## Complex Bridge Rehabilitation on I-380 Viaduct:
Overcoming Design and Construction Challenges in Cedar Rapids


## Agenda

INTRODUCTIONS
- Matt Rasmussen (Schemmer)
- Cliff Rhoads (Jasper)

PROJECT OVERVIEW

FINGER JOINT REPLACEMENT

CLOSED DRAINAGE SYSTEMS

FIELD CHALLENGES

BID ESTIMATION & STAFFING

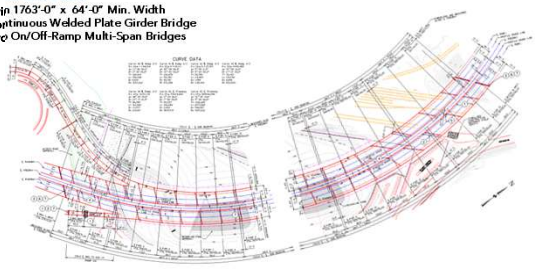
FIELD VERIFICATION

CONSTRUCTION

Q & A

## Project Overview

EXISTING BRIDGES
- Twin 1763'-0" x 64'-0" Min. Width Continuous Welded Plate Girder Bridge
- Two On/Off-Ramp Multi-Span Bridges



# Project Overview

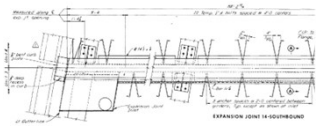
**PROPOSED REPAIRS**

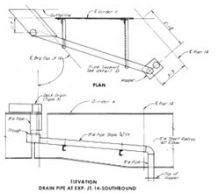
- Strip Seal Joint Replacements at Abutments
- Replace Sliding Plate Joints with Finger Joints at Cantilever Roller Joints
- General Concrete Repairs
- Add Closed Drainage System
- Partial Approach Replacement

# Closed Drainage System

**DESIGN CONSIDERATIONS**

- Locations/Nearby Concrete Repairs
- Relative Movement Between Superstructure and Piers
- Length of Support Available from Deck
- Conflicts with Existing Structure and Site
- Construction Tolerances
- Remaining Life of Structure

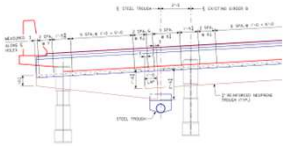


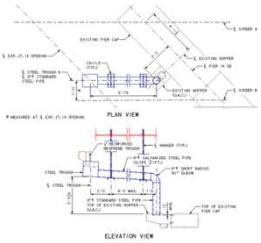


# Closed Drainage System

**DESIGN CONSIDERATIONS**

- Locations
  - *Existing Sliding Plate Joints (Replaced)*

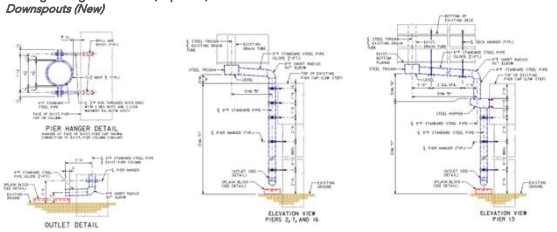




# Closed Drainage System

**DESIGN CONSIDERATIONS**

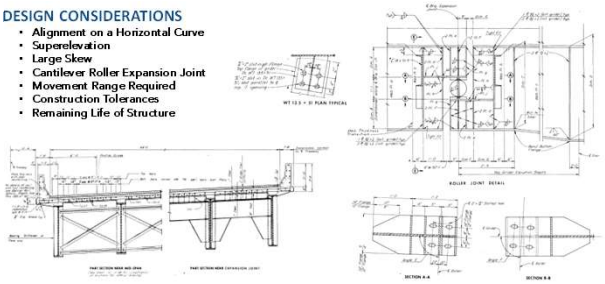
- **Locations**
  - Existing Sliding Plate Joints (Replaced)
  - *Downspouts (New)*




# Finger Joint Replacement

**DESIGN CONSIDERATIONS**

- Alignment on a Horizontal Curve
- Superelevation
- Large Skew
- Cantilever Roller Expansion Joint
- Movement Range Required
- Construction Tolerances
- Remaining Life of Structure



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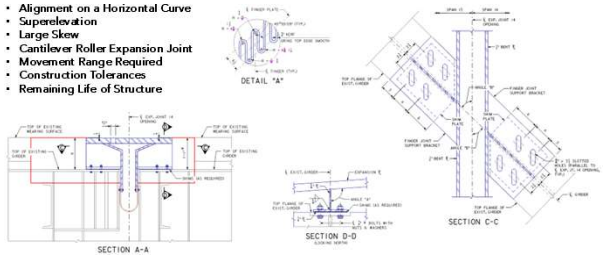
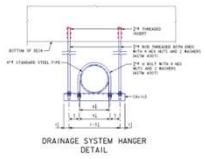


# Field Challenges

**CLOSED DRAINAGE SYSTEM INSTALLATION**

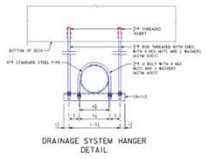
- *Epoxy/Grout System*
  - Both Vertical & Horizontal Applications Needed

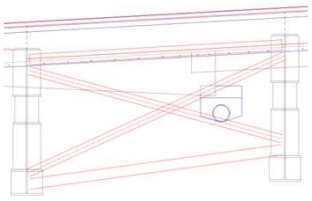



# Field Challenges

**CLOSED DRAINAGE SYSTEM INSTALLATION**

- Epoxy/Grout System
  - Both Vertical & Horizontal Application Needed
- *Pre-Emptive Construction Guidance*
  - Adjustments of Drainage Pipe Grade in the Event of Conflicts with Existing Structure

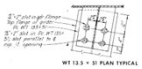


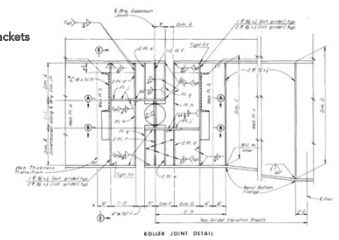



# Field Challenges

**FINGER JOINT INSTALLATION**

- *As-Builts Did Not Match Field Conditions*
  - End Plates at Cantilever Roller Joint
  - Bolt Locations for Finger Joint Support Brackets





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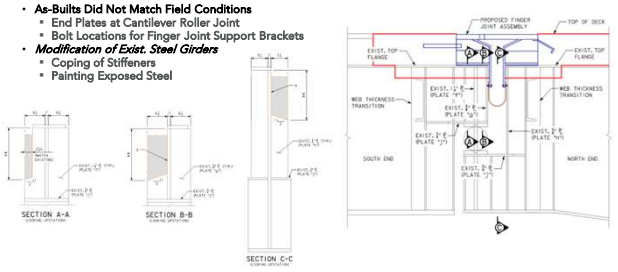
- *Modification of Exist. Steel Girders*
  - Coping of Stiffeners
  - Painting Exposed Steel

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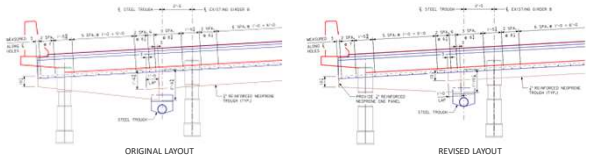


ORIGINAL LAYOUT



REVISED LAYOUT

# Field Challenges

**FINGER JOINT INSTALLATION**

- As-Builts Did Not Match Field Conditions
  - End Plates at Cantilever Roller Joint
  - Bolt Locations for Finger Joint Support Brackets
- Modification of Exist. Steel Girders
  - Coping of Stiffeners
  - Painting Exposed Steel
- *Pre-Emptive Construction Guidance*
  - Additional Fill Plates
  - Long Slotted Hole Length Increase
  - Plate Washers
  - Modifications to Finger Joint Bent Plates
  - Modifications to Finger Joint Support Brackets

## Linn County I-380 Bridge Repair Project

- Letting Date: March 21st, 2023
- Contract Amount: $2,525.808.50
- Late Start Date: July 5th, 2023
- Work Period: (4) weekends from Friday 7:00 PM – Monday 5:00 AM
- Liquidated Damages: $250.00/Hour
- Finger Joint Supplier: RJ Watson, Inc., Alden, NY
- Finger Joint Material Cost: $456,067.00 (172 LF)
- Lead Time: Shop Drawings (6 weeks), Fabrication (20 weeks)

## Bidding, Planning, & Scheduling

**Bidding Concerns**

- Finger joint material lead time
- Significant manpower needed each weekend
- Employees potentially quitting for working long hours
- Other projects going on at the same time (12 projects)
- Equipment mobilization each weekend
- Weather delays during weekend work
- Process to install finger joints
- Time required to install finger joint (start to finish)
  - *Modular joints typically take 7-10 days*
- Time required to install extrusion joint (start to finish)
  - *Typically take 4-6 days*
- Concrete cure time
  - *C-4 mix cure time is typically 36 +/- hours*
- Potential costs incurred if finger joints do not fit properly and work does not get completed in time each weekend
  - *Penalty ($250.00/HR)*
  - *Fabrication costs*
  - *Labor costs*
  - *Reputation*

## Bidding, Planning, & Scheduling

**Planning (Prior to Construction)**

- Transparency with DOT about lead time (26+ weeks)
  - *Best case scenario for starting late October 2023*
- Planning meetings with DOT, Schemmer, and RJ Watson
  - *Discussions related to project scheduling, traffic control staging, as-built drawings vs. field measurements, possible issues installing finger joints*
- Monthly planning meetings with crew supervisors
  - *Some excited for the challenge, some not so much*
- Weekly planning meetings with crew supervisors for 8 weeks prior to start date (September 2024)
- Added project specific incentive pay for all employees
  - *$20/Hr for night crews*
  - *$15/Hr for day crews*
  - *In addition to Zone 1 prevailing wages (overtime)*
- Submitted new mix design to DOT to accelerate cure time
  - *O-4WR with ½" coarse aggregate*
  - *Allowed by DOT – considered small volume repair per specs*
  - *Achieved maturity in 16 hours +/-*

# Bidding, Planning, & Scheduling

**Scheduling (Prior and During Construction)**

- First priority was to field measure I-380 NB and SB bridges
  - *Needed to verify as-built dimensions*
- Scheduling discussions with traffic control subcontractor and material suppliers
- Weekly meetings to discuss manpower needs
  - *Work during week prior to weekend work*
  - *Friday (night work)*
  - *Saturday (day work)*
  - *Saturday (possible night work)*
  - *Sunday (day work)*
  - *Sunday (possible night work)*
- Weekly meetings to discuss equipment mobilization
  - *Equipment mobilizing from multiple jobsites*
  - *Equipment rental needs*
- Daily/Weekly meetings with DOT for work progress updates and changes

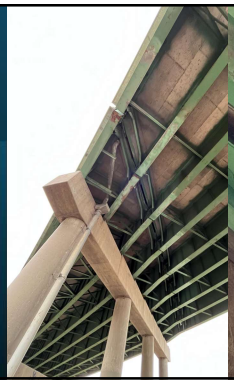
**Weekend #2 (September 20th-22nd)**

| Friday Night Crews | | | Saturday Crews | | | Sunday Crews | |
|---|---|---|---|---|---|---|---|
| North Abutment | Finger Joint | South Abutment | North Abutment | Finger Joint | South Abutment | Nick Wilson | Terry Collor |
| Josh Bogaard | Jorge Chavarria | Jonathon Galvez | Jeremy Holland | Cody Wilson | Dale Hadsall | Dylan Eichhorn | |
| Miguel Cervantes Galvez | Osmar Galvez | Luis Botello Garcia | Jose A Fonseca | Francisco Garcia | Jose F Rivera | Rodrigo Vazquez | |
| Braulio Moreno | Juan Jose Chavarria Perez | Jorge Armando Garcia | Juan Miguel Fonseca | Javier G Garcia (Gonzo) | Jose Oaxaca Madrid | Fidel Cepeda | |
| Damian Corona Chavarria | Mauricio | Fraxis Ortega Marino | Cesar Fonseca | Tony Nunuez | Juan Cabrera Valdovinos | Garret Blankenship | |
| Salvador Ledesma | Juan Carlos Reynosa Garcia | Rigoberto Galvez | Luis F Hernandez Ortiz | Agustin Garcia Ordaz | Jose A Rodriguez Cuba | Randy Jack | |
| Andrew Watson | Emando Buenrostro | Angel Galvez | Marcos J Nunez Chavarria | Gerardo Zamora Mendoza | Anthony Villarruel | Jose A Castanon | |
| Logan Silvius | Joel Garcia Buenrrostro | Isaac Correa | Luis Manuel Reinoza Garcia | Rodrigo Vazquez | Saul Monje Martinez | Joseph Daniel Martinez | |
| | Jose Reynosa Garcia | | | | Adrian Ribera Valdovinos | Vincent | |
| | Carlos Magana | | Finger Joint Forming Crew (In Lifts) | | | Nathan Blankenship | |
| | Juan Carlos Tapia | | Scissor Lift #1: | Ramiro Hernandez | | Layna Jocom | |
| | | | Scissor Lift #2: | Jose F Gomez Garcia | Gabriel Rivera Valdovinos | | |
| | | | Scissor Lift #3: | Arturo Mendoza | Juan F Alcaraz Rodriguez | | |
| | | | Boom Lift #1: | Dylan Eichhorn | Fidel Cepeda | | |
| | | | Boom Lift #2: | Juan Guzman Chavarria | Jesus Garcia (Chuey) | | |
| | | | Finger Joint Forming Crew (On Ground) | | | | |
| | | | Omar Fonseca | Pedro Figuero Hernandez | Damnier Cruz Mendoza | | |
| | | | Daniel Andrade | Jose A Vargas Ceballos | | | |

Friday Night: 24
Saturday: 35
Sunday: 12
Total: 71

| Changes from Weekend #1 |
|---|
| Reduced personnel doing removals at North and South Abutment Joints |
| Added personnel forming finger joint in lifts and on ground |
| Added lift equipment for forming finger joints |

# Field Measuring for Finger Joint Fabrication and Installation



## Field Measuring for Finger Joint Fabrication and Installation

## Construction

Beam Coping and Painting

- Majority of work took place prior to weekend construction
- Measured girder temperature with infrared thermometer and stopped work as necessary
- Sherwin Williams Dura-Plate 235
  - Fast drying epoxy paint (2 hrs at 77 degrees)

## Construction

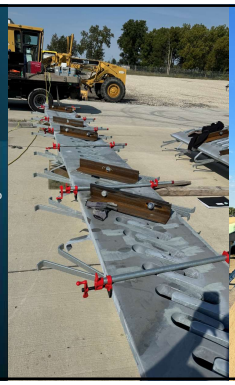
Concrete Demolition Process

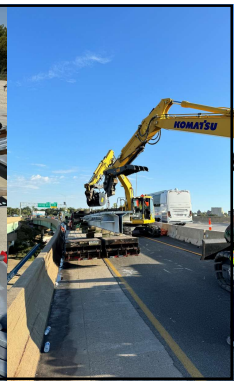
- Saw top and bottom side of concrete first for clean edges
- Lots of jackhammering and hard work
- Torched existing slide plate joint into small pieces and removed with excavator
- No easy way to do removal process

## Construction

Finger Joint Installation

- Pre-set joint opening dimension based on weekend temperature
- Used (2) Komatsu 138 excavators to set in place (Crane on standby)

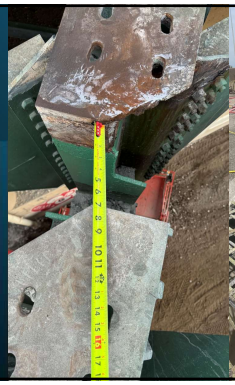


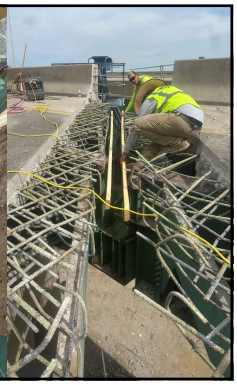



## Construction

Finger Joint Installation

- Extremely tight fit and difficult to make adjustments for the skew angle

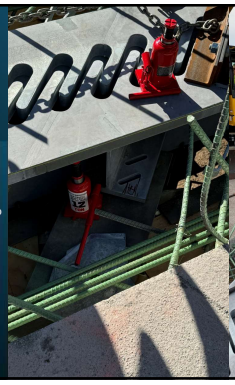


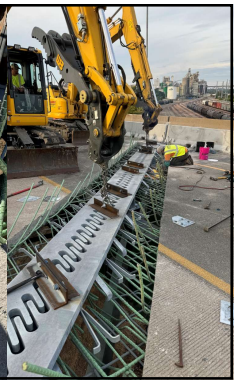


## Construction

Finger Joint Installation

- Used lots of steel shims to account for variable height of steel girders
- Joint setting height was critical for welding joint between stages and to ensure joint was installed ¼" below bridge deck surface





## Construction

Rebar, Formwork, and Concrete

- Slow process to install rebar with limited space
- Difficult formwork and bracing process working from lift equipment

## Construction

Rebar, Formwork, and Concrete

- Difficult formwork and bracing process working from lift equipment

## Construction

Rebar, Formwork, and Concrete

- Poured barrier wall sections with cover plates in place to allow barrier wall to be poured integral with deck concrete
- Weekend #1 Concrete Pour Time: 11:30PM Sat (Cure time: 3:30pm Sun)
- Weekend #2-4 Concrete Pour Time: 5:30PM Sat (Cure time: 9:30am Sun)
- Sunday Work: strip forms, watertight testing, equipment de-mobilization, final cleanup, restoring traffic control

## Linn County I-380 Bridge Repair Project

**Summary**

- Great weather with no rain over (4) weekends
- Crews were excited for the challenge, wanted to prove work could be done on time
- Made critical adjustments after first weekend for better performance
- Project planning and scheduling was critical to project success
- Open communication between DOT, Schemmer, and Jasper was greatly beneficial
- Very stressful project, built confidence to take on more complex projects in the future

**Complex Bridge Rehabilitation on I-380 Viaduct:**
Overcoming Design and Construction Challenges in Cedar Rapids