

2026 ABCD Bridge Technical Conference

September 10, 2026

Giving the Pulaski Skyway Bridge a New Life

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N. Gil, J. Amin and G. Deppert**

Arora and Associates, PC

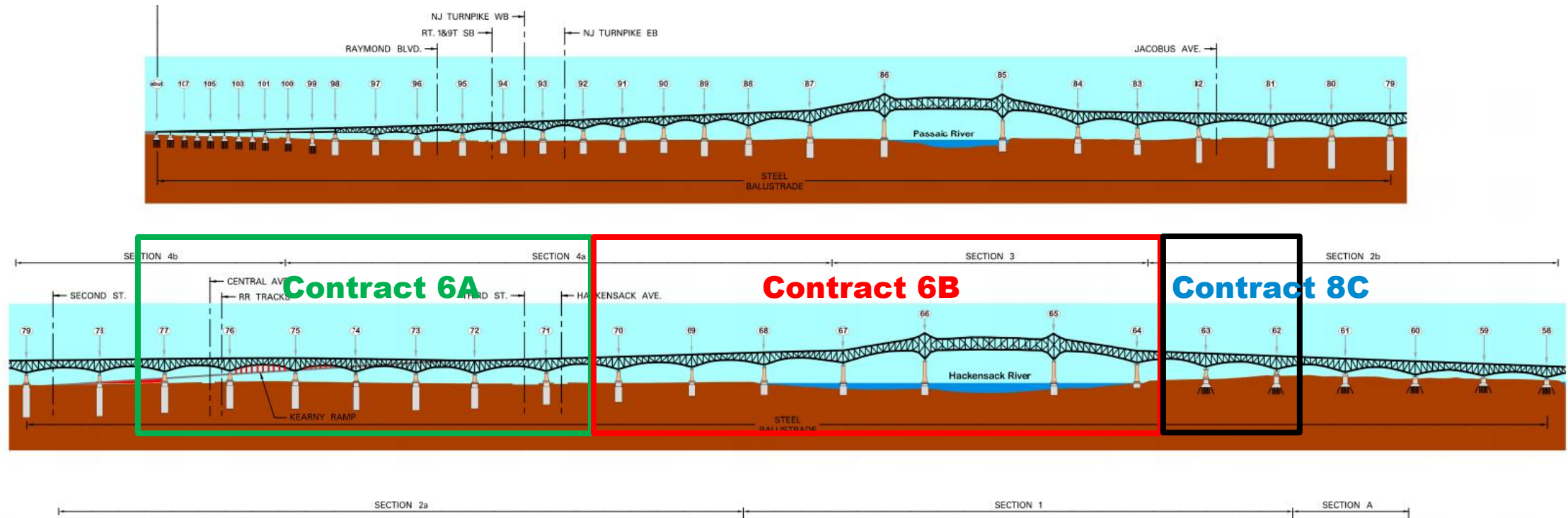
Arora Prime Consultant for Contract 6 (C6) Superstructure & Substructure Rehabilitation, Seismic Retrofit



Contract 6 Limits – Pier 64 to Pier 77 (5,041 LF)

- ***Inspection and Load Rating***
- ***Design of New Piers and Foundations***
- ***Complex Steel Repairs Design***
- ***Rocker Bent Replacement Design***
- ***Bridge Finite Element Modeling and Analyses***
- ***Seismic Design and Retrofit***
- ***Soil-Structure-Interaction Analyses***
- ***Ship Impact Design for Water Piers and Fender Design***
- ***Construction Support Services***

Arora and Associates –Arora and Associates’ Contracts



Arora is Prime Consultant for the Final Design of the rehabilitation from Pier 64 to Pier 77, about 1 mile long-13 spans

Presentation Agenda

- Pier and Truss Rehabilitation Next to the Ramp
 - ❑ Staged Construction
 - ❑ Complex Steel Repairs
 - Staging Analyses
 - Analyses of Repair Details
 - ❑ Structural Health Monitoring During Jacking of the Trusses
- Rehabilitation of the Piers and Foundations
- Rehabilitation of the Rocker Bents
- Seismic Analyses and Design
 - ❑ Soil-Structure-Interaction Process
 - Derivation of the Design Spectrum
- Current Construction Progress

Pulaski Skyway – Typical Existing Piers



Pier 72

The existing piers in the section consist of minimally reinforced concrete columns founded on concrete box caissons. Their column arrangement varies depending on the configuration of the superstructure, the subsurface conditions under each pier, the site conditions. There are two, three and four column piers.



Pier 62



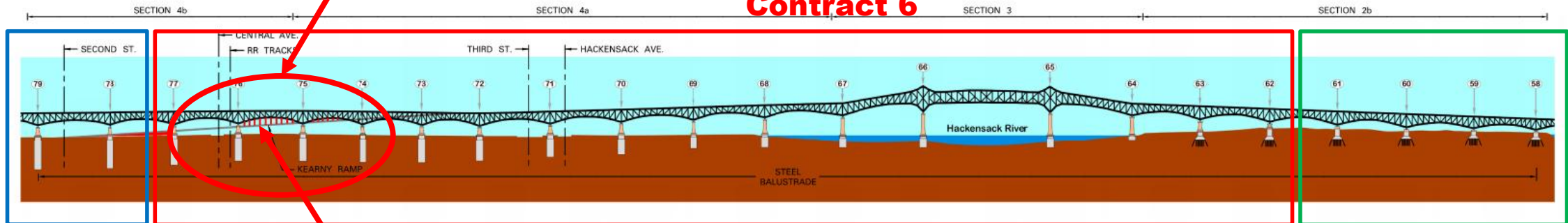
Pier 70

Pulaski Skyway – Truss Spans Rehabilitation

Earlier Construction of Ramp Piers

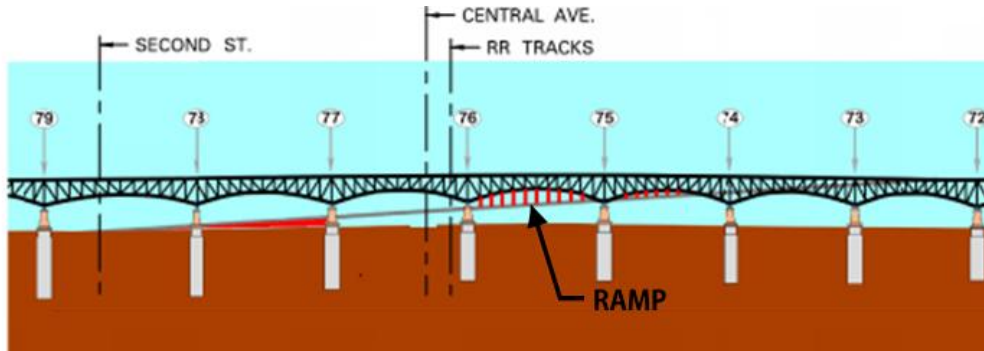
Replacement of the Kearny Ramp Ahead of C6: Accelerated Replacement of Two Piers of C6 and Adjacent Truss Rehabilitation

Contract 6



Kearny Ramp

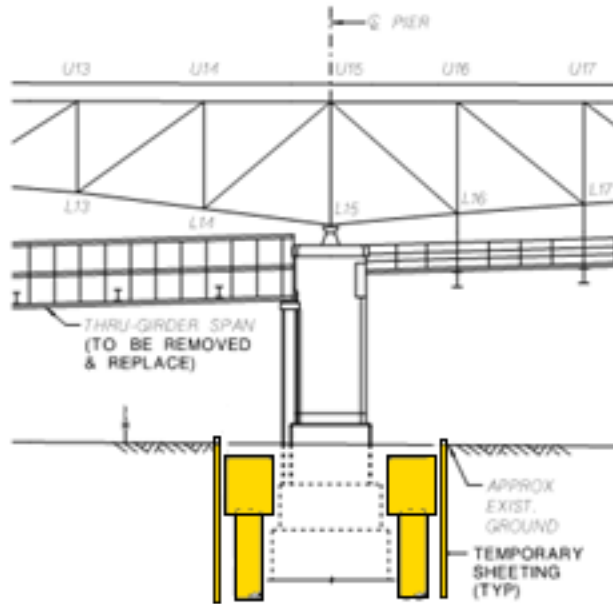
Replacement of the Kearny Ramp within the limits of C6



- ❖ The Bridge widens, adding trusses, the ramp descends in the middle, then the bridge narrows and trusses are removed until the ramp is directly underneath the bridge.
- ❖ As part of the global rehabilitation, the Ramp within the limits of C6 was replaced.
- ❖ Two Piers were replaced as part of this contract.

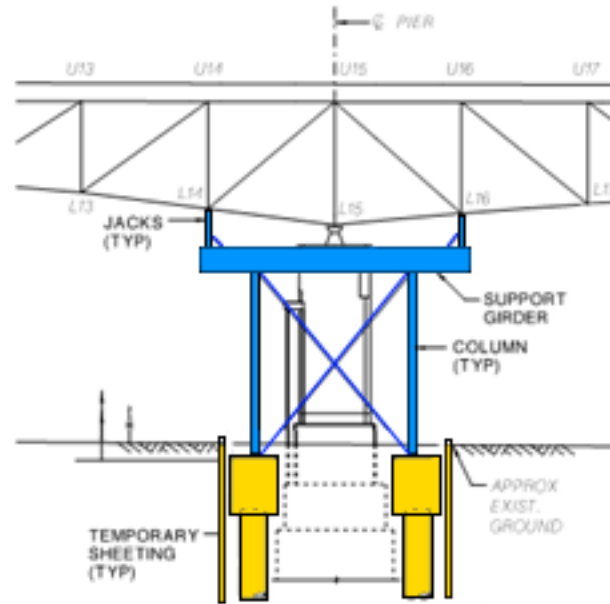


Replacement of the Piers at the Ramp- Construction Staging



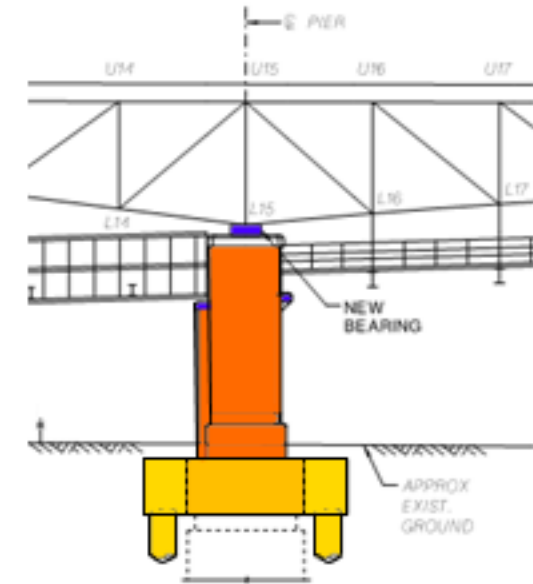
STAGE 1

- Install Temp. Sheeting
- Install drilled shafts and construct Stage 1 footing



STAGE 2

- Install temp. jacking structure
- Jack both trusses and transfer Truss support to temp. support structure.



STAGE 3

- Construct Stage 3 foundation
- Construct pier and install new bearing
- Remove temp. structure

Used the initial stage of the new foundation to hold the temporary truss supports, then built up the new piers inside the temporary supports

Successful Construction of Piers 76 and 77



ORIGINAL PIER 76 – ELEVATION
(SHOWN WITH TEMPORARY
SUPPORT SYSTEM)

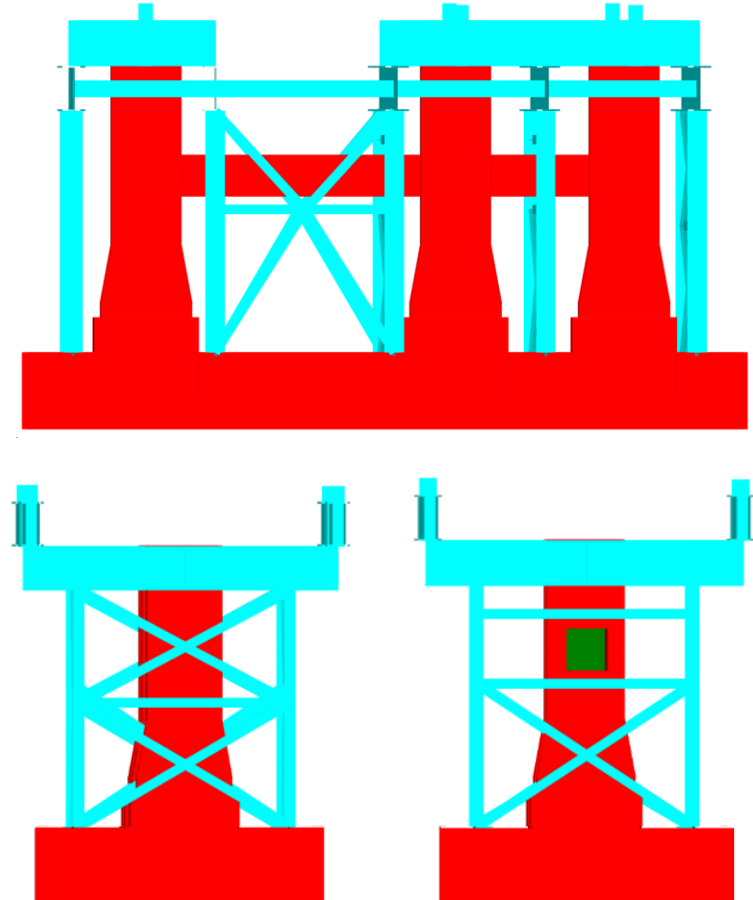
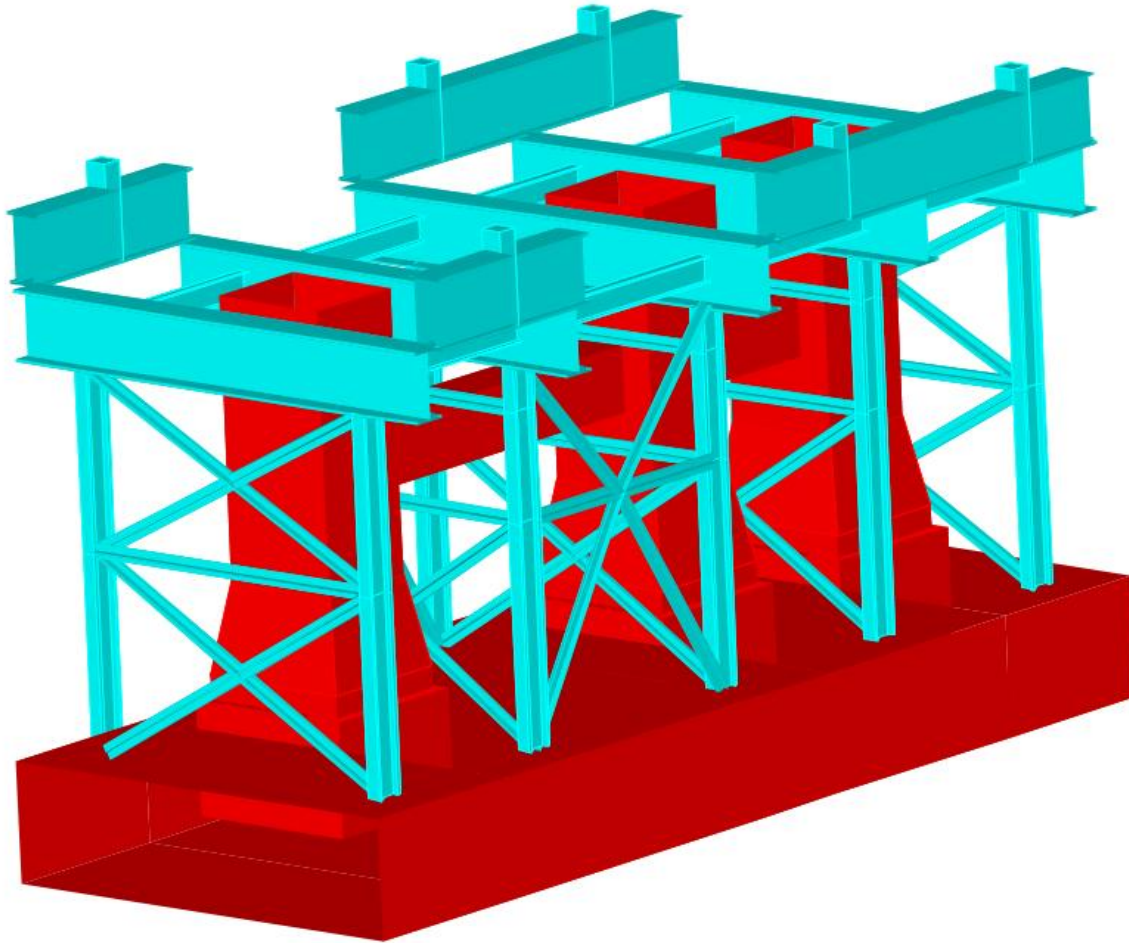


SUPPORT SYSTEM AT
PIER 77
(EXISTING PIER
REMOVED)

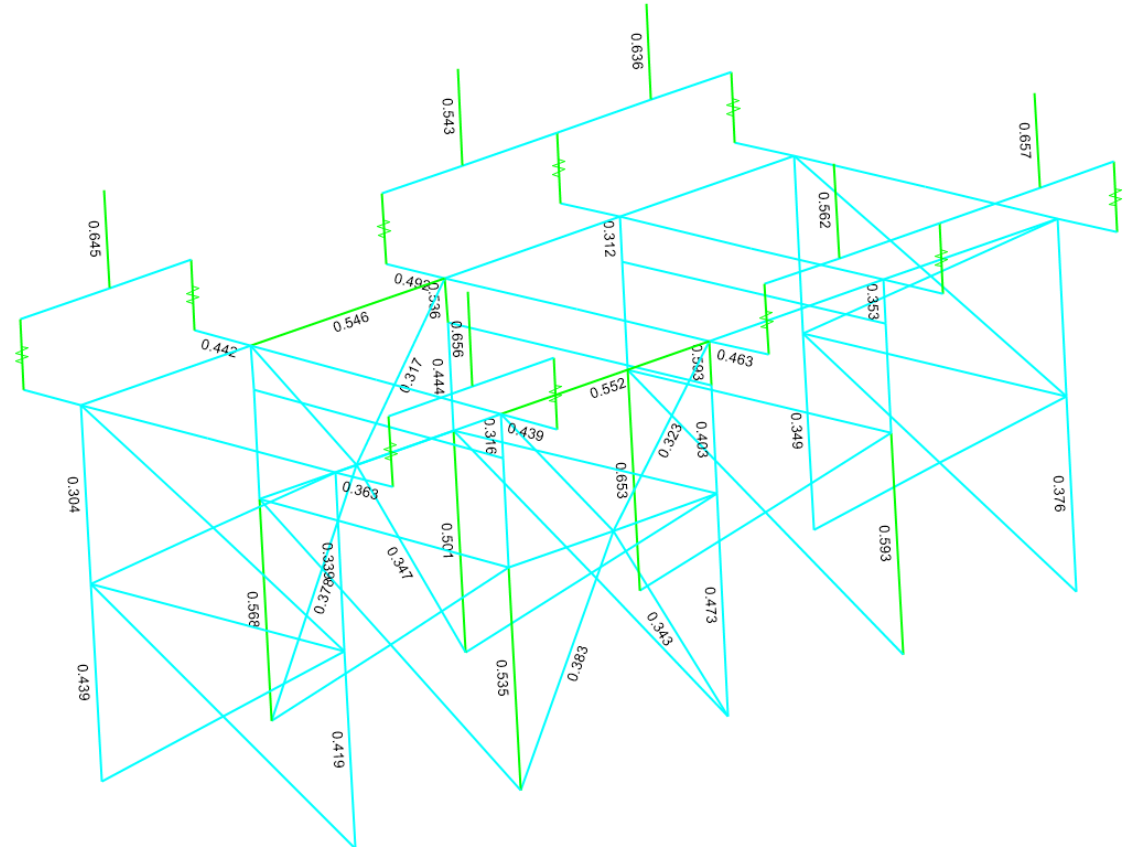
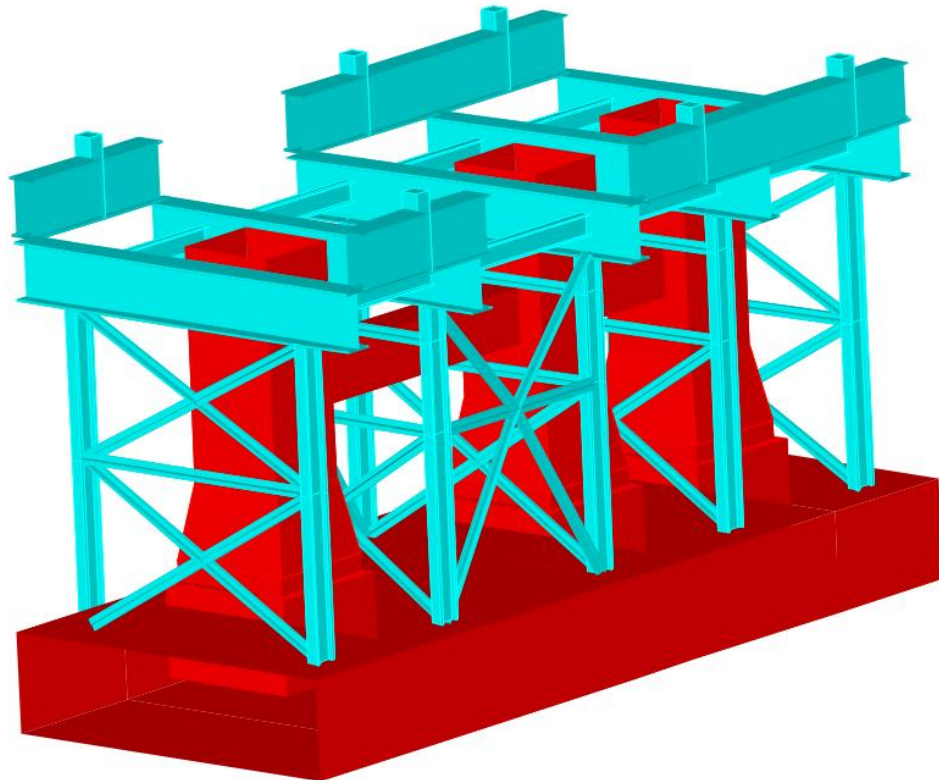


PIER 77 – SOLID PIER
ELEVATION

Temporary Support Towers-Pier 74

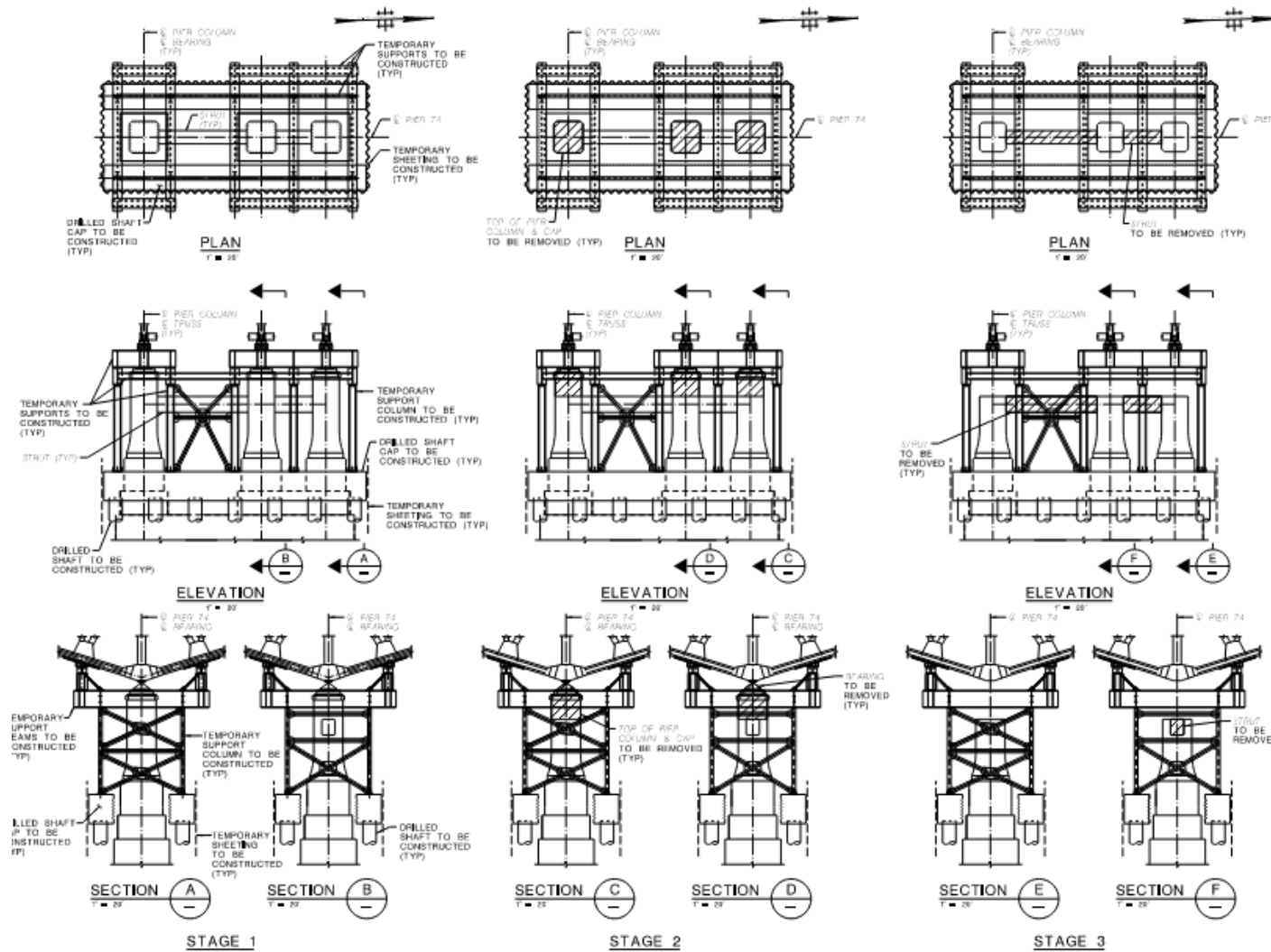


Pier 74 Temporary Support Towers – D/C Check



Pier 74- Construction Staging

STATE	FEDERAL PROJECT NO.	SHEET	TOTAL SHEETS
N.J.		201	201
STRUCTURE NOS 890465			
ROUTE U.S. 189 (PULASKI SKYWAY)			



CONSTRUCTION SEQUENCE STAGE 1

- INSTALL TRUSS MONITORING STRAIN GAUGES AND SENSORS PER MONITORING PLANS.
- INSTALL TEMPORARY SHEETING FOR FOOTING AND EXCAVATE TO BOTTOM OF PROPOSED DRILLED SHAFT CAP PORTION OF THE NEW FOOTING SYSTEM.
- INSTALL DRILLED SHAFTS THEN CONSTRUCT STAGE 1 DRILLED SHAFT CAP SECTIONS.
- INSTALL TEMPORARY TRUSS SUPPORTS.
- CLOSE BRIDGE TO TRAFFIC.
- JACK ALL TRUSSES SIMULTANEOUSLY TO TRANSFER TRUSS SUPPORT TO TEMPORARY TRUSS SUPPORT SYSTEM, REFER TO TEMPORARY SUPPORT NOTES.
- REOPEN BRIDGE TO TRAFFIC.

CONSTRUCTION SEQUENCE STAGE 2

- REMOVE ALL EXISTING BEARINGS.
- DEMOLISH ALL COLUMNS TO THE TOP OF EXISTING TRUSSES.
- INSTALL DEBRIS CONTAINMENT/CATCH SYSTEM PRIOR TO DEMOLITION.
- DISPOSE OF CONCRETE DEBRIS AT THE END OF EACH WORK SHIFT.

CONSTRUCTION SEQUENCE STAGE 3

- INSTALL SCAFFOLDING SUPPORTED PLATFORM BETWEEN COLUMNS FOR REMOVAL OF STRUT.
- DEMOLISH BOTH STRUTS (USING HAND DEMOLITION TECHNIQUES).

REFERENCES

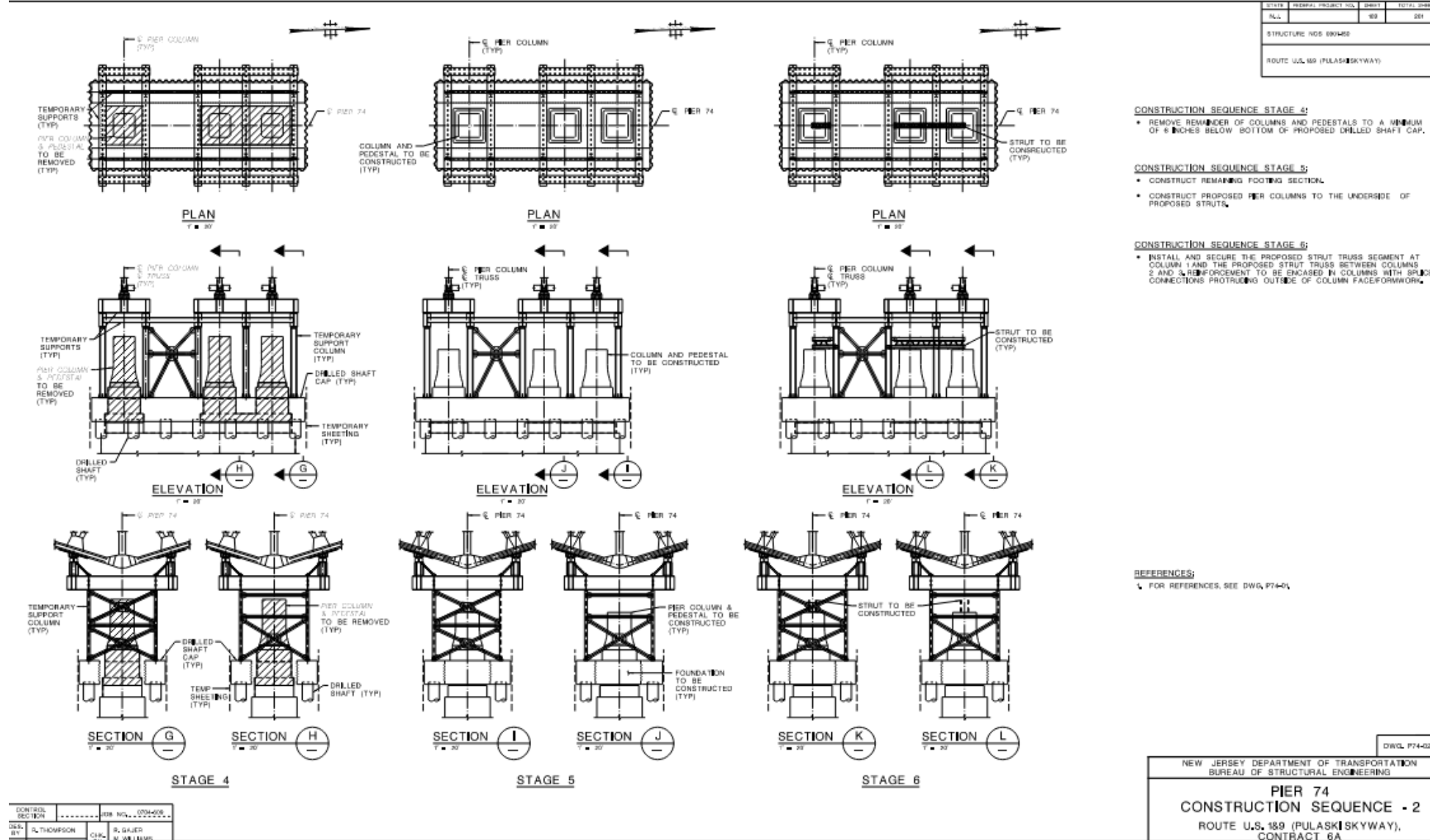
1. FOR GENERAL DEMOLITION NOTES, SEE DWG. P74-01.
2. FOR PROPOSED PIER PLAN AND ELEVATION, SEE DWG. P74-03.
3. FOR TEMPORARY SUPPORT DETAILS, SEE DWGS. P74-04 TO P74-06.

DESIGN	DATE	BY	CHKD	DATE	BY	CHKD
THOMPSON	01/11/2011	01/11/2011	01/11/2011	01/11/2011	01/11/2011	01/11/2011
FLGOLDOWSKY	01/11/2011	01/11/2011	01/11/2011	01/11/2011	01/11/2011	01/11/2011

LEGEND:

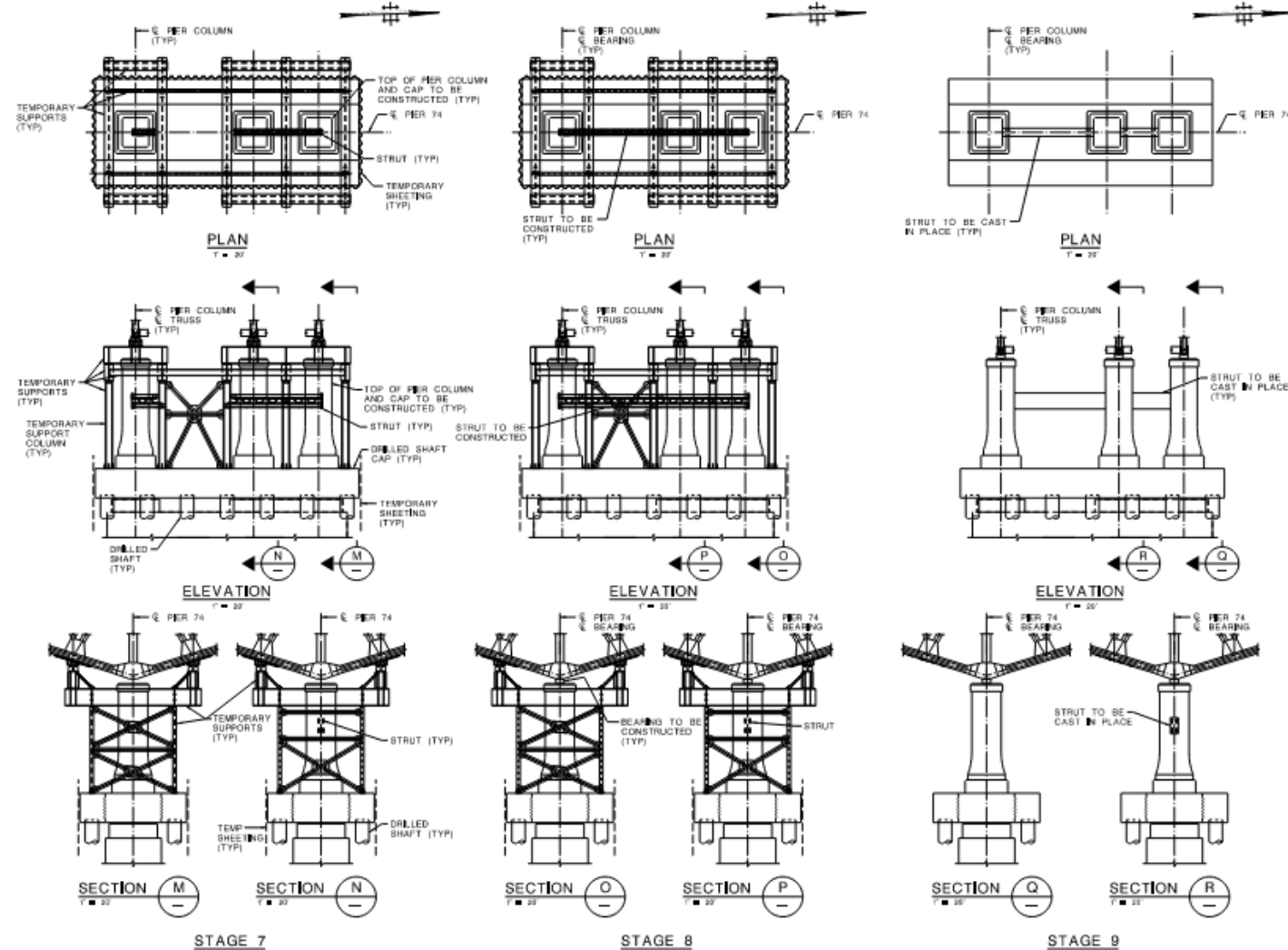
DWG. P74-01
NEW JERSEY DEPARTMENT OF TRANSPORTATION BUREAU OF STRUCTURAL ENGINEERING
PIER 74
CONSTRUCTION SEQUENCE - 1
ROUTE U.S. 189 (PULASKI SKYWAY), CONTRACT 6A CONTRACT NO. 05123280
ARORA and ASSOCIATES, P.C.

Pier 74- Construction Staging



Pier 74- Construction Staging

STATE	NEW JERSEY	PROJECT NO.	604-006	SHEET	89	TOTAL SHEETS	201
N.A.							
STRUCTURE NOS 890405							
ROUTE U.S. 189 (PULASKI SKYWAY)							



CONSTRUCTION SEQUENCE STAGE 7:

- COMPLETE CONSTRUCTION OF PROPOSED COLUMNS.

CONSTRUCTION SEQUENCE STAGE 8:

- ERECT THE REMAINING STRUT TRUSS BETWEEN COLUMNS 1 AND 2.
- CONTRACTOR HAS THE OPTION TO ERECT ALL PROPOSED STRUT TRUSS SEGMENTS IN STAGE 8.
- INSTALL PROPOSED BEARINGS.
- CLOSE BRIDGE TO TRAFFIC.
- LOWER TRUSSES ONTO NEW BEARINGS.
- REOPEN BRIDGE TO TRAFFIC.

CONSTRUCTION SEQUENCE STAGE 9:

- REMOVE THE TEMPORARY TRUSS SUPPORT SYSTEM.
- INSTALL REINFORCEMENT AND FORMWORK FOR THE STRUTS BETWEEN COLUMNS 1 AND 2 AND COLUMNS 2 AND 3.
- PLACE CONCRETE IN PROPOSED STRUTS.
- REMOVE TRUSS MONITORING DEVICES.
- REMOVE TEMPORARY SHEETING WHEN APPROPRIATE.
- RESTORE GROUND LINE TO EXISTING GRADE.

REFERENCES:

✓ FOR REFERENCES, SEE DWG. P14-006.

CONTROL SECTION	FOR NO. 004-006
DESIGNED BY: R. THOMPSON	CHECKED BY: S. GAJOS
APPROVED BY: P. GOLDOVERKY	APPROVED BY: S. WILLIAMS

DWG. P74-03

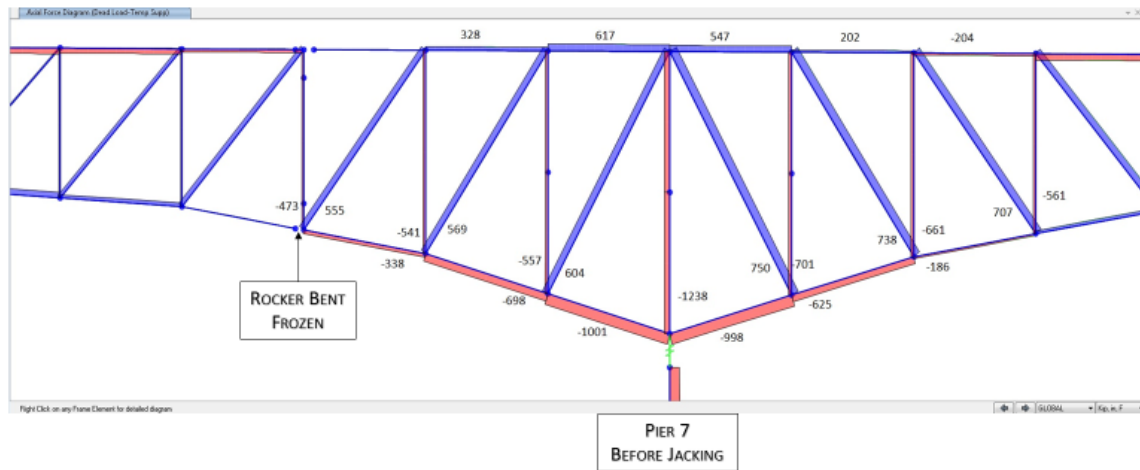
NEW JERSEY DEPARTMENT OF TRANSPORTATION
BUREAU OF STRUCTURAL ENGINEERING

**PIER 74
CONSTRUCTION SEQUENCE - 3**

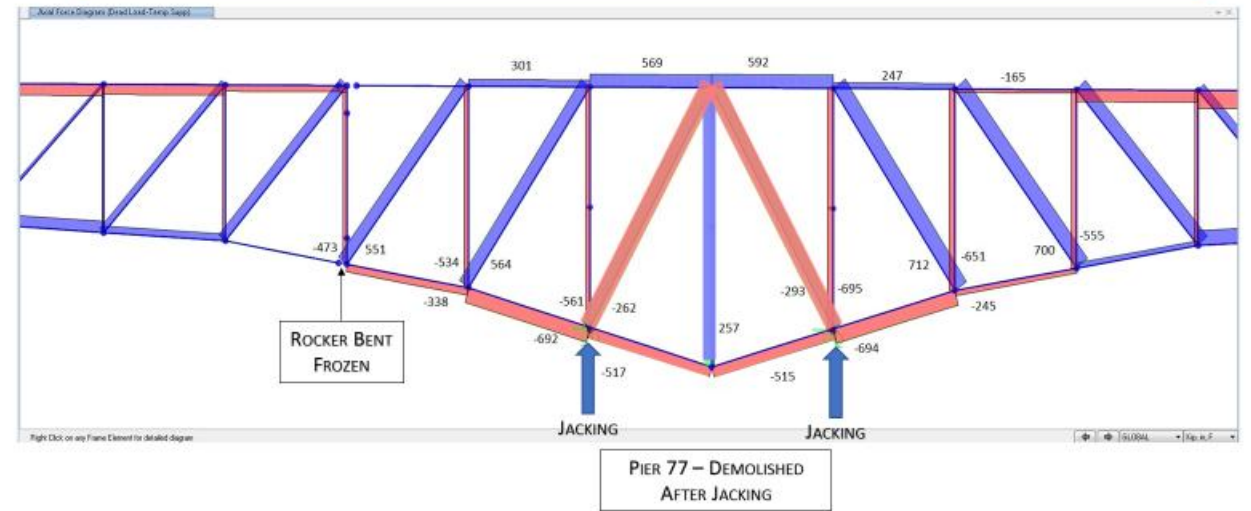
ROUTE U.S. 189 (PULASKI SKYWAY),
CONTRACT 6A
CONTRACT NO. 051123280

Pier Replacement: Variation in DL Forces During Jacking of the Trusses

Dead Load Forces Before Jacking – Rocker Bent Frozen

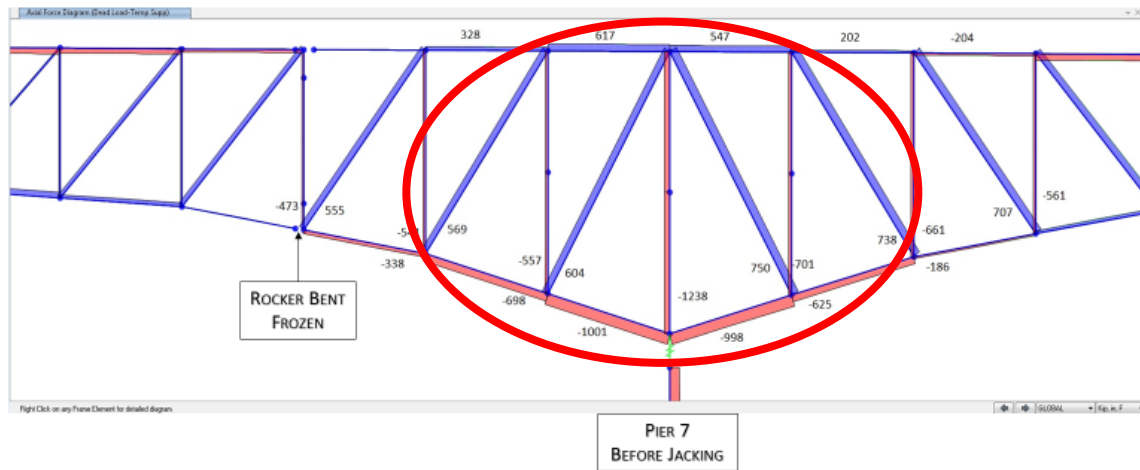


Dead Load Forces After Jacking – Rocker Bent Frozen

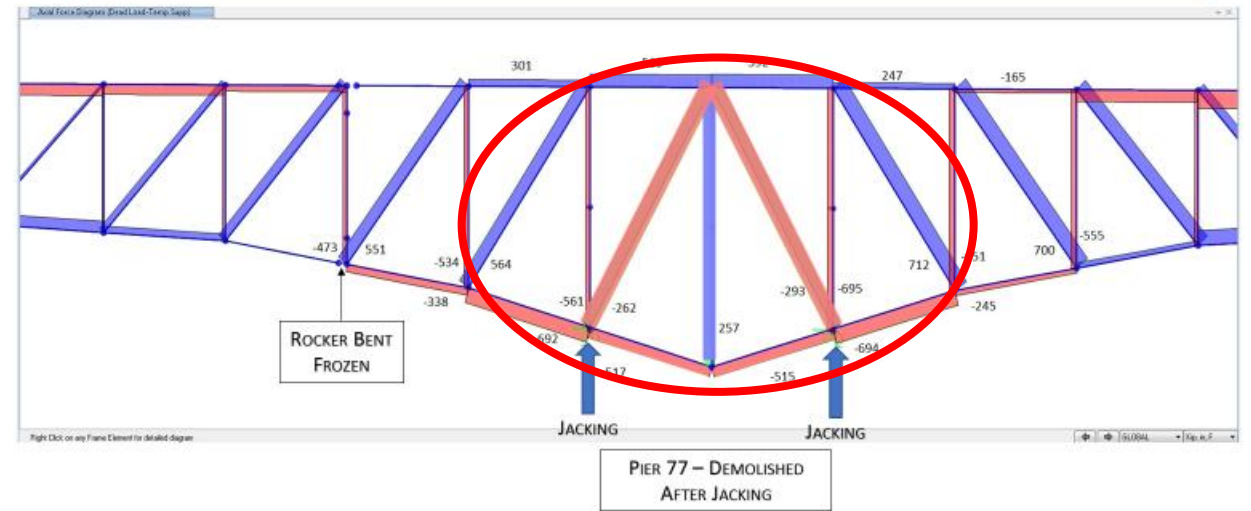


Pier Replacement: Variation in DL Forces During Jacking of the Trusses

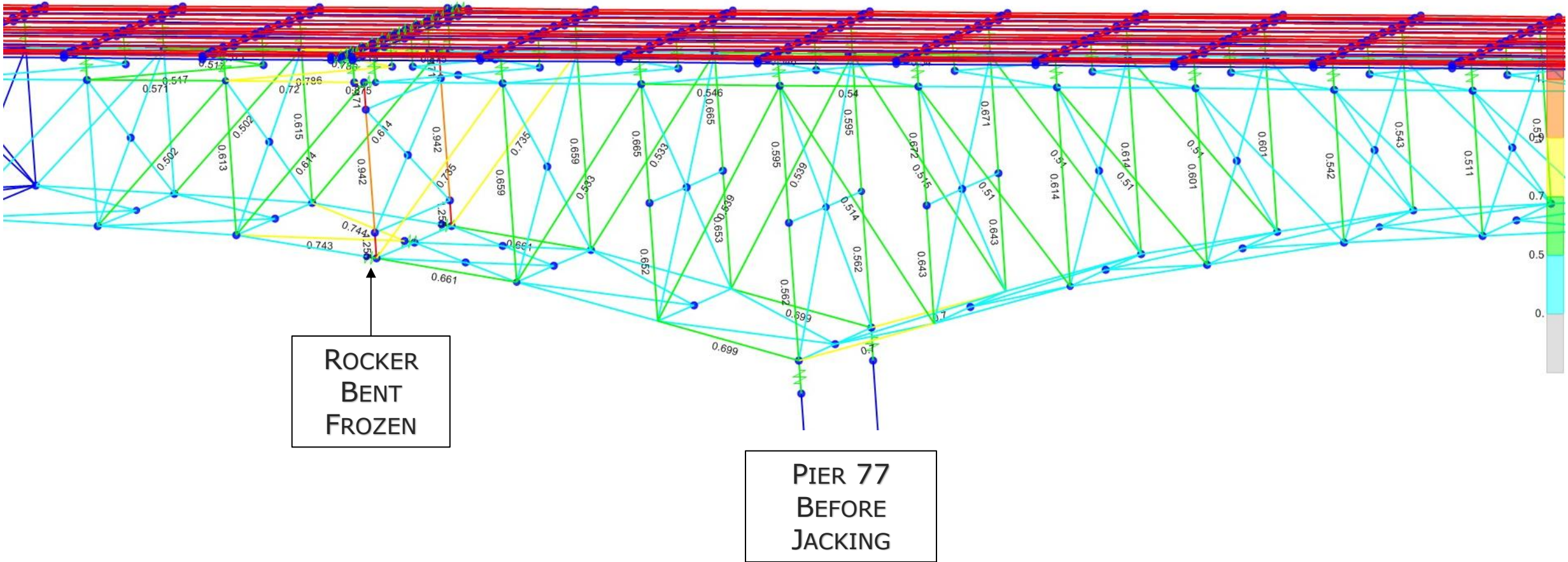
Dead Load Forces Before Jacking – Rocker Bent Frozen



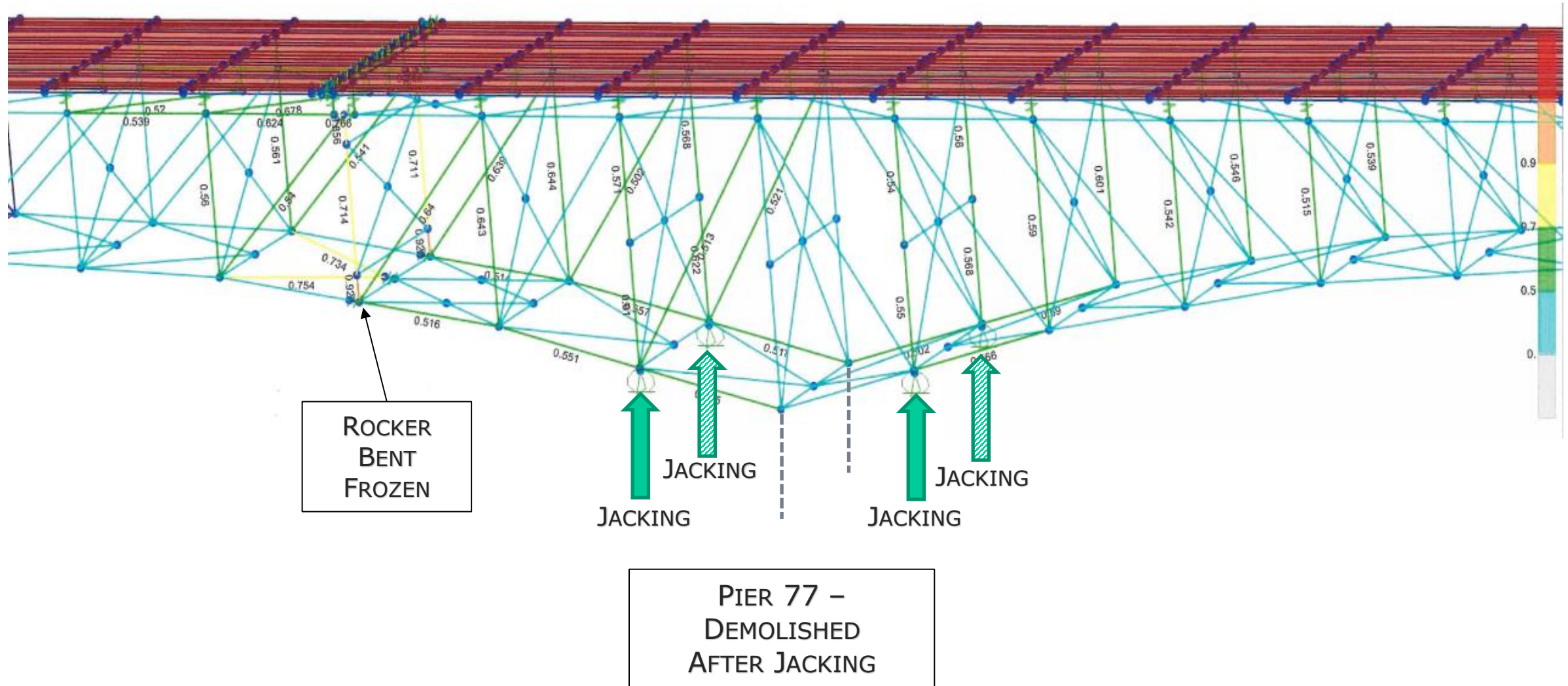
Dead Load Forces After Jacking – Rocker Bent Frozen



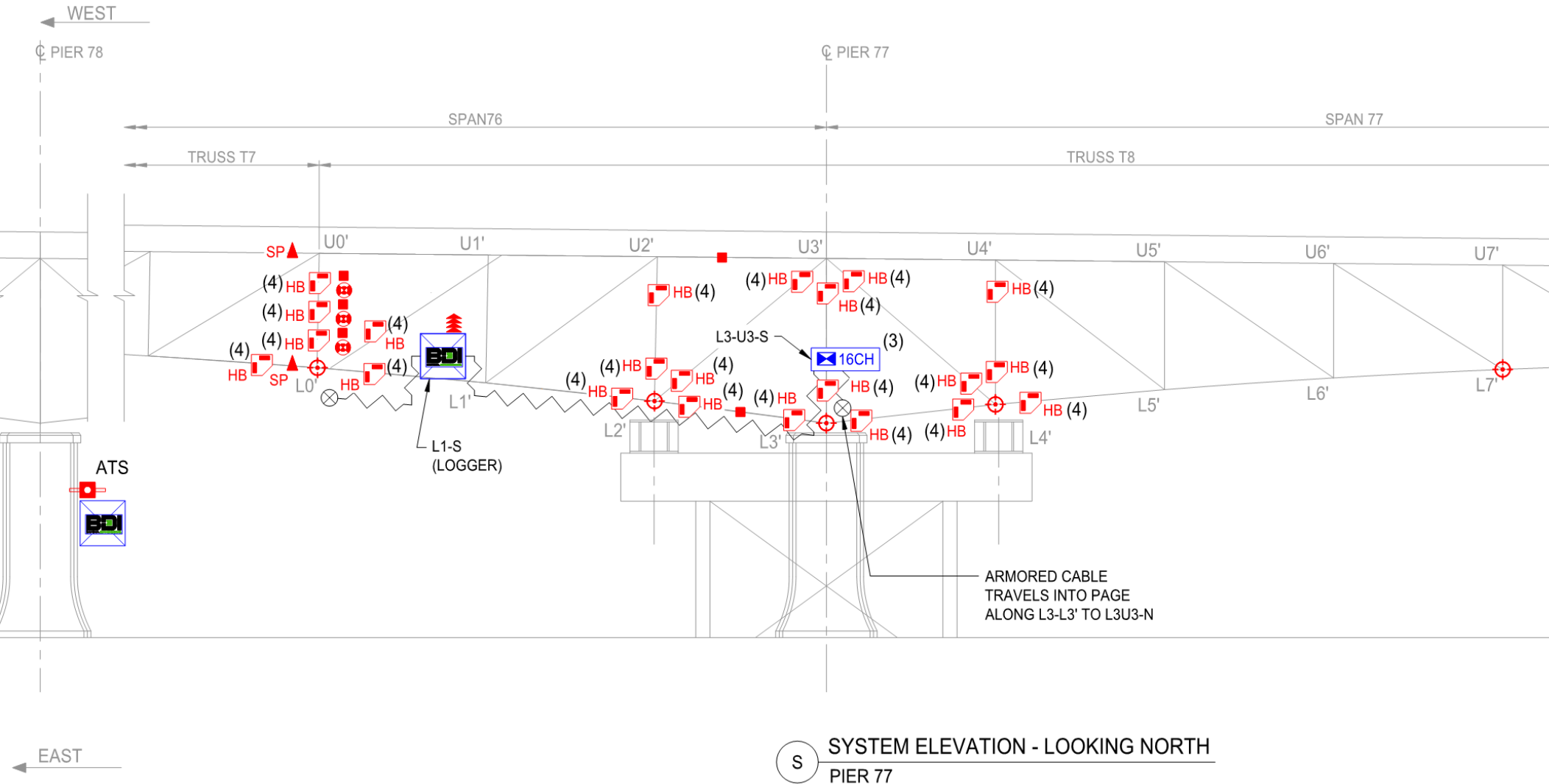
Pier Replacement: D/C – Before Jacking – All Load Cases Considered



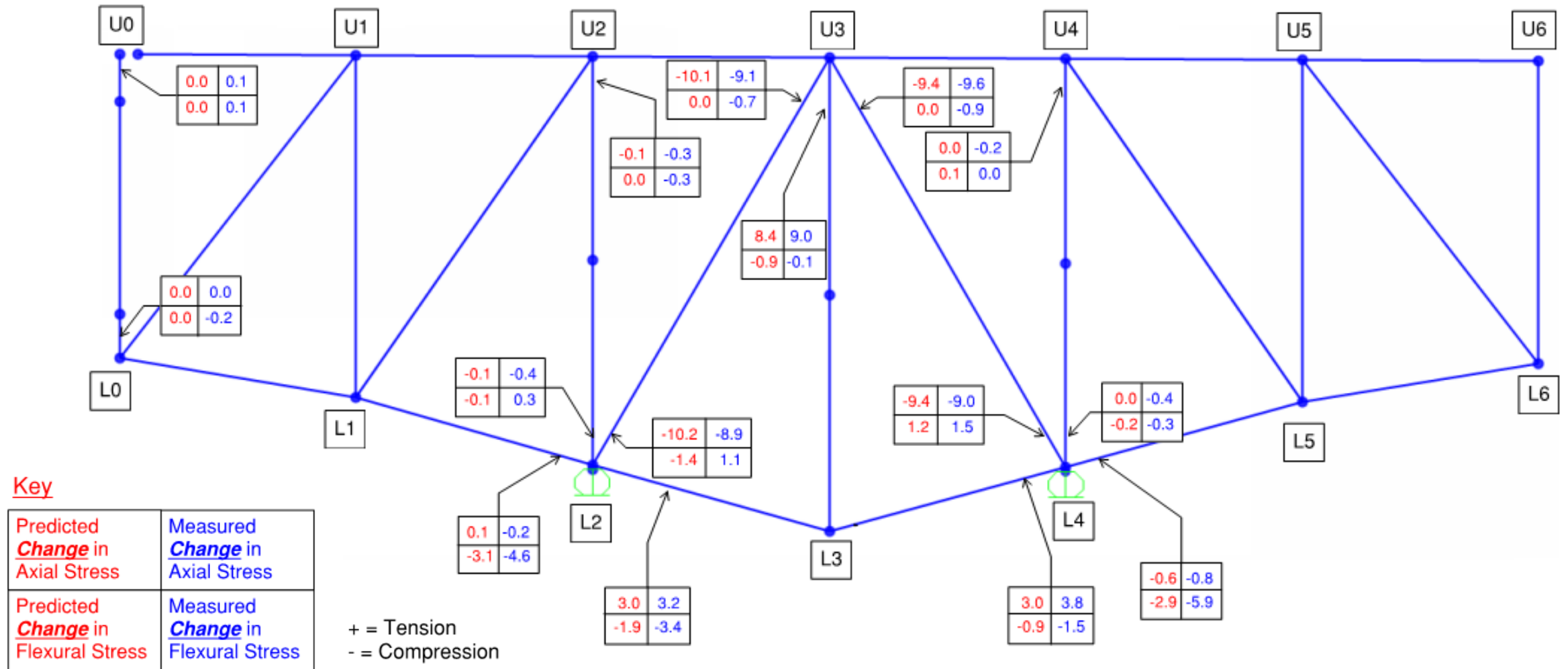
Pier Replacement: D/C for After Jacking – All Load Cases Considered



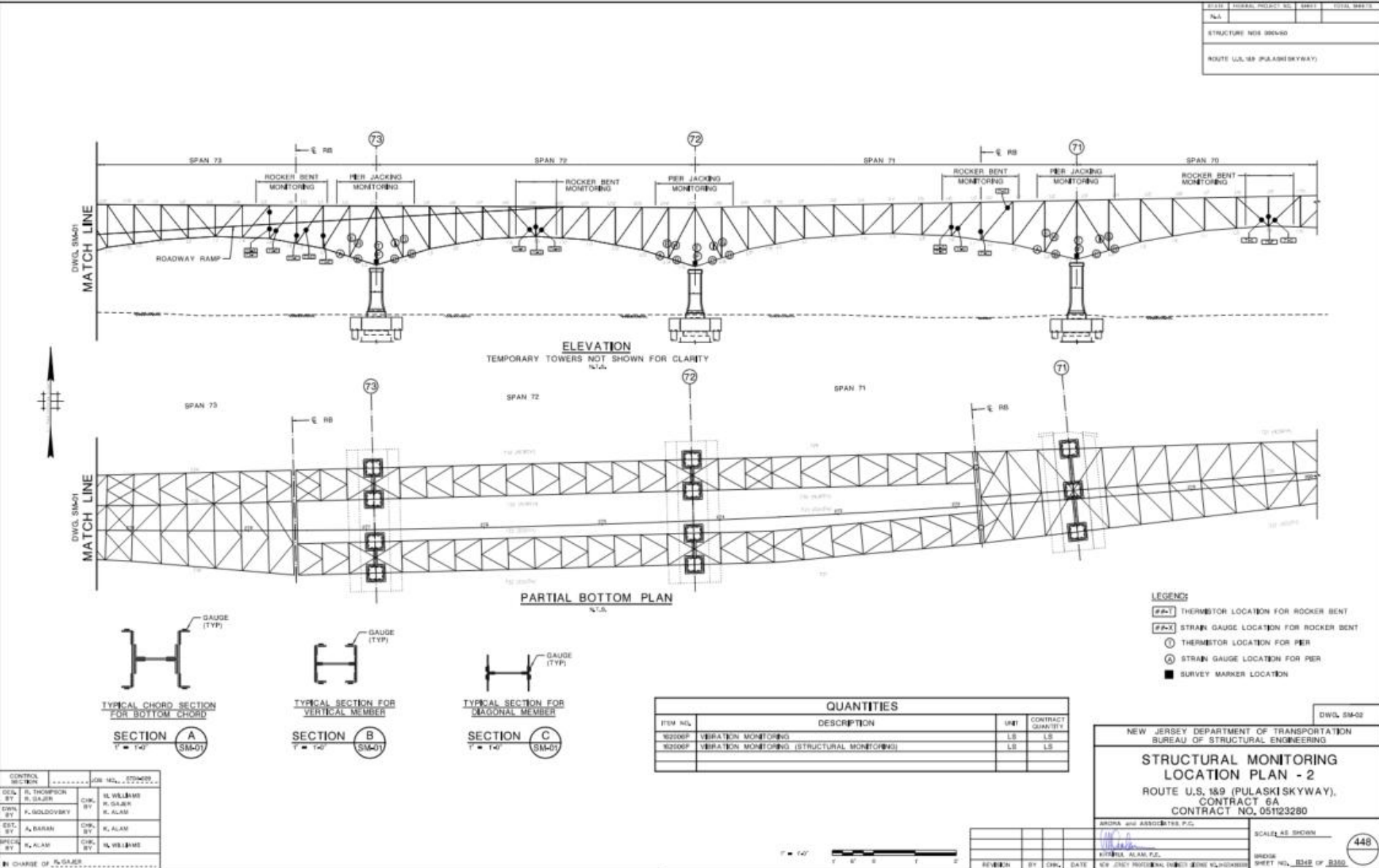
Pier Replacement: Monitoring at Pier 77 Instrumentation Plan Developed by Arora



Pier Replacement: $\Delta\sigma = \text{Change}$ in Stress Due to Jacking Operation ONLY



Structural Monitoring Plan

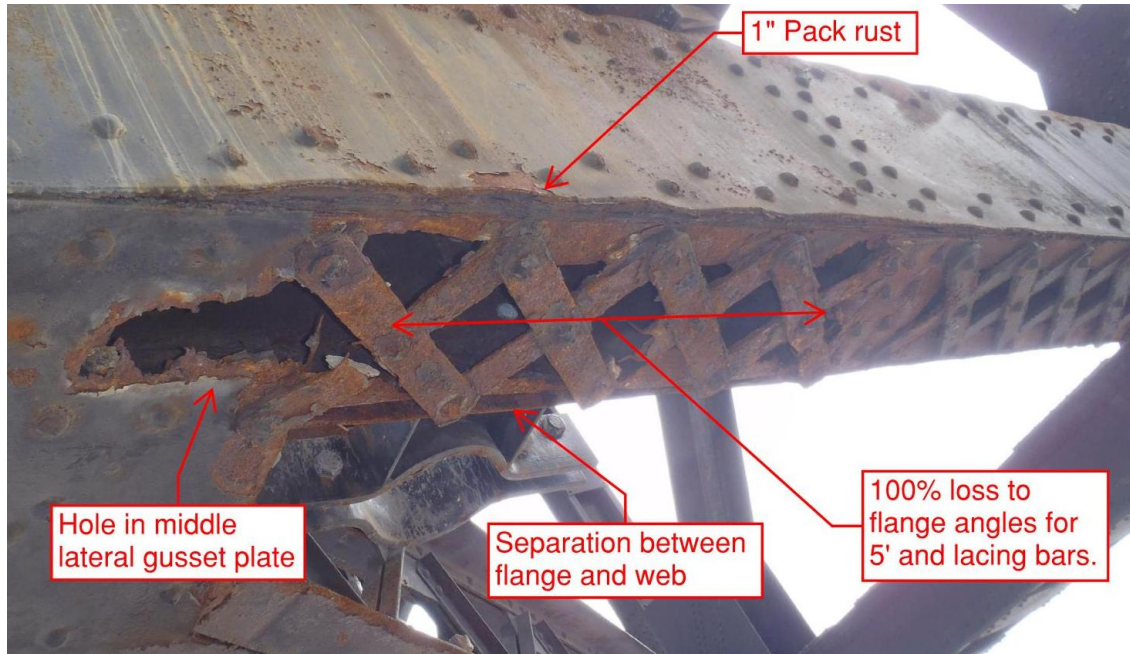


Replacement of the Kearny Ramp within the limits of C6

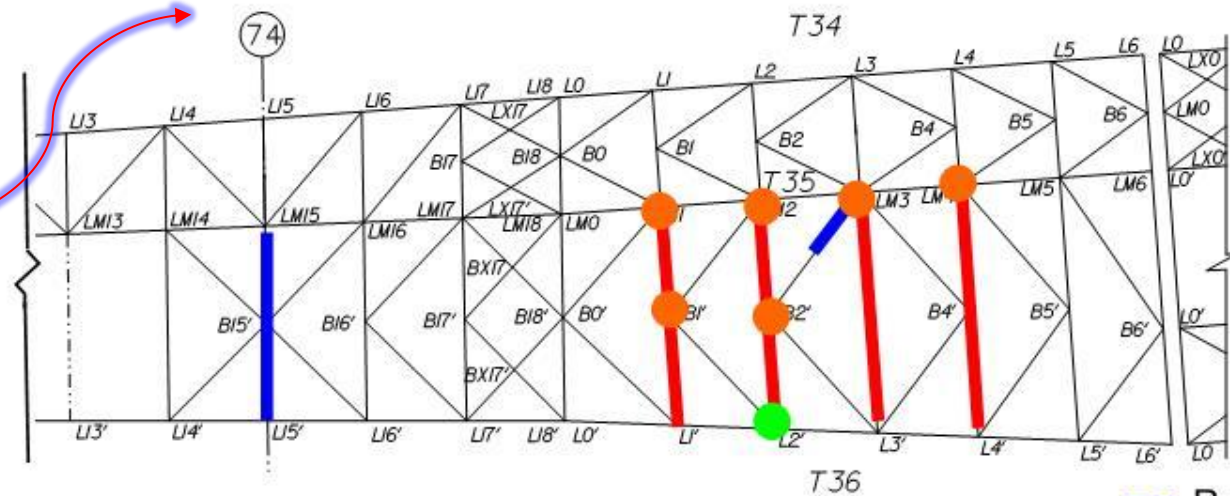
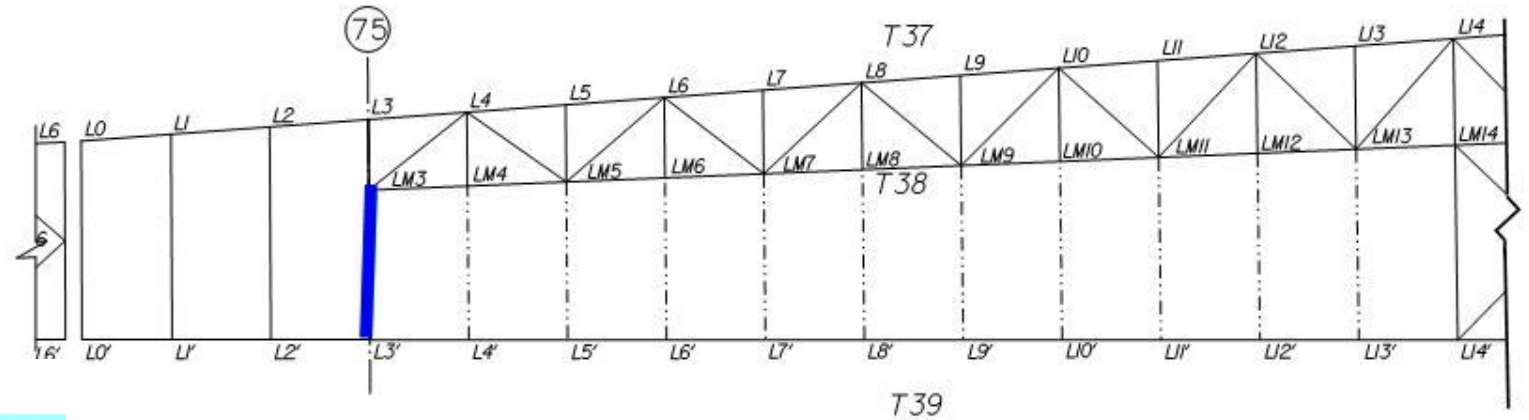
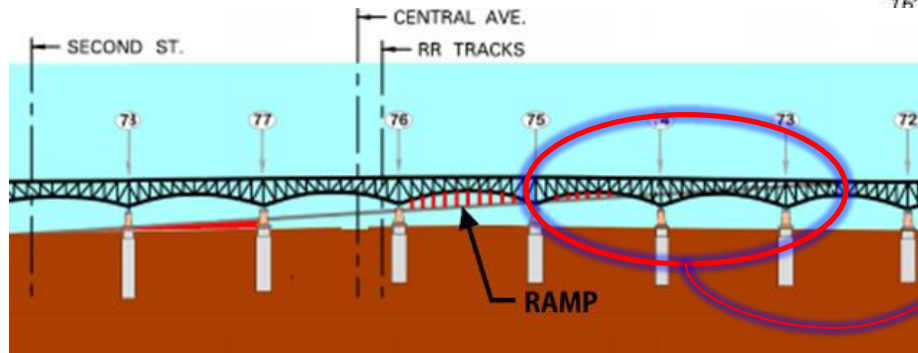
- ❖ As part of the global rehabilitation, the Ramp within the limits of C6 was replaced.
- ❖ Structural Inspection of the Trusses after removal of the Ramp revealed additional deterioration not visible w/o removal of Ramp.



The diagram shows a cross-section of the bridge structure. The bridge deck is supported by several piers. A ramp is indicated by a red arrow pointing to a section of the bridge deck. A red oval highlights the area of interest, which is the section of the bridge deck between piers 75 and 73. The diagram also shows the location of Central Ave. and RR Tracks.



Truss Rehabilitation-Inspection Recommendations

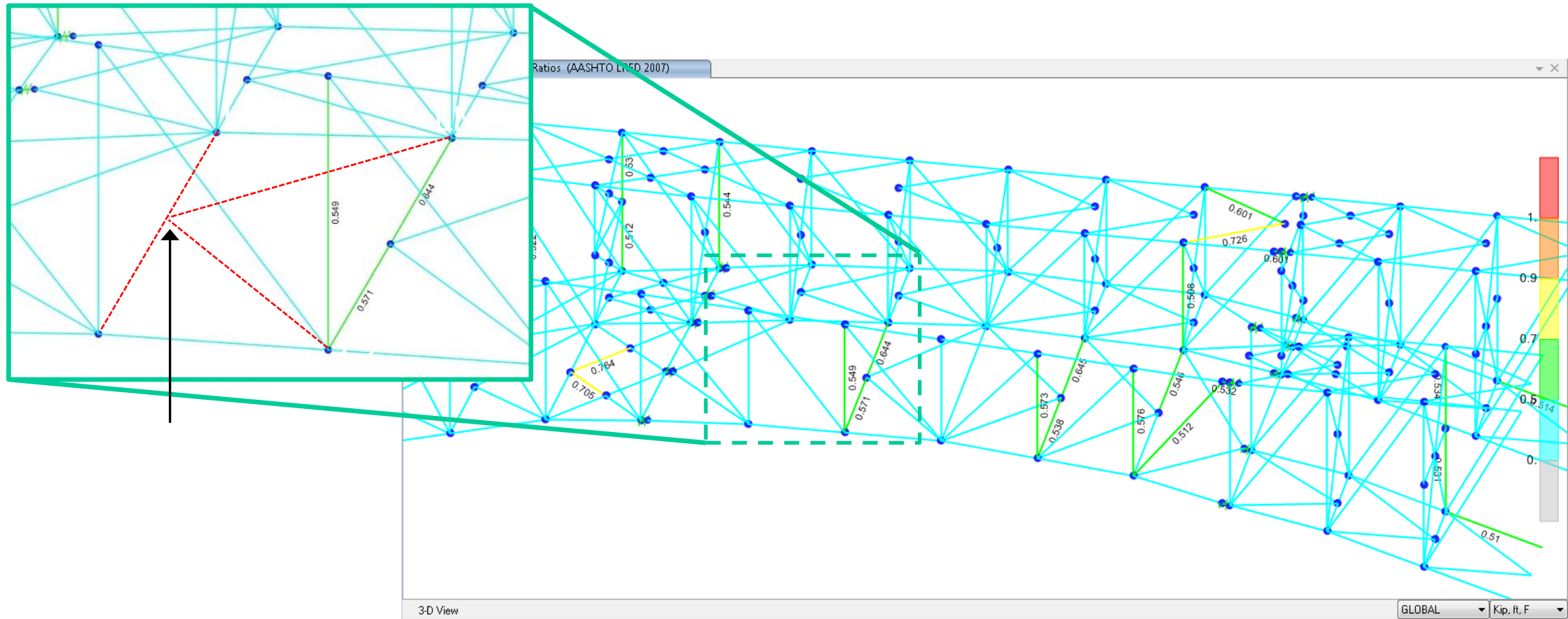


BOTTOM LATERALS

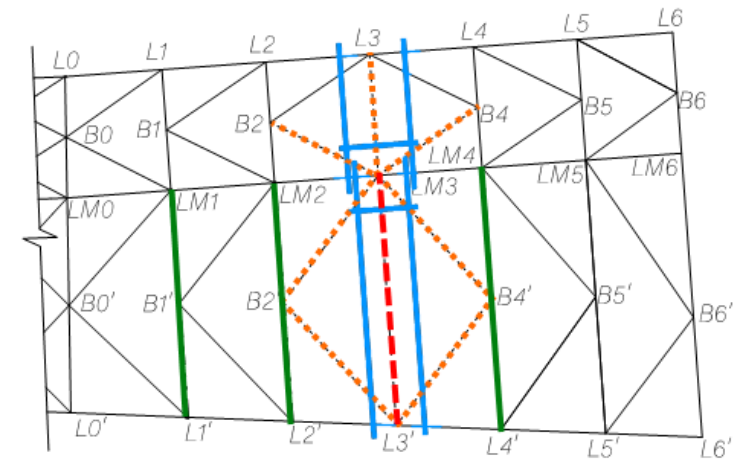
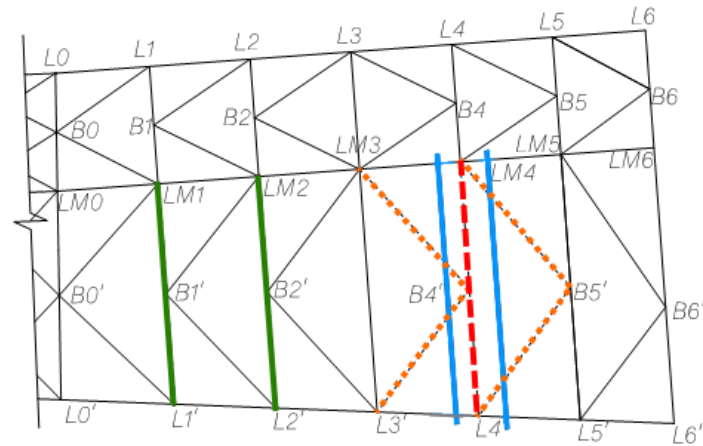
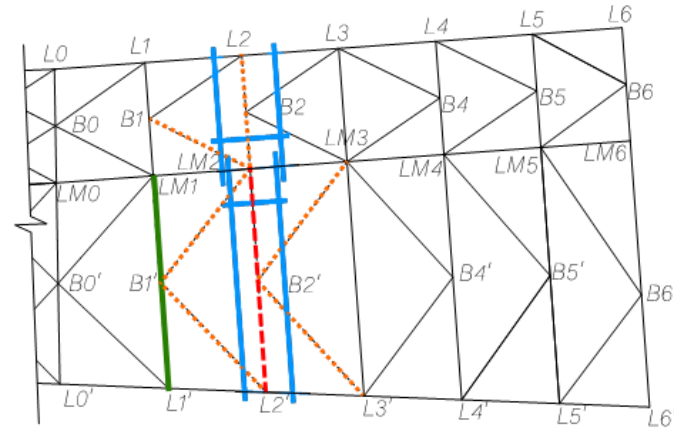
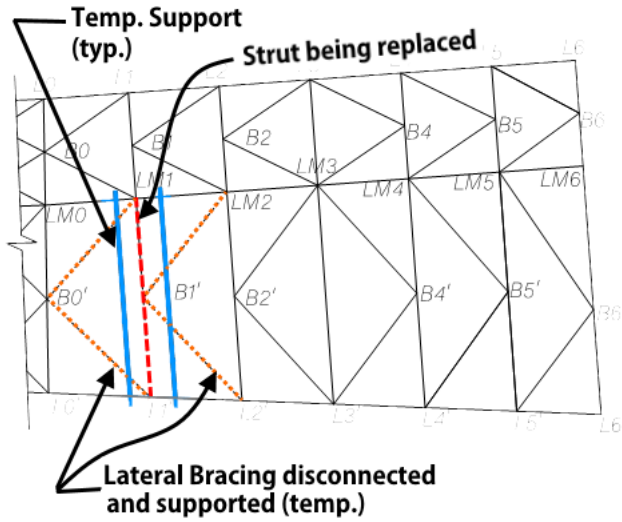
1" = 25'

- █ Repair Member
- █ Replace Member
- Repair Gusset
- Replace Gusset

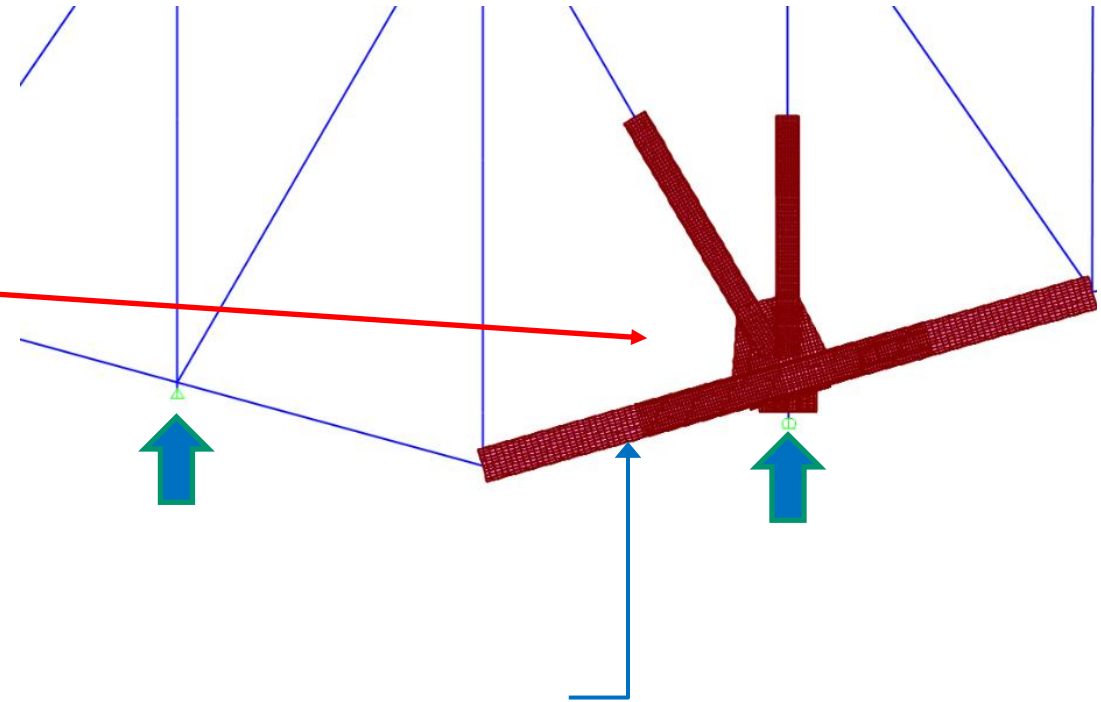
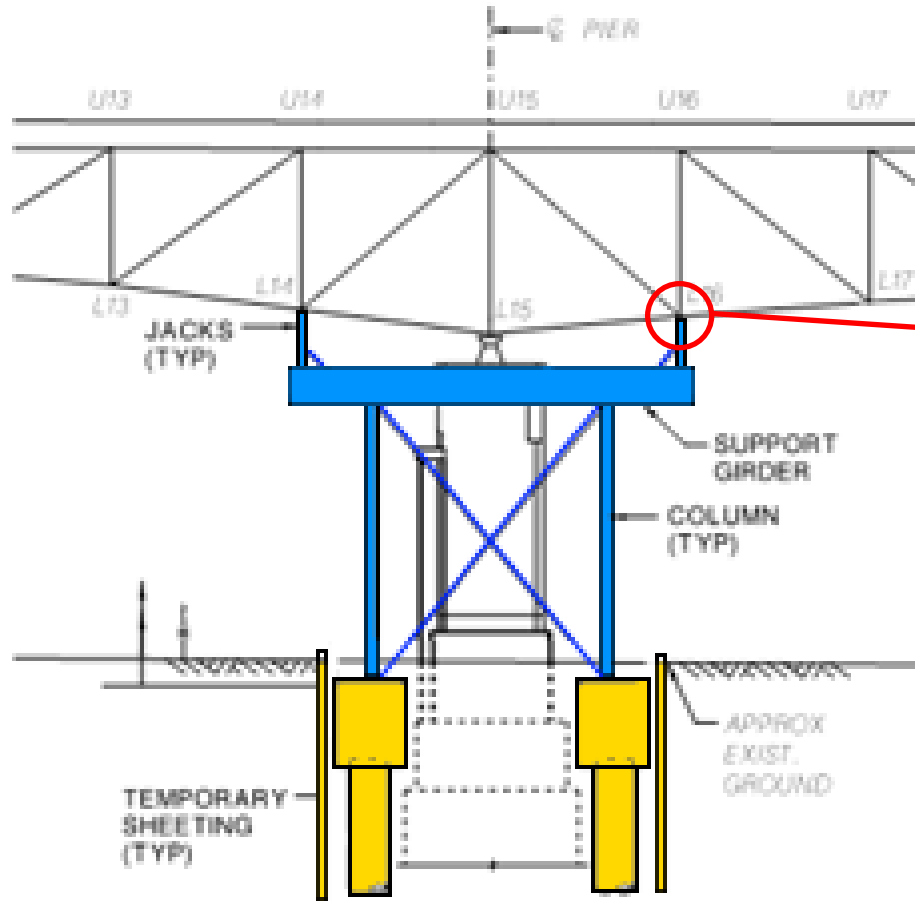
Truss Rehabilitation: CSiBridge Modeling and Analyses to Develop Construction Sequence



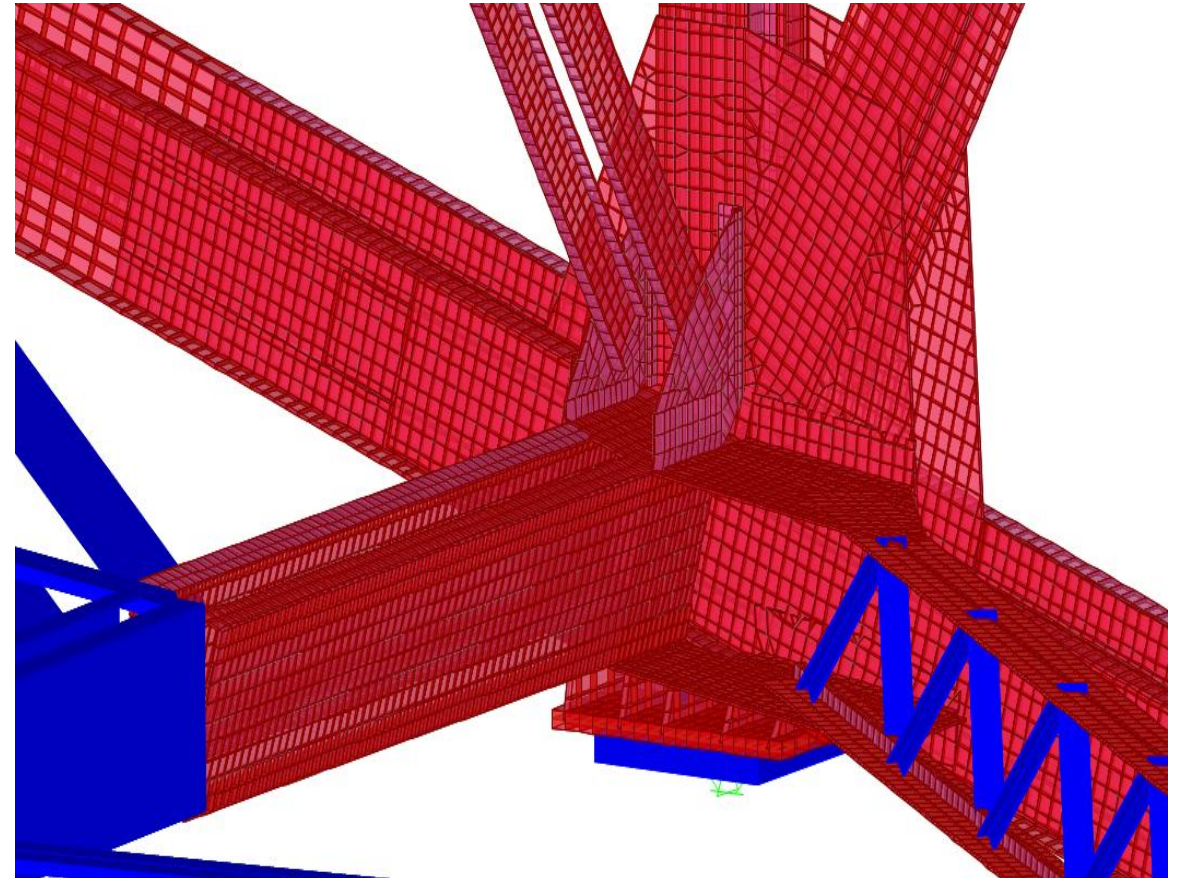
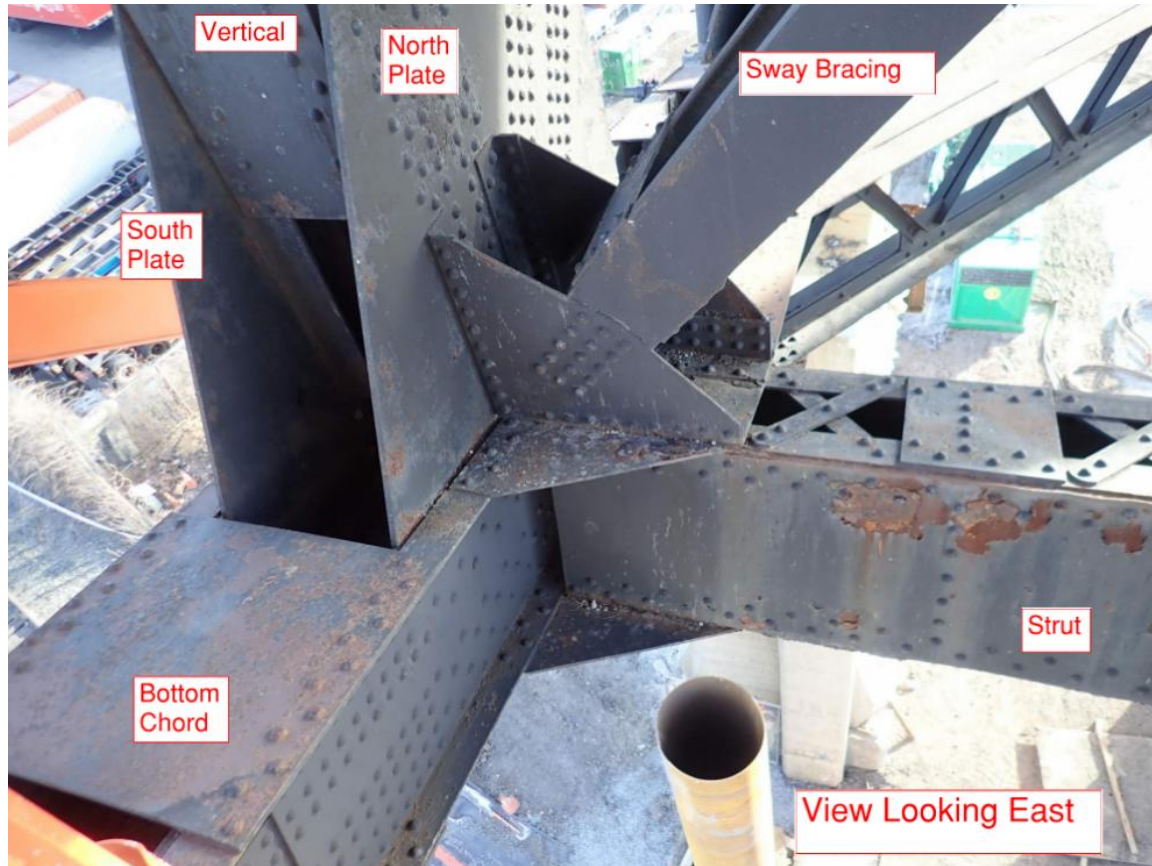
Truss Rehabilitation: Construction Staging



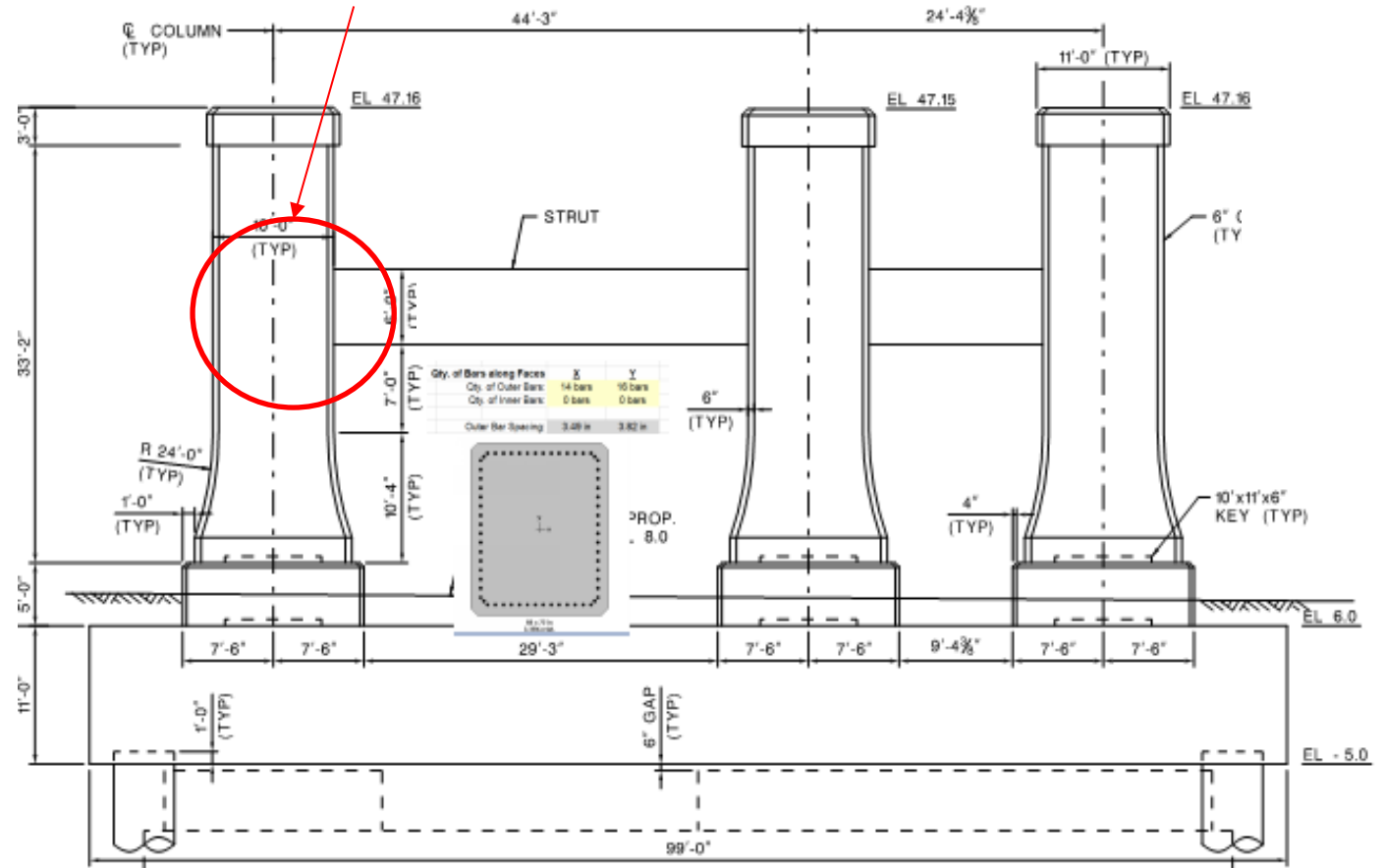
Truss Rehabilitation: Jacking of the Trusses- Complex FEA



Truss Rehabilitation- Complex FEA to Design Difficult Gusset Plates Retrofit

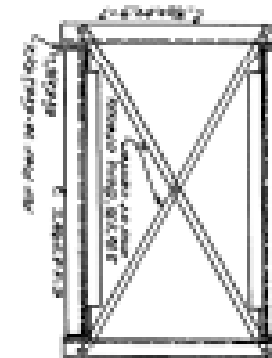
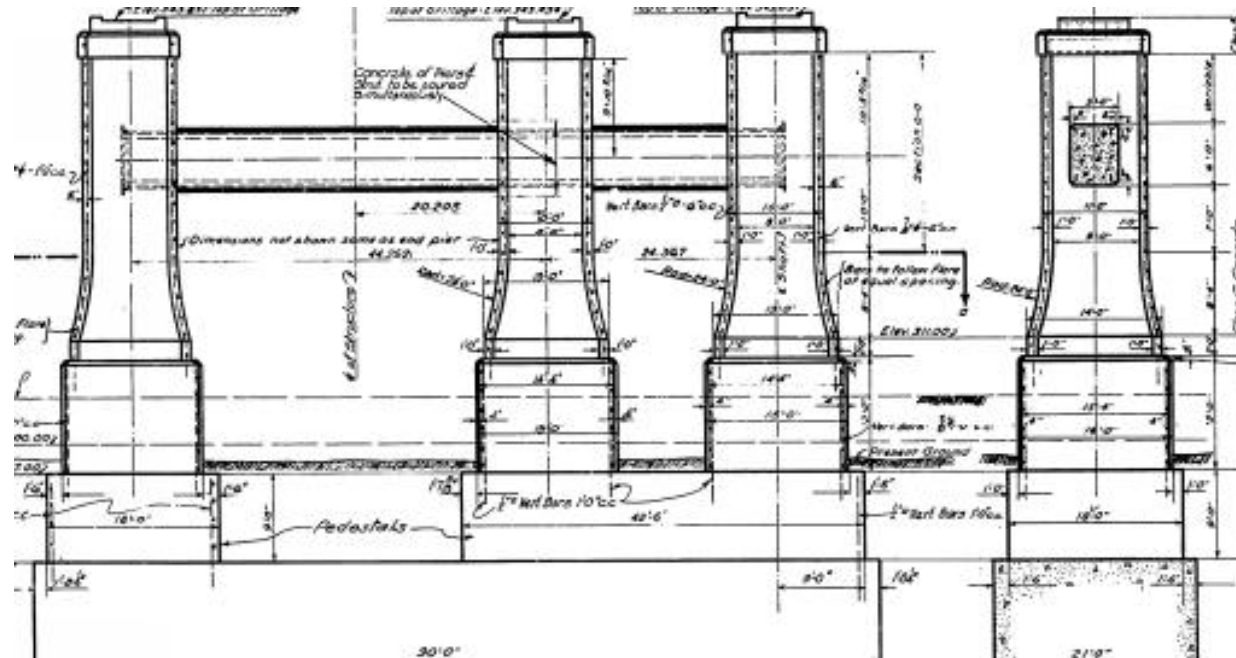


Congestion



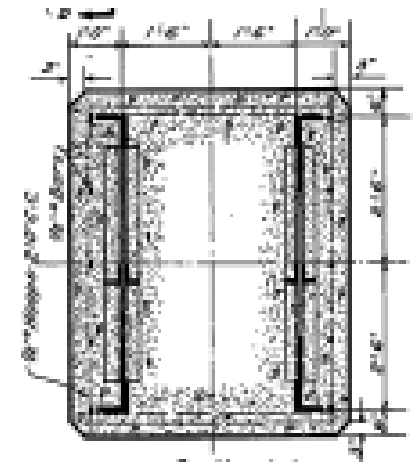
ARORA and ASSOCIATES, P.C.
Consulting Engineers

Pier 74 Strut



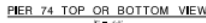
ELEVATION

Reinforce in Top & Bottom portion
1/4" at other 1/4"



DETAIL-STRUT-PIERS 71-75 ~ 77, 78, 79

FO - 22



PIER 74 STRUT ELEVATION

NOTES:

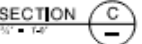
1. LAYOUT OF THE LONGITUDINAL REINFORCEMENT IN THE STRUT MEMBER SHOWN FOR SECTION A IS TYPICAL LONGITUDINAL REINFORCEMENT CALLED OUT IN OTHER SECTIONS OF THE STRUT



SECTION — A —



SECTION B
1/4" = 1'-0"



SECTION C

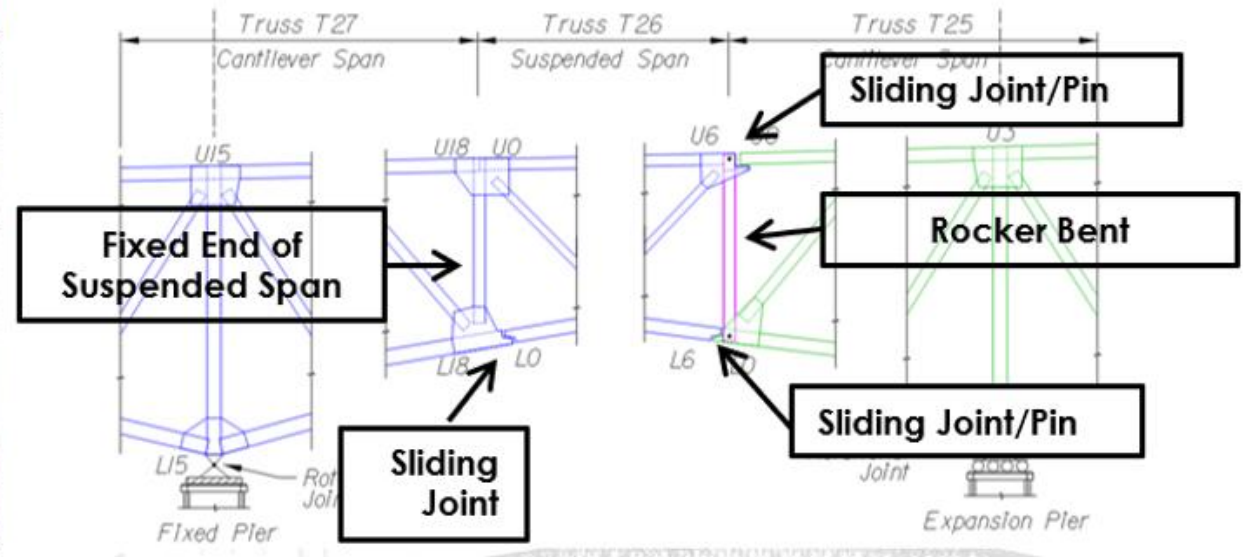
IN A NOTE:
4 AND STRUT
CEMENT NOT
IN THIS VIEW
ABILITY.

SECTION — A —

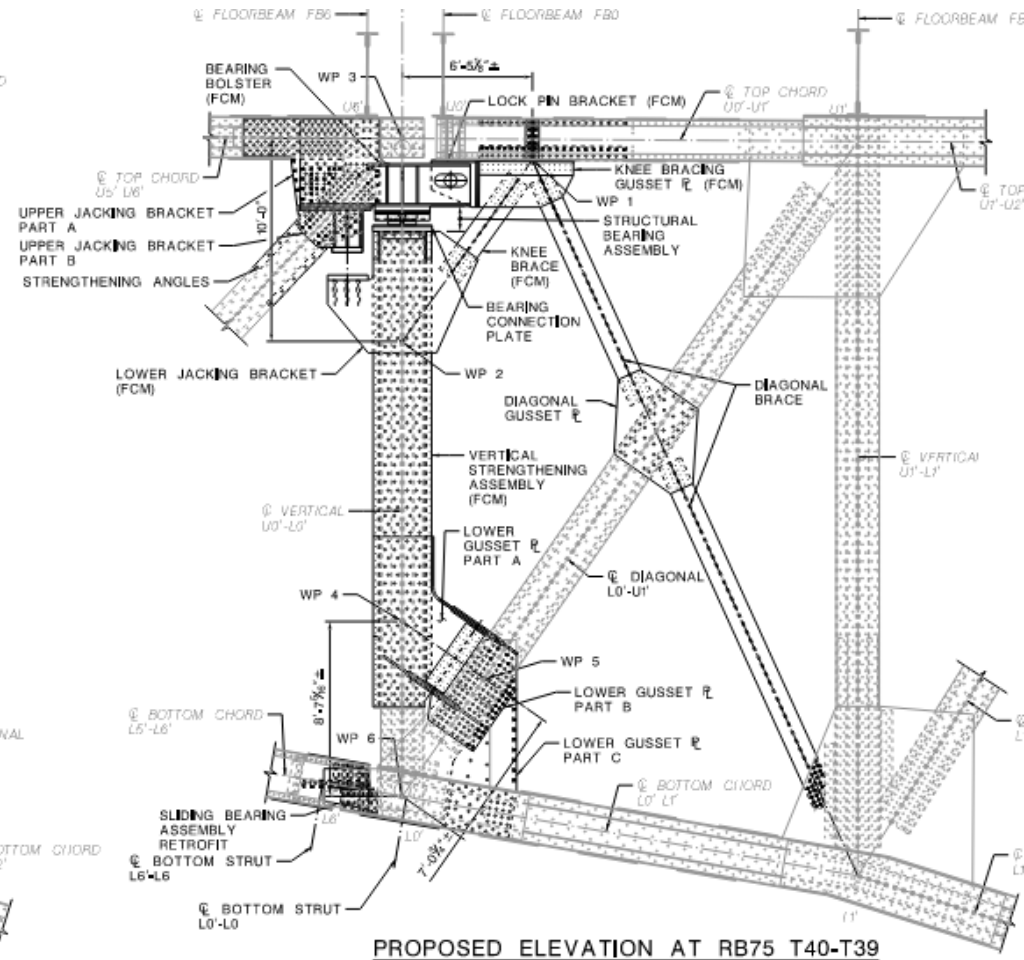
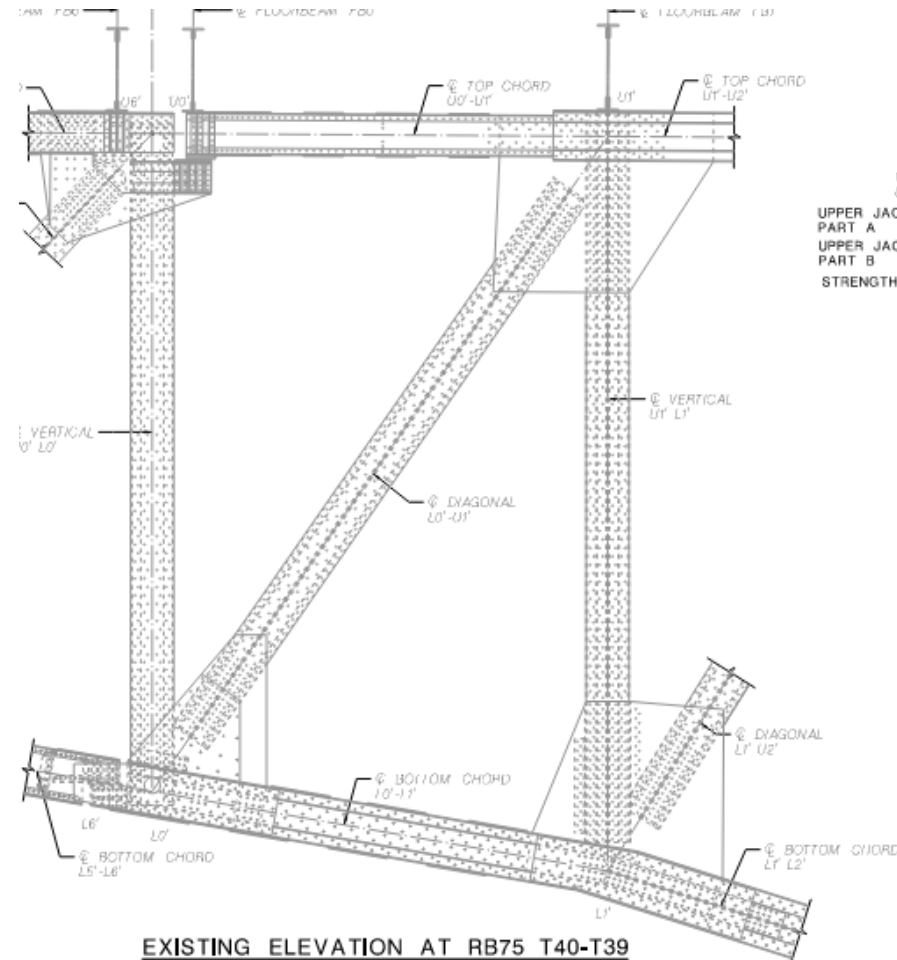
SECTION B
1/4" = 1'-0"

SECTION C

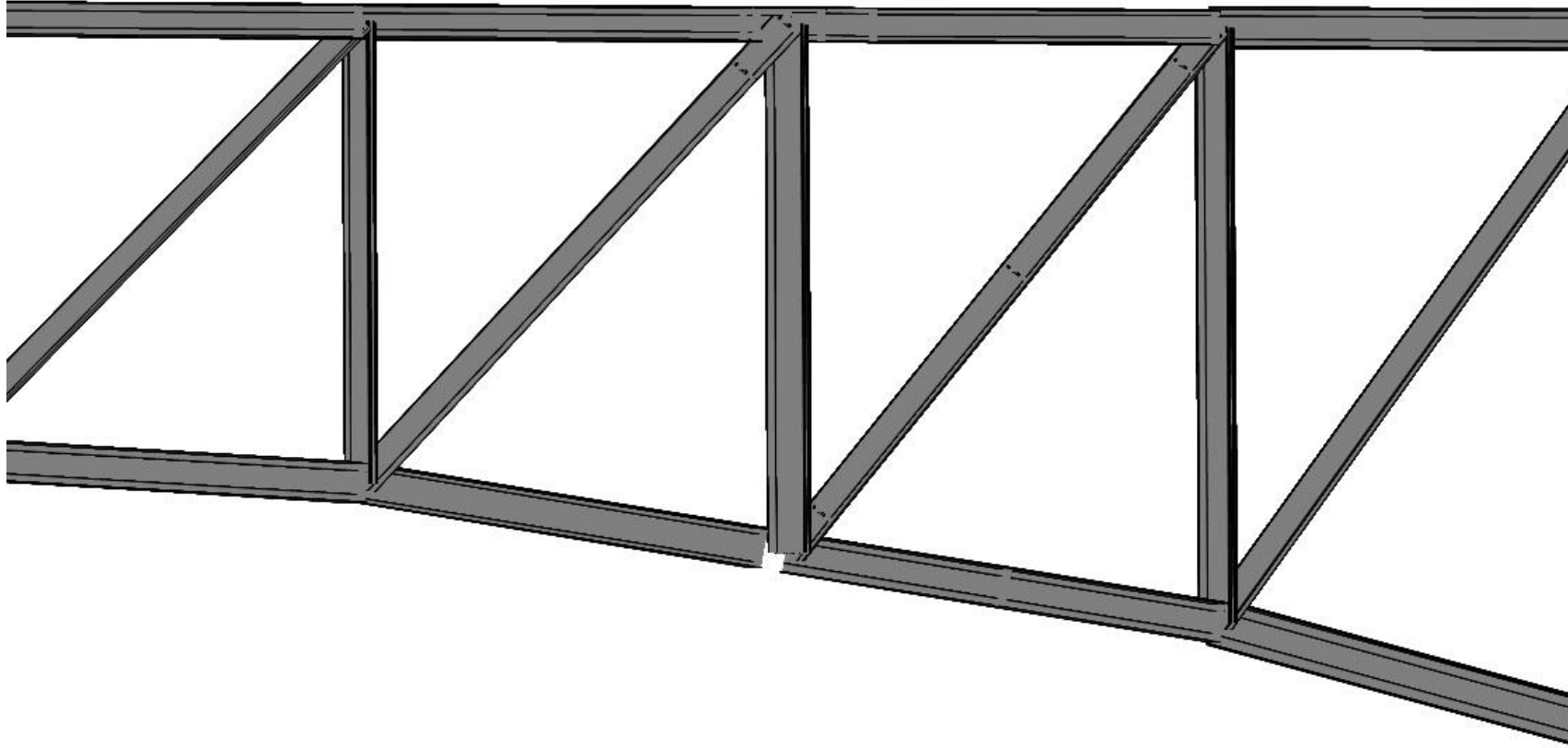
Typical Pulaski Deck Truss Rocker Bent



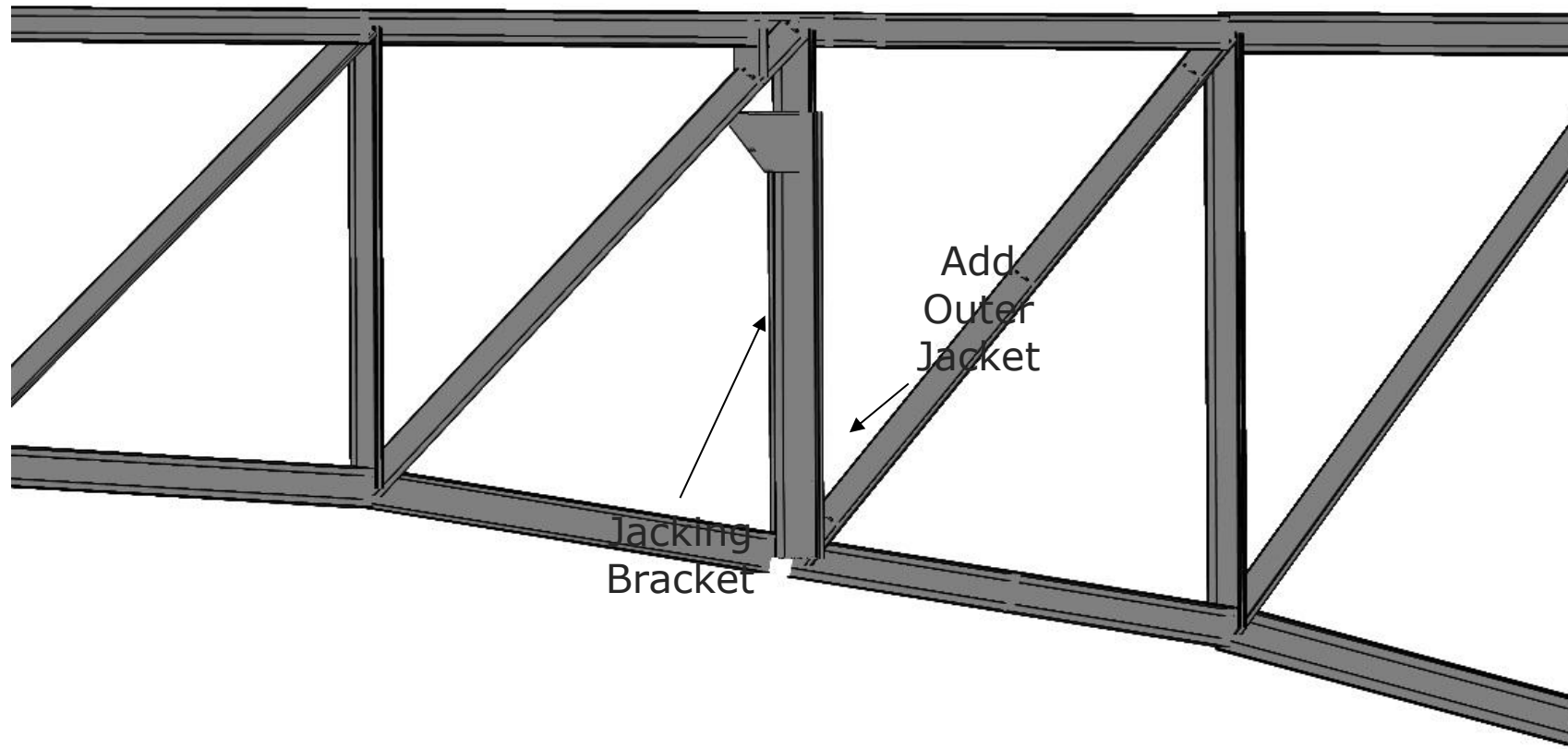
Typical Deck Truss Rocker Bent Rehabilitation



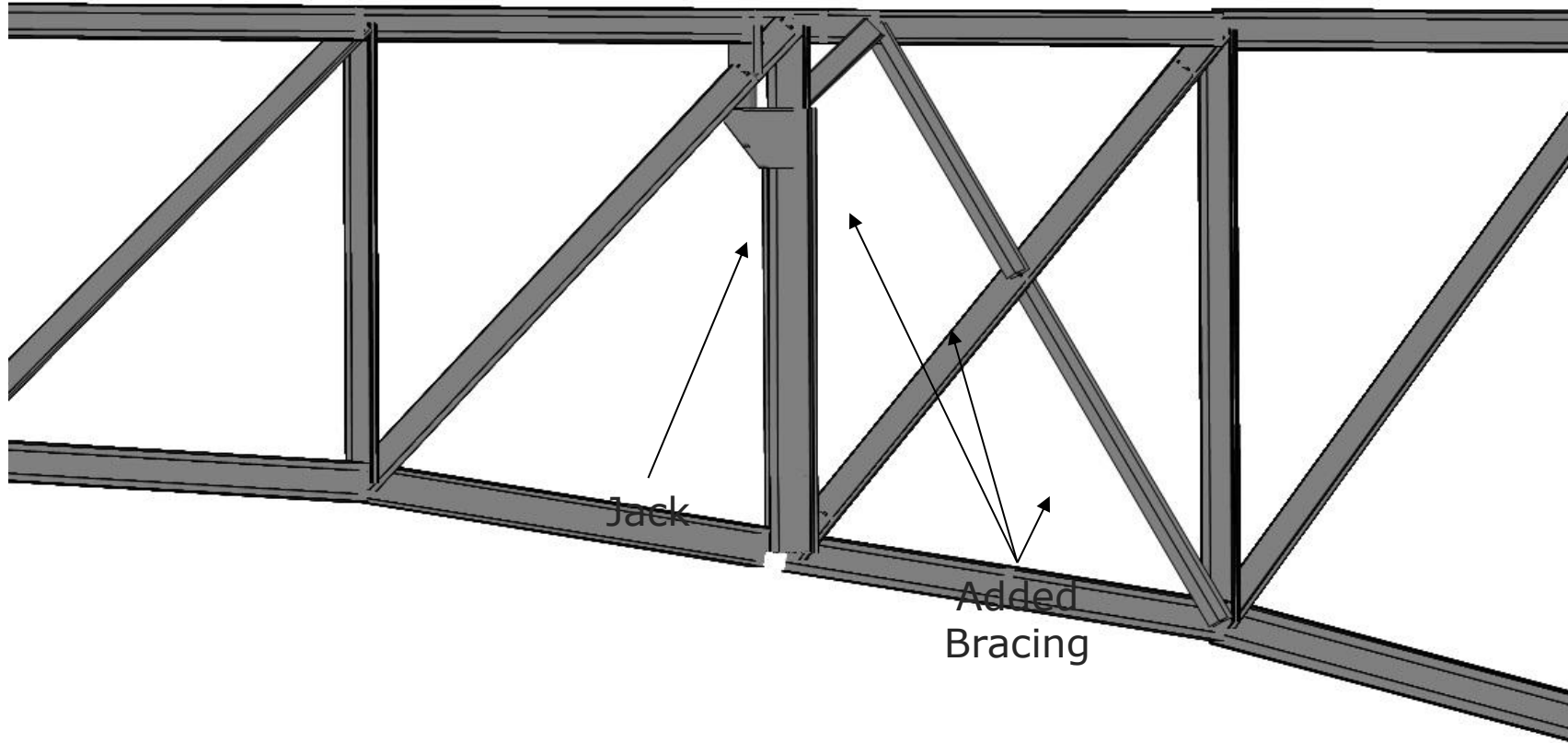
As-Built-CSiBridge Model (within Global Model)



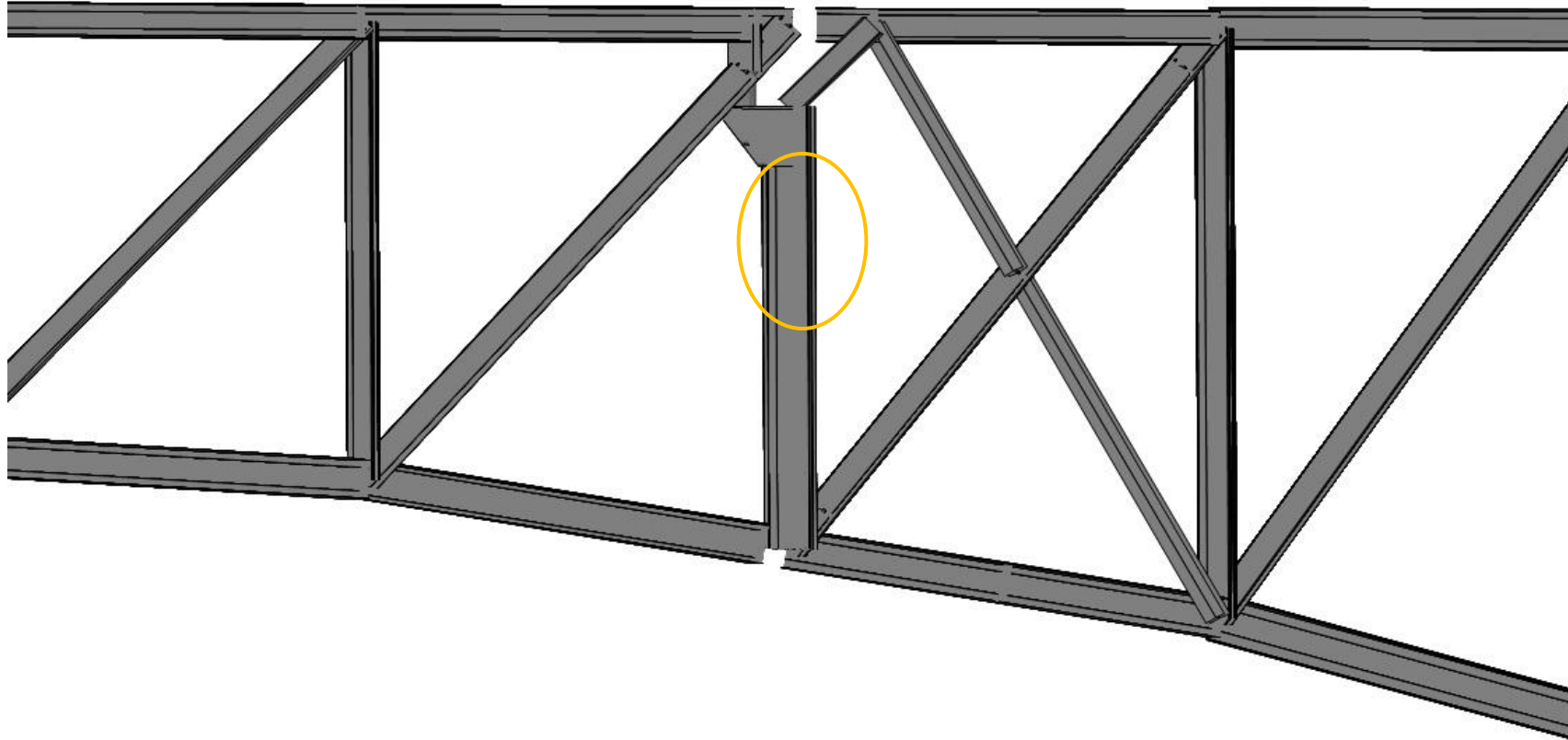
Staging - Strengthen Vertical (within Global Model)



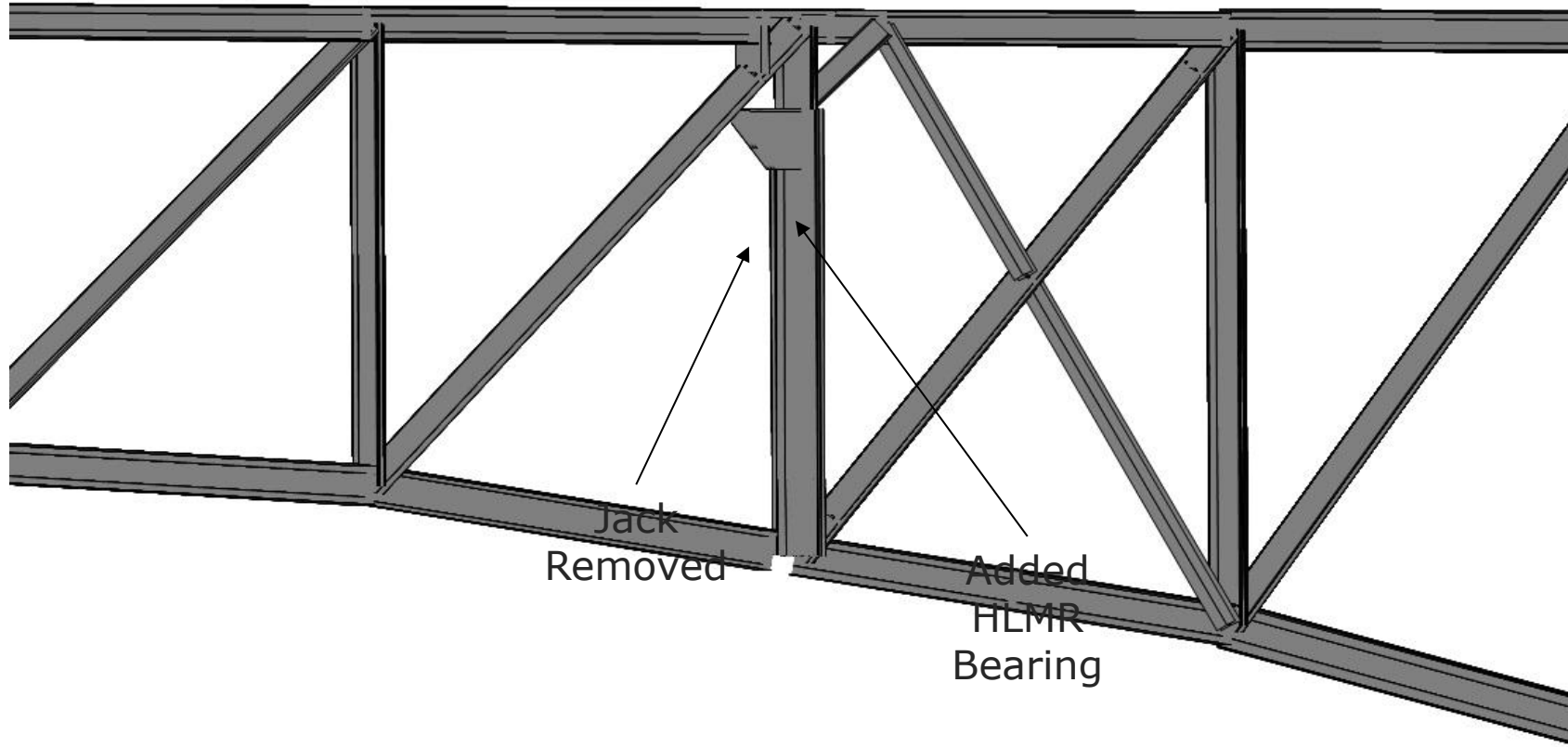
Add Diagonal Bracing and Jack- (within Global Model)



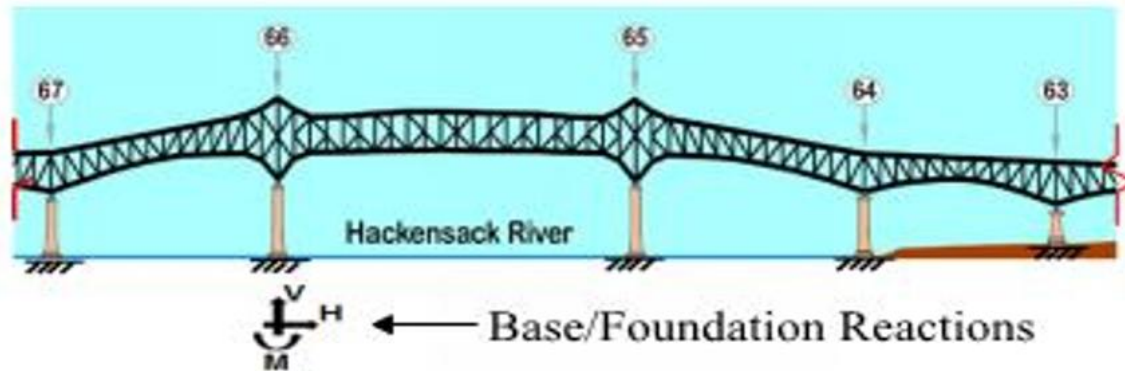
Cut Existing Vertical Top (within Global Model)



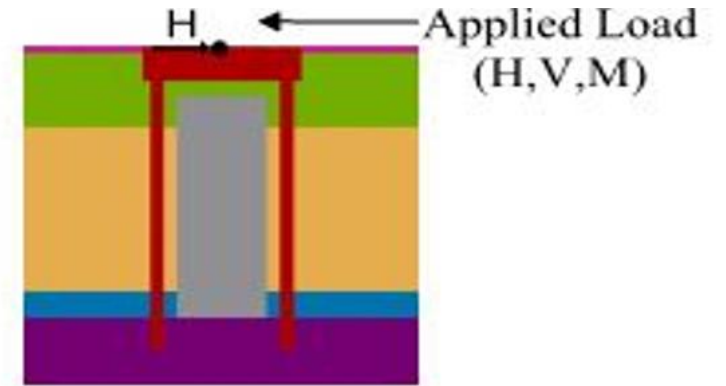
Replace Vertical Top with Bearing Final Condition



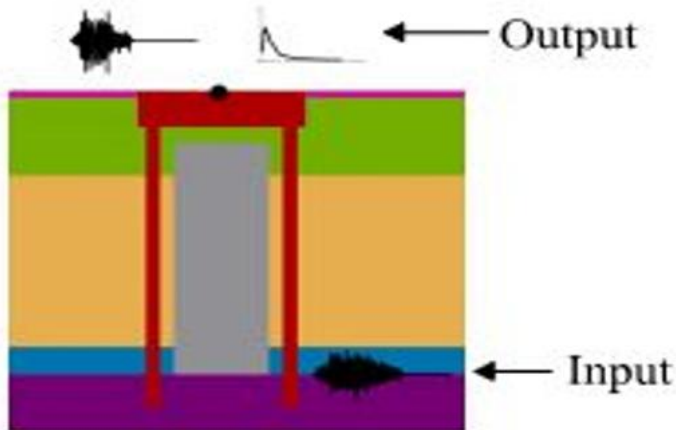
Seismic Analyses and Design



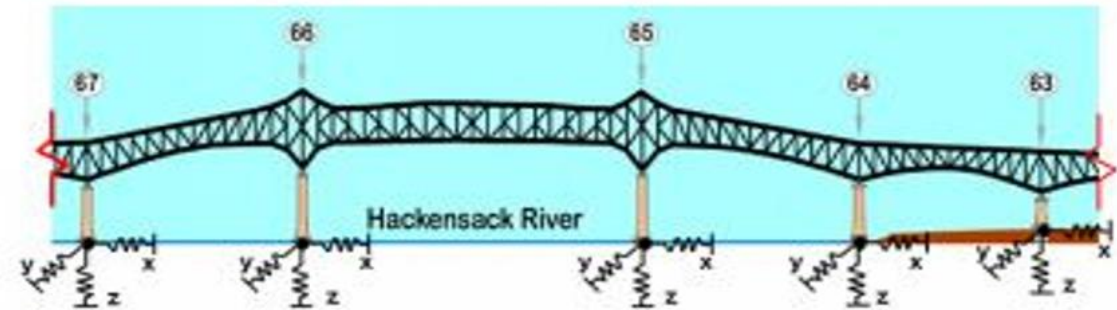
Step 1a - Analyze Bridge Supported on Fixed Base Foundations



Step 1b - Inertial Analysis of Foundation/Soil System

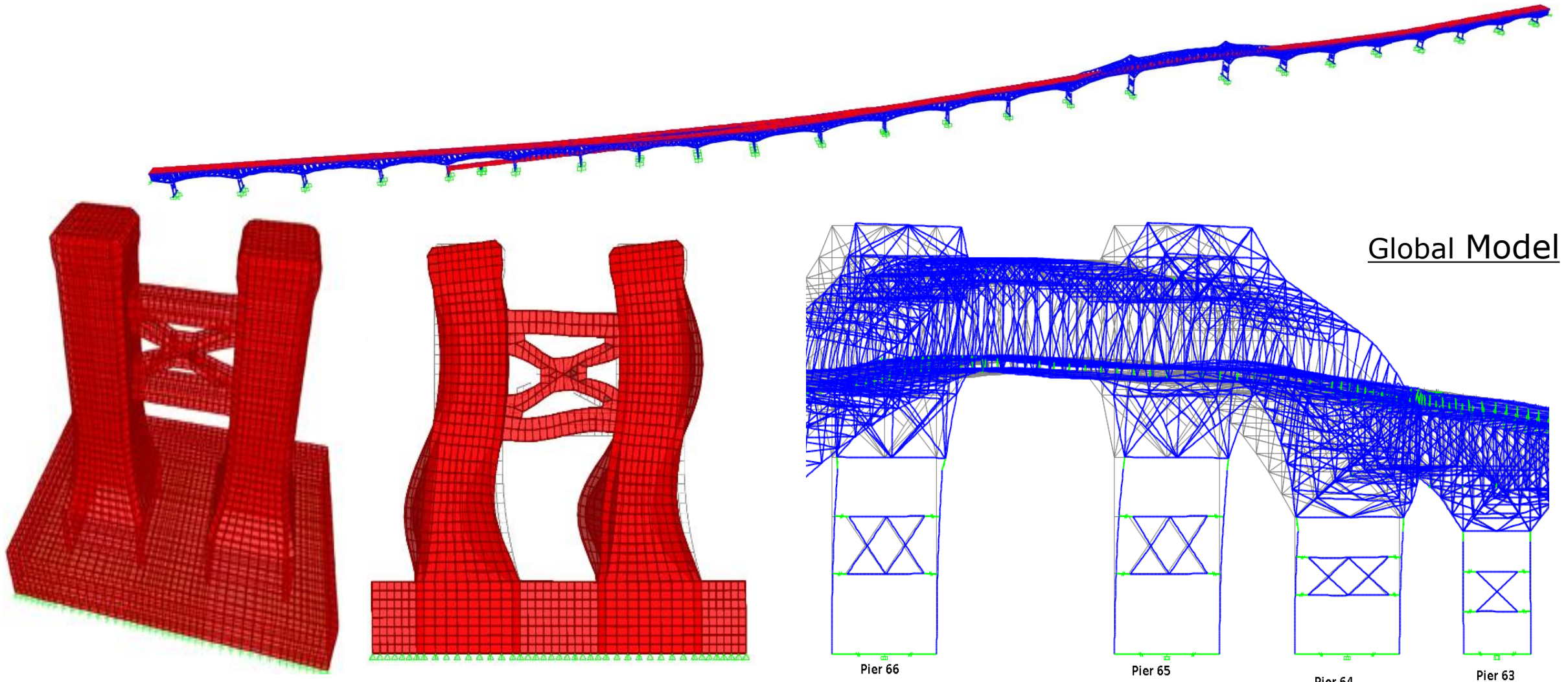


Step 2 - Kinematic Analysis of Foundation/Soil System



Step 3 - Analyze Bridge Supported on Foundation/Soil Springs

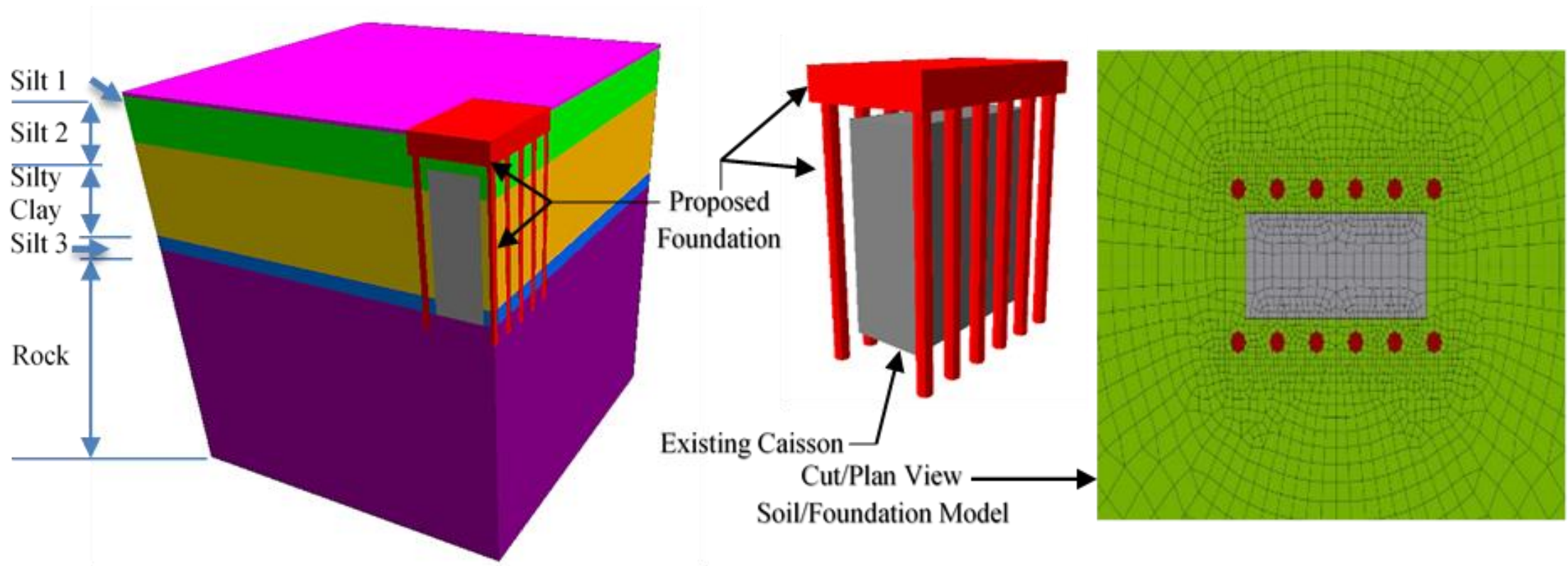
Seismic Analyses and Design



Standalone Model

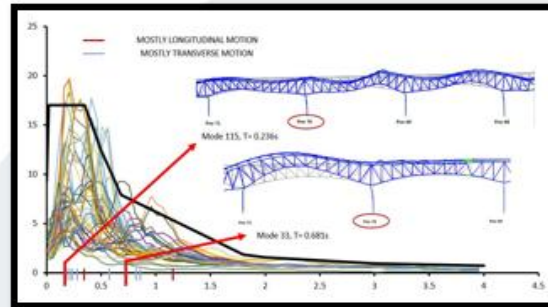
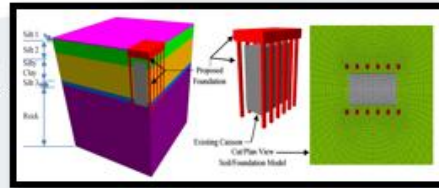
Global Model

Seismic Analyses and Design

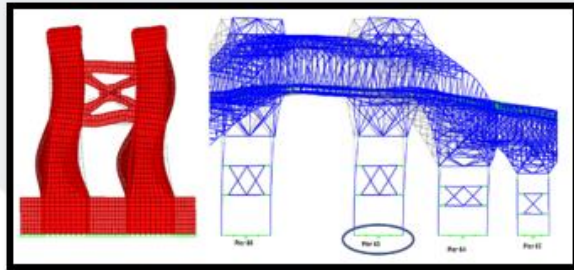


Seismic Analyses and Design: Recommended Design Spectrum Development

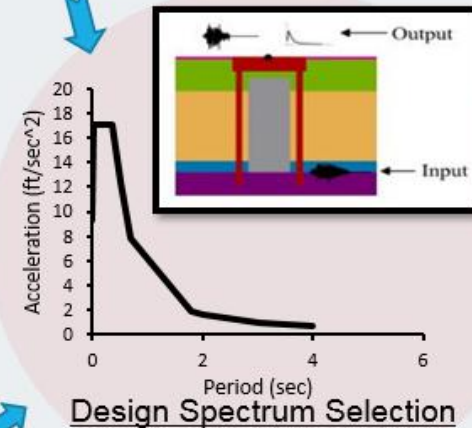
A - Geotechnical and Soil Dynamics Aspects



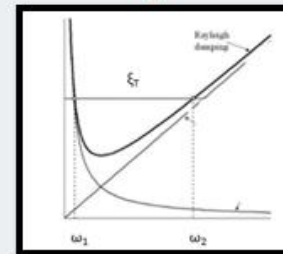
F - Kinematic Effects and Superstructure Response in the Selection of the Design Spectrum



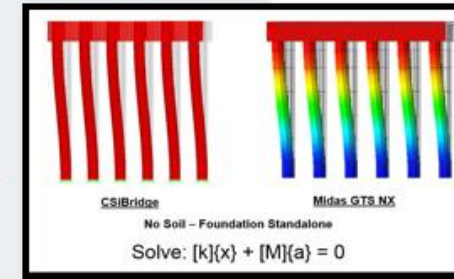
E - Structural FE and Structural Dynamics Facets



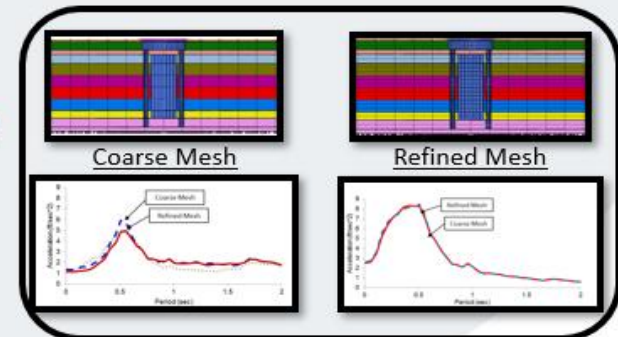
Design Spectrum Selection



D - E/Q and Dynamics Matters



B - Software Validation and Considerations

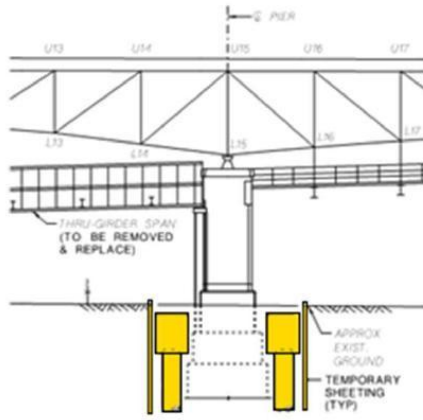


C - Structural and Soil/Foundation FE Modeling of the Foundation

Pier Replacement: Preparation

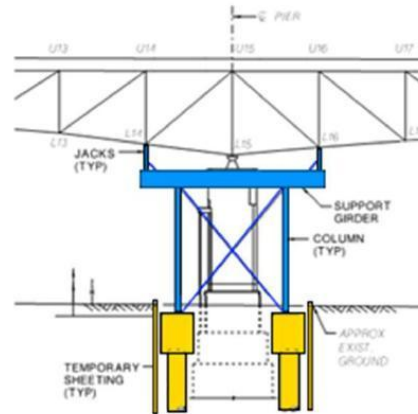


Replacement of the Piers Overall Construction Staging



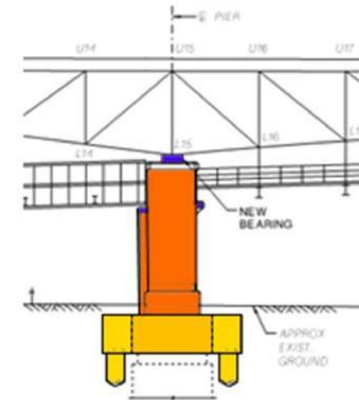
STAGE 1

- Install Temp. Sheeting
- Install drilled shafts and construct Stage 1 footing



STAGE 2

- Install temp. jacking structure
- Jack both trusses and transfer Truss support to temp. support structure.



STAGE 3

- Construct Stage 3 foundation
- Construct pier and install new bearing
- Remove temp. structure

Used the initial stage of the new foundation to hold the temporary truss supports, then built up the new piers inside the temporary supports

Pier Replacement: Stage 1 New Foundations



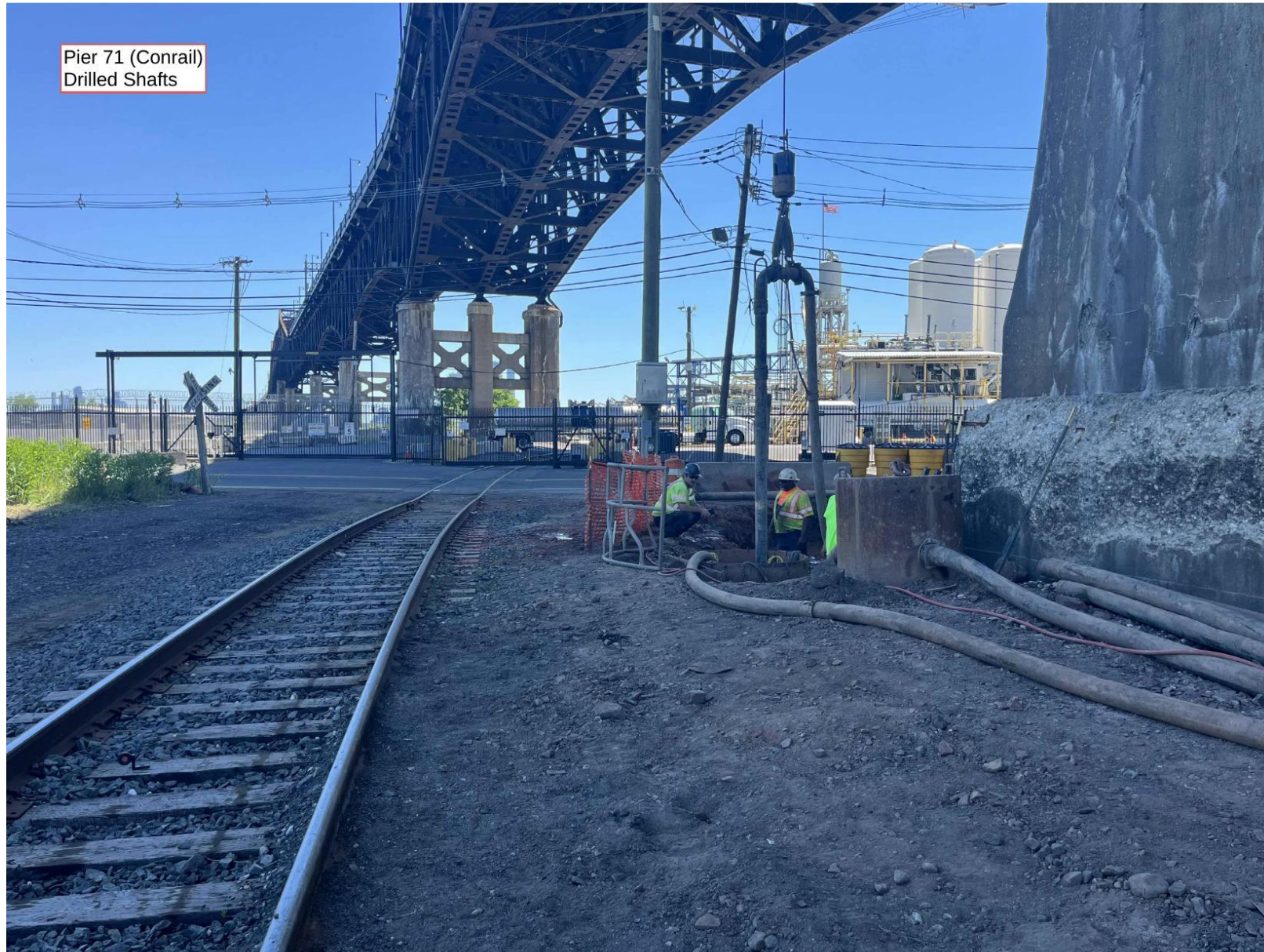
Pier Replacement: Stage 1 New Foundations



Pier Replacement: Stage 1 New Foundations



Pier Replacement: Stage 1 New Foundations



Pier Replacement: Stage 2 Temporary Supports



Pier Replacement: Stage 2 Temporary Supports



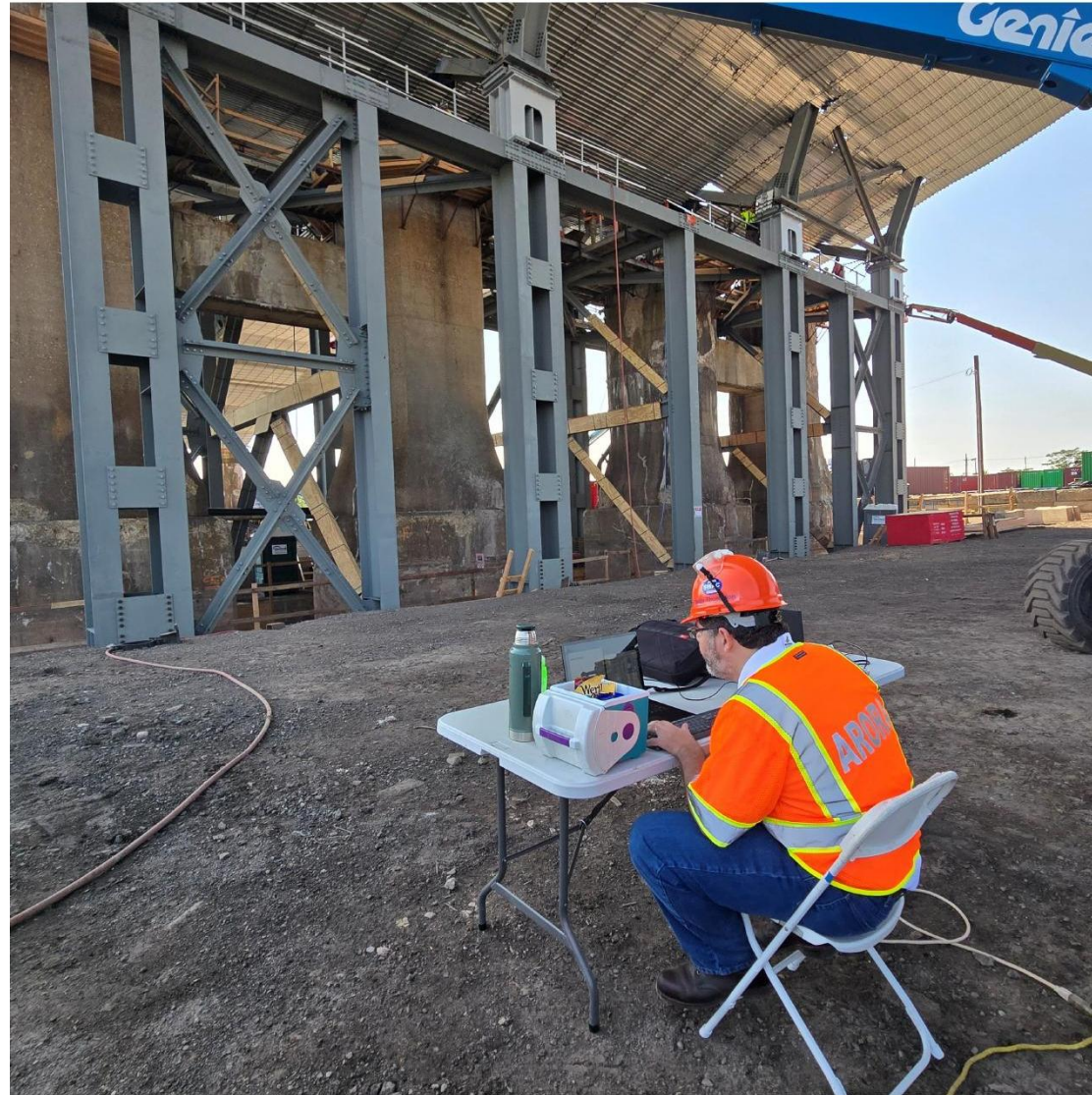
Pier Replacement: Stage 2 Temporary Supports



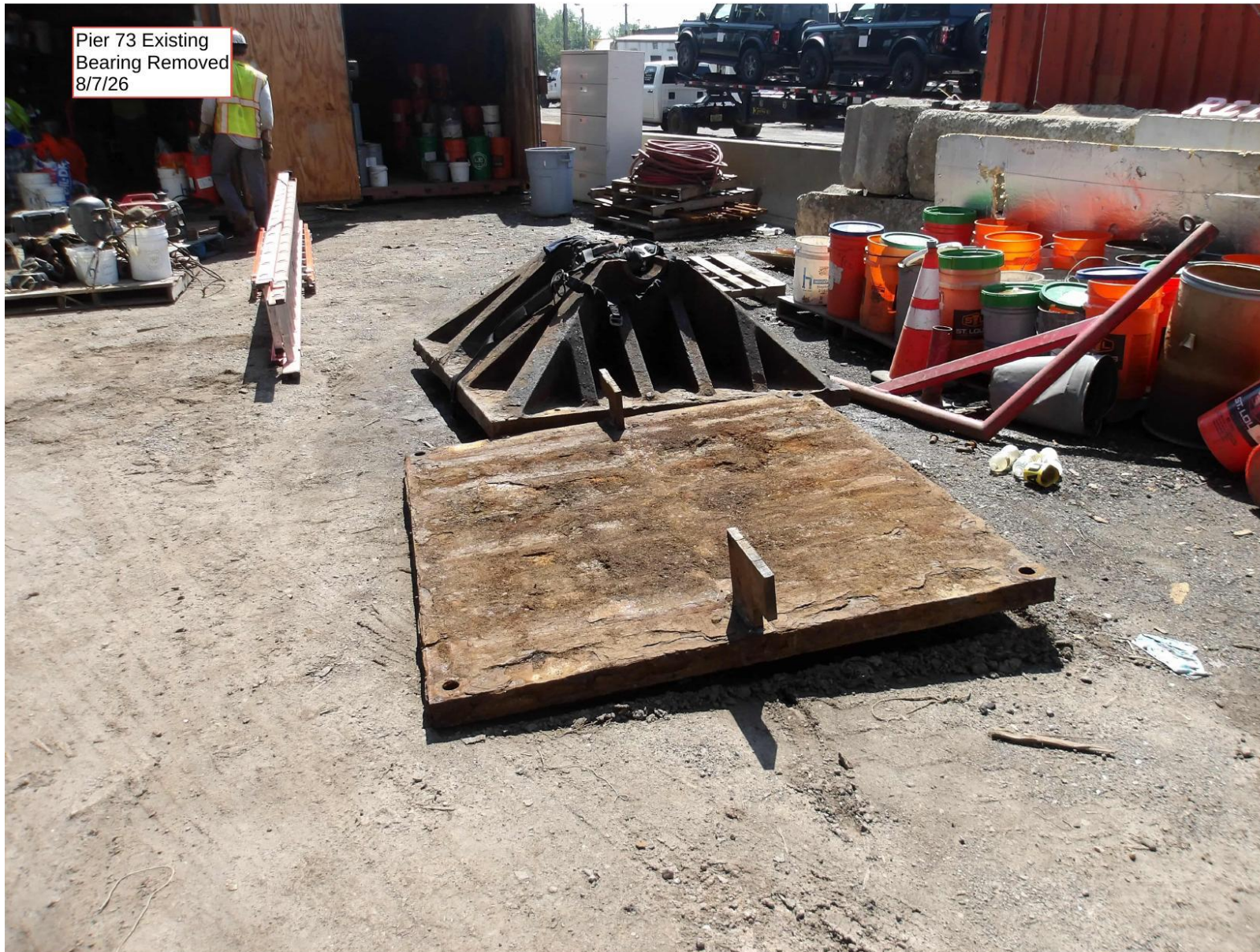
Pier Replacement: Stage 2 Temporary Supports



Pier Replacement: Stage 2 Temporary Supports



Pier Replacement: Stage 2 Demolition



Pier Replacement: Stage 2 Demolition



Pier Replacement: Stage 2 Demolition



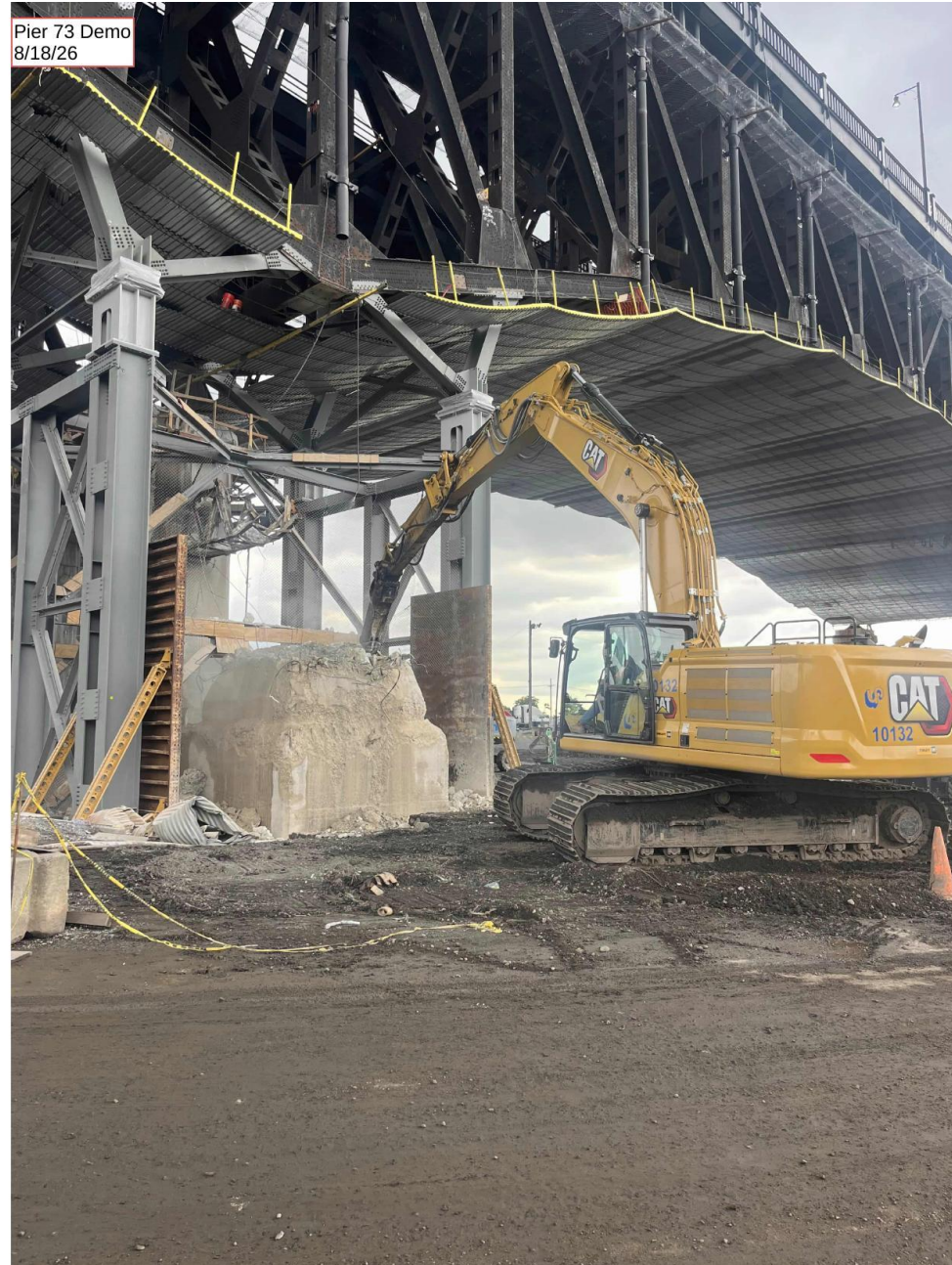
Pier Replacement: Stage 2 Demolition



Pier Replacement: Stage 2 Demolition



Pier Replacement: Stage 2 Demolition



Pier Replacement: Stage 2 Demolition



2026 ABCD Bridge Technical Conference

September 10, 2026

Giving the Pulaski Skyway Bridge a New Life

**R. B. Gajer, K. Alam, R. Thompson, M. Williams, A. Dumitru,
N. Gil, J. Amin and G. Deppert**

Arora and Associates, PC