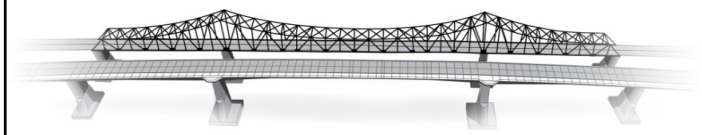


The Winona Bridge Rehabilitation

A Tale of History, Collaboration, and Internal Redundancy

February 5, 2019

Keith Molnau, P.E.

Kent Zinn, P.E.

DEPARTMENT OF TRANSPORTATION

Michael Baker INTERNATIONAL

OUTLINE (Joint MNDOT/Baker Presentation)

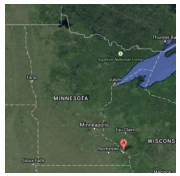
- Project Overview/Project Background (MnDOT)
  - Bridge 5900 – Historic Bridge Review and Previous Repair Projects
  - Chapter 152 Bridge Replacement Program vs. Section 106 Process
  - Scoping, Preliminary Design, and Environmental Assessment, Preliminary Design
  - Construction Manger/General Contactor (CMGC) Delivery Method
  - Project Elements, Work Packages, & Accelerated Project Delivery
- CIP Segmental River Crossing / CMGC Lessons learned
- Bridge 5900 Rehabilitation & Reconstruction (MnDOT/Baker)
  - Design Challenges (MnDOT)
  - Scour Monitoring & Scour Countermeasures (MnDOT)
  - Vessel Impact Considerations and Vessel Impact Event (MnDOT)
  - Timber Pile Investigation (Baker)
  - Consideration of Internal Redundancy (Baker)
  - Design of Bridge 5900 (Baker)
  - Full Build vs. Modernized Approach Spans (Baker)
  - Construction Support/RID Document
  - Pre-construction CMGC input, lessons learned, and EOR Construction Support
- Project Participants – Collaboration of Project Design Team

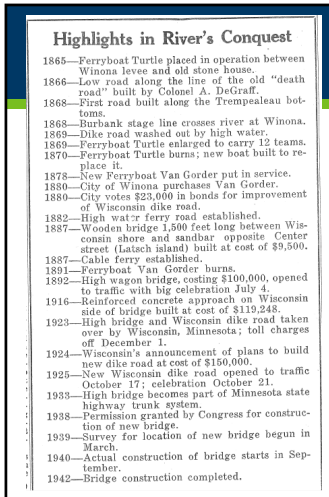
Project Overview / Project Background

Project background:

- Winona, Minnesota
- T.H. 43 over Mississippi River
- 125 Miles South of St. Paul
- Connects Winona to Latch Island, then to Wisconsin
- Bridge 5900 replaced the Wagon Bridge and opened in 1942
- Previous Repair Projects

- Project Needs:
- MN Chapter 152 – Tier 1 bridge
- Legislation and Funding was provided for Fracture Critical Bridge Projects (2007-2018)
- Rehabilitation Study initiated in 2009 resulting in Preferred Alternative in 2013





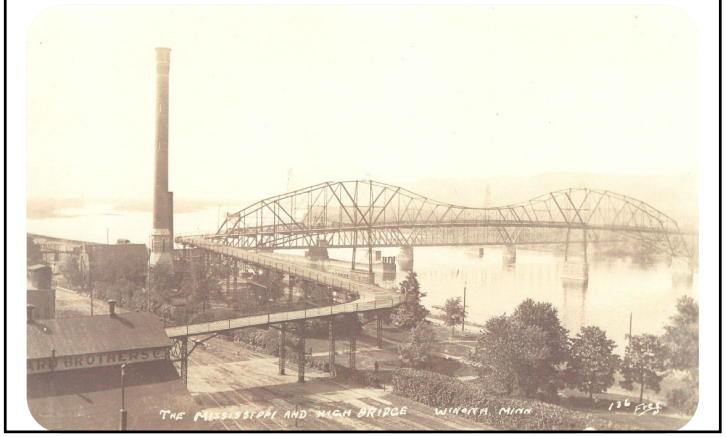
Highlights in River's Conquest

1865—Ferryboat Turtle placed in operation between Winona levee and old stone house.
1866—Low road along the line of the old "death road" built by Colonel A. DeGraff.
1868—First road built along the Trempealeau bottoms.
1868—Burbank stage line crosses river at Winona.
1869—Dike road washed out by high water.
1869—Ferryboat Turtle enlarged to carry 12 teams.
1870—Ferryboat Turtle burns; new boat built to replace it.
1878—New Ferryboat Van Gorder put in service.
1880—City of Winona purchases Van Gorder.
1880—City votes $23,000 in bonds for improvement of Wisconsin dike road.
1882—High water ferry road established.
1887—Wooden bridge 1,500 feet long between Wisconsin shore and sandbar opposite Center street (Latsch island) built at cost of $9,500.
1887—Cable ferry established.
1891—Ferryboat Van Gorder burns.
1892—High wagon bridge, costing $100,000, opened to traffic with big celebration July 4.
1916—Reinforced concrete approach on Wisconsin side of bridge built at cost of $119,248.
1923—High bridge and Wisconsin dike road taken over by Wisconsin, Minnesota; toll charges off December 1.
1924—Wisconsin's announcement of plans to build new dike road at cost of $150,000.
1925—New Wisconsin dike road opened to traffic October 17; celebration October 21.
1933—High bridge becomes part of Minnesota state highway trunk system.
1938—Permission granted by Congress for construction of new bridge.
1939—Survey for location of new bridge begun in March.
1940—Actual construction of bridge starts in September.
1942—Bridge construction completed.

Project Background

- Central Files – Historic Bridge information
- 1865: Furryboat Turtle
- 1892: High Wagon Bridge
- 1942: Bridge 5900 (opened)
- 2016: Bridge 85851 (opened)
- 2019/2020: Bridge 5900 (soon to be opened)

Project Background



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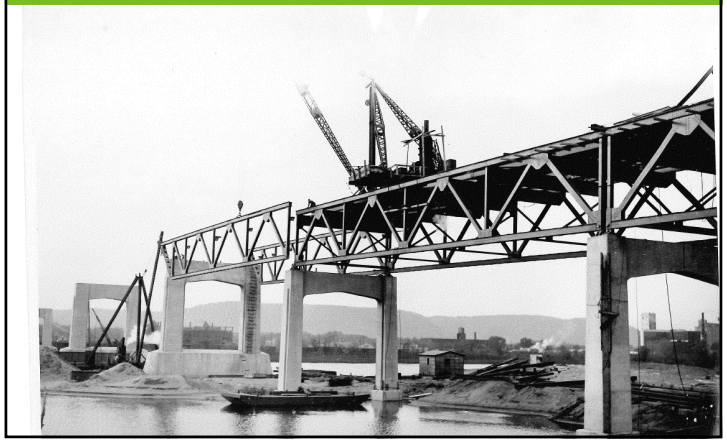
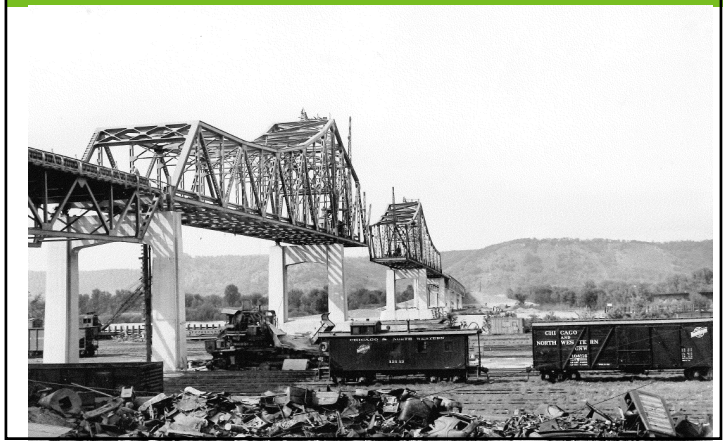


Project Background

Project Background



Project Background

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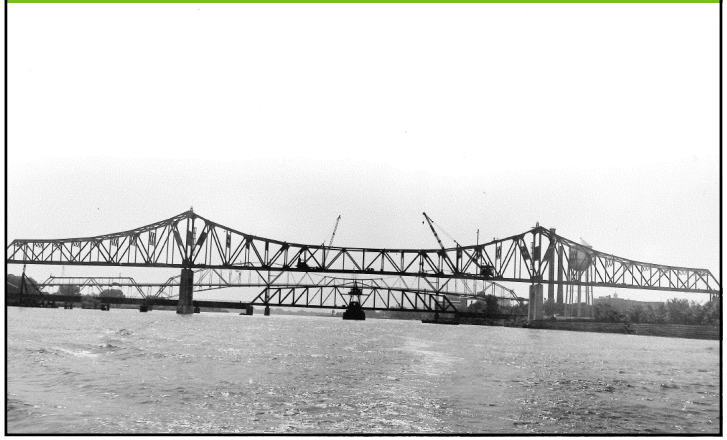
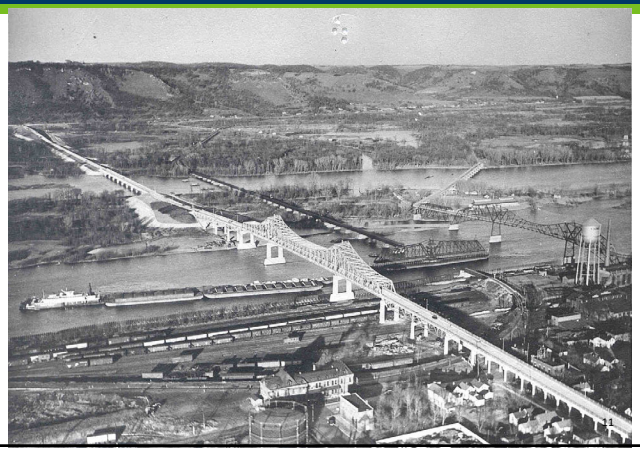


Project Background



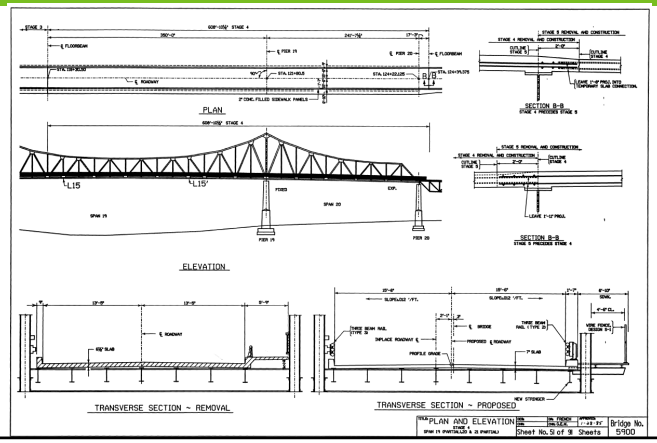
Previous Repair Projects

- 1942 – Bridge 5900 opened to traffic….(functioned for 43 years…)
- 1985 – Bridge Deck Replacement, cantilevered Sidewalk, painted…(12 years…)
- 1997 – Hanger Span Pin Replacement….(1 pin replaced – inspected original)
- 1998 – River Piers 19 & 20 – Concrete Collars Installed at Waterline…(20 years…)
- 2005 – Rocker Bearing(s) Replaced under Deck Trusses
- 2008 – Gusset Plate Repairs (Emergency Contract)

  Sidewalk Grid replaced with used Glu-lam panels

  Scour Analysis Updated – Scour Critical Determination
- 2010 – Additional Gusset Plate Repairs Made, Bridge Posted to 40 ton (legal)

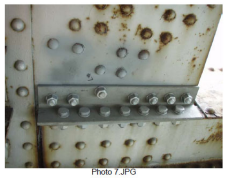
Previous Re-deck and Paint Project, 1985



Previous Gusset Plate Repair Project (2008)


Photo 5.JPG


Photo 6.JPG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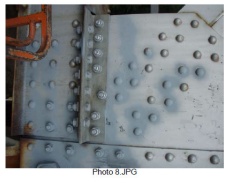


Photo 8.JPG


Photo 10.JPG

- Bridge closed for emergency repair to gusset plates (2008)
- Bridge Posted 40 ton legal loads, (2008)

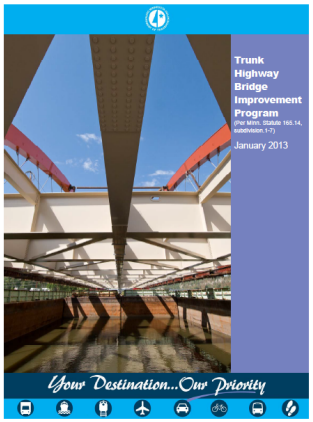
Project Overview / Project Background

Project background:

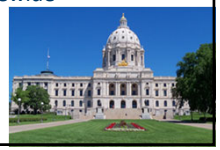
- Winona, Minnesota
- T.H. 43 over Mississippi River
- 125 Miles South of St. Paul
- Connects Winona to Latch Island, then to Wisconsin
- Bridge 5900 replaced the Wagon Bridge and opened in 1942
- Previous Repair Projects

- Project Scoping Phase (2009 – 2013)
- MN Chapter 152 – Tier 1 bridge
- Bridge 5900 is a fracture critical bridge
- Historically Significant: Eligible for listing on National Registry of Historic Places (NRHP)

Chapter 152 Program



- Following the collapse of the 35W Bridge (Aug 1, 2007)
- Legislation and Funding was provided for development of Bridge Replacement Program
- Emphasis on Fracture Critical Bridge Projects (2007-2018)
- $2 Billion Statewide



Chapter 152 Program

Subd. 4.

Prioritization of bridge projects.

- Laws passed by the Minnesota legislature (2008 Chapter 152) required MnDOT to develop a Bridge replacement program, and classify all bridges in the program into tier 1, 2, or 3, where tier 1 is the highest priority tier.
- *"By June 30, 2018, all tier 1 and tier 2 bridges originally included in the program must be under contract for repair or replacement with a new bridge than includes a load-path redundant design, except that a specific bridge may remain in continued service if the reasons are documented in the report documented under subdivision 5."*
- *"for any tier 1 fracture-critical bridge that is repaired but not replaced, an explanation of the reasons for repair instead of replacement".*

Bridge 5900 – Historic Bridge Overview

- Bridge 5900 *eligible for listing*- National Registry of Historic Places (NRHP)
- Federal Laws – provide for projection of Historic Properties (Section 106)
- Selection of a recommended alternative is informed by the historic review process, based on many factors:
  - Cost, feasibility, constructability, general visual quality
  - Impacts to environmental, social and economic resources
- Balances Historic Preservation & Transportation Needs of Traveling Public

Bridge 5900 – Historic Bridge Overview

- Review Alternatives for Rehabilitation in accordance with the SOI Standards and avoid or minimize adverse effects on the Historic Property

Standard 6

Deteriorated structural members and architectural features shall be retained and repaired, rather than replaced.

Where the severity of deterioration requires replacement of a distinctive element, the new element should match the old in design, texture, and other visual qualities and where possible, materials.

From the Virginia Transportation Research Council's adaptation of the Standards for the Special Requirements of Historic Bridges.

Bridge 5900 – Historic Bridge Overview

Minnesota's last example of pre-1946 Cantilever Through Truss – Eligible for NRHP

Section 106 Process Required evaluation of rehabilitation alternatives to determine if feasible and prudent alternatives exist that have *no adverse effect* on historic Bridge 5900

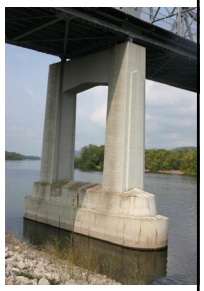
Existing Bridge 5900:

- Built 1942
- Rehab 1985
- Gusset Repairs 2008 and 2010
- Load Posting: 40 Ton
- Timber Piles , scour critical
- *Legislative Funding (Chapter 152) – emphasis on replacement with "Load Path Redundant Design"*

Winona Bridge: Character Defining Features

- Feature 1 – Cantilever through-truss main spans
- Feature 2 – Deck-truss approach spans
- Feature 3 – Architectural style in bridge piers



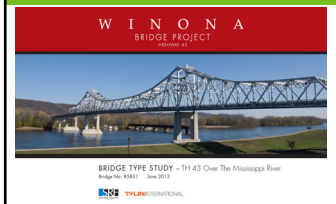


Winona Bridge: additional notable features

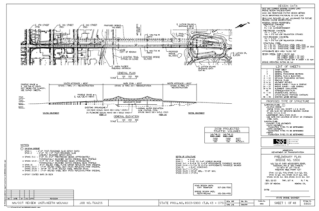
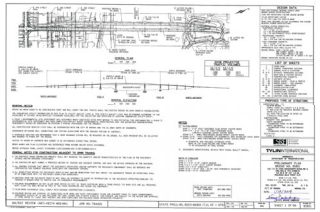
- Latsch Island stonework
- Moderne endpost remnant
- Plate-girder span




Key Milestone: CMGC Project Information Meeting



- June 2013: Nearing completion of Scoping Phase/Prelim Design Phase
- Bridge Type Study, Layout, Preliminary Bridge Plans under development
- EA (DRAFT) work in progress

Project Layout - 2013

- Several Alignments Studied (documented in Environmental Assessment)
- Preferred Alignment: Parallel Upstream alignment selected
- 50 feet between bridges allows for construction and future maintenance
- MOT needs led to need for upstream bridge with pedestrian trail
- Finding of No Significant Impact (FONSI) - Jan. 30, 2014

Project Scoping Phase (2009 – 2013) Environmental Assessment (EA)

- Primary Need: A structurally sound bridge
- Secondary Needs:
  - MOT (25 mile detour), regional crossing with access to 2 river ports in Winona, emergency response fire, law enforcement, medical vehicles
  - Improve Roadway Capacity (20 yr marginal, 50 yr = 19,700 vpd)
  - Maintain Ped and Bike Accommodations
  - Meet Critical Regulatory Requirements (Historic Resources)
  - Maintain Navigational Channel
- Other Considerations:
  - Improve Bike Ped Accommodations
  - *Structural Load Path Redundancy*
  - Improve Bridge Geometrics, Minimize impacts to local roadway & Truck Route Impacts

Key Issue – The Parallel Bridge

Visual Quality – Advanced in 2-Stage Process:

1) Preliminary Design Phase (SRF)
   a) Winona Bridge 3D Simulation Drive Thru completed: Oct. 2013 (SRF & TYLIN)
   b) Preliminary Bridge Plans for New Bridge 85851 developed with input from the Visual Quality Advisory Committee
   c) Vision Statement, Design Theme, Preliminary Bridge Aesthetics (Feb 2014)

Winona Bridge Project | Visual Quality Manual
February 11, 2014

http://www.dot.state.mn.us/winonabridge/index.html

Visual Quality Review Committee Project Vision Statement

DESIGN RENDERINGS

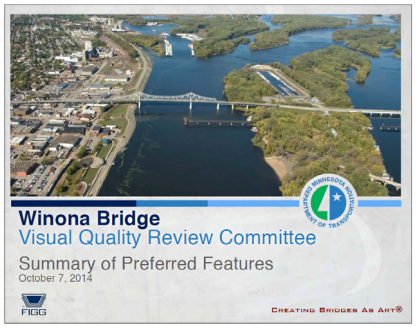
Figure 3.2 View of the project looking upstream from the Waterfront Trail near Levee Park

Figure 3.3 View of the project looking downstream from the Waterfront Trail near Riverview Drive

The Winona Bridge should reflect the current era while respecting the past. The existing bridge is a visual icon for the city, and so the new bridge should defer its prominent visual presence. The new bridge should celebrate the river's natural beauty and the cultural history of Winona that is intertwined with the river. Together, the two bridges should symbolize a welcoming gateway to beauty, culture, and prosperity.

Visual Quality Process

2) Visual Quality Refinements continued with Final Design Phase (FIGG)
Summary of Preferred Features (2/4/14 – 9/25/14)



Organic Theme Selected

- Bridge piers and overlooks
- Abutments & retaining walls
- Pedestrian Railing and curb
- Bridge and railing color
- Bridge Lighting
- Latch Island trail railing
- Winona Sign at North Abutment

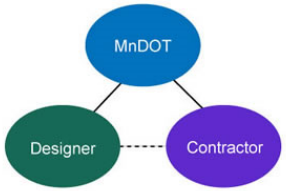
Visual Assessment of Bridge 5900 -

Assessment of Visual Impacts on Historic Properties:
Separate ongoing process concurrent with Development of Bridge 5900 Rehabilitation Plans - Review by CRU, Project Historian, SHPO (Baker/KH)

Construction Manager/General Contractor (CMGC)

- 2012 - MnDOT received Legislative Authority for CMGC Contracting Process on 10 projects
- Integrated approach to planning, design and construction
- Owners, designer(s), and contractors collaborate to develop project scope, optimize design, improve quality, and manage cost.

CM/GC Contracting Relationship

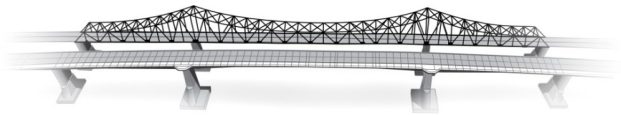


Construction Manager/General Contractor (CMGC) Benefits

- Allows for collaboration with the contractor, but the owner retains control of the design
- Innovation
- Minimize/Manage Risk
- Improved Constructability
- Schedule Optimization
- Cost Management – Cost Certainty earlier in the project

Winona Bridge Project Goals

- Start Construction on the New Bridge ASAP *(July 2014)*
- Place Traffic on New Bridge 85851 ASAP to minimize likelihood for detours due to bridge maintenance work
- Keep river crossing open during construction.
- Meet the overall project funding cap of $162 million.
- Stay within construction funding of $125 million
- Stay within Engineering and ROW funding of $37 million additional.

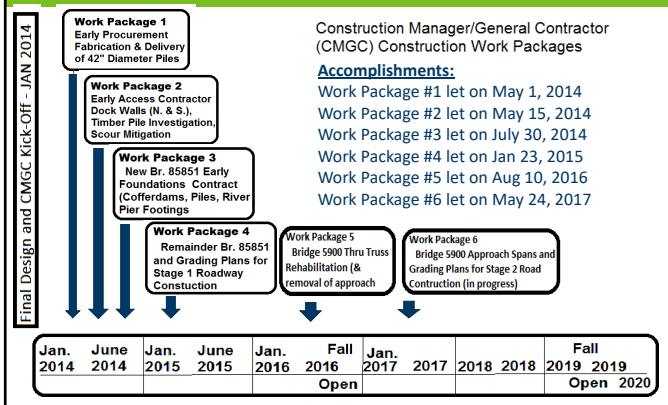


Winona CMGC Project

- WHY CMGC?

1. To meet the goal of opening the new bridge by the end of 2016, it was the only procurement method.
   a. Break Project into Work Packages (get ROW off critical path)
   b. Overall Master Construction Schedule (fluid)
   c. Steam-line Plan Reviews and Advertisements
   d. Coordinate Early with Construction Team (minimize risks)
2. For the Rehabilitation of Bridge 5900
   a. Recent Significant bid Overruns on Similar Work
   b. Contractor Means and Methods
   c. Early input from Constructor's subs (Complex steel rehab)
   d. More time for Section 106 review process (lag schedule)

Winona CMGC Project – Work Packages

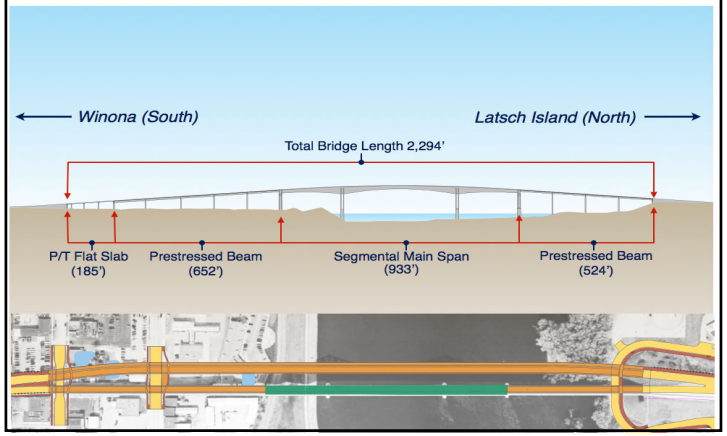


Construction Manager/General Contractor (CMGC) Construction Work Packages

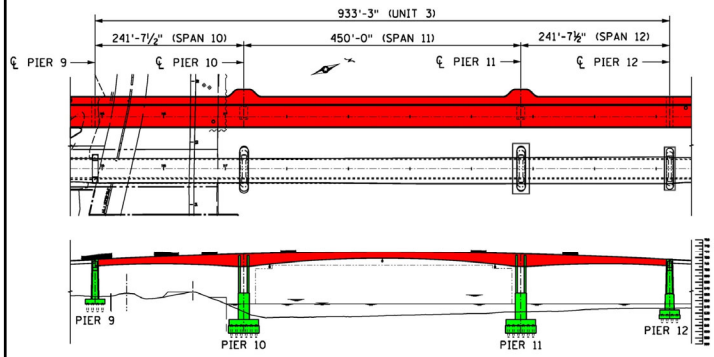
Accomplishments:

Work Package #1 let on May 1, 2014
Work Package #2 let on May 15, 2014
Work Package #3 let on July 30, 2014
Work Package #4 let on Jan 23, 2015
Work Package #5 let on Aug 10, 2016
Work Package #6 let on May 24, 2017

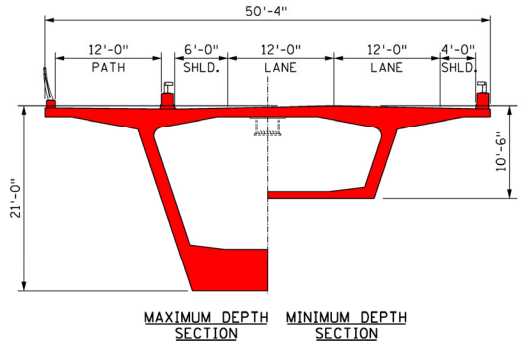
Bridge 85851 Layout / Units



Segmental River Crossing - Main Span Layout



CIP Segmental Bridge Segment Variable Depth Cross Section



TYPICAL CROSS-SECTION

Bridge 85851 - Construction

Work Package 1 – Procurement of Materials

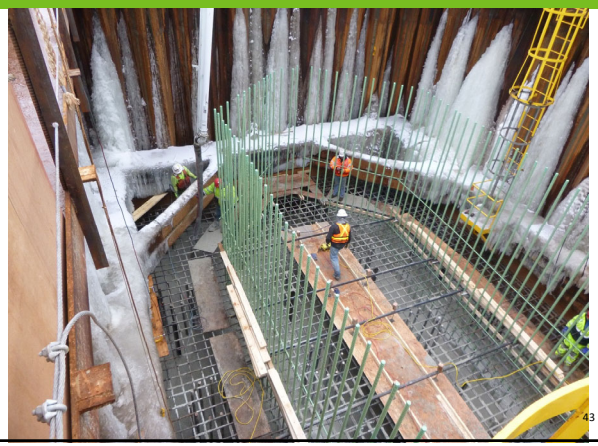
Work Package 2 – Early Contractor Access

North Dock Wall and Contractor's Material Lay-Down Area

Barge delivery of dredged sands used for back fill after testing for contaminants

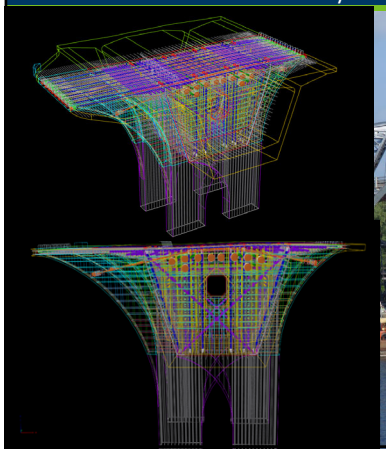
Work Package 2: Contractor Access and Included Timber Pile Investigation

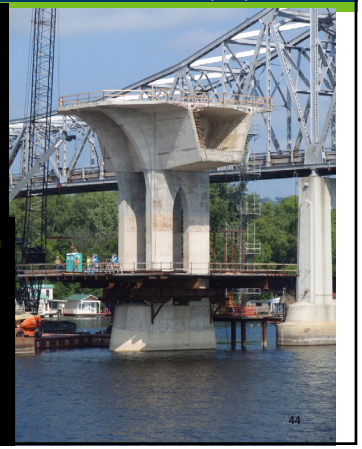
WP 3: Bridge 85851- Early Foundations Contract



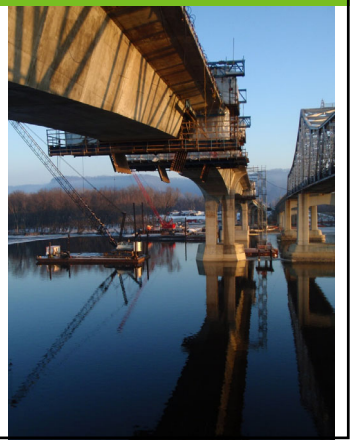
Segmental Shop Drawings – by EOR (Figg) with Review by PEER REVIEWER (PTG)

Likely accelerated schedule by 1 year…





Work Package 4: CIP Segmental Bridge 85851



Work Package 4: Br. 85851 + Approach Spans
Construction Proceeded (Spring of 2015 thru 2016)

Bridge 85851 – Awards and Recognition

- Road and Bridge– Top 10
- ASBI – Honorable Mention
- ASPIRE – Winter 2017

The result is almost a mirror image, ...turns the two bridges into an ensemble, in spite of the fact that they are completely different materials, technologies, and colors. The most powerful visual aspect of any bridge is its overall shape, and here the designers have made that shape work for them very well.

Frederik Gottemoeller, ASPIRE Winter 2017

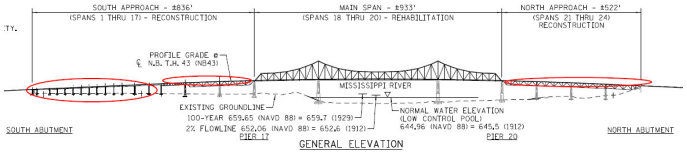
Bridge 85851 – Opened to Traffic Aug. 27, 2016

Bridge 85851 – Lessons Learned

- CMGC Coordination During Final Design Phase
  - Early Procurement of Materials (6 – 9 month lead time delivery 42" piles)
  - Early Access: Construction Access (sheet pile walls on river banks early)
- Early Foundations Contract (decoupled ROW acquisition)
- EOR Development of Segmental Shop Drawings (Collaboration)
  - CMGC Contractor's Post-tensioning suppliers /Collaboration with EOR/PEER REVIEW
  - Incorporated PT Systems, form-traveler details, accelerated shop drawings
  - Process enabled seamless transition to Segmental Construction/ Saving est. 1 year!
- Construction Engineer: All Falsework + Independent Construction Model (Contract requirement)
- EOR Geometry Control & Construction Support (full time on site)
- Earlier Project Cost Assessments (30%, 60%, 90%, IFB Design Phases)

Bridge 5900 Rehabilitation and Reconstruction

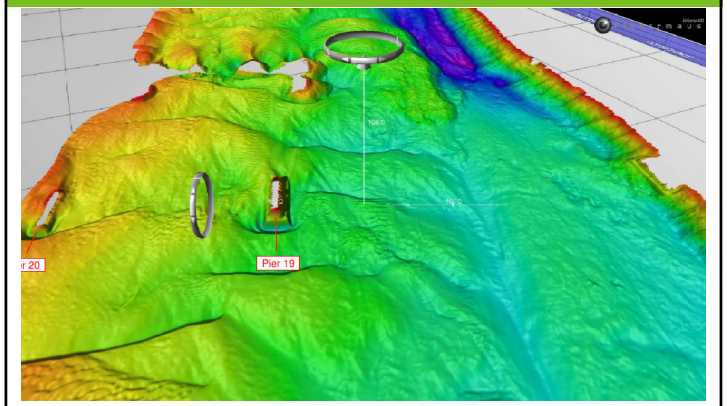
New South Approach Spans Rehab Main Truss Spans New North Approach Spans



Bridge 5900 – Design Challenges

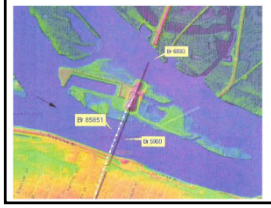
- Scour Mitigation Measures
- Vessel Collision Design and potential foundation retrofit
- Foundations: Timber Pile investigation
- Strengthen Bridge to accommodate all Permit Vehicles
- Include Internal Redundancy / Special Design Loads
- Compliance with Section 106 Requirements – *no adverse effect*
- Construction Challenges and Construction Support
- Lessons Learned/Discussion/Questions

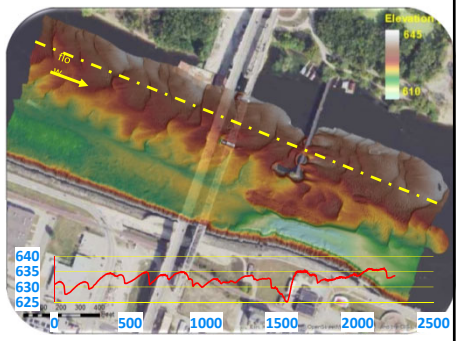
Winona Update: Scour Mitigation



Mississippi River bathymetry at TH43 crossing, Winona

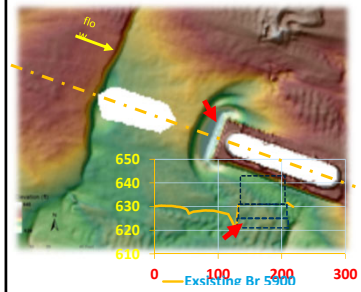
- Mississippi River – Splits into main channel and back channel – separated by Latch Island
- 100yr Q ~240,000 cfs (~160,000 cfs under bridge 5900). Average velocity ~5.5 ft/s
- Two main channel piers subject to scour
- Pool elevation of 645 ft
- River bed dunes of up to 5 ft high at pool elevation



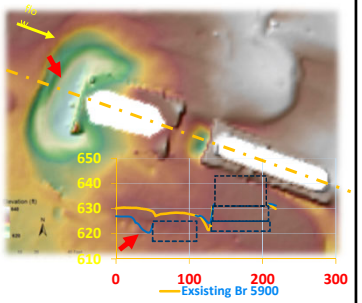


River bed before and after installation of new cofferdam

May 2014

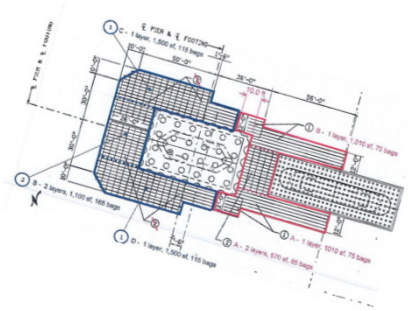


November 2014



Temporary scour countermeasure during construction

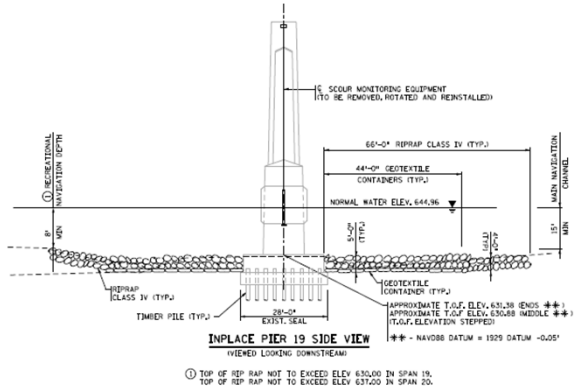
- Geotextile bags were selected:
  - Depth of water
  - Strong current (>3 ft/s)
  - Can be used as stand alone counter measure



…Installation

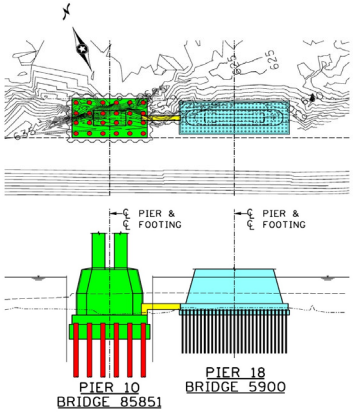
- Size: 4' x 4' x 1'
- Gravel Filled and stitched on site
- Weight: 1 ton

Scour Protection

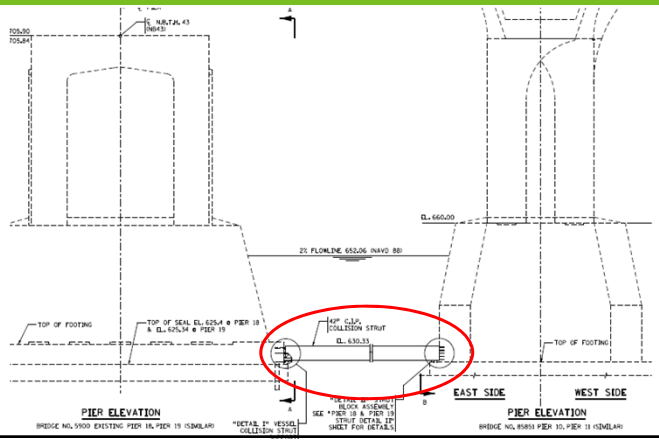


Vessel Impact Study – Br. 85851 & Br. 5900

- 24 – 42" Diam. Pipe Piles ¾" wall
  - Concrete filled
  - 120' long
- Vessel impact load: 3000 kip (P18), and 3664 kip (P19)
- Strut between existing bridge and new bridge for vessel impact
- 264 timber piles Br. 5900 (P18 & P19)



Winona: Vessel Impact – Collision Strut



Winona: Vessel Impact – Collision Strut

Bridge 85851: Vessel Impact 7.31.18

Barge Impact to Pier 11 Upstream nose of Pier Wall

Spall Area = 31 sq. ft.

No cracking in or propagating from impacted areas

Field inspection performed same afternoon by MNDOT (D6) with subsequent close-up inspection of pier blades

Scour Monitoring Equipment (bracket & sensors) damaged

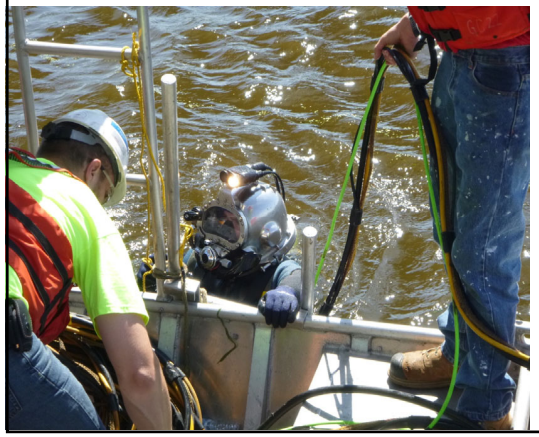
Vessel Impact 7.31.2018

Bridge 5900 – Design Challenges

- *Scour Mitigation Measures*
- *Vessel Collision Design and potential foundation retrofit*
- Foundations: Timber Pile investigation
- Strengthen Bridge to accommodate all Permit Vehicles
- Include Internal Redundancy
- Compliance with Section 106 Requirements – *no adverse effect*
- Construction Challenges and Construction Support
- Lessons Learned/Discussion/Questions

River Pier Foundation Evaluation

Work Package 2 – Pile Investigation



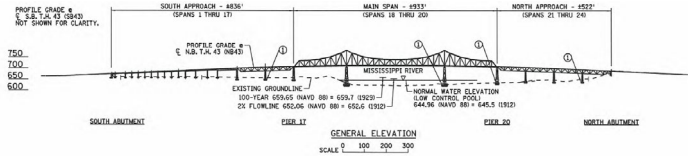
Contractor's sub (BRENNAN) obtained Timber Pile Samples from Bridge 5900

Samples tested by Forest Products Lab for decay and structural integrity

Part 1 (per WP2)
Sample pencil cores taken from 2 river piers and 2 land based piers

Part 2 (Change Order)
Additional pencil cores and full pile sections from P19 and P20

Work Package 2 – Pile Investigation



Part 1: Per original Contract (WP2): Extract pile cores from 4 piers

Pier 16 (Treated) Pier 19 , Pier 20, Pier 23 (Creasote Treated)

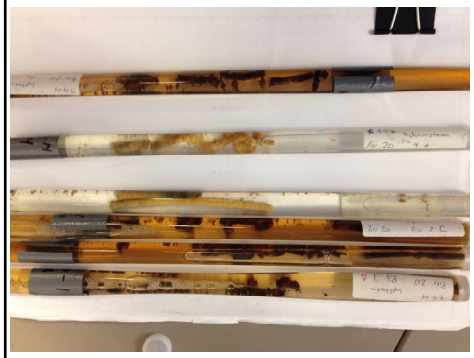
Part 2: Per Supplemental Agreement/Change Order:

Additional Pencil Cores: Pier 17, Pier 18, Pier 19, Pier 20, Pier 22

Extract Full 3' long full pile section from Pier 19, and

Extract Full 3' long full pile section from Pier 20

Timber Pile Investigation – Part 1 Core Sample



Pencil core samples from Pier 19 and Pier 20 - obtained 9-5-2014

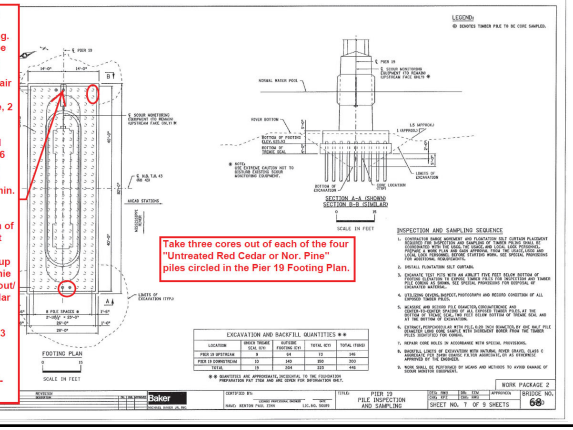
Bubbles encountered during extraction process (with video provided for assessment)

Integrity of Sample as viewed in sample tubes was questionable and was discussed at PDT Mtg.

Review by Project Design Team resulted in Recommendation for Change Order to provide further investigation per Change Order

Timber Pile Investigation – Part 2 Change Order

Extract 3 ft. min. long full pile section for testing. Top cut should be at least 6 inches below bottom of tremie seal. Repair by placing and securing in place, 2 ft. 6 in. min. diameter collar around extracted pile overlapping 6 inch min. stub to bottom of tremie seal and 6 inch min. remaining pile section below extracted portion of pile. Pump grout into collar from bottom of collar up to bottom of tremie seal. Provide grout/ vent holes in collar as required for placing grout. Grout should be 3 ksi min. design strength sand/ cement grout including an anti-washout agent.



Work Package 2 – Pile Investigation

- Part 2: Full Pile Section Samples

Specimen ID: **19-5** ~ 16 in. dia. ~ 35 in. long		
Specimen ID: **20-5** ~14.5 in. dia. ~26 in. long		

Timber Pile Investigation Results

Reuse of Existing Foundations for River Piers 18, 19, 20 and 21 (FADR.rev6 – 1135 pages)

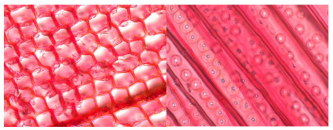
3.0 Existing Pile Conditions

3.1 - Confirm Pile Records, Type, Size, Species

3.2 – Evaluation of small core samples

3.2.1 Specific Gravity

3.2.2 Deterioration



Example of a structurally sound (a) longitudinal and (b) radial section of wood. Note cells are evenly stained, uniform shape, and bordered pits are even intact. These are actual sections taken from Pile 19.

3.3 – Evaluation of Full Pile Section Test Results (P19 & P20)

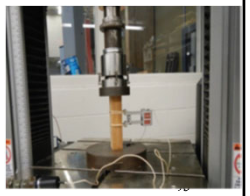
3.3.1 Specific Gravity

3.3.2 Bending Stress

3.3.3 Compression parallel to grain

3.3.4 Modulus of elasticity:

3.3.5 Deterioration: no signs of decay n heartwood



Timber Pile Investigation/FADR Results

Table 9 - Specific Gravity of Large Cut Sections

	Pier 19 Cedar Pile	Pier 20 Cedar Pile
Average SG bending specimens	0.31	0.32
Average SG all compression specimens	0.32	0.34
Average SG Outer 1" compression specimens only	0.28*	0.31**

* Based on one sample only.
** Based on 3 samples obtained from outer 1"

Table 10 - Results of Bending Tests

	Pier 19 Cedar Pile	Pier 20 Cedar Pile
Average Clear F_b (psi)	3650	4050
Std. Dev. (psi)	380	217
Overall average F_b (psi)	3800	
Overall Std. Dev. (psi)	382	

Table 11 - Results of Compression Tests

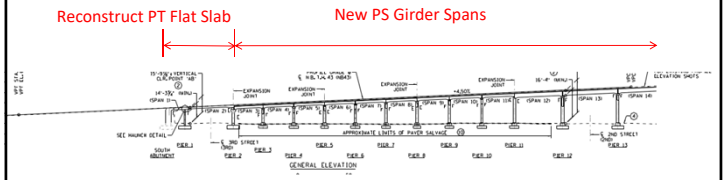
		Pier 19 Cedar Pile	Pier 20 Cedar Pile	Overall
Heartwood	Average Clear F_c (psi)	2267	2583	2425
	Std. Dev. (psi)	218	198	260
Sapwood	Average Clear F_c (psi)	1641	2448	2045
	Std. Dev. (psi)	---	---	571

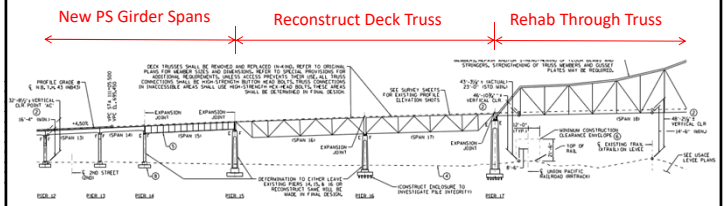
Table 12 - Results of Modulus of Elasticity Tests

	Pier 19 Cedar Pile	Pier 20 Cedar Pile
Average Clear E (ksi)	1000	1000
Std. Dev. (ksi)	93	67
Overall average E (ksi)	1000	
Overall Std. Dev. (ksi)	96	

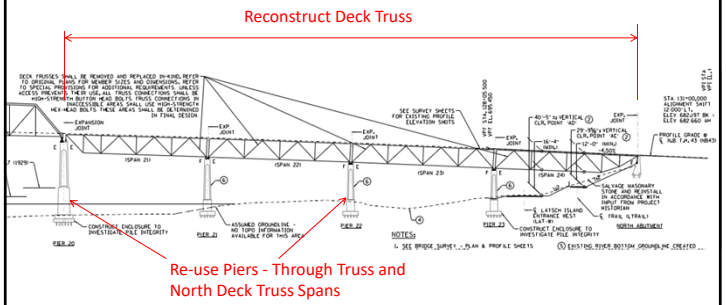
- Results of Timber Pile Investigation resulted in confirmation that Timber Piles OK
- <u>Recommendations:</u>
- Replace South Approach Piers
  - Must replace Pier 16 (new P7)
  - Strong Desire to reuse Pier 21
- Re-use Pier 17 – P23
- Re-use North Abutment

Scope of Work





Scope of Work



Existing Bridge Condition

Existing Bridge Condition

- Floorbeam Connections

Existing Bridge Condition

- Stringers

Existing Bridge Condition

- Pack Rust

Key Issue – Load Path Redundant Design

- Early **Load Path Redundancy** concepts

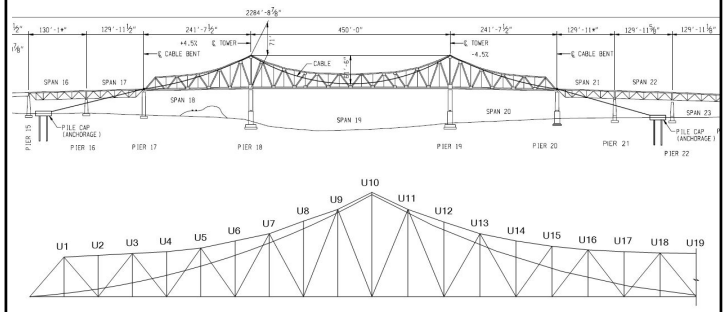
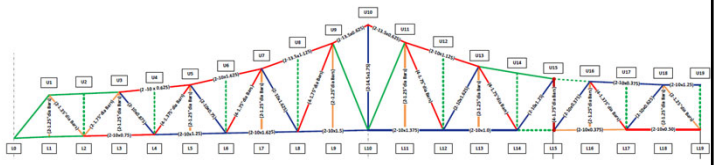


Figure 7. Half-elevation of Suspension Cable Concept

Rehabilitation Scope

- Fracture-Critical Members
- Adding Internal Redundancy
- Partner with CRU



= fracture critical

= fracture critical

Rehabilitation Scope

- Evaluate Options

Deck Description	Number of Members with Inventory RF < 1	Number of Members with Operating RF < 1
Existing Bridge	52	28
8" Standard Deck	56	34
7" Deck	48	24
8" Lightweight Deck	30	8
7" Lightweight Deck	26	4
Exodermic Deck	21	2

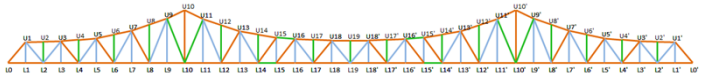
Rehabilitation Scope

Design Variances Granted

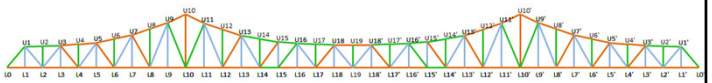
- MnDOT future wearing surface removed
- 8” deck used instead of standard 9” deck
- Refined evaluation for
  - Deterioration
  - System redundancy
  - Utility loads

Rehabilitation Scope

- Analysis Defines Scope



Standard MnDOT design criteria



With design variances

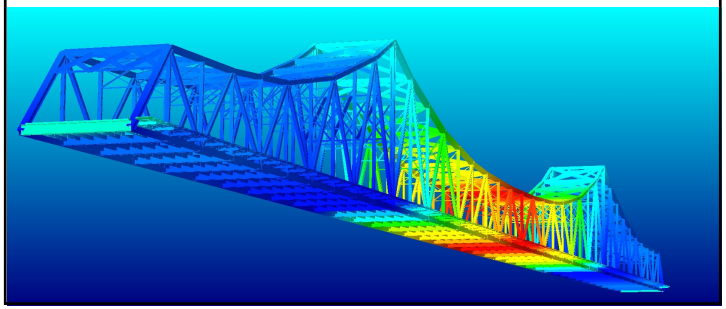
= no retrofit required

= plate retrofit required

= high strength bar retrofit required

Through Truss Analysis

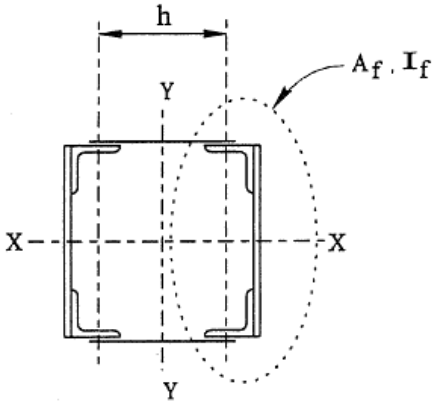
- 2D FEM
- 3D FEM



CMGC Delivery

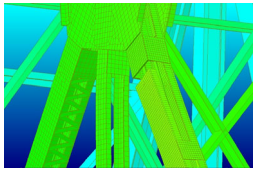
- Internal Redundancy Analysis
  - Compression Members
  - Tension Members
  - Gusset Plates

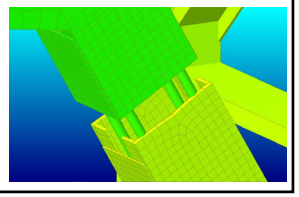
Internal Redundancy Analysis



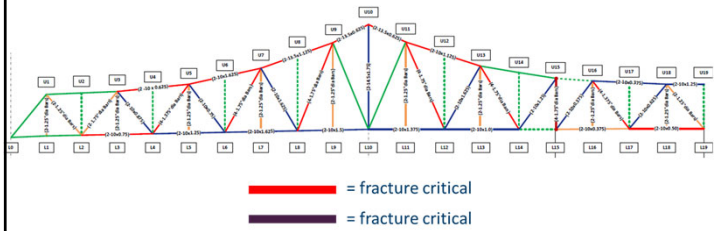
Extreme Event Limit State

- During Fracture: 1.10DC + 1.35DW + 0.75(LL + IM) + 1.1 (Dynamic Forces)
- Post-Fracture: 1.25DC + 1.50DW + 1.30(LL + IM)
- *Design Guidelines for Arch and Cable-Supported Signature Bridges*, FHWA, 2012



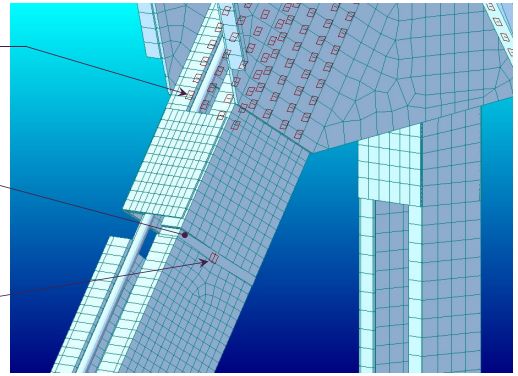


Internal Redundancy Analysis

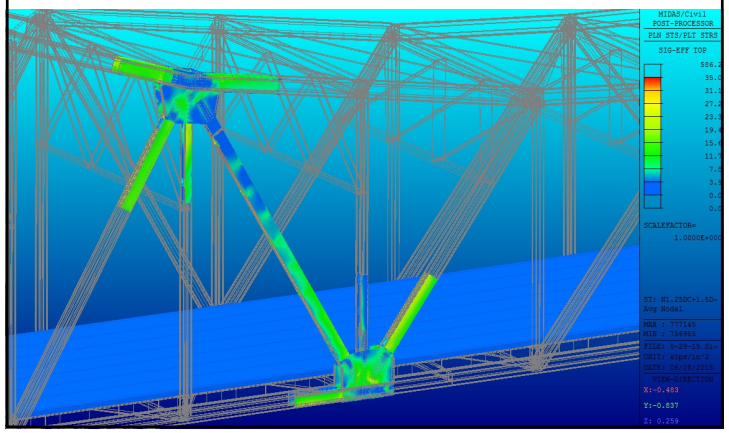


- Check Each Fracture-Critical Member for Extreme Event Limit State
- Retrofits Required?

Internal Redundancy



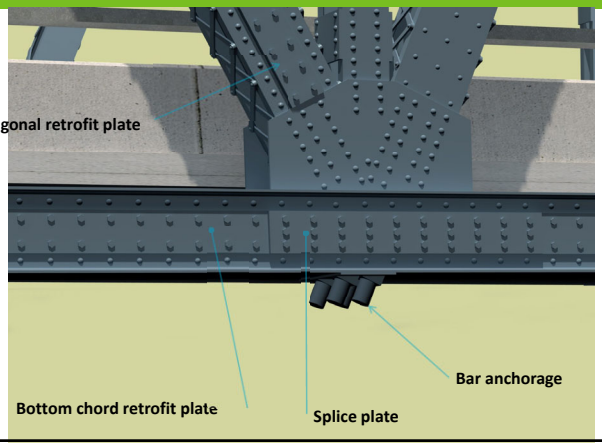
Extreme Event – Post Fracture



Future Inspection Requirements

- No Load Path Redundancy = “Fracture Critical” per FHWA
- NEW 2018 AASHTO Guide Specs
  - Internally Redundant Members may not be “Fracture Critical”
  - Check Strength & Fatigue Resistance of FC Members

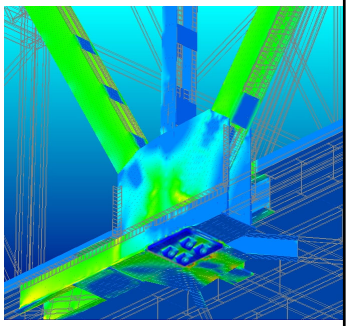
Rehabilitation Scope



Bridge Rehabilitation

High-Strength Bar Retrofits

- Stressed to $0.20f_{pu}$
- Goal is to stiffen bar, not to PT the truss
- Wind vibration restraints
- Bars share new deck and live loads
- Modeling verifies internal redundancy
- Detailed anchorage design



Rehabilitation Rendering

CMGC Benefits: Early Collaboration

CMGG : Ames Construction: Built Mock-Up of Bridge Node - access, space constraints, field splices & fit-up

On site field investigations: Assess accuracy of shop drawings/fit-up

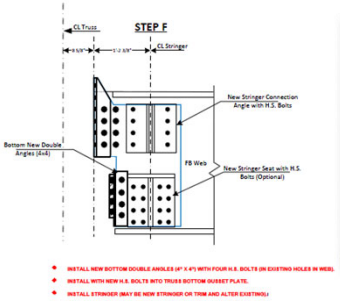
Section 106 Coordination

- Partner with CRU & MNHPO

Procedure for Analysis	Percentage of All Truss Members Retrofit with Plates
Standard MnDOT Design Criteria	24%
With Design Variances	19%
With Design Variances + Ignore AASHTO Extreme Event Load Case	14%
Original Preliminary Design – members considered zero deterioration	10%

Bridge Rehabilitation

- Replace Deteriorated Stringers
- Retrofit Floorbeam Connections



CMGC Delivery

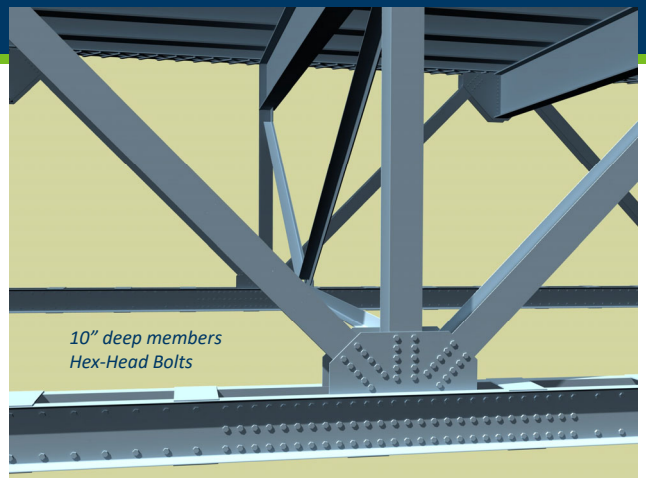
- Section 106 Coordination
  - Bridge Repairs
  - New Deck Truss
  - Approach Spans
  - Pier Reconstruction
  - Railing
  - Design Variances

Deck Truss Historical Considerations

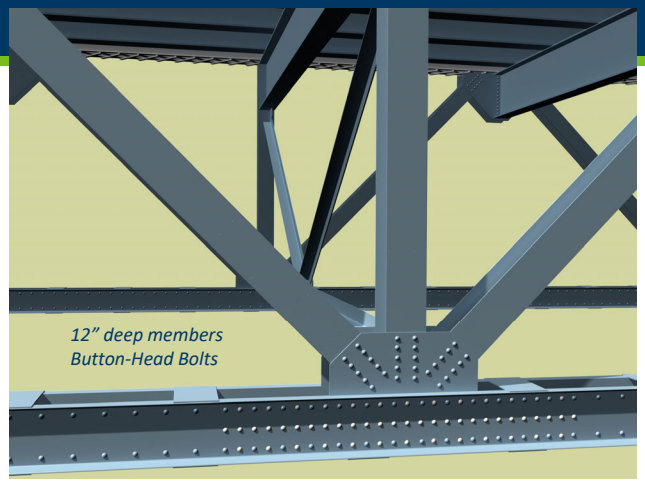
Deck Truss Historical Considerations

Deck Truss Historical Considerations

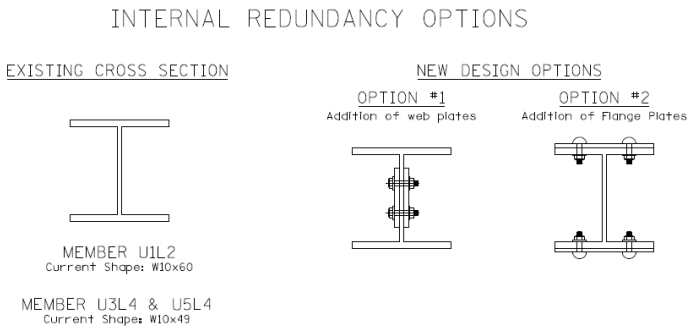
Deck Truss Historical Considerations



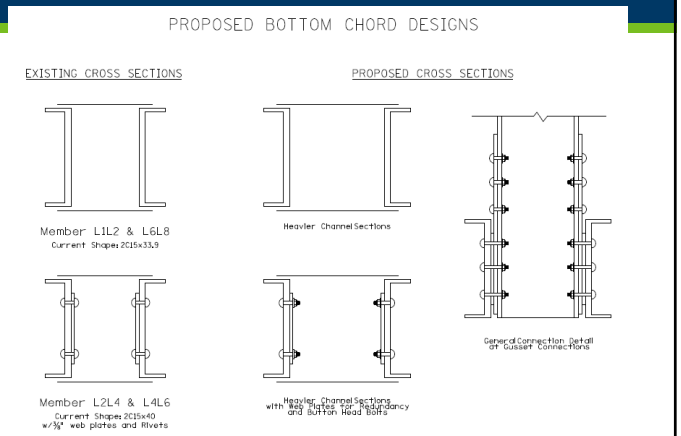
Deck Truss Historical Considerations



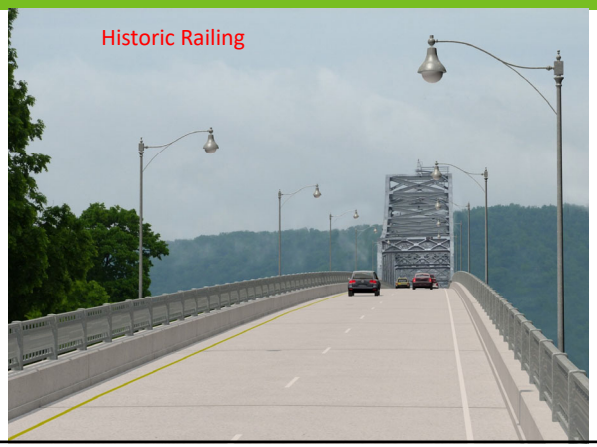
Diagonal Deck Truss Members



Deck Truss Bottom Chord Members



Railings – Historic vs. Crash Ratings



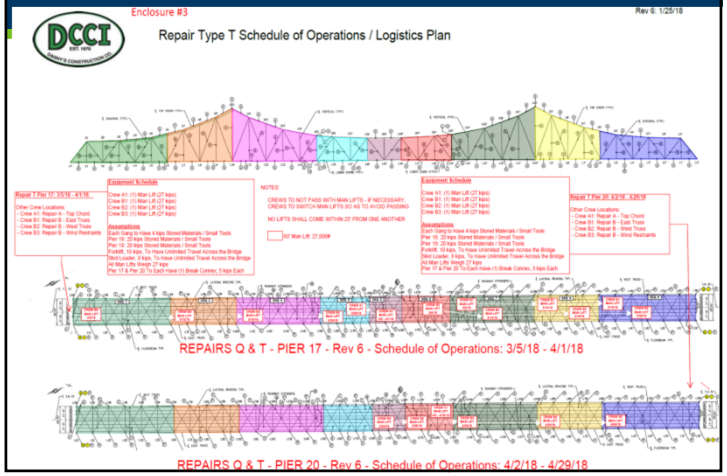
Railings – Historic vs. Crash Ratings

Railings – Historic vs. Crash Ratings

CMGC Delivery

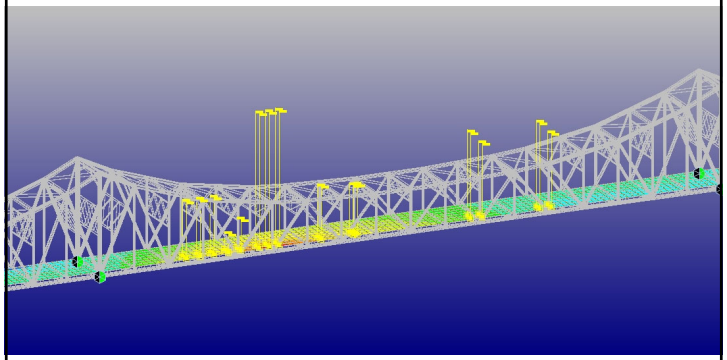
- Construction Loading
- Section Loss
- RID

Construction Sequence



Construction Sequence

- Construction Loading



Reference Information Document

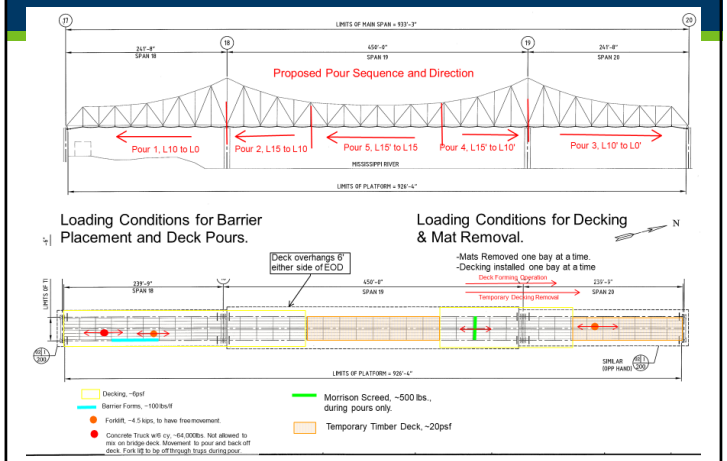
	Member	Inventory Rating Factor After Rehabilitation	Original Web Thickness [in]	Original Flange Thickness [in]	Allowable Thickness Loss on EITHER One Web OR Two Flanges [in]		Allowable Thickness Loss if One Web AND Two Flanges Have Section Loss [in]
					Web Only	Flanges Only	
BOTTOM CHORD - EAST	L0E-L1E	3.58	0.45	0.63	3/16	1/4	1/8
	L1E-L2E	3.66	0.45	0.63	3/16	1/4	1/8
	L2E-L3E	1.86	0.50	0.63	1/8	1/4	1/8
	L3E-L4E	1.51	0.50	0.63	1/8	1/4	1/16
	L4E-L5E	1.24	0.75	0.69	1/8	1/4	1/16
	L5E-L6E	1.24	0.75	0.69	1/8	1/4	1/16
	L6E-L7E	1.05	1.00	0.63	1/16	1/16	0
	L7E-L8E	1.17	1.00	0.63	3/16	1/4	1/8
	L8E-L9E	1.26	1.00	0.94	1/4	1/4	1/8
	L9E-L10E	1.26	1.00	0.94	1/4	1/4	1/8
	L10E-L11E	1.32	1.00	0.81	1/4	1/4	1/8
	L11E-L12E	1.32	1.00	0.81	1/4	1/4	1/8
	L12E-L13E	1.33	0.75	0.63	3/16	1/4	1/8
	L13E-L14E	1.17	0.75	0.63	1/16	3/16	1/16
	L14E-L15E	>10	0.45	0.63	3/16	1/4	1/8
	L15E-L16E	2.58	0.45	0.63	3/16	1/4	1/8
	L16E-L17E	2.66	0.45	0.63	3/16	1/4	1/8
	L17E-L18E	1.19	0.63	0.63	0	1/16	0
	L18E-L19E	1.19	0.63	0.63	0	1/16	0

Construction – Strengthening Plates

Construction – Strengthening Plates

Construction – Strengthening Plates

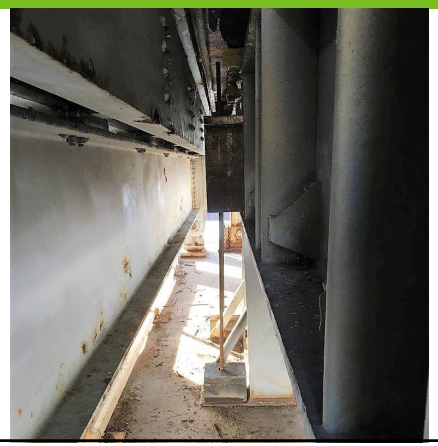
Deck Pour Sequence



Deck Removal

Uplift Bearing Installation

Uplift Bearing Resistance



Jack & Severe existing link

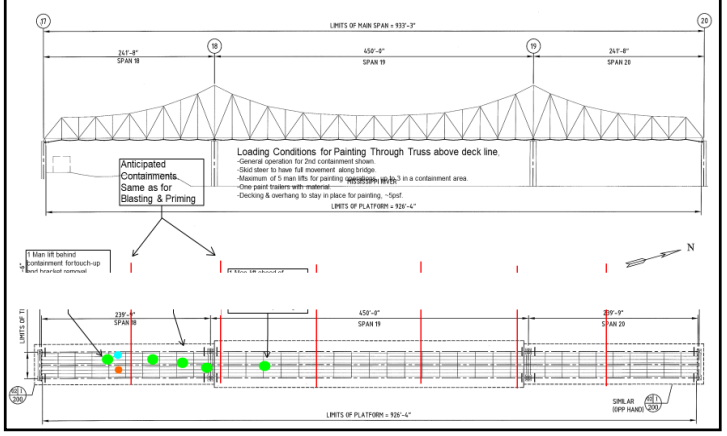
Uplift Bearing Installation

Uplift Bearing Installation

Uplift Bearing Installation

Uplift Bearing Resistance

Paint Blasting & Containment Loading



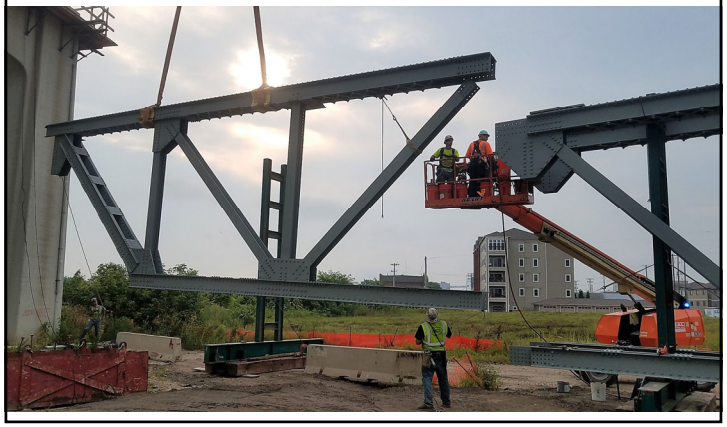
Construction - Painting

Construction – Deck Truss

Construction – Deck Truss

Construction – Deck Truss

Construction – Deck Truss



Construction – Deck Truss

Construction – Deck Truss

Construction – Deck Truss

Construction – Deck Truss

Deck Truss Installation

Deck Truss Installation

Construction – Deck Truss

Construction – Deck Truss

Construction – Deck Truss

Concrete Girder Approach Spans

Concrete Girder Approach Spans

Deck Construction

Modular Joints

Deck Pour

Deck Pour

Aerial Views

Aerial Views

Aerial Views

Lessons Learned

- CMG – Contractor / PDT Collaboration
- CMG – Owner control; constructability; risk reduction
- CMG – Schedule Acceleration via phased work packages
- Partner with CRU on Historic Bridges
- Feasible to add Internal Redundancy to Historic Bridges
- Construction Sequencing can control schedule and loading

Project Participants

Scoping, Preliminary Design, Environmental Assessment: (SRF with TYLIN, Modjeski and Masters)

Preconstruction Permit Support and Grading Plans: WSB; CMGC Cost Estimates: Armeni Consulting Services (ICE)

Bridge 85851 Segmental Bridge: FIGG (EOR), PTG Peer Review
with WSB (Roadway), Braun (Foundations), (Dan Brown & Assoc. - Foundations Peer Review)
MnDOT D6 Construction Oversight with Segmental Shop Drawings & Support by FIGG/PTG

Bridge 5900 Rehabilitation: Baker (EOR), MnDOT Bridge Office & Hydraulics Section (Scour), HNTB/ONE Peer Review
Baker (EOR) with KH, LHB, Forest Products Lab, AET Foundations, (Dan Brown & Assoc. Peer Review)

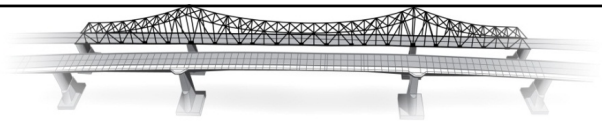
Construction Manager/General Contractor: (CE: Finley, Danny's Construction)
Steel Shop Drawings: Ames/Brennan/Danny's/LeJeune/Candraft/Baker/Bridge Office

Construction Inspection Support (for Bridge 5900)
MnDOT D6 Construction, Bridge Office, HDR
Michael Baker International

Historic Review – MnDOT CRU/Mead and Hunt/SHPO

FHWA/COE/USCG/City of Winona

Michael Baker INTERNATIONAL
Ames Construction
Kimley»Horn
American Engineering Testing, Inc.
LHB
mn TRANSPORTATION



Winona Bridge
CMGC Project

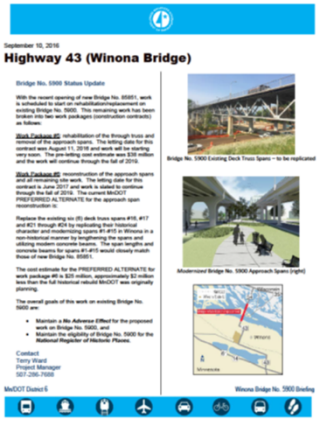
QUESTIONS / DISCUSSION

mn DEPARTMENT OF TRANSPORTATION

Construction Manager/General Contractor (CMGC)

- Work Package 1: 42" Diameter Piles Fab & Delivered
- Work Package 2: Early Contractor Access Plans
  - North and South Dock Walls for Access, Storage
  - Early Pile Investigation Bridge 5900
- Work Package 3: Early Bridge Foundations Br. 85851, Scour Mitigation Bridge 5900:
  - Construct River Pier Cofferdams, Piles, Footings, Pier Ice Breakers
  - Bridge 5900: Scour Mitigation Plan (Monitor scour & Phase 1 installation of Geobags)
- Work Package 4: Construct Remainder of Bridge 85851 & Roadway, walls, Drainage
- ~~Work Package 5: Bridge 5900 Rehabilitation/Reconst'n (FULL BUILD)~~ *(PAUSE BUTTON)*
- Work Package 5: Bridge 5900 Rehabilitation/Reconstruction (Main Through Truss)
- Work Package 6: Bridge 5900 Rehabilitation/Reconsrtuction (Approach Spans Economized)

“Pause Button” - Review of Approach Spans



September 10, 2016

Highway 43 (Winona Bridge)

Bridge No. 5900 Status Update

With the recent opening of new Bridge No. 05881, work is scheduled to start on rehabilitation/replacement on existing Bridge No. 5900. This remaining work has been broken into two work packages (construction contracts) as follows:

Work Package #2: rehabilitation of the through truss and removal of the approach spans. The letting date for this contract was August 11, 2016 and work will be starting very soon. The pre-letting cost estimate was $30 million and the work will continue through the fall of 2019.

Work Package #3: reconstruction of the approach spans and all remaining site work. The letting date for this contract is June 2017 and work is slated to continue through the fall of 2019. The current MnDOT PRELIMINARY ALTERNATE for the approach span reconstruction is:

Replace the existing six (6) deck truss spans #16, #17 and #21 through #24 by replicating their historical character and modernizing spans #1-#15 in Winona in a non-historical manner by lengthening the spans and utilizing modern concrete beams. The span lengths and concrete beams for spans #1-#15 would closely match those of new Bridge No. 05881.

The cost estimate for the PREFERRED ALTERNATE for work package #3 is $25 million, approximately $2 million less than the full historical rebuild MnDOT was originally planning.

The overall goals of this work on existing Bridge No. 5900 are:

- Maintain a ***No Adverse Effect*** for the proposed work on Bridge No. 5900, and
- Maintain the eligibility of Bridge No. 5900 for the ***National Register of Historic Places***.

Contact
Terry Ward
Project Manager
507-286-7608

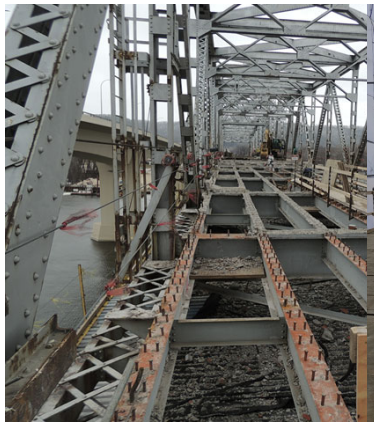
Bridge No. 5900 Existing Deck Truss Spans – to be replicated

Modernized Bridge No. 5900 Approach Spans (right)

MnDOT District 6

Winona Bridge No. 5900 Grading

Winona – Strengthen Truss Spans



Winona – New Deck Truss

Replica, with Internal Redundancy

Scheduled Completion: 2019

Construction Photos