• Bridge Construction Unit
• Special Provisions Update
• Bridge Preservation and Improvement Guidelines
  - Elements
<table>
<thead>
<tr>
<th>Construction and Maintenance</th>
<th>Ed Lutgen</th>
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<tr>
<td>Oversight of Construction Unit</td>
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<tr>
<td>St. Croix Project</td>
<td>Paul Kivisto</td>
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<td>St. Croix project construction</td>
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<tr>
<td>Bridge Repair Scoping Engineer</td>
<td>Dustin Thomas</td>
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<td>Bridge repair scoping reports, BRIM support, repair or replace decision support</td>
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NEW!
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<tr>
<th><strong>Regional Bridge Construction Engineers</strong></th>
<th><strong>See Map</strong></th>
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<tr>
<td>Bridge repair recs, foundation recs, construction support, district liaison</td>
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<table>
<thead>
<tr>
<th><strong>Bridge Construction Support and Special Provisions</strong></th>
<th><strong>Mark Spafford</strong></th>
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</thead>
<tbody>
<tr>
<td>Bridge special provision review, development, coating performances, fielding of bridge construction questions</td>
<td></td>
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<table>
<thead>
<tr>
<th><strong>Bridge Construction Field Support</strong></th>
<th><strong>Mark Mueske</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile authorizations, bridge plan review, special provision review, development, bridge construction field support</td>
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## Bridge Construction Unit

<table>
<thead>
<tr>
<th>NAME</th>
<th>OFFICE</th>
<th>CELL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul Pilarski</td>
<td>651-366-4563</td>
<td>651-485-3167</td>
</tr>
<tr>
<td>Nate Schutte</td>
<td>651-366-4581</td>
<td>651-200-5263</td>
</tr>
<tr>
<td>Karl Gronvall</td>
<td>651-366-4565</td>
<td>651-242-6062</td>
</tr>
<tr>
<td>Nick Haltvick</td>
<td>651-366-4561</td>
<td>651-216-3219</td>
</tr>
<tr>
<td>Mark Spafford</td>
<td>651-366-4564</td>
<td>Lucky…</td>
</tr>
<tr>
<td>Mark Mueske</td>
<td>651-366-4464</td>
<td>651-775-1126</td>
</tr>
</tbody>
</table>

Firstname.Lastname@state.mn.us
• 2018 Standard Specification: Available June 2017

• 2018 Specs and Special Provisions will apply for most projects with Fall 2017 Lettings (more to come)

• Next update: 2020 (hopefully)

• After that? → 5 year cycles (hopefully)
Special Provisions

- [http://www.dot.state.mn.us/bridge/construction.html](http://www.dot.state.mn.us/bridge/construction.html)

Bridges and Structures

Design, construction and maintenance resources

Bridge construction

Resources

- [Standard Specifications for Construction](http://www.dot.state.mn.us/bridge/construction.html)
- 2016 "SB" Bridge Special Provisions ([PDF](http://www.dot.state.mn.us/bridge/construction.html), [Word](http://www.dot.state.mn.us/bridge/construction.html)) - Revised May 2017
- 2014 "SB" Bridge Special Provisions ([PDF](http://www.dot.state.mn.us/bridge/construction.html), [Word](http://www.dot.state.mn.us/bridge/construction.html))
- [Bridge Construction Manual](http://www.dot.state.mn.us/bridge/construction.html)
- [Bridge Preservation and Improvement Guidelines Fiscal Year 2016-2020](http://www.dot.state.mn.us/bridge/construction.html) (PDF)
Special Provisions

• Adding more **DESIGNER NOTE**s to clarify intent and use of special provision.

• Internal S.P.E.C. Committee reviewing all boilerplates.

• List of SB2016s now in 2018 Standard Specs is coming soon.
  • Several specials have become standard

• Questions on Special Provision?
  • Contact Mark Spafford (651-366-4564)
Mass Concrete

• Any volume of concrete with dimensions large enough to require that measures be taken to cope with the generation of heat from hydration of cement and attendant volume change to minimize cracking. (ACI Committee 207)

• This effort consists of **temperature control** of mass concrete for the **purpose** of minimizing potential cracking as a result of excessive temperature differentials due to the heat of hydration in concrete and for limiting the maximum temperature of concrete during the hydration process. (MnDOT SB2016-2401.19)
### Table MC-1

**Mass Concrete, Concrete Temperature Control and Form Removal Requirements**

<table>
<thead>
<tr>
<th>Concrete Element</th>
<th>Least Dimension</th>
<th>Mass Concrete Requirements Apply?</th>
<th>Concrete Temperature Control Requirements</th>
<th>Form Removal Requirements Apply? (Section 3.A.3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum Temperature Differential Apply? (Section 3.A.1)</td>
<td>Maximum Peak Temperature Apply? (Section 3.A.2)</td>
<td></td>
</tr>
<tr>
<td>Pier Tremie Seal Concrete</td>
<td>Any Dimension</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pre-cast Beams</td>
<td>Any Dimension</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>For all other concrete elements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Design Strength ≥ 6,000 psi</td>
<td>≤ 48 in</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Post-Tensioned Elements</td>
<td></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>All Other Concrete Elements</td>
<td></td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>All Concrete Elements*</td>
<td>&gt; 48 in</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Drilled Shafts</td>
<td>&gt; 48 in</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Buried Footings</td>
<td>≥ 60 in</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Except as noted otherwise in table
Design your way out of it!

<table>
<thead>
<tr>
<th>Concrete Element</th>
<th>Least Dimension</th>
<th>Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pier Tremie Seal Concrete</td>
<td>Any Dimension</td>
<td>No</td>
</tr>
<tr>
<td>Pre-cast Beams</td>
<td>Any Dimension</td>
<td>No</td>
</tr>
<tr>
<td>Concrete Design Strength $\geq 6,000$ psi</td>
<td>$\leq 48$ in</td>
<td>No</td>
</tr>
<tr>
<td>Post-Tensioned Elements</td>
<td>$\leq 48$ in</td>
<td>No</td>
</tr>
<tr>
<td>All Other Concrete Elements</td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
Mass Concrete

• Design your way out of it!

<table>
<thead>
<tr>
<th>Concrete Element</th>
<th>Least Dimension</th>
<th>Required?</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Concrete Elements (excepted as noted otherwise in table)</td>
<td>&gt; 48 in</td>
<td>Yes</td>
</tr>
<tr>
<td>Drilled Shafts</td>
<td>&gt; 48 in</td>
<td>Yes</td>
</tr>
<tr>
<td>Buried Footings</td>
<td>≥ 60 in</td>
<td>Yes</td>
</tr>
</tbody>
</table>

• Plan Note: “Includes bridge elements with mass concrete requirements. See special provisions.”
Mass Concrete

• How does this impact construction?
  • Adds time due to curing and form removal requirements.
  • Requires temperature monitoring and control.
  • Requires a special concrete mix design.
  • Crack widths >0.01 inches are to be sealed.
  • Costly
• **Pile Driving Analysis**

• High strain dynamic load testing and pile driving monitoring system.

• Calculate bearing capacity and assess structural integrity

• Assess driving stresses and hammer performance
Piling - PDA

• When and why?
  • Large pile quantities
  • Large pile loads
  • Long friction piles (can save length)
  • Increases phi factor ($\varphi_{\text{dyn}} = 0.65$)

• Why not?
  • Expensive
  • Construction Time

---

VALUES

<table>
<thead>
<tr>
<th>FIELD CONTROL METHOD</th>
<th>$\varphi_{\text{dyn}}$</th>
<th>* $R_n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MnDOT Pile Formula 2012 (MPF12)</td>
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<tr>
<td>$R_n = 20 \frac{W \times H}{1000} \times \log\left(\frac{10}{S}\right)$</td>
<td>0.50</td>
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<tr>
<td>PDA</td>
<td>0.65</td>
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</table>

* $R_n = (\text{Factored Design Load}) / \varphi_{\text{dyn}}$
• Standard Spec 2452.3.E.2(1)
• 2452.528 “Pile Analysis” by Each
Piling – Hard layers

• Drilled in piling for dense layers or socketing into bedrock
• Rotary drill or downhole hammer are most common
• 12” & 16” diameter preferred
• Pay items:
  • 2452.602 “Pile Placement” by Each (instead of test pile)
  • 2452.603 “Rotary Drilled Steel Pile ___” by Lin. Ft.
  • 2452.527 “Pile Redrive” by Each (to seat the pile)
Piling – Down hole hammer
Piling – Down hole hammer
Piling – Rotary Drilling
BPIG: Elements

Bridge Preservation and Improvement Guidelines

5/17/2017
BPIG: Elements

- Barrier and end posts
- Decks and deck protective systems
- Pier protection
- Limits of concrete removal
- Ratings
- Prestressed beam concrete shear
- Retrofit or replacement of fatigue prone components
- Fracture critical bridges
- Asbestos and regulated waste assessment
- Historic Bridges
- Type W bridge culverts
- Pedestrian accommodations per ADA
BPIG: Decks (Chapter 10)

- Low slump concrete wearing course – 2” min.
- Silane treatment
- Epoxy chip seal – 3/8” min.
- Polyester polymer concrete (PPC) – 3/4” min.
• SB2016-2433.1Mono
• Use on jobs where bridge decks being renovated is monolithic.
• SB2016-2433.1WC
• Use on jobs where bridge decks being renovated have an inplace concrete wear course.
• A, B, C = Patch receives an overlay

BPIG: Decks (Chapter 10)
• D, E, F = Patch is full depth
• 1960s: 6.5” to 7.5” thick, 1.5” cover, black bars
• 1970s: Statewide overlay program, 2” to 3” cover, black bars
• 1970s – 1980s: Mixed systems of epoxy top bars, black bottom.
• 1989: All epoxy bars
• 2011: Stainless bars for bridges over $25 million
• 2013: High performance concrete mixes
BPIG: Decks (Chapter 10)

• Future – More monolithic decks

• Why?
  • Accelerated construction
  • Less cracking
  • More economical
• Evaluation criteria found in BDM 11.2.3.

• Protection required when:
  • Substructure widening
  • Roadway edge of traveled lane moves within 30ft of pier
  • Railway center of track is within 25ft plus bridge criteria

• Lists scenarios where consideration should be given.
• Consider protection when (partial list):
  • Roadway below bridge has speed limit > 40 MPH
  • Roadway below bridge has ADTT > 1,200
  • Roadway below bridge has curved alignment
  • Piers have fewer than 3 columns and the superstructure is non-continuous
  • Roadway below bridge has high accident history
  • New guardrail connections to the pier are installed.
  • Profile grade raise reduces the effective height of existing pier protection.
  • Extensive work is being performed on the roadway corridor and the pier does not have an existing crash strut.
BPIG: Ratings

• LRFR: Load and Resistance Factor Ratings
  • Required for all repair projects

• LRFD analysis requirements in both BPIG and BDM (4.6.2)

• Goals:
  • RF ≥ 0.9 (inventory) for superstructure
  • RF ≥ 1.0 for substructures or greater than superstructure
  • Note that substructure analysis guidelines are under development. Will likely include screening criteria such as condition, DL added, original design live load, # of beams, etc.
• Bridge elements of particular interest are:
  • concrete pier caps,
  • continuous steel beams, and
  • prestressed concrete beam shear
• Barriers meeting a 10-kip design load can generally remain in place.

• Refer to Bridge and Structure Inspection Program Manual, Table D.7.3.28-1, “MnDOT Bridge Railing Codes”
• Barrier should be replaced or modified when the following conditions exist;
  • In-place barrier is in poor structural condition (all design speeds)
  • In-place barrier poses an elevated risk:
    • potential snagging condition
    • curb projection greater than 9 inches
  • In-place conditions indicate an elevated risk:
    • history of barrier impacts
    • site-specific roadway geometrics
    • critical superstructure members are susceptible to impact
BPIG: End Posts (Chapter 9)

- Barrier and/or approach guardrail upgrades require end post upgrades
- Must meet NCHRP Report 350 or AASHTO MASH requirements; generally all four corners.
  - Must be same as adjacent element being upgraded
- Best to put new barrier on approach panel (if approach panel is being replaced).
- If existing end post to remain, must meet all criteria list to be considered acceptable.
Existing end posts must meet all of the following requirements to be considered acceptable:

• Minimum length (at the top) = 2'-8"

• Minimum thickness (at the base) = 1'-6"

• Minimum amount of vertical reinforcement in the front face = 3.16 square inches

• Minimum height 2'-8", the leading edge height may be 2'-3" +/- and sloped upward to the 2'-8" minimum height at the trailing edge

• Must be rigidly connected to the bridge or approach panel.
BPIG: Expansion Joints

• Need to be replaced full length if modifying the gutterline.

• Cannot be re-gland if the joint device is:
  • more than 10 years old
  • max opening is less than 1.75”

• New standard details and approved products for E8 joints on approach panels.
• New standard details and approved products for E8 joints on approach panels.
BPIG: Expansion Joints

E8 SPECIAL JOINT CROSS SECTION AT CURB

E8 SPECIAL JOINT END VIEW
MINNESOTA DEPARTMENT OF TRANSPORTATION
BRIDGE OFFICE
BRIDGE REPAIR RECOMMENDATIONS

RDWY. AREA: 6017 SF | T.H. TH 7 over Minnehaha Creek
Length: 83.5' | Rdwy Width: 105.3' | Year Built: 1981

Other Features: Solid median with glare screen ends on bridge

Tentative Letting Date: July 22, 2016 | State Project: 2713-120
Bridge Designer: Stenberg, Consultant | Current ADT: 37500
N Rail Code: 22 Meets 10k? x | Inv. Ratings: HS21.8
S Rail Code: 22 Meets 10k? x | After Constr.: TBD, 1.13 Inv.
Is the bridge Historic or Historic Eligible? No

RECOMMENDATIONS BY BRIDGE ENGINEER

<table>
<thead>
<tr>
<th>Comment</th>
<th>Bridge Element</th>
<th>Scope of work</th>
<th>Yes</th>
<th>X</th>
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<th>District Comments</th>
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BRIDGE NO.: 27193
DIST. NO.: 502
Type: 502
Reference Point 92+00.024

Major Preservation X
Rehabilitation

5/17/2017 Bridge Office | mndot.gov/bridge/construction.html 42
Bridge Recommendations
Bridge No.
Page 3

Bridge paragraph description, location, highway, bridge history, deck type, railing, deck width configuration, superstructure type, steel type, load ratings, permit restrictions, scour code, design speed, clearances, fatigue prone, BRIM results, etc..

Bridge Plan

B-1) Bridge recommendations here, include special provision number as much as possible

B-2)

B-3)

B-4)

B-5)

District Plan

D-1) Approach recommendations here

D-2)
BPIG: Repair Plans

• Spreadsheet for creating repair recs
  • Contact Regional Construction Engineer

• Spreadsheet of standard plan notes for repair plan
  • Under development
Thank you!

Nick Haltvick

nick.haltvick@state.mn.us

651.366.4561