



41st Street Pedestrian Bridge

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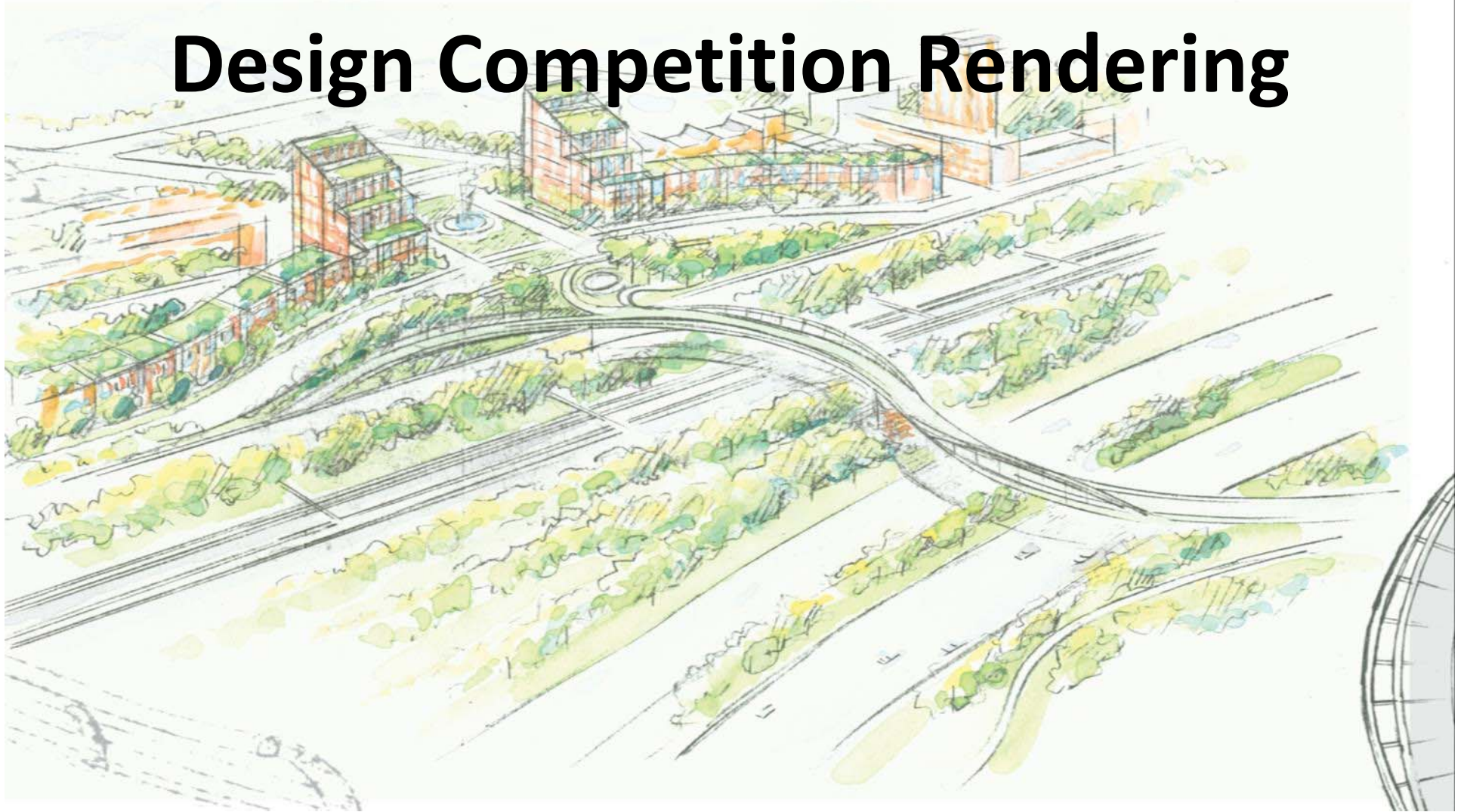
Agenda

- Background and Project Development
- Key Structural Features
- Staging & Construction

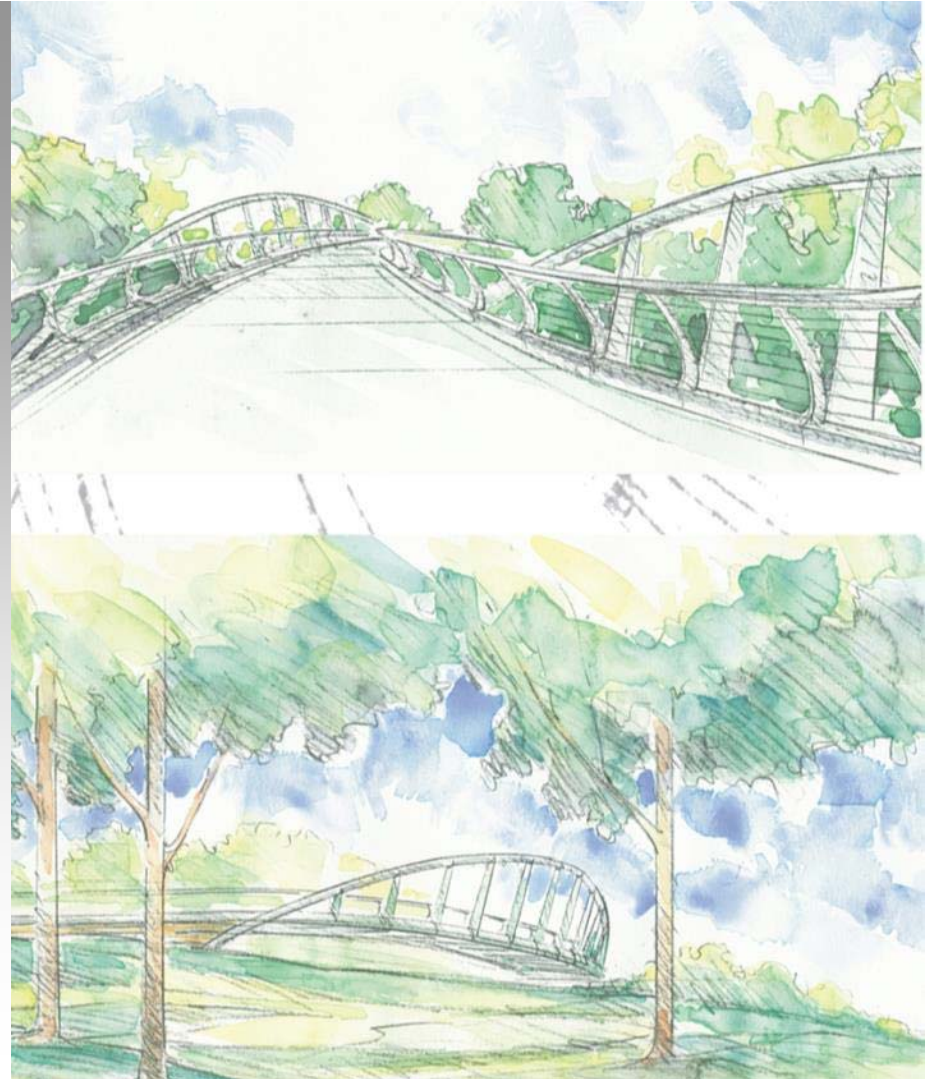
Project Location and Overview



Design Competition Rendering



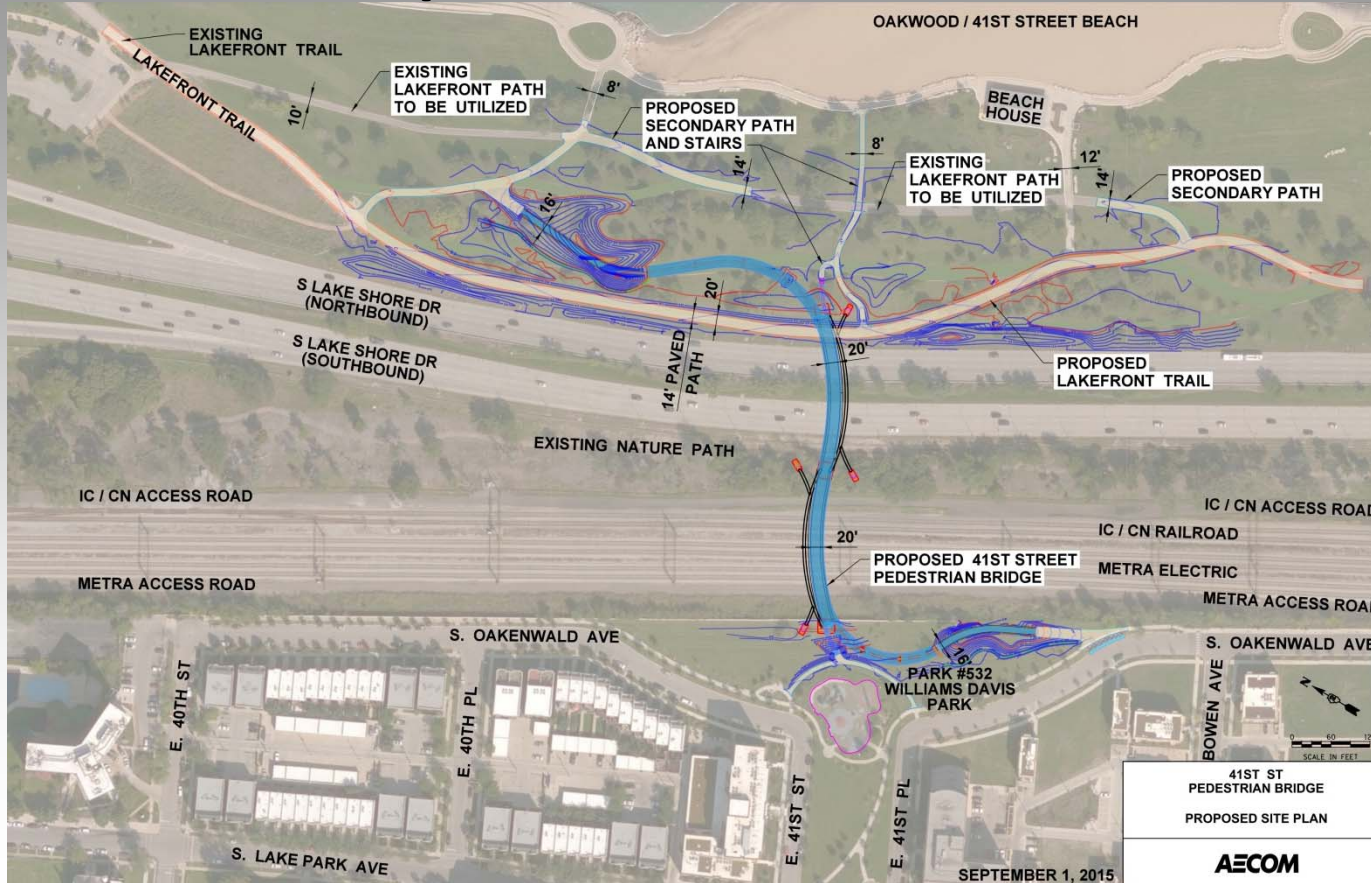
Design Competition Rendering





Aerial Exhibit

Proposed Site Plan



Aerial Rendering



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Rendering Looking East



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Rendering Along Lake Shore Drive



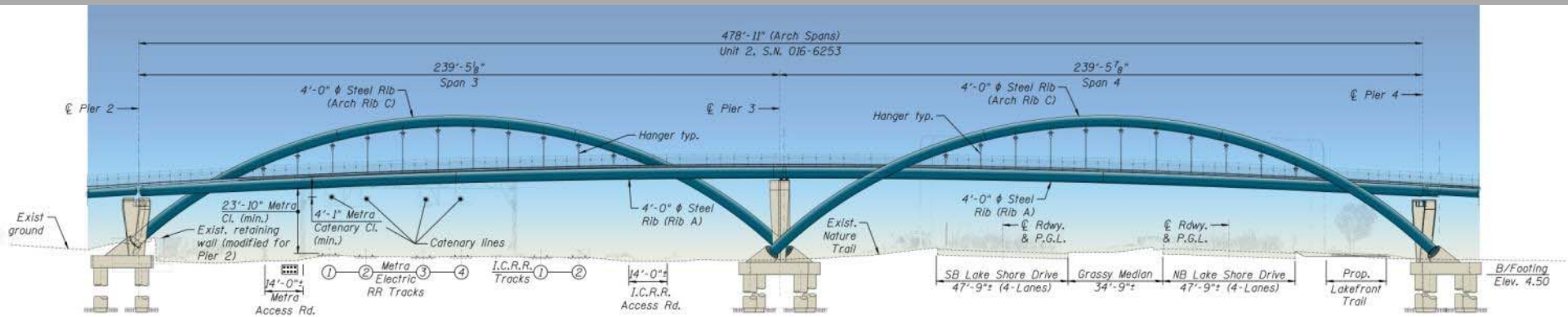
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Rendering - West Landing



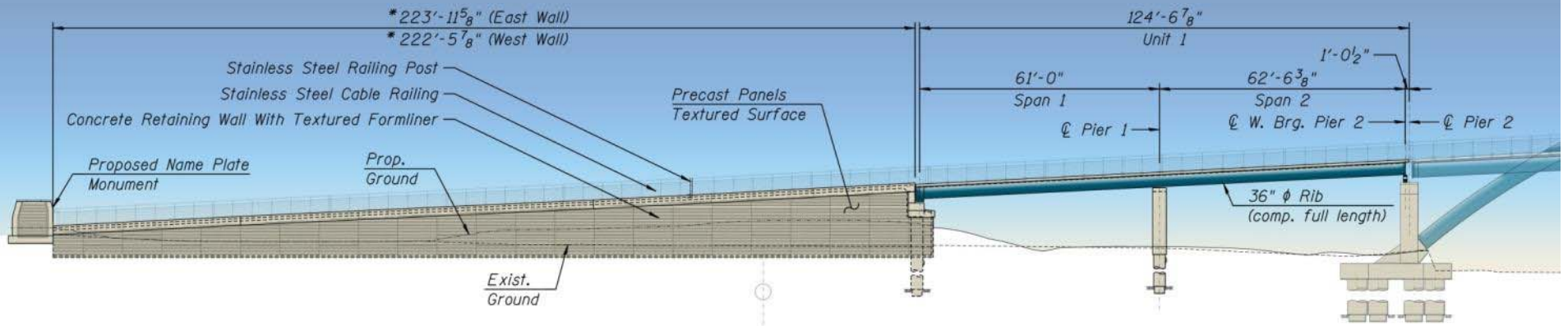
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Arch Structure - Elevation View



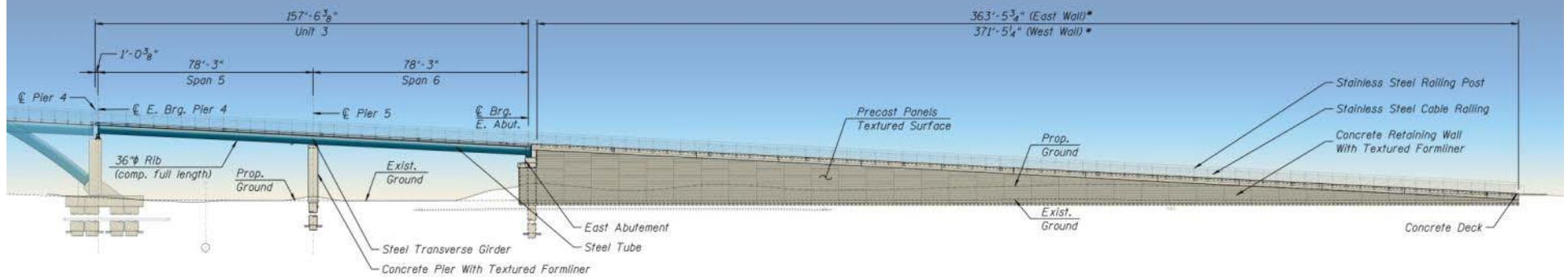
41st ST BRIDGE ELEVATION

West Approach - Elevation View



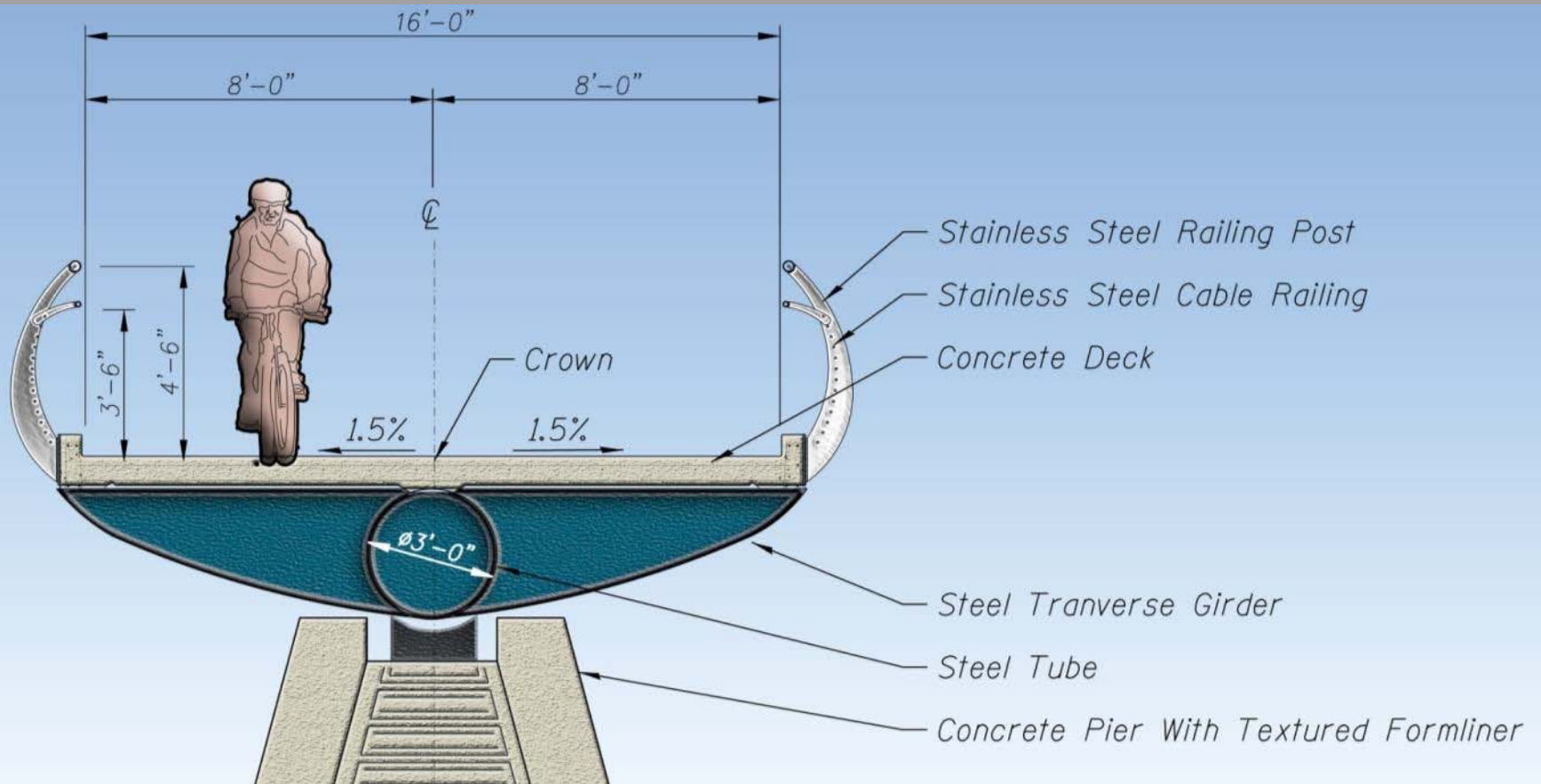
41st ST WEST APPROACH ELEVATION

East Approach - Elevation View



41st ST EAST APPROACH ELEVATION

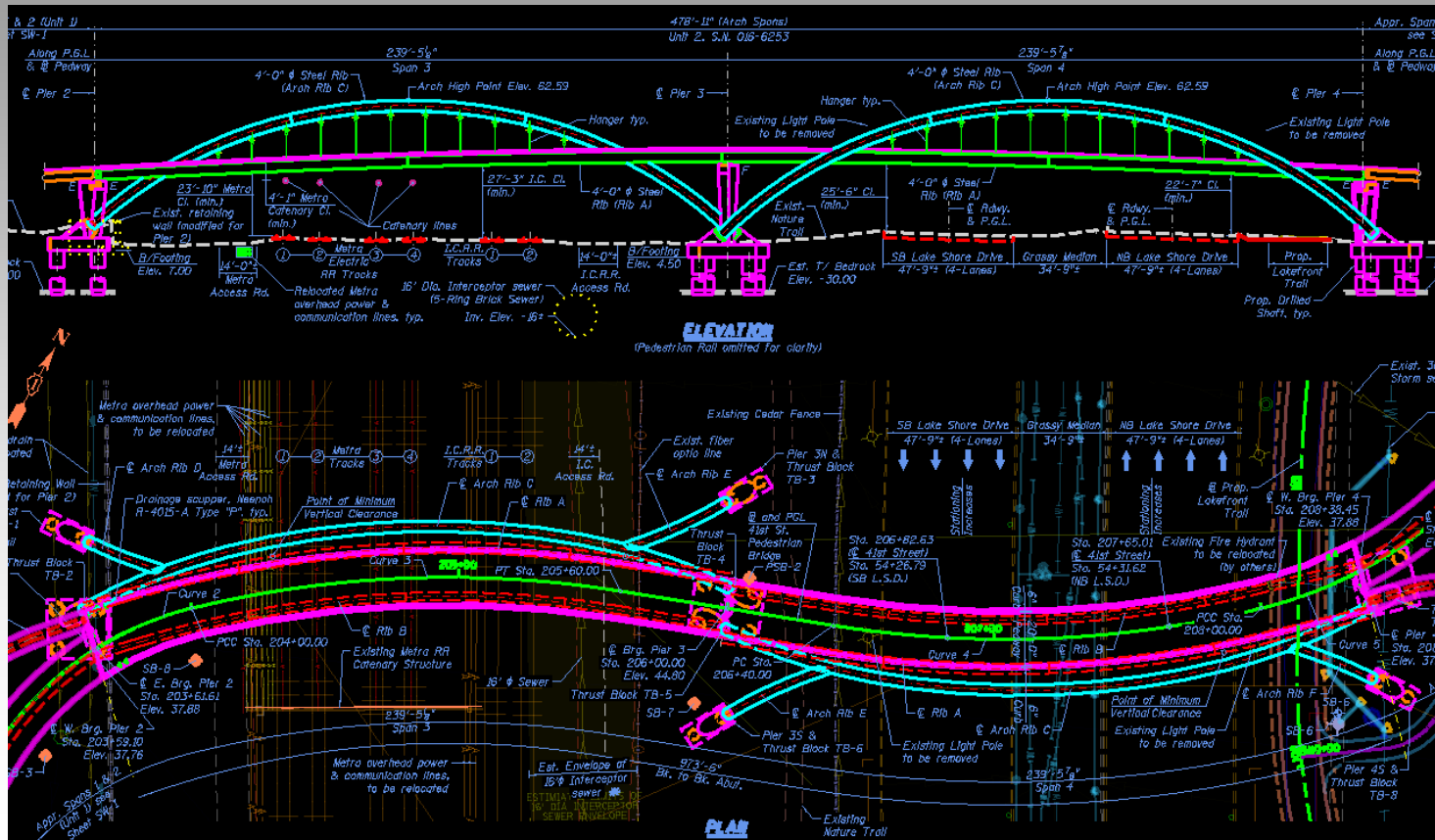
Ramp Approach Section



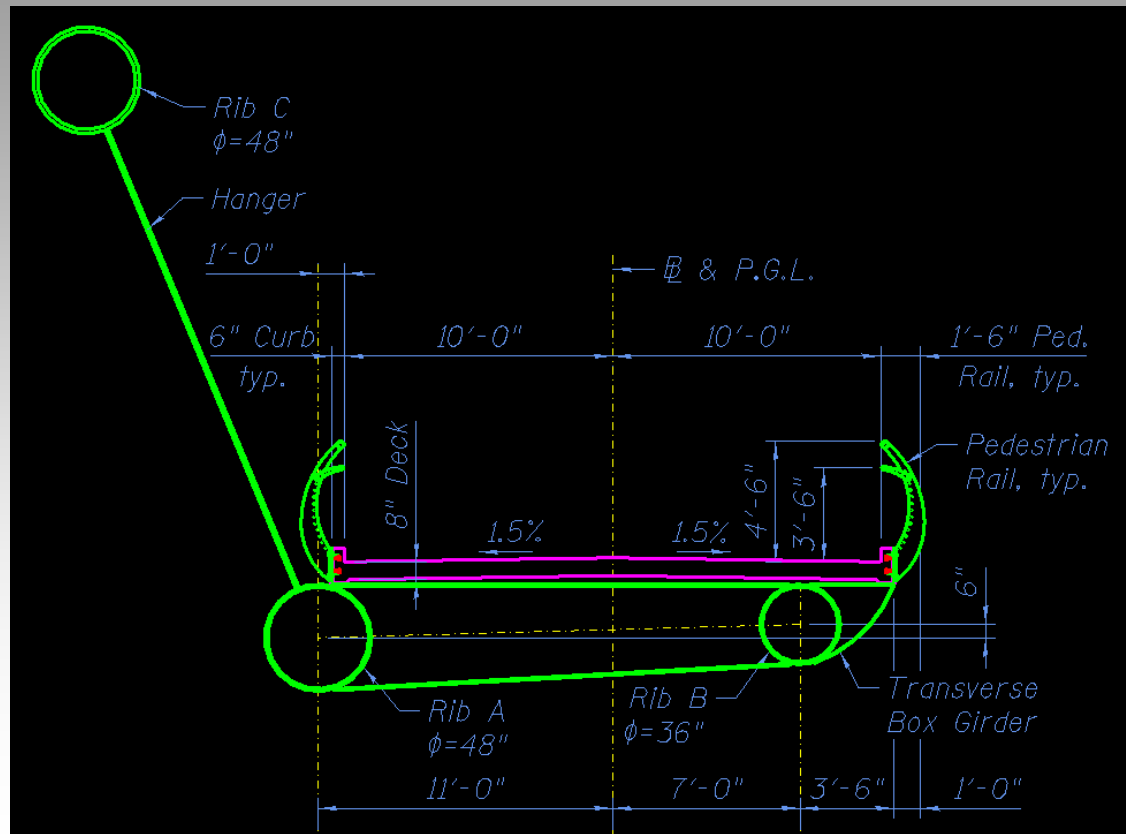


KEY STRUCTURAL FEATURES

General Plan and Elevation



Typical Bridge Section View



Geometry

- Typical arch structures are symmetric in both directions: 41st ped bridge has no symmetry in any direction
- Arch is an arc shape instead of parabolic curve, provides more hanger connections points
- Arch is 30 degree inclined from vertical plane then rotated about vertical axis
- Curved deck framing not following the baseline
- Deck has 5 degree profile grade, which creates 7' elevation difference between the two ends

Main Structural Elements

- Back to back arches, span length of 240' over 6 active RRs and a Freeway forms elegant “S” shape deck
- Arch rib (C) – 4' dia. x 1” thick pipes
- Kicker ribs towards the end of the arch spans for lateral support
- Arch rib supports 4' dia. deck rib (A) via hangers
- Two deck ribs A and B (4' & 3' dia.) along with trapezoidal transverse box beams (spaced 12'-6”) supports 20' wide C-I-P deck
- Hold down devices at the ends @ piers 2 and 4 due to large torque
- Pot bearings to support large lateral loads
- Approach to the main spans – 2 spans consist of single 3' dia. pipe and transverse girders to support 16' C-I-P deck
- MSE wall approaches

Design Features

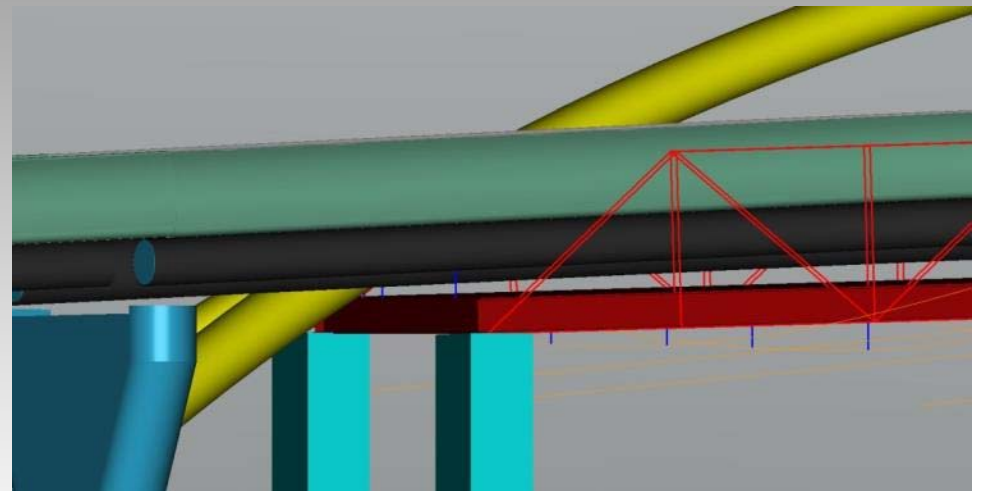
- Structural configurations
 - Arch is incline 30 degrees from vertical plane
 - Deck Rib is curved at 400' radius
 - Deck is supported by hanger on one side only
 - All structural members are made of pipes or box sections
 - Complicated geometry
- Analysis and design
 - CSiBridge modeling
 - Large torsional force at the support
 - Large lateral force at support
 - Bridge vibration concerns due to low fundamental frequencies

Design Features

- Connection details
 - Transverse girder to deck rib connections
 - Deck rib end connections
 - Hold-Down device
 - Expansion bearing with large lateral resistance
 - Lateral stop and jacking support
 - Center transverse girder connections
 - Hanger connections
 - Arch base connections

Temporary Bridge

- To allow Bridge Construction; Steel erection, Hanger installation and deck fabrication over active RRs
- Extremely tight clearance between the bridge deck and existing overhead catenary lines



Existing Condition Photos - West Side

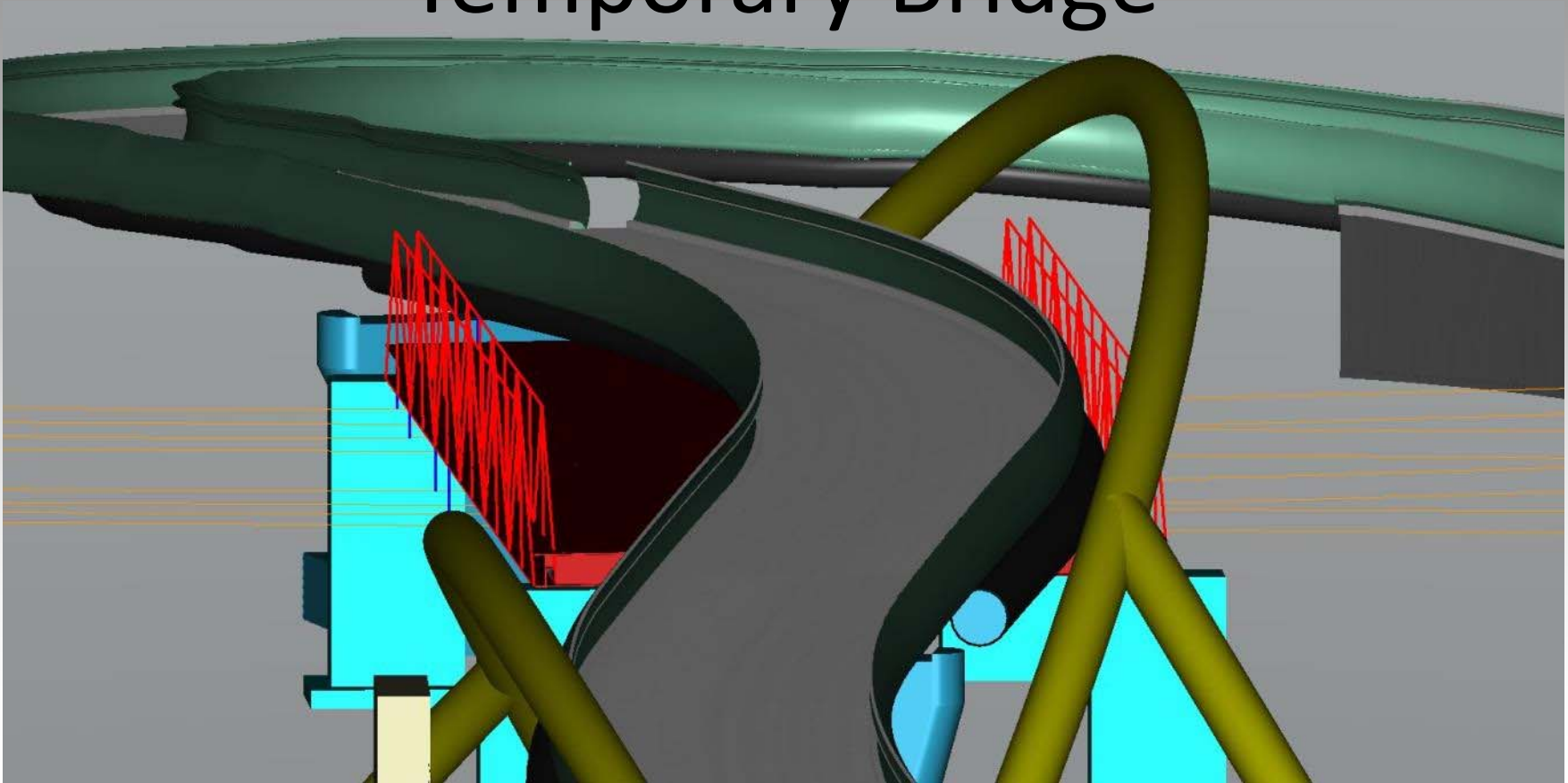


View looking east

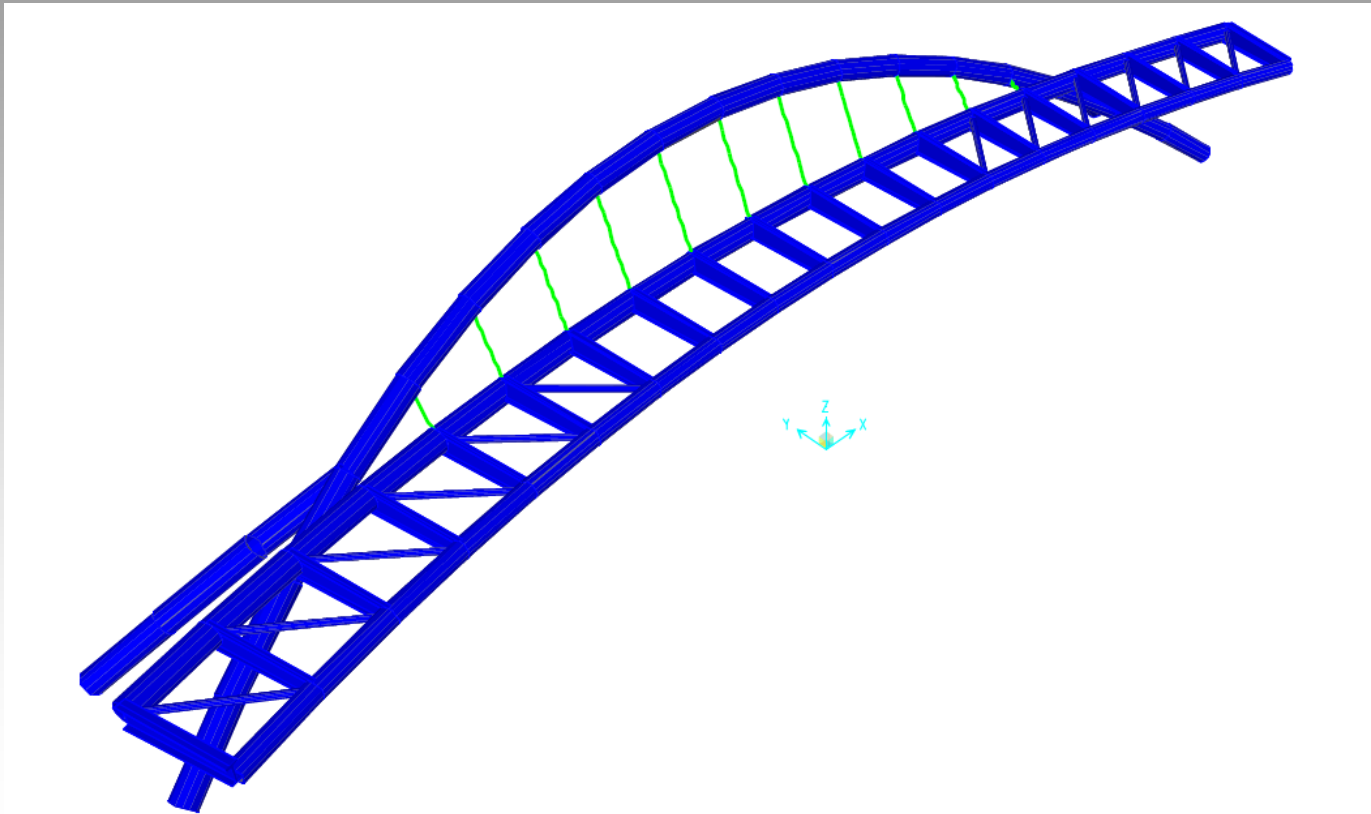


View looking south along
Metra & CN Railroads

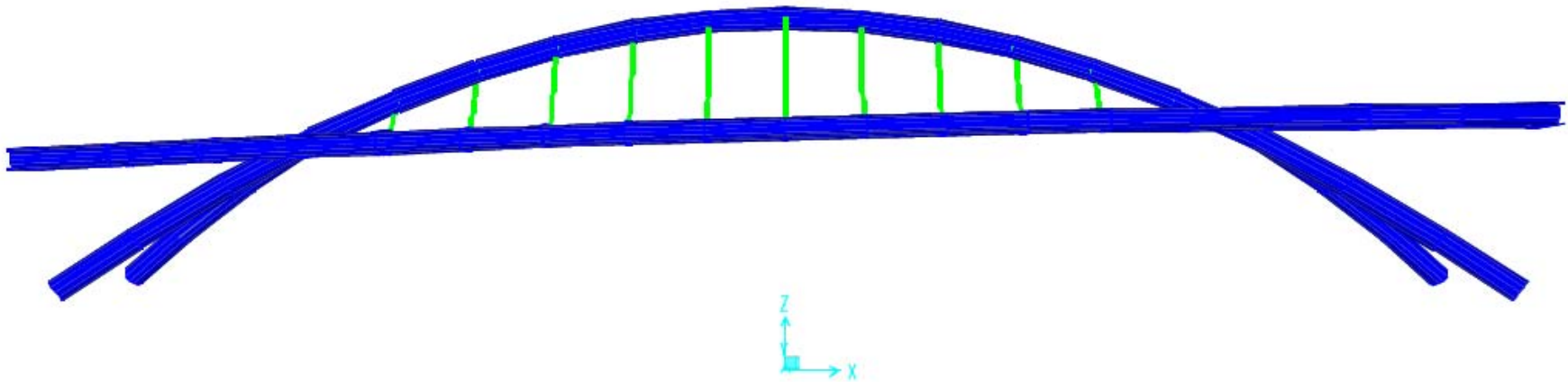
Temporary Bridge



CSiBridge 3-D Model

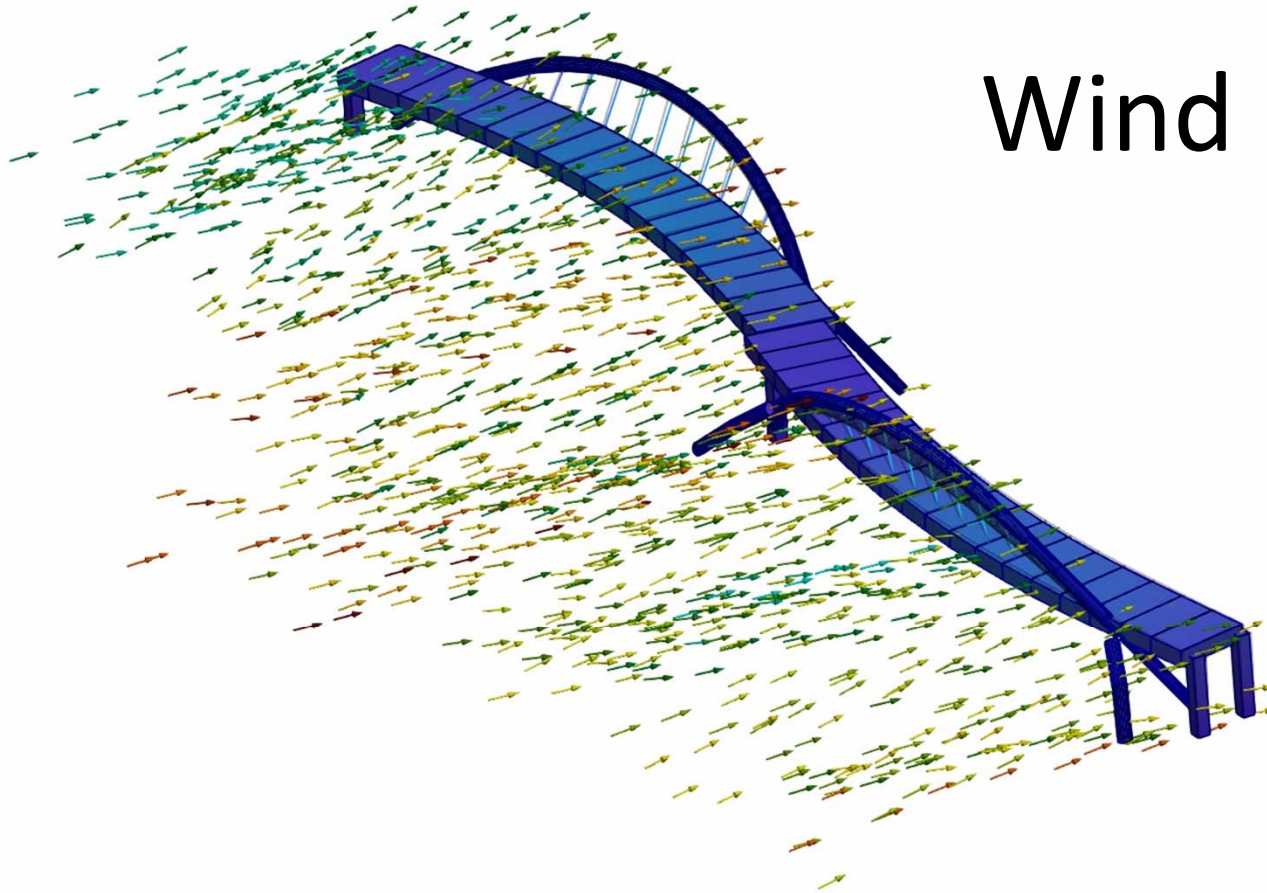


CSiBridge 3-D Model





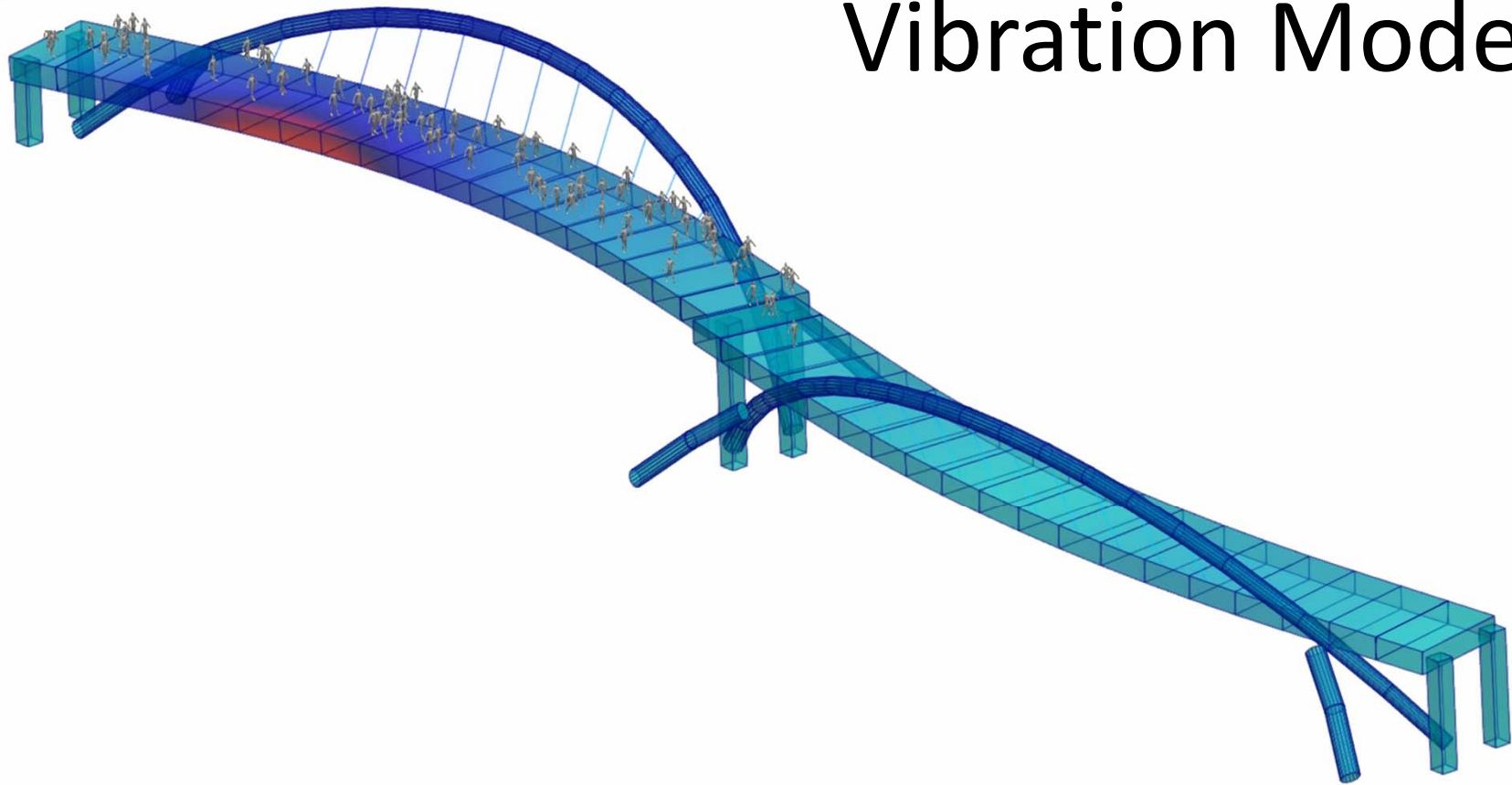
Wind Model



Displacement x 100



Vibration Mode

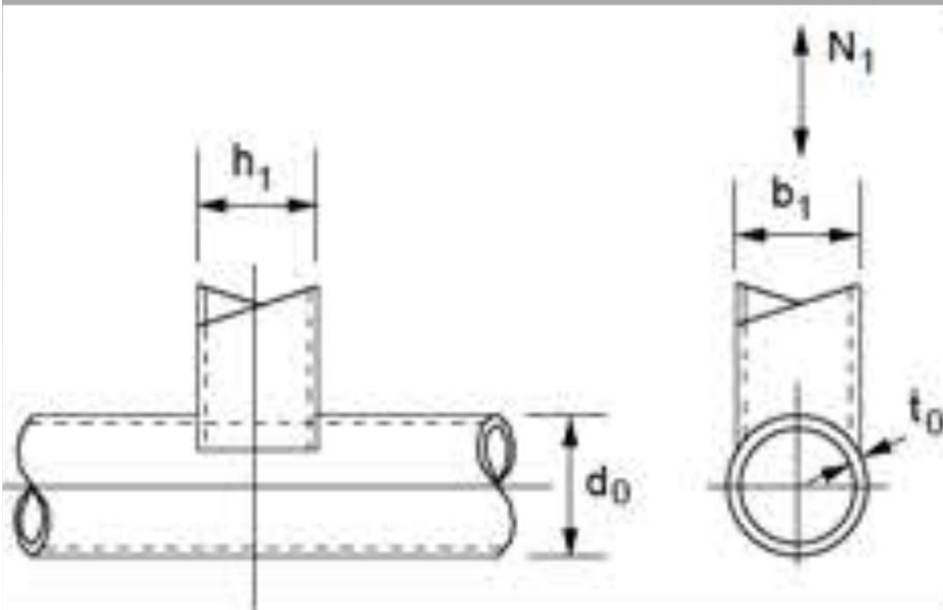


Time: 45.00 sec, displacement x 100

Box Girder to Pipe Connection Design

- AISC Steel Design Guide 24 - hollow structural section connections
- Circular hollow section joints under predominantly static loading, by International Committee for the Development and Study of Tubular Construction (CIDECT)

Connection Strength - CIDECT



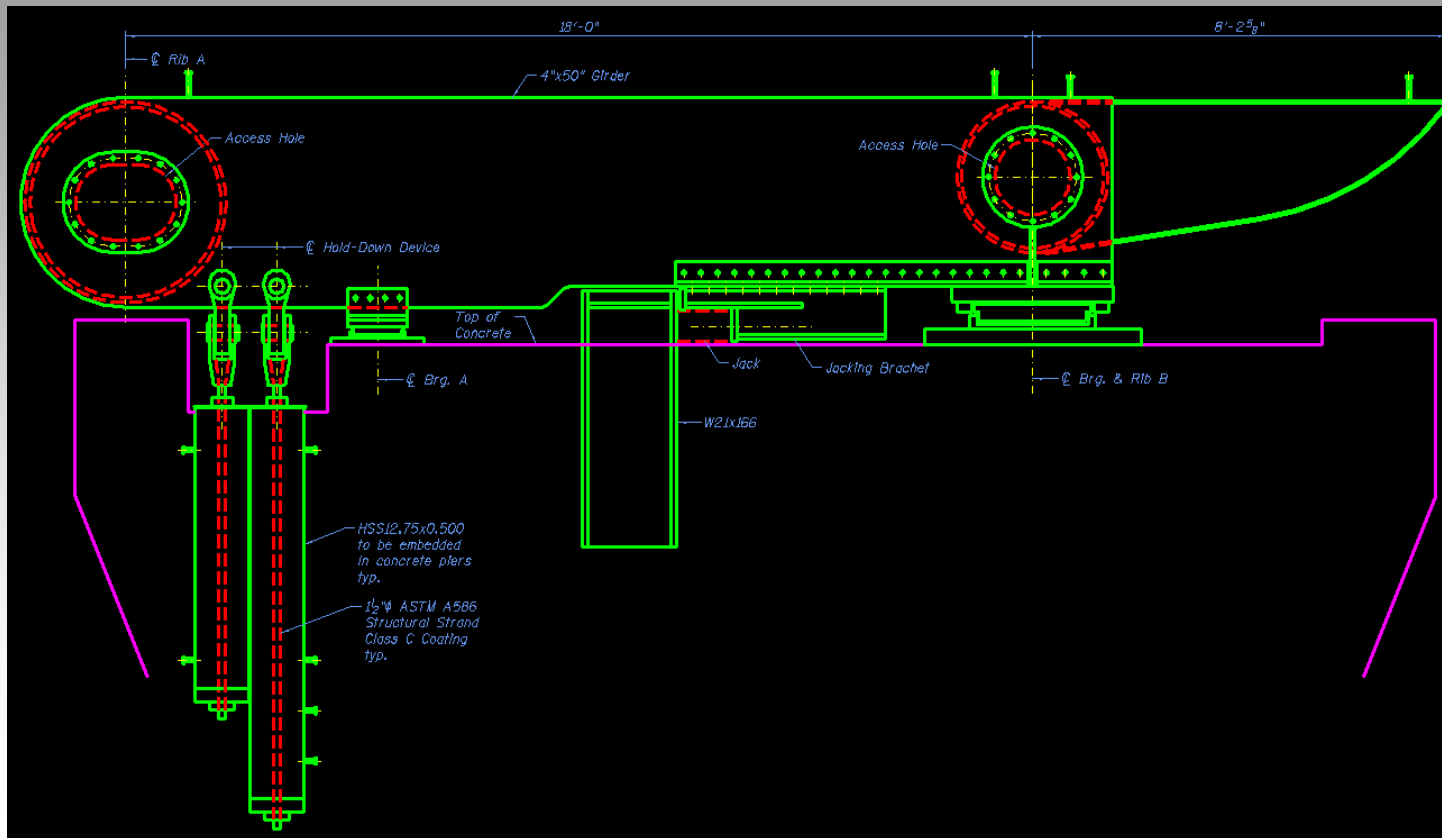
Nominal strength based on chord plastification:

$$M_{1n} = Q_{ub} \cdot Q_f \cdot f_{y0} \cdot t_0^2 \cdot h_1$$

$$Q_{ub} = 0.5 \cdot Q_u \cdot \frac{b_1}{h_1}$$

$$Q_u = 2.2 \cdot (1 + 6.8 \cdot \beta^2) \cdot (1 + 0.4 \cdot \eta) \cdot \gamma^{0.2}$$

End Transverse Girder

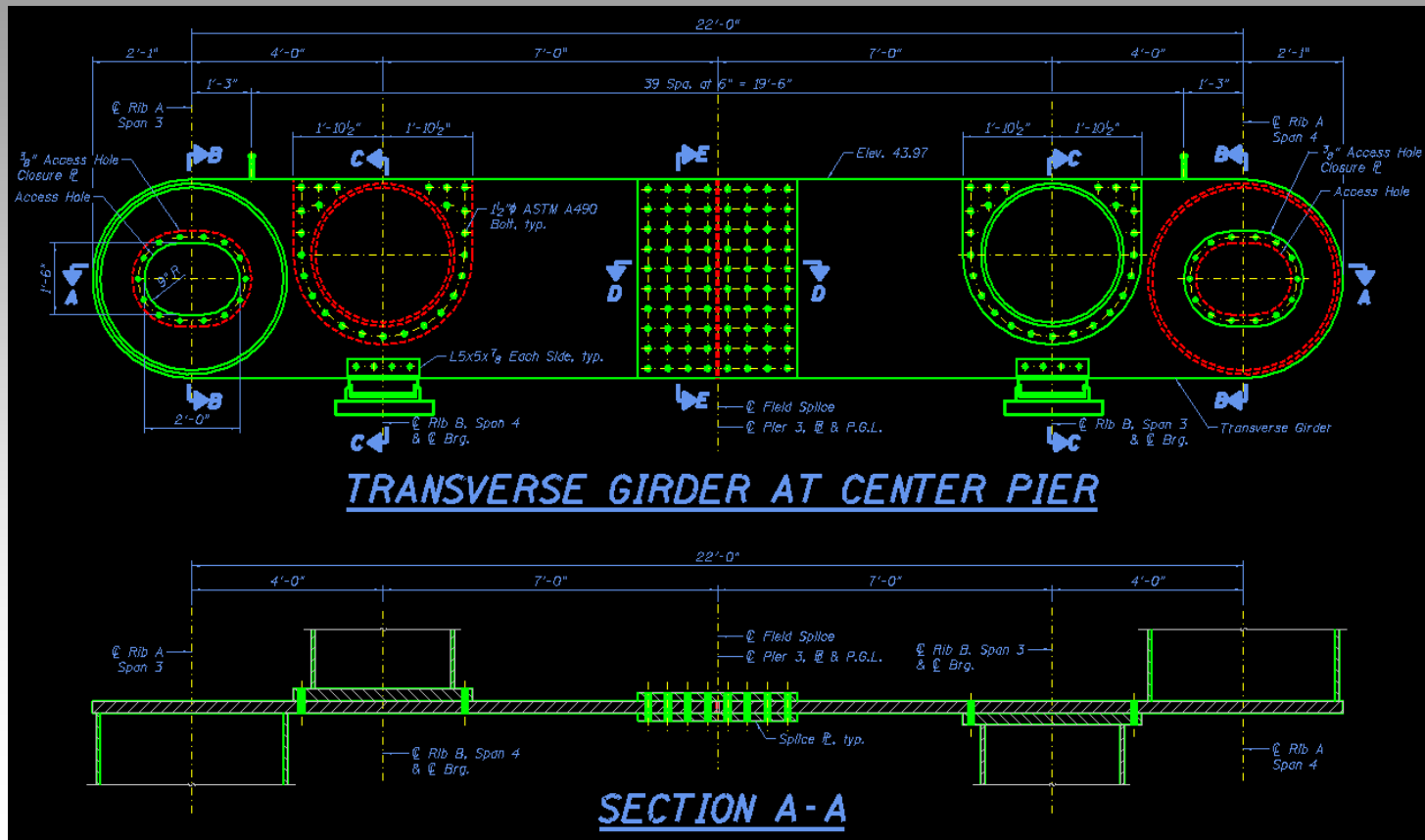


Deck Rib Design

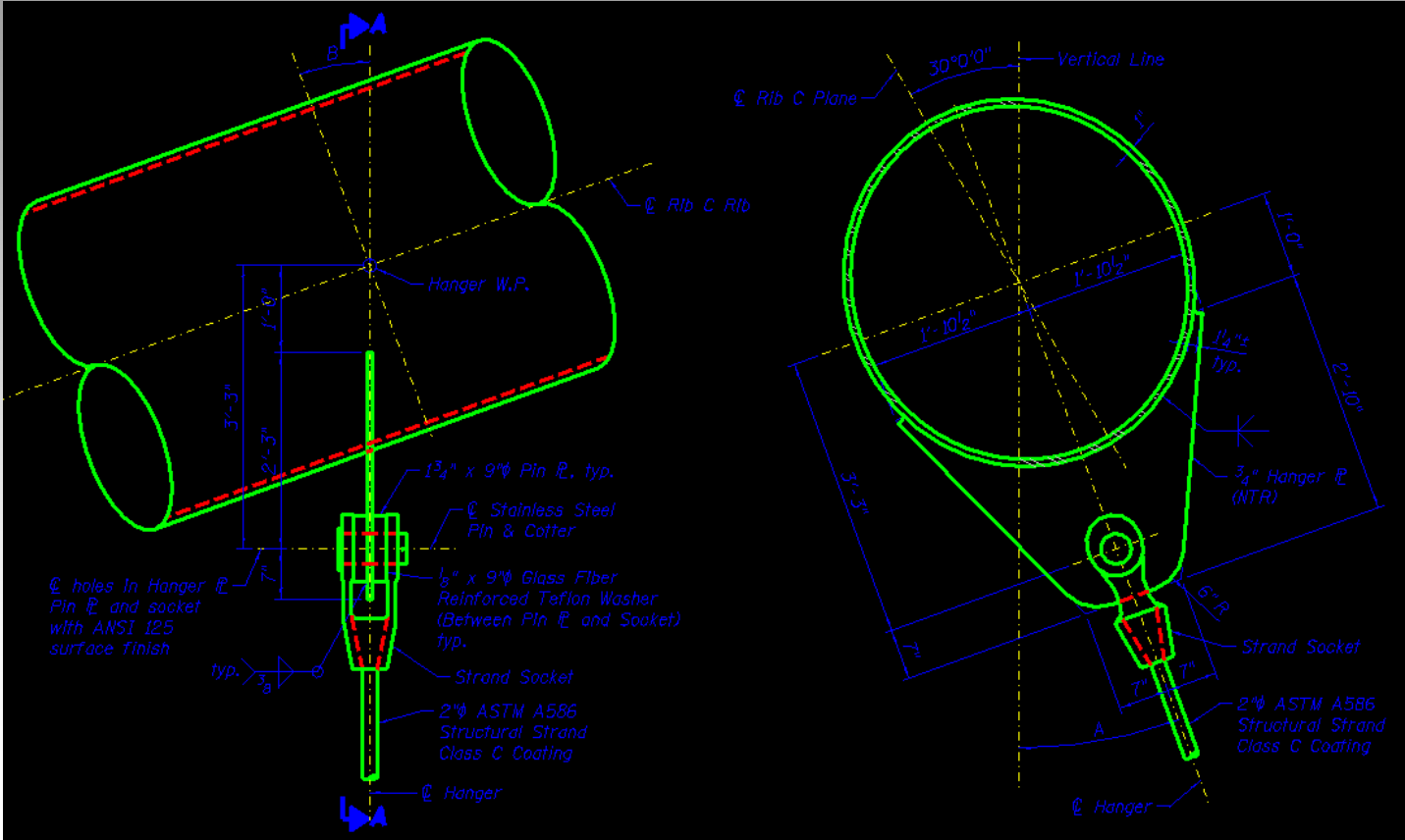
- Torsion not covered by AASHTO
- Tube shape connection not covered by AASHTO
- AISC

$$\left(\frac{P_r}{P_c} + \frac{M_r}{M_c} \right) + \left(\frac{V_r}{V_c} + \frac{T_r}{T_c} \right)^2 \leq 1.0 \quad (\text{AISC Eq. H3-6})$$

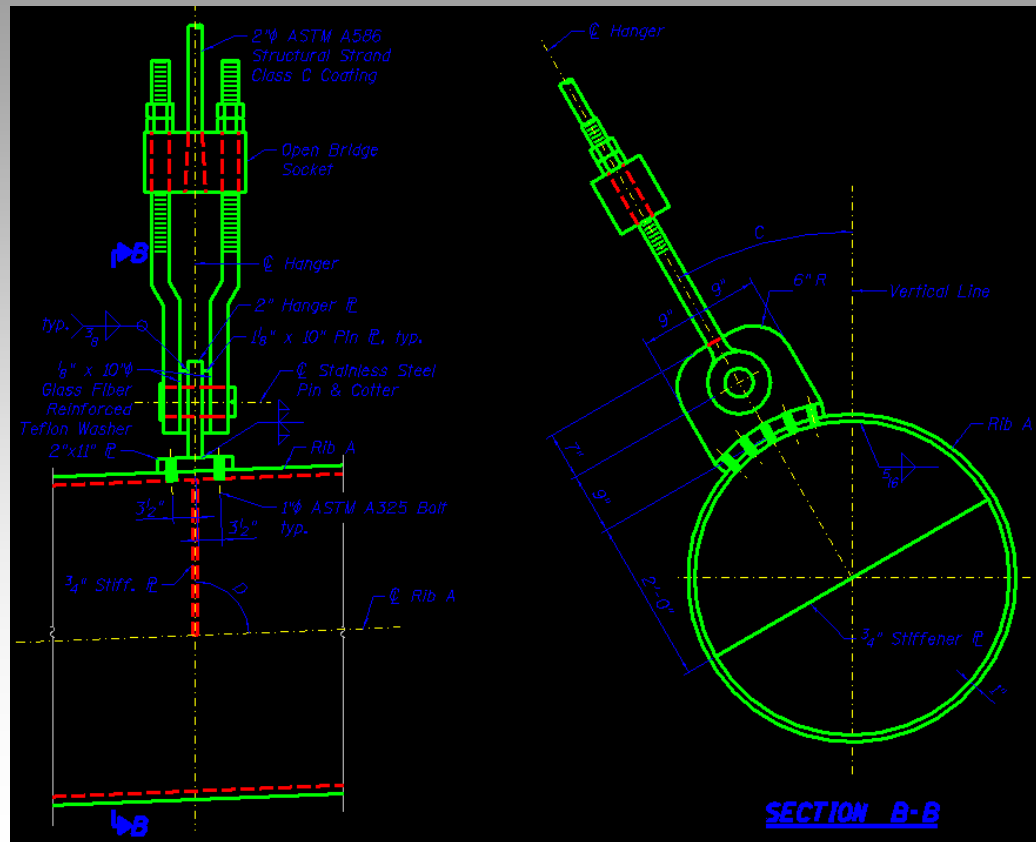
Transverse Girder @ Pier

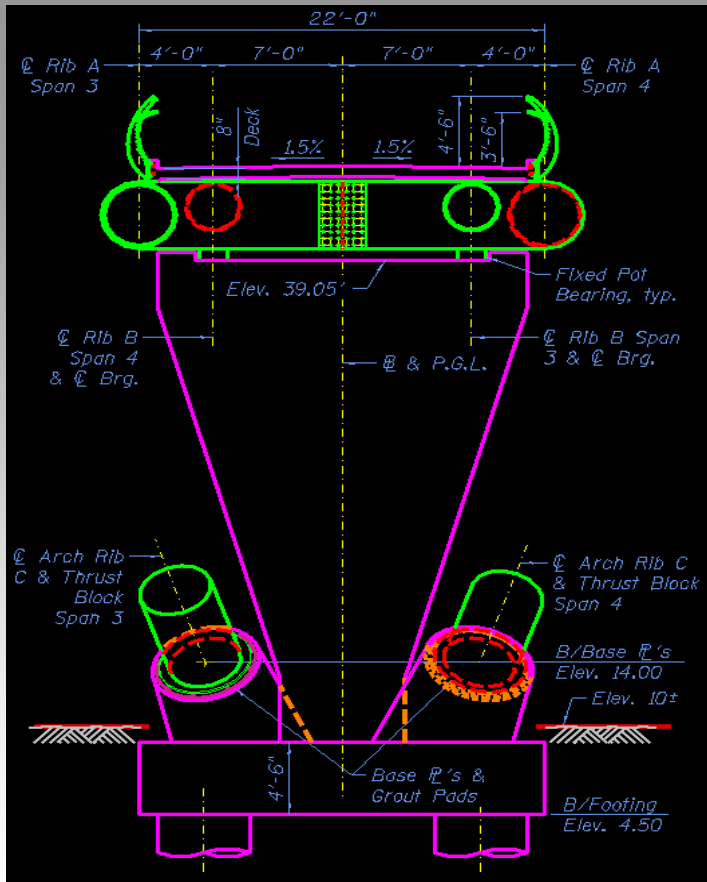


Hanger Connection @ Arch

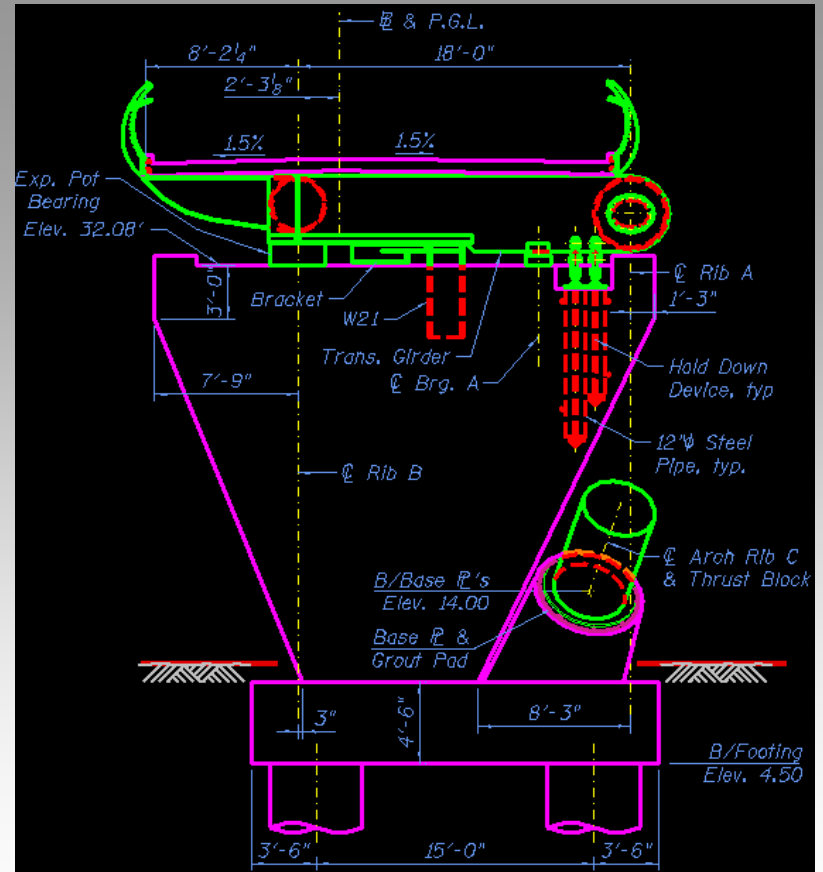


Hanger Connection @ Deck Rib



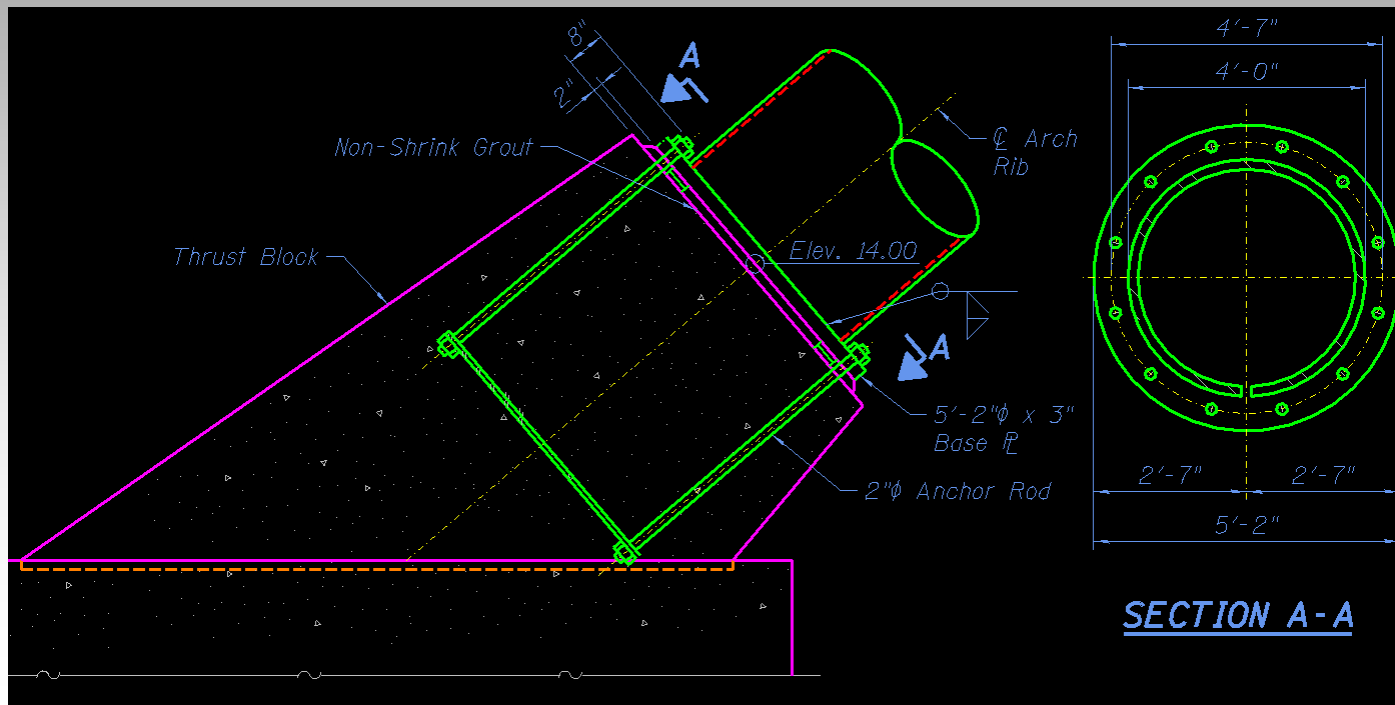


Center Pier



End Pier

Arch Base Connection

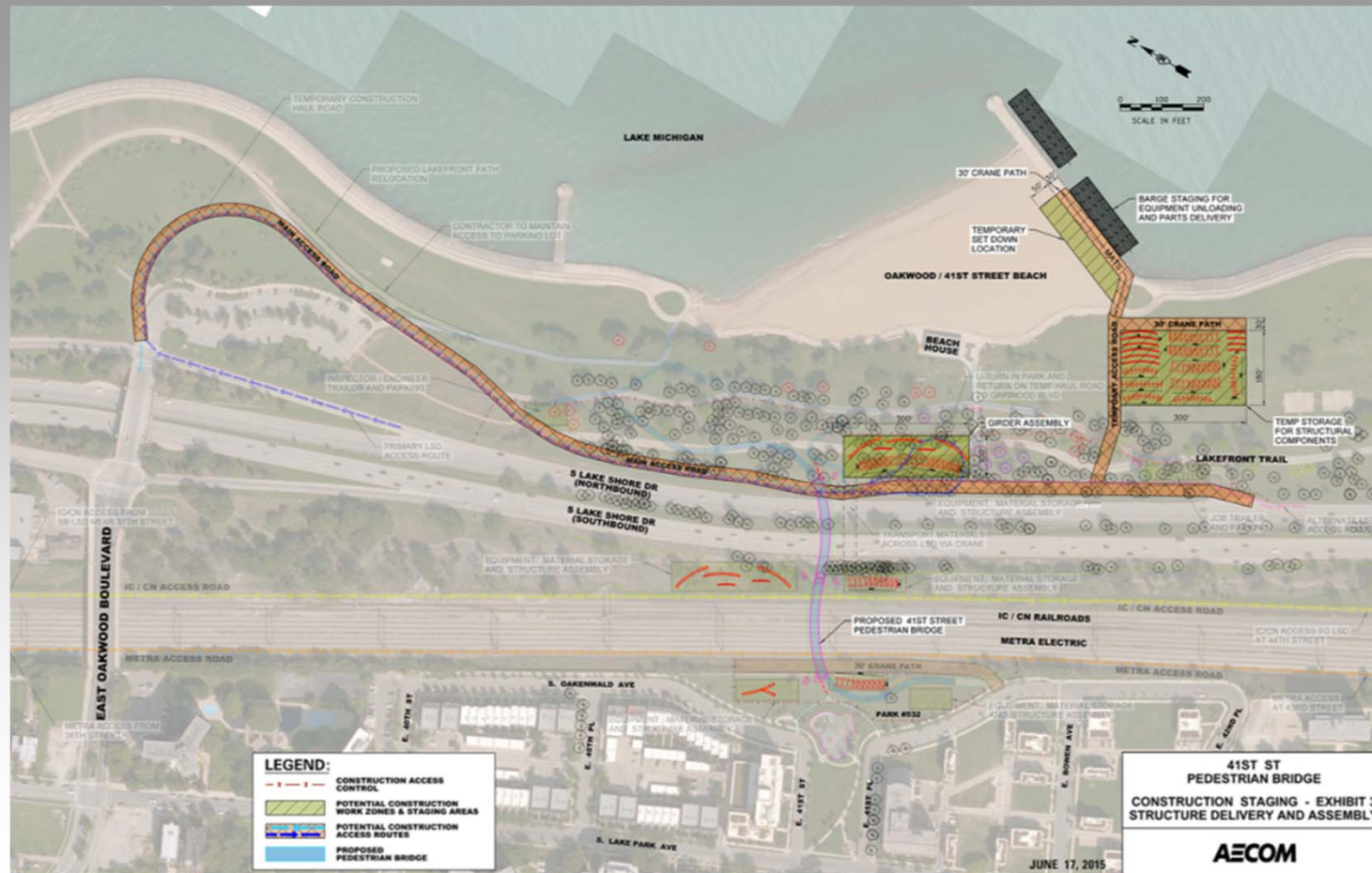




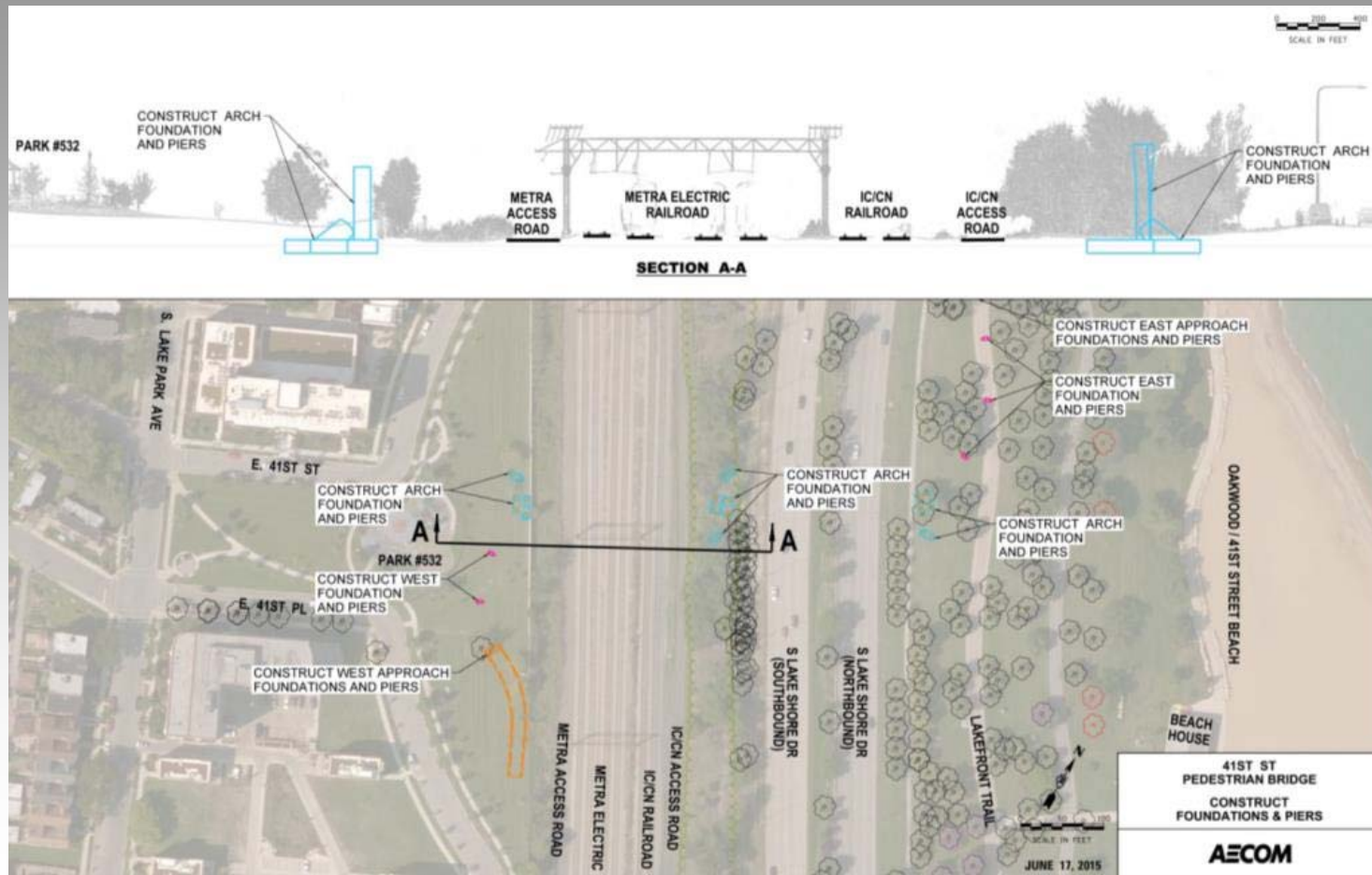
STAGING & CONSTRUCTION

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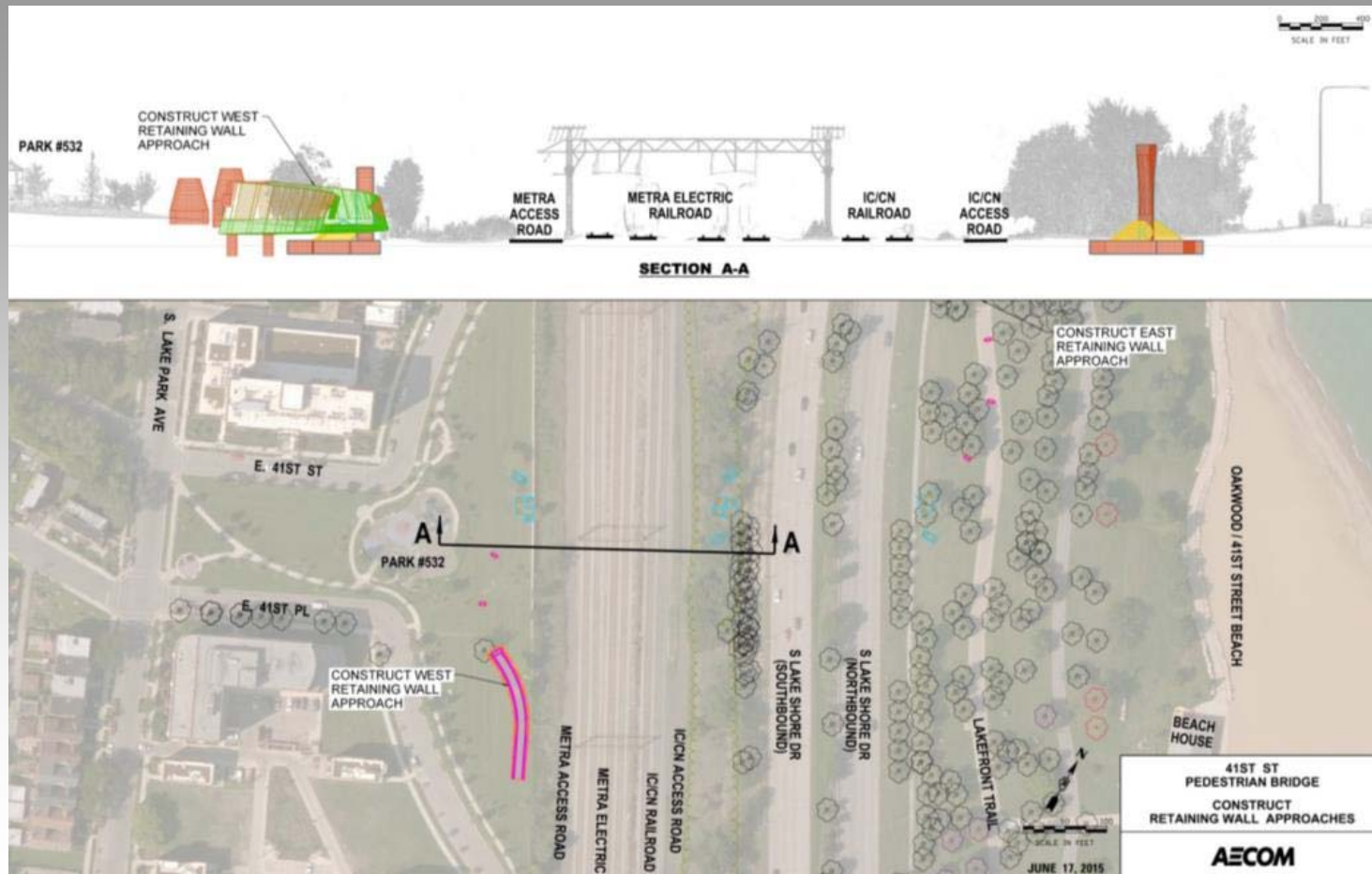
Staging, Delivery and Assembly



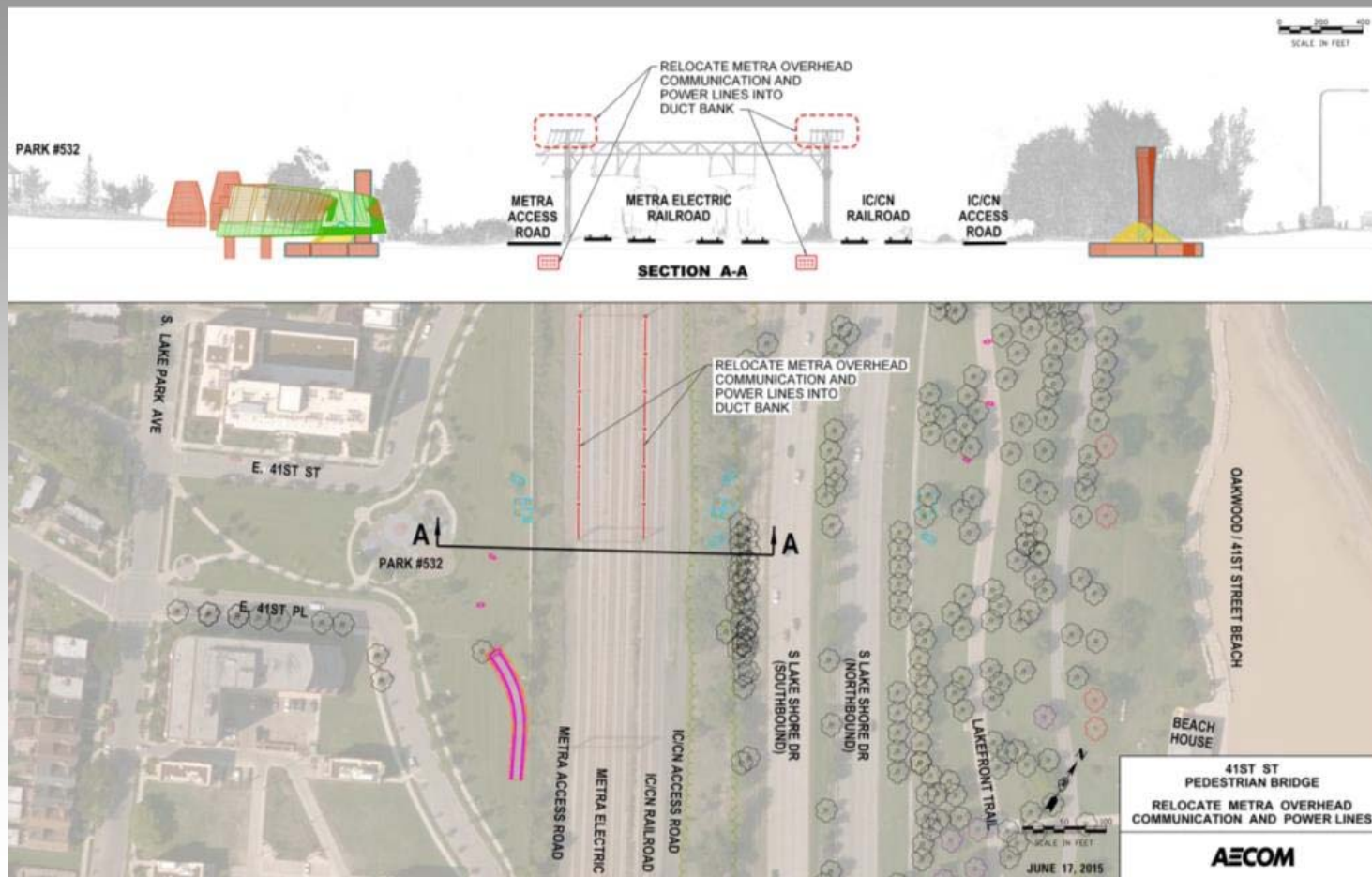
Construct Foundation and Piers



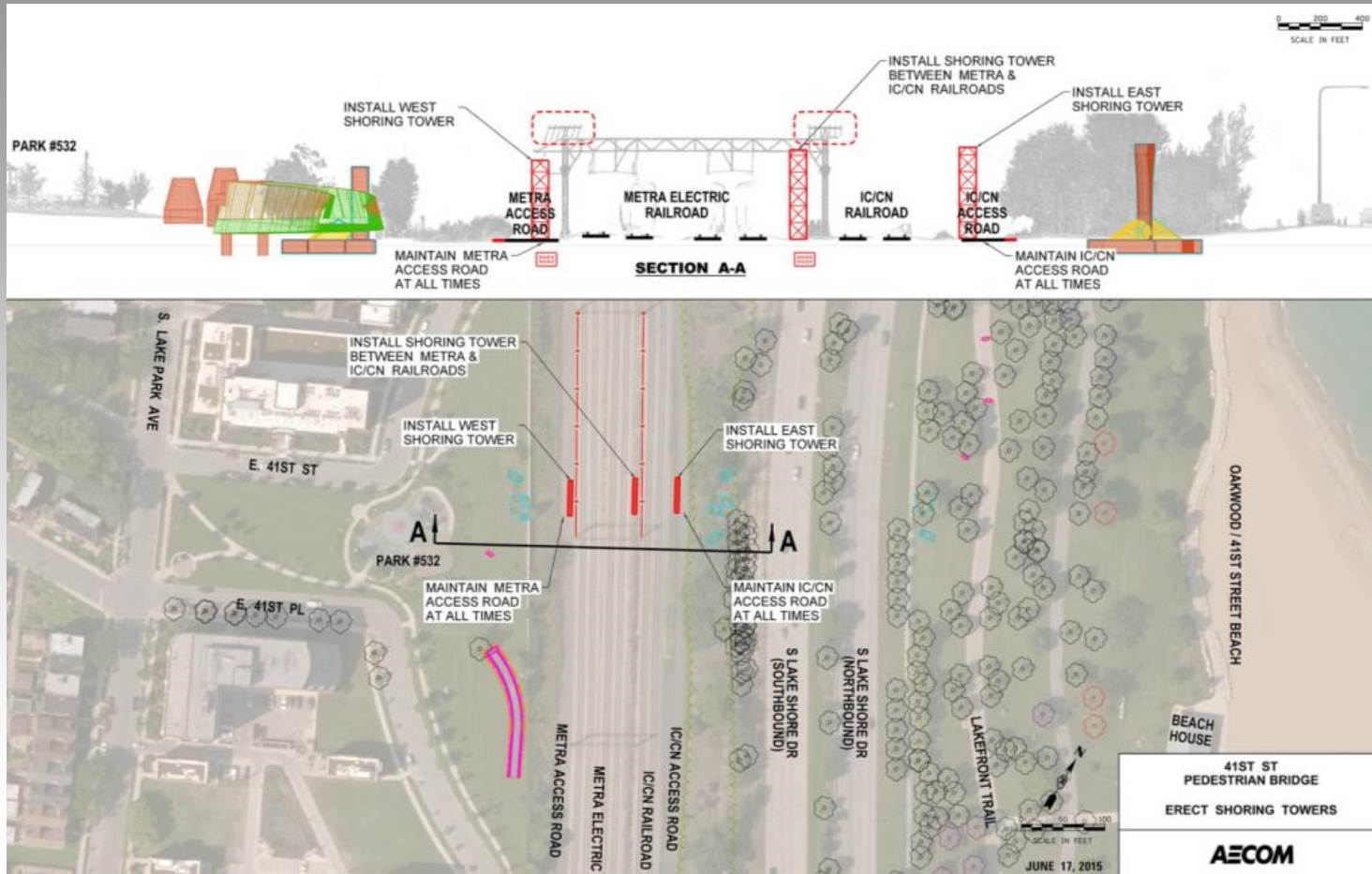
Construct Retaining Wall Approaches



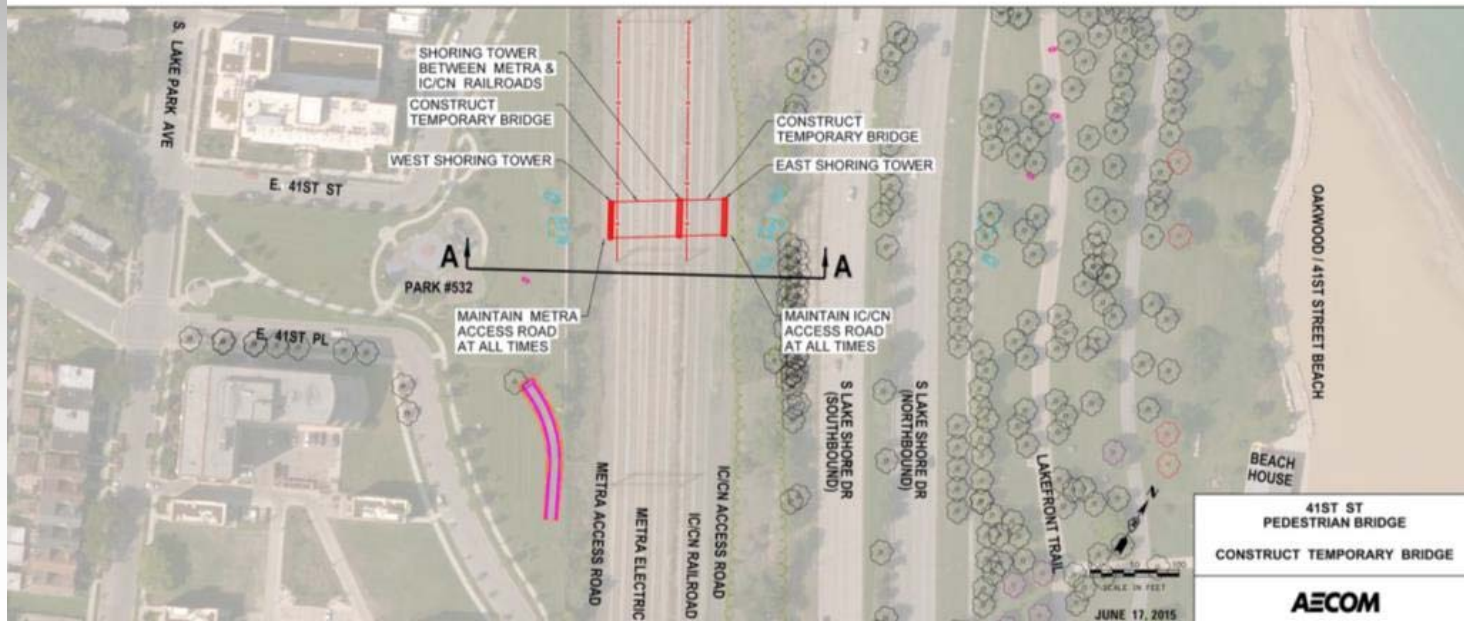
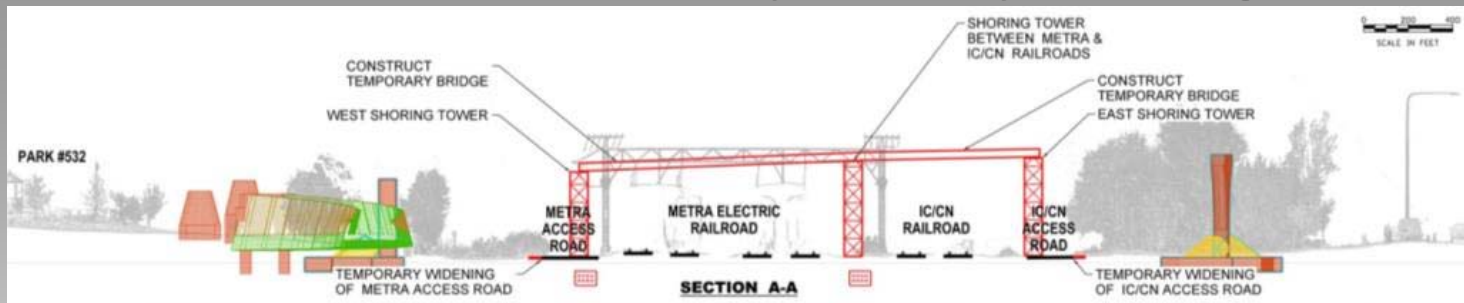
Relocate Metra Overhead Lines



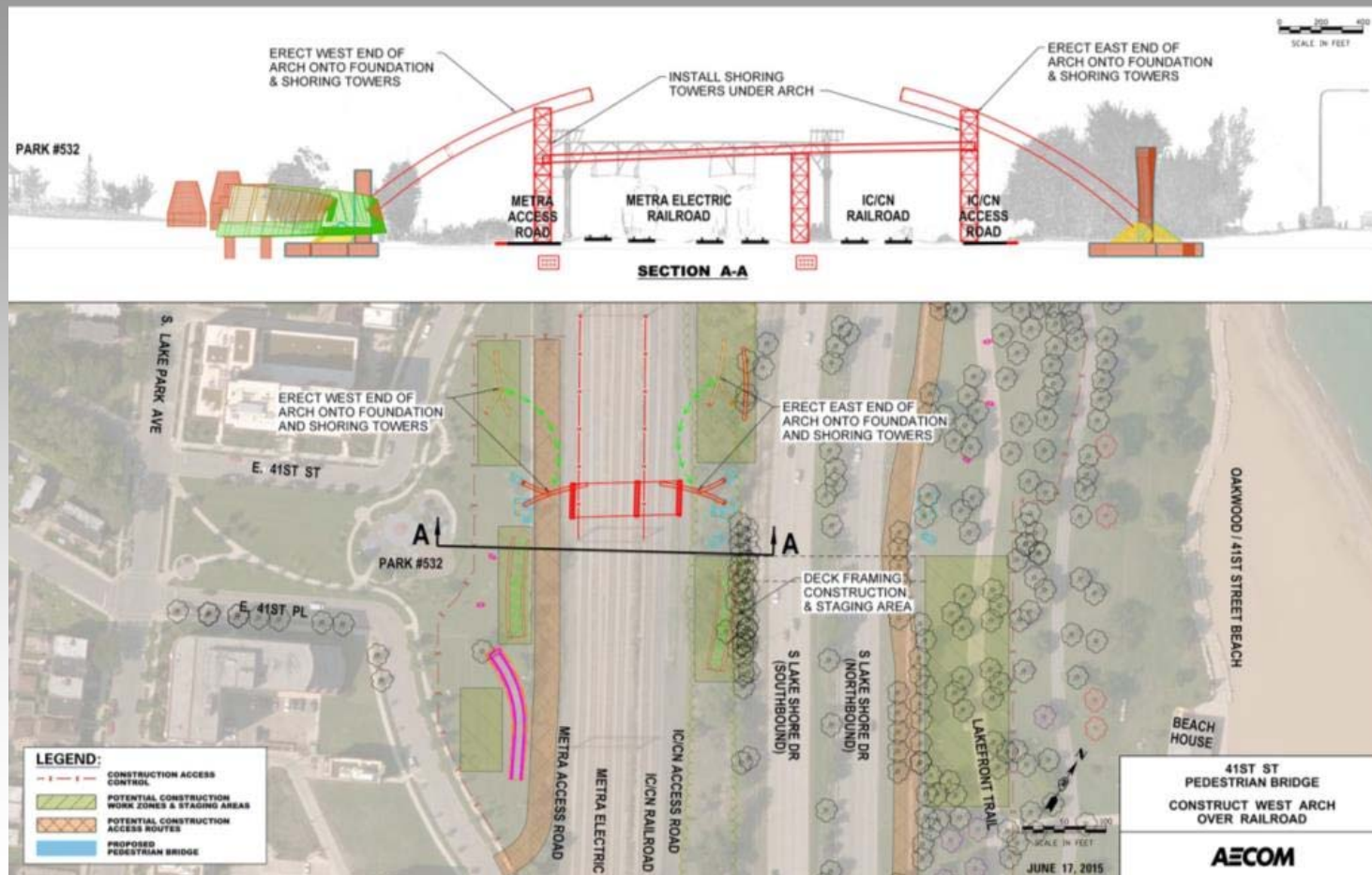
Erect Shoring Towers



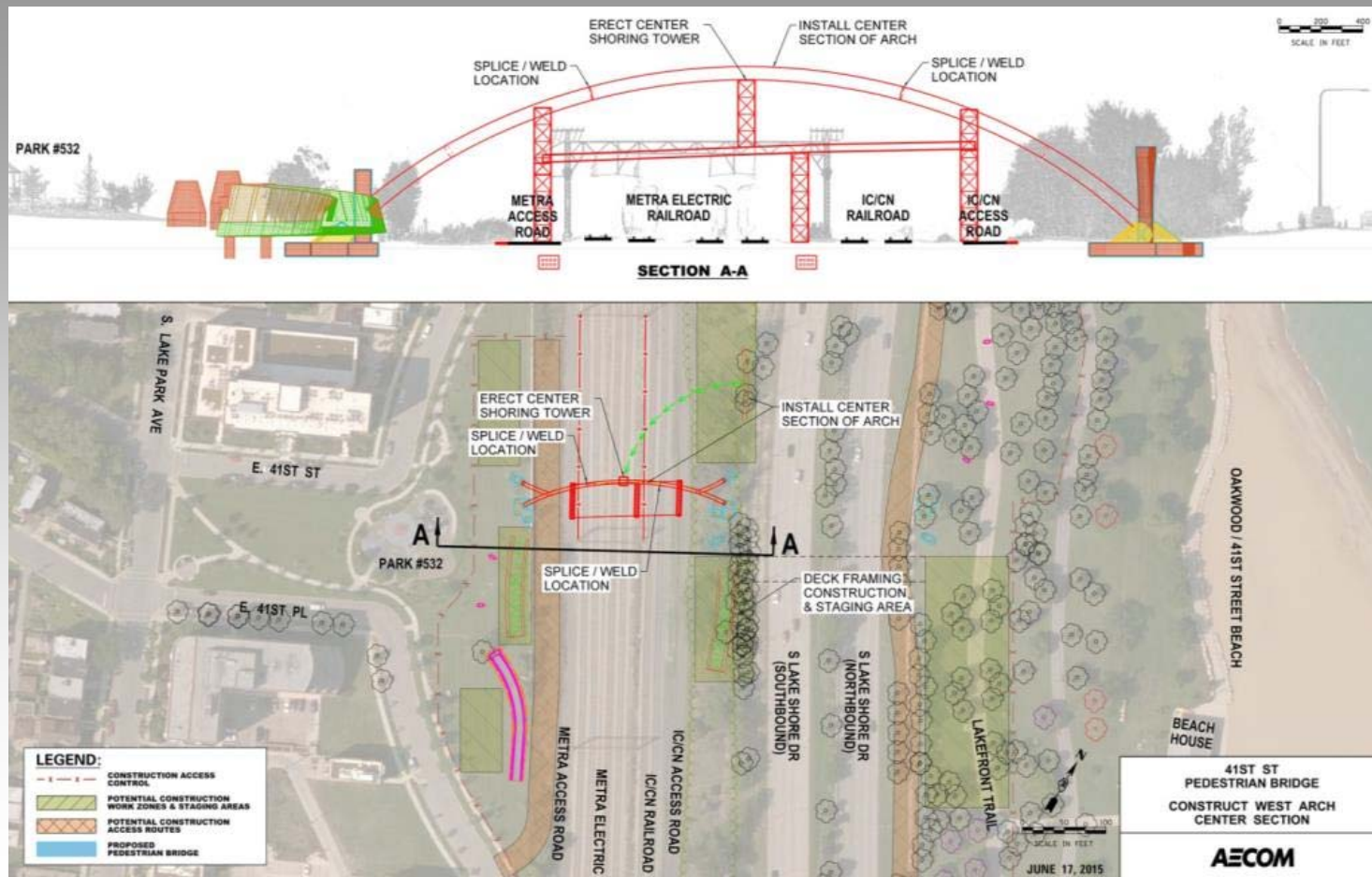
Construct Temporary Bridge



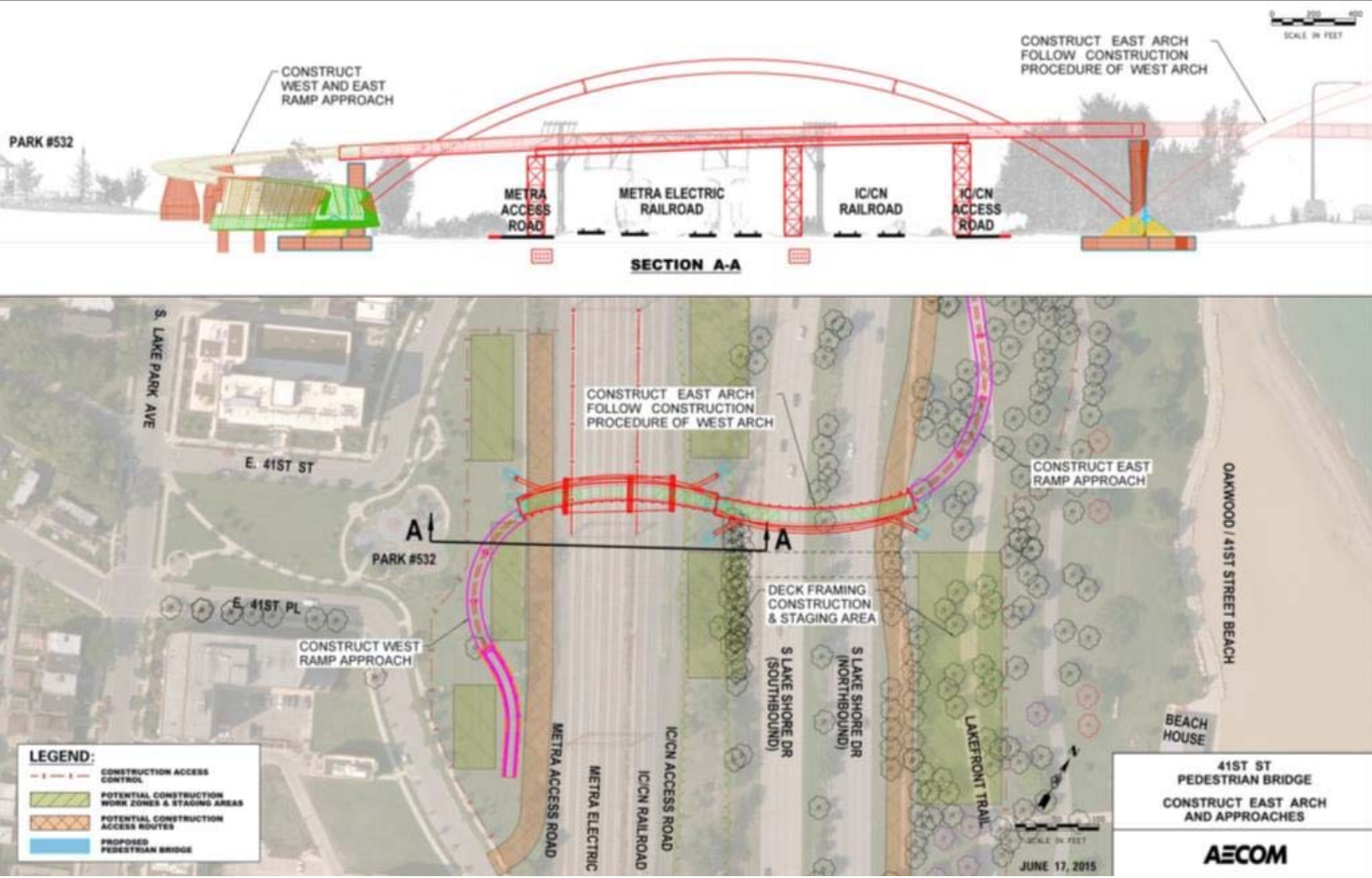
Construct West Arch Over Railroad



Construct West Arch Center Section



Construct East Arch Span and Approaches



Steel Fabrication



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Steel Fabrication



BendTec

FABRICATION & BENDING

West Arch Pier/Thrust Anchors



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West Arch Pier/Thrust Anchors



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West MSE Approach Structure



Temp Bridge & Approach Framing



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Temp Bridge & Approach Framing



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Deck Ribs Delivered to Site



Erection of Arch and Deck Rib



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Erection of Arch and Deck Rib

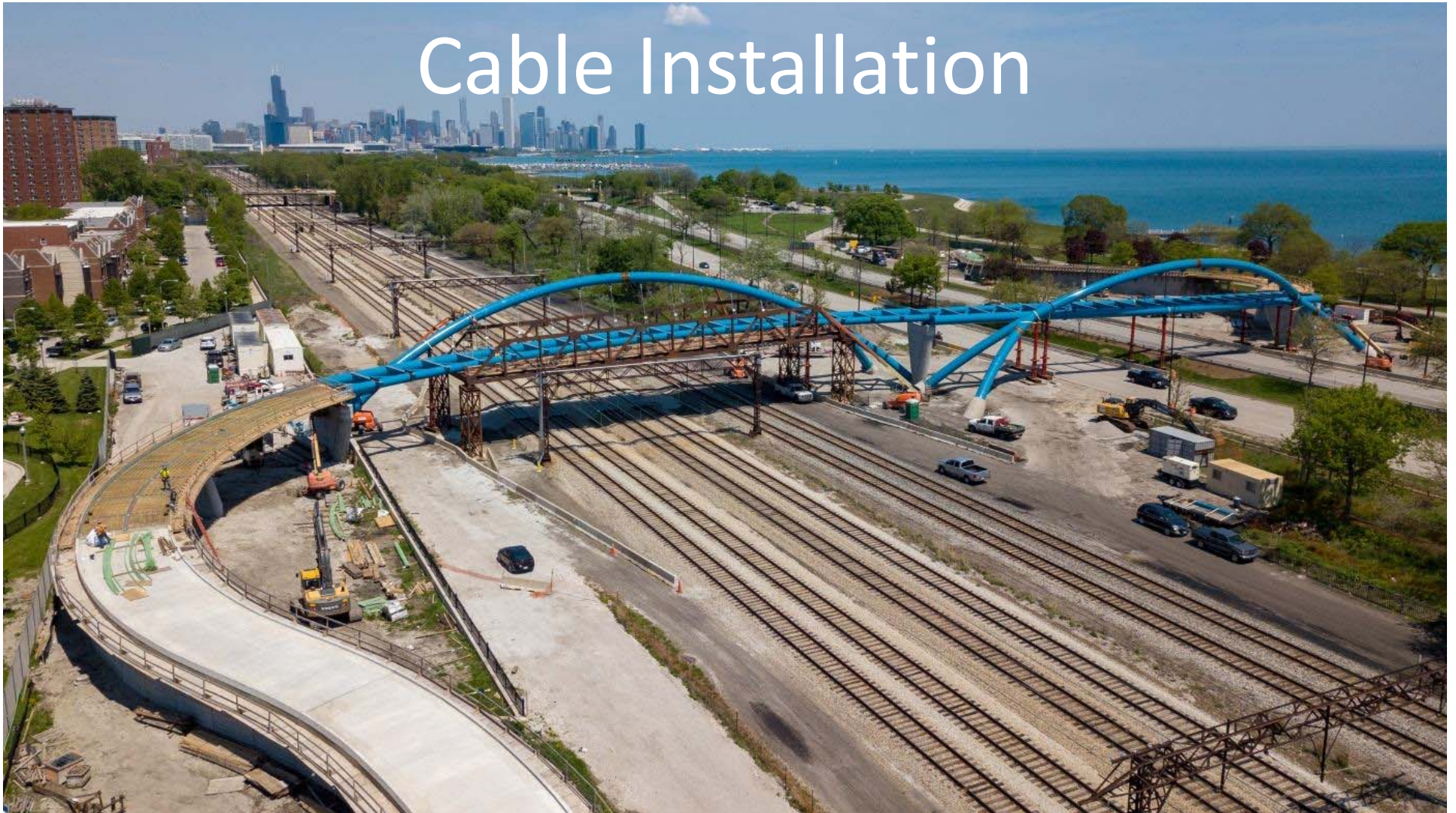


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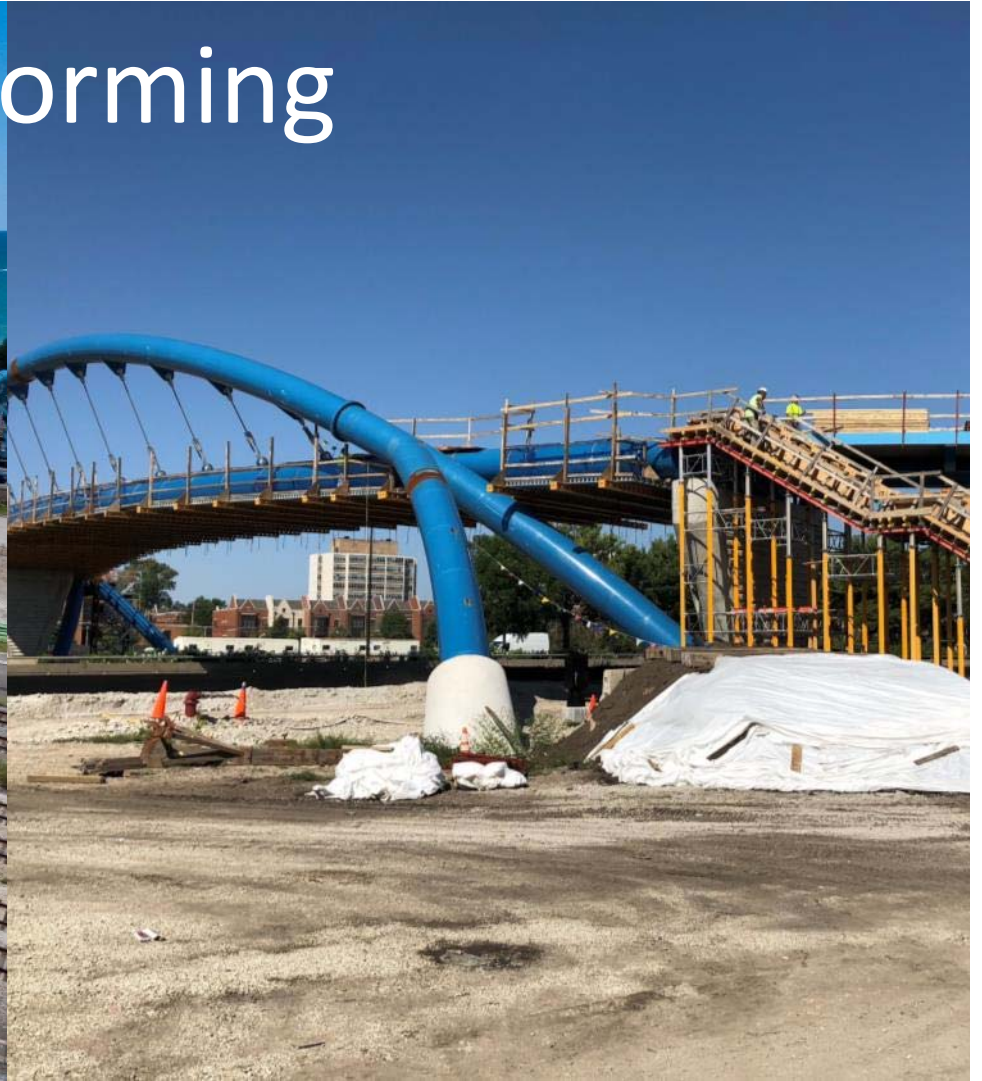
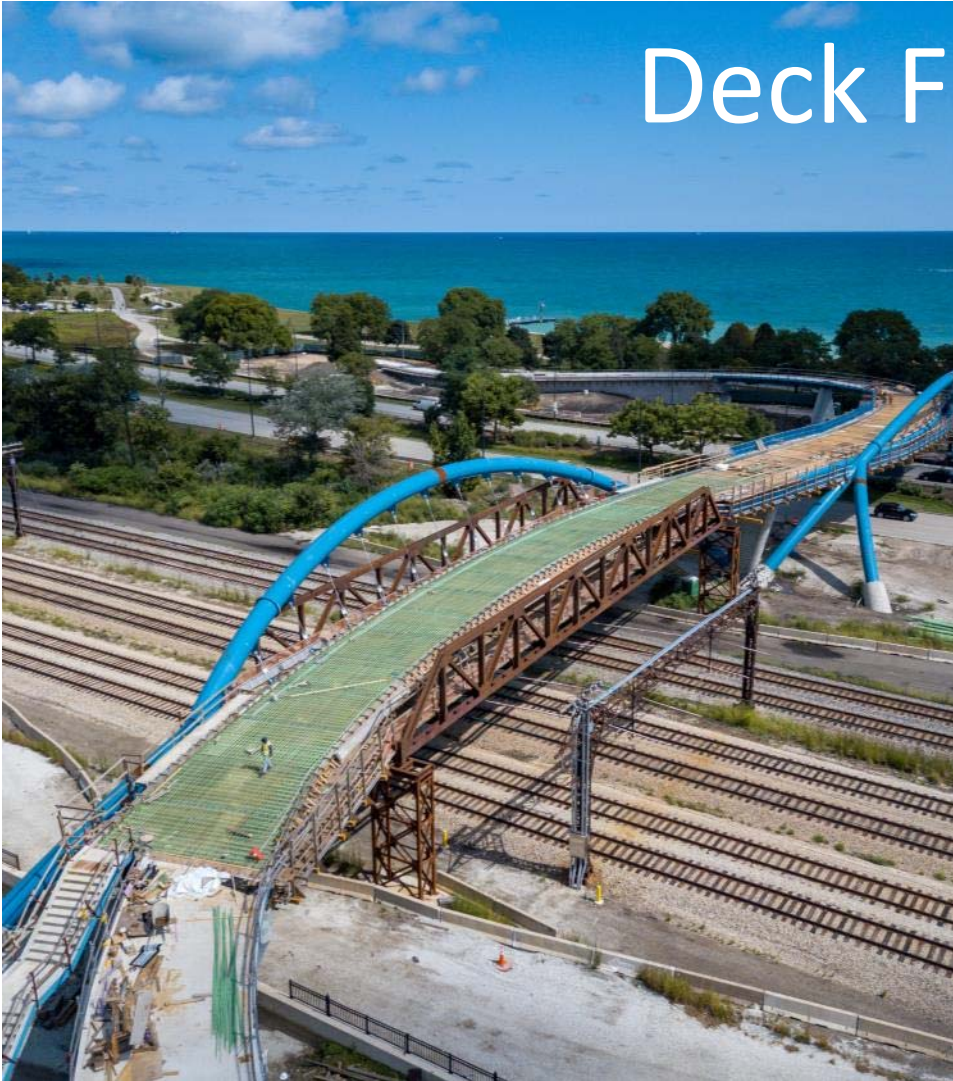
Arch & Deck Ribs Erection over LSD at Night



Cable Installation



Deck Forming



Deck Forming



Pouring Arch Decks



Decks Completed



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Decks Completed



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Completed Bridge



Ground Breaking – December 2018



THANK YOU!!

AECOM



OWNER: CDOT
ARCHITECT: CORDOGAN CLARK
LEAD DESIGN ENGINEER: AECOM
CONSTRUCTION ENGINEER: TRANSYSTEMS
CONTRACTOR: F.H. PASCHEN

