SELLWOOD BRIDGE Project

MULTNOMAH COUNTY

# Sellwood Bridge

## *Final Design of the Main River Crossing Arch Bridge*

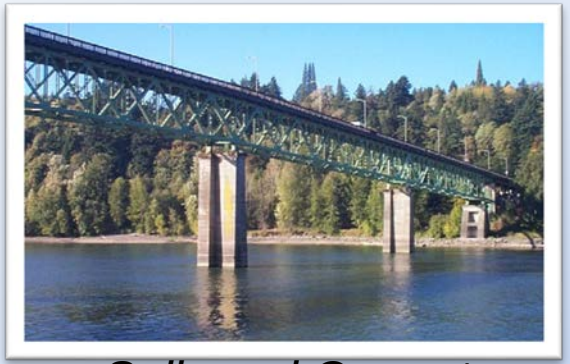
Western Bridge Engineers' Seminar

September 2013

# Sellwood Bridge

*Final Design of the Main River Crossing Arch Bridge*

*Sellwood Past*



*Sellwood Current*

*Sellwood Future*

## Presenters:

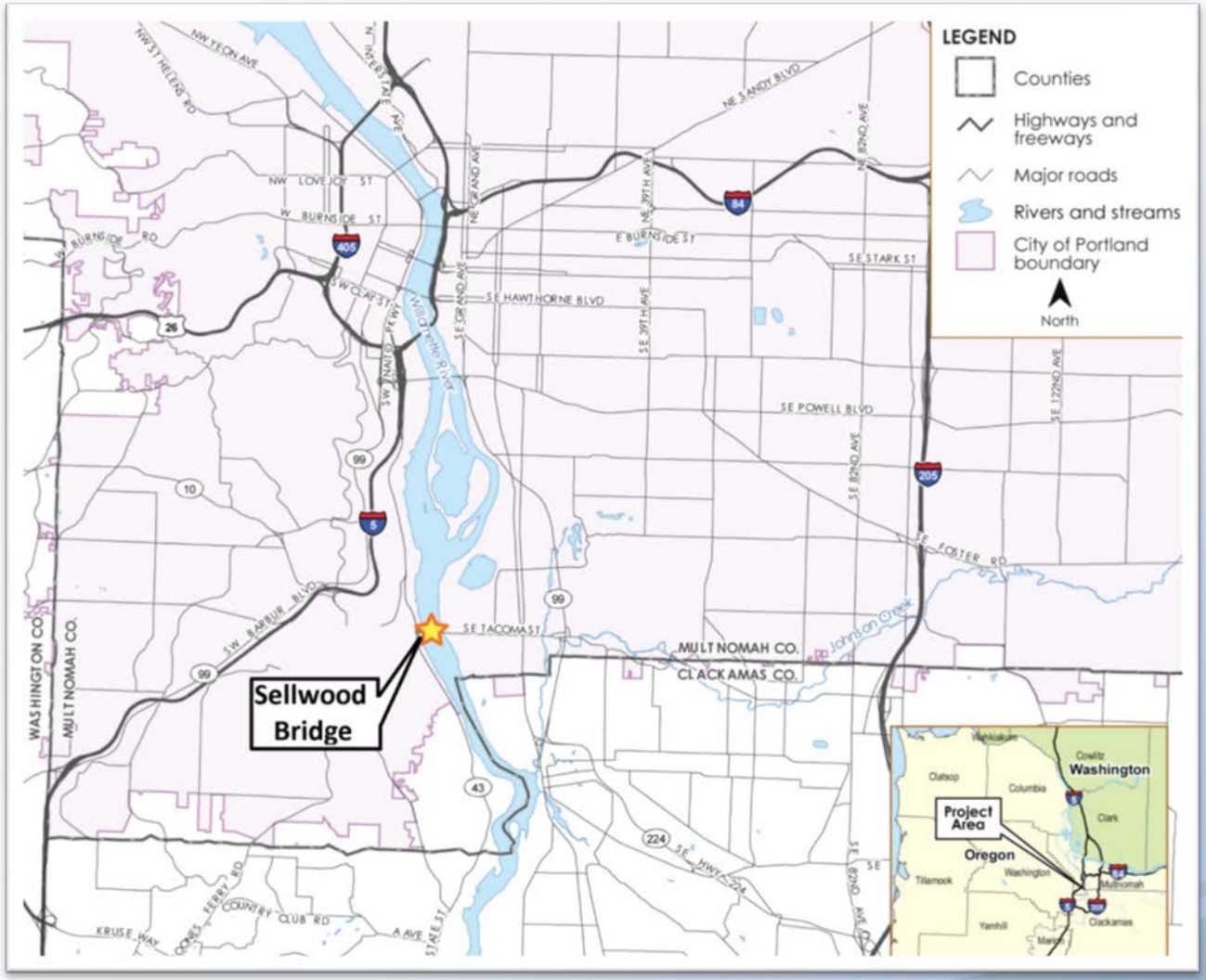

Ian Cannon, P.E., Multnomah County
Eric Rau, P.E., T.Y. Lin International
Mike Lopez, P.E. S.E., T.Y. Lin International

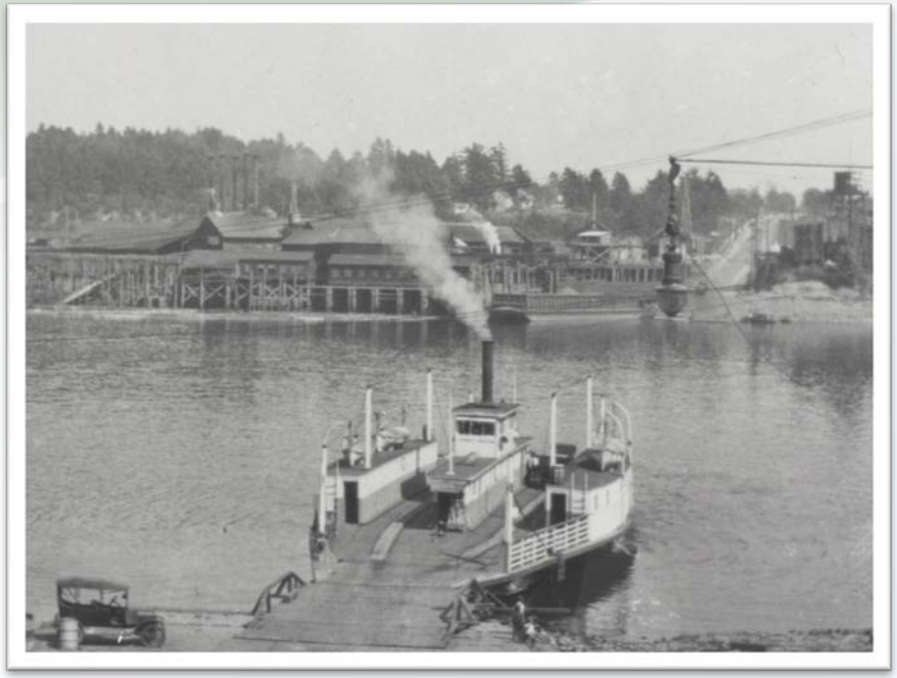
# Agenda

- Sellwood Site Background
- Bridge Replacement Project
- Bridge Type Selection
- Bridge Design Overview
- Construction Updates

# Sellwood Site Background

# Project Location





Ferry at Spokane St

Sellwood Bridge

# History

- Bridge opened 1925
- West approach moved 3ft by 1960
- Loads restricted in mid 1980’s
- Large cracks discovered in 2003
- “Band aids” installed
- Loads further restricted 2004
- NEPA process started in 2006


# Issues

- West end slope instability
- Buses / trucks restricted
- General deterioration
- Bridge not designed for earthquakes
- Narrow lanes, no shoulders
- Narrow sidewalk
- No bike facilities / poor connections
- Tight turns at west end

# Bridge Replacement Project

# Project Team

- Agencies
  - Multnomah County
  - City of Portland
  - Oregon Department of Transportation
  - Federal Highway Administration
- Consultants
  - T. Y. Lin International, Prime Design Firm
  - CH2M Hill, Lead Subconsultant
  - Cornforth Consultants, Landslide Mitigation Consultant
  - Safdie Rabines Architects
  - David Evans and Associates, Owners Rep
- Contractor
  - Slayden/Sundt Joint Venture

# Project Information

- Overall budget - $307.5 million
- About 20% complete construction
- Utilizing CM/GC delivery method
- Traffic on new span – Summer 2015
- East approach/OR 43 interchange complete – Summer 2016

# CM/GC Decision Factors

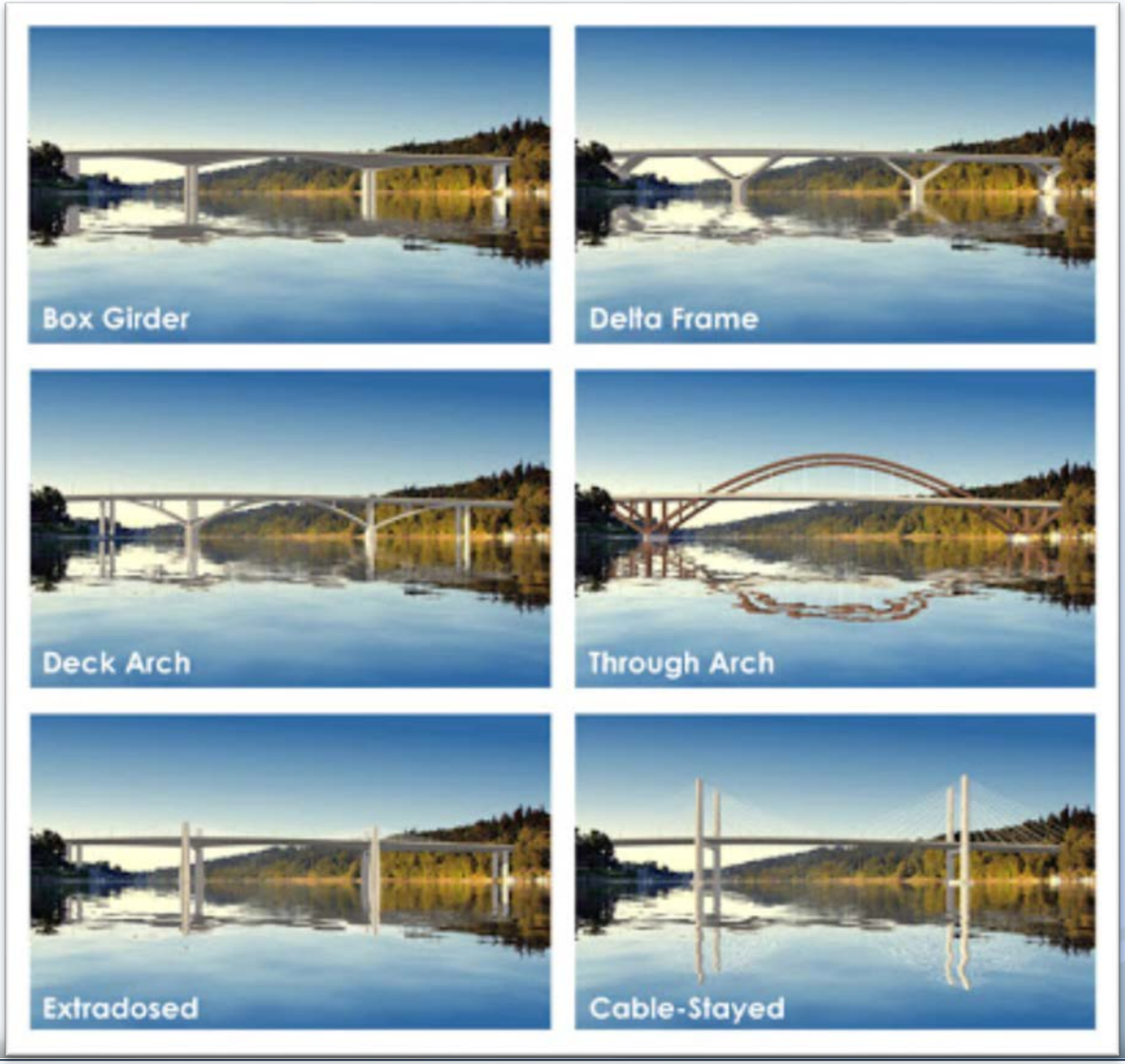
- Cost
- Technical complexity
- Design developing
- ROW acquisition complex
- Schedule
- Risk
- Equity
- Sustainability
- Public involvement

# Bridge Type Selections

# Selection Process

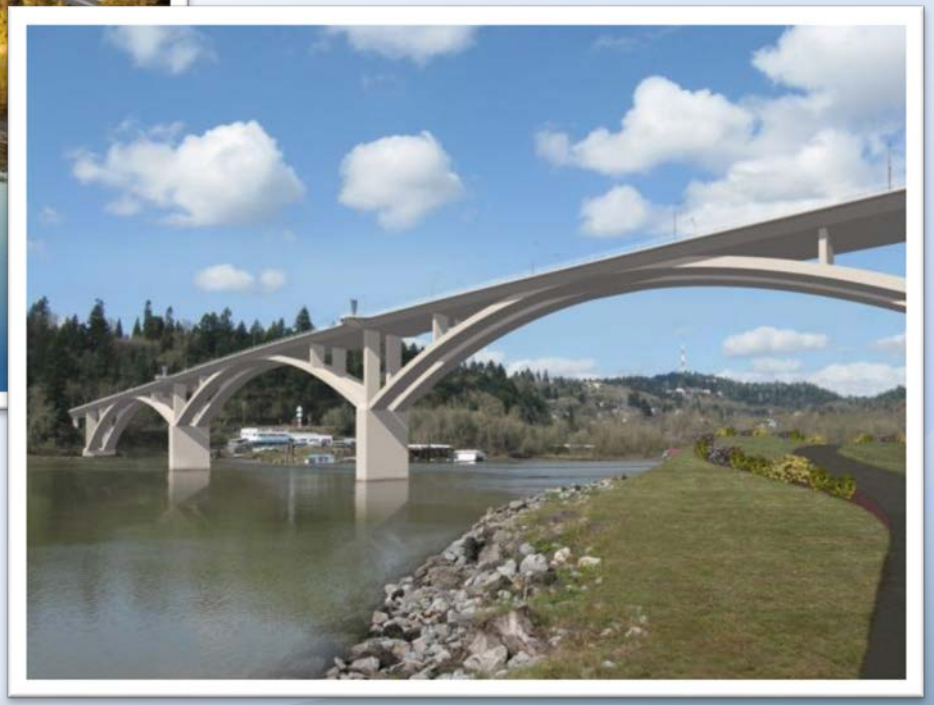
- Conducted in 2010
- 12 bridge types evaluated
- 9 criteria scored in a matrix including:
  - Cost
  - Construction risk
  - Environmental impact
  - Aesthetics
- Public involvement: CAC $\Rightarrow$ PSC $\Rightarrow$ BCC

# Bridge Type Selection



# Concrete Box Girder

# Concrete Deck Arch



# Steel Deck Arch

# Architectural Features

Structural Lighting

# Architectural Features

Pedestrian Belvederes

# Architectural Features

**Enhanced Protective Fencing & Street Lighting**

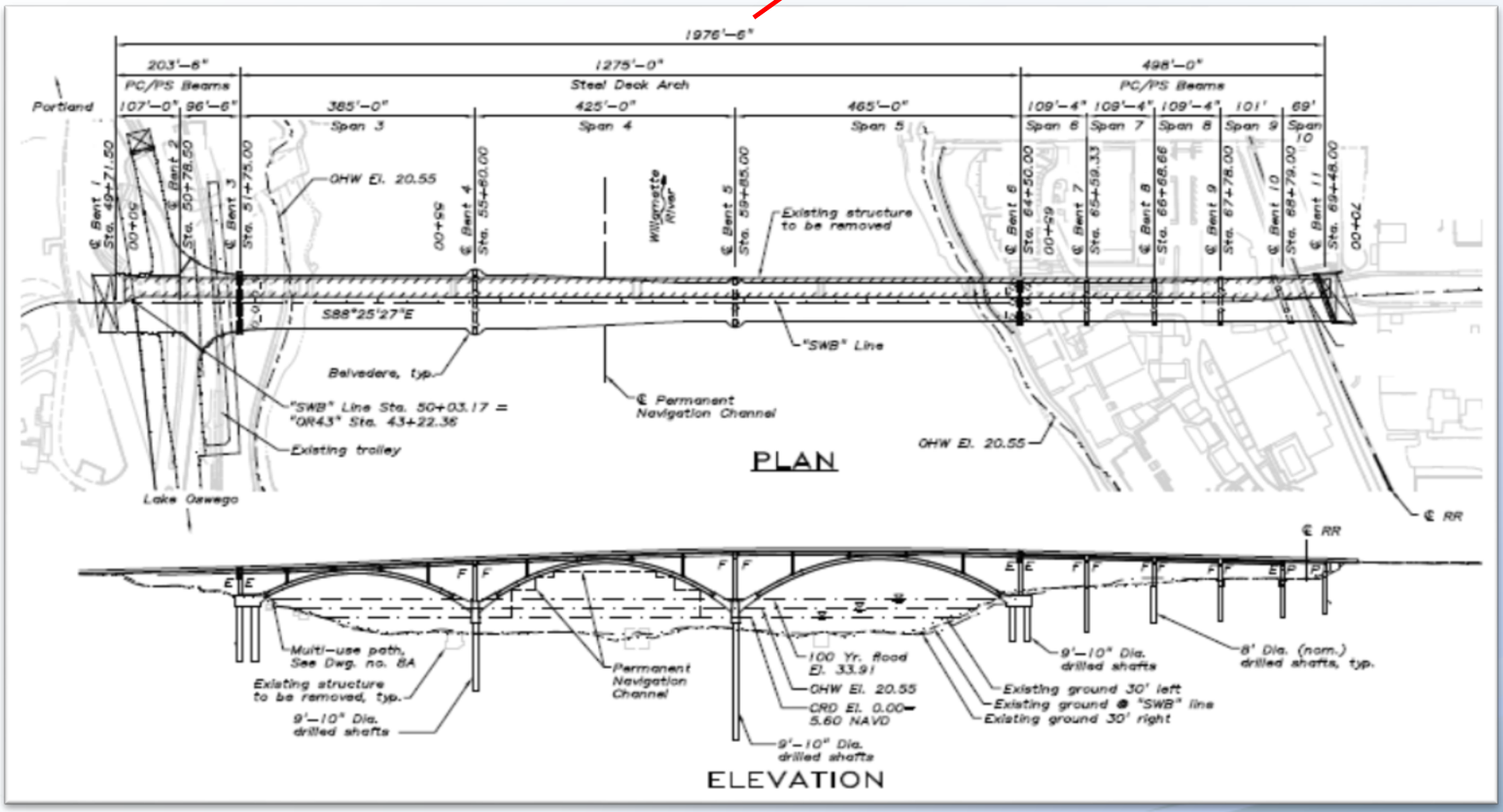
# Architectural Features


Gateway Art

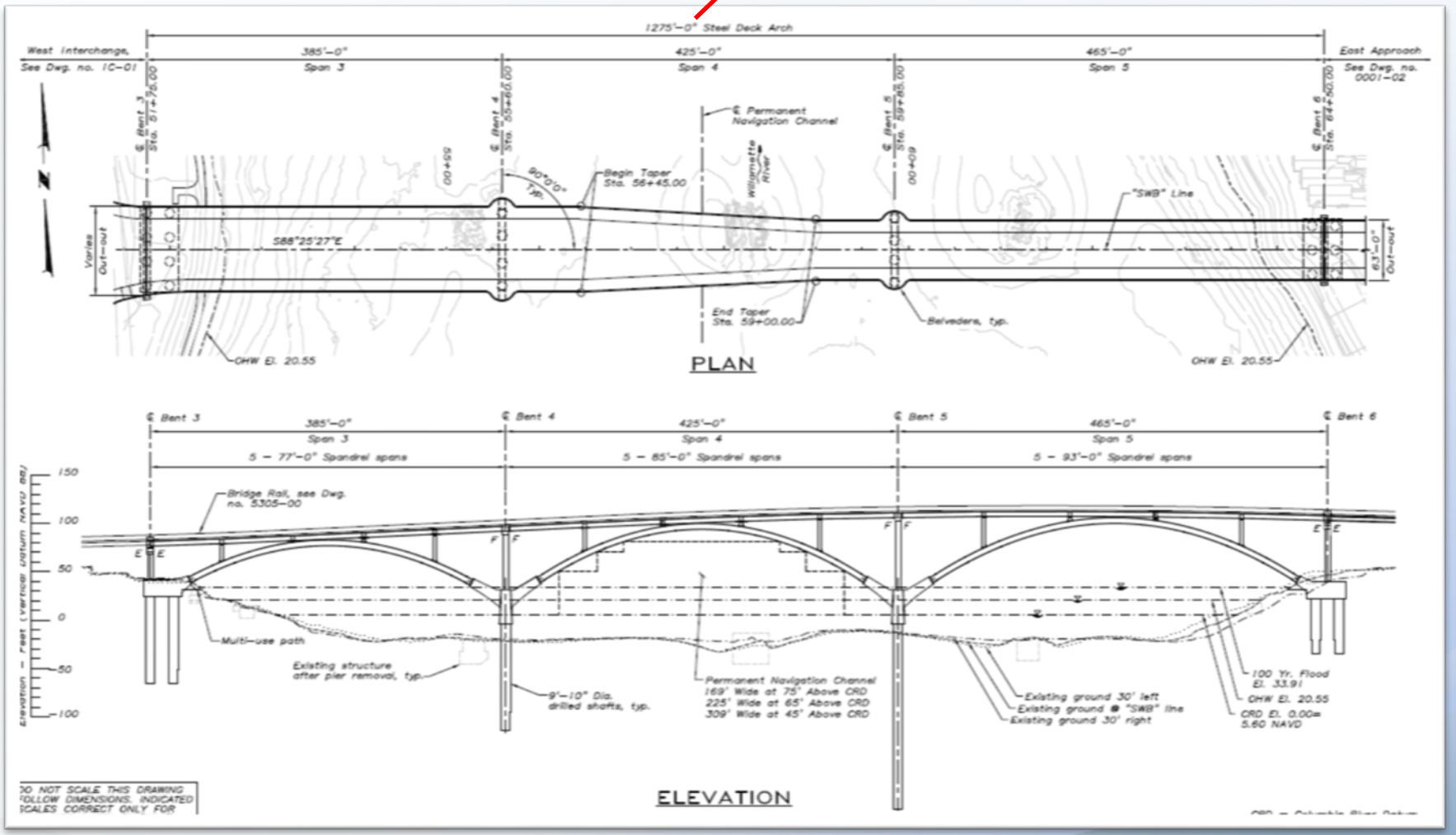
# Bridge Design Overview

# Bridge Project Plan and Elevation

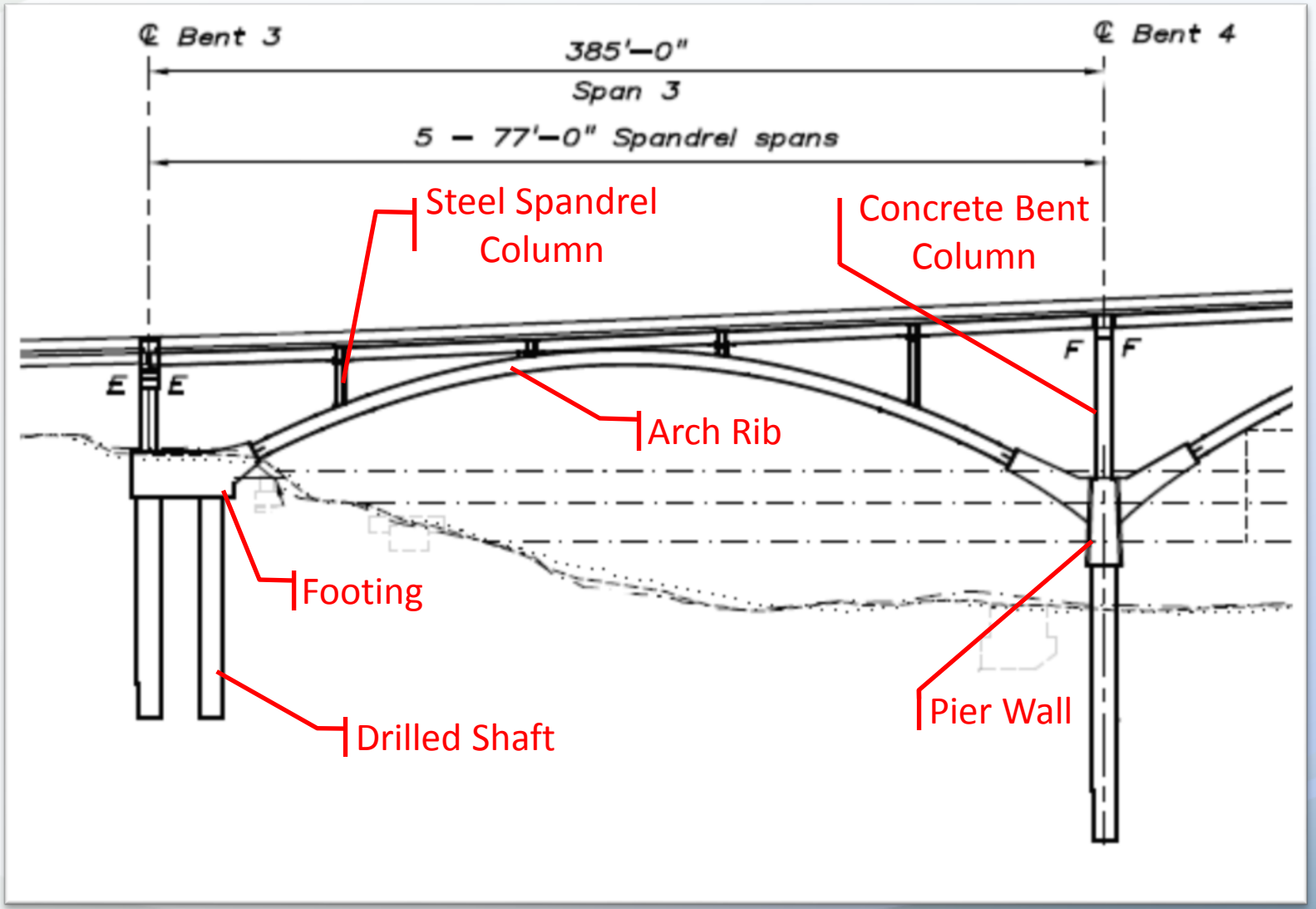
1977’-6”



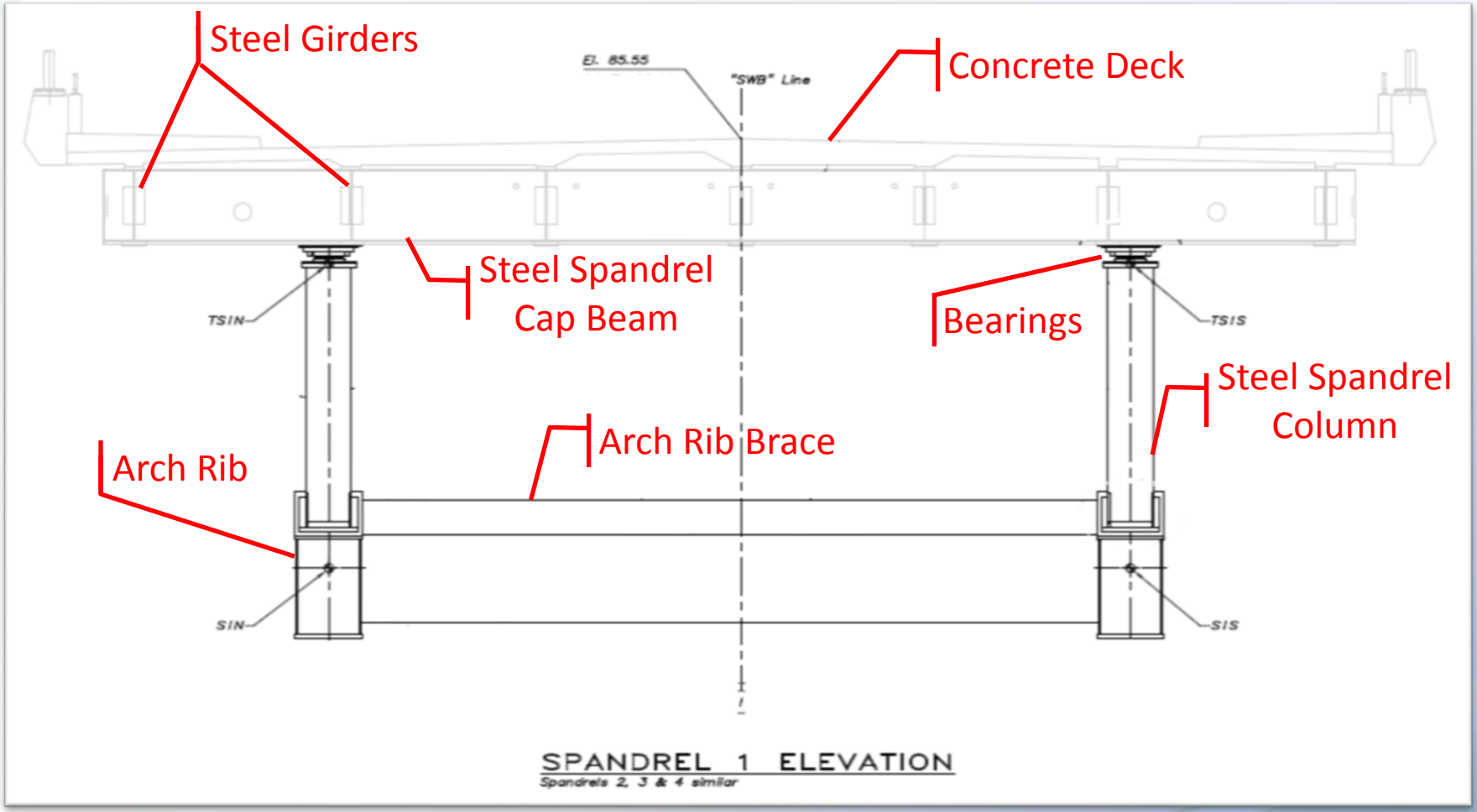
# Main Span Plan and Elevation



# Typical Arch Elevation



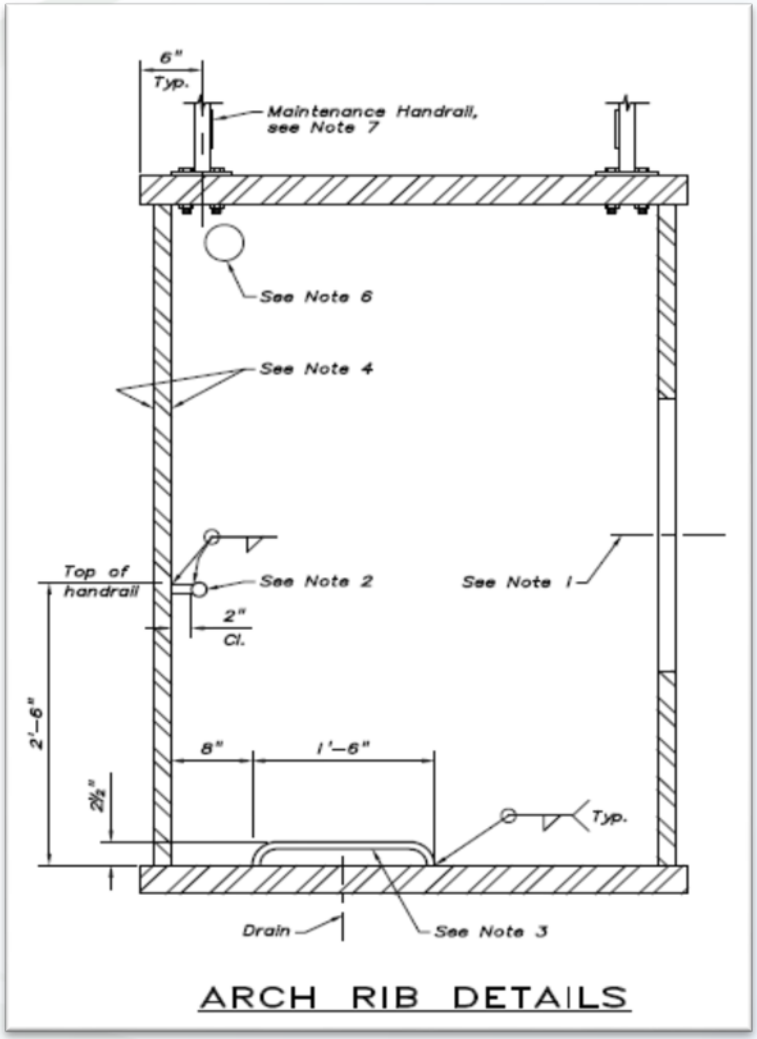
# Typical Arch Section

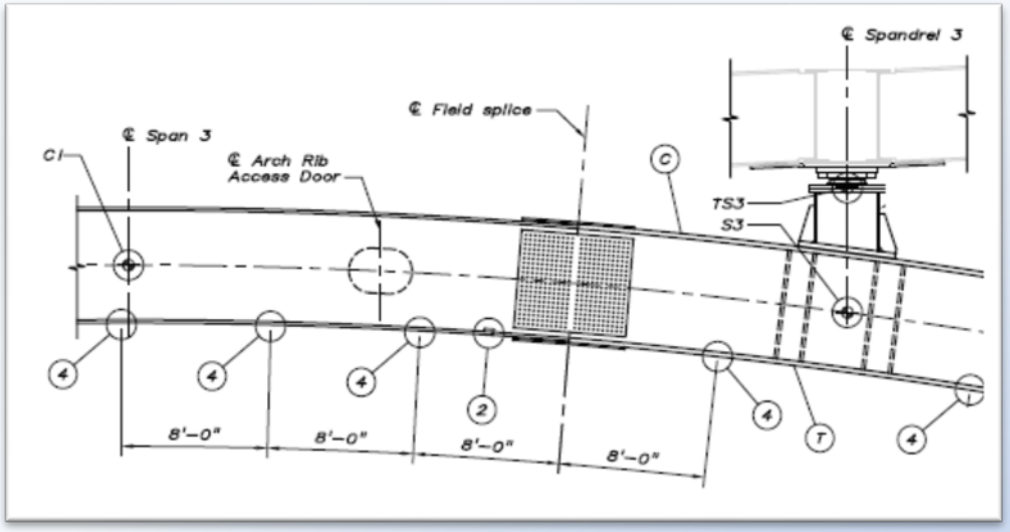


# Structural Steel

- Structural Steel
  - ASTM A709, Grade 50W structural steel
  - 10 Million lbs
  - ASTM A 325 and A490 Type 3 high-strength bolts
- Sub Contractors
  - Fabricator: Thompson Metal Fab Vancouver, WA
  - Erector: Carr Construction Portland, OR

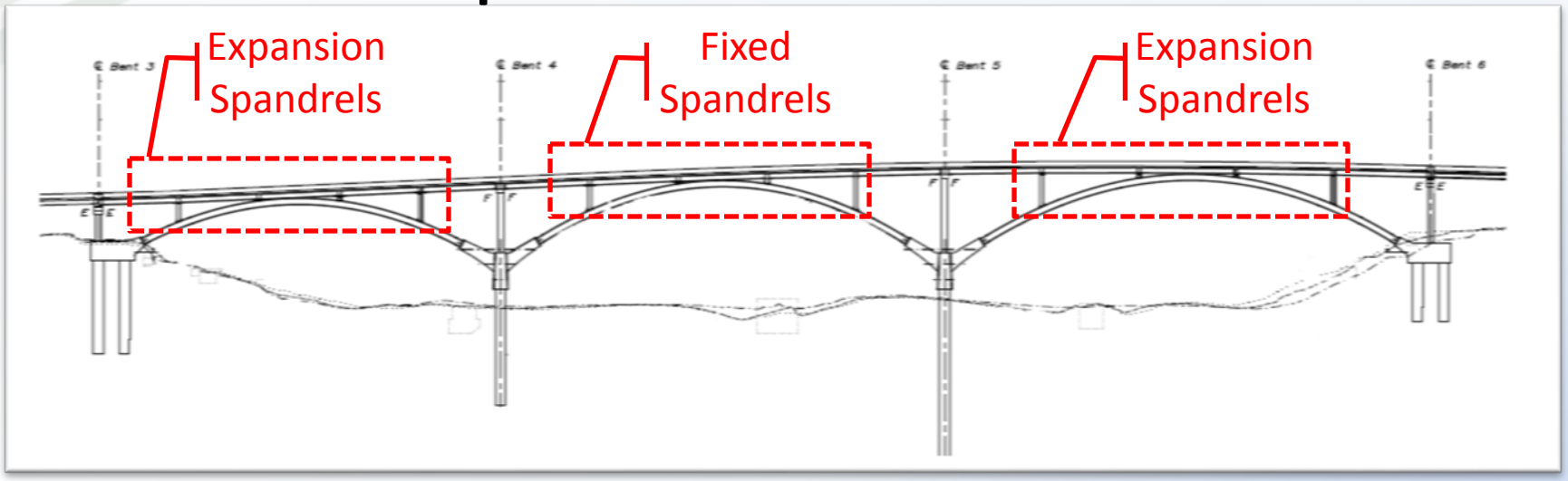
# Arch Rib

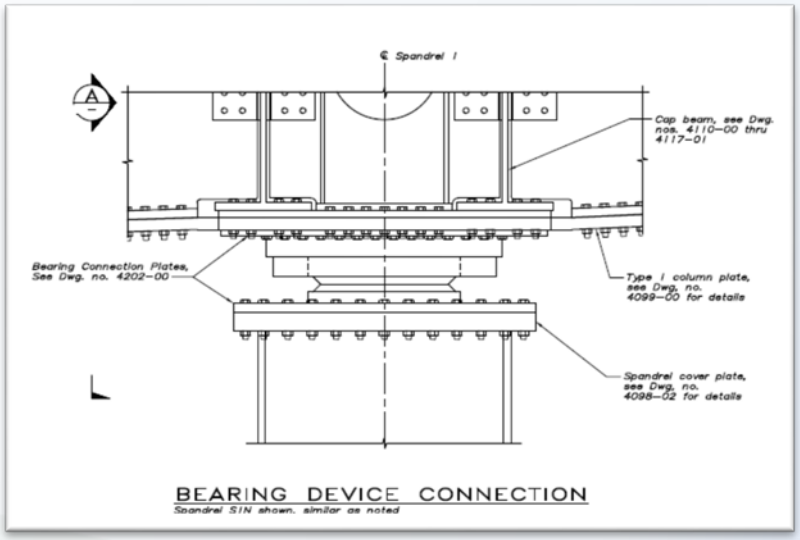


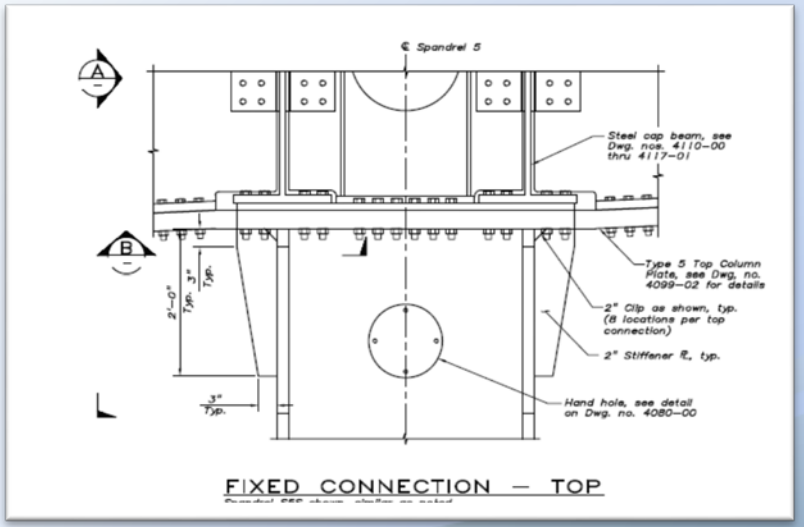




- Arch Rib Box Section
  - Web Depth of 70” with plates ranging from 1.5” to 2.0”
  - Flange Width of 54” with plates ranging from 2.0” to 3.0”

# Spandrel Columns



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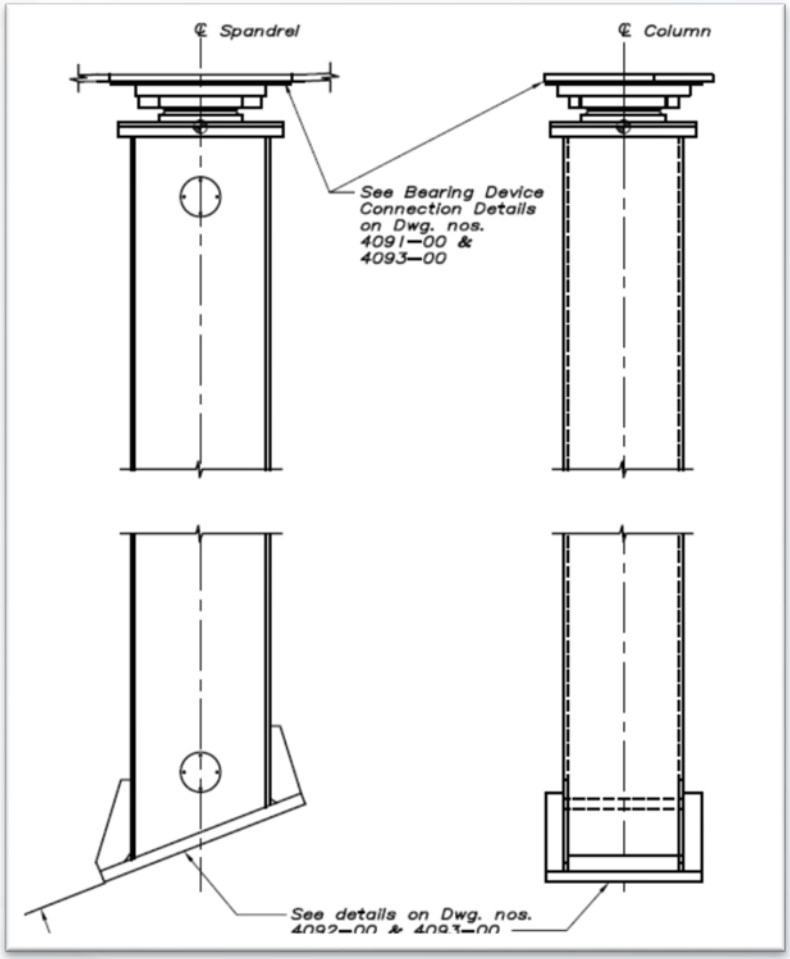
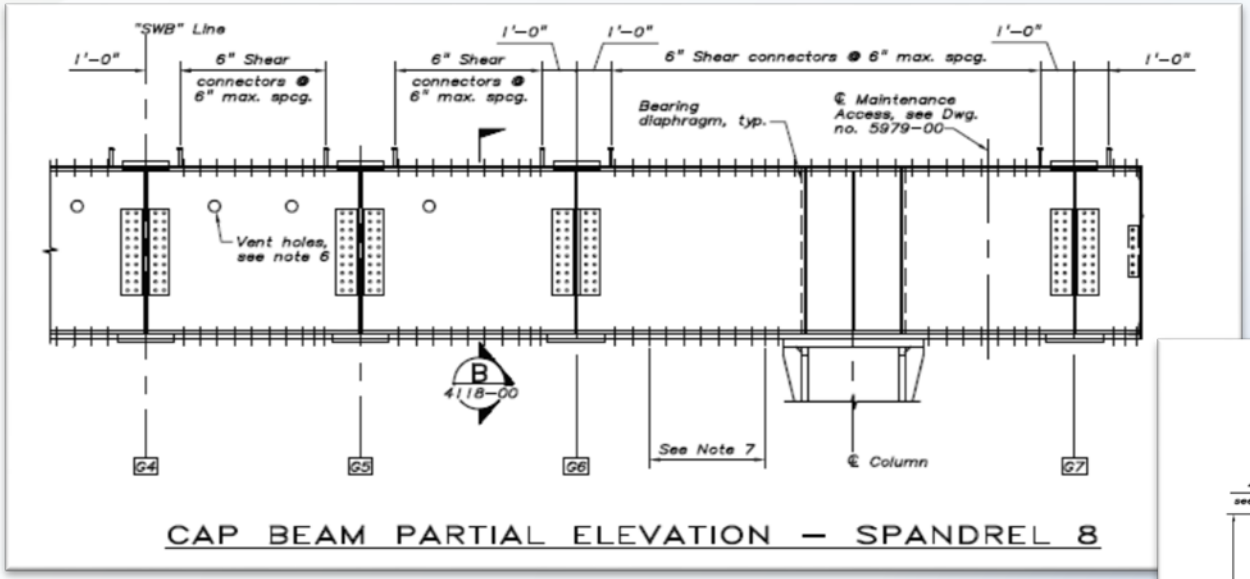
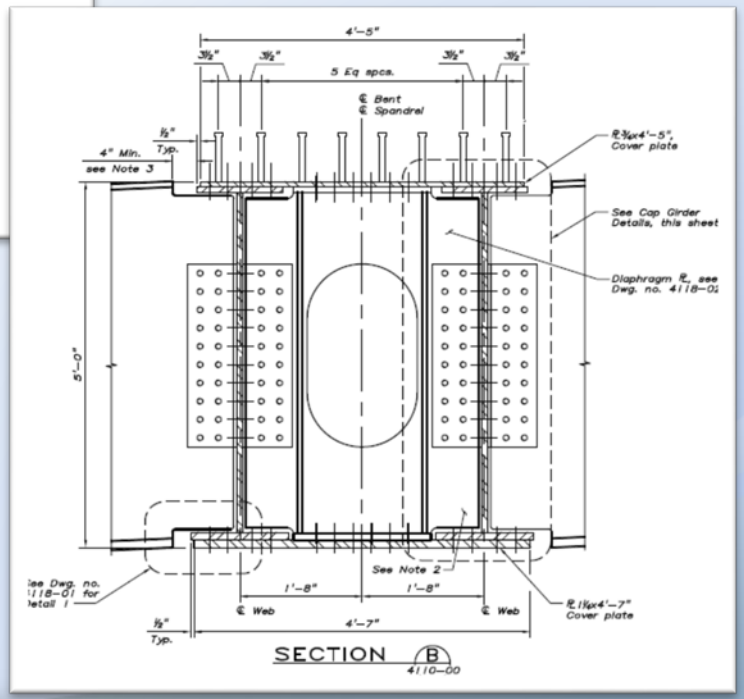



- Spandrel Column Boxes
  - Out-to-out: 3’-6” x 3’-0”
  - Plate thickness varies 1.25” to 2”

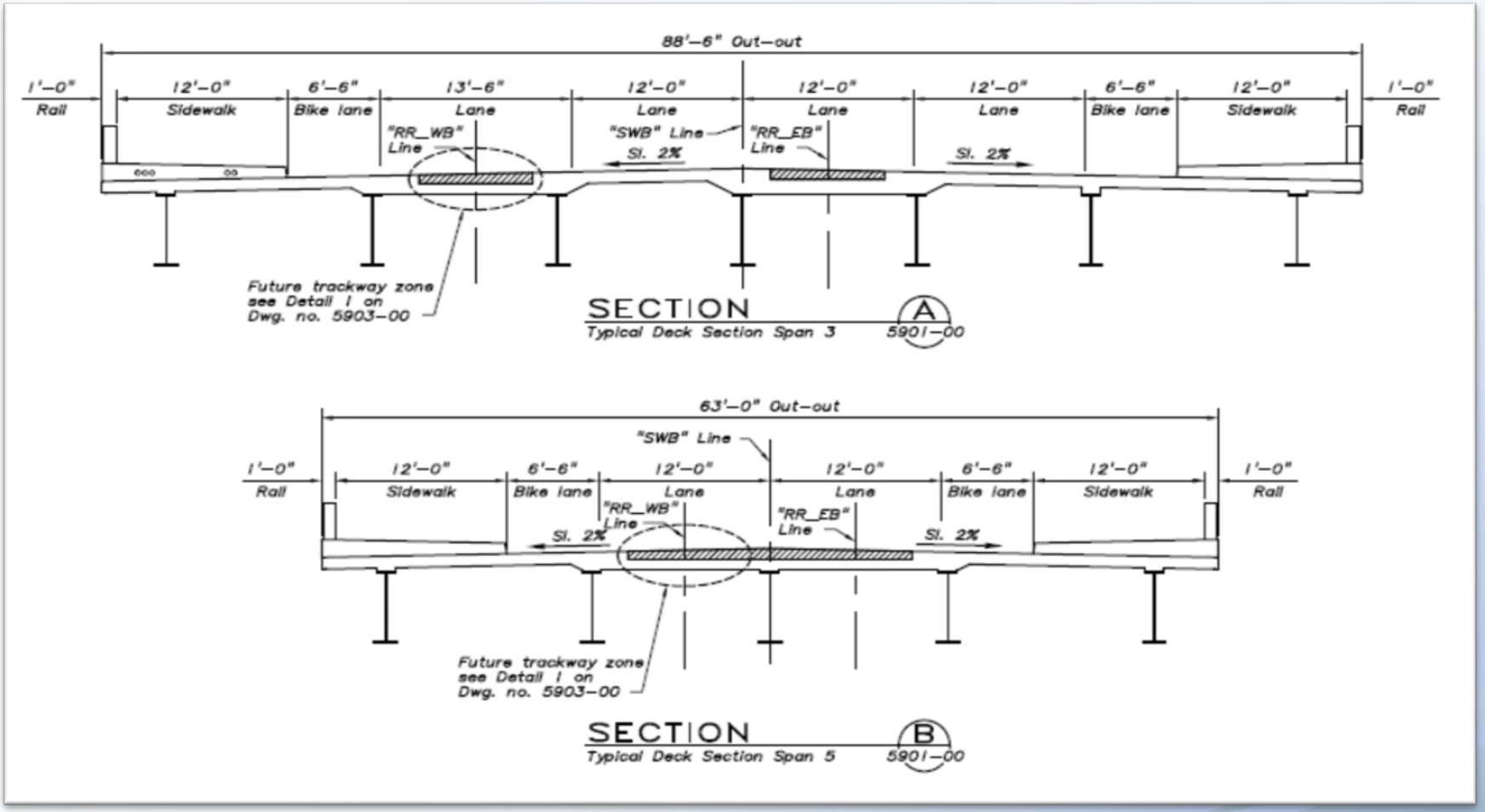
# Spandrel Cap Beam




- Spandrel Cap Beams
  - Bolted built-up box members
  - 5’-0” depth x 3’-4” wide

# Future Streetcar Provisions



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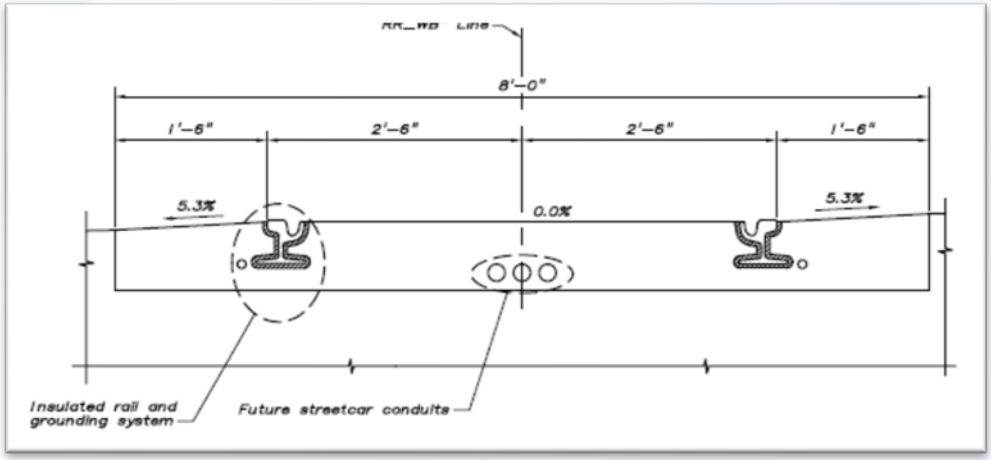
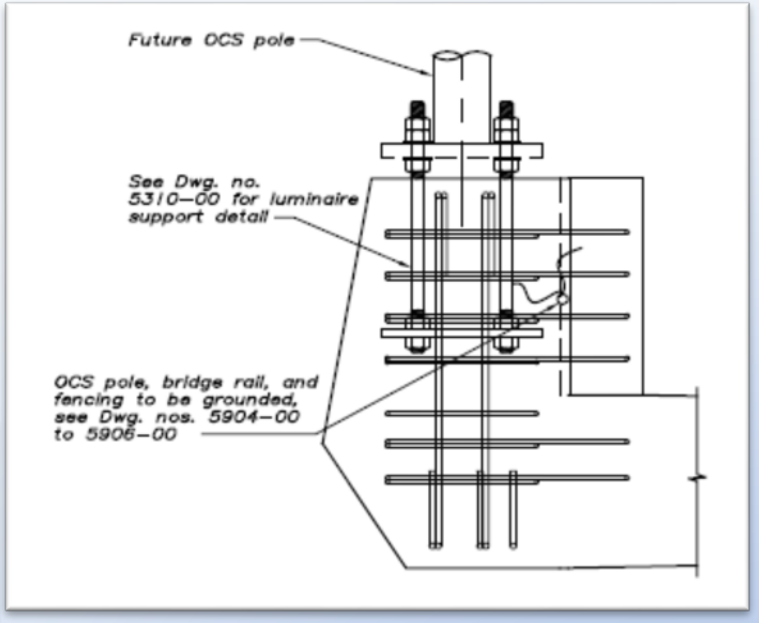
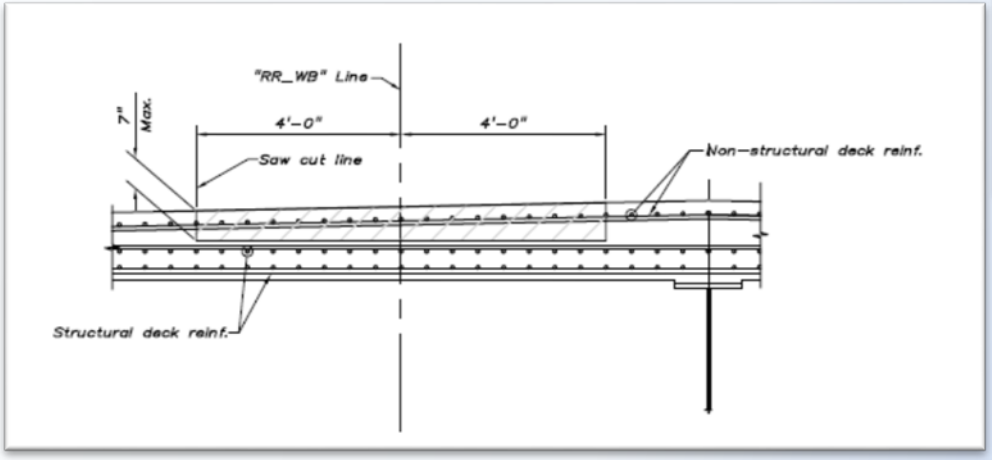


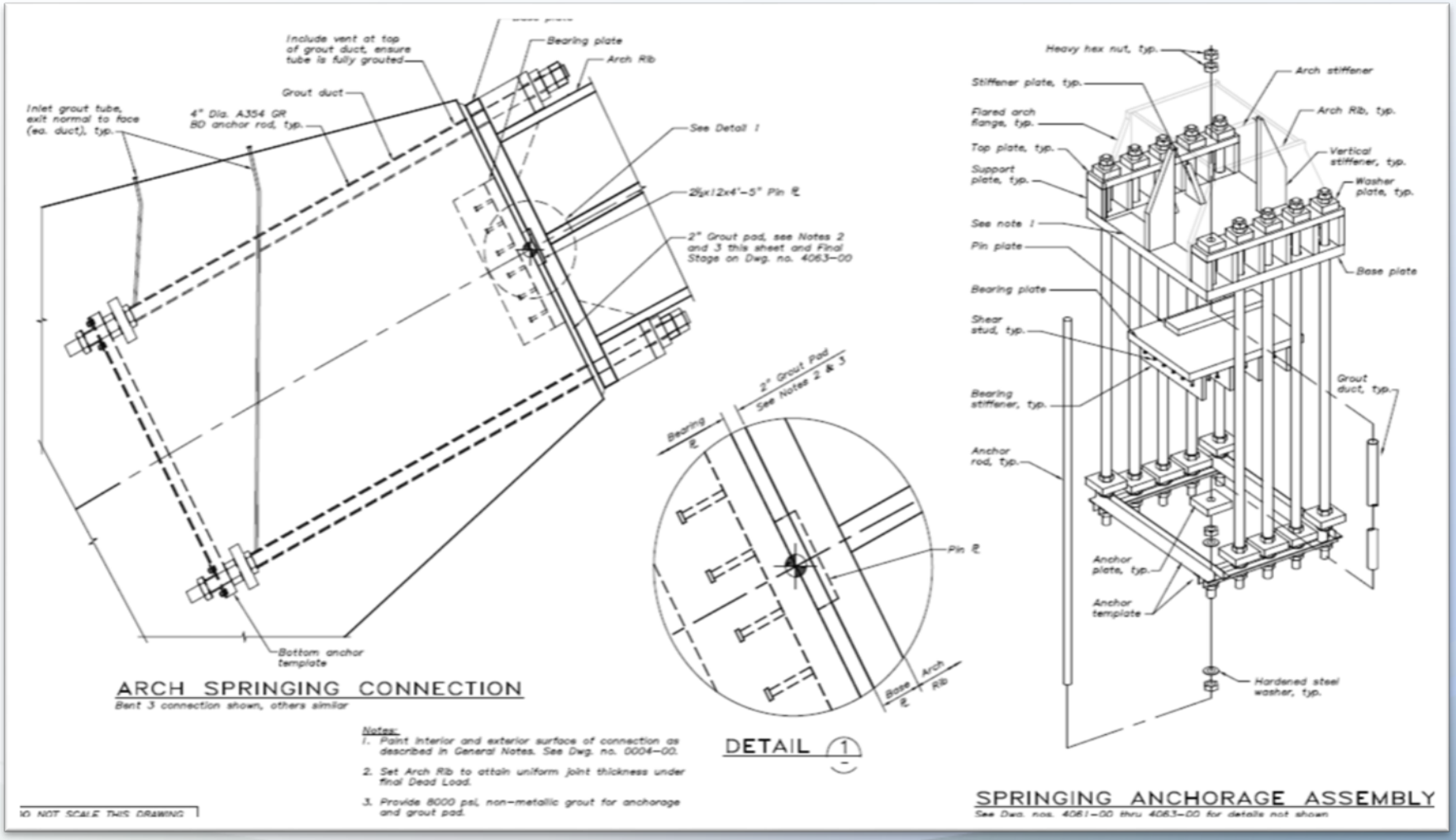




Luminaire Supports




Future Trackway Section

# Arch Springing Assembly



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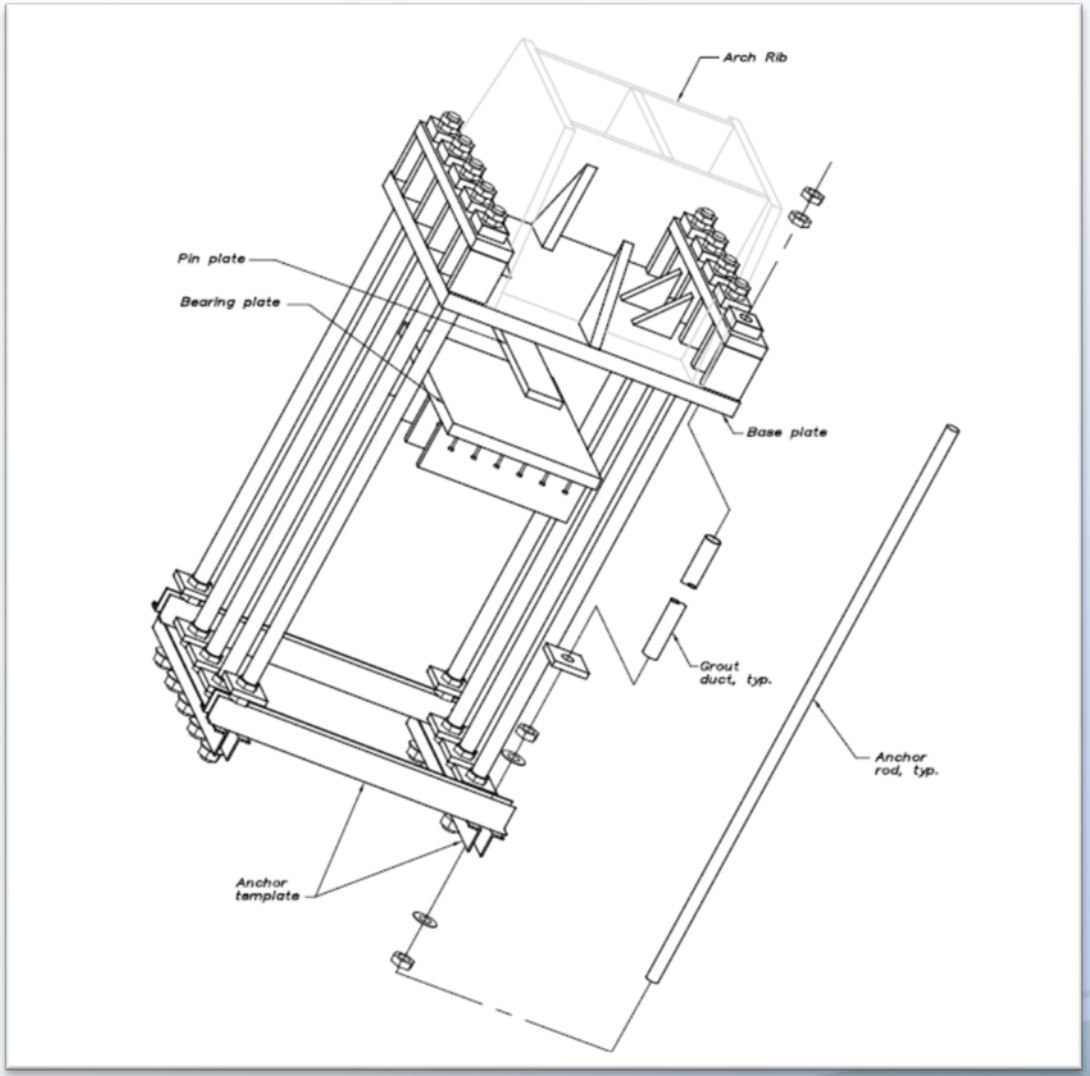

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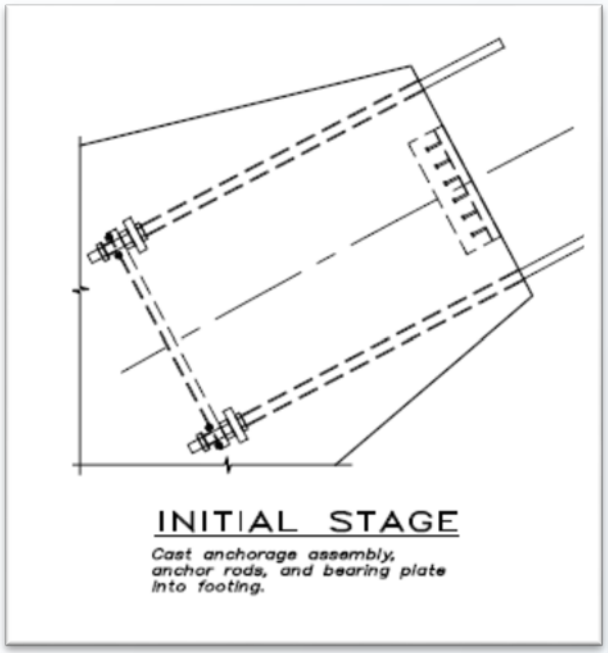
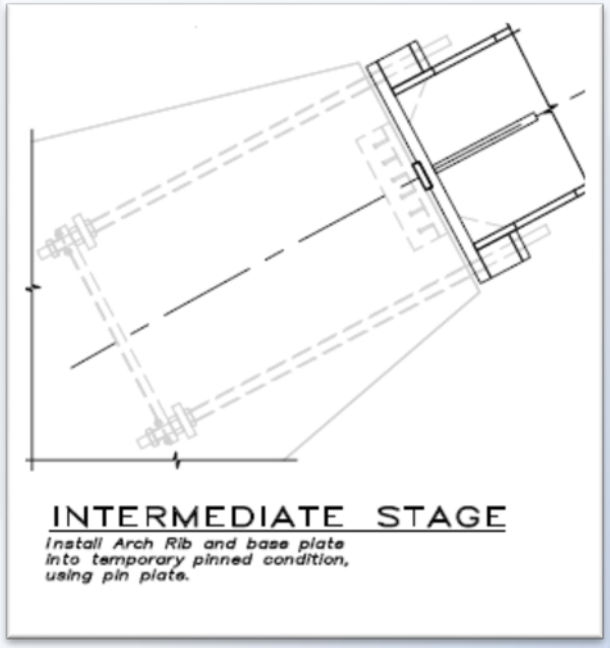


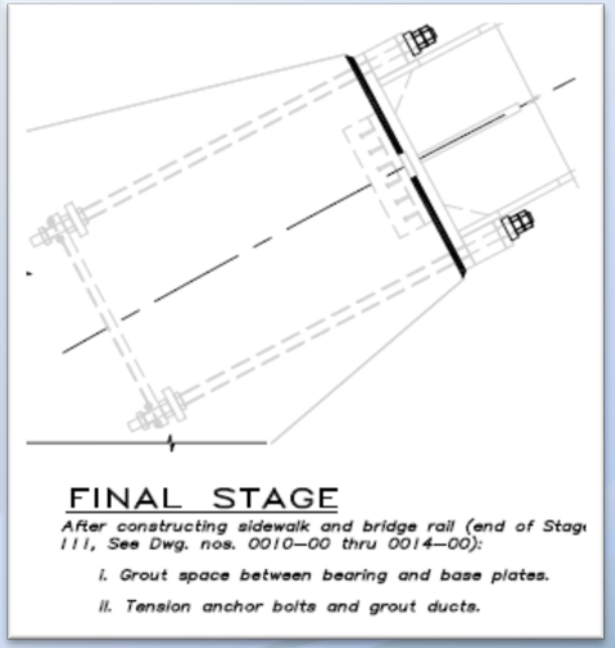
INITIAL STAGE

Cast anchorage assembly, anchor rods, and bearing plate into footing.



INTERMEDIATE STAGE

Install Arch Rib and base plate into temporary pinned condition, using pin plate.



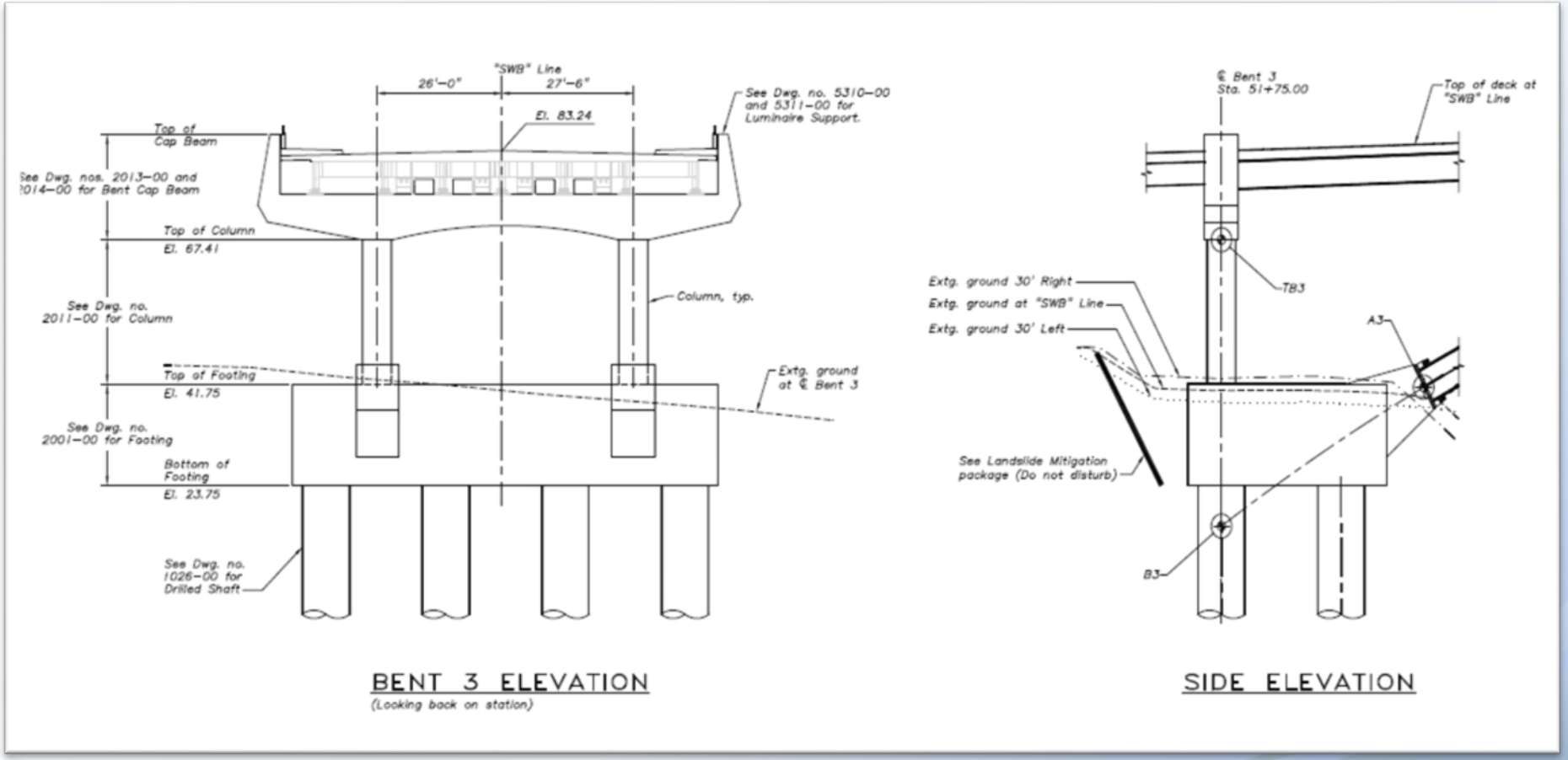
FINAL STAGE

After constructing sidewalk and bridge rail (end of Stage III, See Dwg. nos. 0010—00 thru 0014—00):

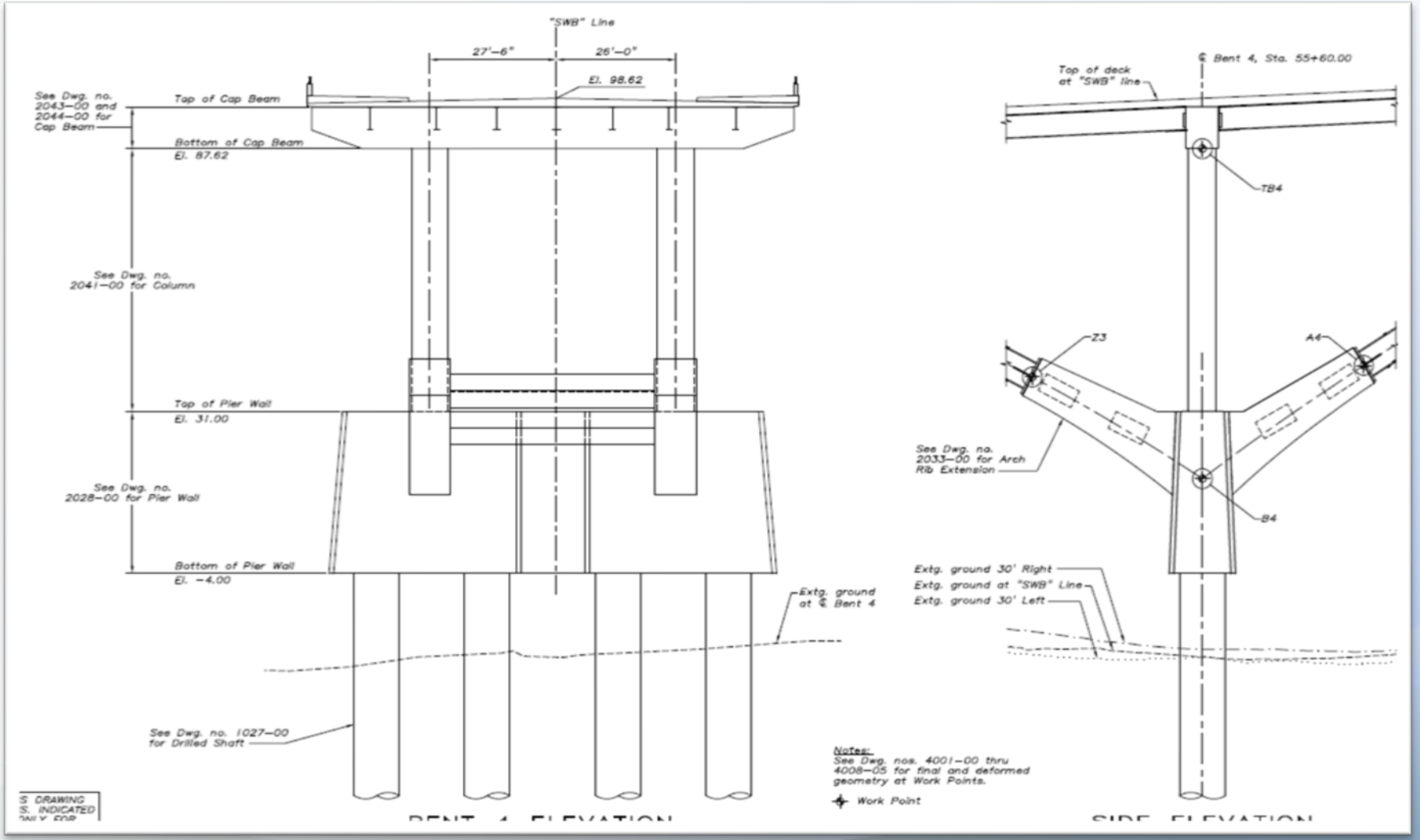
i. Grout space between bearing and base plates.

ii. Tension anchor bolts and grout ducts.

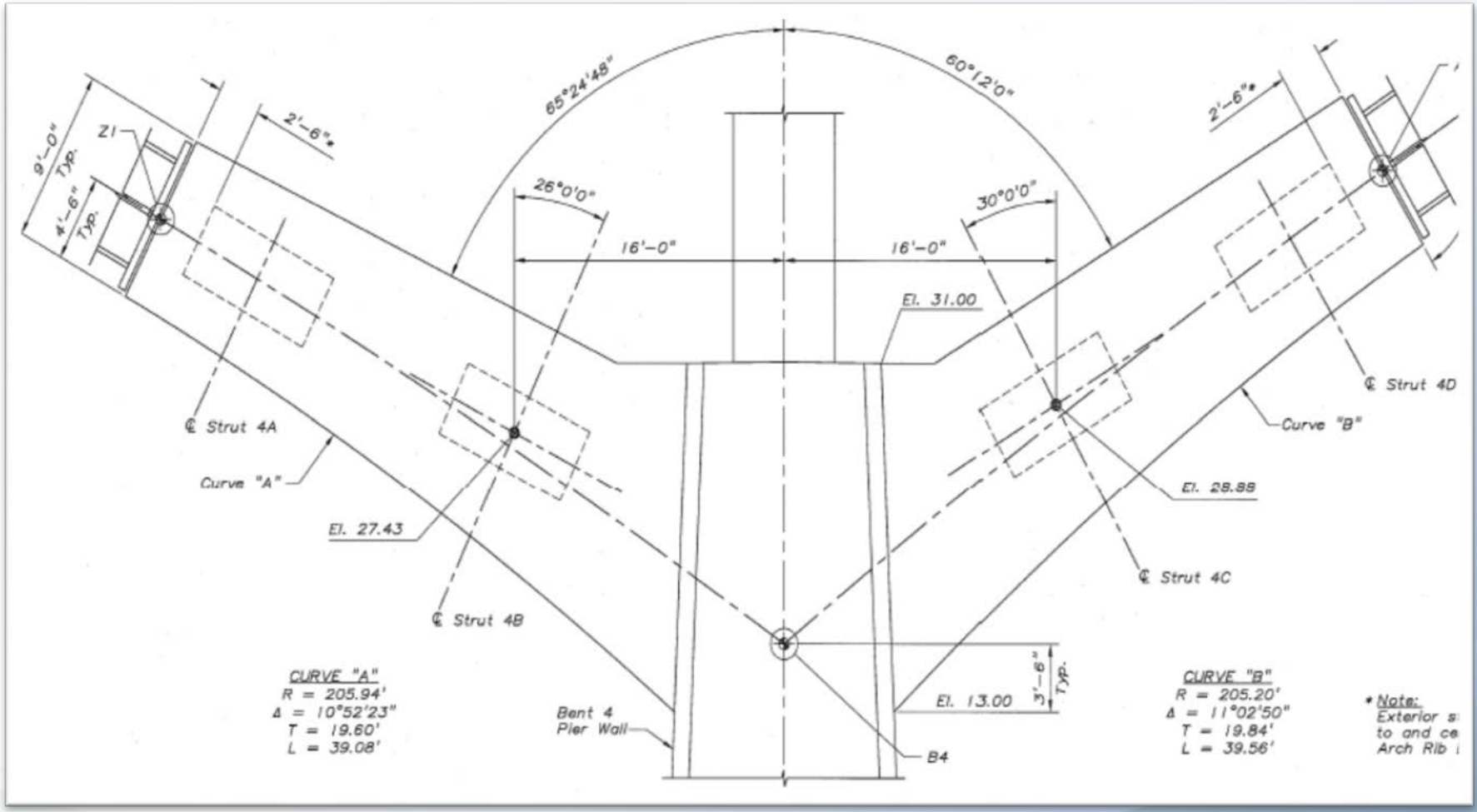
# West Shore Pier



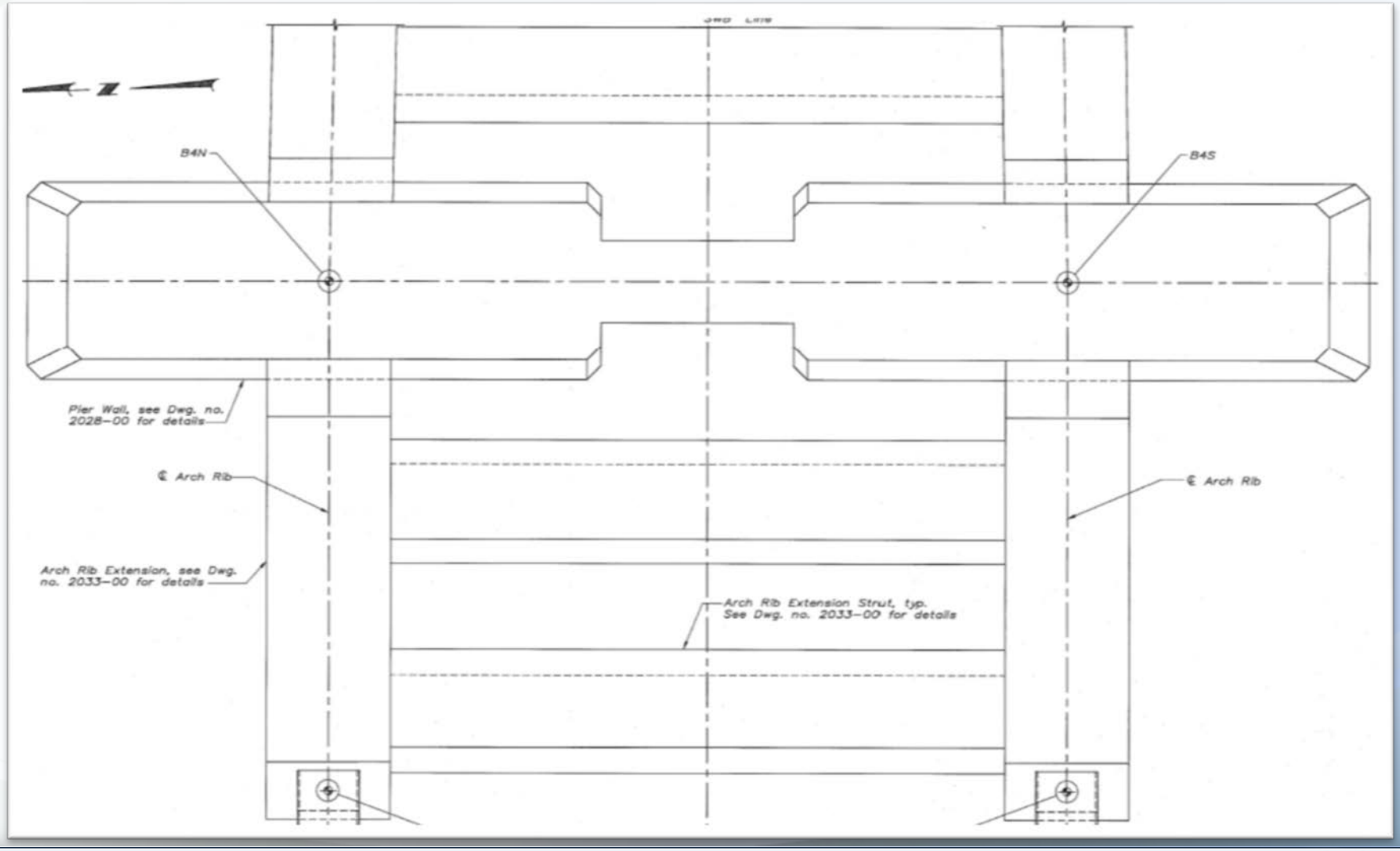
# River Pier


"SWB" Line
27'-6"
26'-0"
El. 98.62
See Dwg. no. 2043-00 and 2044-00 for Cap Beam
Top of Cap Beam
Bottom of Cap Beam
El. 87.62
See Dwg. no. 2041-00 for Column
Top of Pier Wall
El. 31.00
See Dwg. no. 2028-00 for Pier Wall
Bottom of Pier Wall
El. -4.00
Extg. ground at ℄ Bent 4
See Dwg. no. 1027-00 for Drilled Shaft
℄ Bent 4, Sta. 55+60.00
Top of deck at "SWB" line
TB4
Z3
A4
See Dwg. no. 2033-00 for Arch Rib Extension
B4
Extg. ground 30' Right
Extg. ground at "SWB" Line
Extg. ground 30' Left
Notes:
See Dwg. nos. 4001-00 thru 4008-05 for final and deformed geometry at Work Points.
Work Point

# Springing/Wall/Column/Strut Interface

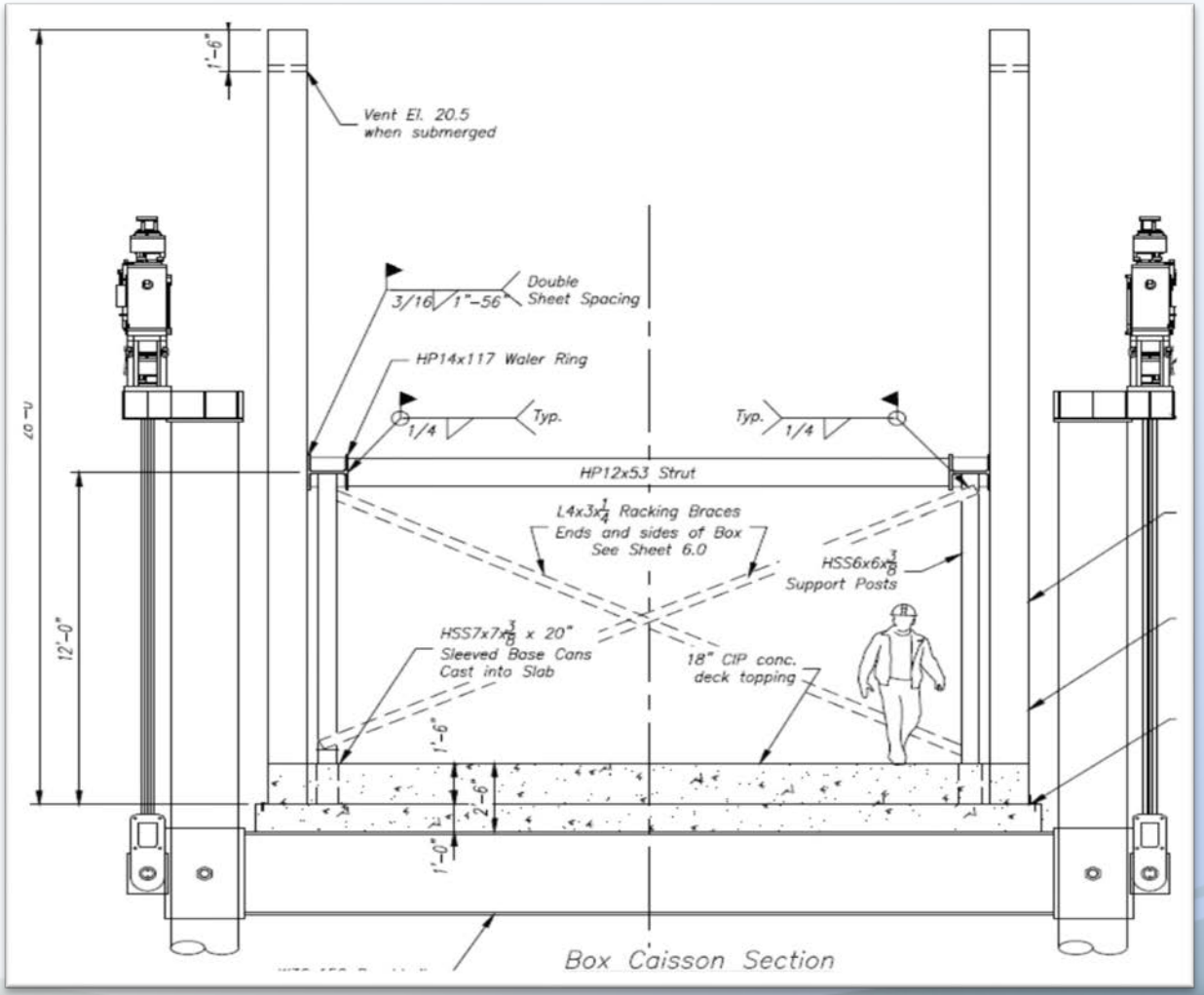


# Pier Wall Plan

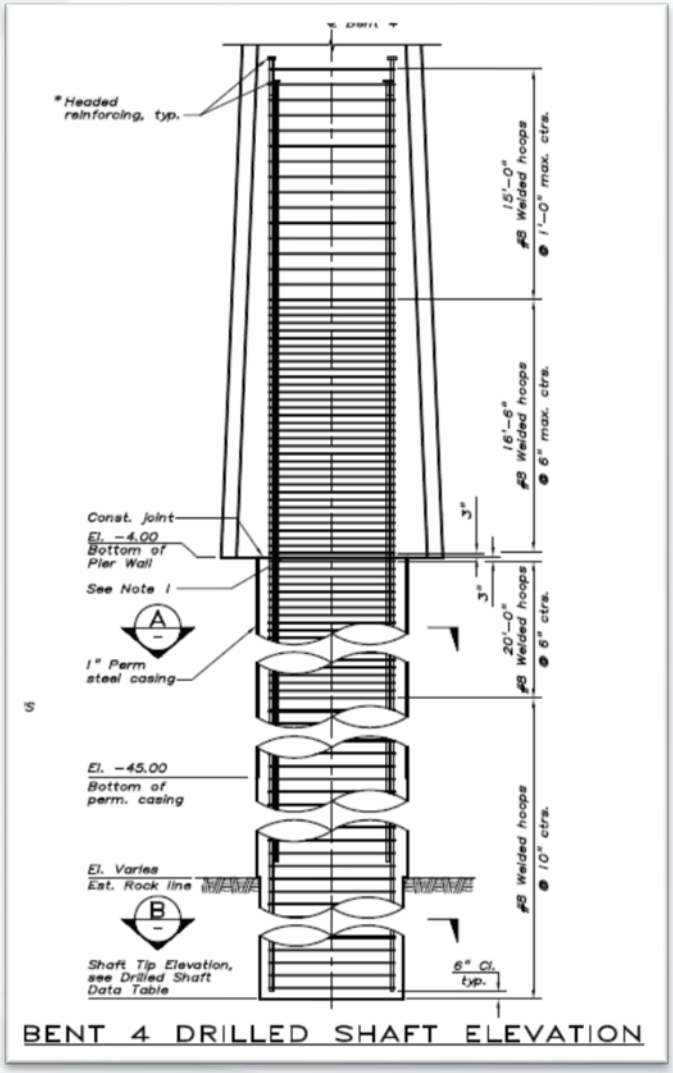


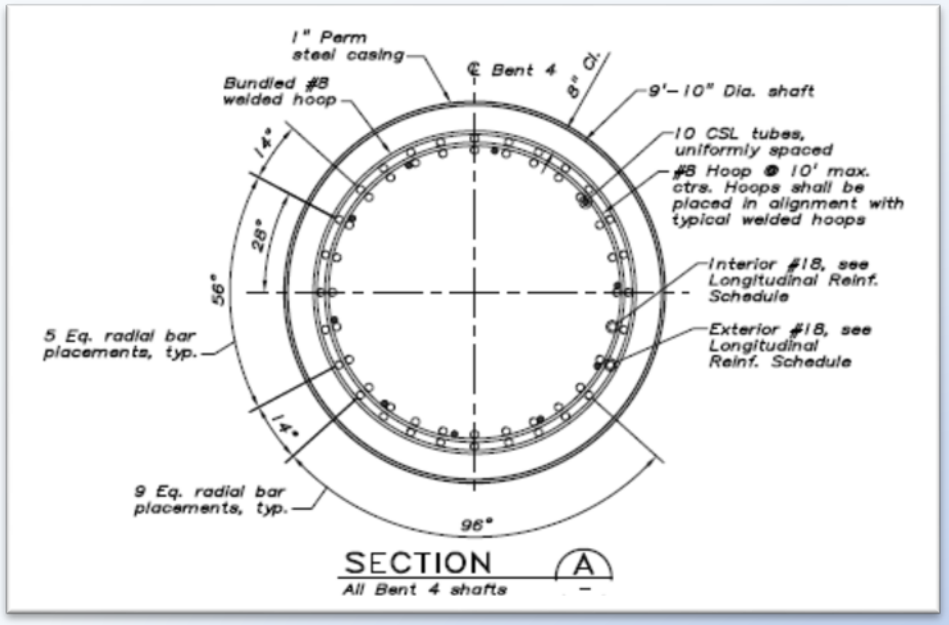
# Box Caisson Section

Courtesy of McGee Engineering Inc.



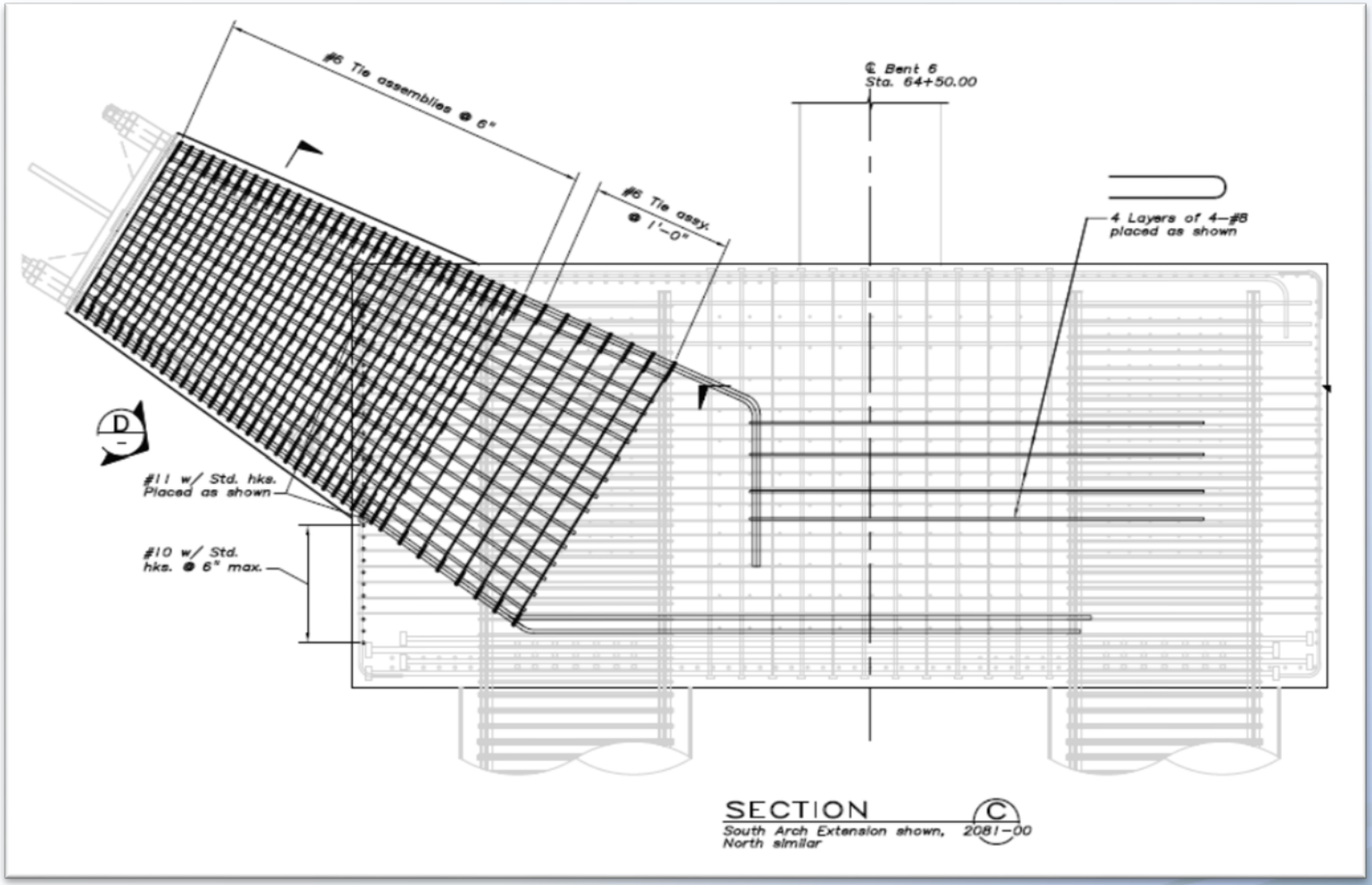
# Drilled Shaft Details




- A706 Grade 80 used for all drilled shaft reinforcing
- Permanent casing provided at Bents 4 and 5
- Slope inclinometers installed in (2) Bent 3 shafts

# 3D Rebar Modeling



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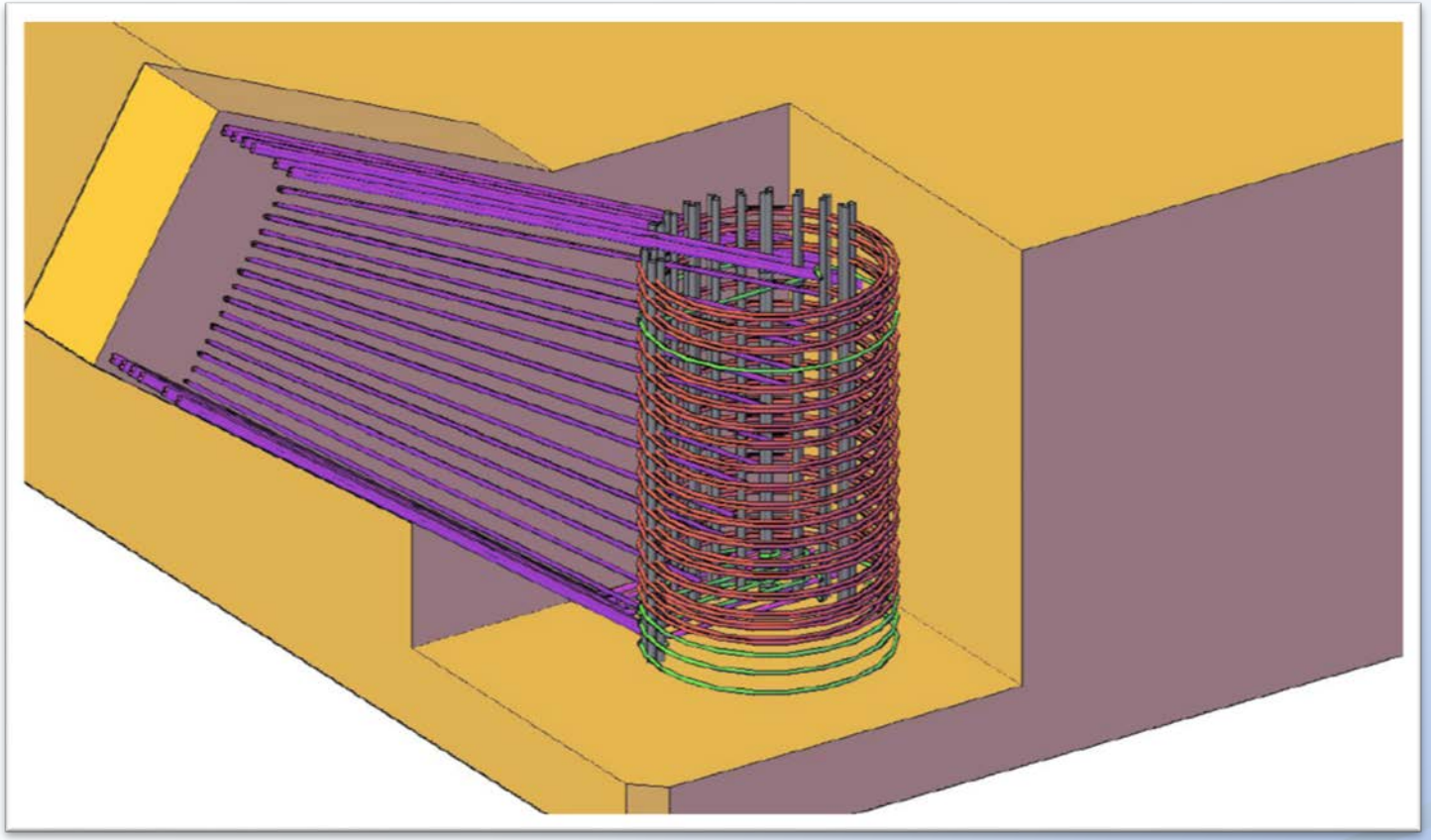
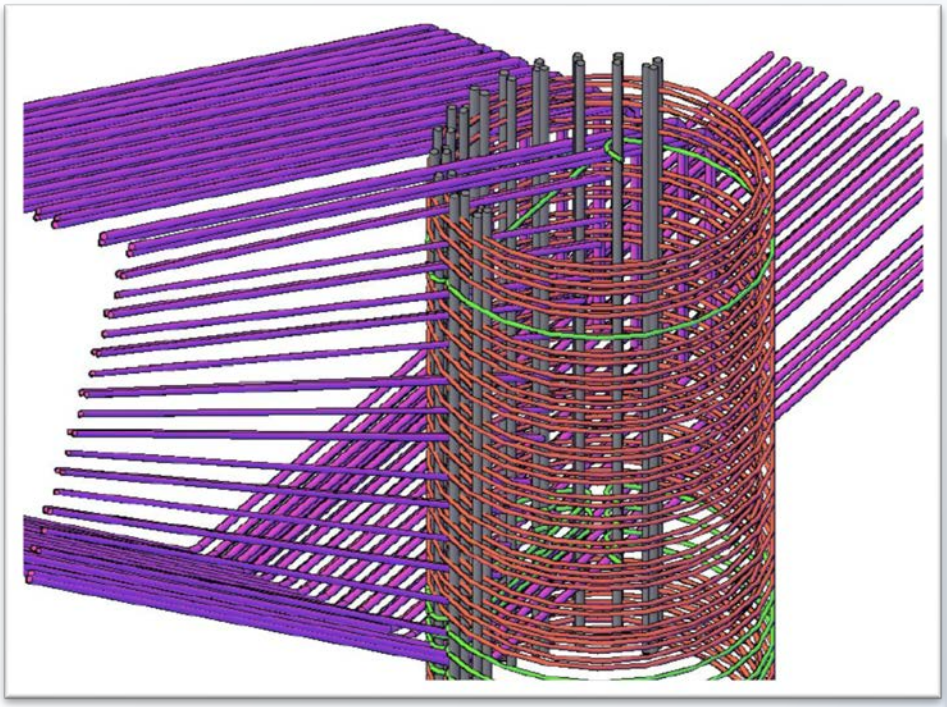
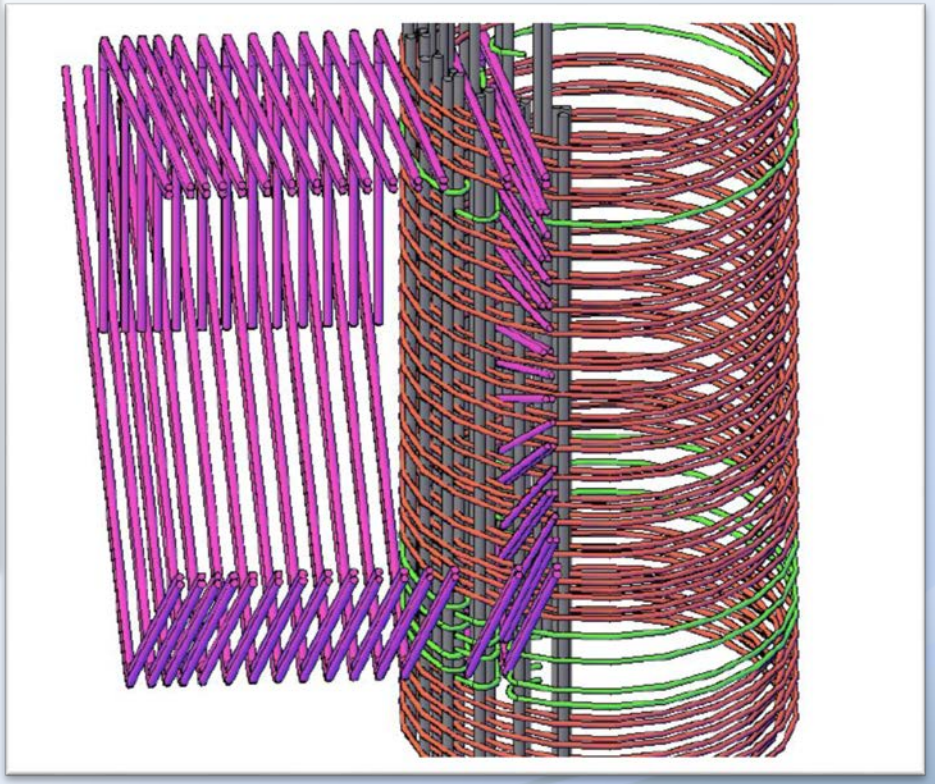
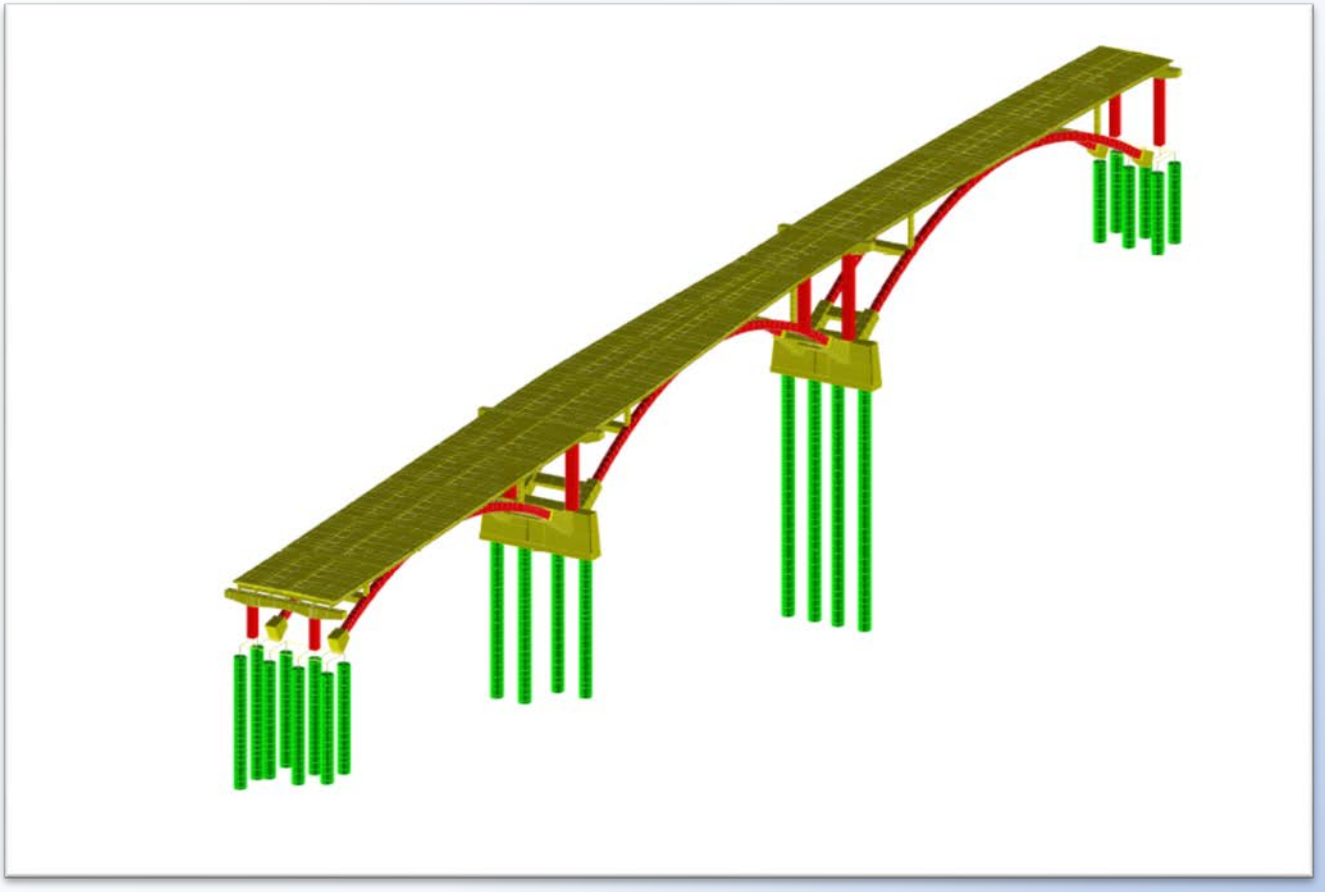


# 3D Rebar Modeling





# Analysis and Design Criteria



**LARSA 4D Global Analysis Model**

# Design Criteria

- **Seismic:**
  - Minimal damage allowed in a 500-year earthquake
  - Collapse is prevented in a 1000-year earthquake
  - Allowable material strains are defined and enforced for these events
  - Structure response is calculated via enveloped suites of site-specific acceleration response spectra and nonlinear static push analyses.

- **Landslide**:
  - Mitigation measures are being constructed to prevent movement in service conditions.
  - Finite element analysis was performed using scaled time histories of four earthquakes to predict soil-structure interaction with the proposed structure and mitigation in place.

- **Vessel Collision:**
  - Bridge design for vessel impact
  - Controlling vessel was the Portland Spirit , 150-ft long, 420 long ton

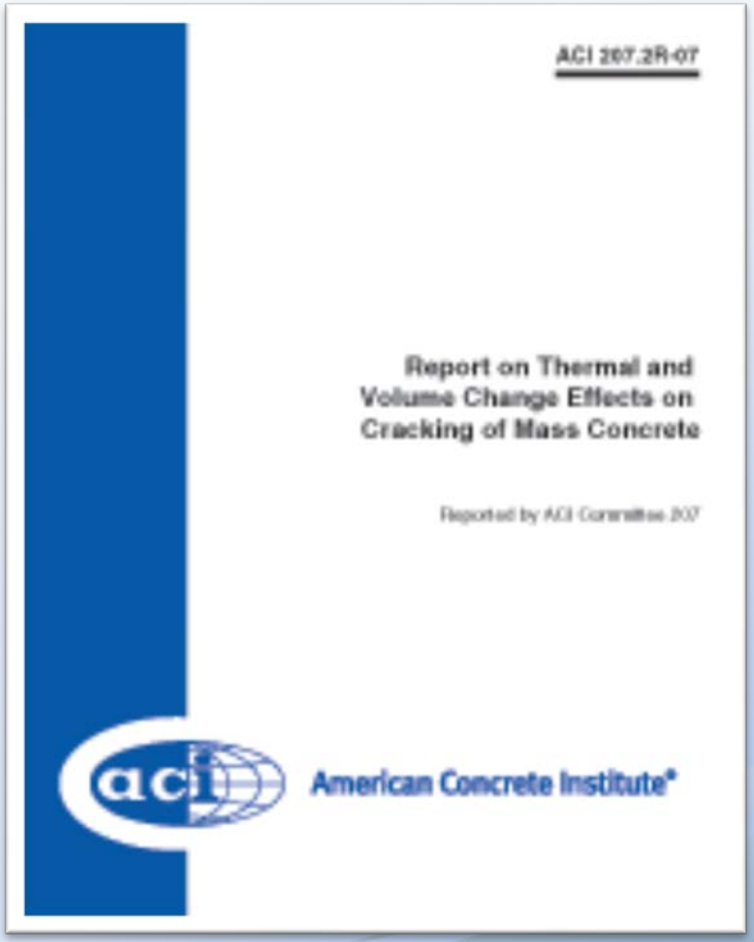
- **AASHTO Live Load:**
  - Bridge designed for trucks and pedestrians; conditions were evaluated with complete removal of sidewalks.

- **Streetcar Live Load:**
  - Streetcar vehicles were substituted into load combinations for HL-93 trucks.

# Mass Concrete Provisions

- Main span elements are subject to mass placement requirements and conformance with ACI 207.

- An engineered thermal control plan is required. A performance-based approach to controls of concrete peak temperatures, temperature gradients, and induced cracking is acceptable.



# Construction Update

# First Shaft Installation at Bent 6

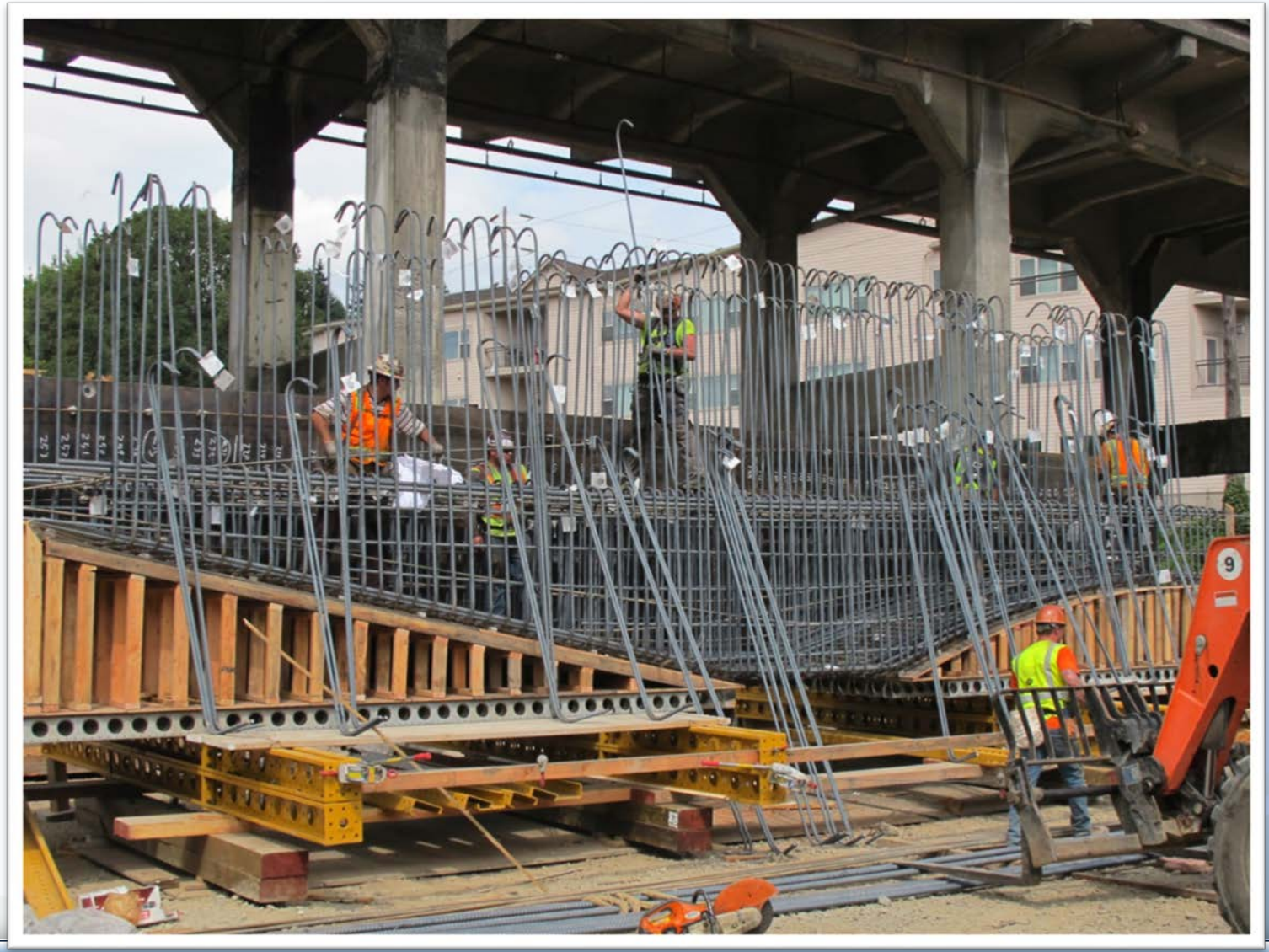
# First Shaft Installation at Bent 5

# First Shaft Installation at Bent 5

# East Abutment, First Stage

# East Approach Columns, First Stage

# East Approach Bent Cap



# Questions