Outline

• Quality Management
• Design Personnel
• Software
• Drafting of Plans
• Technical Reviews
• Coordination with Roadway Plans
• Time vs. Quality
• Few Last Thoughts
• Quality Control (QC)
  • Checking of assumptions, plans, and calculations
  • Documenting review process

• Quality Assurance (QA)
  • Verifying quality control process was followed
“Quality control is implemented to detect and correct problems when they occur, quality assurance is implemented to prevent problems from happening”
• Why needed?
  
  To assure a consistent, high level of quality in all calculations, plans, and reports generated

• How to Provide:

  Quality Management Plan (QMP): Plan of how quality will be integrated and achieved for the specific project
What belongs in a Quality Management Plan:

- Project specific requirements
- Project staff responsibilities
- QC/QA Process
  - What are the steps to assure quality
  - Who will be filling those roles
- Software usage
- Calculation and plan review process
- Usage and integration of Independent Technical Reviews (ITR) or Constructability Reviews (CR)
People involved and preferred interaction:

- Designer (QC)
- Checker (QC)
- Quality Manager (QA)
Checker experience ≥ Designer experience

- Design Calculations
  - Can be softened if both people meet minimum experience levels
- Plan preparation
- Experience with component design or drafting
  - Include critical expert if needed
Software

• Software must be appropriate for project-specific circumstances.

• Institutionally understand limitations of software and validation process
  • Is software appropriate for my task?

• MnDOT LRFD Bridge Design Manual Section 4.1
  • Basic
  • Intermediate
  • Complex
Software – Basic

• Bridge elements
  • Abutments
  • Splices
  • Bearings
  • Most cases of prestressed concrete beams

• Methods
  • Independent set of calculations
  • Line-by-line check of calculations
  • Using software that has been validated for a similar situation
• Bridge elements
  • Piers
  • Straight steel girders
  • Prestressed beams – flared or variable overhangs

• Methods
  • Independent design and check each using a different software package
  • Hand check using moderate simplifications with sound engineering judgment
Software – Complex

• Bridge elements
  • Concrete box girders
  • Steel box girders
  • Curved steel girders

• Methods
  • Independent design and check each using a different software package only!
• **Bridge Live Load Distribution**
  
  • Needed for some structure types
    
    • Concrete box girders
    
    • Curved steel girders
    
    • Beyond AASHTO parameters
    
    • Structures requiring a soil-structure interaction model

• **Checking Methods**
  
  • Compare to simplified AASHTO LLDF if appropriate
  
  • Utilize another model
Software – Checking methods

• Validated design software/spreadsheets
  • Evaluate all input and assumptions.
  • Review output to confirm a reasonable answer.

• Line-by-line check
  • Every line of calculations must be verified.

• Non-independent checking methods
  • Handwritten initials on each page reviewed
  • Not preprinted!
Software – Checking methods

• Independent checks
  • Must use different software packages or spreadsheets
  • Compare (at a minimum)
    • Input
    • Intermediate and final output values
      • Section properties
      • Dead load moments and shears
      • Live load moments and shears
      • Code checks
I'm going to need a little more for the root cause than, who'da thunk.
• Utilize appropriate procedures:
  • Drafting
  • Checking
  • Modifying
• Checklists
Drafting of Plans

- Quantities (with a check)

<table>
<thead>
<tr>
<th>SUMMARY OF QUANTITIES FOR SUPERSTRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRIDGE SLAB CONCRETE (3Y36)</td>
</tr>
<tr>
<td>CONCRETE WEARING COURSE (3U17A)</td>
</tr>
<tr>
<td>TYPE MOD F (TL-4) FAILING CONCRETE (3Y46)</td>
</tr>
<tr>
<td>REINFORCEMENT BARS (EPOXY COATED)</td>
</tr>
<tr>
<td>DIAPHRAGMS FOR TYPE MN54 PRESTRESSED BEAMS</td>
</tr>
<tr>
<td>EXP. CURVED PLATE BRG. ASSY TYPE E1</td>
</tr>
<tr>
<td>EXP. CURVED PLATE BRG. ASSY TYPE E2</td>
</tr>
<tr>
<td>EXP. CURVED PLATE BRG. ASSY TYPE E3</td>
</tr>
<tr>
<td>EXP. CURVED PLATE BRG. ASSY TYPE E4</td>
</tr>
<tr>
<td>FIXED CURVED PLATE BRG. ASSY TYPE F1</td>
</tr>
<tr>
<td>BEARING ASSEMBLY</td>
</tr>
<tr>
<td>EXPANSION JOINT DEVICES TYPE 4</td>
</tr>
<tr>
<td>PRESTRESSED CONCRETE BEAMS MN54</td>
</tr>
<tr>
<td>ENCH MARK DISK</td>
</tr>
<tr>
<td>BRIDGE NAME PLATE</td>
</tr>
<tr>
<td>1” LOW DENSITY POLYSTYRENE</td>
</tr>
</tbody>
</table>

- Reinforcing Steel
  - Bends, lengths, and numbers

BILL OF REINFORCEMENT FOR SUPERSTRUCTURE

<table>
<thead>
<tr>
<th>BAR</th>
<th>NO.</th>
<th>LENGTH</th>
<th>SHAPE</th>
<th>LOCATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1901E</td>
<td>583</td>
<td>40’-6”</td>
<td>SLAB TRANSVERSE BOT.</td>
<td></td>
</tr>
<tr>
<td>S1902E</td>
<td>583</td>
<td>28’-7”</td>
<td>SLAB TRANSVERSE BOT.</td>
<td></td>
</tr>
<tr>
<td>S1903E</td>
<td>2 SER. OF 50</td>
<td>FROM 3’-4” TO 58’-4”</td>
<td>SLAB TRANSVERSE BOT.</td>
<td></td>
</tr>
<tr>
<td>S1604E</td>
<td>741</td>
<td>47’-0”</td>
<td>SLAB TRANSVERSE TOP</td>
<td></td>
</tr>
<tr>
<td>S1605E</td>
<td>741</td>
<td>21’-5”</td>
<td>SLAB TRANSVERSE TOP</td>
<td></td>
</tr>
<tr>
<td>S1606E</td>
<td>2 SER. OF 64</td>
<td>FROM 3’-6” TO 60’-9”</td>
<td>SLAB TRANSVERSE TOP</td>
<td></td>
</tr>
<tr>
<td>S1701E</td>
<td>414</td>
<td>40’-0”</td>
<td>SLAB LONGITUDINAL TOP</td>
<td></td>
</tr>
<tr>
<td>S1801E</td>
<td>46</td>
<td>18’-3”</td>
<td>SLAB LONGITUDINAL TOP</td>
<td></td>
</tr>
<tr>
<td>S1609E</td>
<td>606</td>
<td>60’-0”</td>
<td>SLAB LONGITUDINAL BOT.</td>
<td></td>
</tr>
<tr>
<td>S1610E</td>
<td>101</td>
<td>19’-0”</td>
<td>SLAB LONGITUDINAL BOT.</td>
<td></td>
</tr>
<tr>
<td>S1911E</td>
<td>270</td>
<td>15’-6”</td>
<td>SLAB LONT, TOP OVER PIER</td>
<td></td>
</tr>
<tr>
<td>S1121E</td>
<td>164</td>
<td>3’-6”</td>
<td>END BLOCK TIE</td>
<td></td>
</tr>
<tr>
<td>S1131E</td>
<td>4</td>
<td>3’-11”</td>
<td>END BLOCK TIE</td>
<td></td>
</tr>
<tr>
<td>S1141E</td>
<td>4</td>
<td>3’-4”</td>
<td>END BLOCK TIE</td>
<td></td>
</tr>
<tr>
<td>S1151E</td>
<td>4</td>
<td>3’-0”</td>
<td>END BLOCK TIE</td>
<td></td>
</tr>
<tr>
<td>S1161E</td>
<td>4</td>
<td>4’-0”</td>
<td>END BLOCK TIE</td>
<td></td>
</tr>
<tr>
<td>S1171E</td>
<td>4</td>
<td>6’-8”</td>
<td>SLAB TIE</td>
<td></td>
</tr>
<tr>
<td>S1181E</td>
<td>8</td>
<td>10’-0”</td>
<td>END BLOCK TRANSVERSE</td>
<td></td>
</tr>
<tr>
<td>S1191E</td>
<td>32</td>
<td>38’-7”</td>
<td>END BLOCK TRANSVERSE</td>
<td></td>
</tr>
</tbody>
</table>
• Use Independent Technical Review for complex or unusual details

• Use Constructability Review for access, assumed means and methods, girder installation, congested details

• MnDOT staff involvement:
  • Unit Leader
  • Regional Construction Engineer
  • State Bridge Design Engineer
  • Others
Coordination with Roadway Plans

• Retaining Walls
  • Standard and non-standard

• Approach Panels

• Utilities (MnDOT LRFD Bridge Design Manual 2.4.1.6)
  • On bridges or near foundations

• Box Culverts

• Special Hydraulic Structures
Time vs. Quality

• At times we are limited on time to deliver plans

• **DO NOT** skip QC process to save time!

• Use over-the-shoulder (OTS) reviews to reduce risk and plan changes at final submittals

• Project manager responsibilities:
  
  • Follow the steps in order; if not over-communicate
  
  • **Communicate** potential issues with MnDOT ASAP, including personnel changes
  
  • Involve all stakeholders
PM’s – Use the Right Tools

The biggest mistake....

...is picking tools before you know the job.

flickr.com/photos/schillergarcia
Few Last Thoughts To Consider

• Design / Fabricated Components
  • Disc bearings, modular joints, pedestrian truss bridges
  • Design and check completed by supplier
  • We require a review – focus on assumptions

• MnDOT Reviews
  • We will be doing less review of consultant plans
  • 95% submittal is a ready to sign plan
    • Too many ‘swapped sheets’ after 100% turn in
Few Last Thoughts To Consider

Is this an error and by whom?
Few Last Thoughts To Consider

- Quality vs. Time vs. Cost
  - Never reduced quality (but others are important too!)

- Efficient design and detailing
  - Component size
  - Number of piling
  - Rebar size, detailing, and constructability
  - PCB – release strength (and final too)

- If you don’t agree with information provided, question it
Few Last Thoughts To Consider

• Plan quality – we’ve had some issues
• Your focus on quality is better than 5 years ago
• Having a good plan and improving on it is vital
• Over communicate changes and issues

Keep improving!!
ANY QUESTIONS ON QUALITY
Thank you!

Kevin Western
kevin.western@state.mn.us
651.366.4501