

***I-59/20 Viaduct Replacement
Birmingham, AL***

**CONTRACTOR INITIATED
VALUE ENGINEERING USING
PRECAST SUBSTRUCTURE**



Presented to

**In-Depth
Web Training**

I-59 / I-20 Downtown Birmingham, AL



6000' Long Viaduct Replacement through downtown Birmingham

- 14 Month Allowable Complete Closure of I-59/20
- Incentive / Disincentive Payments
 - \$250,000 per day
 - Maximum Incentive capped at \$15M
- Proposed Foundations under existing bridge structure (pile and drilled shaft)
- 163 Footings and Cast in Place Columns to be constructed after demo of existing bridge but before erection of segmental superstructure





VALUE ENGINEERING TEAM



➤ Owner: **ALDOT**



➤ Contractor: **Johnson Bros. / Oscar Renda JV**

➤ Substructure EOR: **Volkert**

➤ VE EOR: **ICE of Carolinas**

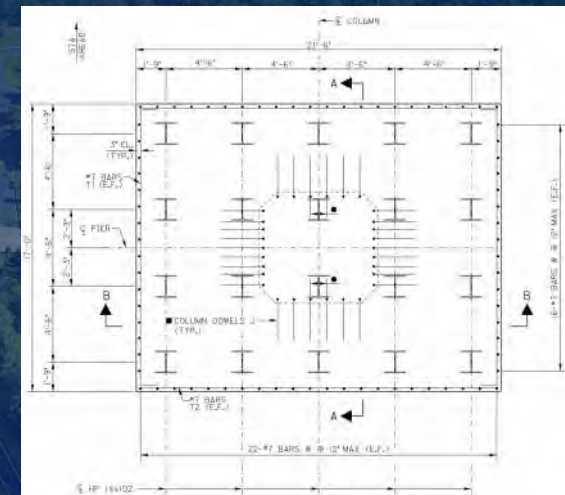
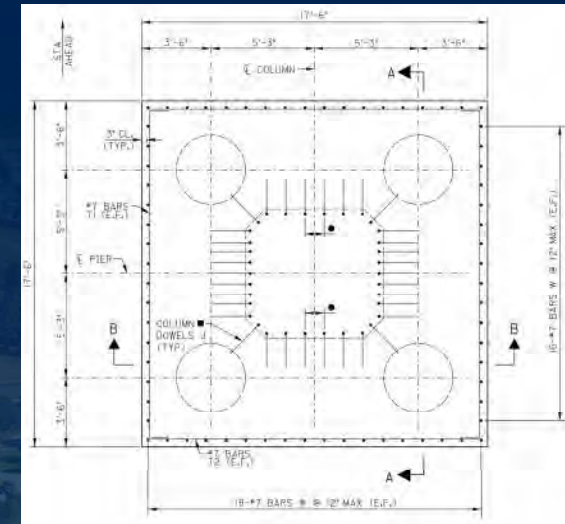
➤ Foundation Subcontractor: **Russo**



Substructure & Foundations

A combination of pile footings and drilled shaft footings support the proposed structure

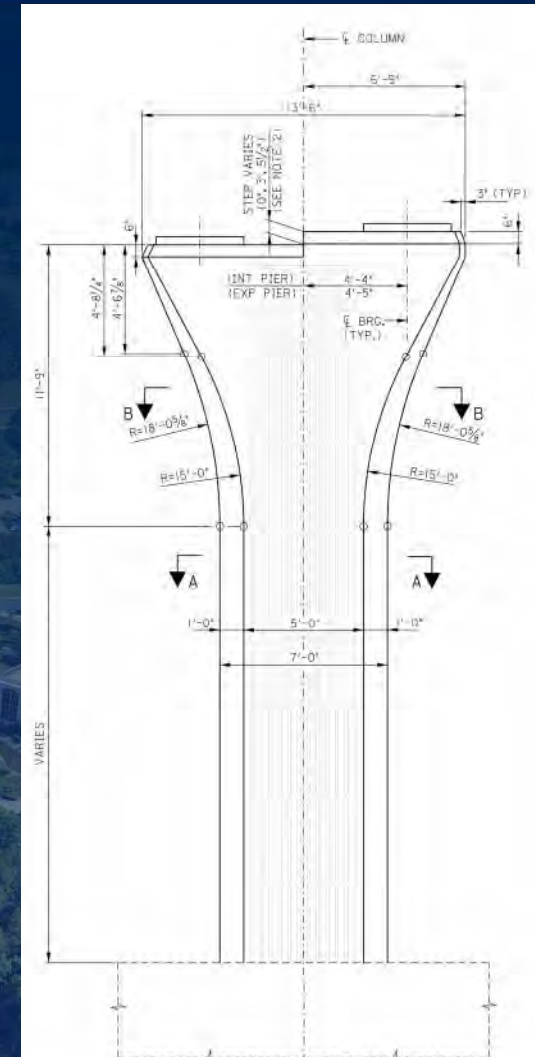
- Drilled shaft footings 22nd Street to the West
- H-pile footings 22nd Street to the East
- Required low headroom construction prior to demo of existing viaduct
- Required Significant Equipment Utilization During Closure Period
- Significant onsite Construction Traffic Congestion



Substructure & Foundations

Fluted Rectangular Columns with Flared Cap

- Solid cast-in-place concrete column varying in height (4' to 25')
- Solid flared cast-in-place concrete cap with a standard height (12')
- Each pier supports a single segmental box girder
- Typical bents are 4 piers wide (2 EB and 2 WB)
- 163 Piers Required (nearly 7000 cy of cast-in-place concrete)



Substructure & Foundations

Micropile Foundations and Precast Piers

- Drilled shaft footings West of 22nd Street were redesigned to Micropile footings
- All Piers were redesigned to a Precast Column & Cap system
- Benefits
 - Construction of foundations / pile caps start prior to bridge closure & demo
 - Columns & Caps can be precast & stockpiled prior to bridge closure & demo
 - Erection of precast columns can be done on site (2 per day per crew instead of 1 per 2 weeks per crew)



Substructure & Foundations

Foundations

- Low Headroom Drilled Shafts
- Really Low Headroom Drilled Shafts
- H-piles



Substructure & Foundations

Foundations



Substructure & Foundations

Foundations

LOW HEADROOM ISSUES



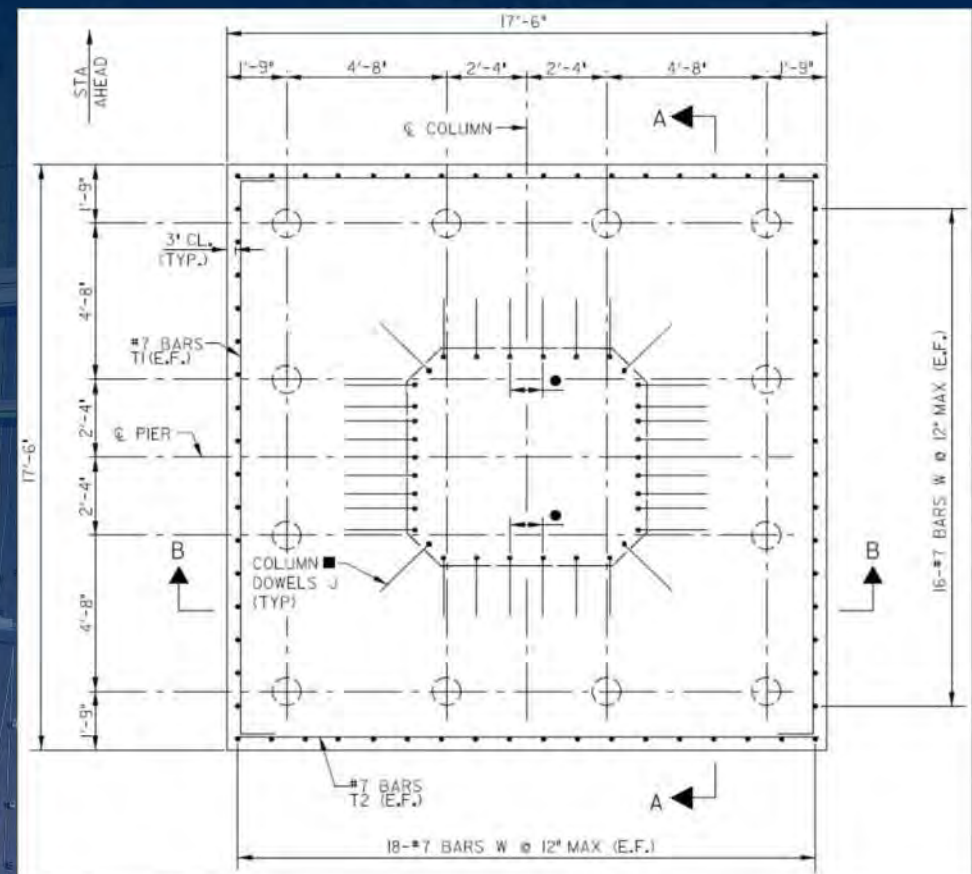
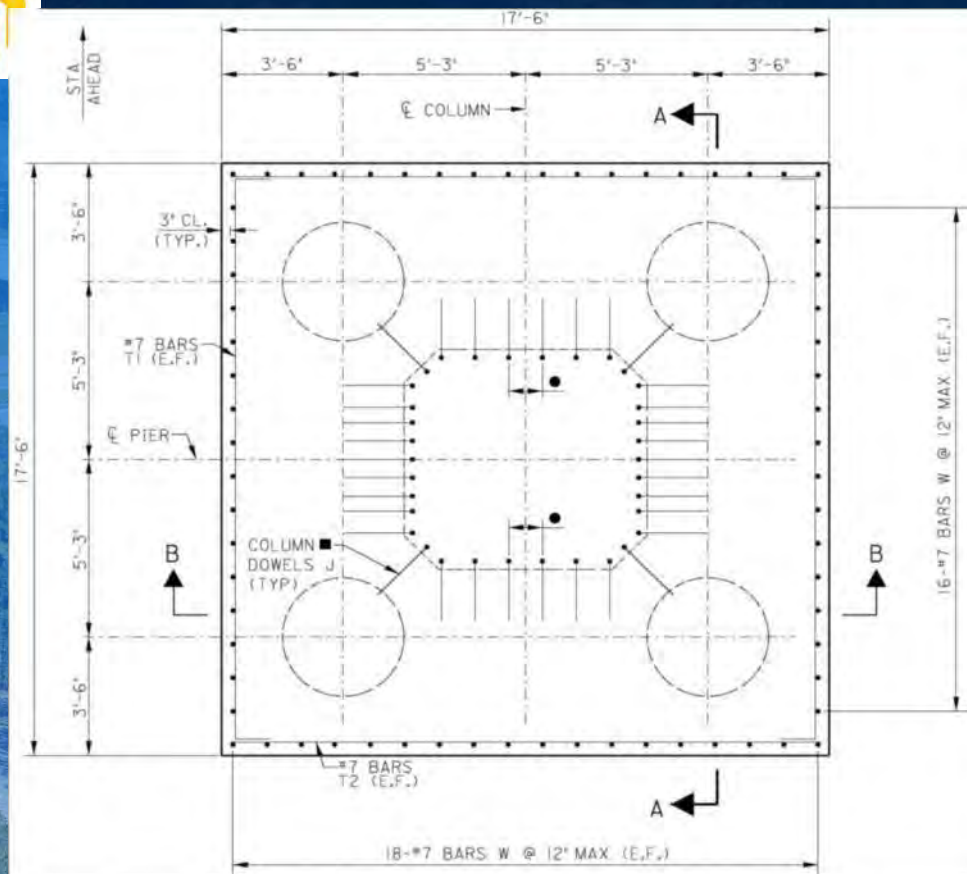
Substructure & Foundations

Foundations



Substructure & Foundations

Drilled Shaft vs Micropile Layouts



Substructure & Foundations



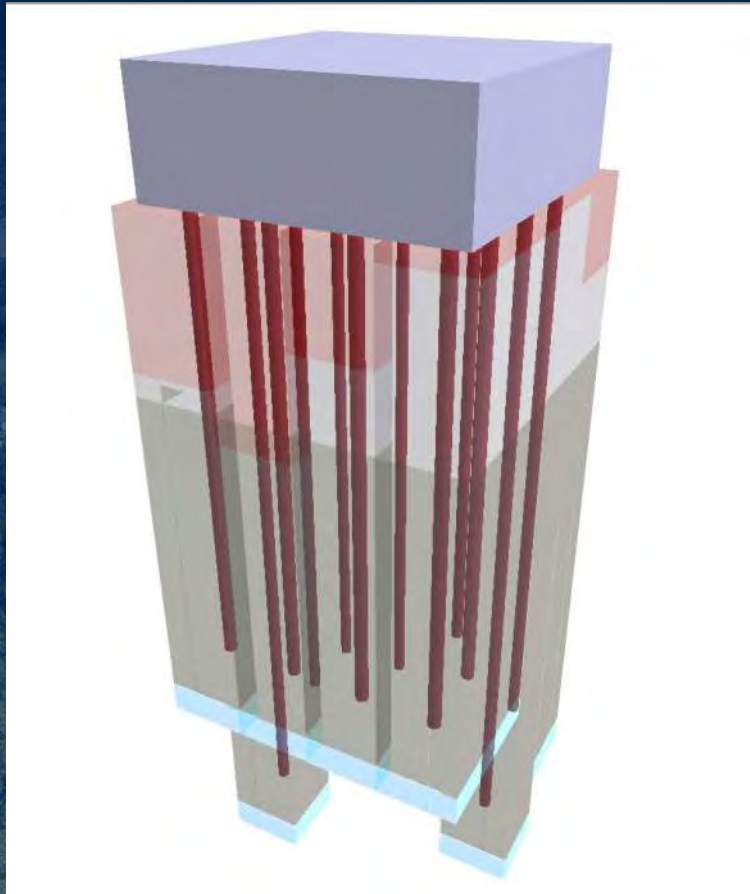
9.625" dia. Casing Threaded Sections



3" diam Gr75 Bar

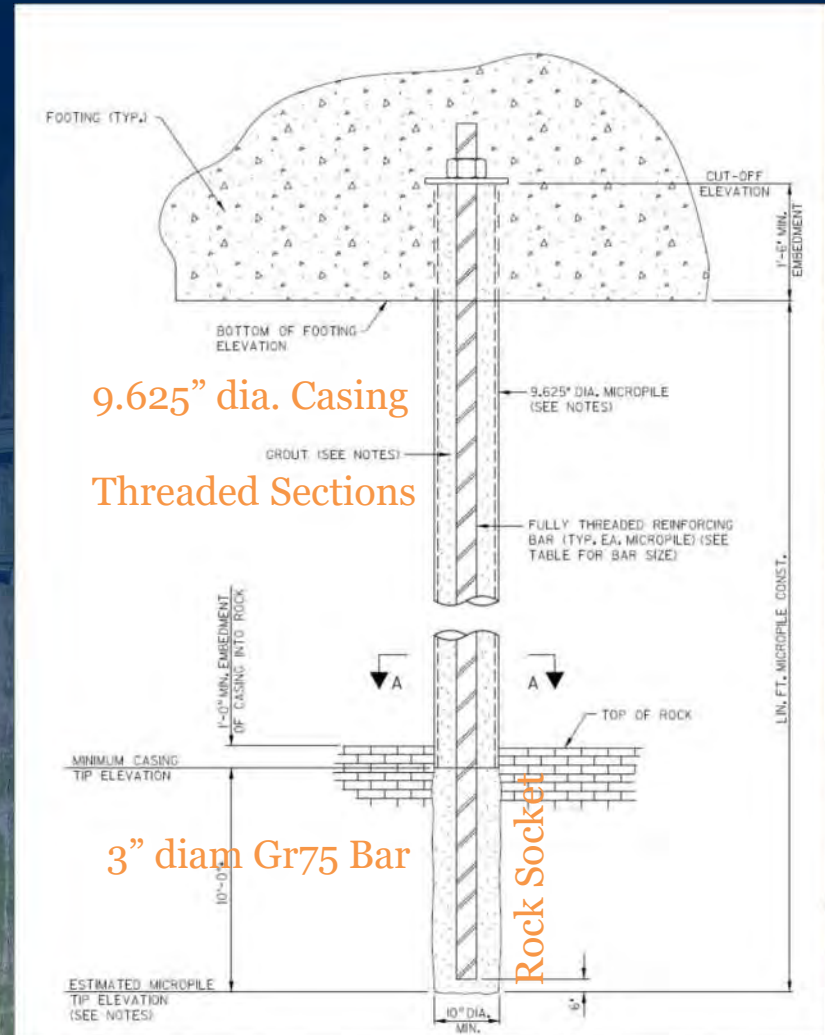
Substructure & Foundations

FB-MultiPier Analysis



MICROPILE DESIGN

Substructure & Foundations



9.625" dia. Casing

Threaded Sections

3" diam Gr75 Bar

Rock Socket

Slide 15

JB2 maybe noted that this pile was being prepared for testing as to why not exposed high strength bar
Joe Bailey, 11/19/2020

Substructure & Foundations



Substructure & Foundations



Substructure & Foundations

Micropile Static Load Test



Substructure & Foundations



Substructure & Foundations



LOW HEADROOM INSTALLATION

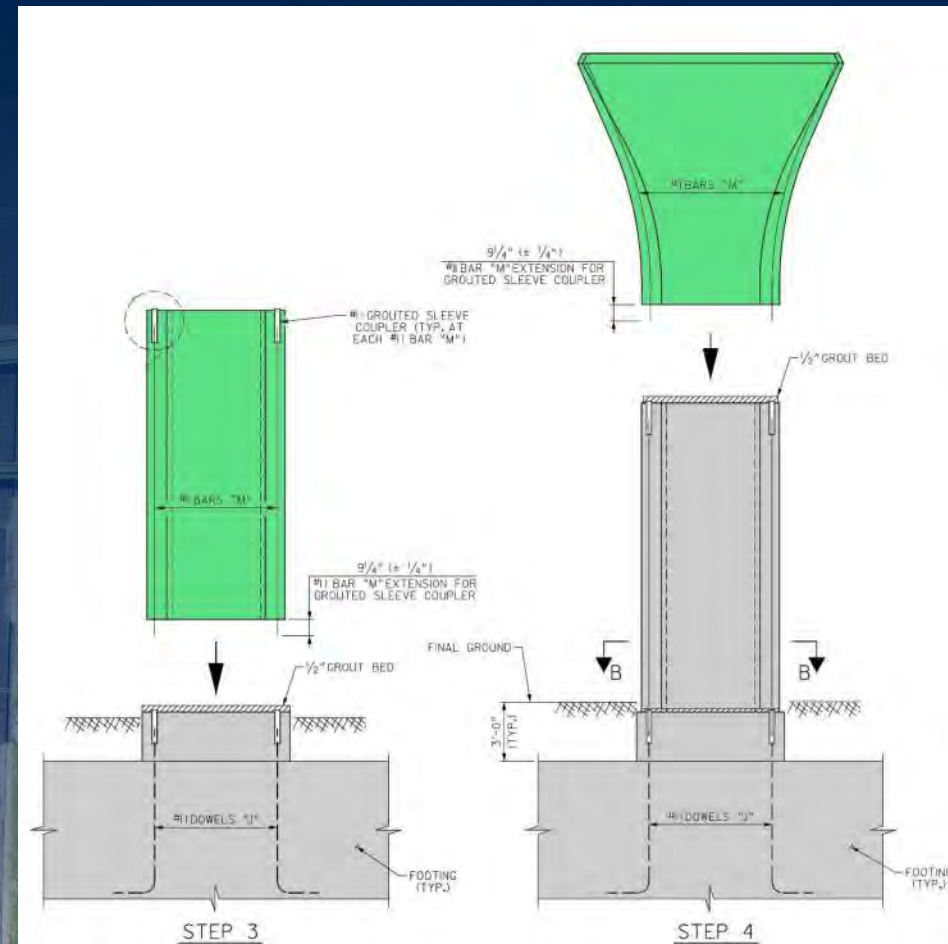
Substructure & Foundations



Precast Pier Construction

A complete “system” was designed including casting, lifting & erection equipment including the “details”

- STEP 1: Pre-bridge Closure Work
 - Construct foundation and pile cap with embedded couplers in low headroom
 - Simultaneously precast column and cap elements off-site
- STEP 2: Bridge Closure & Demolition
 - Protect pile cap and stem during demolition
- STEP 3: Erect Precast Column & Cap Pieces
 - Column Piece delivered to site from casting yard
 - Lift, turn and erect Column/Cap Piece



Precast Pier Construction

A complete “system” was designed including casting, lifting & erection equipment including the “details”

➤ Casting, Lifting & Storage Considerations

- Columns cast horizontal
- Caps cast vertical
- All pieces stored horizontally (double stacked)
- Lifting & Turning System
- Lift, turn and erect Column/Cap Piece

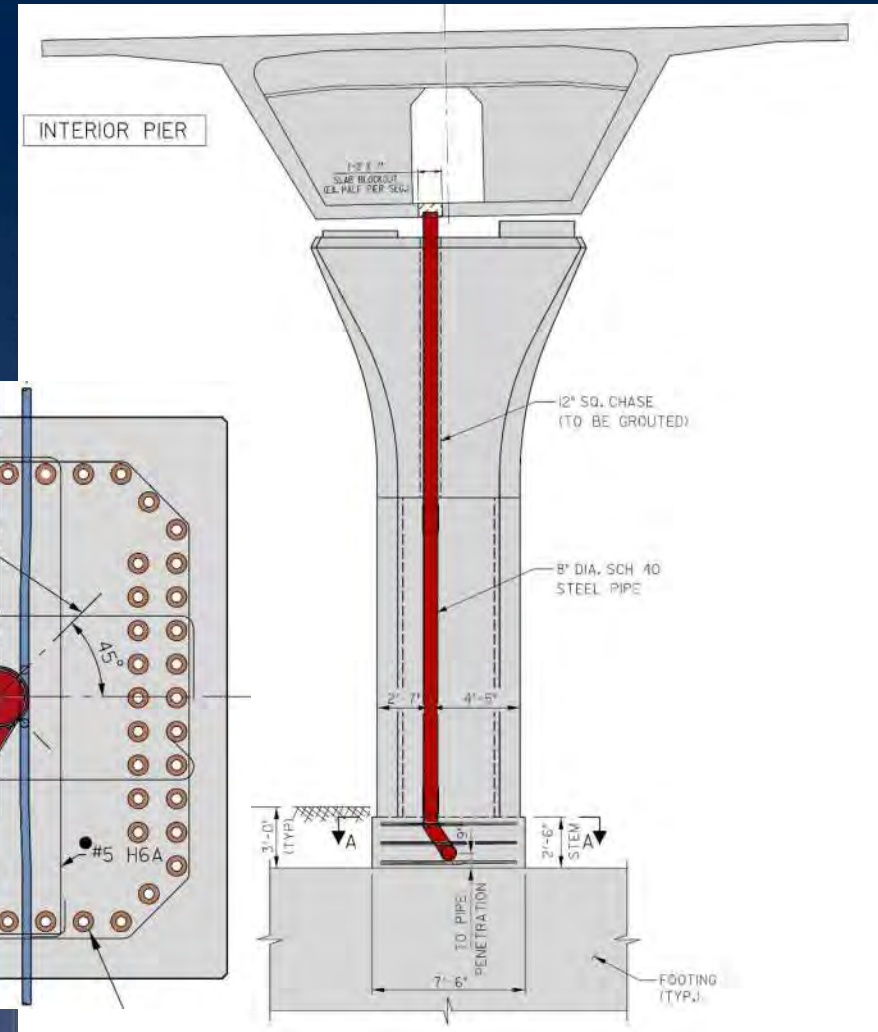
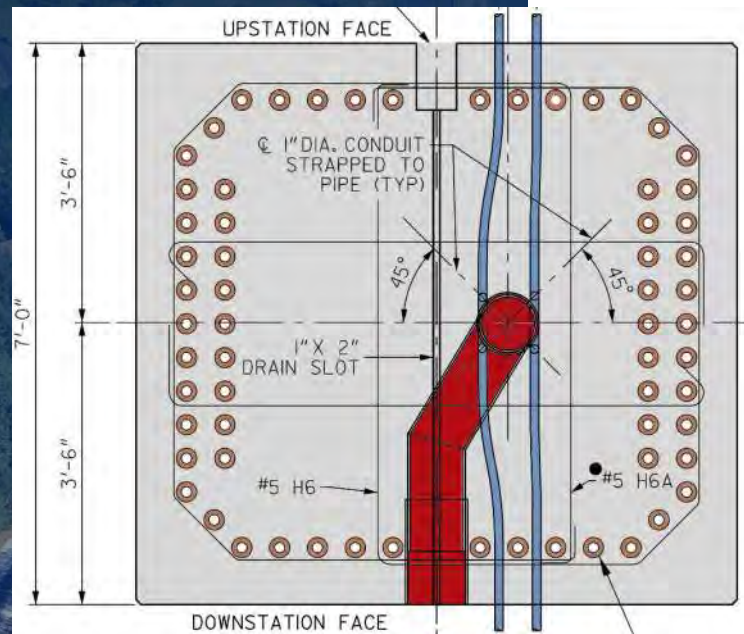


Precast Pier Construction

A complete "system" was designed including casting, lifting & erection equipment including the "details"

➤ Drainage & Utility Considerations

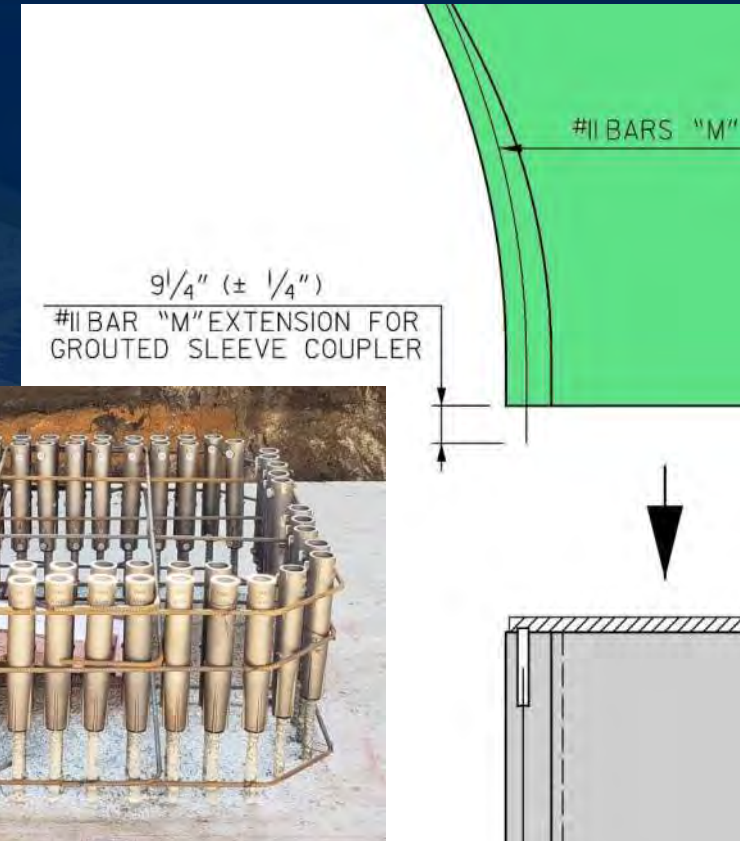
- Internal steel drainage pipe accommodations
- Lighting & electrical conduit accommodations



Grouted Splice Couplers

Use of grouted splice couplers (NMB Splice Sleeve A11W)

- #11 Bars Coupled at Column to Stem and Column to Cap Joint
- Couplers are located to allow pre-filling rather than post-grouting
- Fit-up requires tight tolerance on coupler and dowel bar extensions
- Templates for footing, stem and precast pieces to keep very tight tolerances on location and dowel extension



PRECAST STRUCTURAL CONNECTIONS

Grouted Splice Couplers

Use of grouted splice couplers (NMB Splice Sleeve A11W)

- Pre-grout method of filling couplers and grout bed ensure complete filling of couplers



Handling & Erection Equipment Design

60 Ton Pieces Require Special Designed Handling and Erection Equipment

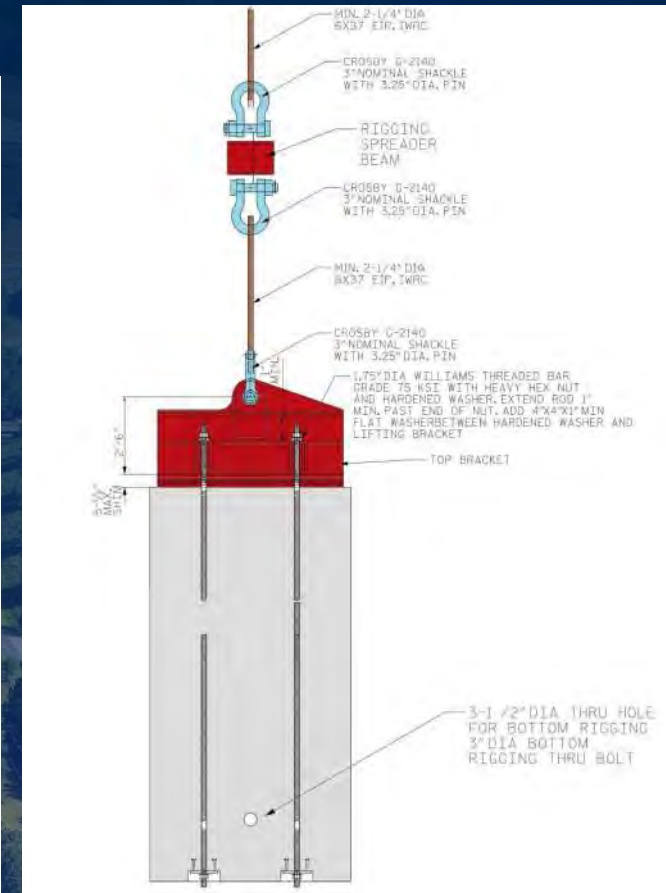
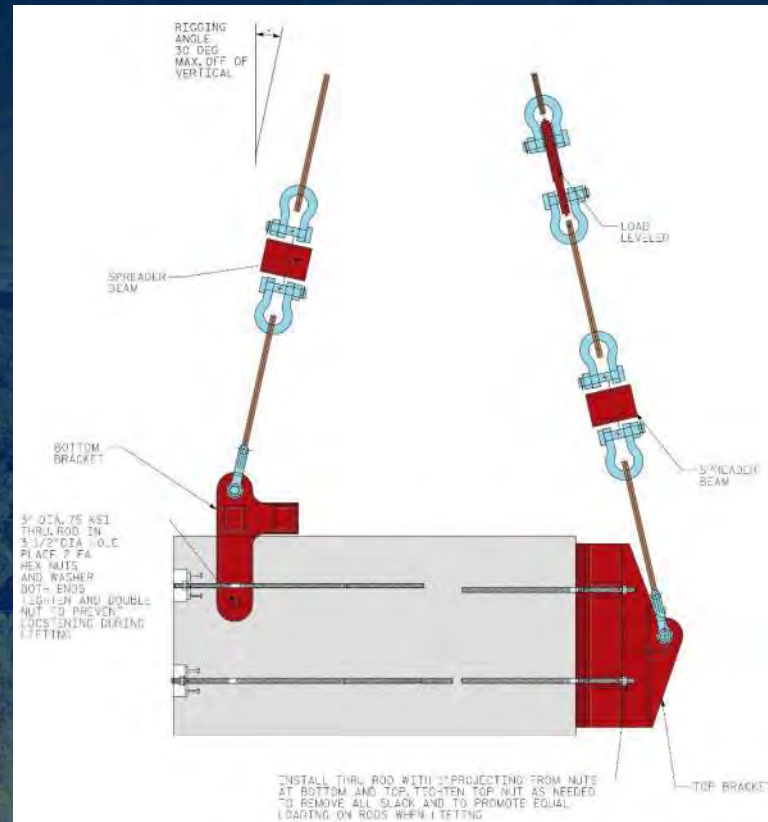
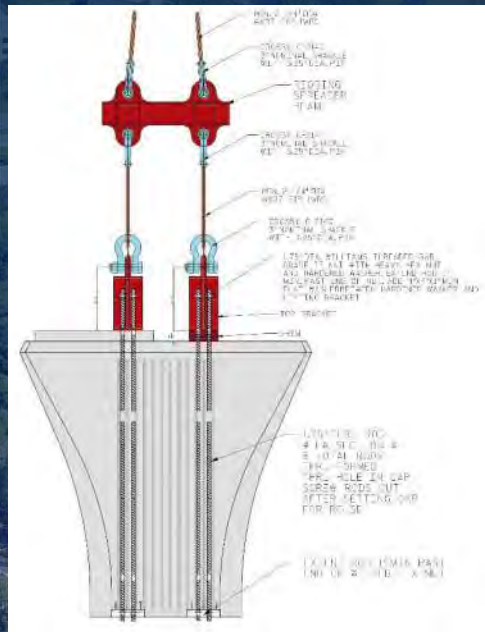
- As discussed previously, between casting, storage and erection, caps and columns must be turned



Handling & Erection Equipment Design

Cap Piece Handling

- Must Accommodate turning from 0 to 90°



Handling & Erection Equipment Design

Cap Piece Handling

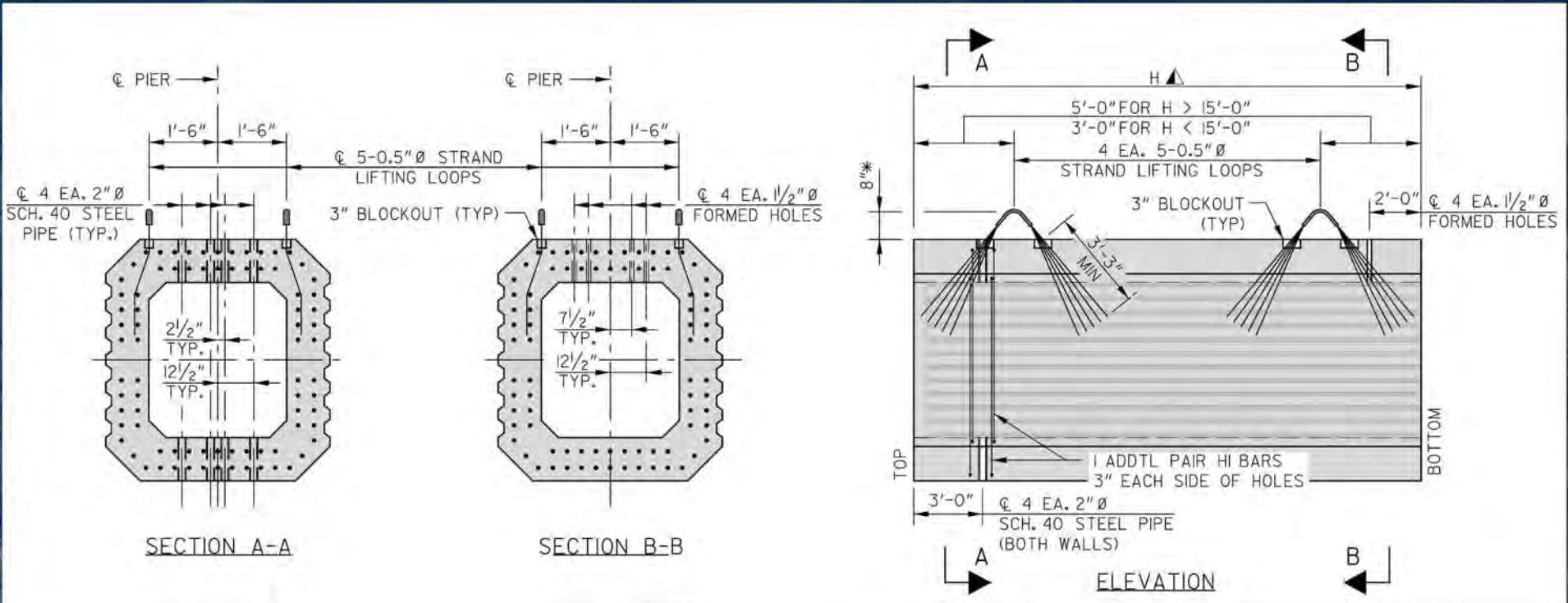
- Must Accommodate turning from 0 to 90°



Handling & Erection Equipment Design

Column Piece Handling

➤ Similar lifting & turning brackets require embeds in precast



Handling & Erection Equipment Design

Column Piece Handling

➤ Casting Yard Moving & Storing



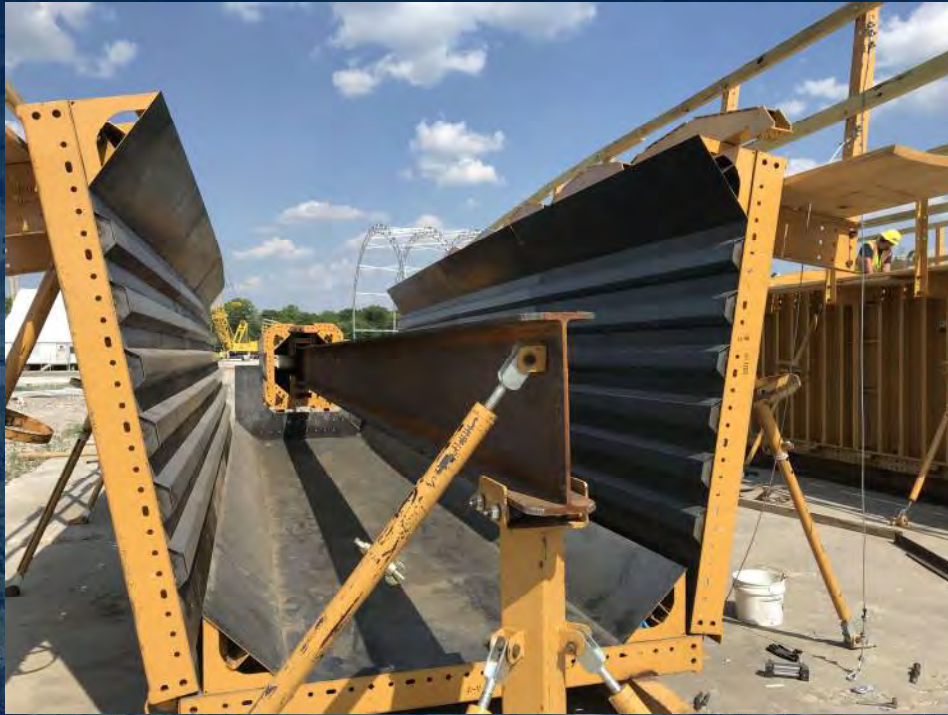
Handling & Erection Equipment Design

Column Piece Handling

➤ Erection On-site



Precast Pier Casting & Erection



Precast Pier Casting & Erection



Precast Pier Casting & Erection

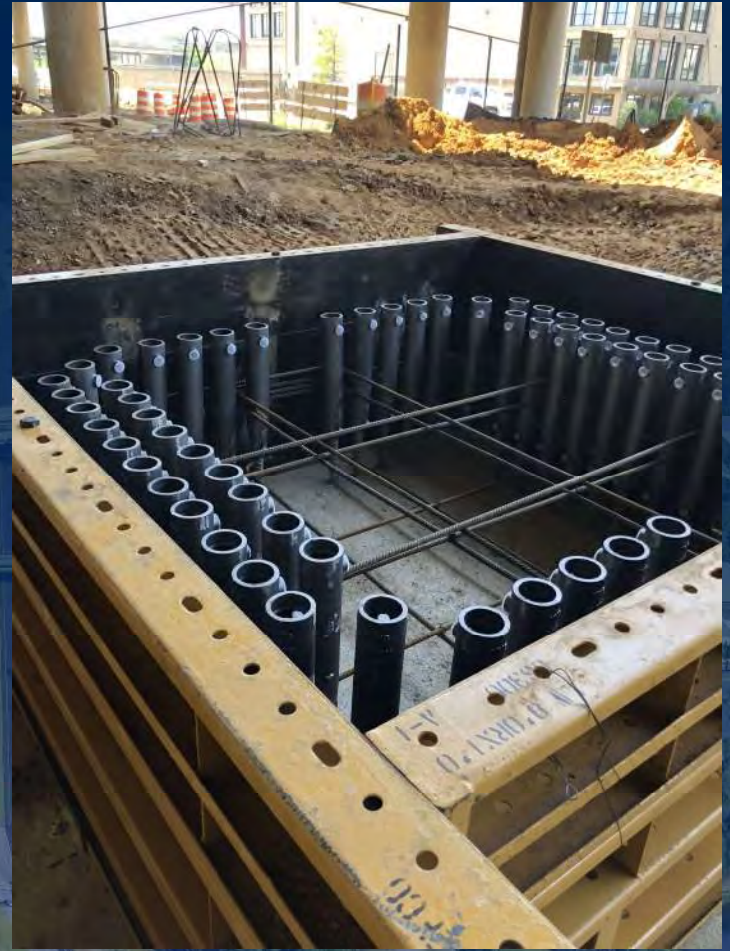
CONSTRUCTION IN ACTION



Precast Pier Casting & Erection



Precast Pier Casting & Erection



Precast Pier Casting & Erection



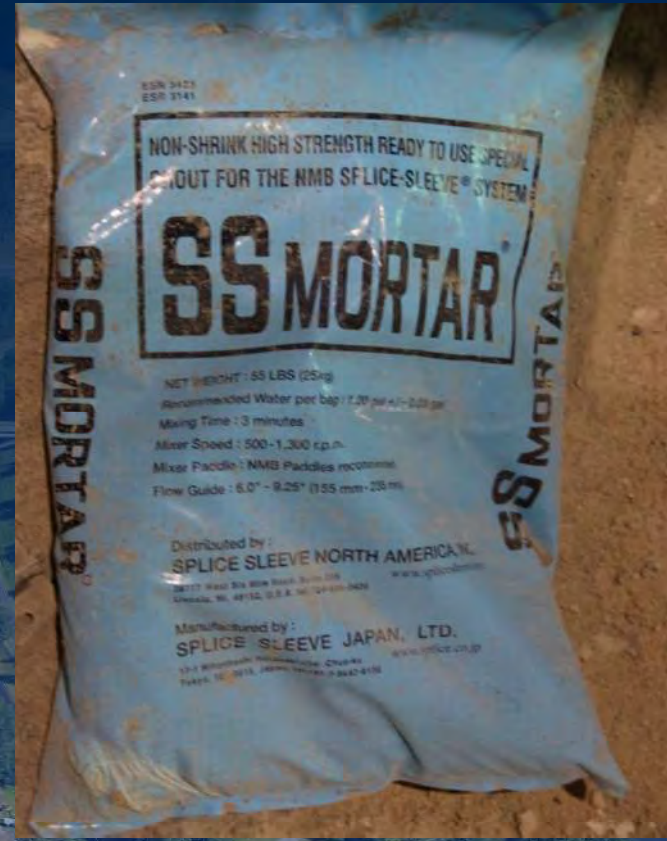
Precast Pier Casting & Erection



Precast Pier Casting & Erection



Precast Pier Casting & Erection



Precast Pier Casting & Erection



Precast Pier Casting & Erection





Project Accomplishments



- 70% of foundations were installed prior to demolition of existing bridge
- All Precast Piers were cast prior to demolition of existing bridge
- 163 Precast Piers were erected in 3 months after demolition of existing bridge
- Superstructure segment erection proceeded at up to 6 simultaneous headings without delay
- Site congestion was reduced
- **CONTRACTOR FINISHED 61 DAYS EARLY EARNING MAXIMUM \$15 MILLION BONUS**





QUESTIONS?

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Technical Director

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