High Bridge Re-Deck Project
MnDOT Contract No. 1000532

Presented to:
Minnesota Department of Transportation

Bridge Repair Recommendations
- September 22, 2016
Bridge Overview

- 11 Total Spans, 2755’-0” Long
- 3-Span Continuous Steel Arch (282’-520’-242’) – Spans 3-5
- South Approach: 2-Span Continuous Multi-Girder Steel – Spans 1 & 2
- North Approach: 6-Span Continuous Multi-Girder Steel – Spans 6-11
Bridge Overview – Arch Spans

- Open Spandrel Tied Deck Arch
- Key Components: Arch Rib, Spandrel Columns, Tie
- Unique Aspects: Tie - W33X118 & 4 - Post-Tensioned (PT) Tendons
  - PT Tendons Consist of 19 - 0.6” diam. Strands
Bridge Overview – Arch Spans

- Arch Spans – Spans 3-5
- Variable Width in Span 3 & ½ of Span 4
- Width Varies from 54’-4” to 68’-10”
Existing Bridge Deck / Cross Section

Out-to-Out Width Varies from 54’-4” to 79’-1”
Proposed Cross Section

PROPOSED TRANSVERSE SECTION
Bridge Overview – North Approach Spans

- 6-Span Continuous Steel Multi-Girder (225’ Spans & 160’ N. End Span)
- 8’ Deep Constant Web Depth and Variable Depth Sections
- Unique Aspects:
  - Horizontally-curved for northern end span
  - Variable-Width Flared and Kinked Framing
  - 11’-3” to ~14’ Variable Width Girder Spacing
  - Girder 3 is Partial Length with Sub-Stringer Added in Span 9 to support Deck
Bridge Overview – South Approach Spans

- 2-Span Continuous Steel Multi-Girder (~ 213’-213’)
- Approx. 13’ Girder Spacing, 12’-0” Web Depth
- Unique Aspects:
  - Horizontally-curved
  - Variable-Width Flared and Kinked Framing
## Load Rating Results (Inventory Level)

<table>
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<tr>
<th>Unit</th>
<th>Component</th>
<th>Bridge Originally Constructed (BOC)</th>
<th>BOC with Condition &amp; System Factors</th>
<th>Bridge Re-Deck with Condition &amp; System Factors</th>
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<tr>
<td>Main Arch Spans</td>
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- Low ratings largely a function of code changes and/or a result of sidewalk loadings not considered in original design
- Arch Rib Strengthening Not Required
- **Arch Span Stringers:**
  - Original design assumed bracing at DL contraflexure points and partial composite behavior, neither permitted by modern code
  - Bridge rehab will include **new diaphragm bracing** and full composite design with new deck
- **Approach Span Girders:**
  - Ratings driven by Lateral Torsional Buckling: Anticipated that addition of select new **cross-frames** will improve inventory ratings above 1.0 as part of re-decking
Major Items of Work

• **Deck Removal & Replacement**
  - Arch Spans: Deck Demolition and Replacement to be Sequenced with PT Tie D- Tensioning/Replacement

• **Replacement of Arch Tie PT Tendons**

• **Deck Construction**
  - Arch Spans – 9" (Includes 2" Wearing Course)
  - Approach Spans – 10" (Includes 2" Wearing Course)
  - Composite Construction – Existing Shear Stud Removal and Install New
  - Stainless Steel Rebar in Arch Spans
  - 6 Deck Joints, including 2 Modular Joints

• **Construction of Barriers**
  - Constructability of Slip-Forming of Barriers
  - Aesthetic Treatment to Barriers
  - Bridge Lighting

• **Decorative Pedestrian Railing at Fascia**
Re-Decking of Arch Spans

- Span Configuration = 282’-520’-242’; Out-to-Out Width Varies 54’-4” to 68’-10”
- 9’-8” Typical Stringer Spacing within Constant-Width Section
- 10’-6” Max Stringer Spacing in Flared Section
- Interior Stringers – Simple-Made Continuous Between Relief Joints
- Fascia Stringers – Fully Continuous Between Relief Joints
Re-Decking of Arch Spans

- Exist & Proposed Deck in Arch Spans = 9” Deck (Includes 2” Wearing Surface)
- Original Deck Construction Sequence:
  - Partial Tie Post-Tensioning (PT)
  - Partial Tie PT; 5. Place Deck Between PP 11 – 19. Then Partial PT
  - Construct Sidewalks, Barriers, and Wearing Surface; Then Finalize PT.
Re-Decking Analysis

- Sequential Construction Analysis
- Deck Removal / PT De-Tensioning Sequence – Design team will assess two options for CMGC to consider:
  - Option 1: Reverse of Original Deck Construction
  - Option 2: Removal in Longitudinal Strips Sequenced with PT De-Tensioning

Tie (WF & 4-PT Tendons)

Steel Arch Sequential Construction Analysis Model
Replacement of Arch Tie Tendons
Replacement of Arch Tie Tendons
Replacement of Arch Tie Tendons
Re-Decking of South Approach Spans

- Span Configuration = 212-9” – 212-9”
- Out-to-Out Width Varies  74'-9” to 68'-10”
- Girder Spacing Varies: 13’-2” max
- Exist & Proposed Deck = 10” Deck (Includes 2” Wearing Surface)
Re-Decking of North Approach Spans

- **Spans 6-11:**
  - 6-Span Continuous:
  - 225’-225’-225’-225’-225’-160’
  - 11 Deck Pours Anticipated in Sequence

- **Curved End 2 Spans**

- **Flared Framing**
  - Out-to-Out Width Varies 54’-4” to 79’-1”

- **Girder Spacing Varies:** 14’-0” max

- **Additional Girder Line (and Sub-Stringer)** added in Span 9

- **Existing Slab Varies** from 9¼” to 10½” (Including 2” Wearing Surface)

- **Proposed Slab Thickness** = Constant Thickness of 10” (To Be Confirmed)
Major Items of Steel Work

- Stringer Diaphragm Installation (140 New Channel Diaphragms)
  - Stringers Require Bottom Flange Bracing Between Supports for LTB checks per current AASHTO LRFD Code
- Install Select New Cross-Frames in North Approach Spans
- Pot Bearing Replacement at North Abutment

New Diaphragms (Steel Channels Between Stringers)
Major Items of Steel Work

- Floorbeam Overhang Strengthening
Major Items of Steel Work

- Stringer-to-Floorbeam Connection – Crack Repairs
  - Grind to Remove Weld and/or UIT Treatment
Major Items of Work Continued

- Zone Painting at Joints and Near Base of Arch
- Pot Bearing Replacement at North Abutment
- Substructure Concrete Repairs
- Abutment Decorative Barrier Walls to be Removed for Construction of Platform Overlooks over Flared Wingwalls
Construction Schedule

- **Project Letting:** September 2017
- **One Year On-Site Construction (Complete by Dec 2018)**
- **Important to begin placing deck concrete in April 2018**
- **Arch Span or Approach Span Re-Decking Preferable to be First?**

**Key Fall 2017 / Winter 2018 Work:**
- Constr Submittals /Approvals for Arch Span Sequenced Demolition & PT Work
- Feb / March - Arch Span Demolition / PT Work
- Structural Steel and Modular Joint Shop Drawing Approvals / Procurement

**Traffic Control and Construction Co-ordination with Adjacent Roadway Projects**
Questions and Answers