Project Background
Interchange and Project Details

• Locally known as the “Can of Worms”
• Built in late 1969-1972
  • Ramp from NB I-35 to NB T.H. 53 was an “add-on”
• 33 total bridges (includes Garfield & I-535, 27th Avenue West and T.H.53)
  • 25 overweight permit restricted
  • 2.6% of the bridge deck statewide
• 4th highest interchange crash rate statewide
Duluth’s “can of worms”
to be replaced with barrel of monkeys

Duluth, Minn. MnDOT has announced that it plans to begin construction of a new Lincoln Park highway in 2019 to replace the infamous “can of worms” with a new freeway system that experts are calling a “barrel of monkeys.”

“While really gets my goat,” says MnDOT spokesman Cherylyl Cowen, “is not knowing who let the cat out of the bag. I mean, that’s kind of like playing the elephant in the room. I think there’s a good chance someone will give us the heat. The drum is online if it turns into a herd of elephants.”

MnDOT spokeswoman Karen Lee admits that “some constituents seem to have misinterpretations about the project. But the changes weren’t that big, and everyone can just hold their horses, because it’s moving along at a snail’s pace, so we can have all our ducks in a row and not foul up that nest of vipers like a ball in a china shop.”

If the project is successful, Larson has promised to correct another Duluth annoyance, the infamous Miller Hill of Rama.

Storby Daniels to appear at DECC

Storby Daniels, whose alleged flag with Donald Trump resulted in scandal and payoffs and whatnot, has invited a “Make America Horny Again” tour performing at strip clubs. She will bring her show to the DECC April 1. “Just for Duluth. I’m changing my name to be Storby.”
Project Goals

• **Enhance safety by eliminating blind merges and left exits**
  • Moving left exits to the right
  • Relocating merges

• **Replace aging infrastructure**
  • Reconstructing weight restricted and non-redundant bridges
  • Reduces maintenance and closures
  • Eliminates some bridge structure

• **Improve freight mobility**
  • Allow oversize/overweight freight on the Interstate
  • First and last mile to port!
Project Layout/Scope (Fall 2018)
Project Layout/Scope (Fall 2019)
TPI Timeline (Design to Start of Construction)

• Project Development
  • 2016: Roberta Dwyer, MnDOT Project Manager, starts on early work
  • 2018: Dedicated MnDOT team assigned to TPI

• September 2018 – Ames/Kraemer Joint Venture (AKJV) selected as CMGC contractor and co-location began

• January 2019 - Final Design - Final Bridge and Roadway Design teams onboard; key personnel co-located

• July 2019 – 30% design - Work Packages 3 and 4 deferred due to budget shortfall (November 2019)

• March 2020 COVID hits – final project development goes remote

• October 2020 - Construction starts (Work Packages 1 and 2)

• August 2022 - Construction starts (Work Packages 3 and 4)
Challenge:
The infrastructure in this area comprises 3.5% of the bridge infrastructure managed in the entire state. It is in deteriorated condition and hosts some of the highest crash rates in the state, jeopardizing the ability of this economic engine to safely and efficiently conduct business.

TWIN PORTS INTERCHANGE TIMELINE:
- Environmental Documentation: 2017-2018
- Design: 2018-2020
- Construction: 2020-2024

PRELIMINARY BLATNIK BRIDGE TIMELINE:
- Environmental Documentation: 2020 – 2024
- Preliminary Design: 2024 - 2026
- Design: 2026 - 2028
- Estimated Construction Start: 2028
Replace Aging Infrastructure
Load restrictions and Freight Mobility
Oversize/Overweight Loads not able to travel through interchanges
2019 Local Roads Project (Separate Design-Bid-Build (DBB) Project) - COMPLETE

- Pavement Rehabilitation
  - 46th Avenue W
  - 27th Avenue W & restriping
  - Garfield Avenue & restriping
  - Railroad Street

- New Rail Crossings by BNSF
  - New Rail crossings at 4 locations
  - One crossing removal
2020 TH 194 (Central Entrance) DBB Surfacing: COMPLETE

- Low-bid “Band-Aid” project
- Improve ride and hold pavement together until reconstruction
TPI WP 1 and 2 Scope
TPI WP 3 (TH 53 Bridges) Scope

• Complete reconstruction of the TH 53 bridges
• Limited utility work
• City street reconstruction
• Deferred Fall 2019
• Added back in August 2022 (executed contract)
TPI WP 4 (I-535/Garfield Interchange) Scope

- Reconstruct bridges 69808, 69808A, 69809
- Significant reconstruction of 69810
- Utilities, storm sewer, pavement reconstruction
- Minor track relocation near 69810
- Deferred Fall 2019
- Added back in August 2022 (executed contract)
Public Outreach/ Model and Comments
Contracting Methods & Collaboration

- Design-Bid-Build (Traditional Low Bid)
  - No up-front collaboration
- Design-Build
  - Collaboration between contractor and designer
- CMGC (Construction Manager General Contractor) – used on TH 53
  - State is authorized for 20 CMGC projects.
    - 8 either ongoing or complete so far.
  - Collaboration between owner, contractor and designer BEFORE CONSTRUCTION (and during!)
  - Contractor selection complete: Ames/Kraemer Joint Venture
CMGC Benefits & Challenges

Benefits

• **Innovation** – Contractor input into the design process
• **Cost Management** – Contractors provide real-time cost information
• **Design Savings** – Streamline design
• **Design Control** – MnDOT retains control of the design, with contractor input
• **Construction Risk** – Construction risks mitigated during project development
• **Cost Certainty** – Greater cost certainty earlier in the project
• **Time Savings** – Able to deliver early work packages similar to design-build

Challenges

• **Cost Validation** – Negotiated versus bid contract
• **Culture** – Relatively new to the transportation industry
• Project Team
  • Owner: MnDOT
  • Designers: Many (or everybody)!
  • Contractor: Ames – Kraemer Joint Venture (AKJV)
• Key individuals were co-located at 1220 Railroad Street for project development until COVID 19 hit
CMGC Test Programs
Challenges Worked Through in Advance/Preconstruction
Contaminated Soils

- **Red** to landfill
- **Yellow** can be re-used if there is an engineering purpose and there is no debris in it.
- **Purple** not able to drill, or not drilled yet. Stockpile and test during construction.
Contaminated Water
Contaminated Water
Limited area to work, store materials, etc.

• Confined Work Area
  • Limited areas for laying down construction materials
  • Limited areas for storing soil
  • Some double handling of materials will be necessary
  • Very tight quarters to construct the project
Limited area to work, store materials, etc.
Soil Storage – No Room Onsite!
Current Soil Storage Areas
Foundations/Ground Improvements

• Geotechnical–
  • Very poor non-uniform soils, mostly old fill and debris
  • Ground improvements and cost associated with them were not known at time of planning;
  • Design as advanced and the foundation costs have become more defined.
Foundations/Ground Improvements

326,700 LF or about 62 miles of grout columns for ground improvements!

Ground improvements will allow more highway on grade and reduce total bridge deck area by almost 50%
Foundations/Ground Improvements
Archeological and Cultural
Railroad Coordination (BSNF)

- Early and frequent coordination with BNSF on design
- Early and frequent coordination with contractor engineering submittals and approvals
- = less risk and quicker construction start
Combined Miller and Coffee Creek Culvert
Combined Miller and Coffee Creek Culvert

- Miller Creek Culvert Replacement
  - Deep placement
  - 10 stages of construction
  - Supporting the roadway during construction
  - Staging across the railroad
  - Poor soils
  - Require deep foundations
  - Under bay water level
Miller and Coffee Creek – they are a project on their own!
Combined Miller-Coffee Creek Box Culvert
Traffic Staging: The Driver for 2020/2021
Traffic Staging: CMGC Benefits during Prelim/Final Design

- Used lower Michigan for two lanes of SB I-35

   - Advantages:
     - 4 lanes of traffic through the winter
     - Allowed work to proceed through the winter
     - Reduced construction by a year

2/28/23
mndot.gov
Overall Project Staging Summary

• Fall 20: Two lanes in each direction on I-35. Working offline.

• Spring 21 – Fall 21: Single lane in each direction on I-35.

• Fall 21 – Fall 23: Maintaining two lanes in each direction on I-35 will keep traffic flowing (I-535 and US Hwy 53 detoured)

• Lower Michigan St. bypass allows two lanes of traffic on I-35 in each direction allowing year-round construction and shortens project by one year

• Fall 2023: I-35 and I-535 open to traffic

• Fall 2024: USTH 53 open to traffic

• 2025: Final completion
Plans and Specifications – 9,505 sheets/pages

WP 1 and 2 Plan Sheets
Project Facts

- Construction Cost: $276 million (WP 1 and 2) + $159 (WP 3 and 4) = $435 million
  - $221 million paid to date; tracking within budget and on schedule

- Substantial Completion (open to traffic):
  - I-35 and I-535 – fall of 2023
  - USTH 53 – fall of 2024

- Final Completion: Spring/Summer 2025
Foundations for Non-Geotechs

Nick Haltvick | MnDOT
Timeline

Preliminary (2018)

Testing (2019)

Recommendations & Design (2020)

Construction (2020 – current)
Preliminary (2018)

194 CPT
280 SPT
Variety of soils

Images Courtesy Rich Lamb
Existing pile records

Preliminary (2018)
3D View

Subsurface – cross section

Images Courtesy Itasca Consulting Group
• An upper layer of weak soils in the first 40 to 60 feet, followed by a dense sand that varies in thickness from 20 to 60 feet

• Deeper soiling boring indicated that in several locations, this dense layer of sand is underlain by a compressible layer of clay, followed by bedrock.

Two scenarios applied to 16 substructures (7 Bridges):

1. Drive HP Piling to Rock
   • 40,300 LF
   • $3.9M

2. Stop piling in dense layer
   • 16,800 LF
   • $2.1M
Initial settlement calculations indicate that long-term settlement could be as much as 2.5 inches under the dead load of structures that do not have piling which extend through the lower layer of compressible clay to bedrock.
1. Determine the **geotechnical capacity** of larger diameter CIP Concrete Piling that are not typically installed on MnDOT projects.

2. Quantify the amount of the **load transfer** due to end-bearing and skin friction from the piling into the soil in order to refine the pile group settlement calculations.

3. Define the neutral plane location to refine the **down drag analysis**.

4. Assess the likelihood of potential cost and time **saving** associated with suspending friction piles in the upper dense sand layer as compared to driving to the lowest dense layer or bedrock.
Final locations: 69902 Pier 1 69902 Pier 3
### Test Pile

**Location** | **Ground EL [ft]** | **Top of Dense Layer EL [ft]** | **Depth from surface [ft]** | **Bot. of Dense Layer EL [ft]** | **Dense Layer Thickness [ft]** | **Est. EOD from surface [ft]**
---|---|---|---|---|---|---
69902 P1 | 606 | 553 | 53 | 523 | 30 | 63
69902 P3 | 605 | 541 | 64 | 518 | 23 | 75

**Axial Limit**

<table>
<thead>
<tr>
<th>Driveability</th>
<th>( \Phi )</th>
<th>( \Phi_Rn ) [kips]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driveability</td>
<td>1.00</td>
<td>936</td>
</tr>
<tr>
<td>Steel Only</td>
<td>0.70</td>
<td>728</td>
</tr>
<tr>
<td>Composite</td>
<td>0.70</td>
<td>1248</td>
</tr>
</tbody>
</table>

Test Piles

\( D_0 = 20 \text{ inch} \)

\( t = \frac{1}{2} \text{ inch} \)
1000 Ton MnPile Test Frame

Notes:
- Orientation of test pile site shown conceptually.
- B reaction pile configuration similar to MnPile foundations to determine final analysis at reaction piles.

1000 Ton MnPile Test Frame
<table>
<thead>
<tr>
<th>Pile</th>
<th>Estimated Pile Length [ft]</th>
<th>Installed Pile Length [ft]</th>
<th>Estimated depth to dense layer [ft]</th>
<th>Observed depth to dense layer [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 16” Rx</td>
<td>70</td>
<td>80</td>
<td>53</td>
<td>~65</td>
</tr>
<tr>
<td>P1 20” TP</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3 16” Rx</td>
<td>80</td>
<td>95</td>
<td>64</td>
<td>~51</td>
</tr>
<tr>
<td>P3 20” TP</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Measured nominal bearing

<table>
<thead>
<tr>
<th>Test Pile</th>
<th>Test Condition</th>
<th>MPF12 [kips]</th>
<th>PDA [kips]</th>
<th>Static Load Test [kips]</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>EOD</td>
<td>674</td>
<td>917</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>RST</td>
<td>670</td>
<td>939</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>SLT</td>
<td>-</td>
<td>-</td>
<td>960</td>
</tr>
<tr>
<td>P3</td>
<td>EOD</td>
<td>602</td>
<td>924</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>STL</td>
<td>-</td>
<td>-</td>
<td>840</td>
</tr>
</tbody>
</table>

### NOTES
- Restrike (RST) occurred 6 days after initial end of drive (EOD).
- Static Load Test (SLT) occurred about 22 days after EOD for both locations.
- Resistances (MPF12, PDA, and Static Load Test) are shown as nominal bearing resistance.
Conclusions

Geotechnical capacity

φRn = 600 kips (65% Utilization)

Settlement calculations

Reduced estimated settlement by 50% to 75%

Refine the down drag analysis

Established lower, project-wide value for design

Potential cost and time saving

Estimated savings $1.3M (including cost of test)
### Br69902 – Pile Type & Lengths

<table>
<thead>
<tr>
<th>Substructure Unit</th>
<th>Approx. Station</th>
<th>Est. Bottom Elevation of Footing or Cap</th>
<th>Foundation Type</th>
<th>Factored Resistance (tons)</th>
<th>No. Test Piles</th>
<th>Test Pile Length (ft)</th>
<th>Tip Protect</th>
<th>Redrive</th>
<th>PDA</th>
<th>Est. Fnd. Pile Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>W. Abut</td>
<td>18+43.0</td>
<td>600.0±</td>
<td>20&quot;x3/8&quot; CIP</td>
<td>300</td>
<td>3</td>
<td>115</td>
<td>X</td>
<td></td>
<td></td>
<td>105</td>
</tr>
<tr>
<td>Pier 1</td>
<td>20+79.0</td>
<td>597.0±</td>
<td>20&quot;x3/8&quot; CIP</td>
<td>300</td>
<td>2</td>
<td>75</td>
<td>X</td>
<td>X</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Pier 2</td>
<td>23+00.0</td>
<td>605.0±</td>
<td>20&quot;x3/8&quot; CIP</td>
<td>300</td>
<td>2</td>
<td>75</td>
<td>X</td>
<td>X</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>Pier 3</td>
<td>24+63.0</td>
<td>605.0±</td>
<td>20&quot;x3/8&quot; CIP</td>
<td>300</td>
<td>2</td>
<td>85</td>
<td>X</td>
<td>X</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>E. Abut</td>
<td>26+54.0</td>
<td>616.3±</td>
<td>20&quot;x3/8&quot; CIP</td>
<td>300</td>
<td>2</td>
<td>95</td>
<td>X</td>
<td></td>
<td></td>
<td>85</td>
</tr>
</tbody>
</table>

Foundation Memo date: 2/7/2019, 11/22/2019

Bridge Hydraulics Memo date: N/A

Preliminary Plans Request date: 02/15/19
• Two pile types:
  • HP14x89 (to rock)
  • CIP20”x3/8” (to dense layer)
• Similar factored capacities
  • 250 tons (HP), 300 tons (CIP)
• CIP determined to have adequate:
  • lateral soil resistance
  • down drag resistance when battered
### Br69902 – Pile Type & Lengths

<table>
<thead>
<tr>
<th>Location</th>
<th>Borings</th>
<th>Length</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>W. Abut.</td>
<td>T152, T224, T401, T451</td>
<td>105’</td>
<td>average depth to bedrock from borings (varies by 15’)</td>
</tr>
<tr>
<td>Pier 1</td>
<td>T225, T450</td>
<td>65’</td>
<td>estimated to stop approx. mid-depth of 30' thick layer of dense sand</td>
</tr>
<tr>
<td>Pier 2</td>
<td>T226</td>
<td>65’</td>
<td>estimated to stop approx. mid-depth of 40' thick layer of dense sand</td>
</tr>
<tr>
<td>Pier 3</td>
<td>T227, T448</td>
<td>75’</td>
<td>estimated to stop approx. mid-depth of 30' thick layer of dense sand</td>
</tr>
<tr>
<td>W. Abut.</td>
<td>T228, T229, T447</td>
<td>85’</td>
<td>estimated to stop approx. mid-depth of 40' thick layer of dense sand</td>
</tr>
</tbody>
</table>
RECOMMENDATIONS & DESIGN (2020)

BRIDGE 69902

PIER 3
Pile group settlement based on the piling hanging up in the upper dense layer of sand has been estimated to vary between 0.5" and 1.1" over the service life of the bridge. Given the span lengths and structure type, this settlement has been determined to be permissible.

Downdrag has been quantified on a project-wide level as 250 kips per pile. Batter piles will be permissible.
Br69902 – Key Remarks

① Tip Protection: use a CIP-1/2" thick X 10 long section for tip protection of CIP at west abutment.

③ Water table will likely impact the West Abutment and Pier 1.
④ At Pier 2 & 3 and East Abutment, galvanize the upper # of piling. This is to provide enhance corrosion protection in the wet/dry zone near EL. 603.
### Variation in Lengths

#### Construction (2020 – current)

<table>
<thead>
<tr>
<th>Location</th>
<th>No. Driven within 5’±</th>
</tr>
</thead>
<tbody>
<tr>
<td>W. ABUT</td>
<td>29 of 48</td>
</tr>
<tr>
<td>PIER 1</td>
<td>2 of 32</td>
</tr>
<tr>
<td>PIER 2</td>
<td>0 of 18</td>
</tr>
<tr>
<td>PIER 3</td>
<td>4 of 20</td>
</tr>
<tr>
<td>E. ABUT</td>
<td>12 of 18</td>
</tr>
</tbody>
</table>
Settlements

The settlement of the pile cap is about 18 mm considering all the loads applied. About 4 mm is coming from the pile cap-backfill activation which is irrelevant for the superstructure. The settlements is also uniform with a differential in the order 1-2 mm depending on the loading condition. The anomaly is not active in this model and the piles are all terminating in the upper sand.
Settlements

The maximum settlements are similar but the rotation is about 10 times bigger. The differential settlement is about 10 mm. The longer piles are creating a stiffer side of the pile cap favoring rotation toward girder 1.

DL+LL = 12 mm
Settlements

The addition of two H-Piles (14x49) helps to re-balance the pile group. The differential settlement is now around 4 mm in comparison to 10 mm without any helping pile (slide 13).

Adding 3 piles should bring the pile ground close to the original design configuration.
Pier 3 Lengths

Construction (2020 – current)

Distance below cut-off [ft]

0 20 40 60 80 100 120 140 160

REC 1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 TP8 TP9 TP9A EP1 EP2

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Pier 1 Lengths

Construction (2020 – current)
WP 1 & 2 Pile Lengths

Construction (2020 – current)

![Graph showing pile lengths](image)

- 2019: -18%
- 2020: -7%
- 2021: -13%
- 2022: -7%
- 2023: -5%
## Weekly meetings, daily interactions

### Construction (2020 – current)

#### Microsoft Teams

- [Image of construction workers with Microsoft Teams logo]

#### Submission Log

<table>
<thead>
<tr>
<th>Date Received</th>
<th>Transmittal No.</th>
<th>Submittal Description</th>
<th>Rev. No.</th>
<th>Grade No.</th>
<th>Submittal Type</th>
<th>BNSF Review/Appr</th>
<th>SWU Appr</th>
<th>Status</th>
<th>Date Due</th>
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<tbody>
<tr>
<td>10/1/22</td>
<td>T-1306</td>
<td>WF3_4Hammer Report Br 66068 D15-42</td>
<td>--</td>
<td>66068 (WP4)</td>
<td>Spec. Reqmt.</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>19/22</td>
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<tr>
<td>10/22</td>
<td>T-1366</td>
<td>WPC_4 NEO WP Lighting</td>
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<td>66068 (WP4)</td>
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<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>11/22</td>
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<tr>
<td>11/21/22</td>
<td>T-1408</td>
<td>WP1_2 Concrete/RetainedSign Shop Drawings</td>
<td>--</td>
<td>66068 (WP4)</td>
<td>Spec. Reqmt.</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>11/22</td>
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<td>01/23/23</td>
<td>T-1472.1</td>
<td>WP3_Drainage Shop Drawings - Fiberglass</td>
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<td>66068 (WP4)</td>
<td>Spec. Reqmt.</td>
<td>AKIV</td>
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<td>Returned</td>
<td>12/01/23</td>
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<td>02/13/23</td>
<td>T-1552</td>
<td>WP3_Escalator/Shop Drawings - Fiberglass</td>
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<td>66068 (WP4)</td>
<td>Spec. Reqmt.</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>02/27/23</td>
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<td>03/13/23</td>
<td>T-1576</td>
<td>WP3_Passageway/Shop Drawings - Fiberglass</td>
<td>--</td>
<td>66068 (WP4)</td>
<td>Spec. Reqmt.</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>03/07/23</td>
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<td>03/13/23</td>
<td>T-1580</td>
<td>WP3_Wall AK Handrail Shop Drawing</td>
<td>--</td>
<td>66068 (WP4)</td>
<td>Shop Drawings</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>03/07/23</td>
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<tr>
<td>02/20/23</td>
<td>T-1258.1</td>
<td>Retaining Wall B &amp; W Pipe Hailing Shop Drawings</td>
<td>--</td>
<td>66068 (WP4)</td>
<td>Shop Drawings</td>
<td>AKIV</td>
<td>No</td>
<td>Returned</td>
<td>03/07/23</td>
</tr>
</tbody>
</table>
Thank you!

Nick Haltvick, P.E.
nick.haltvick@state.mn.us
Bridge Design Oversight Manager

Bridge Plans

Roadway Plans

Ground Improvement

Contractor

Jeff Cavallin (DOM)

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CMGC Benefits during Prelim/Final Design

- Complex Construction Staging Development for Miller/Coffee Creek Culvert
  - Staging under both I-35 and BNSF railroad tracks
  - Temporary shoring design / dewatering
Miller-Coffee Creek Culvert

Existing Structure

INLET

OUTLET
CMGC Benefits during Prelim/Final Design

- Early coordination with the railroad
  - Existing footing removal
  - Earth shoring for excavations
CMGC Benefits during Prelim/Final Design

- Early coordination with the railroad
- Beam erection sequences
CMGC Benefits during Prelim/Final Design

- Early coordination with the railroad
- Retaining wall types

MSE WALL
CIP WALL
BNSF
• The Twin Ports Interchange (TPI) Project
  • Super Load = OSOW = Oversize Overweight Permit Loads
  • May consist of any/all: Heavy Loads, Tall Vertical Heights, Long Overall Lengths/Turning Movements

• TPI Project Goals
  • Provide for Increased Bridge Design Capacity to handle heavy Permit Loads
  • Provide for Increased Geometric Capacity to handle large oversize Permit Loads
  • Reduce reliance on relief routes that use local streets
Super Load Study

• Reviewed over 3000 single trip permit vehicle data sets from Duluth-Superior Port

• Compared with MnDOT Standard Permit Load Rating Vehicles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Selected Upper Limit Parameter</th>
<th>No. of Permits Within Limit</th>
<th>% of Permits Within Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Vehicle Weight(^1)</td>
<td>lb.</td>
<td>255,000</td>
<td>2,994</td>
<td>93%</td>
</tr>
<tr>
<td>No. of Axles Total(^1)</td>
<td></td>
<td>13</td>
<td>2,849</td>
<td>88%</td>
</tr>
<tr>
<td>Maximum Axle Load(^2)</td>
<td>lb.</td>
<td>23,000</td>
<td>3,132</td>
<td>97%</td>
</tr>
<tr>
<td>No. of Axles at Maximum Axle Load(^1)</td>
<td></td>
<td>12</td>
<td>3,093</td>
<td>96%</td>
</tr>
<tr>
<td>Height</td>
<td>ft.</td>
<td>16</td>
<td>3,179</td>
<td>99%</td>
</tr>
<tr>
<td>Length(^1)</td>
<td>ft.</td>
<td>117</td>
<td>2,559</td>
<td>79%</td>
</tr>
<tr>
<td>Width</td>
<td>ft.</td>
<td>10</td>
<td>3,142</td>
<td>97%</td>
</tr>
<tr>
<td>Average Gross Vehicle Weight(^3)</td>
<td>lb./ft.</td>
<td>2,900</td>
<td>3,144</td>
<td>98%</td>
</tr>
<tr>
<td>Total No. of Permits</td>
<td></td>
<td>3,223</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Standard P413 Truck  \(^2\) Standard C198.23 Truck  \(^3\) Standard C152b Truck
Twin Ports Interchange – Super-load Design Criteria

To and From Port OSOW Permits Jan 2010 to Oct 2017

- Average Gross Vehicle Weight, 1,000 lb./ft.
- No. of Permits

Note: Maximum Standard Permit Vehicles = 2,900 lb./ft.

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• Precast Concrete Beam Structure Types – Design per standard MnDOT Bridge Design Manual

• For Curved and Skewed Steel Girder Structure Types – Include the MnDOT Special S351 single trip rating vehicle as an additional design permit load
Visual Quality Process

- Project split into segments
- Engagement with multiple stakeholders
- Open houses
- Precedent imagery
- Project textures and colors
Visual Quality – Main Interchange

As-built

Visualization

As-built
Visual Quality – Main Interchange

Visualization

As-built
Visual Quality – TH 53

Visualization

As-built
Br.69902:
- I-35 NB ramp to I-535 SB (over BNSF)

Br.69904:
- I-35 SB ramp to I-535 SB (over I-35, I-535 Ramp, BNSF)

Br.69905:
- I-535 NB ramp to I-35 NB (over BNSF)
Curved Steel Flyover Bridges

Br.69902:
• I-35 NB ramp to I-535 SB (over BNSF)

Br.69904:
• I-35 SB ramp to I-535 SB (over I-35, I-535 Ramp, BNSF)

Br.69905:
• I-535 NB ramp to I-35 NB (over BNSF)
Steel Superstructure Design Committee

• Comprised of Lead Designers from each of the three steel flyover bridges
  • Br.69902 – Parsons, Br.69904 – MnDOT, Br.69905 – Michael Baker Intl.

• Monthly meetings during design schedule to coordinate design among teams for consistency in final bridge design plans

• Coordination Items Included:
  ✓ Use of MnDOT Std Details
  ✓ Disc Bearing Std Details
  ✓ Modular Expansion Joint Detailing
  ✓ Cross Frame and Diaphragm Detailing
  ✓ Field Splice Locations
  ✓ Structural Steel Grade / Hybrid Design
  ✓ Girder Painting Limits
  ✓ Bridge Deck Drain Details
• Segment 1 – Main Interchange includes 27 existing bridge removals
  • MOT / Construction Staging required several ‘partial’ bridge removal operations requiring
detailed structural analysis and load rating work
  • Steel girder structures, including in-span hinge joints as well as some fracture critical steel piers
• Segment 2 – TH53 bridge removals included full removal of the 2 main reinforced
concrete box girder structures and the 4 connected ramp structures
  • In-span hinge joints
• Segment 3 – I-535/Garfield included full superstructure removal of the 4
reconstructed bridges as well as full or partial above ground substructure removal
Main Interchange ‘Can of Worms’ Existing Bridge Removals
Partial Existing Bridge Removals

Stage 1 "Intersection in the Sky" Removal Limits

Above

Below (Looking North)
AKJV teamed with MnDOT Bridge Design Consultant Partner LHB for detailed analysis and load rating work for partial removal of existing bridges where traffic would remain supported - to confirm no degradation of existing load ratings throughout removal sequence.

Example of the ‘Intersection in the sky’; off ramp from I35 NB to TH53 NB.
Existing Bridge Removals

STAGE 3 REMOVALS WP 1  TPI Main
TH53 Existing Bridge Removals
Bridge 69139 Temporary Connector

What happens when you are overbudget?

Work Package 1 & 2

Work Package 3
Bridge 69139 Temporary Connector

CONSTRUCTION JOINT W/CLEAR PLASTIC SHEETING (MIN. THICKNESS 6 MIL.)
Thank you!

Jeff Cavallin | Parsons Transportation Group
Nick Haltvick | Minnesota Department of Transportation
TPI Construction Challenges

Alex Schulz, P.E. | TPI Construction Manager - Kraemer North America
Cost and Schedule Certainty

Constructability Reviews

Long Lead/Critical Submittals

- Temporary Earth Retention Systems
- Bridge Demolition Plans
- Girder Erection Plans
- MnDOT/BNSF Review
Preconstruction Submittals

Temporary Earth Retention Systems

• Traffic/RR Staging
• Foundation Type and Location

Bridge Demolition Plans

• Traffic Staging
• Structural Stability

Girder Erection Plans

• Field Splices
  • Trucking Concerns
• Shoring Tower Locations
Temporary Earth Retention Systems

27th Avenue Bridge
- Maintaining Traffic
  - Installation
  - Bridge Construction

Main Interchange Area
- RR Track Support
Temporary Earth Retention Systems

27th Avenue Bridge - ERS Installation

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Temporary Earth Retention Systems

27th Avenue Bridge – Bridge Construction

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Temporary Earth Retention Systems

27th Avenue Bridge – Bridge Construction
27th Avenue Bridge

- Weekend Closure

Main Interchange Area

- Staged Demolition
- Detailed Removal Sequence
- RR and Freeway Constraints
  - Superstructure Removal
Bridge Demolitions

27th Avenue Bridge

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Main Interchange Area

- Staged Demolition
- Detailed Removal Sequence
- RR and Freeway Constraints
  - Superstructure Removal
Bridge Demolitions

TH53 Bridge

- Proximity to public
  - Vibration Monitoring
  - Dust Control
  - Utility Protection
  - Controlled Access
- Unique Structure Type
  - “Non-Linear” Hinges
  - Falsework
Miller/Coffee Creek Box Culvert
Miller/Coffee Creek Box Culvert Outlet – Structure Excavation
Temporary ERS/Permanent Construction Interface
Miller/Coffee Creek Box Culvert - Middle
Miller/Coffee Creek Box Culvert – Final Stripping and Opening
• 20”/16” Pipe and 14” H-Piling
  
  • Overall Quantity
    • 142,000 LF (Proposed WP1/2)
    • Material Handling/Storage
  
  • Variable soil conditions and bedrock depth
    • Additional Piling (Added HP, test piling)
    • Galvanizing
    • Quantity Management
  
  • Piling in Water
Cast-In-Place Retaining Walls

- Variable Heights
  - Multiple formwork types needed
- Proximity to RR
  - Schedule impacts
  - Access issues
- Reduced schedule
  - Clashing operations/activities
  - Formwork needs
  - Dissipating cure

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Cast-In-Place Retaining Walls
Visual Quality

• Arched Facade
  • Bridge 69909
  • Bridge 69906

• Formliner
  • WP2 CIP Retaining Walls
  • WP2 Abutments
  • WP3 Substructure
Arched Facade

- Bridge 69909
Visual Quality

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Visual Quality – TH53 Substructure
Steel Girder Erection

Submittals

• Precision Bolting System
• Quality Management Plan

Training

• Project Specific training for all project personnel operating the Precision Bolting System
Steel Girder Erection

Delivery Challenges

• Multiple staging/offload locations
• Load Restricted Bridges
• Police Escorts
• Traffic Control
Steel Girder Erection

Delivery Challenges

• Multiple staging/offload locations
• Load restricted bridges
• Police Escorts
• Traffic Control

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Delivery Challenges

• Multiple staging/offload locations
• Load restricted bridges
• Police Escorts
• Traffic Control
Quality Issues/Challenges

- Material Testing Failures
  - Washer galvanizing thickness
  - DTI hardness

- Steel fabrication
  - Undersized/missing splice holes
  - Undersized/missing bearing/flange holes

- Blocking Challenges

- Access Challenges
Steel Girder Erection – Access Challenges
Steel Girder Erection – 69902 Span 1 Misalignment
Winter and Mass Concrete

• Temperature Control
  • Command Center software
  • Blankets/Poly
  • Heaters
    • SPCC Plan/Environmental

• Schedule
  • Necessary to pour in winter
  • Extended Cure Time
  • Additional Formwork
Railroad Coordination

- Full time BNSF flagger
- Pre-Activity Meetings
- Full/Intermediate Closure Planning
  - Bridge Demolition
  - Girder Setting
  - Deck Forming
  - Deck Pours
  - Stripping
  - Painting

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Railroad Coordination
Mainline I35 Closure Planning

Fully or partially close I35 traffic

- Multiples bridges/spans
- Bridge Demolition
- Girder Setting
- Deck Forming
- Deck Pours
- Stripping
- Painting

2/28/23
Thank you again!

Alex Schulz
Kraemer North America
aschulz@kraemerna.com
612-248-5660
Check out posted photos and videos

- Sign up for updates on the project website: [https://www.dot.state.mn.us/d1/projects/twin-ports-interchange/](https://www.dot.state.mn.us/d1/projects/twin-ports-interchange/)

- There are three project cameras on the project home page
Questions?