2014
Strive for accuracy
- Inspections
- Structure Inventory Data forms

### HSI Database

**STATE OF WISCONSIN**
**DEPARTMENT OF TRANSPORTATION**

**Inspection Report for B-11-001**

**5TH 13/16/23-BROADWAY ST over WISCONSIN RIVER 16**
Feb 03, 2016

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**Time Log:**

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<th>Number</th>
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<td>WISCONSIN</td>
<td></td>
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</table>

**Inspection:**

Inspector: Steven D

Compiled by HSI System 05/03/16
Policy

- FHWA and MAP-21
  - No more Sufficiency Rating (SR) driven program
  - Emphasis on justification for infrastructure investment
  - Data- and performance-driven goals and approach
Policy

- WisDOT Bridge Preservation Policy Guide
  - First draft 2015
  - Bridge Maintenance Engineering Judgement & Research
  - Maximize the useful life of bridges in a cost-effective way
Preventative Maintenance Agreement

- Updated in 2016
- Establishes which maintenance activities are eligible for federal funding
- More work types are eligible for federal funding
Implementation

Highway Structures Information System (HSIS)

Inventory & Other Data

Review & Manage Bridge Data

Wisconsin Structures Asset Management (WiSAM)

Perform Network Analysis

WisDOT Preservation Policy

Condition Data

Cost Data

Provide Report with Recommended Work Actions, Optimal Year to Perform, and Cost Estimate

Develop and Perform Bridge Projects

Regional Planning/PDS

Inspect Bridges

Regional Maintenance
Implementation

- WiSAMS – Wisconsin Structures Asset Management System
  - Systematic network-level analysis
  - Planning tool
WiSAMS

- Where is it at?
  - Coordination and main development in 2015
  - Draft reports released to regions in April 2016
  - Production version of reports to be released July 2016
  - Exciting list of future refinements and new possibilities
WiSAMS

- How does it work?
  - Data pull
  - Work action analysis
  - Deterioration model projection
  - Recommended work actions
How does it work?

- Rule 4
  - If Substructure NBI < 3, and
  - Deck NBI < 3
  - Then, Replace Structure

- Rules increase in complexity as program runs through the rule sequence (currently about 60 rules)
WiSAMS

- How does it work?
  - Deterioration models
    - Rule 4
### How does it work?

#### Recommended work actions

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</tbody>
</table>

### Inventory Data
- Pulled from HSI

### History of past work

### Planning
- Help prioritize structure work within the region
Do-nothing Scenario

- **Condition Assessment Index (CAI)**

- See deterioration of CAI value

**Planning**

- See negative effect of postponing important structure work

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AGE</th>
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<tr>
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<td>2026</td>
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## Improvement Scenario

- **Primary and possible work to combine**
- **Cost & life extension estimates**
- **Planning**
  - More information early in the process = better decisions

<table>
<thead>
<tr>
<th>PRIMARY WORK ACTION</th>
<th>CAI</th>
<th>COST: PRIMARY WORK ACTION</th>
<th>EST. LIFE EXTENSION (YRS)</th>
<th>INCIDENTAL WORK ACTIONS</th>
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</tr>
</tbody>
</table>
WiSAMS

Future Development

- Scoping report
  - Eligible work within existing project limits
- Prioritization factors
  - Criticality, vulnerability, etc.
- Element defect deterioration modeling
  - Ex. Delaminations (defect 1080) in deck elements
Questions?

Philip Meinel  
Structures Asset Management Engineer  
BOS – Development – Bridge Management Unit  
Philip.Meinel@dot.wi.gov  
608-261-2590
Chapter 45 Re-Organization

Structural Engineers Symposium
June 7, 2016
Why does Chapter 45 exist?

- Design isn’t rating, and vice versa
  - Some design considerations aren’t applicable for rating
    - Construction checks
  - Some rating considerations aren’t applicable for design
    - Deterioration

- In 2015 let projects (State and Local):
  - New bridge construction: 54%
  - Bridge rehabilitation: 46%
Purpose of this Effort

- Create better organization
  - Give everything a home

- Document current practice
  - Not much is new…but new to Bridge Manual
This Presentation

- Raise awareness on pending updates

- Give a sense for what to expect
  - Highlight some specific policies/procedures

- DRAFT, DRAFT, DRAFT!!!
Table of Contents

- Better organization
- Better flow
- Easier to find information on specific policies and procedures for your project
45.1 Introduction
45.2 History of Load Rating
45.3 Load Rating Process
45.4 Load Rating Computer Software
45.5 General Requirements
45.6 Policy and Procedure – Superstructure
45.7 Policy and Procedure – Substructure
45.8 Policy and Procedure – Culverts
Table of Contents

- 45.9 Documentation and Submittals
- 45.10 Load Postings
- 45.11 Over-Weight Truck Permitting
- 45.12 Construction Loading
Applicability

45.1.2 Scope of Use

- State and Local

45.1.2 Scope of Use

All requirements presented in this chapter are to be followed by WisDOT Bureau of Structures (BOS) staff, as well as any consultants performing load rating or load posting work for WisDOT BOS. Local municipalities and consultants working on their behalf should also follow the requirements of this chapter.
Primary Load Rating References

- 45.1.3 Governing Standards for Load Rating
  - AASHTO Manual for Bridge Evaluation (MBE)
  - Wisconsin Bridge Manual, Chapter 45
  - LRFD design code (LRFR)
  - 2002 Standard Spec (LFR)
When a Rating is Required

45.3.2.1 When a Load Rating is Required (Existing In-Service Bridge)

- Removal and replacement of existing overlay
- Thin epoxy overlay
  - Quality control for the rating process
  - Review inspection reports for deterioration
What to Load Rate

45.3.3 What Should be Rated

- Example: Steel trusses

Steel truss structures

Primary elements for rating include truss chord members, truss diagonal members, gusset plates connecting truss chord or truss diagonal members, floor beams (if present), and stringers (if present).

Secondary elements include splices, stringer-to-floorbeam connections (if present), floorbeam-to-truss connections (if present), lateral bracing, and any gusset plates used to connect secondary elements.
Load Rating Software

- 45.4.1 Rating Software Utilized by WisDOT
  - Steel girder: SIMON, AASHTOWare BrR
  - PS girder: In-house, BrR
  - Slab: In-house, BrR
  - Truss: BrR
  - Other: MDX, CSI Bridge, LARSA, Conspan

- Submittal requirements
  - Typical
  - Complex
Live Loads

- 45.5 General Requirements

- Live load placement
  - Truck on sidewalk
  - Striped lanes

Figure 17.2-18
Distribution of Loads to Exterior Girder for Girder Structure with Raised Sidewalk Design Case 2
Material Properties

- 45.5.2 Material Structural Properties

- Old information is still there
  - Rebar, concrete, PS strands, structural steel
  - See also AASHTO MBE

- Added information for timber
  - Superstructures (possibly)
  - Substructures (likely)
Policy - Superstructure

- 45.6 WisDOT Policy and Procedure - Superstructure

- Separated by superstructure type

- Example: PS girder superstructures (45.6.1.1)
  - Different girder spacings by span (1&4, 2&3)
    - With a “made-continuous” deck
Policy - Superstructure

- Example: steel girder superstructures (45.6.3.1)
  - Plastic analysis - $M_Y$ vs $M_P$
  - Curvature
Policy - Superstructure

- Example: steel truss superstructures (45.6.3.2)
  - Gusset plates
Policy - Substructure

- 45.7 WisDOT Policy and Procedure - Substructure
- Separated by substructure type
- Timber piles (45.7.1)
Load Posting (45.10)

- General clarification
  - What vehicles to use
  - LL factors
  - Distribution factor (multi vs. single)

- SHVs…
Construction Loading (45.12)

- Refer to Wisconsin Standard Specification
  - Section 108.7.3

- “If the engineer directs, submit stamped and signed copies of analyses and associated calculations performed by a professional engineer…”

- “If a PE’s analysis is required…”
Stay tuned...

- Raise awareness on pending updates

- Give a sense for what to expect
  - Highlight some specific policies/procedures

- 45.8 - Policy and Procedure – Culverts
Load Rating Culverts

Structural Engineers Symposium
June 7, 2016
Culverts:
Are Load Ratings Required?

- **Wisconsin Bridge Manual:**
  - Chapter 36 (Box Culverts), 36.1.2:
    - “Current WisDOT policy is to not rate box culverts. In the future, rating requirements will be introduced as AASHTO is updated to more thoroughly address box culverts.”
  - Chapter 45 (Bridge Rating):
    - Load Rating Summary Form not required for culverts
    - Insert “placeholder” ratings on plans
Culverts: Are Load Ratings Required?

- FHWA requires documented load ratings for all bridges. But when is a *culvert a bridge*?

- NBIS-23 CFR 650 Subpart C:

  Clear distance b/w openings less than half the smaller adjacent opening

  \[ \geq 20 \text{ feet} \]
Culvert Rating Methods

- 2013 Interim Revisions to MBE
  - Article 6A.5.12 – Rating of RC Box Culverts (LRFR)

- 2016 Interim Revisions to MBE
  - Article 6B.7.1 assigns rating factors of Inventory HS20 & Operating HS33 for concrete culverts with...
    - Fill depths of 2.0 ft or greater with known details, or
    - With unknown components (such as culverts w/o plans)
  
  … if they have been carrying normal traffic for an appreciable period and are in fair or better condition.
Culvert Rating Methods

- MBE does not currently provide explicit direction for other types of culverts.

- Other references:
  - 2002 AASHTO Standard Specifications
  - Current AASHTO LRFD Specifications
  - National Corrugated Steel Pipe Association (NCSPA)
    - Design Data Sheet No. 19 (free download) – *Load Rating and Structural Evaluation of In-Service, Corrugated Steel Structures*
Ongoing Research

- NCHRP 15-54:
  - Proposed Modifications to AASHTO Culvert Load Rating Specifications
  - Goal Completion Date: July 2018
# Ratings Based on Engineering Judgment & Field Evaluation

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<tr>
<th>NBI Culvert Condition Rating</th>
<th>Over-burden</th>
<th>Element in CS4 Under Traffic Lanes?</th>
<th>Inventory Rating</th>
<th>Operating Rating</th>
<th>MVW (kips)</th>
<th>Load Restriction</th>
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<td>HS00</td>
<td>HS00</td>
<td>0</td>
<td>CLOSURE</td>
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Exceptions:

- Postings and Inventory Ratings were not increased based on the new criteria.

- If designed via LRFD, ratings assumed to be Inventory RF1.00, Operating RF1.67, MVW 190k

- If calculated LRFR ratings provided on plans or in submitted calculations, they were not changed.
Exceptions:

- Alternate ratings could be determined through judgment and/or calculations with consideration of:

<table>
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<th>Condition</th>
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<td>Live Load History</td>
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<tr>
<td>Similar Structures</td>
<td>ADTT</td>
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- Requires Load Rating Summary Form with written justification submitted by professional engineer.
Ratings for New Culverts

Concrete box culvert requirements:
- Accurate Load Ratings on Plans
- Calculation Submittal
- Per MBE, need not be rated if:
  - Single-span, 8 ft or more of fill
  - Multiple-span, depth of fill exceeds distance b/w faces of end walls

Pipe culvert requirements:
- Plans must include design vehicle (HL-93)
- Load Ratings may be calculated or assigned
Thank you!
Specialized Hauling Vehicle (SHV) Rating

Bria Lange
Development Bridge Rating Engineer
WisDOT – Bureau of Structures
What are SHVs?

- Dump trucks, construction vehicles, solid waste trucks, etc.
- Cause forces exceeding HS20 by up to 22 percent.
- Shorter bridges at higher risk for overstress.
- Four (4) single unit posting vehicles: SU4, SU5, SU6, SU7
Important dates

- December 31, 2017
  - All bridges with shortest span less than 200’

- December 31, 2022
  - All other bridges
SHV rating is NOT required when:

- LFR/ASR HS20 Operating RF>1.2
- LRFR HL-93 Operating RF>1.0
- LFR/ASR AASHTO legal truck Operating RF>1.35
- LRFR AASHTO legal truck Operating RF>1.35
  - SU4 and SU5 for all spans
  - SU6 for spans above 70 feet
  - SU 7 for spans above 90 feet
NRL screening tool:

Run Notional Rating Load (NRL):
- Operating RF>1.0 – Need not to be rated for SHVs

\[ V = \text{VARIABLE DRIVE AXLE SPACING} \quad 6'0" \quad \text{TO} \quad 14'-0". \text{SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM LOAD EFFECTS.} \]

\[ \text{AXLES THAT DO NOT CONTRIBUTE TO THE MAXIMUM LOAD EFFECT UNDER CONSIDERATION SHALL BE NEGLECTED.} \]

\[ \text{MAXIMUM GVW} = 80 \text{ KIPS} \]

\[ \text{AXLE GAGE WIDTH} = 6'0" \]
SHV posting analysis

Run four (4) SHV vehicles:
- Operating RF>1.0 – Posting not controlled by SHVs

- Type SU4 Unit Weight = 54 Kips (27 tons)
- Type SU5 Unit Weight = 62 Kips (31 tons)
- Type SU6 Unit Weight = 69.5 Kips (34.75 tons)
- Type SU7 Unit Weight = 77.5 Kips (38.75 tons)
Policy and Standards Updates

Dave Kiekbusch, P.E.
Supervisor – Automation, Policy and Standards Unit
WisDOT Bureau of Structures
Updating the Bridge Manual to be Compliant with AASHTO

- Design according to the Bridge Manual. A BOS approval prior to beginning design is required if wanting to implement AASHTO changes prior to Bridge Manual updates.

- 7th Edition, 2016 Interims
  - Published November, 2015
  - Probable Bridge Manual updates by January, 2017
    - Wind speed
    - Increased compressive stress limit for prestressed girders
    - Increase in Fatigue I load factor
    - Strut-and-tie methodology
AASHTO Updates (continued)

  - Likely published later this year, or early next year
  - Updates to Bridge Manual: July, 2017 and beyond!
  - Fairly substantial changes
    - Complete reorganization of Section 5: Concrete Structures
    - Elimination of the simplified method for determining shear resistance of prestressed concrete (no more Vci, Vcw)
    - Changes to bolt shear strength and friction values on the faying surfaces
    - New, simplified field splice design
Future AASHTO Updates

- Every 3 years (2020, 2023, etc.)
- No more interims
  - Meaning no more pink interim sheets!
- BOS is working on generating a work plan for current and future updates, especially with regards to the AASHTO updates being every 3 years
  - Bridge Manual text
  - Bridge Manual standard drawings and insert sheets
  - Bridge Manual design examples
  - In-house software
  - Understanding timeline of proprietary software updates
Bridge Manual policy discusses lettings and SMA’s before/after August 15, 2016
- There may be a newer, sooner date
- Non-geometric (e.g., rocks) formliner and stain are CSS
- Staining
  - Initial staining cost can be fairly reasonable
  - Re-staining cost can be very high ($20+/SF when considering traffic control)
  - Plain concrete looks better in 20 years than poorly maintained stain
Aesthetics Policy (continued)

- Any railing/parapet in the Standards is **not** considered CSS
  - Maintenance of paint will be the responsibility of the community and should be defined in the SMA
- Not yet known the impact to:
  - Current projects under construction
  - Impending major/mega projects
- Stay tuned for updated policy, including a memo from Bill Dreher!
No matter the date, you can use either Type I...
Type II
Type III
From Chapter 30 of Bridge Manual:

**Notice**: All contracts with a letting date after December 31, 2019 must use bridge rails and transitions meeting the 2016 Edition of MASH criteria for new permanent installation and full replacement.

*BOS understands the urgency of getting approved parapets and railings available for your use!*
Anchor bolt conflicts with reinforcement
Anchor bolt conflicts with reinforcement (continued)
Anchor bolt conflicts with reinforcement

- Layout reinforcement with thought to anchor bolt placement
- Provide 4” clear between anchor bolt and rebar
- 5” to 6” clear between bars for tremie and concrete vibration
- Detailing multiple layers is acceptable (use correct structural depth)
Automation, Policy and Standards (Updates)

James Luebke
Development Engineer – APS Unit
WisDOT Bureau of Structures
Piling - Usage

2012-2014 Costs Data

- 75% H-Piles
  - 31% HP12x53
  - 30% HP10x42
  - 14% HP14x73

- 25% CIP Piles
  - 9% 12 ¾ x 0.375-Inch
  - 6% 10 ¾ x 0.365-Inch
  - 10% other CIP Piles

Note:
Wisconsin has relatively shallow depths with hard bearing layers. Generally making end bearing H-piles an attractive choice.

Note:
H-piles have the potential to accommodate downdrag forces.

Note:
Drilled shafts and spread footings represent very few projects, but are becoming more popular.
550.5.2 Piling

Adjust pay under the Piling Quantity Variation administrative item if total driven length of each size is less than 85 percent of, or more than 115 percent of the contract quantity.

<table>
<thead>
<tr>
<th>Percent of Contract</th>
<th>Pay Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Driven</td>
<td></td>
</tr>
<tr>
<td>&lt; 85</td>
<td>(85% contract length - driven length) x 20% unit price</td>
</tr>
<tr>
<td>&gt; 115</td>
<td>(driven length - 115% contract length) x 5% unit price</td>
</tr>
</tbody>
</table>
Piling - PDA

- Pile Driving Analyzer (PDA)

  - Advantages
    - More accurate method
    - Potential cost savings
    - Provides other useful information

  - Limitations:
    - Time (24 hours) for analyses and feedback
    - Subcontractor
    - Savings vary

Note:
PDA has saved the department over $3 million over the past years
Structure Backfill - Quantities

Issues:
- Backfill payment disagreements (some cases 2 times)
- Inconsistencies (bid items and graduations)
- Units

Design Considerations:
- Show pay limits on plans
- Add notes for payment (backfill pay limits only)
- Better communicate quantities (roadway and structures)
Granular - Quantities

- Abutments, Walls, Culverts, etc.
- Show pay limits on plans
- Note contractor is responsible for excavation limits
Structure Backfill - Gradations

Plan Inconsistencies:
- Structural Backfill
- Structural Backfill w/ 209.2.2 Gradations
- Granular Backfill

2017 Specifications:
- Structural Backfill Type A (New Gradations)
- Structural Backfill Type B (Old Gradations)
Structure Backfill - Units

2017 Specifications:

- Field Disagreements with “CY” Unit

- Added “Tons” Unit

- BOS Recommends “Tons”
  - Unless Region directs otherwise
  - Similar to Structural Approaches Slabs (Base Aggregate)
  - Assume 2.0 tons/CY conversion factor
MSE Walls

- Clearly identify wall payments
- Be careful with “Incidental to MSE Wall” for unknown subgrade improvements
Cofferdams

- Allows substructures to be poured in the dry

- Construction Protection

- Controls Sediment
Cofferdams

Abutment – Poured Dry
Cofferdams

Pile Encased Pier – Tremie Poured (Protected)
Cofferdams

Pile Encased Pier – Tremie Poured (Assumed Unprotected)
Cofferdams

- Site and structure conditions vary greatly
- Ensure quality and minimize field disagreements
- Designer Coordination
  - Regional personnel (environmental representative)
  - BOS
  - DNR and others as needed
- Design Options
  - Cofferdam & Dewatering
  - Cofferdam (noted: underwater pour allowance)
  - No Cofferdam (noted: underwater pour allowance & Roadway covers erosion control measures)
Pile Encased Piers:

- Historically haven’t been required
- Cofferdams are expensive
- Better protection than open pile bent
- Simple forming and pouring operations (compared to a spread footing)
Cofferdams – Plan Preparations

- Cofferdam vs. Excavation for Structures

- Underwater pours
  - Difficult to pour structural concrete underwater
  - Strength and long term durability
  - Recommend note to clarify allowances

- When to Include a Cofferdam bid item?
  - Substructure to be poured in the dry
  - Water depths greater than 5 ft (pile encased subs)
  - Other cases
Slab Pouring Sequence

Std. 24.11
Slab Pouring Sequence

- Optional
  - Limits pour volume < 600 CY Urban (< 300 CY)
  - Acceptable Continuous Pour

- Required
  - Serviceability (minimize deck cracking and deflections)
  - Stresses (sequential pours)
  - Section properties (sequential stages)
PS Girder - Diaphragm

- Standards 19.34-19.38 Updates
- Length measured from girder ends (1/16)
- Revised notes (7/16)
  - 2017 Standard Spec updates
  - Connection requirements

Draft Updates
Concrete Anchors

- Types: CIP, Adhesive, and Mechanical
- Design: New vs. Rehabilitation
- Type S or Type L?
- Field substitutions for Type S anchors
- Mechanical types (Screw vs. Expansion)
- Testing
Concrete Anchors

- Types: CIP, Adhesive, and Mechanical
- Design: New vs. Rehabilitation
- Type S or Type L?
- Field substitutions for Type S anchors
- Mechanical types (Screw vs. Expansion)
- Testing
Concrete Anchors

Mechanical Anchors

- Design Memo – 10/21/15 Moratorium
- Removed from 2017 Specifications
- Bridge Manual Updates – July 2016
Concrete Anchors

Adhesive Anchors

- Updated 2017 Specifications
  - Eliminated Type L and Type S
  - New Bid Items: Adhesive Anchors (Size)
  - Removed proof loads table

- Added CMM Guidance (5-15.7)
  - Added proof load tables
  - Noted railing attachment testing

- Bridge Manual Updates – July 2016
Concrete Anchors

Adhesive Anchors on Plans:

- **MASONRY ANCHORS TYPE S X/X-INCH. MIN. EMBED XX” IN CONCRETE.**

- **ADHESIVE ANCHORS X/X-INCH. MIN. EMBED XX” IN CONCRETE.**
Structural Approach Slabs

- Usage: All bridges with AADT > 3500

- Not required on: Buried structures, Culverts, and Rehabilitation Projects

- Contact BOS for detail/pour modifications
Structural Approach Slabs

Table 15.1 Bridge Approach Requirements

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Other Roadways with AADT ≤ 3,500</th>
<th>IH, USH, or Other Roadways with AADT &gt; 3,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Pavement Type</td>
<td>Concrete</td>
<td>N/A *</td>
</tr>
<tr>
<td>Bridge Skew</td>
<td>N/A *</td>
<td>Skew ≤ 20°</td>
</tr>
<tr>
<td>Structural Approach Slab</td>
<td>No</td>
<td>Skew &gt; 20°</td>
</tr>
<tr>
<td>Concrete Pavement Approach Slab</td>
<td>Yes</td>
<td>N/A *</td>
</tr>
</tbody>
</table>

Structural Approaches: See Bridge Manual Chapter 12 Standard Drawings
Concrete Pavement Approaches: See FDM 14-10-15 and SDD 13B2
Commercial Bridge Design (Rating) Software

Andrew Smith, P.E.
Development Engineer
WisDOT – Bureau of Structures
In-House Software

- Work Horse for Design and Rating of
  - Prestressed Girders
  - Steel I-Girders*
  - Concrete Slabs
  - Culverts
- Structure types make up ~ 90% State and Local Inventory
RC-Pier (LEAP Bridge)

- Multi-Columned and Hammerhead type pier design
- Spread footing or footing on piles
RC-Pier

The Good...

- User friendly interface
- Useful for most common pier (multi-column on piles)
- ...
The Bad...

- Tedious to enter loads and modify
- Automated designs not constructible
- Problems with strut-and-tie modeling
- No pile uplift redistribution
Comments on RC-Pier or Substructure Design Software?
AASHTOWare BrR

Very Good...

- “Crowdfunded” software
- R” for Rating
  - Supports LRFR, LFR, and ASD
- Multiple Structure Types: Common types + Timber, floorsystems, trusses, & more
- BrD version for Design – BOS early stages of evaluation
- 3D analysis capabilities
Comments on AASHTOWare or Other Rating Software?
Steel Design (& Rating)

- Simon
  - Straight, Line-girder Analysis
  - Long history beginning with WisDOT
  - Many older steel ratings maintained in Simon
  - Shifting to BrR for steel rating

- MDX
  - Curved Girders
  - Steel I and Box (Tub) Girders
  - 2D Grid and PEB methods
MDX

The Good...

- Fast
- Prompted for information
- Design and Rating
  - LRFD/R and LFR
  - Curved Steel Structures
- LL DFs calculated based on relative stiffness
- Manageable output
The Bad...

- “Bad” as it relates to curved and highly skewed structures
- Simplified cross frame analysis
- Neglects I-girder warping stiffness
- Not rigorous enough for
  - Design of bracing members
  - Predicting deflections accurately
<table>
<thead>
<tr>
<th>Date</th>
<th>Class</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/13/16</td>
<td>Class 3</td>
<td>Top flange weight was being doubled in girder output weight table for closed box girders. Self weight calculations used for the analysis.</td>
</tr>
<tr>
<td>5/6/16</td>
<td>Class 2</td>
<td>Possibility of LRFD splice location greater than 0.20 unbraced length from brace not reducing Cb. [6.5.3048]</td>
</tr>
<tr>
<td>4/29/16</td>
<td>Class 3</td>
<td>Possible problem with slab tension stress in LRFD pour tables. [6.5.3041]</td>
</tr>
<tr>
<td>4/2/16</td>
<td>Class 2</td>
<td>The permanent deflection control allowable stress table may not have included the hybrid girder reduction factor. [6.5.3014]</td>
</tr>
<tr>
<td>3/30/16</td>
<td>Class 3</td>
<td>The LRFD service moment table may not have included the effect of two trucks plus lane over the pier for max effect. Stress tables at...</td>
</tr>
<tr>
<td>3/24/16</td>
<td>Class 1</td>
<td>In some cases composite dead loading effects were inadvertently zeroed in single girder project force tables. [6.5.3005]</td>
</tr>
<tr>
<td>3/23/16</td>
<td>Class 2</td>
<td>Bracing forces from sidewalk loading if number of exterior girder braces exceed number of tenth points. [6.5.3003]</td>
</tr>
<tr>
<td>2/27/16</td>
<td>Class 2</td>
<td>Problem with use of PINVRAT to generate an LRFD Strength II inventory rating. [6.5.2979]</td>
</tr>
<tr>
<td>2/17/16</td>
<td>Class 3</td>
<td>Some locations in LFD Max Performance Factor table given in inches. [6.5.2970]</td>
</tr>
<tr>
<td>2/17/16</td>
<td>Class 1</td>
<td>Possible LFD strength at a pier based on tension flange instead of compression flange. [6.5.2969]</td>
</tr>
<tr>
<td>2/10/16</td>
<td>Class 2</td>
<td>Possible LRFD rating problem where a service moment table was generated where yielding occurred in bending strength. [6.5.2962]</td>
</tr>
<tr>
<td>1/30/16</td>
<td>Class 2</td>
<td>An entry for bending in Maximum Performance Factor table had been generated where yielding occurred in bending strength. [6.5.2951]</td>
</tr>
<tr>
<td>1/30/16</td>
<td>Class 3</td>
<td>Incorrect messages generated concerning Cb values and output moment values near inflection points. [6.5.2948]</td>
</tr>
<tr>
<td>1/27/16</td>
<td>Class 2</td>
<td>Possible problem with LRFD &quot;Design of Steel Bridges&quot; LRFD Cb values taken from LDF code values where values are significantly different. [6.5.2933]</td>
</tr>
<tr>
<td>1/2/16</td>
<td>Class 2</td>
<td>Possible problem with LRFD reactions. [6.5.2921]</td>
</tr>
<tr>
<td>12/31/15</td>
<td>Class 2</td>
<td>LRFD Service II rating table was not issued when slab tension exceeded the allowable. [6.5.2920]</td>
</tr>
<tr>
<td>12/24/15</td>
<td>Class 3</td>
<td>LRFD reactions in hinges tables listed were not the correct values were correctly listed by locations. [6.5.2914]</td>
</tr>
<tr>
<td>12/14/15</td>
<td>Class 3</td>
<td>A stress violation message in the LRFD code was not issued when slab tension exceeded the allowable. [6.5.2905]</td>
</tr>
<tr>
<td>12/2/15</td>
<td>Class 1</td>
<td>Problem with live load effects in hinges. [6.5.2898]</td>
</tr>
<tr>
<td>11/24/15</td>
<td>Class 2</td>
<td>Possible LRFD shear strength parameter used for design of pier. [6.5.2877]</td>
</tr>
<tr>
<td>10/28/15</td>
<td>Class 3</td>
<td>Permit loading used HL93 factored loads in moment reaction analysis with HL93 loading. [6.5.2857]</td>
</tr>
<tr>
<td>10/14/15</td>
<td>Class 3</td>
<td>Only the LRFD 1/3 pouring stress had been correctly listed as shown by (6.10.3.2.1-1) [6.5.2848]</td>
</tr>
<tr>
<td>10/12/15</td>
<td>Class 3</td>
<td>Block shear resistance to rupture in boxed flange plate. [6.5.2849]</td>
</tr>
<tr>
<td>9/28/15</td>
<td>Class 2</td>
<td>Possible problem with shear capacity at splice locations. [6.5.2828]</td>
</tr>
<tr>
<td>9/18/15</td>
<td>Class 3</td>
<td>Problem with listed capacities in the LFD rating table. Ratings unaffected. [6.5.2817]</td>
</tr>
<tr>
<td>9/16/15</td>
<td>Class 2</td>
<td>Possible slight increase in LRFD stud spacing at a few locations. [6.5.2815]</td>
</tr>
<tr>
<td>9/11/15</td>
<td>Class 2</td>
<td>Possible problem with cover plated single girder dead deflections. [6.5.2811]</td>
</tr>
<tr>
<td>8/24/15</td>
<td>Class 2</td>
<td>Some Service II rating table strengths did not reflect the allowances in the Factored Bending Stress table. [6.5.2793]</td>
</tr>
<tr>
<td>8/5/15</td>
<td>Class 3</td>
<td>The amplification factor STEELFACT was not reflected in the weight table. [6.5.2774]</td>
</tr>
<tr>
<td>8/3/15</td>
<td>Class 3</td>
<td>Some bottom flange segments in the LFD girder weight table used the top flange thickness. Analysis unaffected. [6.5.2772]</td>
</tr>
<tr>
<td>7/25/15</td>
<td>Class 2</td>
<td>The factor STAGFCT was not being used in the rating table. [6.5.2763]</td>
</tr>
<tr>
<td>7/23/15</td>
<td>Class 2</td>
<td>The factor WHEELS used in LFD line girder data for amplifying stresses also was being applied to reactions. [6.5.2761]</td>
</tr>
<tr>
<td>7/1/15</td>
<td>Class 2</td>
<td>The LFD Service II rating table was not generated as per the code requirements. [6.5.2760]</td>
</tr>
<tr>
<td>6/29/15</td>
<td>Class 3</td>
<td>Possible LFD strength rating was not being taken into account where slab tension exceeding the allowable. [6.5.2759]</td>
</tr>
<tr>
<td>6/23/15</td>
<td>Class 3</td>
<td>The LRFD Service Moment table was not being used where slab tension exceeding the allowable. [6.5.2758]</td>
</tr>
<tr>
<td>5/13/15</td>
<td>Class 3</td>
<td>Possible problem with slab tension stress in LRFD pour tables. [6.5.2757]</td>
</tr>
<tr>
<td>5/10/15</td>
<td>Class 2</td>
<td>The permanent deflection control allowable stress table may not have included the hybrid girder reduction factor. [6.5.2756]</td>
</tr>
</tbody>
</table>
Comments on Simon, MDX or Other Steel Design Software?
CSI Bridge

- BOS *preferred* Advanced Finite Element Software
- Complicated structure design and/or rating
- Validation of results from other programs
- Avoid posting using refined analysis – see MBE 6A.3.3
- Special evaluations
CSI Bridge

The Good...

- Parametric Bridge Modeling, but also supports general modeling features
- Visually Appealing
- Selectable Data Output... directly to Excel
- Extensive Support (due to relationship to SAP)
- Steel Frame Design
CSI Bridge

The Bad...

- Parametric Bridge Modeling
- Automesh feature not great
- Design feature only works with linked model
- Rating feature only works with certain structure types
- Vehicle Response Component
- Files not backward compatible
- Cannot save file as older version
Comments on CSI Bridge or Other FEA Software?
June 7, 2016

SOUTH 1ST STREET BASCULE BRIDGE
Over the Kinnickinnic River Rehabilitation Project

Michael Delemont, CWI, PE, SE

WisDOT Structural Engineering Symposium

City of Milwaukee Department of Public Works
Infrastructure Services Division
Types of Movable Bridges

(a) SIMPLE TRUNNION BASCULE

Lawe Street, Appleton
Water Street, Milwaukee
South 1st Street, Milwaukee
Simple Trunnion Bascule Bridge

Counterweight
Types of Movable Bridges

(b) ROLLING LIFT BASCULE

CN over Fox River, Oshkosh

17th Street, Two Rivers
Scherzer Rolling Lift

• William Scherzer (January 27, 1858 – July 20, 1893) invented rolling lift bascule bridge (patent filed May 29, 1893, granted in December)
  • In 1897, Albert Scherzer founded Scherzer Rolling Lift Bridge Company (until 1936)
    • 1936 - Hazelet + Erdal
    • 1995 - Dames and Moore
      • 1999 - URS
    • 2014 - AECOM
Types of Movable Bridges

(e) VERTICAL LIFT BRIDGE

Veteran’s Memorial, Kaukauna

Clybourn Street, Milwaukee
Types of Movable Bridges

(c) SWING BRIDGE

CP over Kinnickinnick River, Milwaukee
Types of Movable Bridges

(d) RETRACTILE BRIDGE

Borden Ave, Queens, NY
South 1st St. Bascule Bridge
Simple Trunnion Bascule Bridge

(c) LEAF OPEN

BASCULE GIRDER

TRUNNION BEARING

RACK PINION

CWT

PIT

BACK WALL

FRONT WALL
Steel Grid Deck

- Existing Deck
- Replacement Panels
- Existing Center Break
- Enhanced Center Break
Steel Grid Deck – Riveted vs. Welded

Heavy Duty Riveted

4-Way Welded
Steel Grid Deck – Half Fill

3/8" GRID BOLTDOWN PLATE AT 15" CTRS. WITH 3/8" DIA. HOLES.
WELD FLUSH WITH BOTTOM OF MAIN BEARING BARS BEFORE GALVANIZING.

INTERMEDIATE BAR, TYP.
MAIN BEARING BAR, TYP.
CROSS BAR

5/8"

3/4" Ø ASTM A325 BOLT AND NUT.
SEE NOTE 2 ON SHEET 206
1/4 (3/8"

TOP FLANGE OF ROADWAY STRINGER

AT OPEN GRID PORTION

AT CONCRETE FILLED GRID PORTION

20 GA. FORM PANS WHERE HALF FILLED WITH CONCRETE. WELD TO GRID BARS. SEAL ALL SPACES AROUND PANS TO PREVENT LEAK THROUGH DURING CONCRETE POUR

3 REINF. BAR IN CONC. FILLED AREAS

LIGHTWEIGHT CONCRETE FILL
Concrete Decks

Deck over Machinery & Counterweight Pits

North Approach Span Deck

Accommodation of Traffic Warning Devices

Corroded Steel Bearings
Sidewalk and Railing Systems

Existing Timber System

Galvanized Bridge Railing

Slip Resistant Steel or Fiberglass Plate
Rear Break Details

Existing Break Detail

- Interference & Binding Occur Here

Improved Break Detail
Bascule Steel Repair & Replacement

Conceptualization of Work

Green - Replace
Orange – Rehabilitate
Pier Repairs

Counterweight Pit Wall

Spalled Pier Face

Bascule Pier Repair

Completed Repair
Fenders & Protection Cells

Existing Timber Fender

Existing Fender Pier

Rehabilitated Fender Pier
Counterweight & Span Balance

- Counterweight
- Existing Counterweight with Pocket Space
- Shore Unbalanced Leaves
- Ctwt. Shoring
Counterweight & Span Balance
## Balance Calculations

**Concrete Blocks (x=1)**

<table>
<thead>
<tr>
<th>EXIST.</th>
<th>DBLS. ADDED</th>
<th>TOTAL</th>
<th>CAPACITY</th>
<th>VT. BLKS</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>MX</th>
<th>MY</th>
<th>NZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0.00</td>
<td>-16.54</td>
<td>-3.32</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>0.00</td>
<td>-16.54</td>
<td>-3.32</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>0</td>
<td>24</td>
<td>-1.64</td>
<td>-16.54</td>
<td>-3.32</td>
<td>3.00</td>
<td>23.08</td>
<td>-0.47</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Steel Blocks (x=1)**

<table>
<thead>
<tr>
<th>EAST</th>
<th>WEST</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>MX</th>
<th>MY</th>
<th>NZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>45</td>
<td>-16.54</td>
<td>-3.32</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>45</td>
<td>0</td>
<td>-16.54</td>
<td>-3.32</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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**Steel Plate (1.5x 1th)**

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## Removals

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### Steel Plate (1.5x 1th)

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**Concealed Ventilation System**

- Rainbow Grid: Balanced, 24,357 ft²
- Sidewalk Grid: Balanced, 0 ft²
- Sidewalk Deck: Balanced, 0 ft²
- Top Floor: Balanced, 0 ft²
- Bottom Floor: Balanced, 0 ft²

**Building Components**

- Green Roof System: Balanced, 24,357 ft²
- Sidewalk Grid: Balanced, 0 ft²
- Sidewalk Deck: Balanced, 0 ft²
- Top Floor: Balanced, 0 ft²
- Bottom Floor: Balanced, 0 ft²

**Replacement**

- Rainbow Grid: Balanced, 24,357 ft²
- Sidewalk Grid: Balanced, 0 ft²
- Sidewalk Deck: Balanced, 0 ft²
- Top Floor: Balanced, 0 ft²
- Bottom Floor: Balanced, 0 ft²

---

**City of Milwaukee Department of Public Works Infrastructure Services Division**

23
Control House Architectural

- Lighting
- Plumbing
- Doors and glass block windows
- Roof
- HVAC
Mechanical System

Existing Machinery

Cracked Bearing Cover

Misaligned Brake

Existing Machinery Brake
Mechanical System

New Speed Reducers & Brakes

New Motors and Supports
Mechanical System

Rehabilitate Bearings

Rehabilitate Open Gearing
Mechanical System

Existing Heel Block Assembly

New Heel Block Assembly
Mechanical System

Existing Inboard Lock with Open Gearing
Mechanical System

New Centerlock
Electrical System

- Dual Power Feeds
- Submarine Cables
- Relays & PLC
- Motors

[Image of electrical system components: PLC, Console, Machinery]
Remote Operation

Can operate locally or from KK bridge

Upgrade communications and console at KK bridge
Traffic Gates

“Motorist gets a lift in Sturgeon Bay”
Maintaining Navigation

Active Waterway during Nav. Season

Work with 1 Leaf Up/1 Down

Rehab Closed During Winter
Enhancements

- Solid surface bicycle accommodations
- Concrete stain
- Steel painting
- LED architectural lighting
- Bridge railing
Questions?
Construction Topics

Bill Dreher
WisDOT Structures Design Chief
Piling

- H Piles for displacement piles
  - H piles tend to drive considerably longer than plan length
  - Work with Geotech engineer
Haunches

- Limit haunch heights – added DL
  - 54W & 72W
Exterior Girder Deflections

Existing 22-foot wide conc. deck and steel railing to be removed and replaced

Point referred to on profile grade line

2.0% Proposed
1.0% Existing

8" Proposed Deck

Remove and replace ext. steel girder

3'-11\(\frac{1}{4}\)"

5 SPA. @ 4'-1\(\frac{1}{2}\)" =
Rustications and Formliners
Structural Approach Slabs

**Legend**

- **Dimension is taken parallel to C. girder.**
- **Dimension is taken normal to C. substructure units.**
- **Paving notch is 1'-0" wide by 1'-4" deep if structural approach slab (STD. 12.10) is used.**
- **Bars placed parallel to girders, spacing perpendicular to C. girders.**

**Prestressed Girder with Semi-Expansion Seat**
Member Availability
Inspection Access
Specification Changes

502.2.11 Crack and Surface Sealers

- Clarifies materials for crack, deck, and parapet sealing (from the approved products list)
Specification Changes

- 502.2.11 Crack and Surface Sealers
  - Crack Sealer?
  Low Viscosity Crack Sealers for Bridge Decks
Specification Changes

- 502.2.11 Crack and Surface Sealers
  - Protective surface treatment?

Concrete Protective Surface Treatment
Specification Changes

- 502.2.11 Crack and Surface Sealers
  - Pigmented surface sealer?
  - Cure & Seal Compounds for Non-trafficked Surfaces on Structural Masonry
  - For use on the inside face and top of parapets
Specification Changes

505.5 Payment (Steel Reinforcement)

- Eliminates separate bid items for bridges, culverts, and retaining walls
- 3 new bid items:
  - Bar Steel Reinforcement Structures
  - Bar Steel Reinforcement HS Structures
  - Bar Steel Reinforcement HS Coated Structures
Specification Changes

- 513.4 Measurement & 513.5 Payment (Railing)
  - All railing bid items now measured by linear foot
- 2018: look for revisions to 513 including addition of galvanized and painted steel railings (Combination Railings Types "C1-C6")
SPV Reduction

- SPV's create variability in plans, specifications, and estimates
- SPV’s make up approximately $1/4$ of contract dollars
- Affects bidding, plan review, and construction
- Develop standard bid items for SPV items that are utilized frequently
SPV Reduction

- BOS
  - SPV to STSP
    - 6 complete
    - 18 sent to BPD
    - 40 ready soon
  - SPV to Historic File
    - 29 complete
  - SPV to Standard Specification
    - 3 complete
    - 4 sent to BPD
Innovative Materials

- Self-Consolidating Concrete (SCC)
  - Eliminate problems associated with vibration
  - Less labor
  - Faster construction
  - Improved quality and durability
  - Higher strength
  - WHRP: prestressed concrete girders
    - Investigate material properties (modulus, shrinkage, creep)
    - Related to time-dependent characteristics, flexural stiffness change, prestress losses
Innovative Materials

- Polyester Polymer Concrete (PPC)
  - Mixture of aggregate, polyester polymer resin and initiator
  - Placed as a deck overlay using conventional concrete mixing and placement equipment
  - Thickness of \( \frac{3}{4} \)” to 1”
  - 4 hour cure time
  - Practically impermeable
  - Expected service life of 20-30 years
  - Estimated cost of placing PPC overlay is $12/SF
Innovative Materials

- Fiber Reinforced Polymer (FRP)
  - Composite material consisting of glass or carbon fibers in resin matrix
  - High strength and stiffness; lightweight and thin
  - Installed relatively quickly; minimizes impact on traffic
  - Corrosion protection (pier columns)
  - Strengthen existing structures (shear and flexure)
  - BM Chapter 40 – July release
Innovative Materials

- Internally Cured Concrete
  - Supplies additional curing water throughout the concrete mixture
    - Uses water absorbed in lightweight aggregate
    - “Curing concrete from the inside out”
  - Prevents early age shrinkage, increases hydration of cementitious materials
  - Lowers the permeability of the concrete
Lead Paint on Steel Girders

- Paint is not a hazardous waste until it is removed from the steel
- If contractor takes possession of steel with paint attached, they are responsible for safe handling and disposal
Lead Paint on Steel Girders

- If paint is removed for repainting, waste must go through DOT disposal process
  - Always assume there is lead paint present
  - Labeling and Disposal of Waste Material
  - Portable Decontamination Facility
  - Cleaning by blasting with grit: Negative Pressure Containment and Collection of Waste Materials
  - Cleaning by hand or power tools: Containment and Collection of Waste Materials
Staging Considerations

- Staged construction joint locations on plans must allow working room for contractor/field staff.
- Work with roadway designers to ensure adequate clearances are provided.
Questions
• Determine if Standard Specifications are consistently administered throughout the Regions
• Identify best practices/opportunities for improvement
Team Members

- FHWA
- WisDOT
  - NE Region Construction
  - Bureau of Project Development
  - Bureau of Technical Services
  - SE Freeways/SE Region
  - Bureau of Structures: Design/Maintenance
• 2015 Construction Season
  – Full-depth concrete bridge decks & Grade E overlays
  – Four Regions – NE, NC, SE, & SW
  – 22 State and local bridge projects
  – Compare program to neighboring states IL, IA
  – Contractor interviews
Some Observations

- Application of fogging/continuous, wet, curing is not timely – Grade A, HPC
- Inadequate length of finishing machine rails results in unnecessary hand finishing
Curing, Finishing Machine Rails

HPC doesn’t mean “Hey, Postpone Curing!”
More Observations

Wisconsin Division Office

- Roles & responsibilities aren’t well understood
  - Inspector Quality Assurance
    - Dry runs not performed in consistent manner
    - No written notification to proceed with deck pour
  - Contractor Quality Control
    - Ineffective contingency plans
    - Unacceptable burlap condition
Dry Runs, Poor Mix Designs, & Holy Burlap!
Observed Best Practices

• **Use of stainless steel in decks for Mega/Major projects and complex structures**

• **Quality Management Plan**
  – Material testing and sampling procedures
  – Verification testing program (QV)
  – Independent Assurance (IA)
Recommendations

Wisconsin Division Office

• Need for training
  – Expand 1-day Bridge Construction Inspection course
  – Refer to WisDOT Construction Critical Inspection guidance
  – Update pre-pour meeting checklist in CMM
  – Inform industry of findings at Bridge Technical Committee meetings

FHWA Final Report mid-June
Take Aways

• Remember **C.E.R.T.**
  ✓ Cure decks....continuously, timely
  ✓ Extend rails
  ✓ Review contingency plans
  ✓ Take the training
Ancillary Structures

Ben Koeppen – BOS Inspection Engineer
Anthony Stakston – NC Ancillary Program Manager
Program Creation

- Transportation Asset Management Plan (TAM)
  - Required for Pavement and Bridge Structures per MAP-21
  - Each State has to submit a TAM to FHWA to be certified by October 1, 2016
Transportation Asset Management

- TAM is a data driven decision-making framework that includes: Risk, Condition, Prioritization, Network, and Operation effects.

- Mission Statement:
  - The aim is to apply the appropriate treatments and activities at the proper time resulting in extended service life at an optimal life cycle cost.
WisDOT Ancillary Program

- WisDOT took the federal mandate from MAP-21 and expanded it to other areas of operation
- Asset Management Groups for WisDOT include:
  - Traffic Features (Pavement Marking, Traffic Control Signs, Light Poles, Ramp Meters, etc.)
  - Roadside Facilities (Rest Areas, Waysides, SWEFs, Park & Rides, etc.)
  - Roadway Features (Salt Storage Facilities, Ramp Gates, Culvert Pipes, Cable Barriers, Crash Cushions, etc.)
  - Pavement & Bridge Structures
  - Ancillary Structures (Small Bridges, Retaining Walls, Noise Barriers, Overhead Signs, Signal Monotubes, and High Mast Lighting)
Ancillary Program Contacts

- Regional Ancillary Program Managers
  - NC Anthony Stakston
  - NE Brady Rades
  - NW Kyle Harris
  - SE Jason Zemke
  - SW-L David Bohnsack
  - SW-M Shiv Gupta

- Statewide Ancillary Inspection Program Manager
  - Travis McDaniel
Ancillary Program Contacts

- BOS Design Contacts
  - Wind Loaded Structures – Vu Thao
  - Sign Structures – Alex Crabtree, Steve Doocy
  - Noise Walls – Matt Coupar, Jon Resheske
  - Retaining Walls – Emily Kuehne
  - Box Culverts – Danielle DeTennis, Nick Rice

- And many other Bureau and Regional folks that work with these structures.
Ancillary Program Contacts

- Bureau of Structures
  - Maintenance & Inspection
    - Program Managers

- URL:
  [http://www1.wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/inspection-pm.aspx](http://www1.wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/strct/inspection-pm.aspx)
New Forms

- ID Request Form
  - Standard for all Regions
# New Forms

- **Inventory Form(s)**
  - Structure Specific (C, R & N, S & G, and L)
  - Updated Directions on Back of Form
- **Consultant Designed** – Submit via Esubmit
- **Contractor Designed** – Submit to BOS and Regional PM

## Construction Data

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## Route Near Information

| 17 | General Location of Pole |      |
| 18 | Enter name of closest primary route under pole |      |

## Structure Data

| 20 | Pole Data |      |
| 21 | Overall Pole Height (ft); |      |
| 22 | Pole Material and ASTM Grade; |      |
| 23 | Number of Splices; |      |
| 24 | Foundation Data |      |
| 25 | Footing type; |      |
|    | □ Caisson |      |
|    | □ Pile |      |
|    | □ Spread |      |
| 26 | Base Plate Thickness (in); |      |
| 27 | # of Anchor Bolts; |      |
| 28 | Diameter of Anchor Bolt (in); |      |
| 29 | Bolt Material and ASTM Grade; |      |
| 30 | Luminaire (Lighting) Details |      |
| 31 | Manufacturer; |      |
| 32 | Type; |      |
| 33 | Number of Luminaire(s); |      |

## FOR INTERNAL USE ONLY

| 34 | Type Service On; | High Mast Lighting |      |
| 35 | Type Service Under; | Land |      |
| 36 | Primary Route On; | High Mast Lighting |      |
| 37 | Route on Designation; | Water Tank and Other |      |
New/Updated Forms

› Bureau of Structures
  › Maintenance & Inspection
    › Inventory & Rating Forms

› URL:
  http://www1.wisconsindot.gov/Pages/doing-bus/eng-consultants/cnsIt-rsrces/strct/inv-forms.aspx
C-Structures  (Small Bridges)

- Redefined per 2015 Policy Memo
- Small Bridge Structures require a unique structural design and have a clear opening of 20 ft. or less measured along the centerline of the roadway. This includes:
  - Bridge like structures (i.e. Deck Girders, Flat Slabs, etc.)
  - Box Culverts (with openings 20 ft² or greater)
  - Rigid Frames
  - Arches
  - Structures without a floor slab (including arches on footings)
  - Metal Bolted Plate Structures
C-Structures (Small Bridges)

- Bureau of Structures
  - Maintenance & Inspection
    - Policy Memos
      - Small Bridge (C Structure) Definition

- URL:
C-Structures

- Design Considerations
  - Box Culvert wing walls now require epoxy-coated rebar
  - Box Culverts shall be designed for a range of fill (not a single height) [See Bridge Manual 36.5]
    - This range should be detailed on the plans
Walls (Noise and Retaining)

- Noise Barriers are structures constructed to alter the normal noise travel at a site.
- Retaining Walls are structures used to provide lateral resistance for a mass of earth or other material to accommodate a transportation facility.
Walls (Noise and Retaining)

- Design Considerations
  - Noise Walls
    - If possible, designers should avoid attaching noise barrier to bridge railings [See Bridge Manual 30.3(4)]
  - Retaining Walls
    - Aesthetic and Constructability considerations with top of wall elevations and railings
    - Maintain awareness of right-of-way limits
Wind Loaded Structures

- Presentation by Vu Thao
Wind Loaded Structures

Vu Thao
Structural Design Engineer
SE Region Liaison
Wind Loaded Structures Program Leader
WisDOT / BOS
General Commentary

- Wind Loaded Structures
  - Sign Structures
    - Sign bridges, overhead sign supports and road side sign supports
  - Traffic Signal Structures
    - Monotubes and signal supports (trombone arm)
  - Lighting Structures
    - High mast lighting towers
    - Light poles
  - Others
    - Camera poles
    - Ramp meter structures
General Commentary

- Design Manual Updates
  - WisDOT Bridge Manual
    - Chapter 39
    - Standard details
    - Standard insert sheets
  - FDM
    - Sections 11-55-20 – design guidance for sign structures
    - Section 15-1-20.10 – plan preparation for overhead sign supports
    - SDD plates for concrete bases
General Commentary

- Construction Specifications Updates
  - Standard Specifications
  - Repair SPV’s – to be completed later this summer
  - Construction Materials Manual (CMM)
    - Construction Inspection Checklist for Ancillary Structures, See Attachment 1
  - Major implementation in the construction area
    - Utilizing Direct Tension Indicator (DTI) washer in place of turn-of-the-nut method for H.S. bolt field installation
    - Utilizing turn-of-the-nut installation method for anchor rod
    - Eliminate field ROCAP tests – data provided by H.S. bolt manufacturer only
    - Handling and storage
General Commentary

- Construction Resources
  - Installation Procedures
    - Form DT2322 – Ancillary Structures Pre-installation Verification Test of H.S. Bolts
      - Pre-installation test procedure
      - Installation steps
      - QC & QA requirements
    - Form DT2321 – Anchor Rod Installation Tensioning Record
      - Preparation and installation procedure
      - Verification Torque requirement
      - QC & QA requirements
General Commentary

- Construction Resource Cont’d
  - 2014 Training
    - All Region – DOT staffs and consultants
    - Contractors
Contract Plan Development process

- Structure Plans (Structural Engineer)
  - Structure Types
    - Sign bridges
    - Overhead sign supports
      - Multiple structures
      - Unique structures, structure Mounted, and non-standard foundations
    - DMS roadside sign supports
    - Foundation for high mast lighting tower
  - Follow Bridge Design Process
    - Submittals
      - SSR, preliminary and final plans, design computations, PE stamp, structure inventory form, etc…
Structure Plans Cont’d
- Follow Bridge Design Process Cont’d.
  - Exceptions
    - Combined plan for multiple structures of the same type (WisDOT Bridge Manual 6.3.3.3)
    - SSR submittal timing – further discussion
  - BOS Review
    - Optional
    - Sign bridges – preliminary and final plans
    - Overhead sign supports – concentrate on preliminary plans to ensure structure type and size are properly selected
Contract Plan Development process

- Construction Details (Traffic Engineer)
  - Overhead sign supports (contractor design)
    - Standard overhead sign supports
    - Stand alone projects
  - Traffic monotubes (procurement process)
  - High mast lighting towers (contractor design?)
  - Other traffic signal supports and light poles (contractor supplied)
Highlight of Current Design Policy

- Design Specifications for Sign Structures
  - Standard Specifications for Highway Bridges, 17th Edition
  - ASD Design until LRFD conversion project is complete
  - Design Specifications to be noted on plans
  - Material specifications to be noted on plans, see latest Section 39.3 of the WisDOT Bridge Manual
Highlight of Current Design Policy

- Design Specifications for Sign Structures Cont’d.
  - Fatigue Requirements
    - All wind loaded structures are designed with fatigue loads except the following structures
      - Four chord full span sign bridges carrying type I and II signs with truss type tower supported on concrete footings
      - Full span overhead sign supports on standard bases
Highlight of Current Design Policy

- Sign Structures and traffic monotubes
  - Utilizing Minnesota four chord steel angle truss configuration for overhead DMS sign bridges
  - DMS roadside sign supports to be shielded, and not supported on break-away
  - No flat washer between faying surface of mast arm connection plates
  - Do not detail construction joint on drilled shaft foundation. Consult BOS for further guidance on drilled shaft with wings.
  - Maximum drilled shaft length is limited to 20-ft.
LRFD Conversion

- BOS will be working on LRFD design conversion plan between late 2016 and early 2019
- Tentative efforts
  - Evaluate each structure type and configuration for economic engineering and selection
  - Provide design guidance for various types of structure
  - Re-write Chapter 39 of the WisDOT Bridge Manual
  - Develop new design software
  - Develop new design standards
THANK YOU
Research Updates

Bill Oliva
WisDOT Structures Development Chief
Research Updates – Bill Oliva

Our research explores and develops solutions to current and future transportation needs.

Research results help shape the practices, policies, and standards used to develop and maintain Wisconsin’s transportation infrastructure.
Sources of research needs and opportunities

- BOS Initiatives (ABC, SCC, & others)
- Bridge Technical Committee – Industry
- Other DOT’s – Pooled Fund (common benefit)
- Structures community & partners
  - Academia
  - FHWA
  - AASHTO
  - TRB (Transportation Research Board)
Research Programs

- Sources of research development
  - Wisconsin Highway Research Program (WHRP)
  - NCHRP – Staff Participation
  - Center for Freight & Infrastructure Research and Education (CFIRE)
  - Transportation Pooled Fund Studies (TPF)
  - Research Programs (IBRD/IBRC/SHRP2) - FHWA
Where are we with Research?

BOS Research Progress (2015-2016)

- WHRP:
  - Completed: 4
  - Pre-Final: 3
  - In Progress: 1

- CFIRE:
  - Completed: 0
  - Pre-Final: 0
  - In Progress: 0

- NCHRP:
  - Completed: 0
  - Pre-Final: 3
  - In Progress: 0

- TPF:
  - Completed: 0
  - Pre-Final: 0
  - In Progress: 3
Evaluation of Thin Polymer Deck Overlays and Deck Sealers - February 2016

- The objectives of this research was to explore the effectiveness and durability of thin polymer overlays with respect to restoring and protecting bridge decks, improving safety, and extending service life.

- Research program was performed to study and compare the performance of nine different overlay systems.
The overlay system with an epoxy resin provided the best overall performance.

The polyester multi-lift overlay system delaminated from the concrete surface in all nine specimens utilizing that overlay type.
Reflective Cracking between Precast Prestressed Box Girders

- Goal is to eliminate reflective deck cracking in adjacent box-beam bridges.

- Cracking at the shear key locations that reflects to the deck surface.

- Provided recommendations on box-beam and shear key geometry, shear key grout, cast-in-place deck slab concrete, transverse post-tensioning.
Reflective Cracking between Precast Prestressed Box Girders

- Updated Standard 19.54
Where are we going with Research?

- Self Consolidating Concrete (SCC) - Girders
- Staged Longitudinal Construction Joints
- Highly Skewed Girder Structures
- Damaged Prestressed Girders (deck removal and impact)
- Pilot Project to examine bridge Inspection with Unmanned Aerial Systems (UAS) “Drones”
Study of Over Sized Over Weight Vehicles on Complex Bridges
Study of Over Sized Over Weight Vehicles on Complex Bridges

The objective of this project is to simplify the overload permitting process executed by WisDOT engineers for complex bascule, arch and rigid frame bridges subjected to OSOW vehicles located on critical freight routes in Wisconsin.
A few requests of you

- As practitioners, we are interested in your ideas of needs and opportunity
- We are also interested in your participation in providing guidance and oversight to structures research
- Please consider providing ideas or getting involved with WHRP
WHRP - Structures Technical Oversight Committee

- William Oliva, Chair – WisDOT
- Richard Marz - WisDOT
- Darrin Stanke - Zenith Tech, Inc.
- David Pantzlaff - Ayres & Associates
- Travis McDaniel - WisDOT
- Adam Dour - Lunda Construction Company
- Professor Mike Oliva - University of Wisconsin
- William Dreher – WisDOT
- Dave Kiekbusch - WisDOT
- David Bohnsack - WisDOT
- Professor Baolin Wan - Marquette Univ.
- Professor Al Ghorbanpoor - University of Wisconsin-Milwaukee
- Tony Shkurti - HNTB Corporation
- Joe Balice - FHWA Bridge Engineer – Wisconsin Division
Where to find the results of the research:

- [http://wisconsindot.gov/Pages/about-wisdot/research/whrp.aspx](http://wisconsindot.gov/Pages/about-wisdot/research/whrp.aspx)
Accelerated Bridge Construction

James Luebke
Structures Development Engineer
WisDOT Bureau of Structures
Accelerated Bridge Construction

ABC is bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time...

-FHWA
Accelerated Bridge Construction

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-FHWA
WisDOT ABC Projects
2005 - 2016
Overview

- Precast Piers
- GRS Abutments and PS Box Girders
- Bridge Moves - Slides
Precast Piers

- Past Usages:
  - 2013 – (1) Custom Application
  - 2014 – (1) Standardizing
  - 2015 – (3) Standardizing/Institutionalized
  - 2016 – (1) Standardizing/Institutionalized
Precast Piers

- **Current Policy**
  Evaluation and plan preparations for accommodating a noted allowance for a precast pier option as indicated in this section is only required for I-39/90 Project bridges.

- **Policy Direction**
  Stronger guidance for statewide evaluation

- **Considerations**
  - Limitations
  - Project value
  - Geometric compatibility
Precast Piers

- Standard 7.05
- Designer

To determine allowable precast elements

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INQUIRE THE FOLLOWING NOTE ON AT LEAST ONE PIER SHEET FOR EACH PIER:

THE CONTRACTOR MAY FURNISH A PRECAST CONCRETE PIER (INSERT ALLOWABLE PRECAST ELEMENTS) IN LIEU OF THE CAST-IN-PLACE PIER WITH THE ACCEPTANCE OF THE SHOP DRAWINGS BY THE STRUCTURES DESIGN SECTION. THE PRECAST CONCRETE PIER SHALL CONFORM TO PRECAST DETAILS IN CHAPTER 7 STANDARDS OF THE CURRENT WISCONSIN DOT BRIDGE MANUAL AND SPECIAL PROVISIONS RELATED TO PRECAST ELEMENTS WITH THE EXCEPTION OF METHOD OF PAYMENT. PAYMENT FOR THE PRECAST PIER SHALL BE BASED ON THE QUANTITIES AND PRICES BID FOR THE ITEMS LISTED IN THE "TOTAL ESTIMATED QUANTITIES" FOR THE CAST-IN-PLACE PIER.

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- Contractor

Use precast segments at their discretion

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THE CONTRACTOR MAY USE PRECAST SEGMENTS AT THEIR DISCRETION (E.G. PRECAST CAP ONLY) WITH APPROVAL BY THE BUREAU OF STRUCTURES. SEE STANDARD 7.07 FOR CAST-IN-PLACE BEARING BLOCK DETAILS AND ADDITIONAL NOTES.
# Precast Piers

- In-House Tracking
- Geometric Compatibility

## Precast Pier Considerations

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Precast Piers - Opportunities

- IH 39/90
  - SHRP2 Projects
  - Numerous noted allowances

- Statewide Precast Piers

- Other Opportunities
ABC Costs – Precast Piers

![Precast Costs Chart]

- **Cap**
- **Column**
- **Average**
- **CIP**

**Axes:**
- **Y-axis:** Pier Costs ($/CY)
- **X-axis:** Bridges

**Legend Points:**
- B-40-810
- B-13-727
- B-13-702
- B-13-703
- B-13-709
- B-13-707
GRS Abutments

- Updates
GRS Abutments

- Geosynthetic Reinforced Soil (GRS)
  - Reinforcement (Fabric)
  - Backfill
  - Facing Elements
GRS Abutments

- GRS History (2011 – Current)
  - FHWA - Every Day Counts (EDC1, EDC2, & EDC3)
  - Demonstration and AID Grants
  - Actively participating and promoting GRS Technology
  - Standard Details, specifications, and experience
  - New tool and not for every location
States Constructed GRS Abutments?

- **5** States (2011)
- **44+** States (2016)
  
  200+ GRS Structures

- FHWA EDC 2011-2016
GRS Abutments - Chippewa Co.

Less Complex Construction Methods

Reduced Construction Time
GRS Abutments - Dodge Co.

2016 Construction (February Let)

- Two Single Span Bridges
- Four GRS Abutments
- Prestressed Box Girders
- Cofferdams

Beaver Dam
GRS Abutments – Dodge Co.

PS Box Girders
Improved shear key
Composite Details
Construction Schedule:
- Remove Existing Bridge
- Install Sheet Piling
- Excavate for GRS Ftg.
- Install GRS Ftg. & Abutment
- Install PS Box Girders
- Pour Deck
GRS Abutments – Dodge Co.

Schedule:
- B-14-216 - July
- B-14-217 – August
- Showcase
  - Beginning of August?
GRS Abutments – Dodge Co.

Showcase Tentative Agenda:

- General Overview
- Construction Considerations
- Project Breakdown
- Field Trip to Site
- Wrap-Up Discussion
GRS Abutments – Dodge Co.

Showcase Attendees:
- FHWA and WisDOT
- Consultant Designers
- Local Owners and others
GRS Abutments

WisDOT Future

- WisDOT Lessons Learned (Dodge County)
- Monitor Prestressed Box Girder Projects
- FHWA coordination and updates
- Continue to provide technical support
Accelerated Bridge Construction - Slides

Bill Oliva, P.E.
Structures Development Chief
WisDOT Bureau of Structures
Why Slide in bridge construction?

- All the benefits of other ABC technologies
- Less traffic disruption
- Greater safety for motorists and construction workers (shortened work-zone durations)
- Greater quality and constructability
- May reduced Right-of-Way (FEE) needs
M-100 Bridge Slide in Potterville, Michigan

- Permanent bridge deck will be constructed at the temporary location on temporary abutments.

- Two-way traffic will be maintained on the temporary road and on new bridge superstructure with temporary abutments.
M-100 Bridge Slide

- Original Construction 1940
- Length of Structure 157’
- Width of Structure 40’
M-100 Bridge

Maintenance of traffic
M-100 Bridge
M-100 Bridge
M-100 Bridge
M-50 Bridge over I-96 Bridge Slide Design – Michigan

- Existing 4-span 200 foot

- Proposed 2-span 200 foot prestressed box beam

- Demolish the bridge, that’ll be a one-weekend closure of I-96
M-50 Bridge
M-50 Bridge