



FINLEY

An Introduction to Bridge Integration Modelling
Through the Veterans Memorial Bridge
2019 FES | ACEC-FL Annual Conference - Ivan Liu, P.E.



Biography

- 6+ years as Bridge Engineer with FINLEY Engineering Group.
- Professional Engineer in States of Texas and Florida.
- Graduate of Texas A&M University with Structural Engineering focus.
- Past work experience in the Oil & Gas industry.

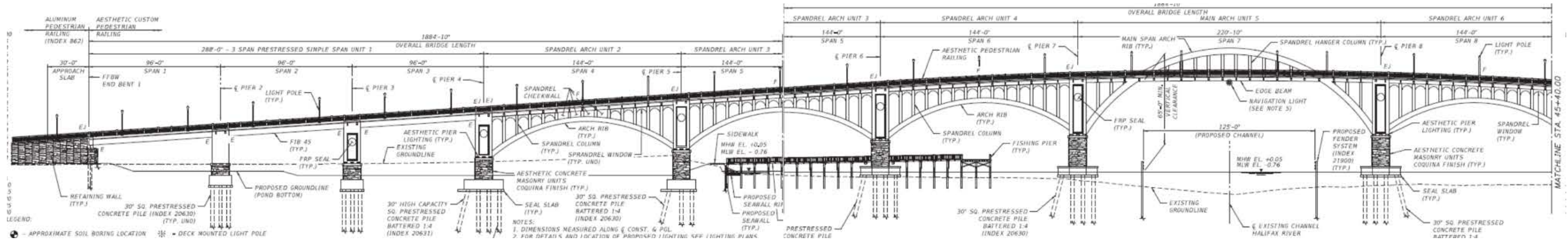


Presentation Objectives

- What is the FINLEY BrIM Workflow?
- Why was it developed?
- How was it used for FINLEY projects?
- Benefits for the Future?
- Use of BrIM on the Veterans Memorial Bridge.



Veterans Memorial Bridge



- Total of 15 Spans
- 8 Florida I-beam (FIB) spans
- 7 Spandrel Arch Spans
- Precast concrete arch substructure
- Precast T-beam or precast FIB
- 220'-10" above-deck arch mainspan

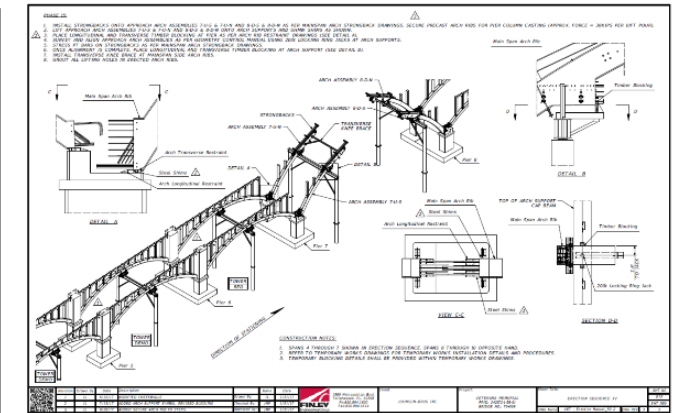
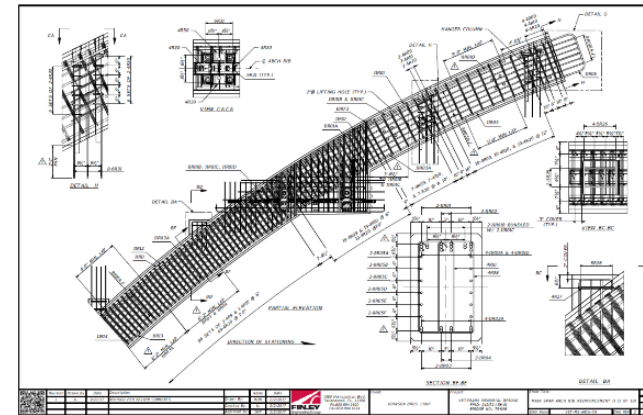
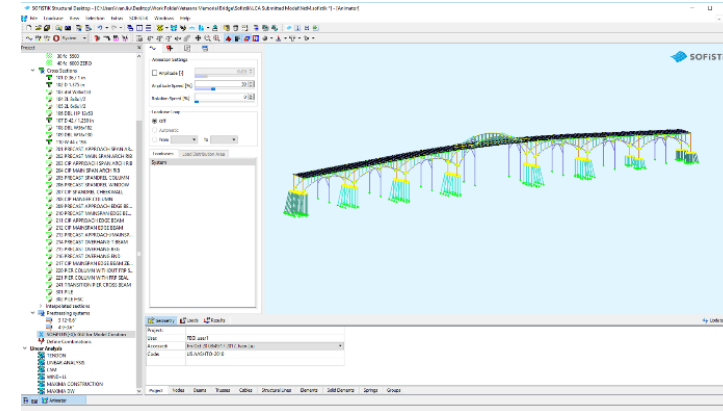


Veterans Memorial Bridge

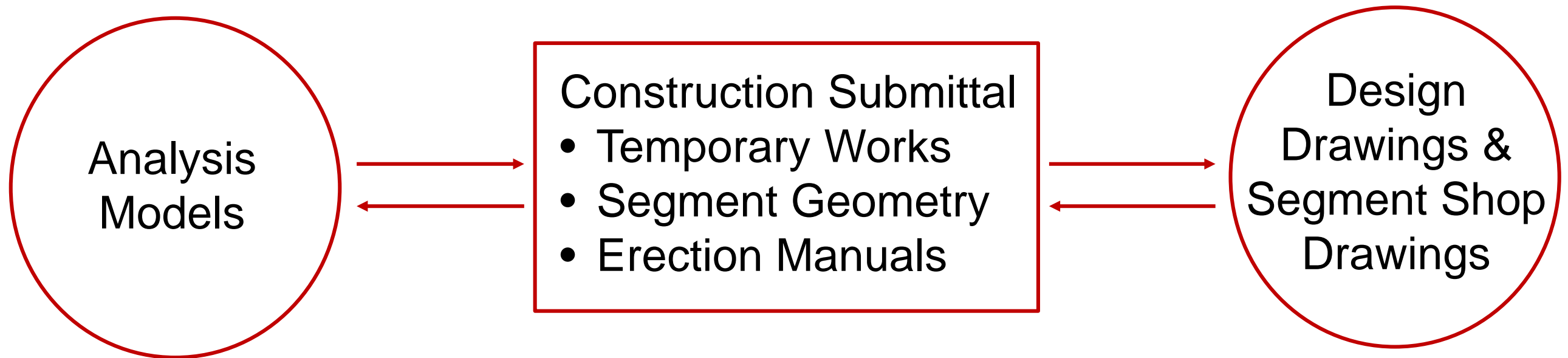
Contractor: Johnson-Bros Corporation, a Southland Company

FINLEY Scope of Work:

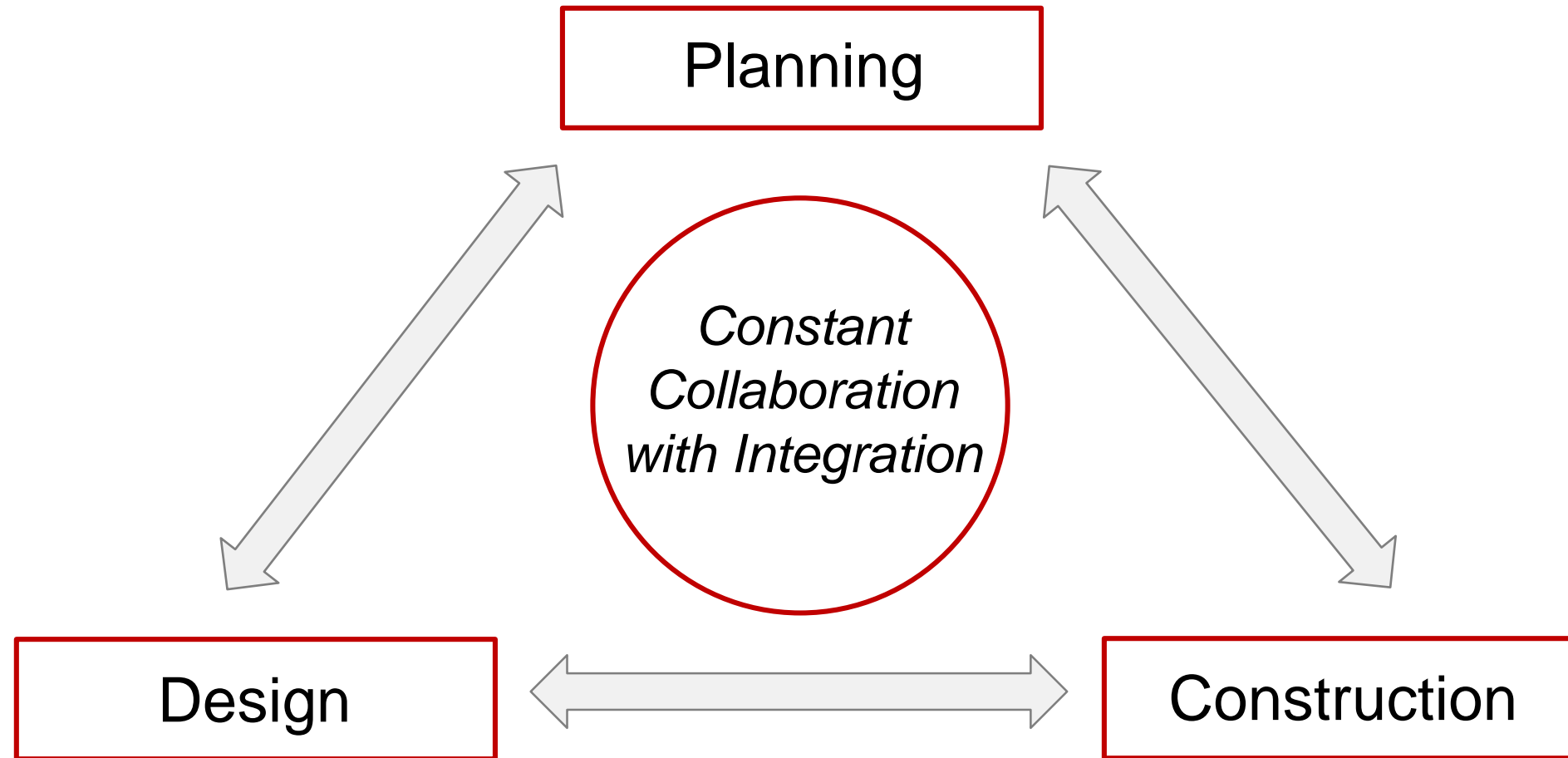
- Construction Analysis of Spandrel Arch Spans
- Geometry Control Services
- Precast Arch Rib Shop Drawing Production
- Construction Manuals
- Design/Drawings of Temporary Works



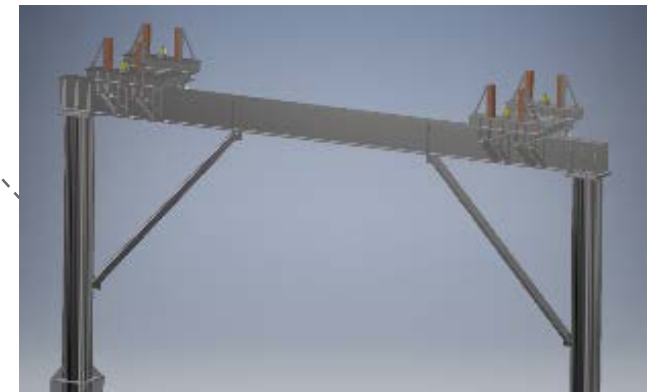
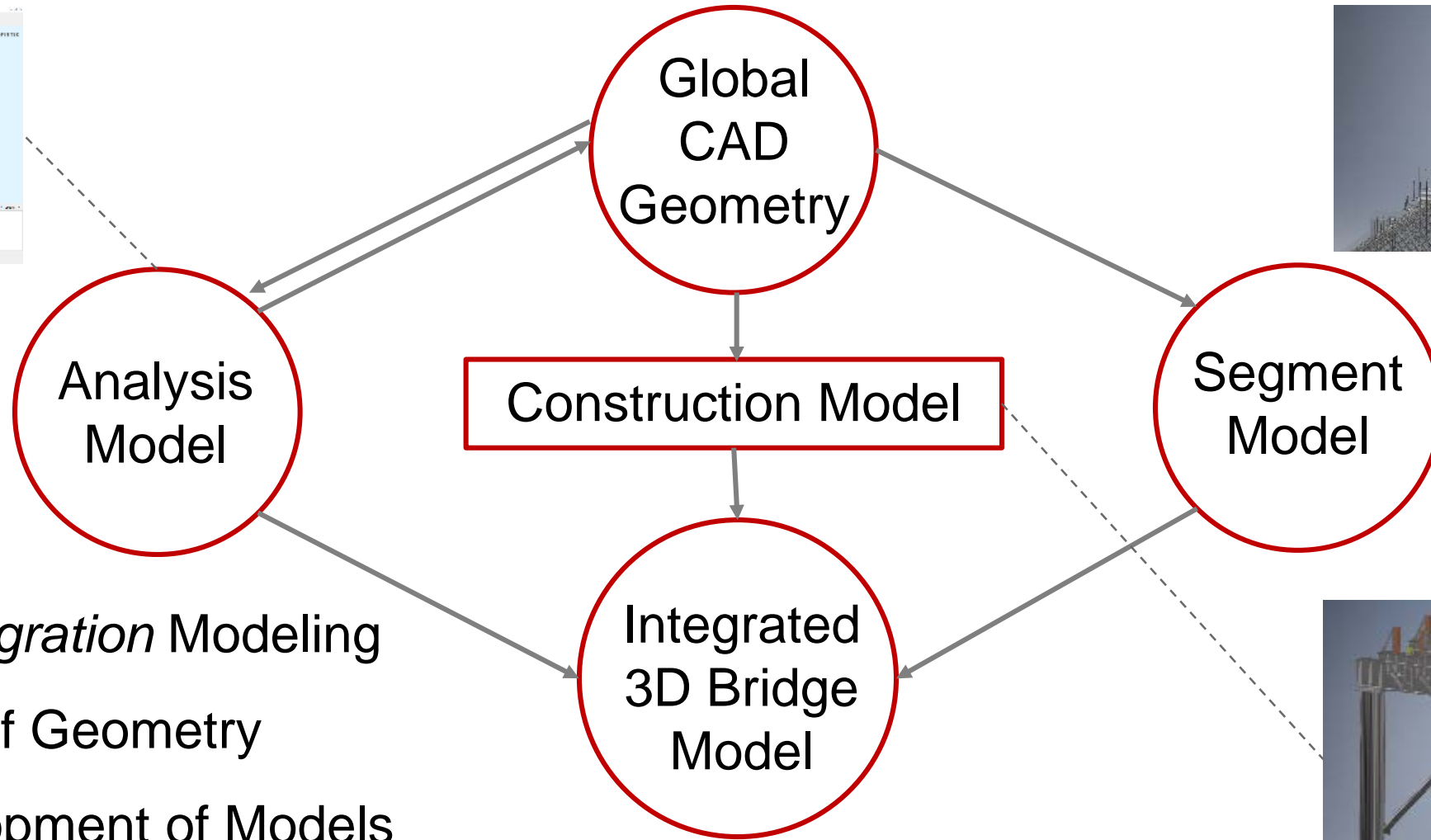
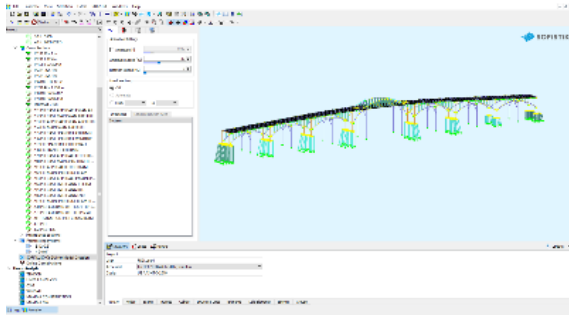
Traditional Workflow



What is Bridge Information Modeling



FINLEY BrIM Workflow



BrIM = Bridge *Integration* Modeling

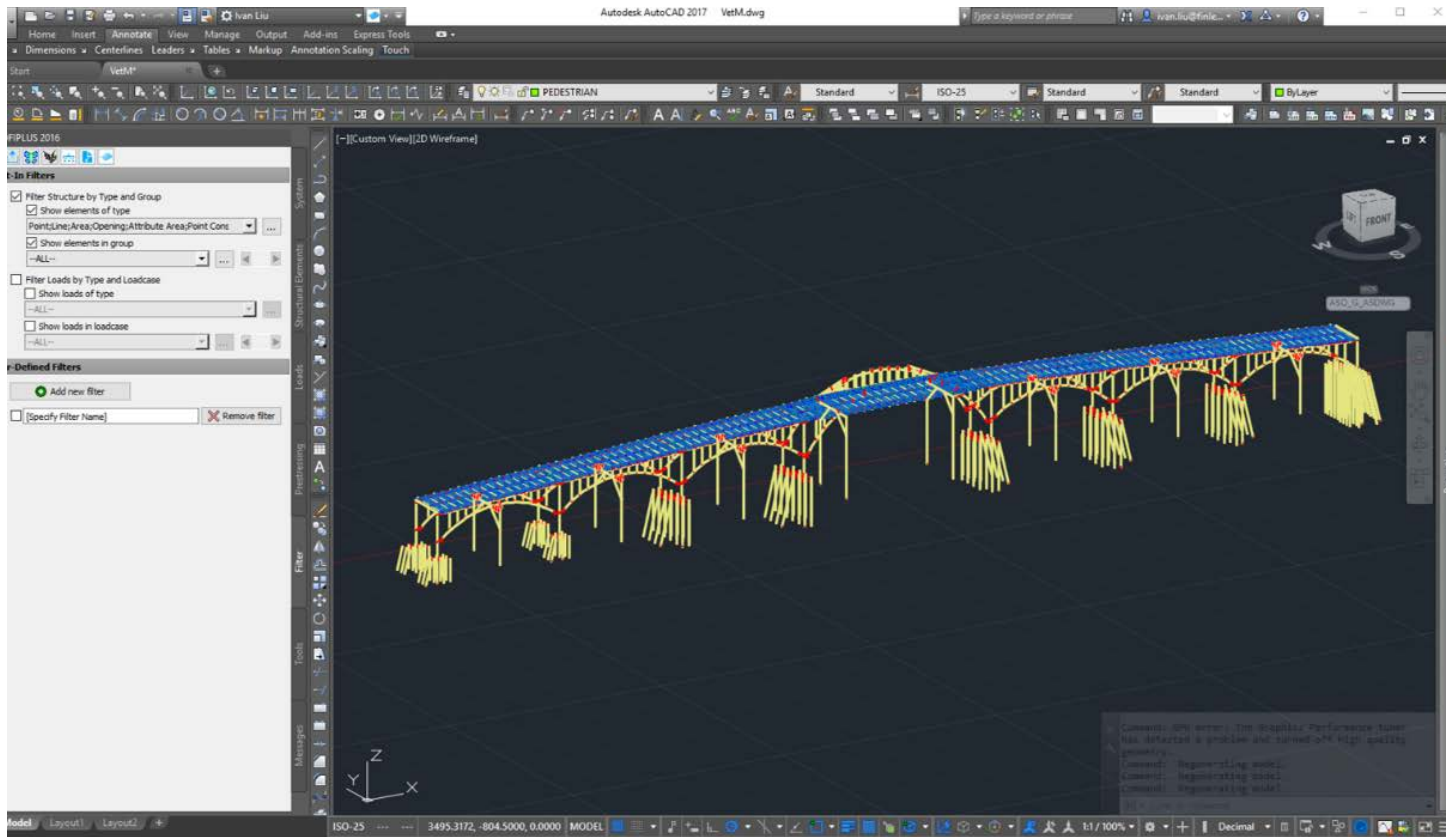
Phase 1 → Input of Geometry

Phase 2 → Development of Models

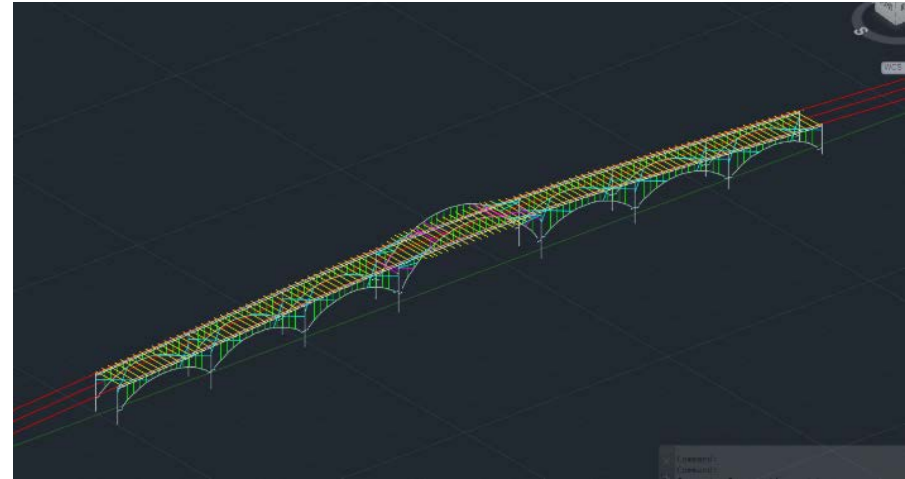
Phase 3 → Assemble Integrated Model

BrIM Workflow – Phase 1

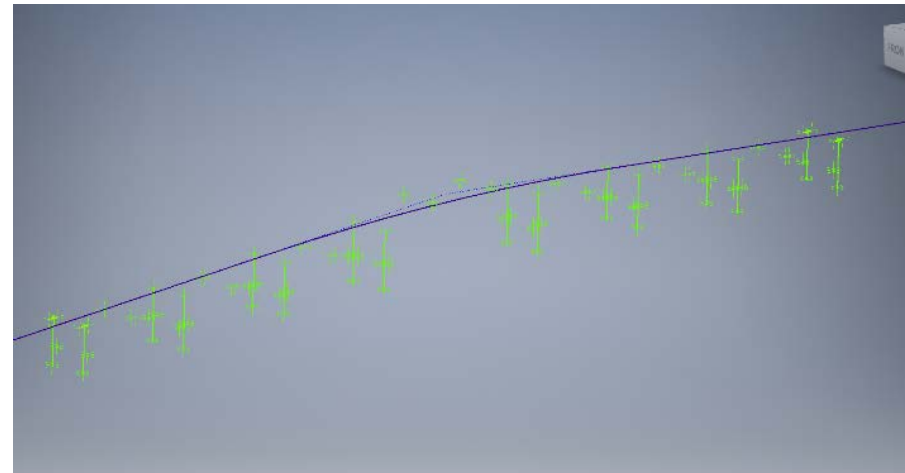
Global CAD Geometry in SOFiPlus:



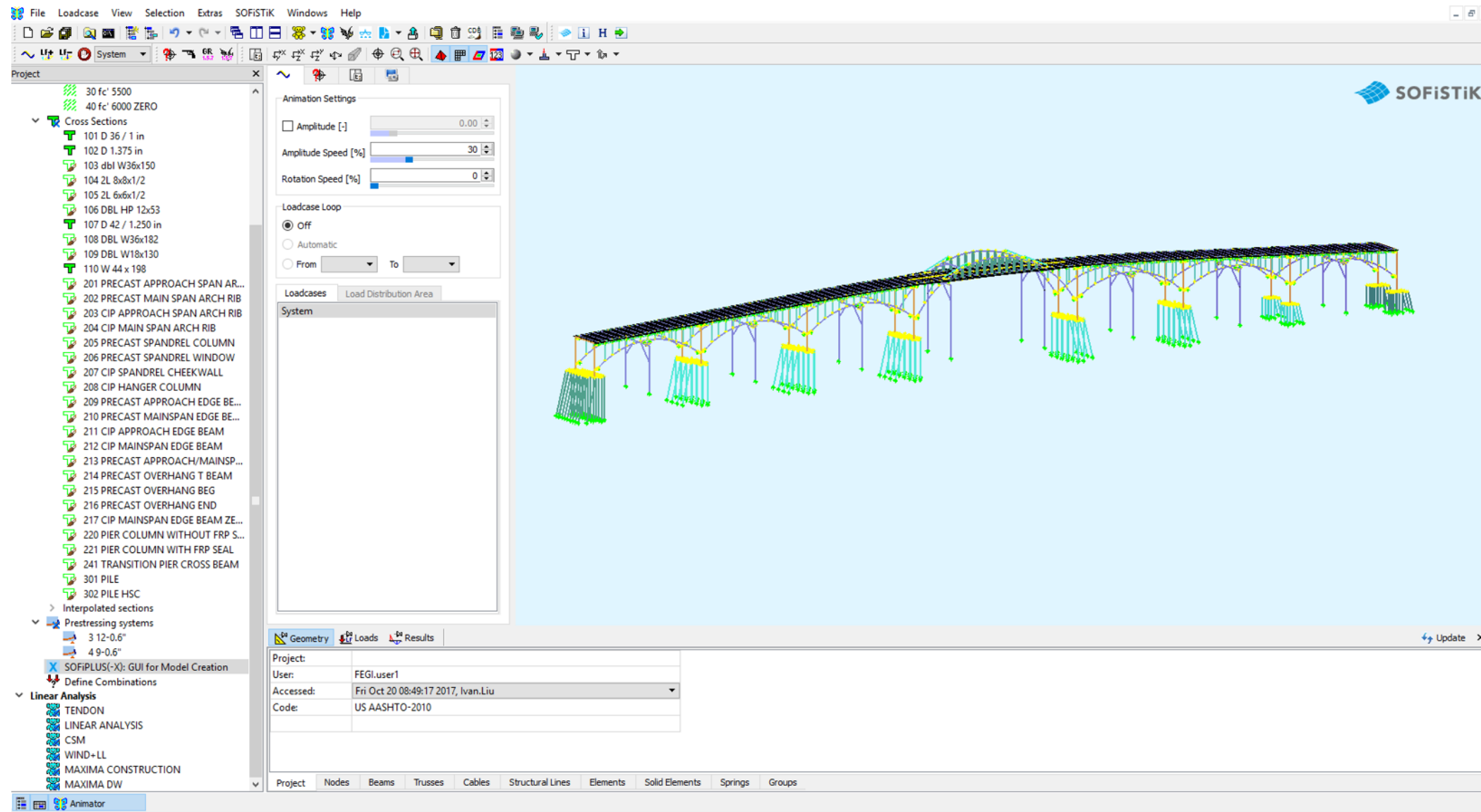
Geometry in AutoCAD:



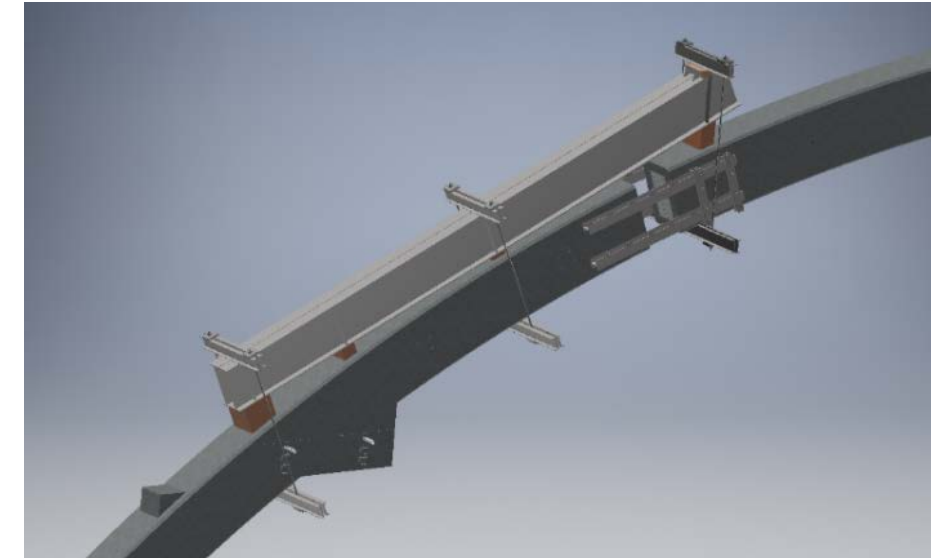
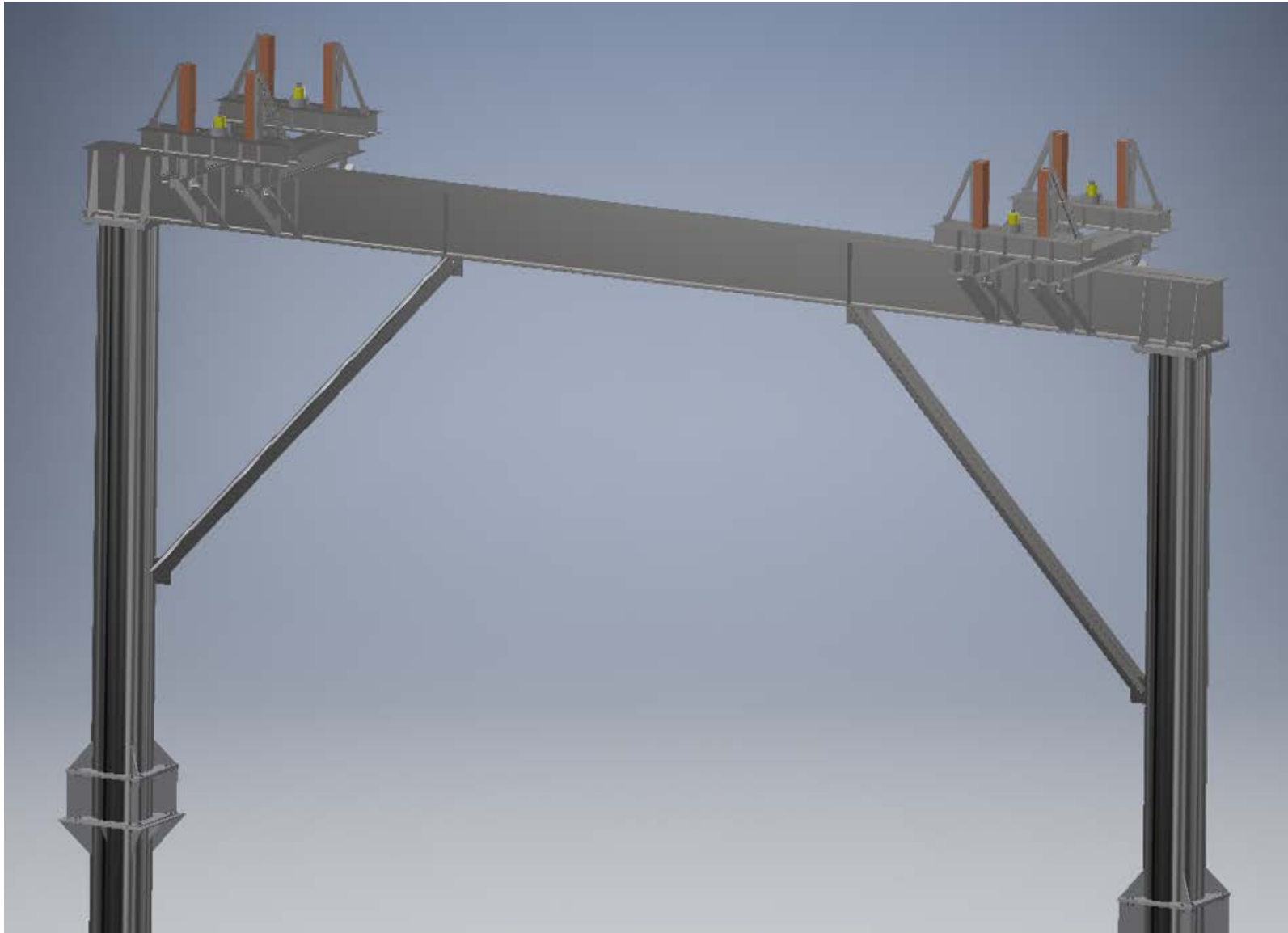
Coordinates to Production:



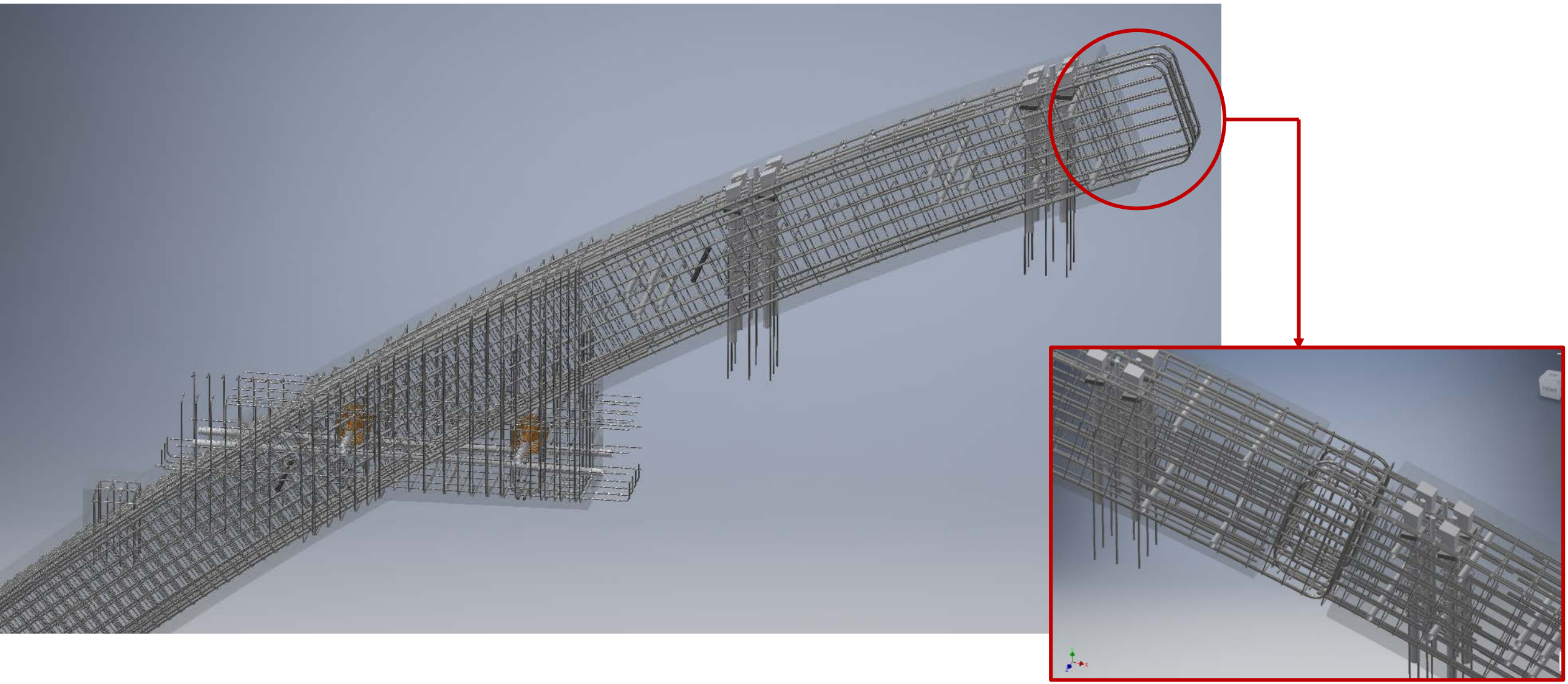
BrIM Workflow – Phase 2 Analysis



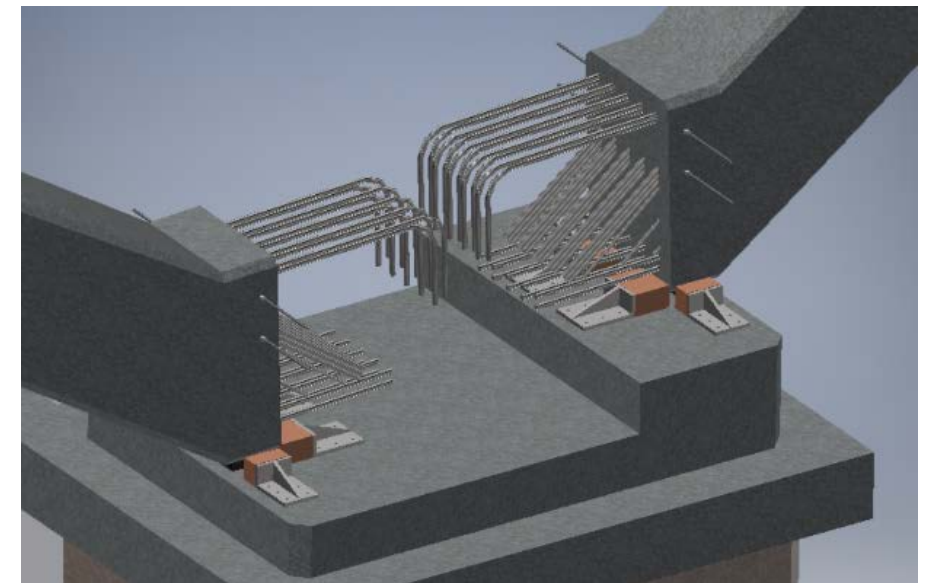
BrIM Workflow – Phase 2 Construction



BrIM Workflow – Phase 2 Segment



BrIM Workflow – Phase 3



Development Process



Rhinoceros®
NURBS modeling for Windows



SOFiSTiK



**AUTODESK®
INVENTOR®**



**AUTODESK®
AUTOCAD**

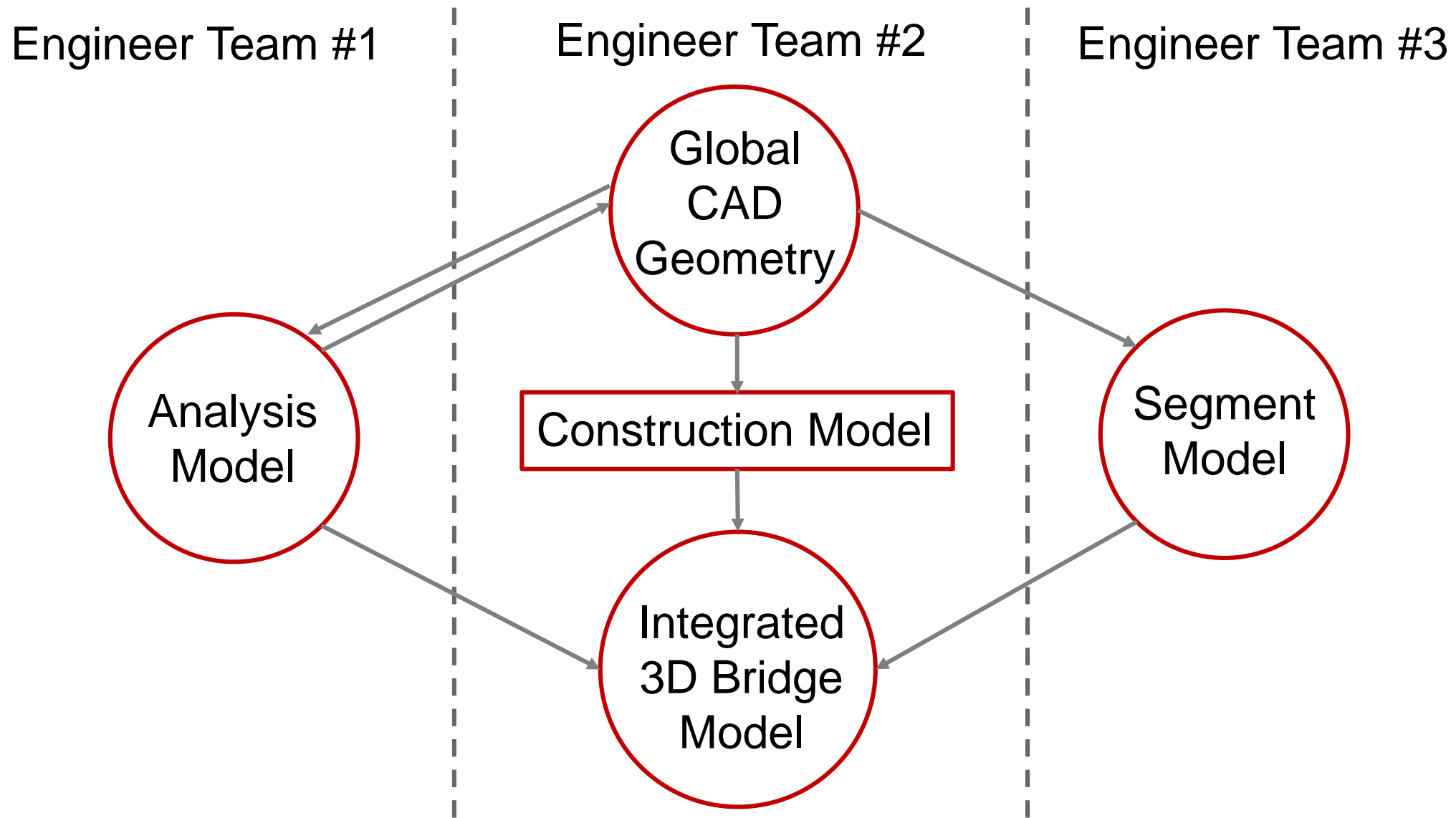


**AUTODESK®
INFRAWORKS™**



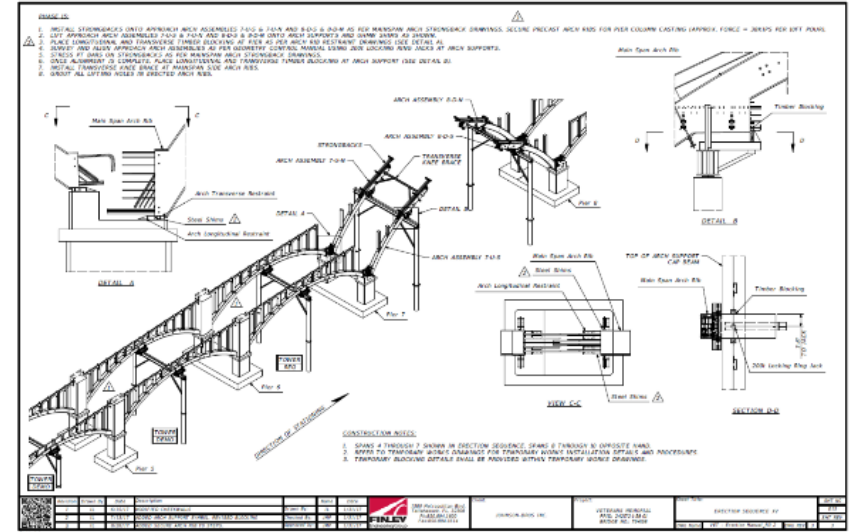
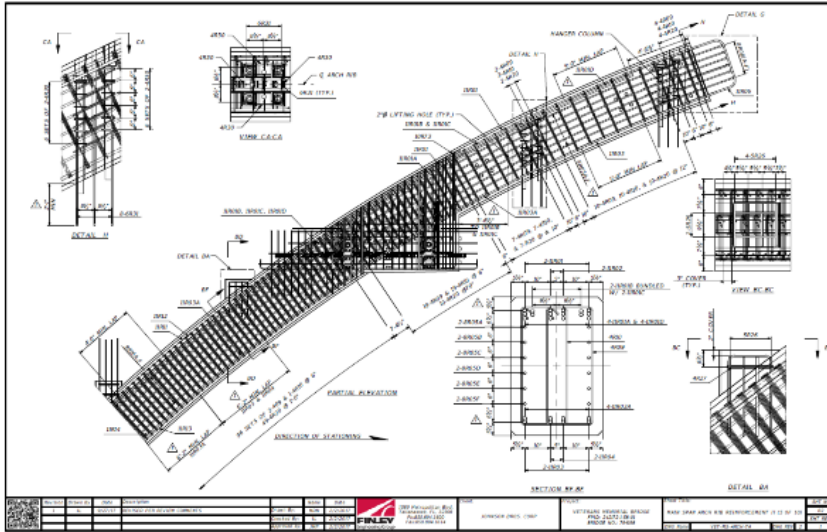
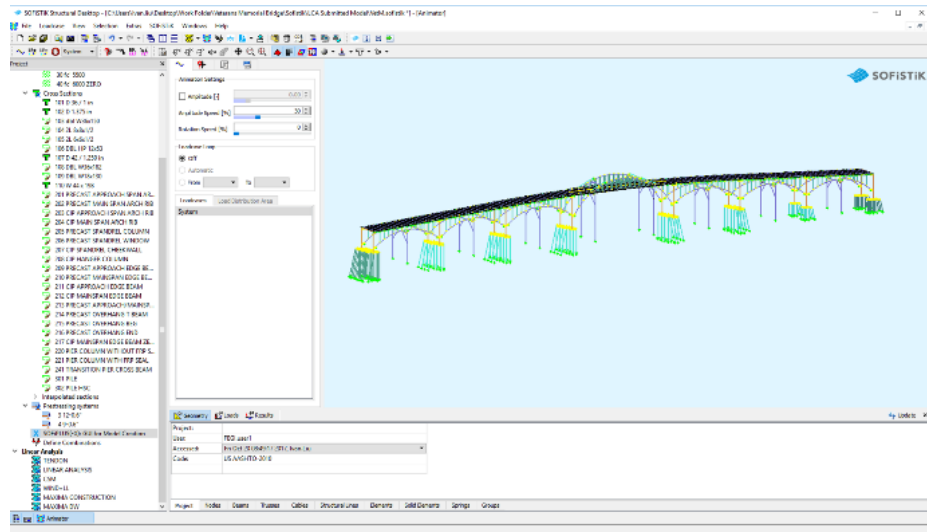
python™

BrIM Application on Project



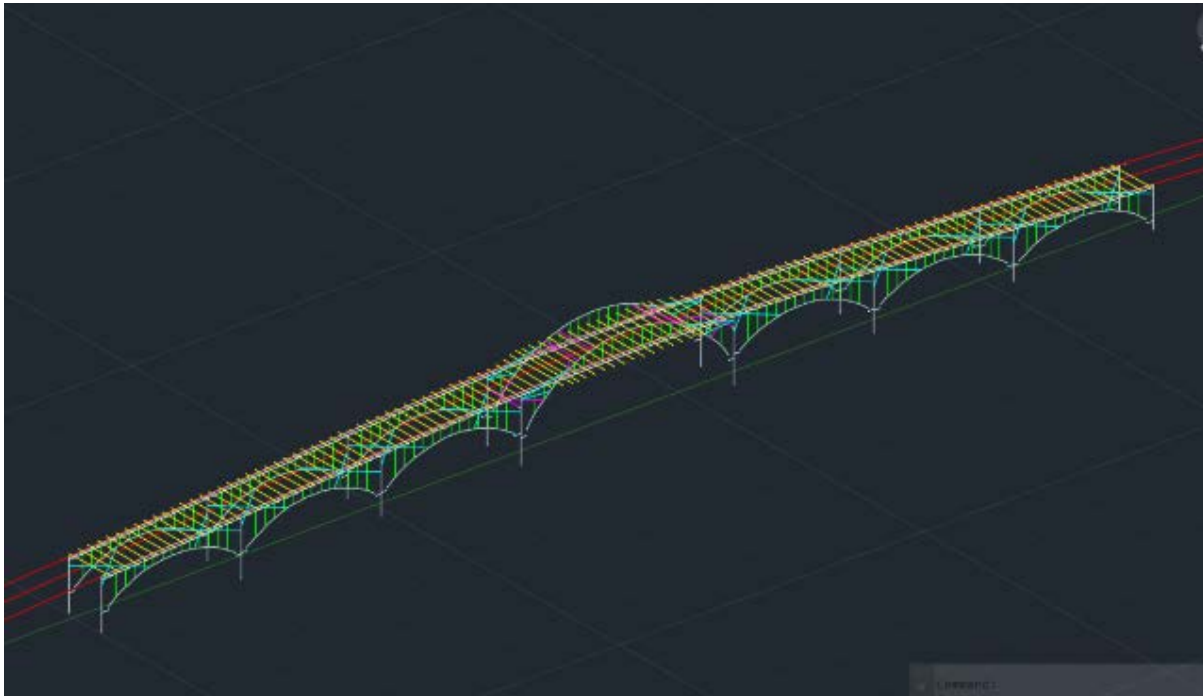
Veterans Memorial Bridge

- First Application of BrIM by FINLEY
- Complex Bridge with many design and construction components.

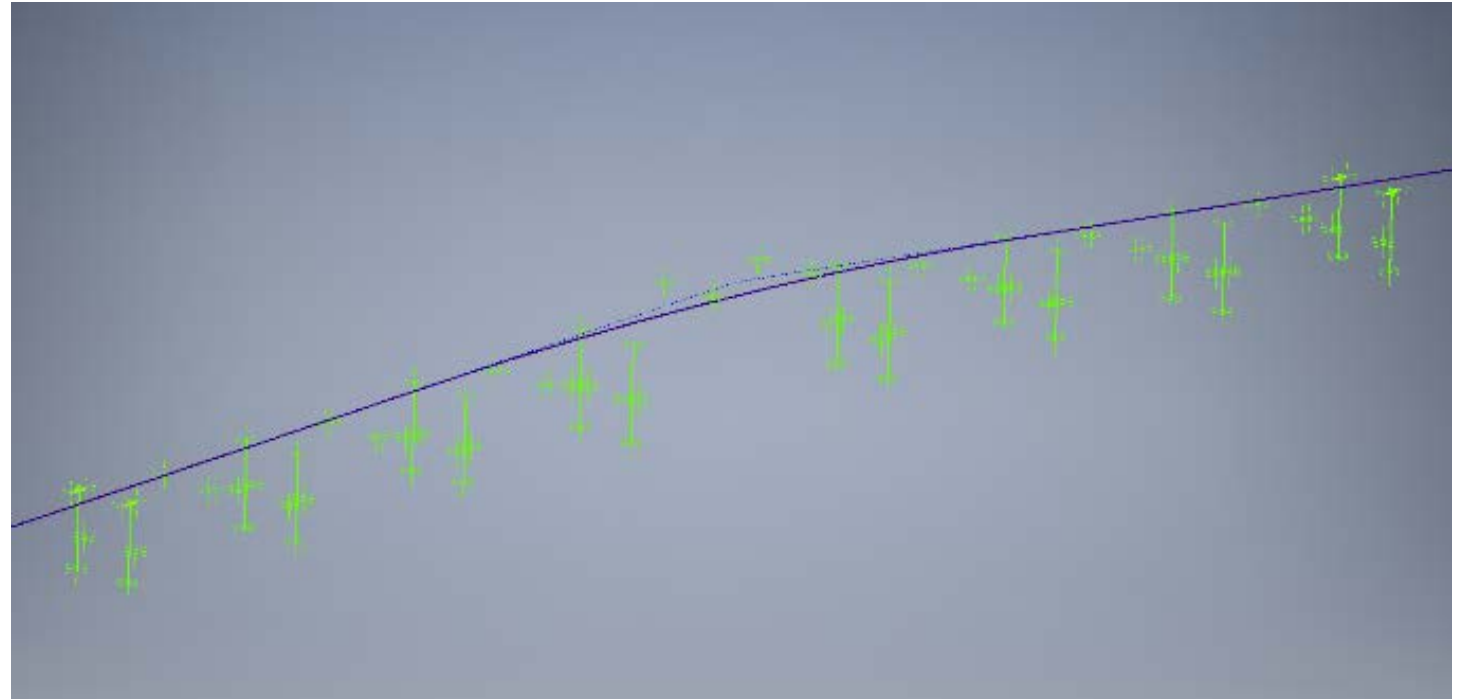


Global CAD Geometry – Phase 1

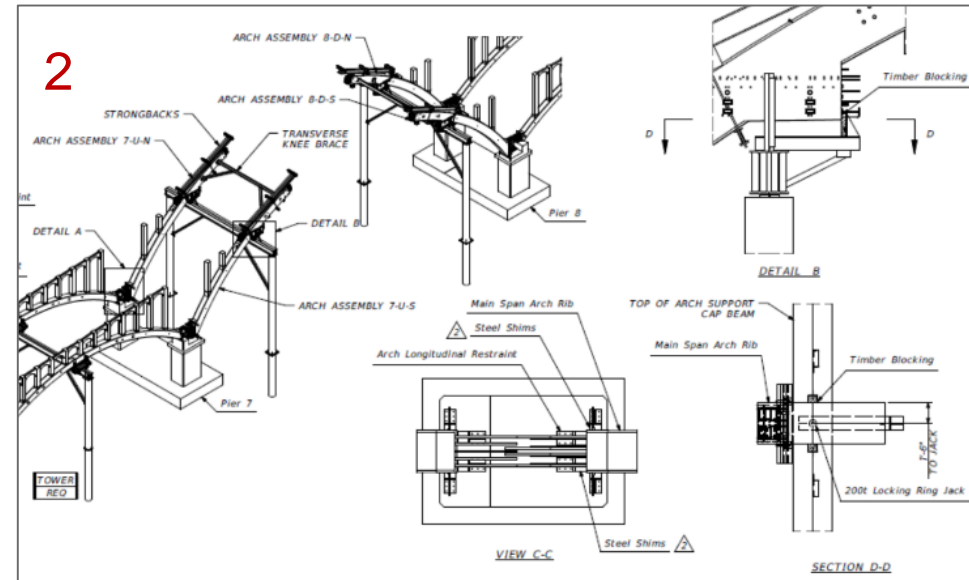
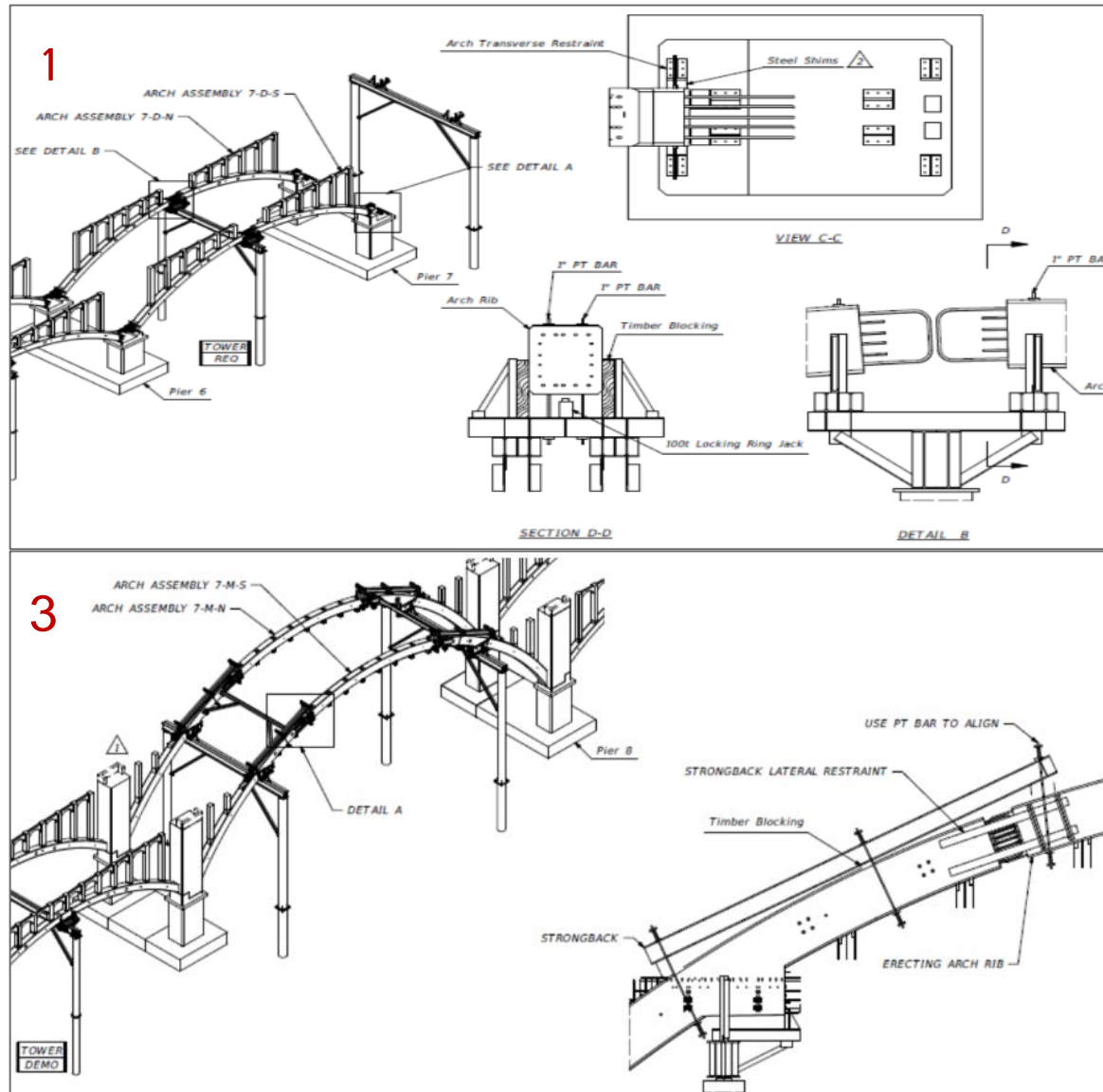
Input within SOFiPlus/AutoCAD:



Geometry Exported to Phase 2/3:



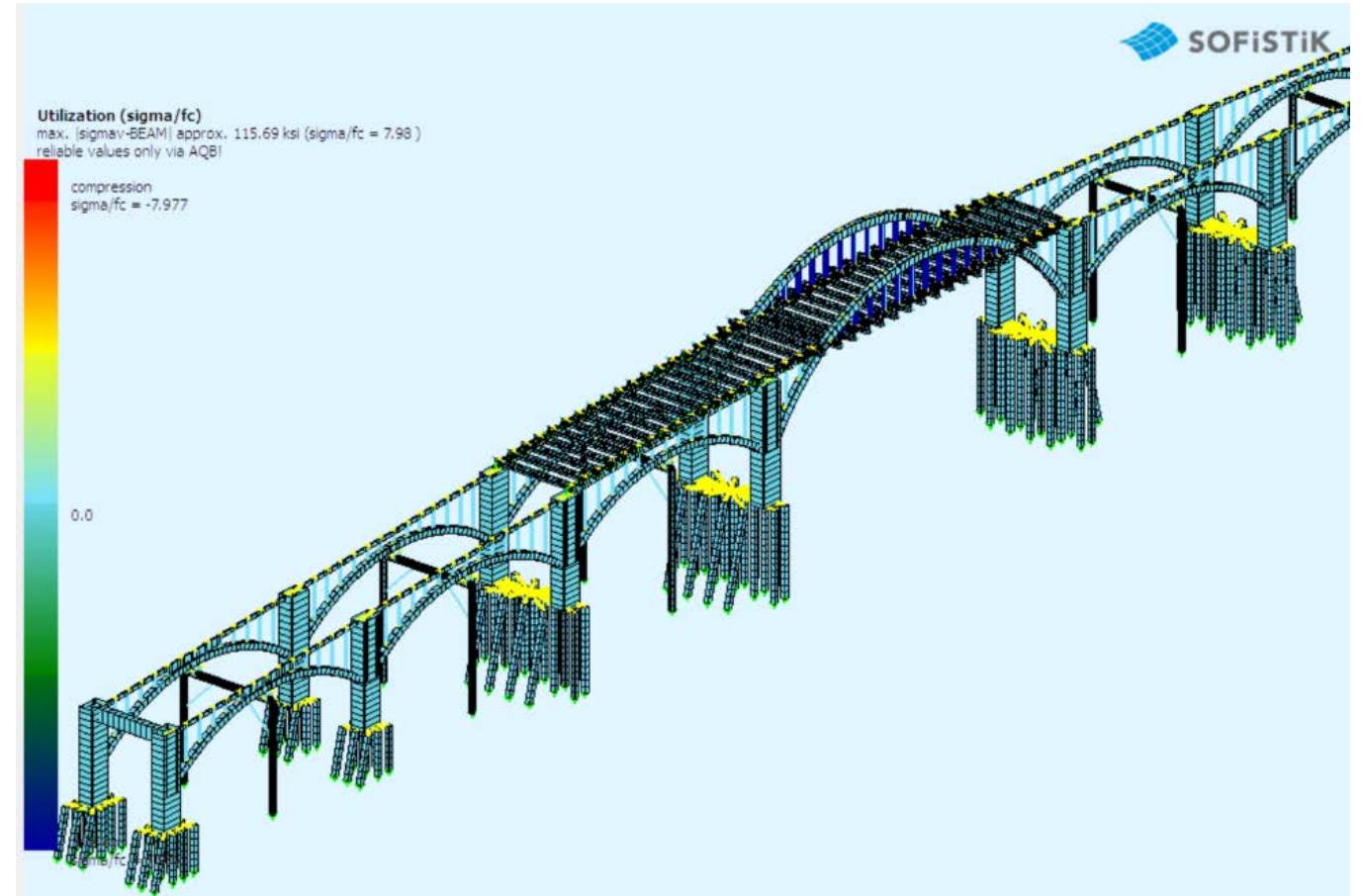
Analysis Model – Phase 2



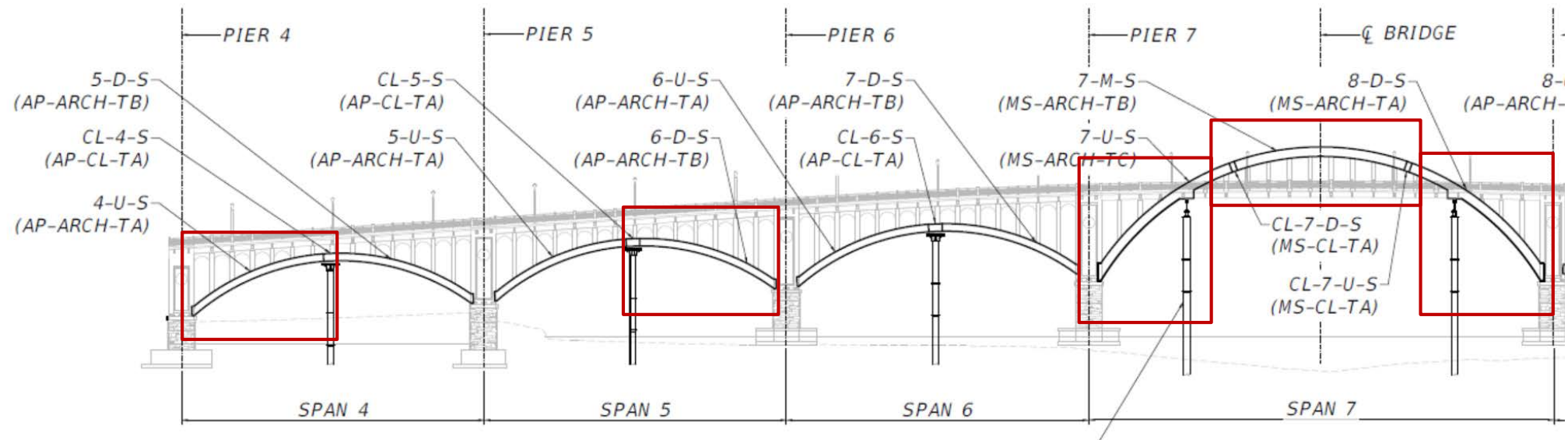
Critical Stages of Construction:

1. Approach Arch Rib on Falsework Towers
2. Mainspan Arch Rib on Falsework Towers
3. Erection of Center Mainspan Arch Rib on Strongback Beams

Analysis Model – Phase 2



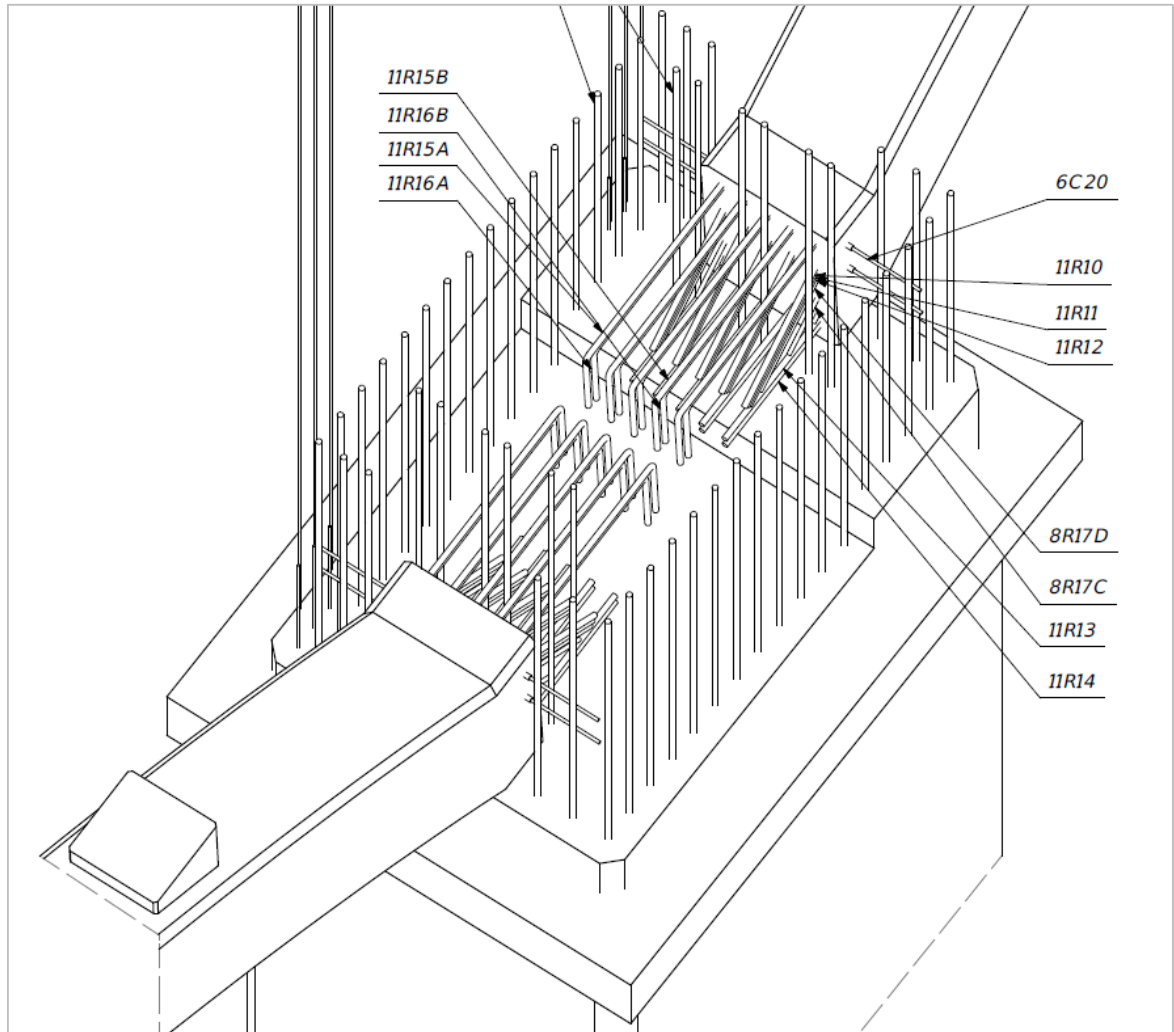
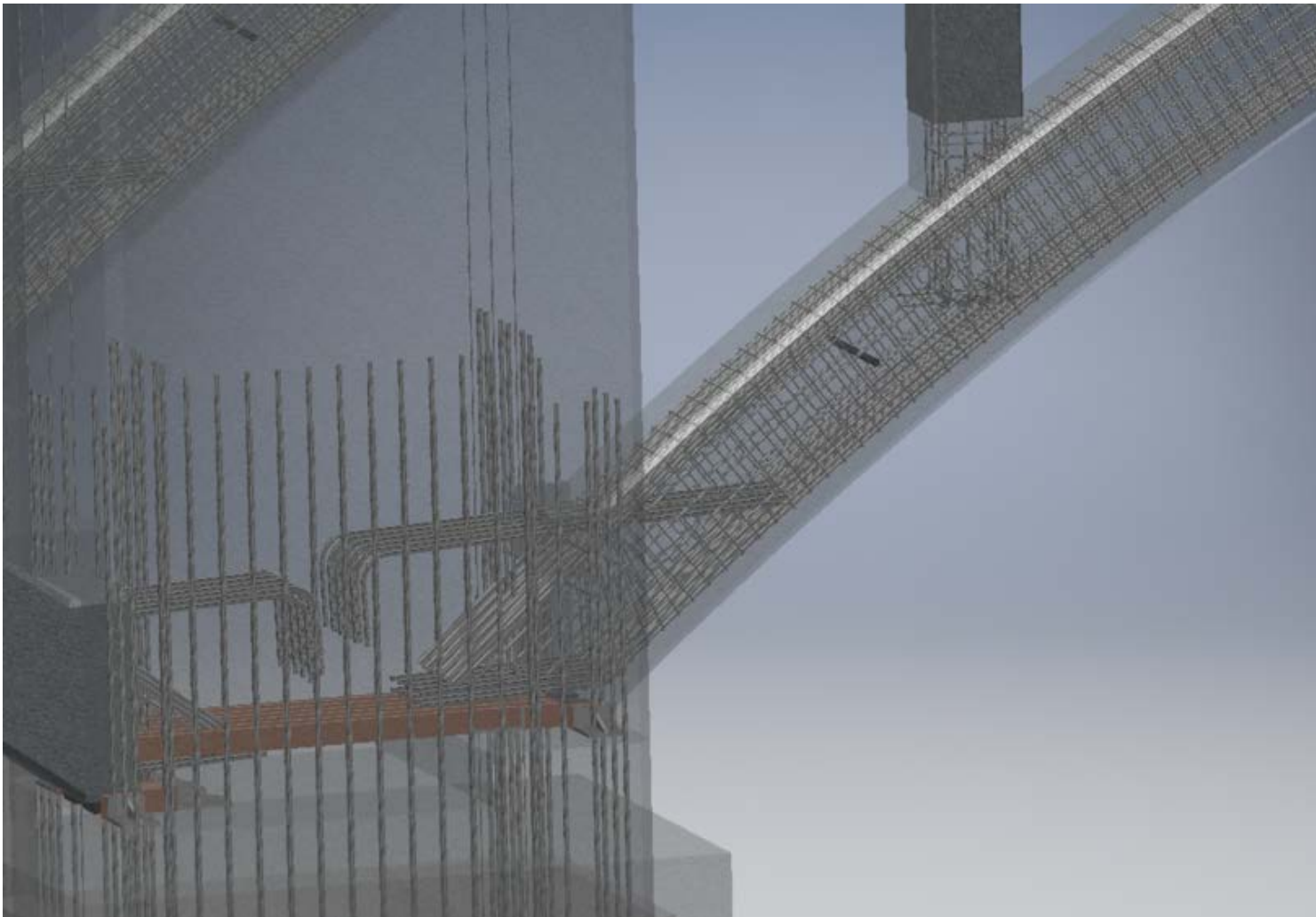
Segment Model – Phase 2



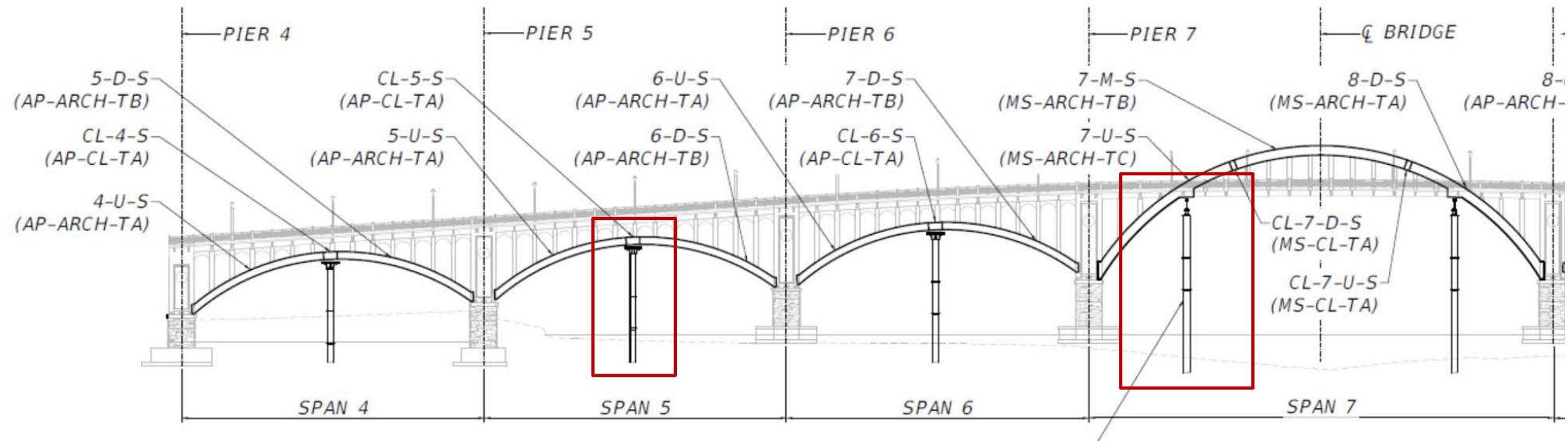
Precast Drawing Requirements:

- Precast Approach Arch Rib – 2 Types
- Precast Mainspan Side Arch Rib – 2 Types
- Precast Mainspan Center Arch Rib

Segment Model – Phase 2



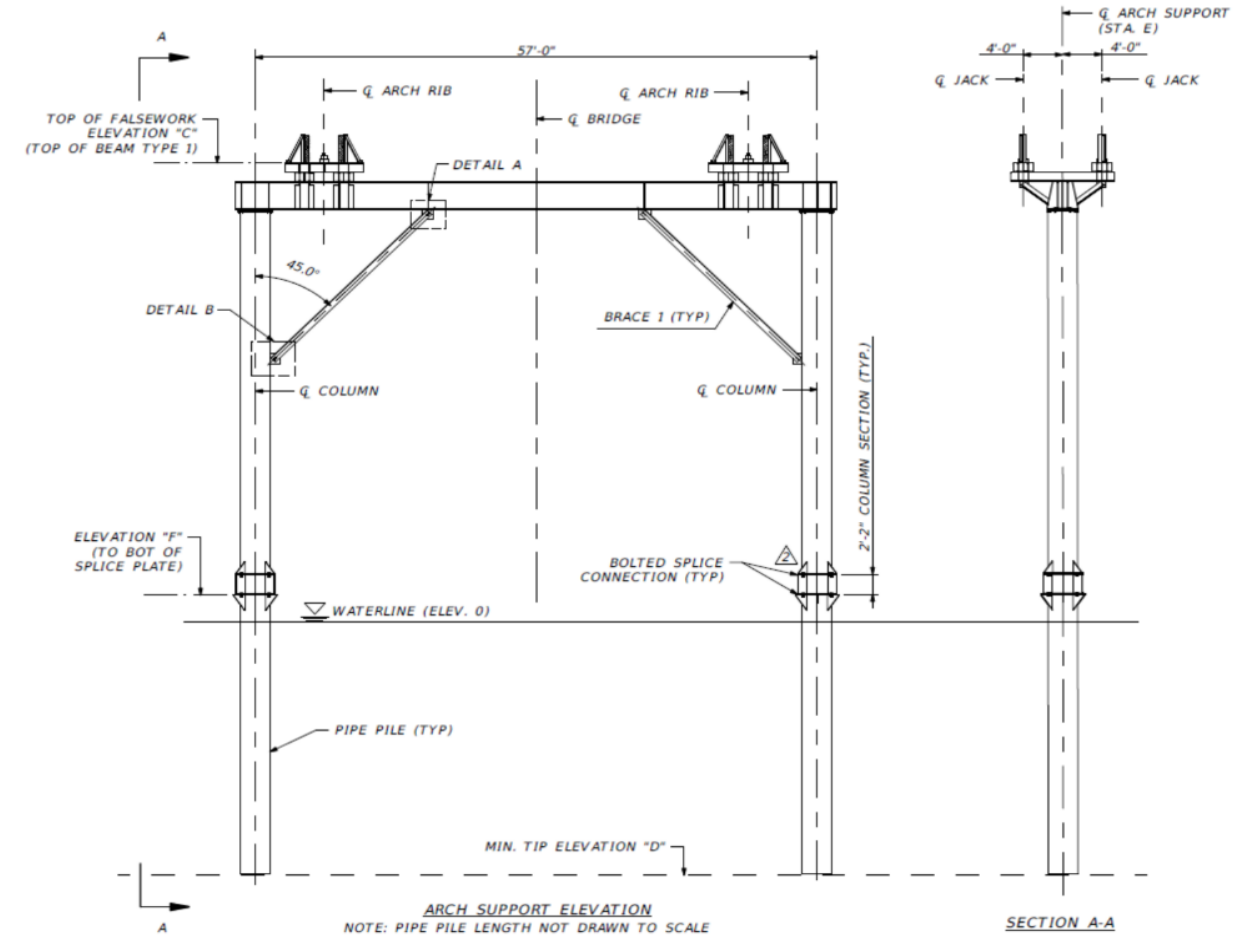
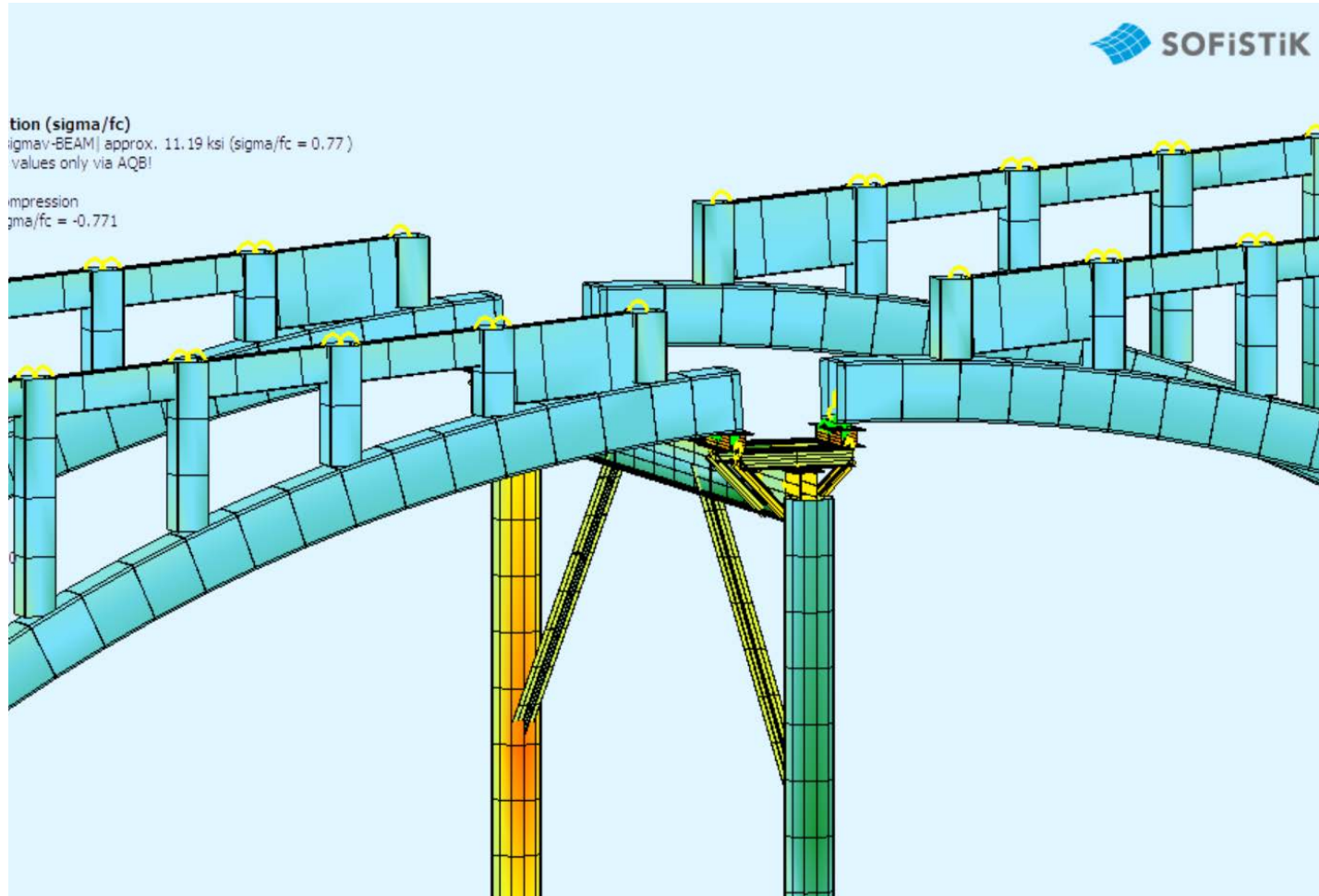
Construction Model – Phase 2



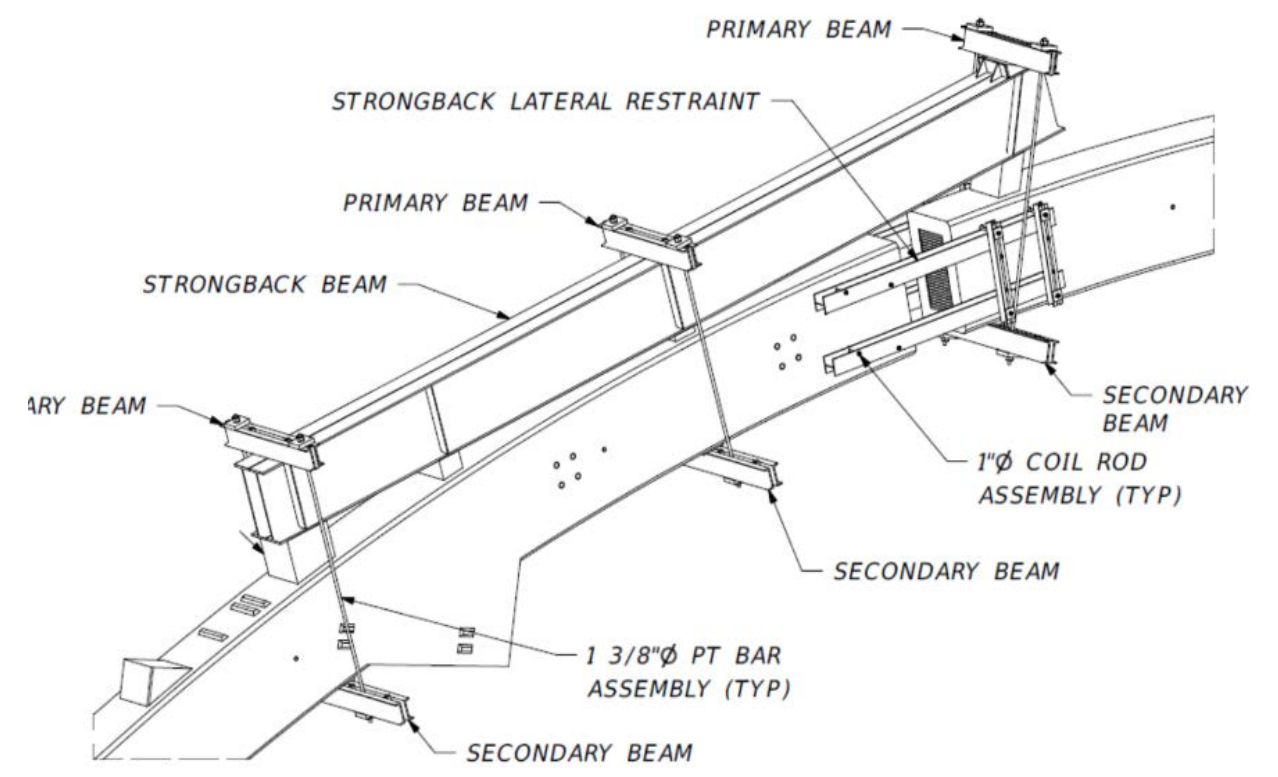
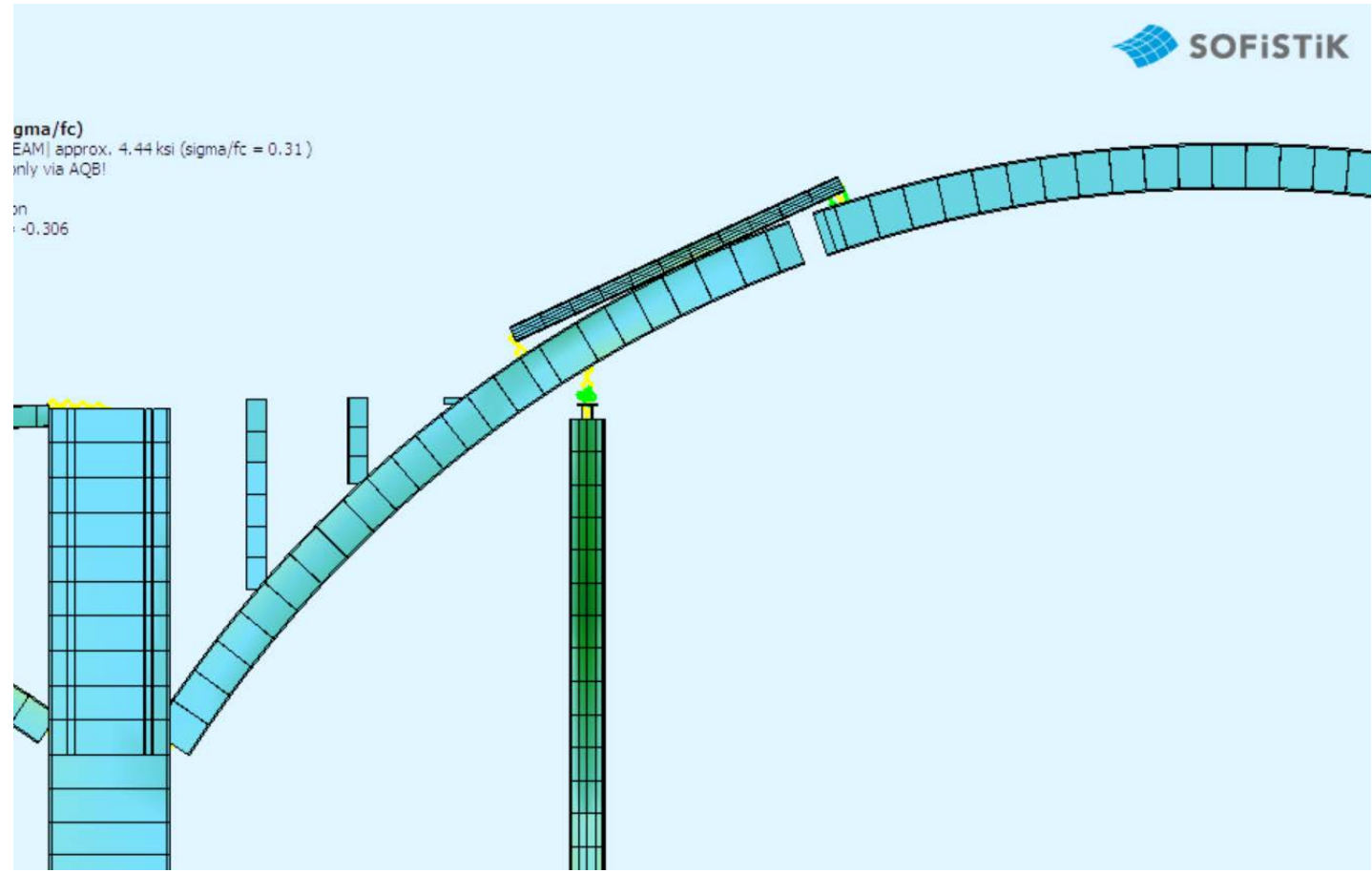
Temporary Works Requirements:

- Approach Span Falsework Tower
- Mainspan Falsework Tower
- Mainspan Strongback Beams

Construction Model – Phase 2

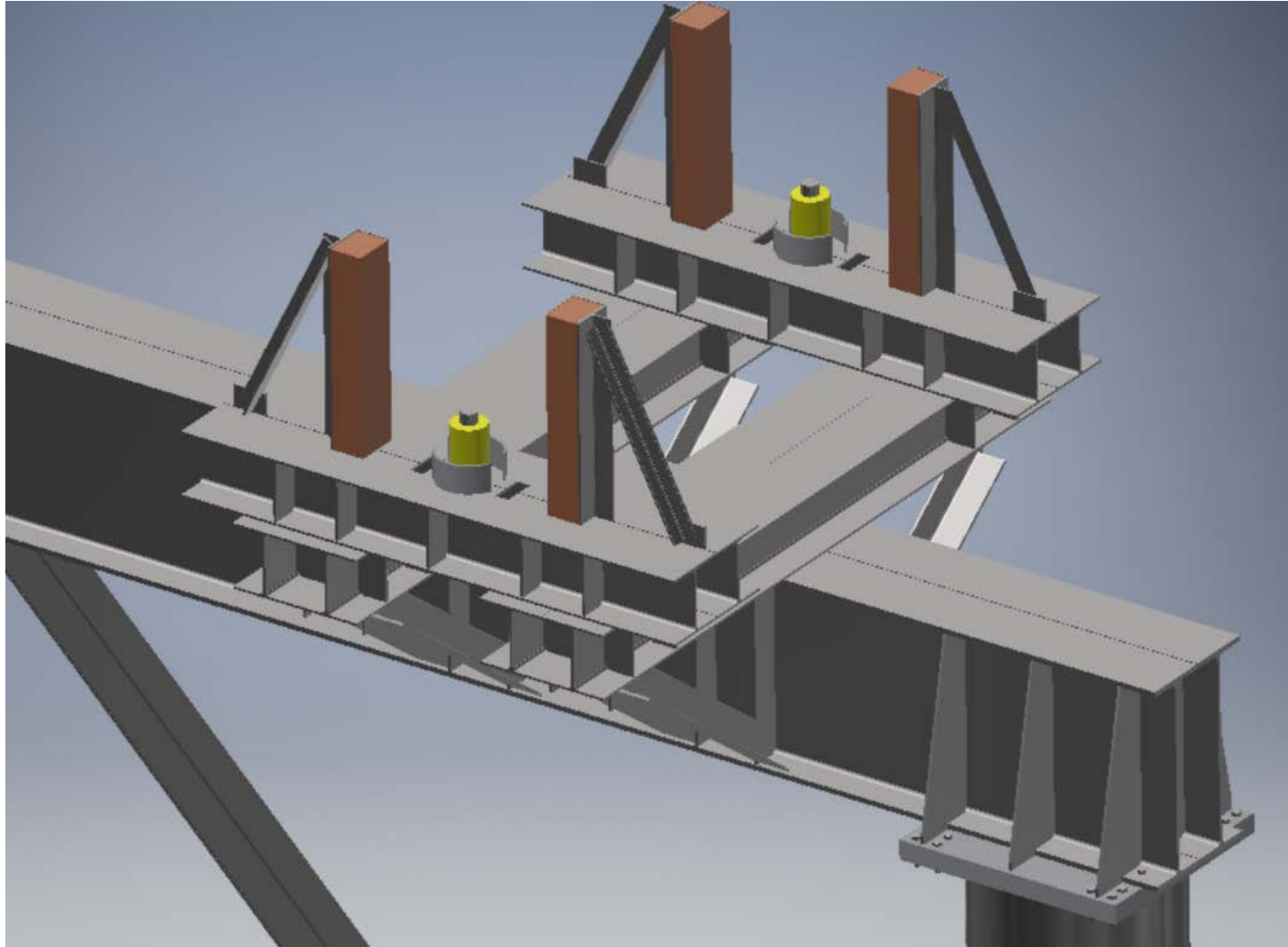


Construction Model – Phase 2

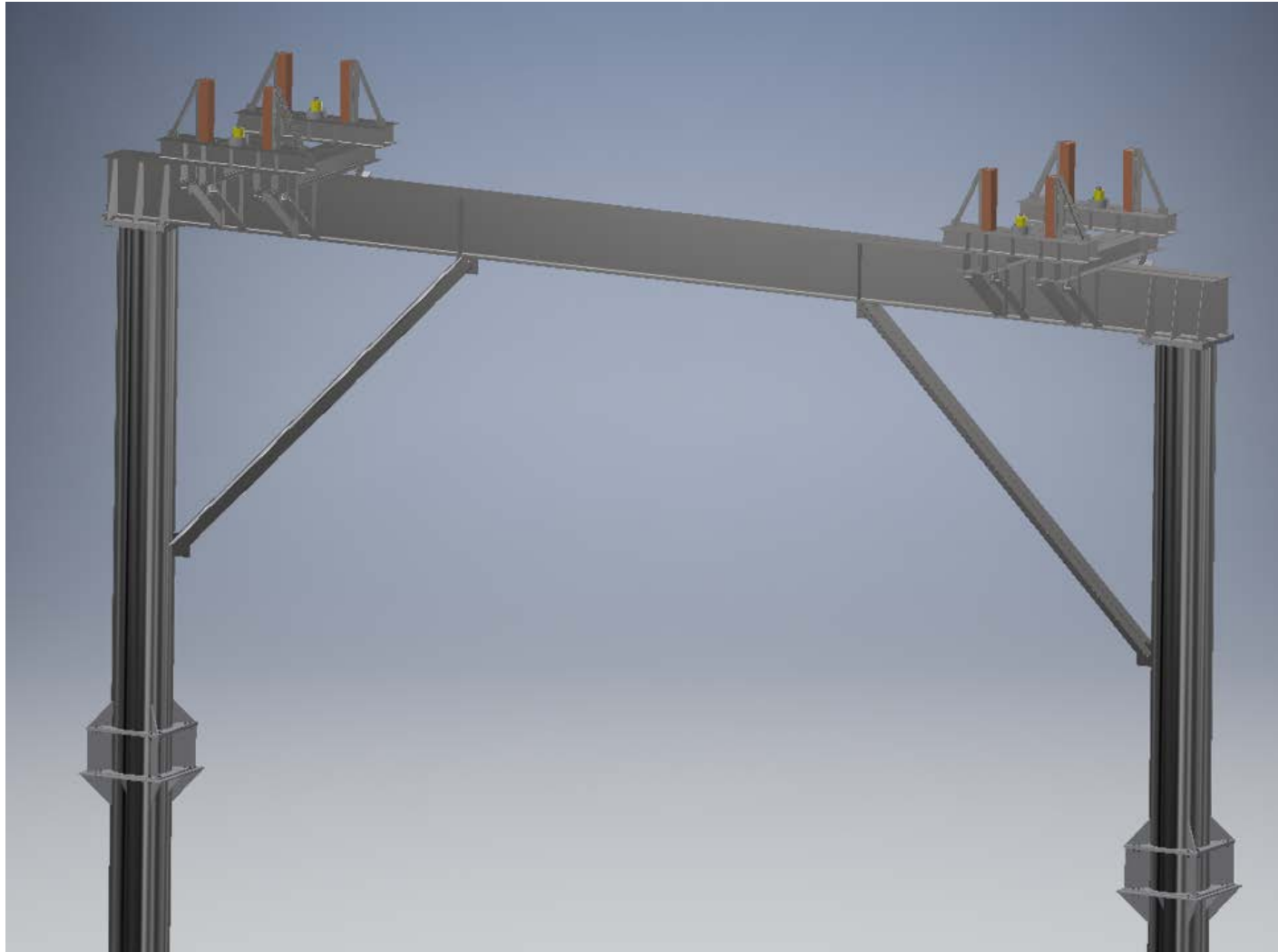


MAINSpan ARCH STRONGBACK - ERECTION VIEW

Construction Model – Phase 2



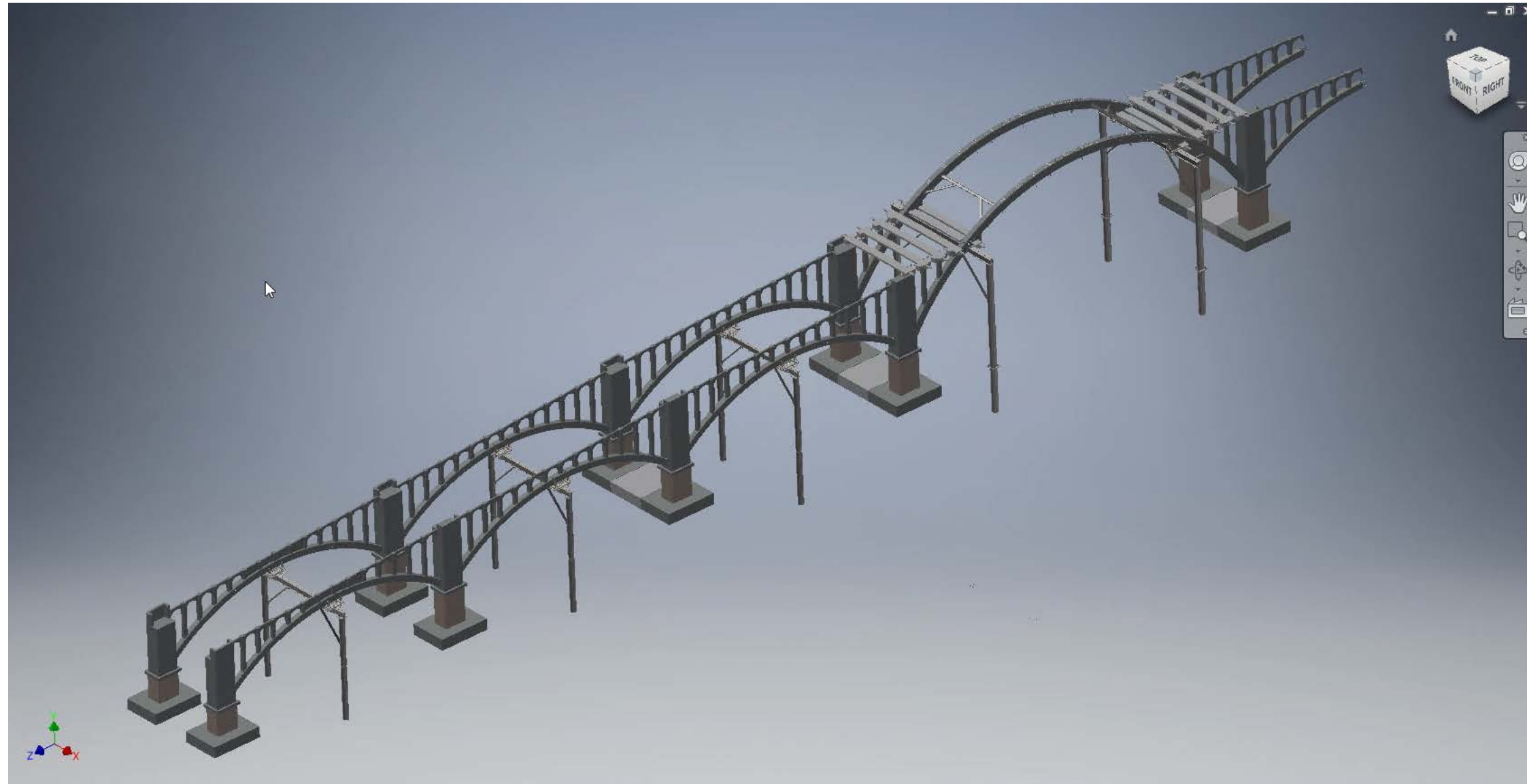
Construction Model – Phase 2



Construction Model – Phase 2



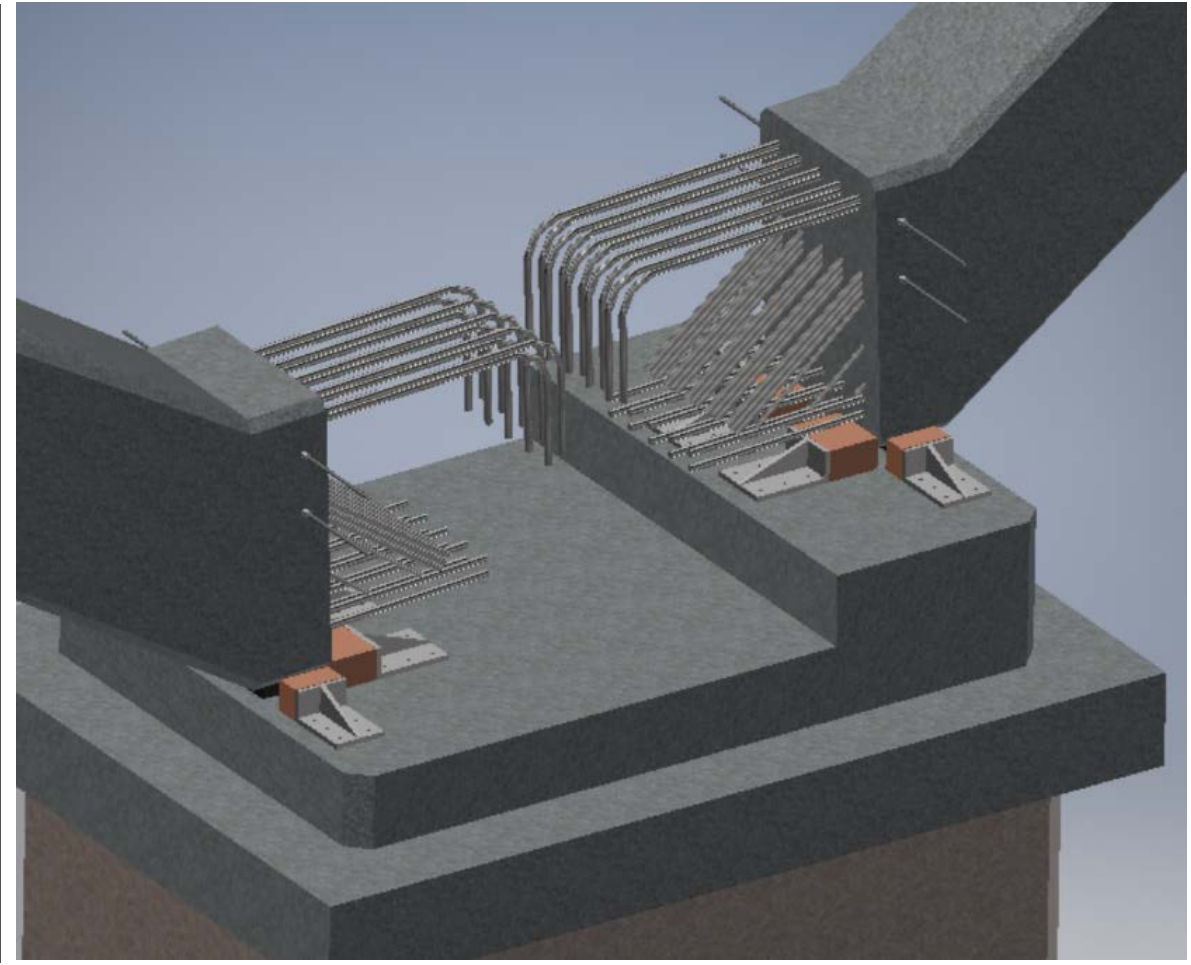
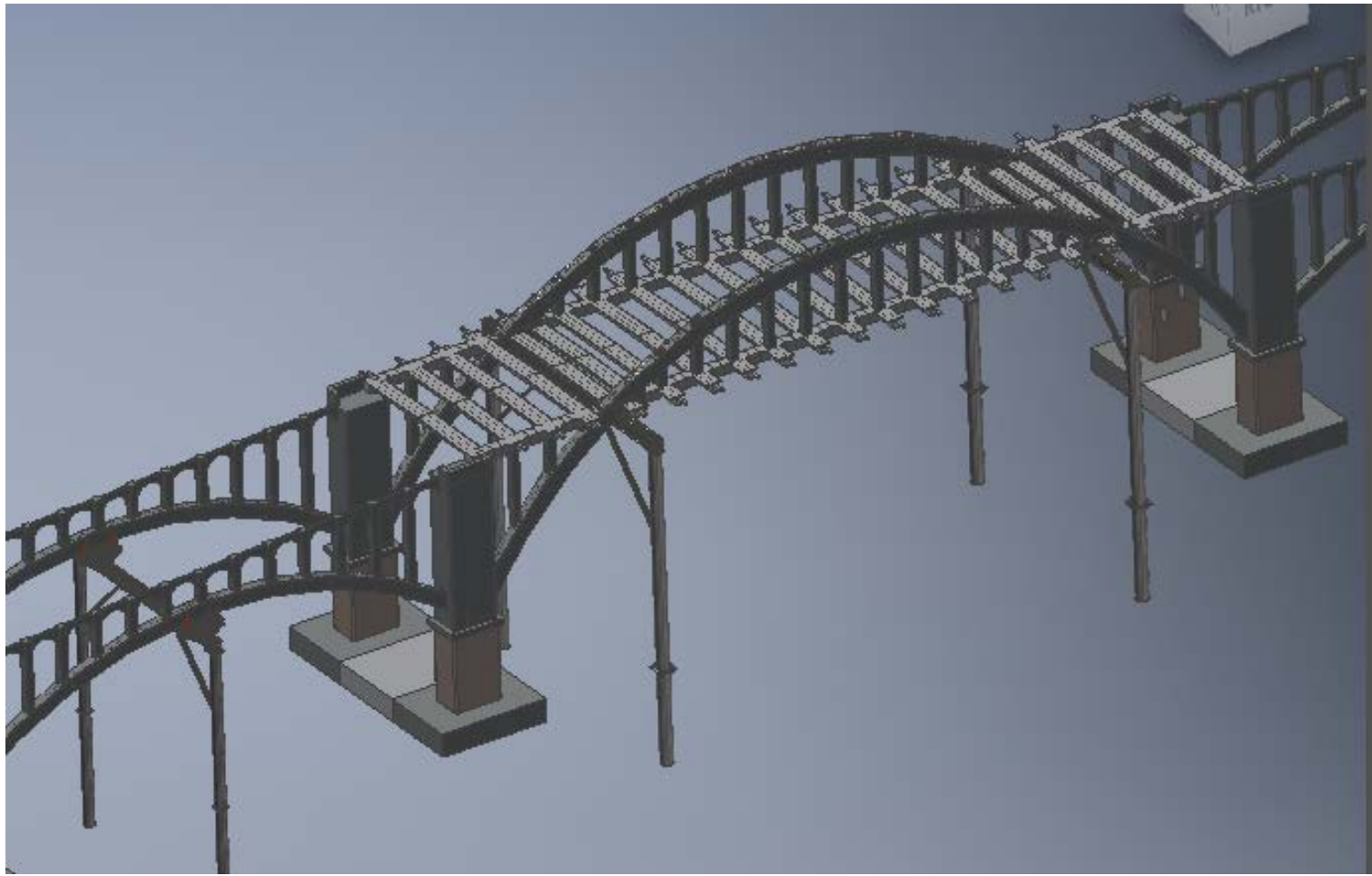
Integrated 3D Bridge Model – Phase 3



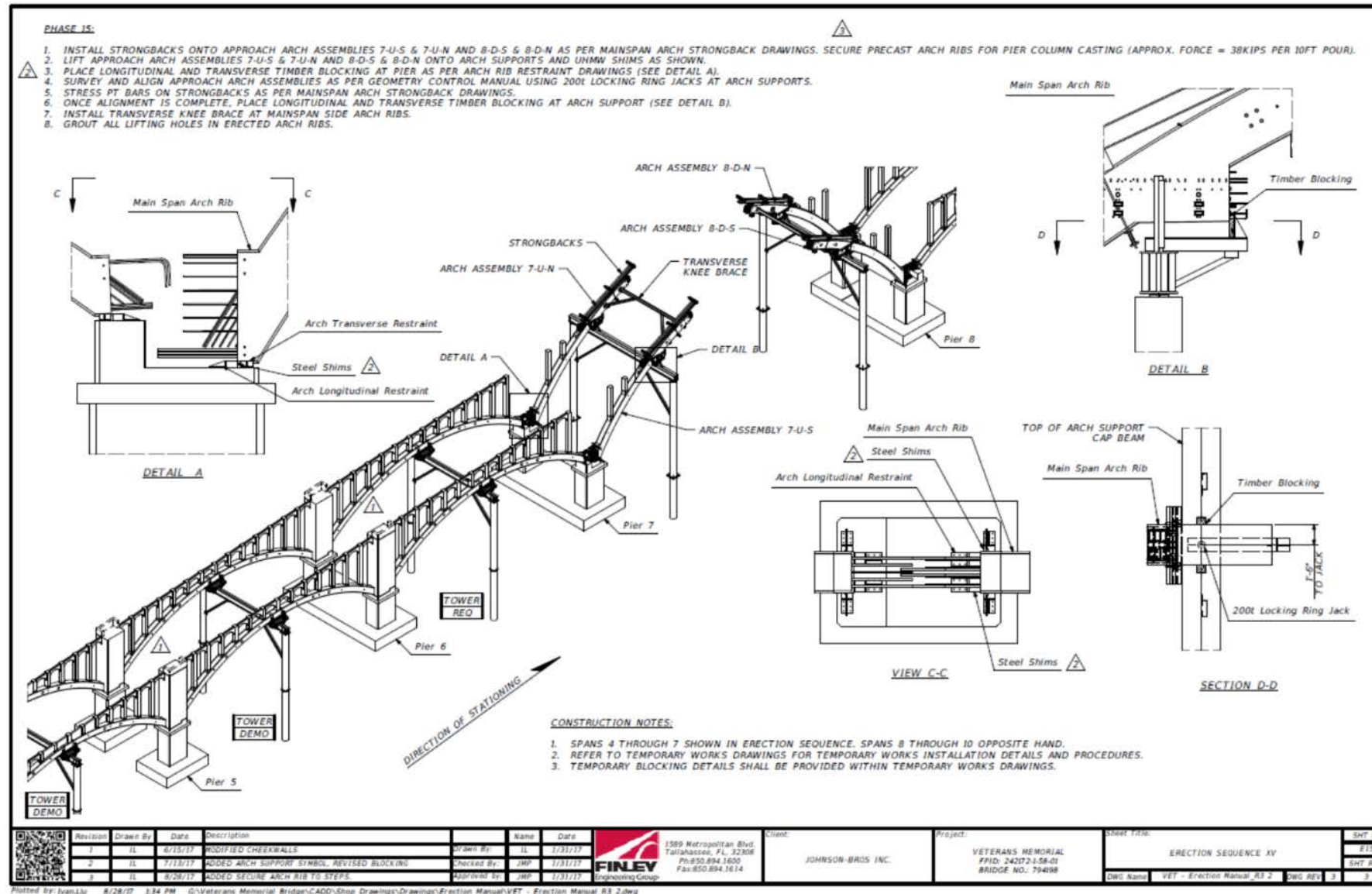
Integrated 3D Bridge Model – Phase 3



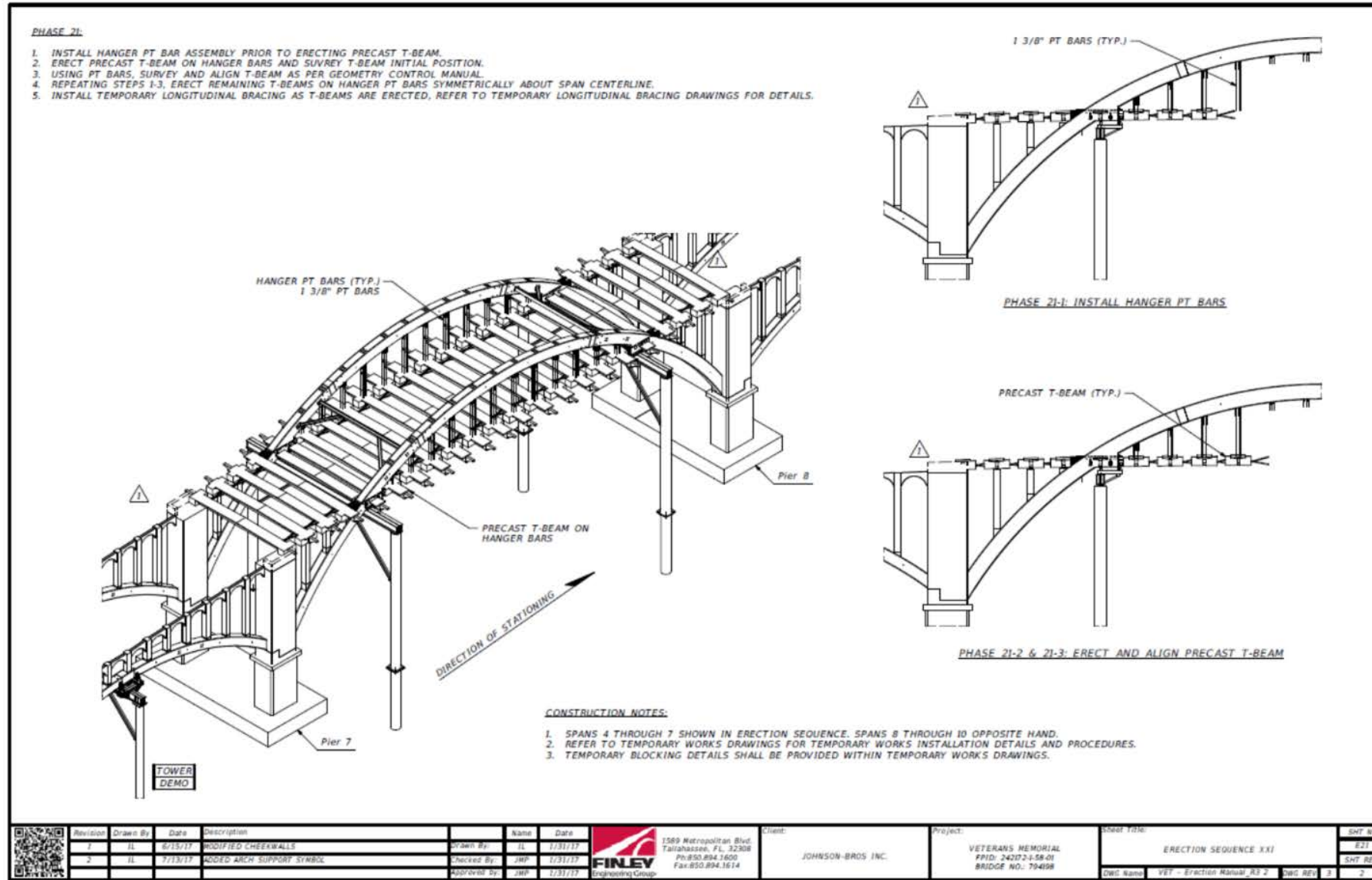
Integrated 3D Bridge Model – Phase 3



Integrated 3D Bridge Model – Phase 3



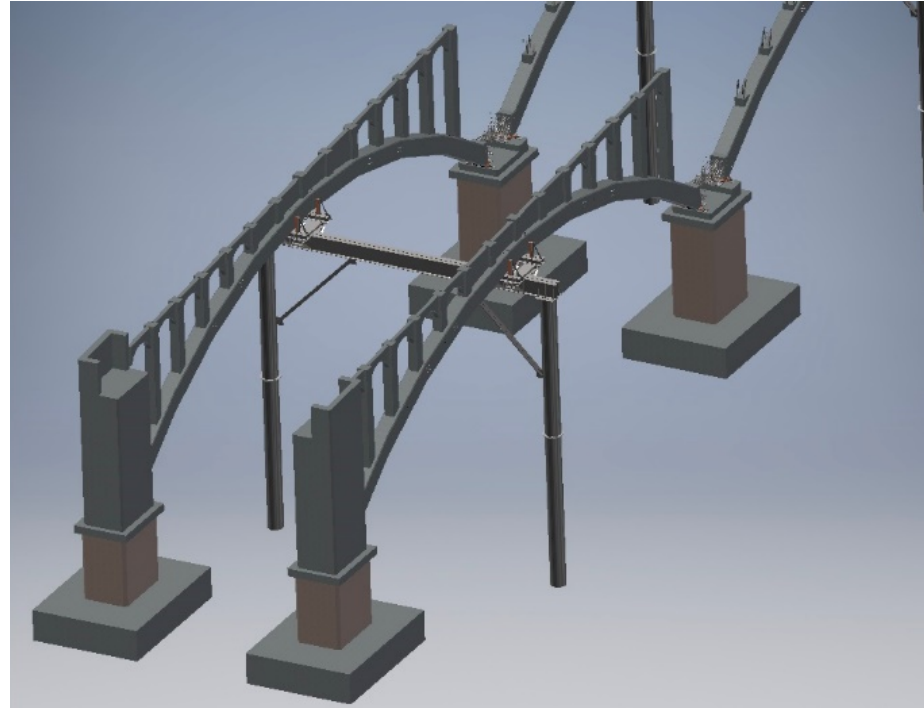
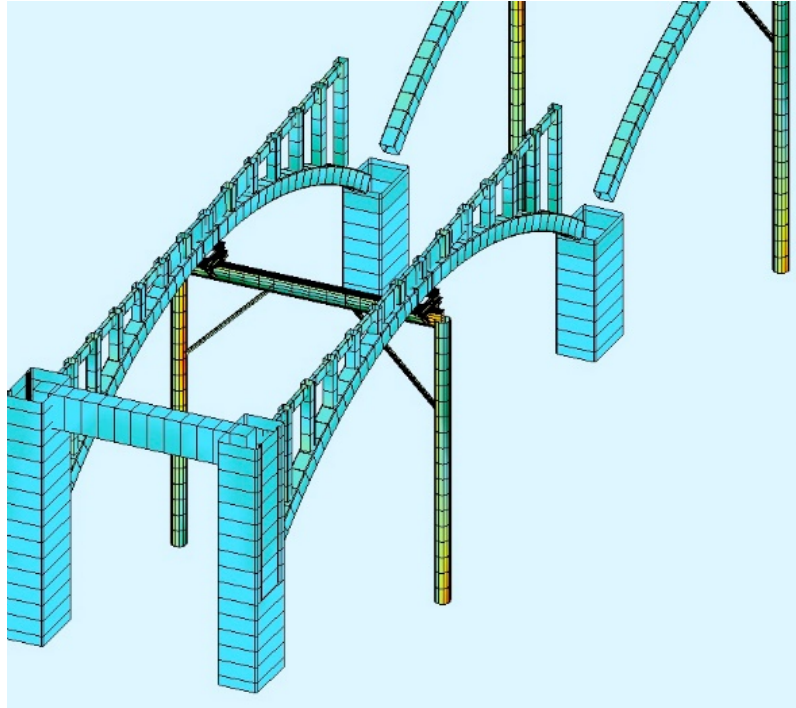
Integrated 3D Bridge Model – Phase 3



Integrated 3D Bridge Model – Phase 3



Lessons Learned from Veterans



Analysis



Production



Reality

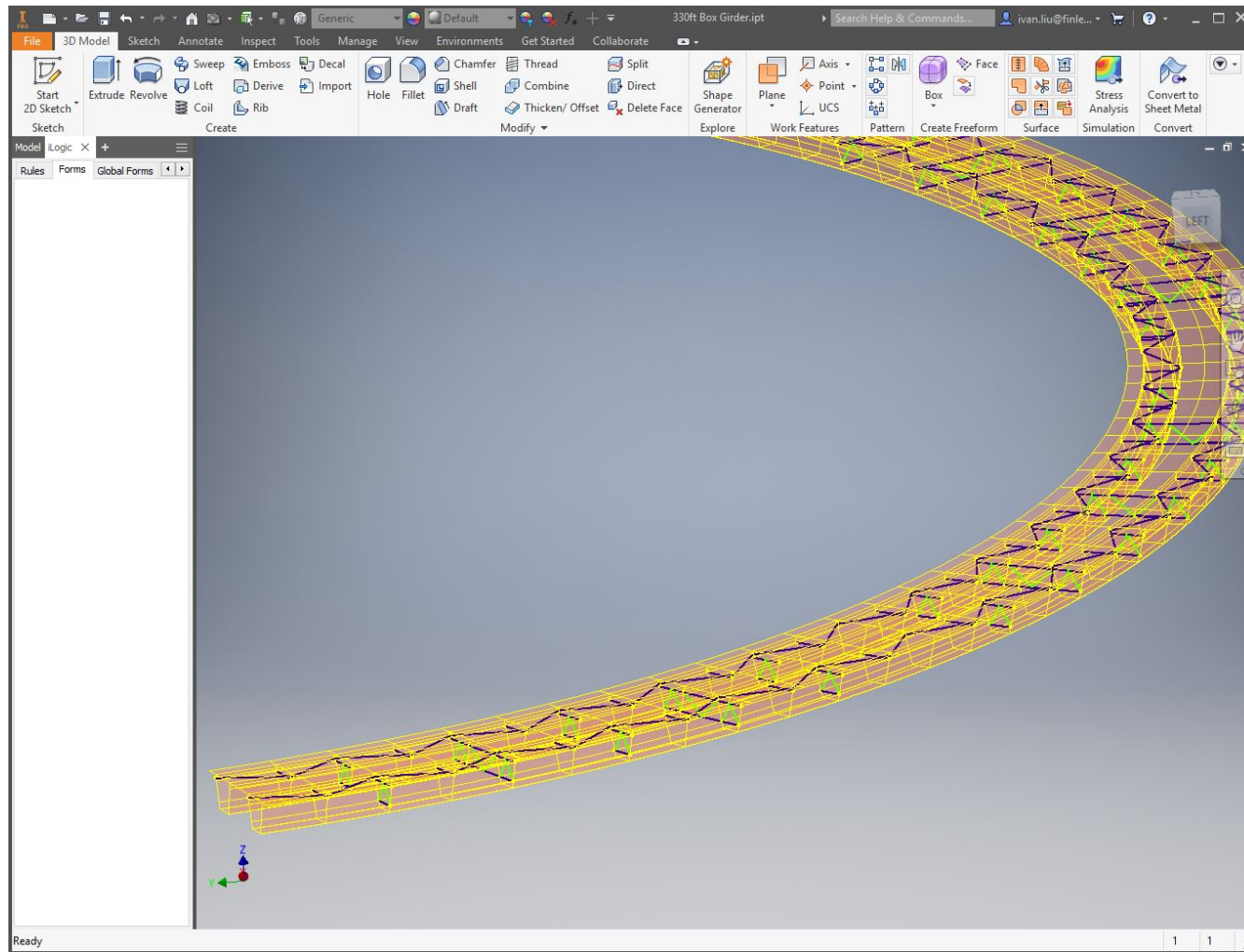
Case Studies

Past/Current Project with BrIM Applications:

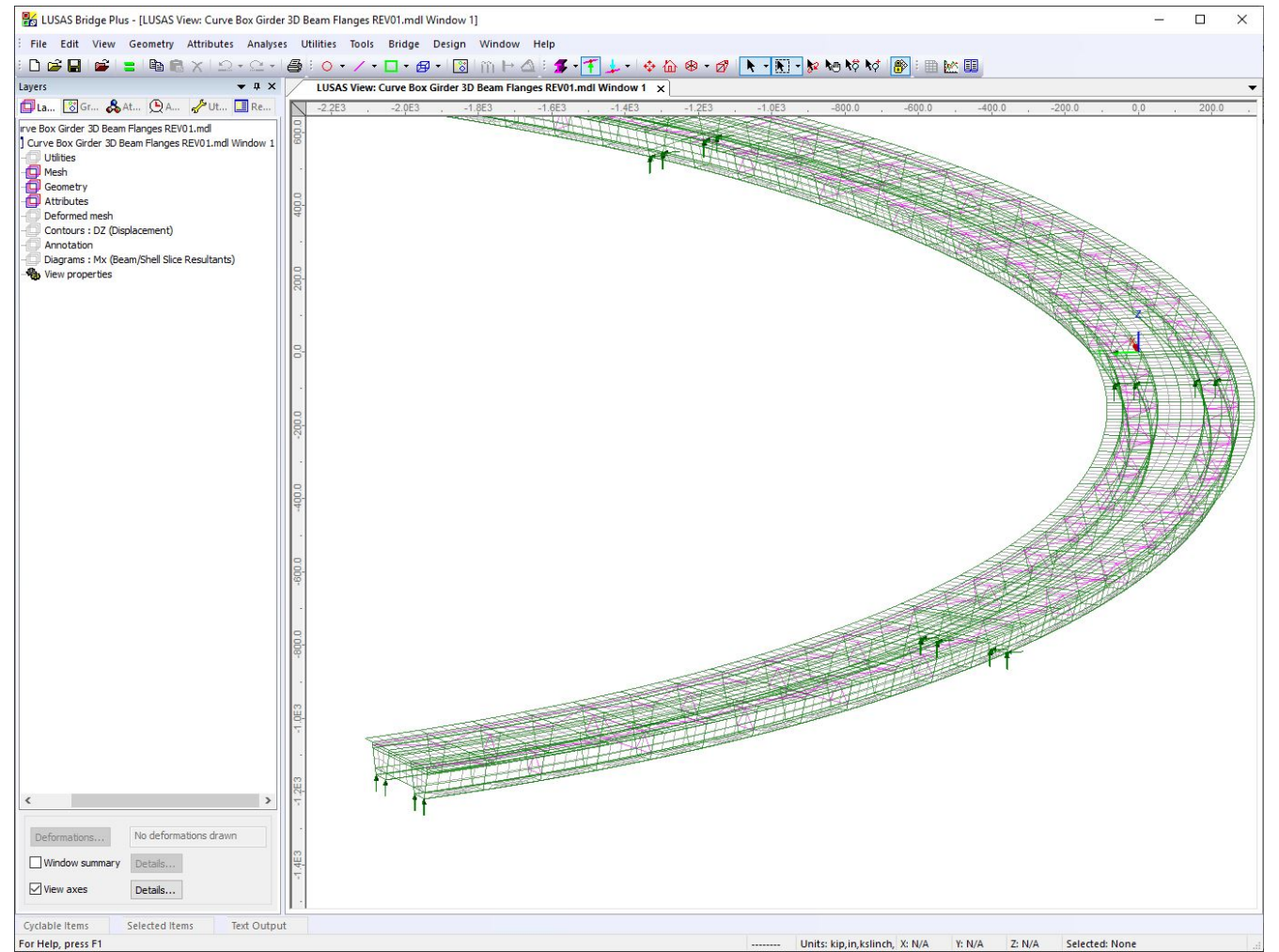
- SR25 Okeechobee Rd – Composite Steel Tub Girder Bridge
- I4 Pedestrian Bridge – Cable Stayed Steel Girder Bridge
- Edmonton LRT – Extradosed Cast-in-Place Segmental Bridge
- Honolulu Hart LRT – Precast Span by Span Segmental Bridge
- 3rd Avenue Rehabilitation – Spandrel Arch Bridge with Milan Truss
- Greenline Metro – Balanced Cantilever Cast-in-Place Segmental Bridge

Case Study – SR25 Okeechobee Rd

Geometry Creation in CAD:

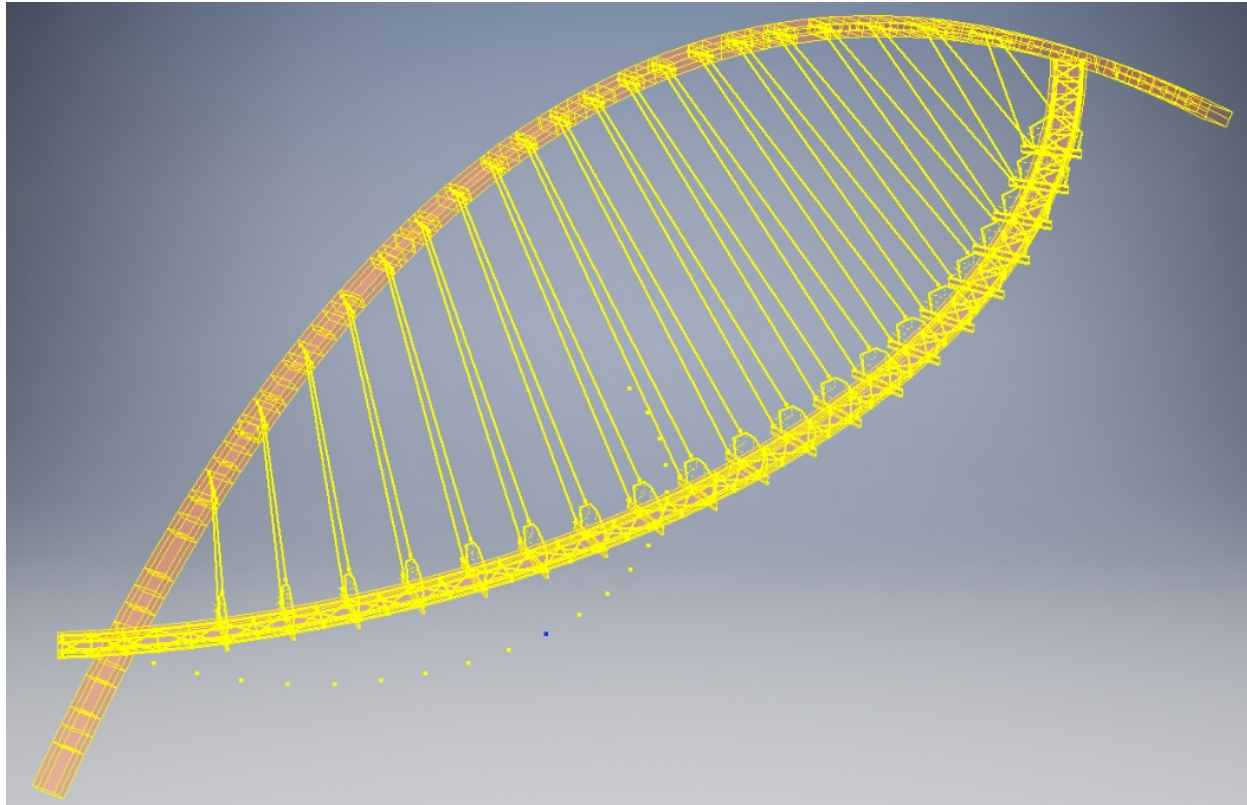


Geometry Exported to LUSAS:

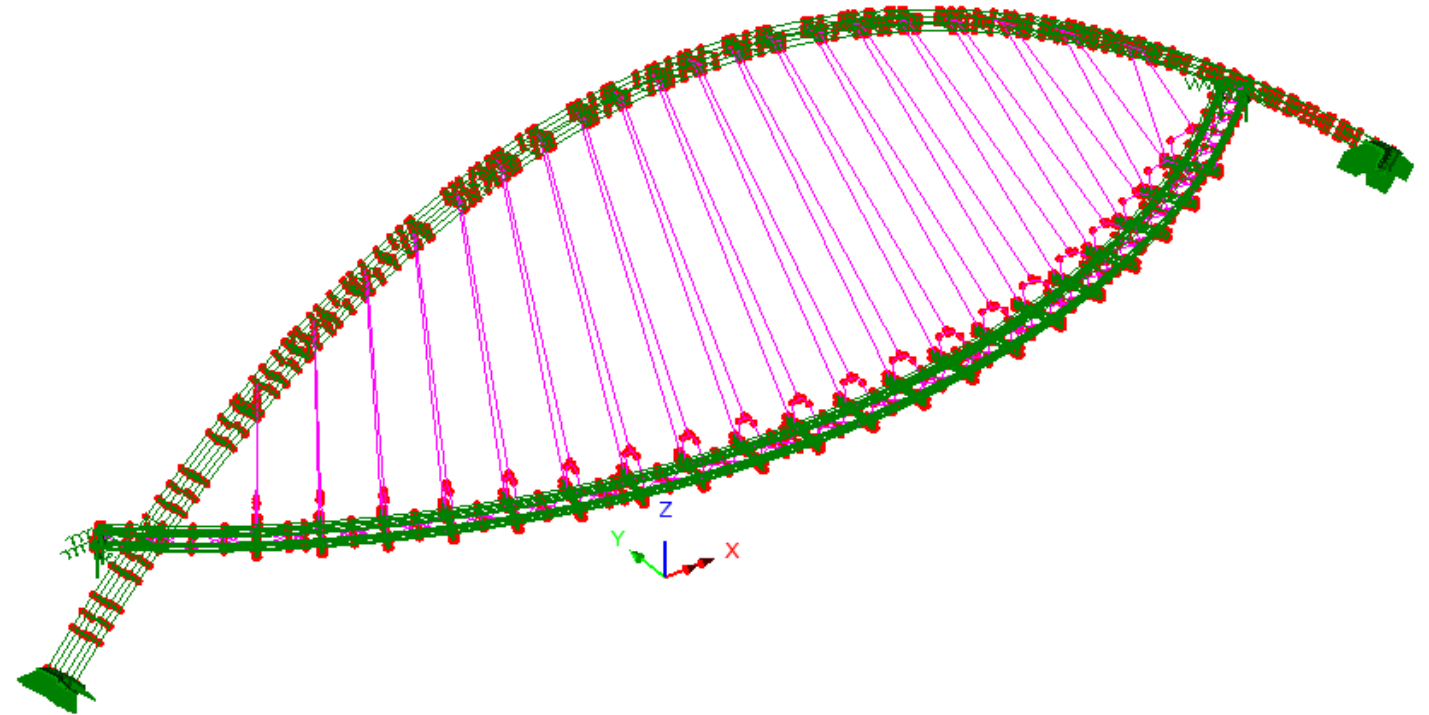


Case Study – I4 Pedestrian Bridge

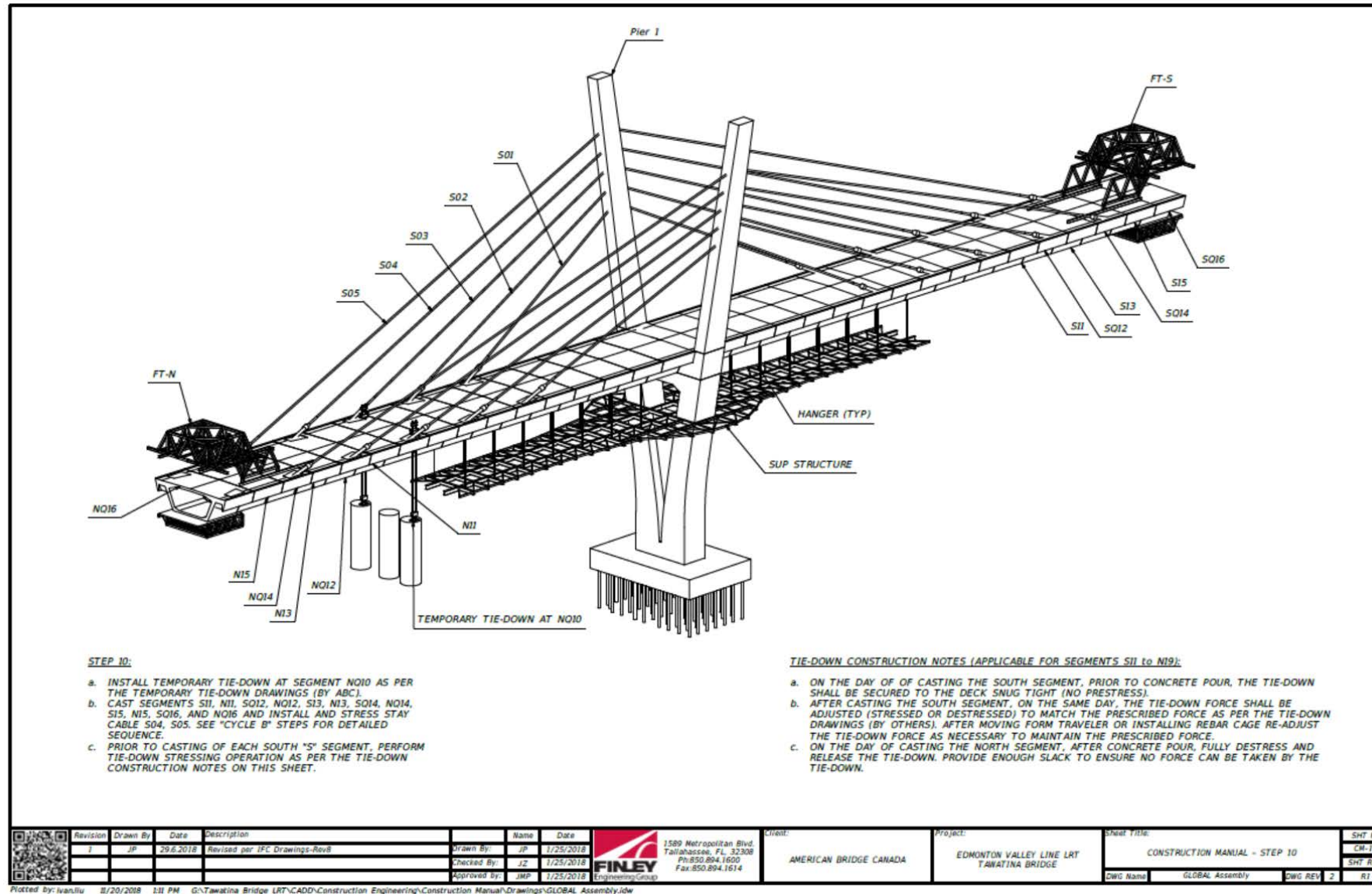
Geometry Creation in CAD:



Geometry Exported to LUSAS:



Case Study – Edmonton LRT

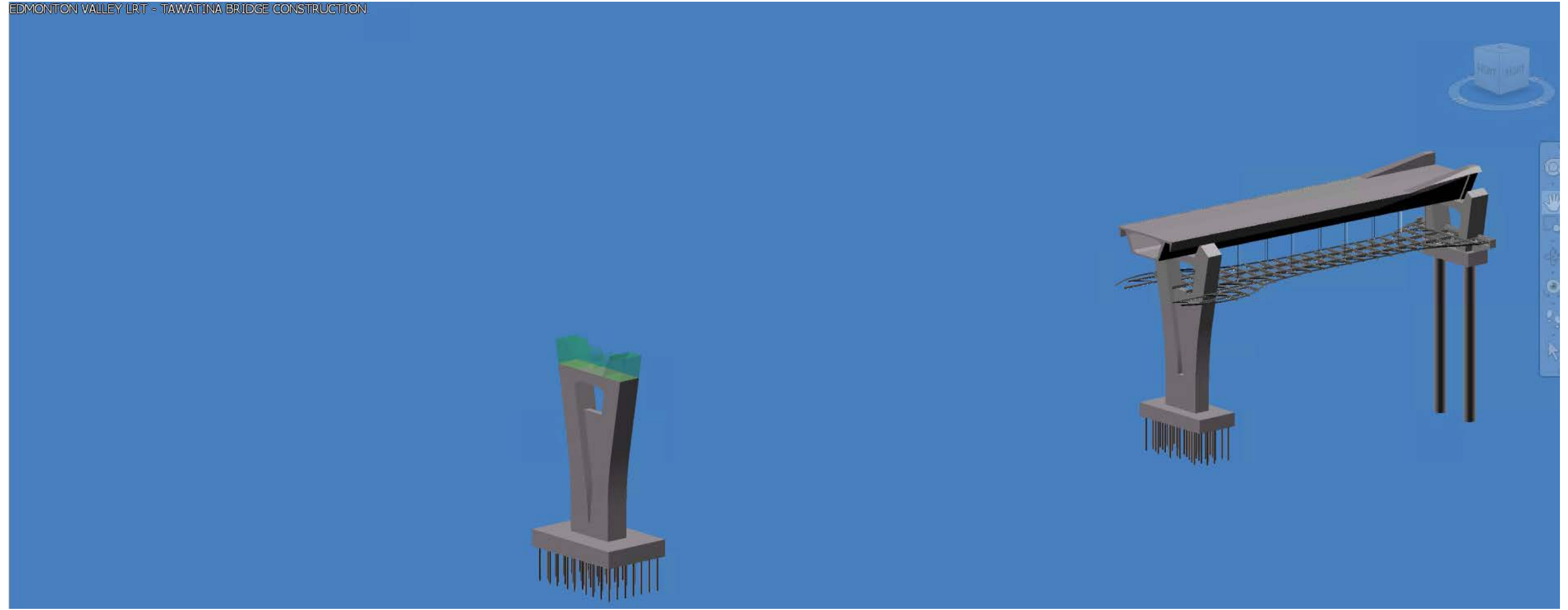


Case Study – Edmonton LRT

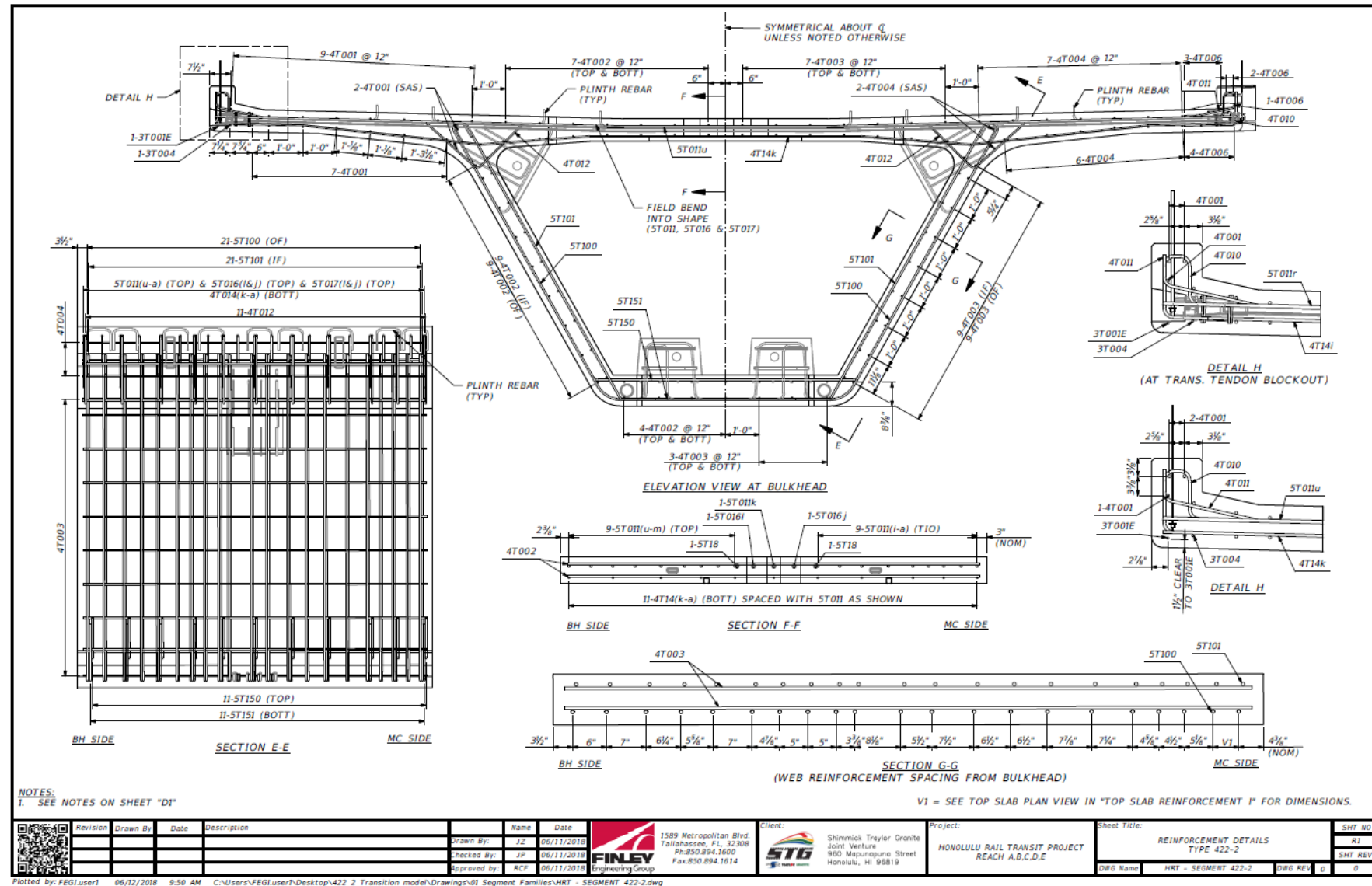


Case Study – Edmonton LRT

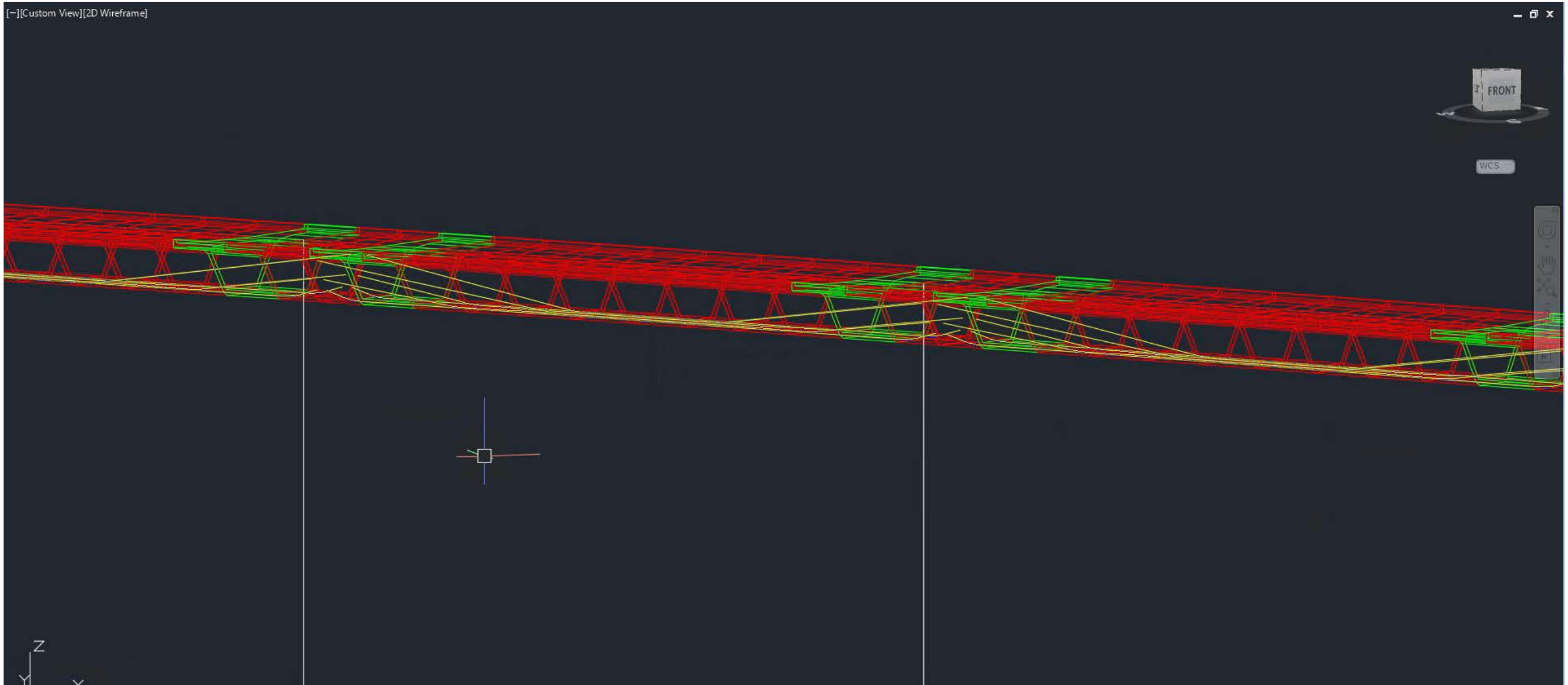
EDMONTON VALLEY LRT - TAWATINA BRIDGE CONSTRUCTION



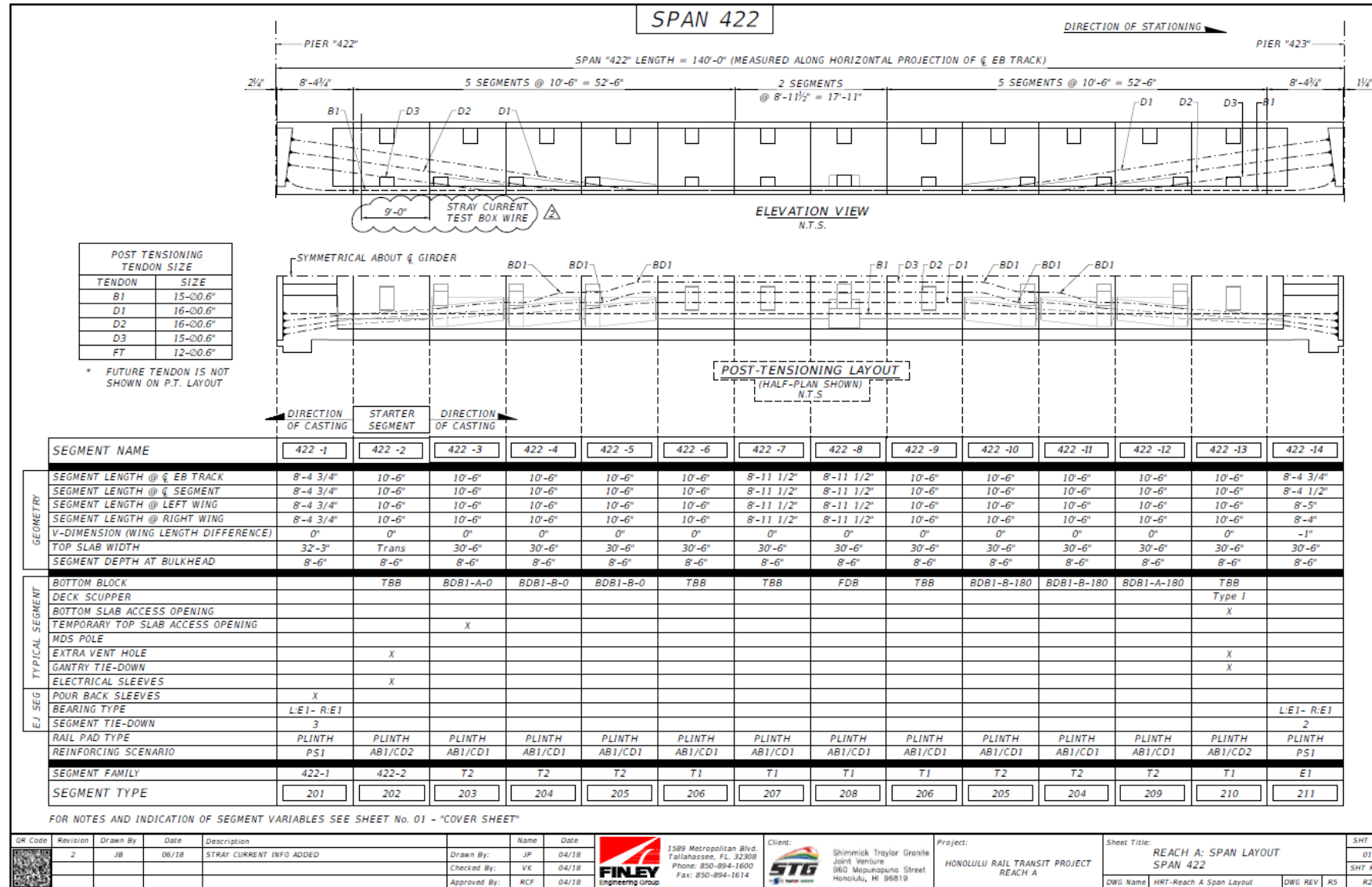
Case Study – Honolulu Hart LRT



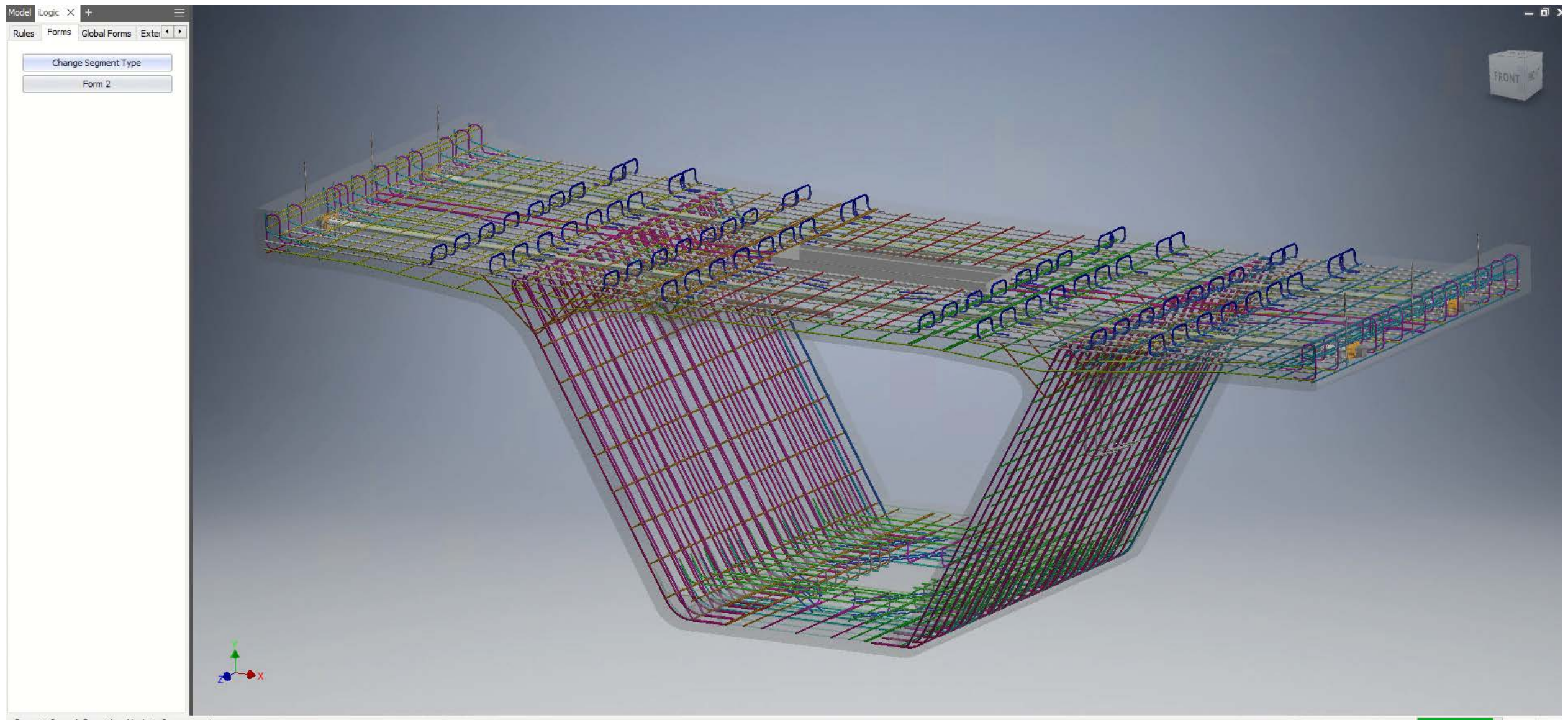
Case Study – Honolulu Hart LRT



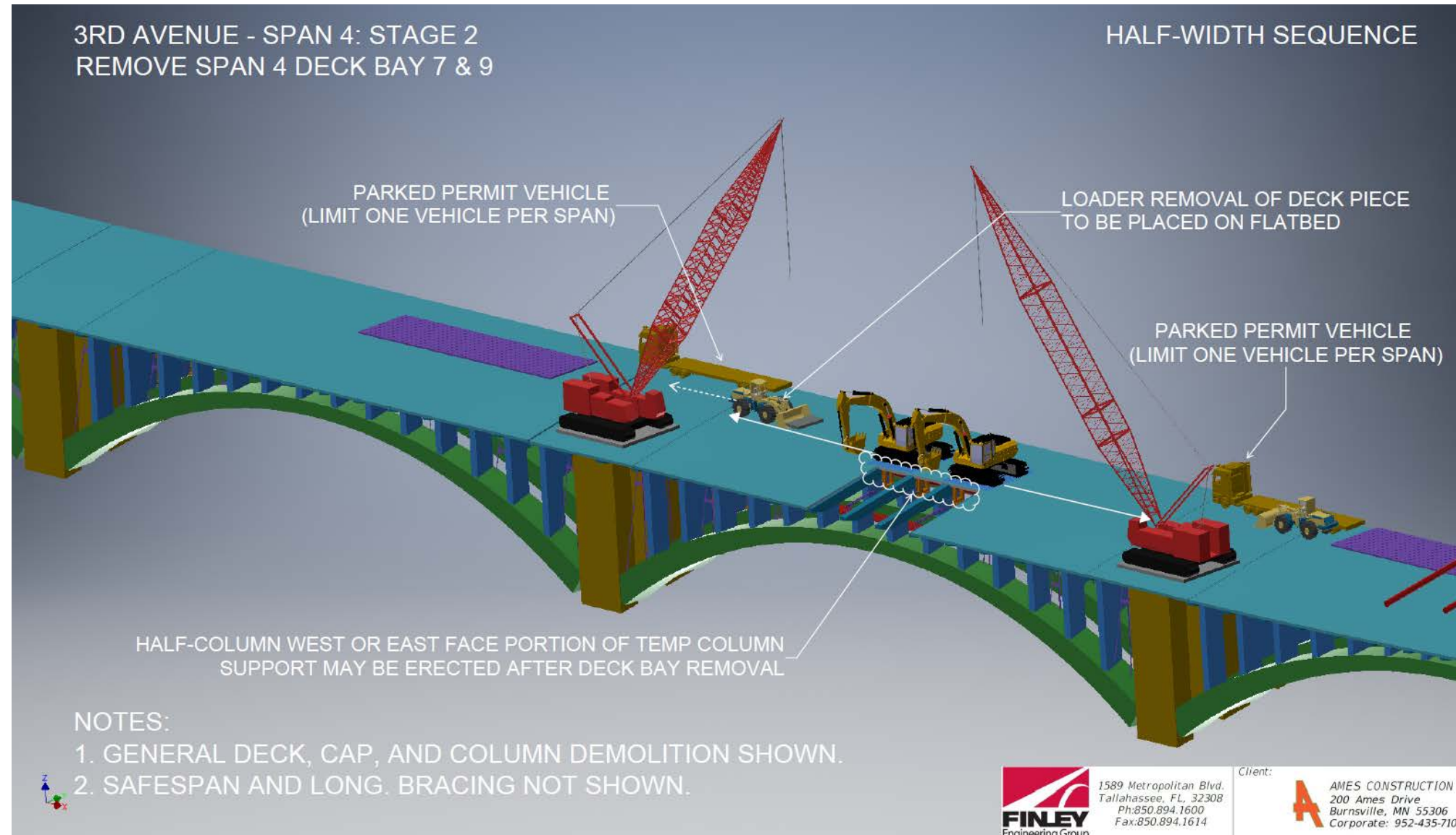
Case Study – Honolulu Hart LRT



Case Study – Honolulu Hart LRT



Case Study – 3rd Avenue Rehabilitation

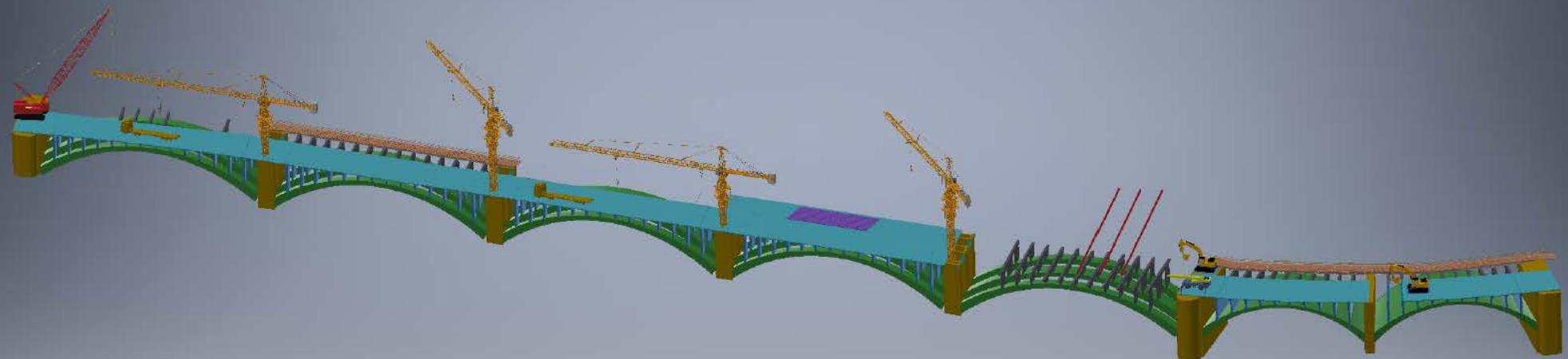


Case Study – 3rd Avenue Rehabilitation

3RD AVENUE REHABILITATION

TOWER CRANE PART-COLUMN FULL-DECK SEQUENCE
(FULL-WIDTH AND 1/3 - 2/3 WIDTH REMOVAL)
PAGE NO. 8

BEGIN PHASE 2 ONE-WAY REMOVAL OF SPAN
7 TOWARD PIER 8.

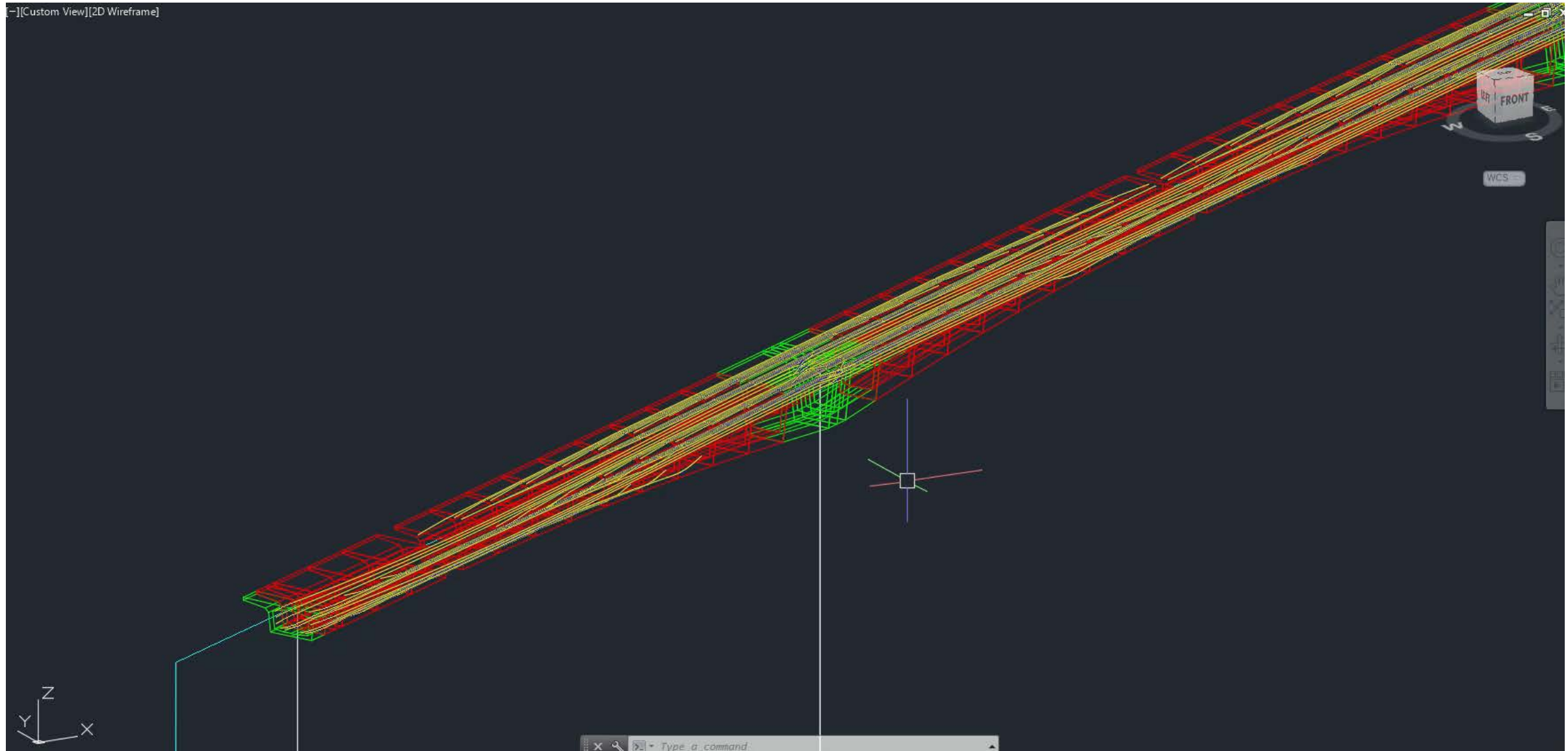


NOTES:
1. GENERAL DECK, CAP, AND COLUMN DEMOLITION SHOWN.
2. WORK PLATFORMS, LONGITUDINAL BRACING, AND SIMILAR TEMPORARY WORKS ITEMS NOT SHOWN.
3. CONSTRUCTION EQUIPMENT ON DECK SHOWN ONLY FOR SPECIFIC SEQUENCES.

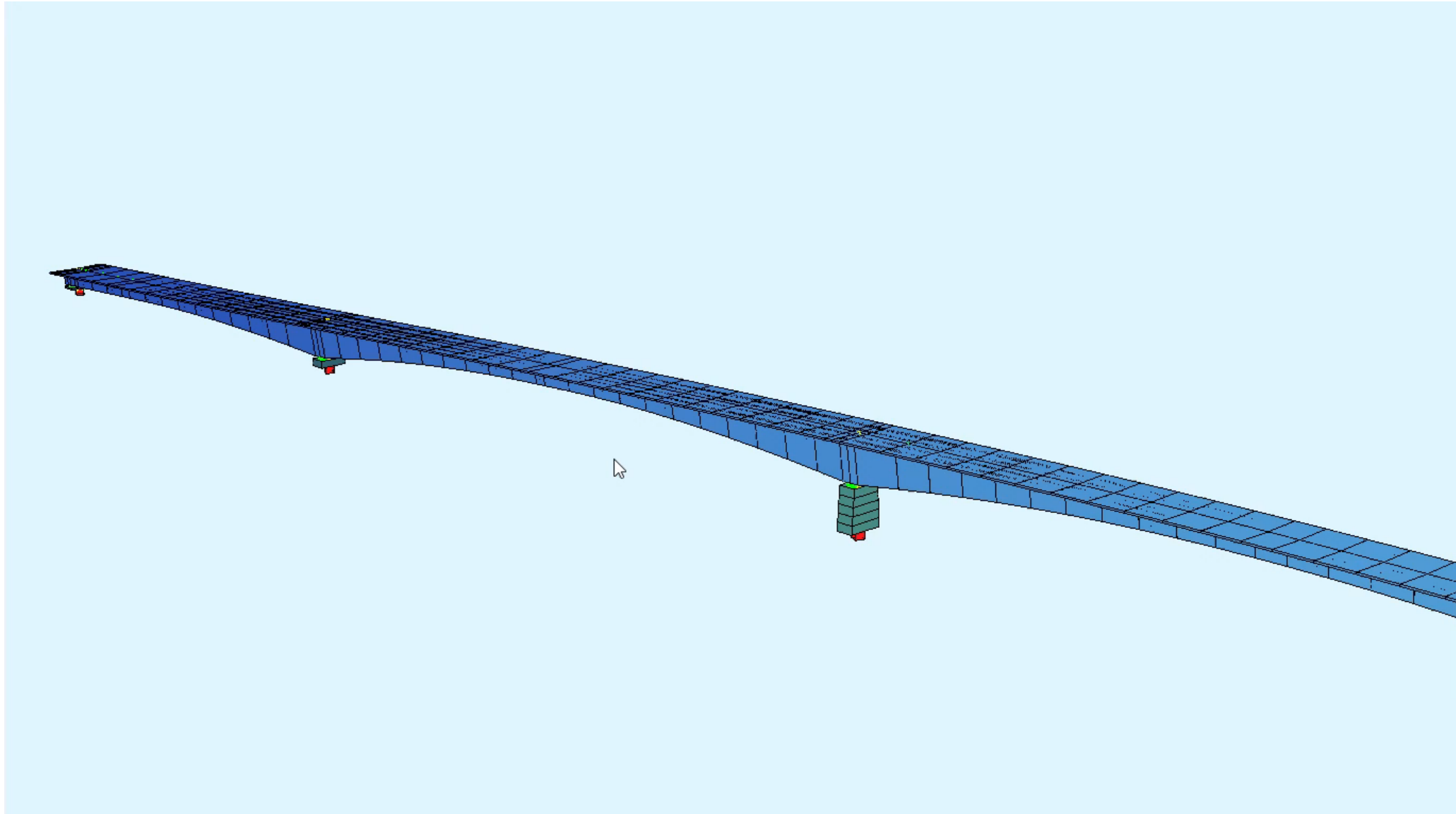
FINLEY
Engineering Group

Client: **A**
Ames Construction

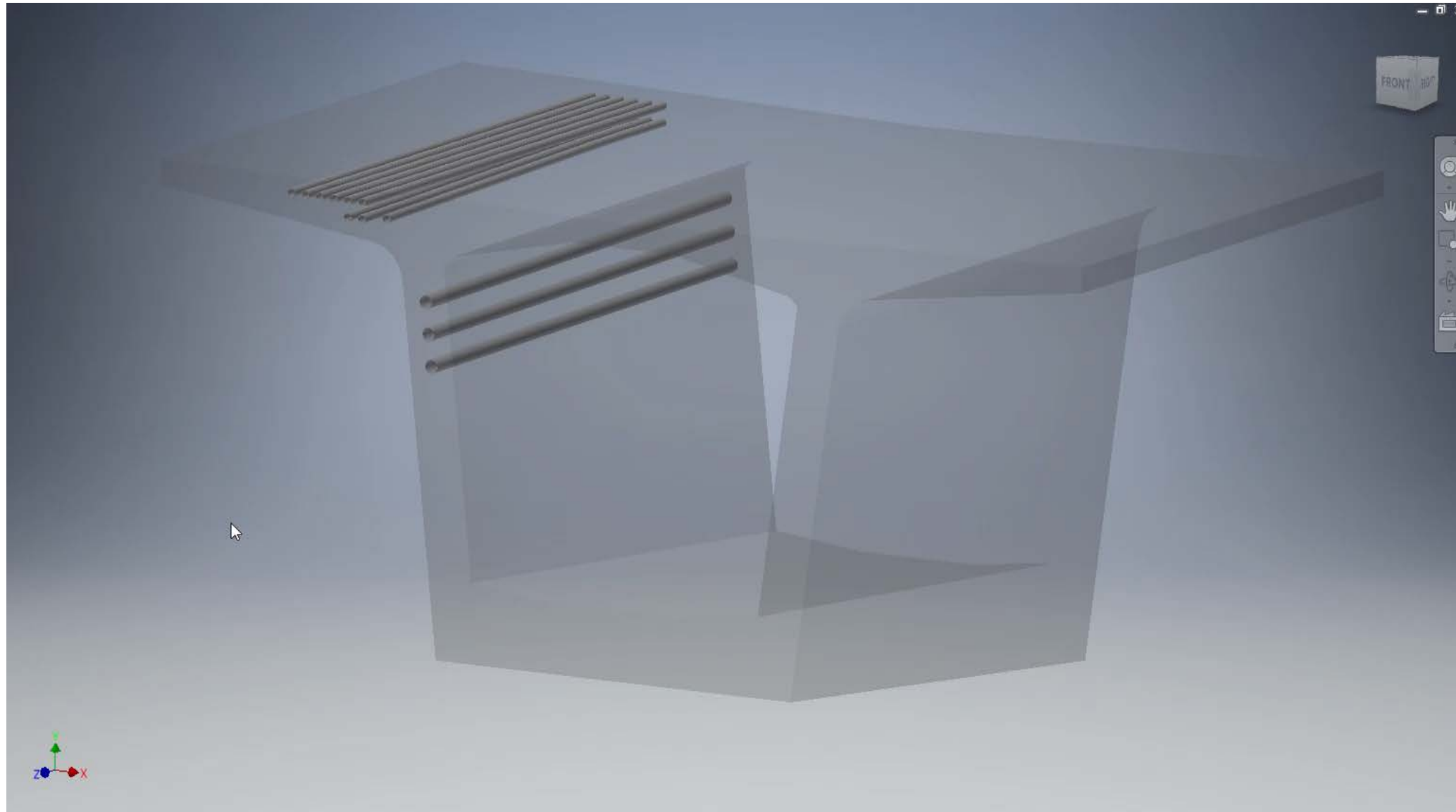
Case Study – Greenline Metro



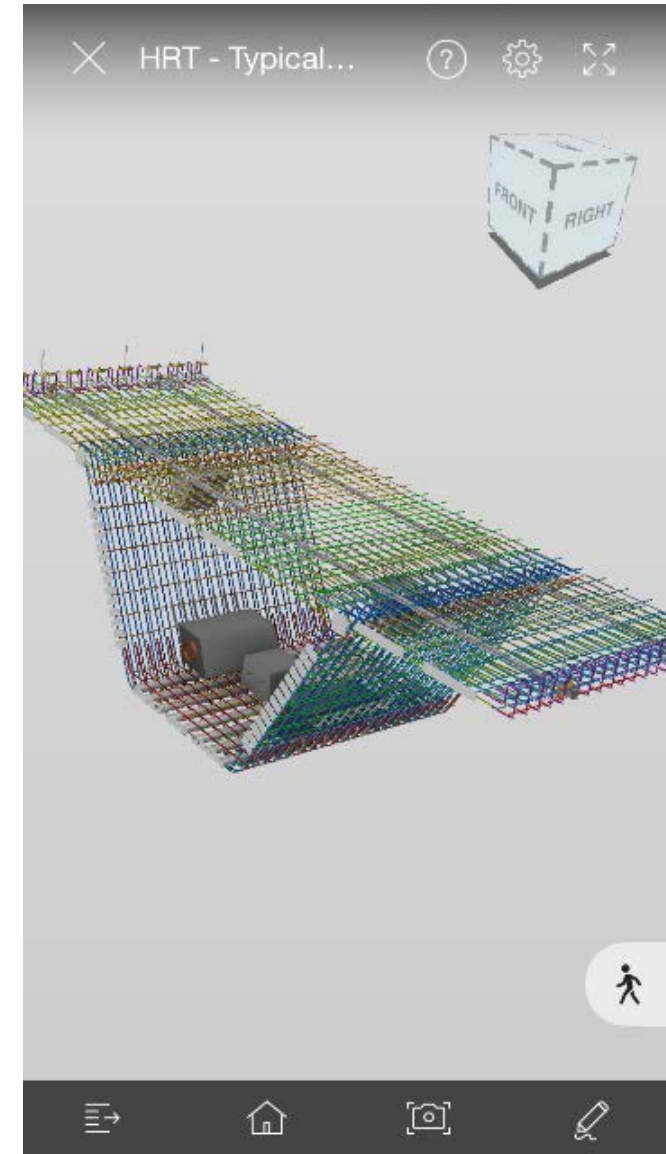
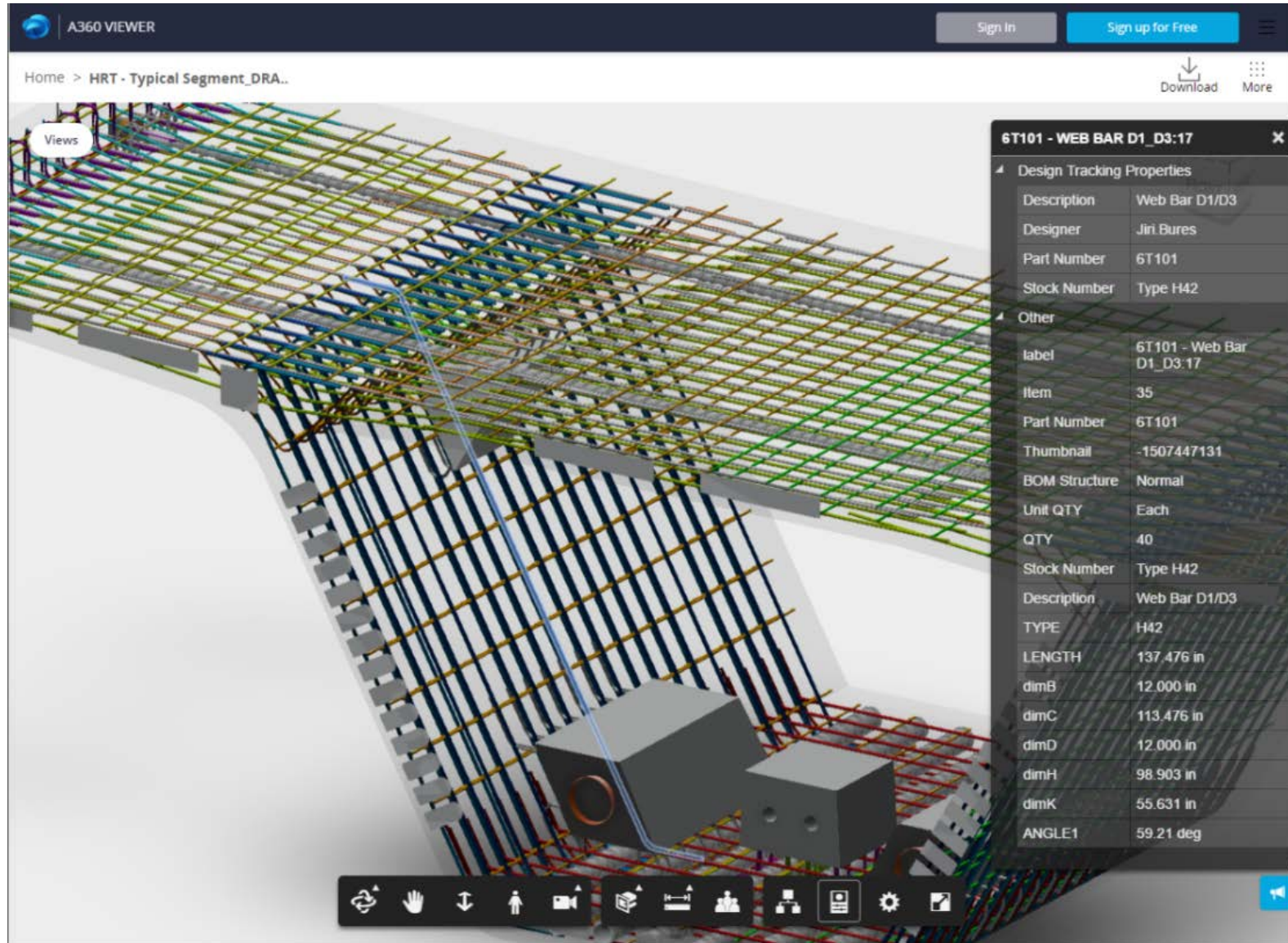
Case Study – Greenline Metro



Case Study – Greenline Metro



Future Development



Future Development

Bridge Asset Management:

- As-Built Records
- Repair Procedures
- Inspection Notes



Model x ILogic +

Engineer's Notebook

- CASTING INFORMATION
- EAR
 - EAR 15 SPANDREL COL SPALL
 - EAR 29 INCREASE COLUMN HEIGHT
 - EPOXY INJECTION REPAIRS
 - SIDE RIB CRACKING
 - EAR 29-2 SPANDREL COLUMN CR**

Ivan Liu Sunday, June 9, 2019
PROJECT ID: VETERANS MEMORIAL
FIN#: 24217215801
CAST BY: JOHNSON BROS. CORPORATION

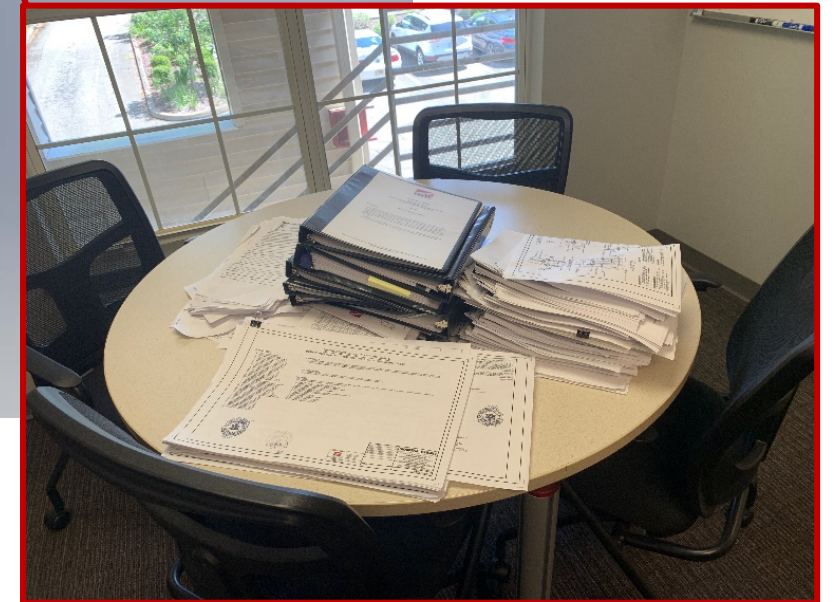
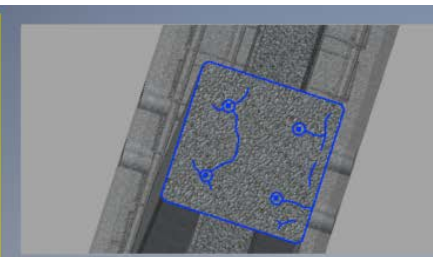
SEGMENT ID: 4-U-N
EAR #: 29.2
DATE: 03-26-2019

SUMMARY: CRACKING WITHIN GROUT PAD AT TOP SURFACE OF SPANDREL COLUMN S4-3.

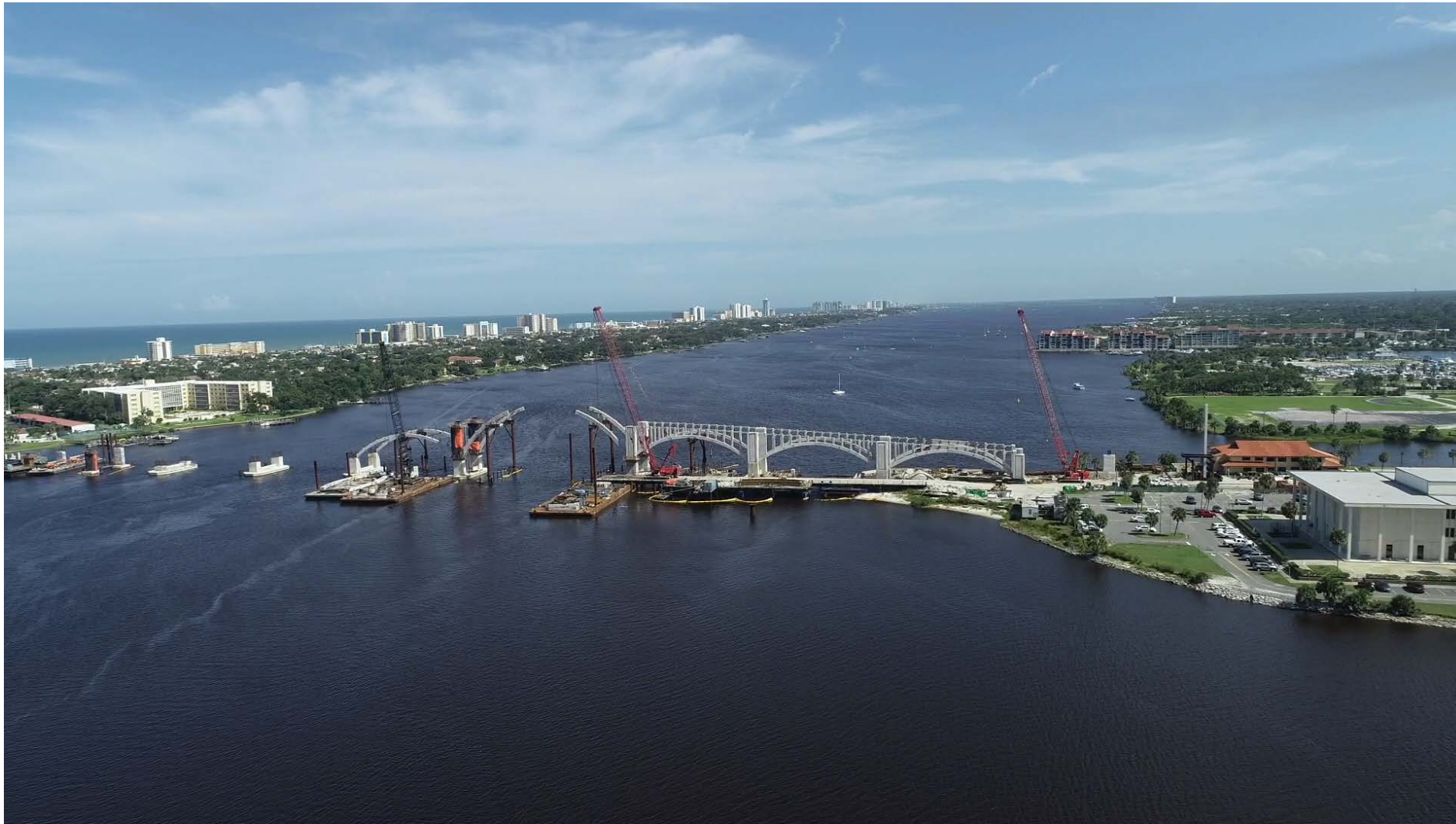
NOTES:
-CRACKS SIZE RANGE FROM 0.006" TO 0.02"
-DO NOT EXTEND PAST GROUT PAD INTO CONCRETE.
-OBSERVED AFTER REMOVAL OF GROUT PAD FOR REPAIR.
-SPECIFIC SIZES PROVIDED IN PICTURE BELOW.

ACCEPTANCE RESPONSE:
FINLEY RECOMMENDED REPAIR PROCEDURE FOR ACCEPTANCE, REPAIR BY EPOXY INJECTION OR VIBROPRUF#11 GROUT OR PILGRIM MAGMAFLOW GROUT PAK.

FINLEY EAR 29-2



Summary and Closing Remarks



Why is BrIM better? Efficient, Integration, and Visualization!

Questions?



Ivan Liu, P.E.
Bridge Engineer

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Phone: +1-850-894-1600
Fax: +1-850-894-1614



Prague Location:

Na Morani 1750/4
Prague 2 – Nove Mesto, 12800
Czech Republic
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