USA | LAX Automated People Mover (APM)

LINXS Constructors

Nabil Bouabid, MBA

Head of Strategic Projects, PERI USA

Pawel Okolowicz

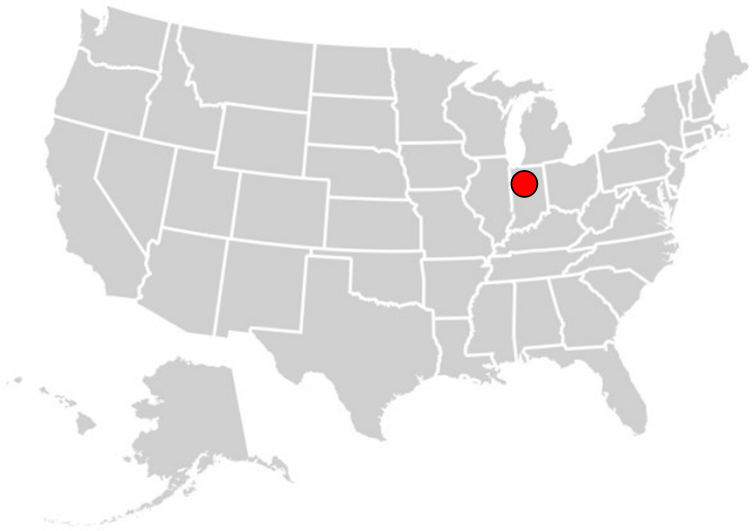
Project Manager, PERI ISSU

27.02.2024

Personal Introductions

Nabil Bouabid, MBA

- Head of Strategic Projects, PERI USA
- 24 Years with PERI
- 30 Years in Construction Industry
- Father of 4
- Graduate of Purdue University



Pawel Okolowicz

- Project Manager, Infrastructure Support at PERI
- 14 Years with PERI
- 17 Years in Construction Industry
- Father of 1
- Structural Engineering at Technical University of Bialystok and Southern Denamark University

Content Summary

- General Project Overview
- Introduction of Balanced Cantilever Construction
- Customer Requests
- Design Process
- Field Challenges
- Q&A

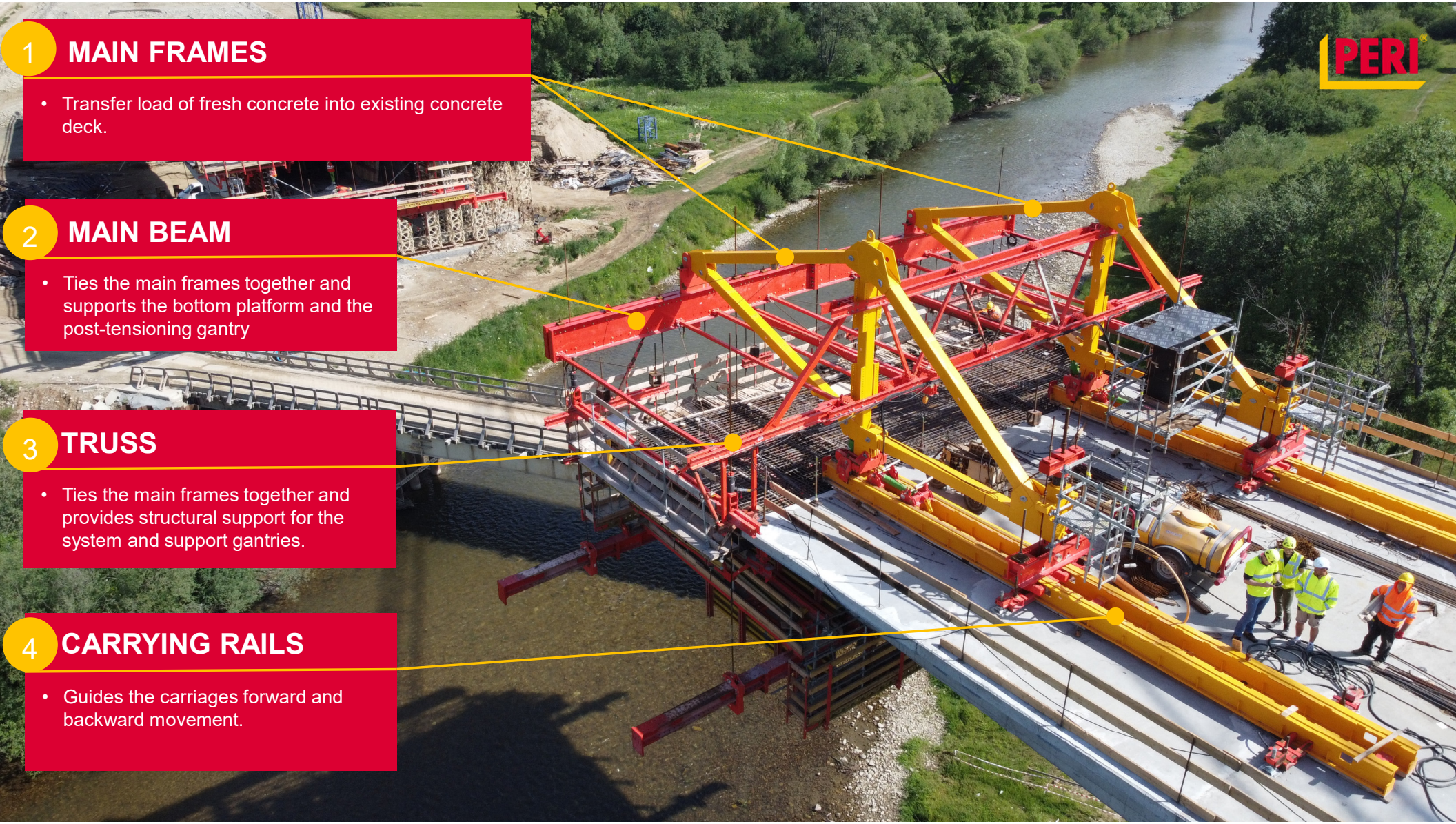
PROJECT OVERVIEW

Project Overview

- 2.25-mile-long guideway
- 3 balanced cantilever bridges, 4 spans
  - 1GW1 Westway Street over Parking Lot
  - 1GW4 Sepulveda Blvd
  - 1GW5 Century Blvd
- 3 pairs of carriages
- 14-month duration

LINXS
LAX INTEGRATED EXPRESS SOLUTIONS
FLATIRON
McNARY BERGERON & JOHANNESEN

QUICK INTRODUCTION TO BALANCED CANTILEVER CONSTRUCTION



1 MAIN FRAMES

- Transfer load of fresh concrete into existing concrete deck.

2 MAIN BEAM

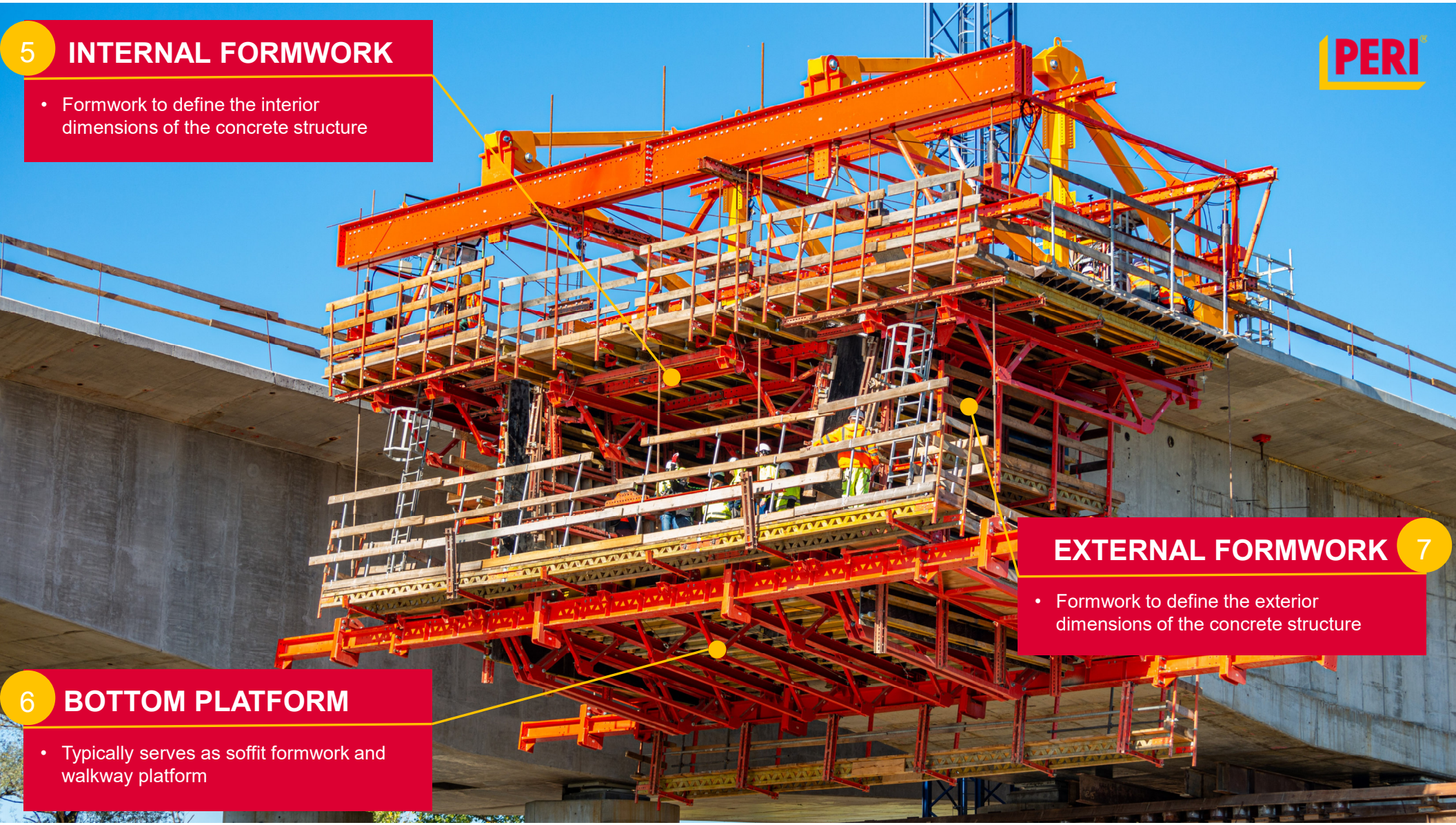
- Ties the main frames together and supports the bottom platform and the post-tensioning gantry

3 TRUSS

- Ties the main frames together and provides structural support for the system and support gantries.

4 CARRYING RAILS

- Guides the carriages forward and backward movement.



5 INTERNAL FORMWORK

- Formwork to define the interior dimensions of the concrete structure

6 BOTTOM PLATFORM

- Typically serves as soffit formwork and walkway platform

EXTERNAL FORMWORK 7

- Formwork to define the exterior dimensions of the concrete structure

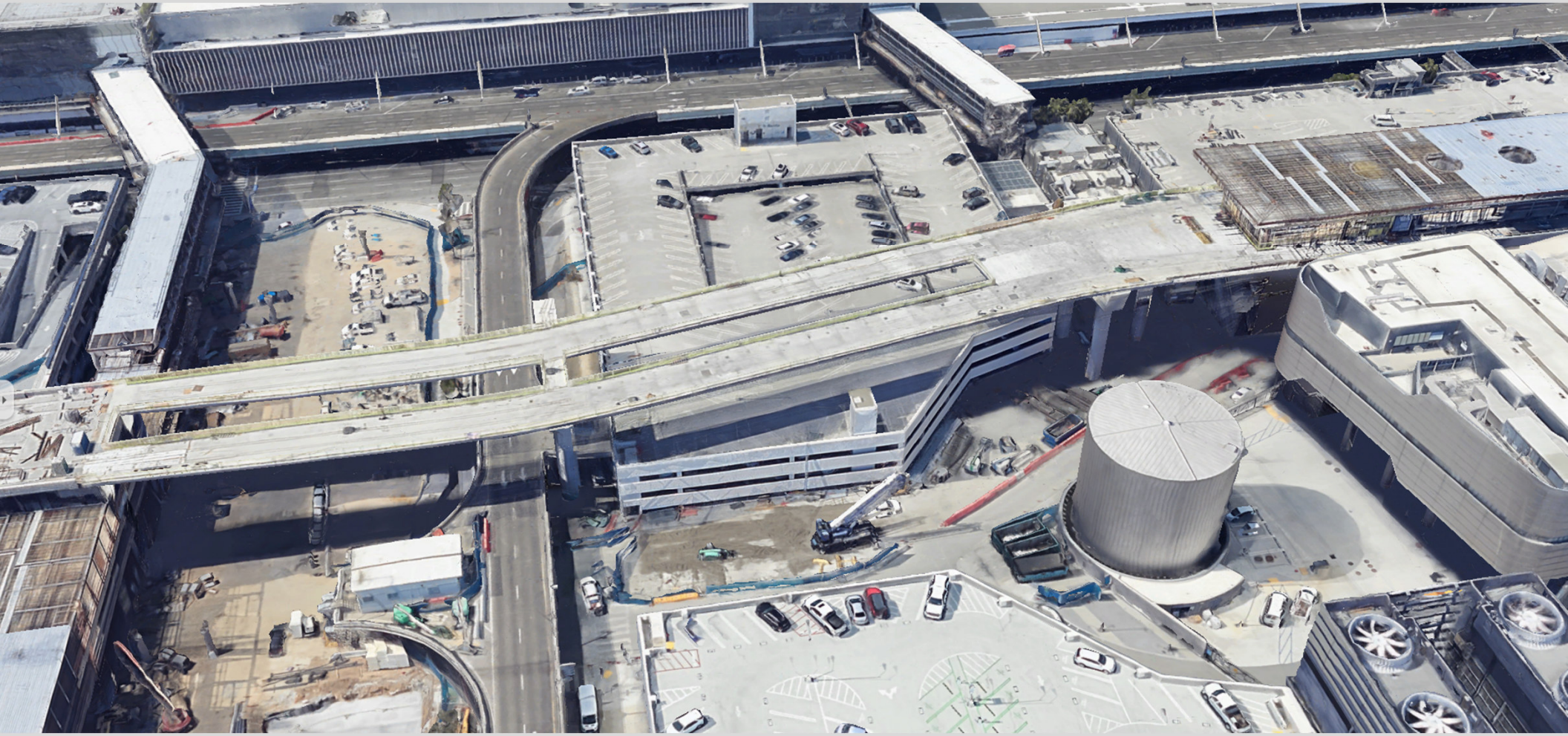
CUSTOMER REQUEST & CHALLENGES

Customer Challenges

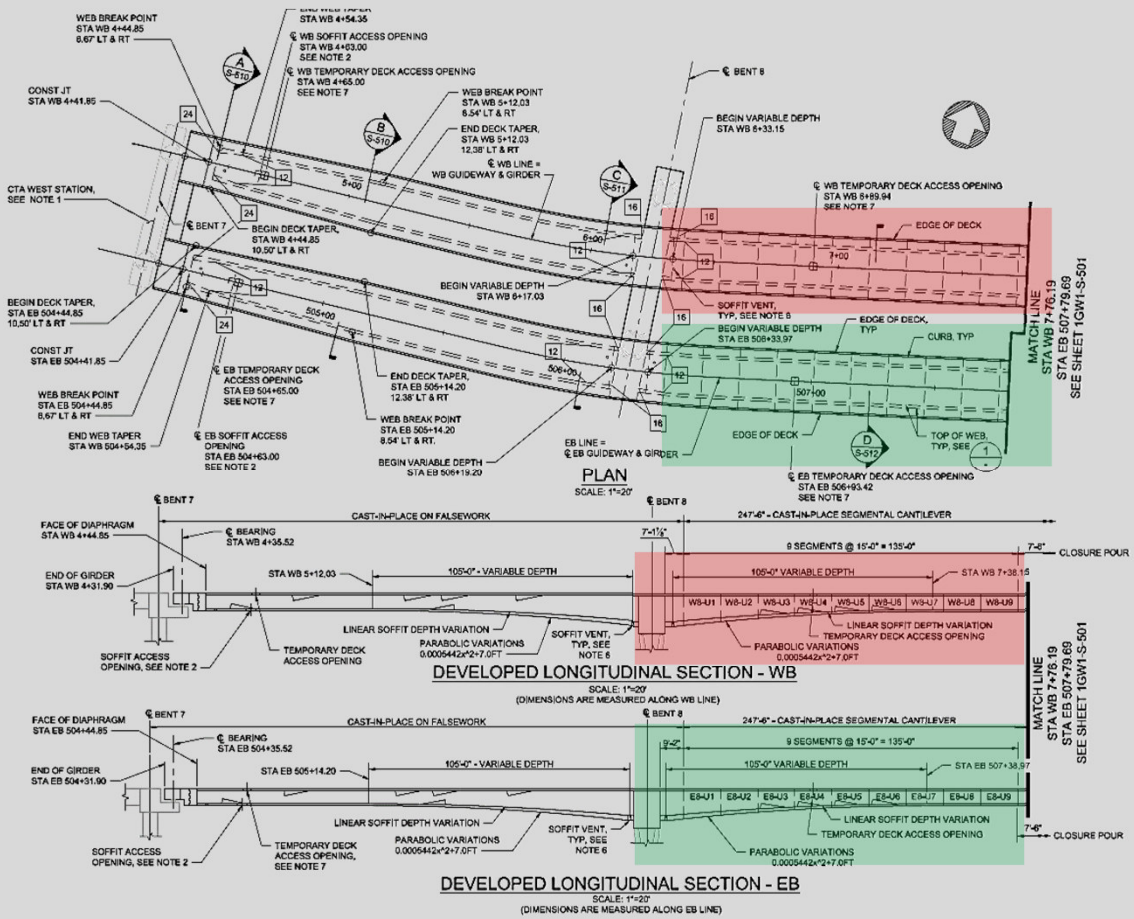
1. Safety – workers & travelling public
2. Traffic cannot be shut down – it's the airport!
3. Tieless bottom slab with adjustable platform

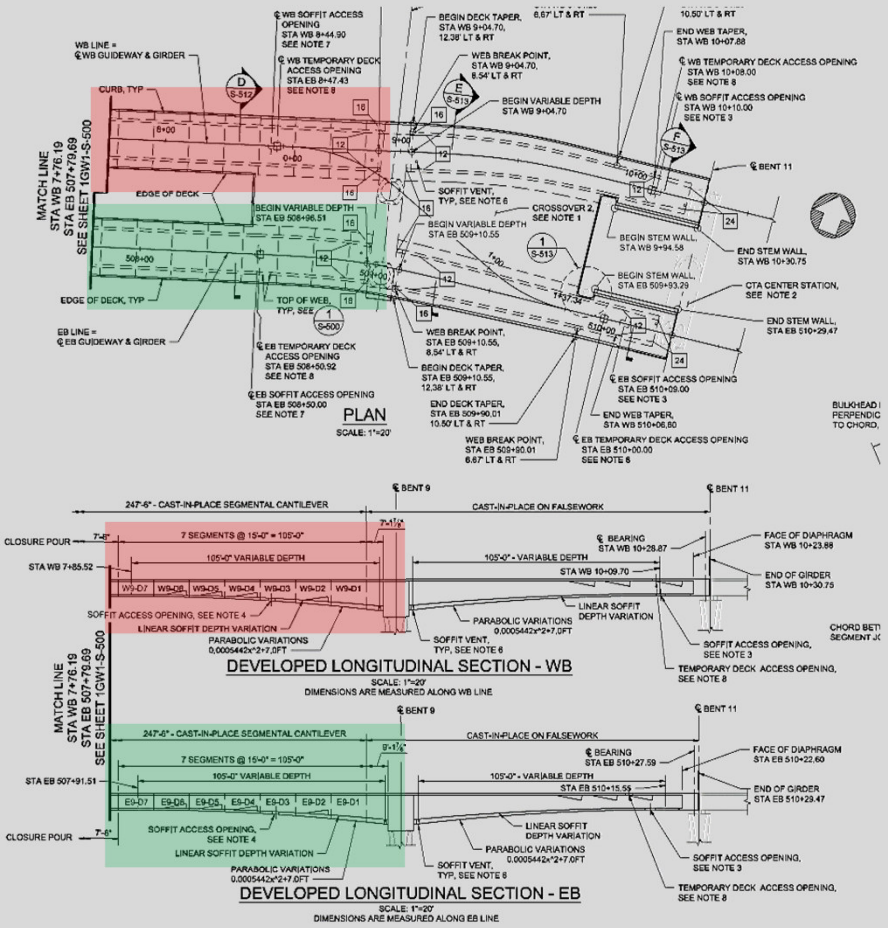
GEOMETRY

1GW1 - West Street Spanning Over the Parking Lot



1GW1 - West Street Spanning Over the Parking Lot





WB span - 272'-10 ½"
EB span – 276' – 10 ½"

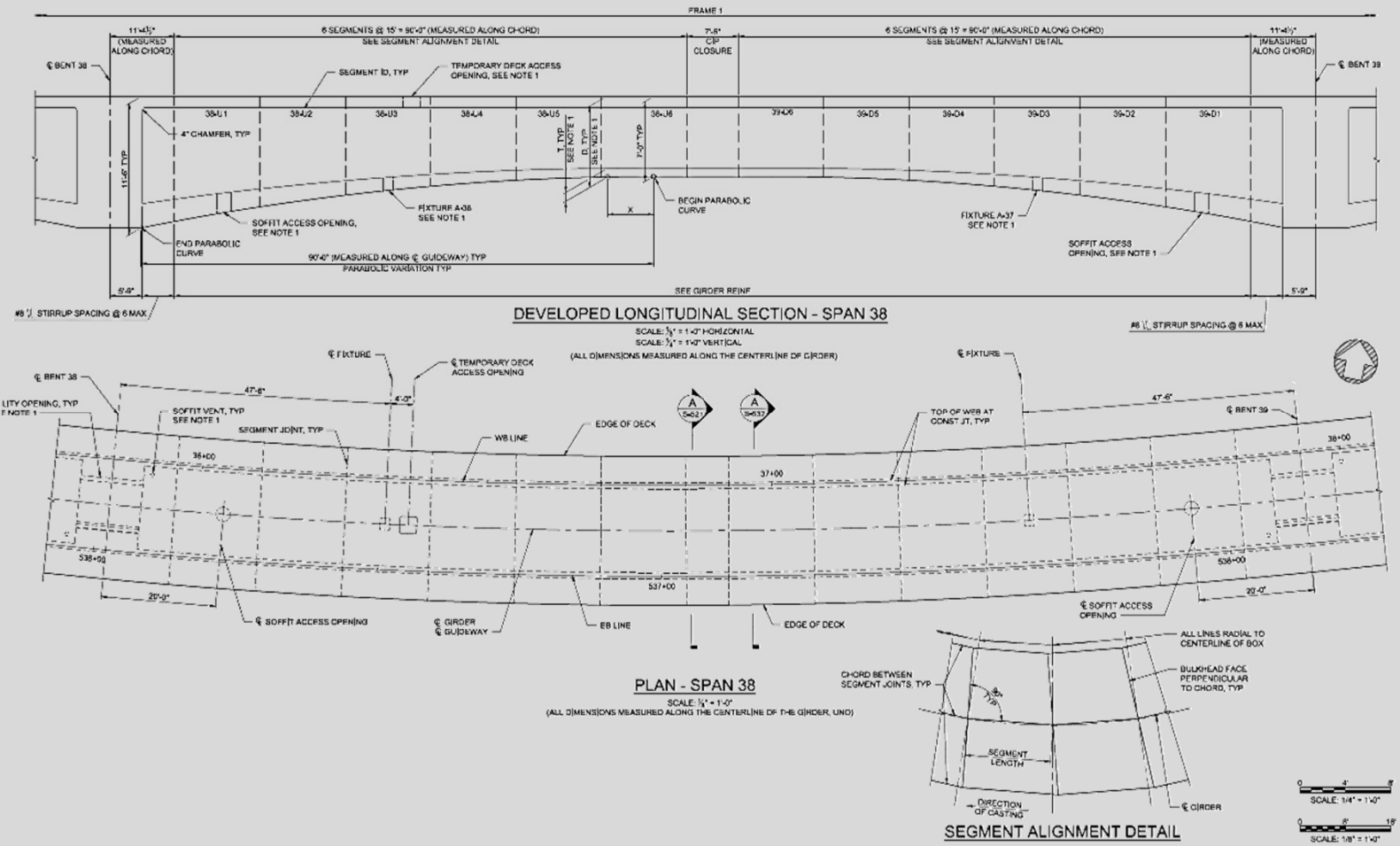
9 x 15' segments from BENT 8
7 x 15' segments from BENT 9

Closure pours – 7'-6"

1GW1

1GW4 Spanning Over Sepulveda Blvd.

1GW4 Spanning Over Sepulveda Blvd.



6 x 15’ segments at each side of the span

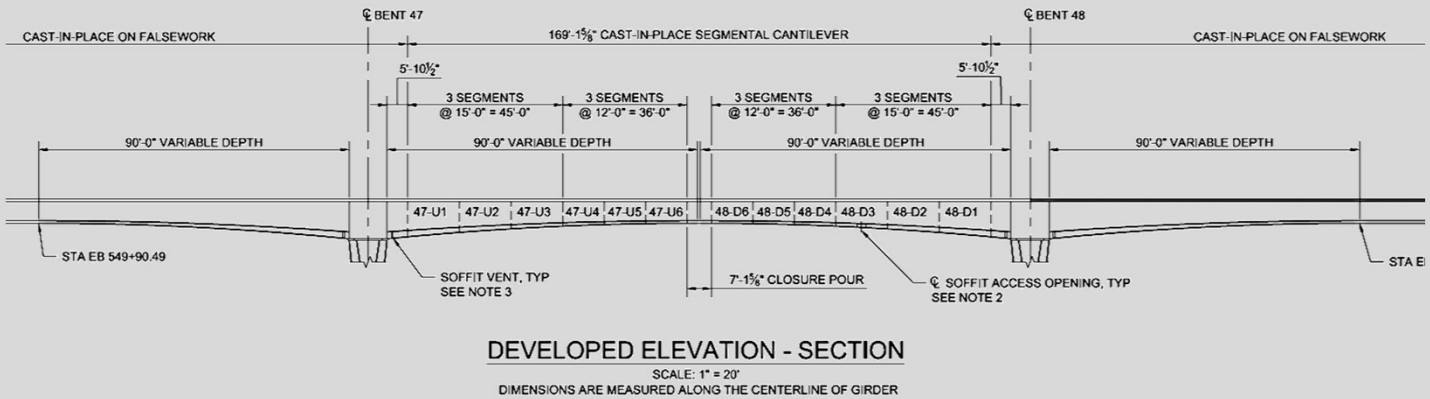
Closure pour – 7’-6”

Internal curb radius – 1055’

1GW4

1GW5 Spanning Over Century Blvd.

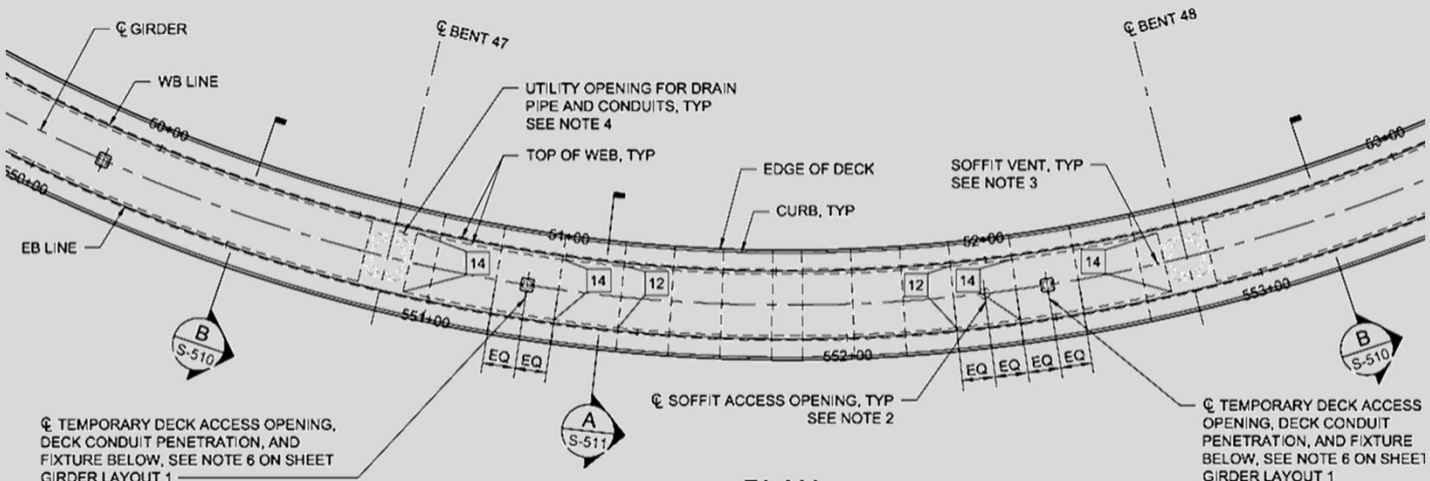
1GW5 Spanning Over Century Blvd.



DEVELOPED ELEVATION - SECTION

SCALE: 1" = 20'

DIMENSIONS ARE MEASURED ALONG THE CENTERLINE OF GIRDER



PLAN

SCALE: 1" = 20'

3 x 15' + 3 x 12' segments at each side of the span

Closure pour – 7'-1 5/8"

Internal curb radius – 387'

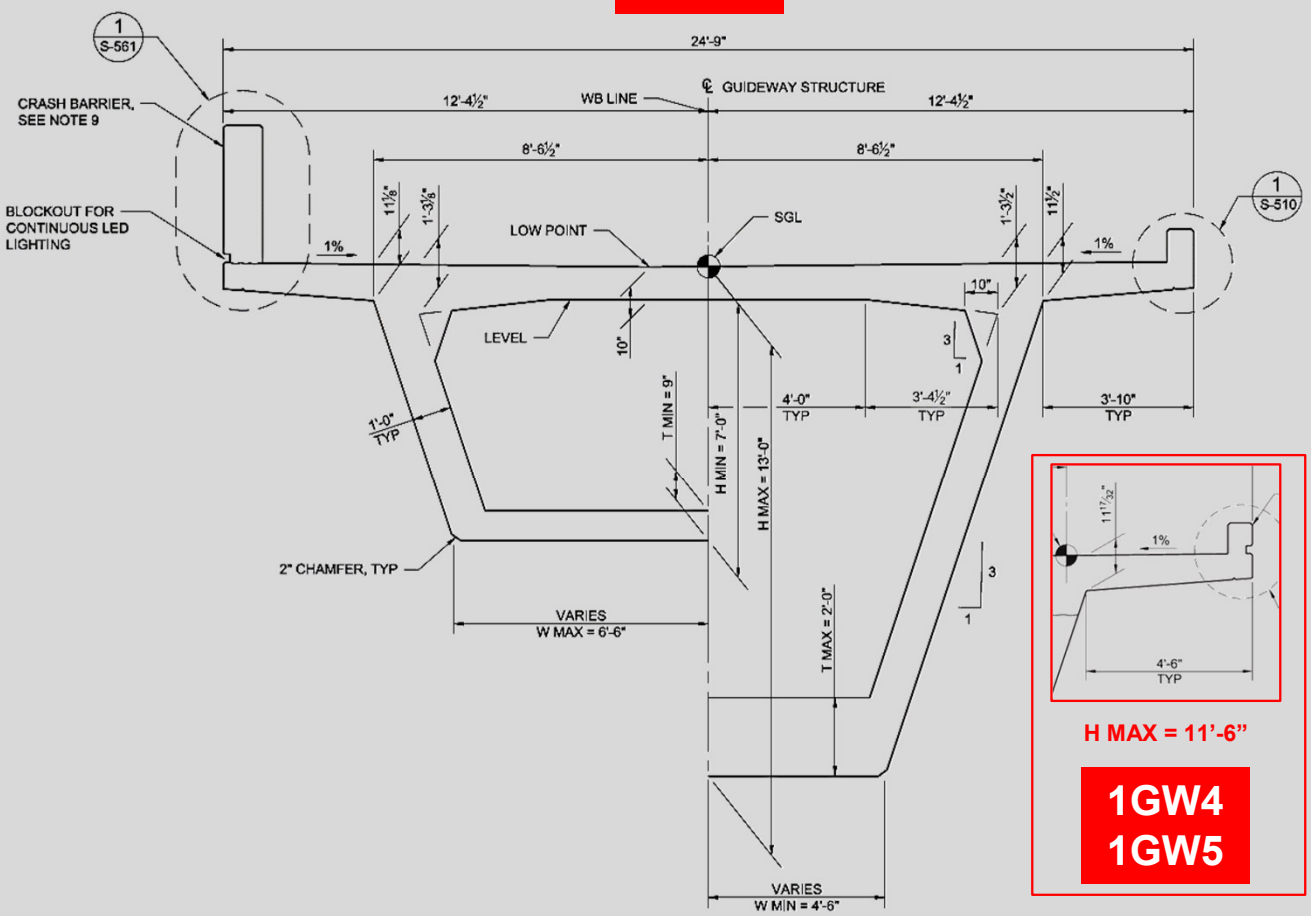
1GW5

1GW5 Spanning Over Century Blvd.

CONCEPTS

Geometry

1GW1



H MAX = 11'-6"

1GW4
1GW5

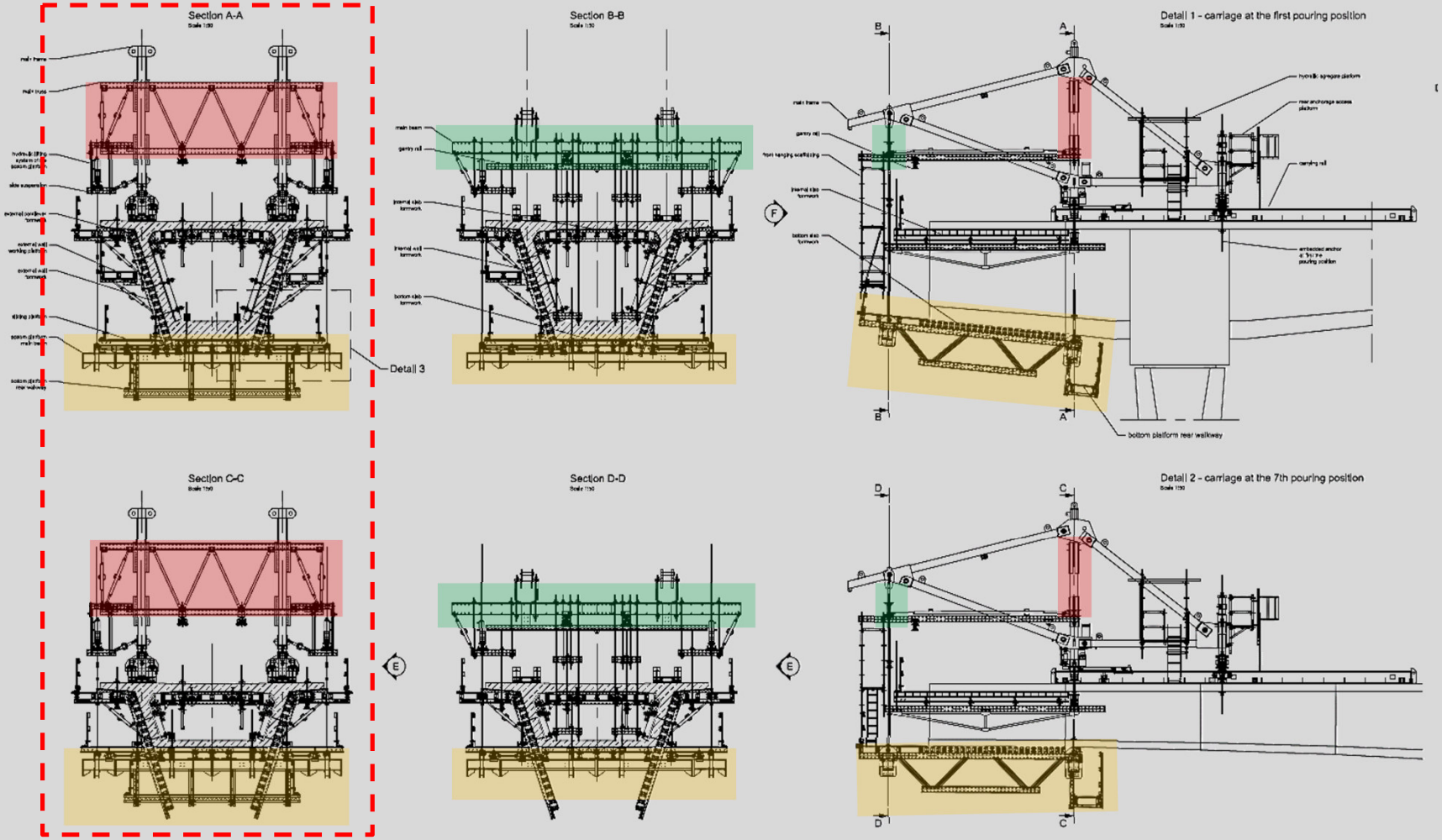
Viaducts 1GW4 and 1GW5 with the same envelope.

Same framework and formwork could be planned for the whole project.

Segment lengths – 15' and 12'
Closure pours – 7'-6" and 7'-1 5/8"
The heaviest segment - 170 kips

Initial PERI Concept

PERI VARIOKIT Balanced Cantilever Carriage - VBC

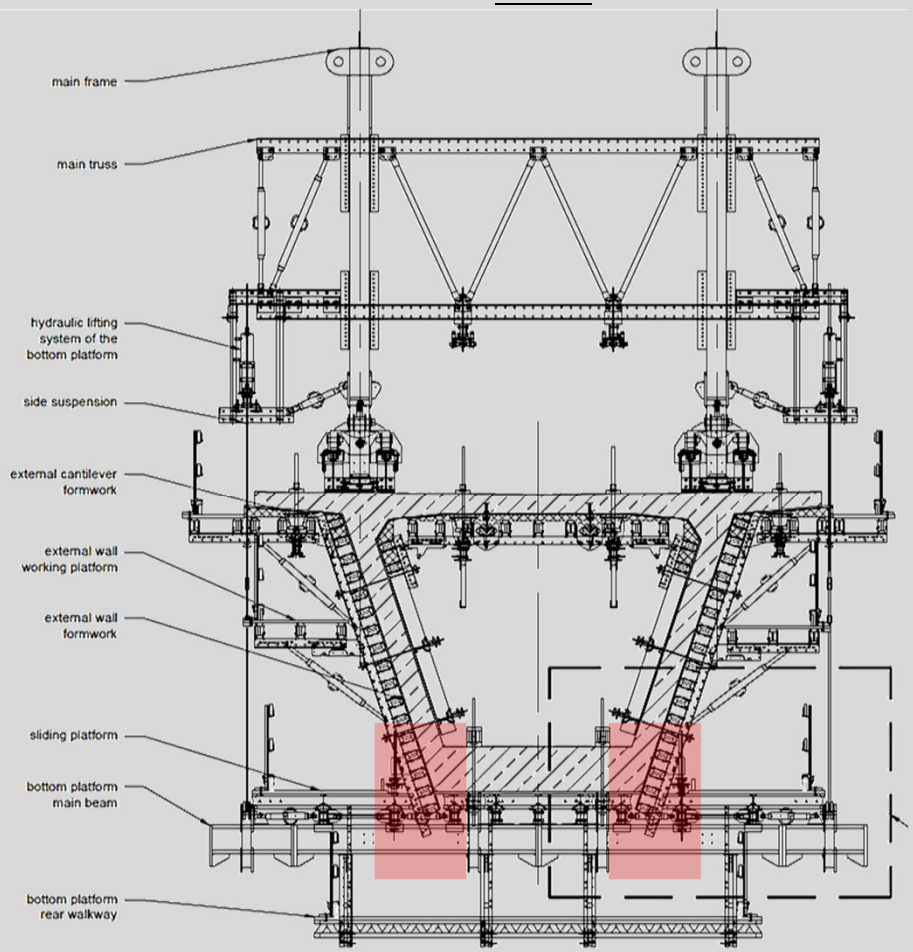


PIER

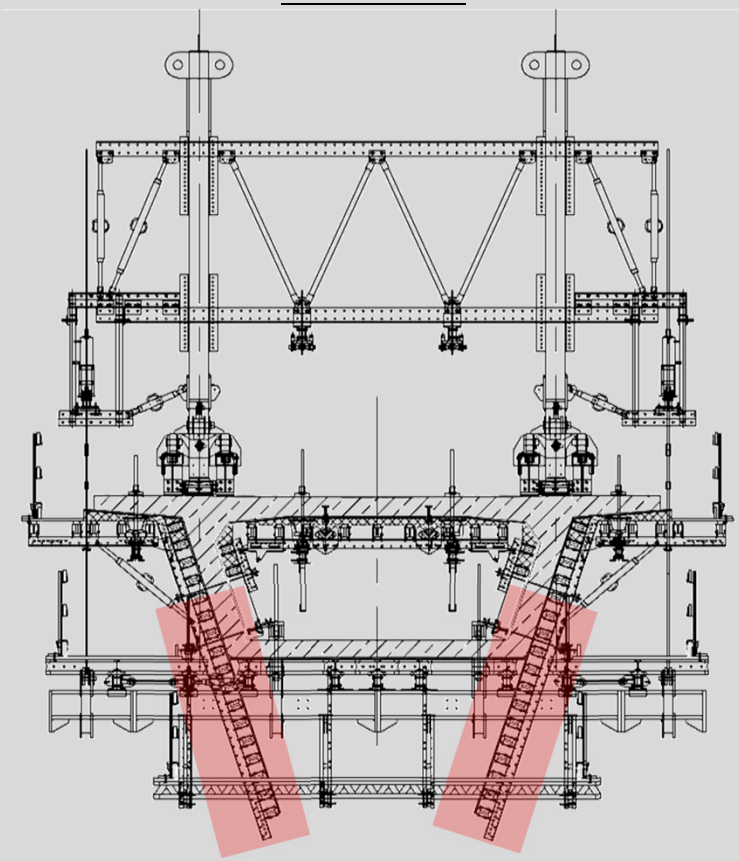
MIDSPAN

Initial PERI Concept

PIER



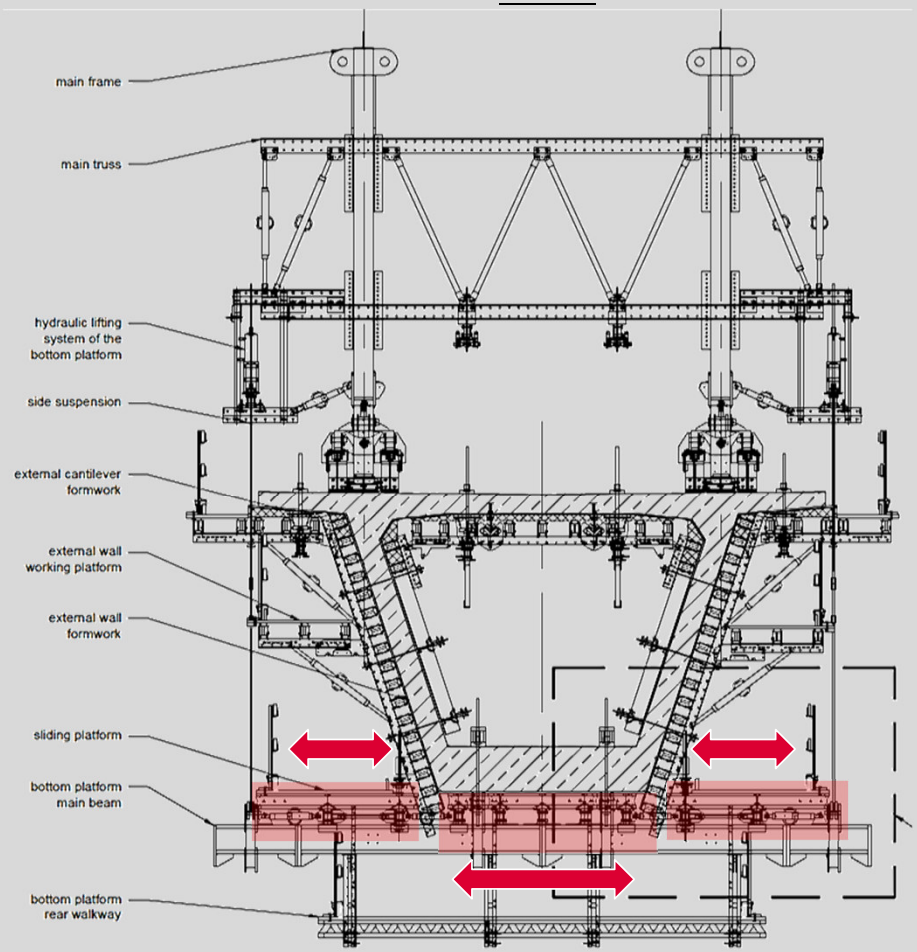
MIDSPAN



External wall formwork overlaps the bottom slab

Initial PERI Concept

PIER



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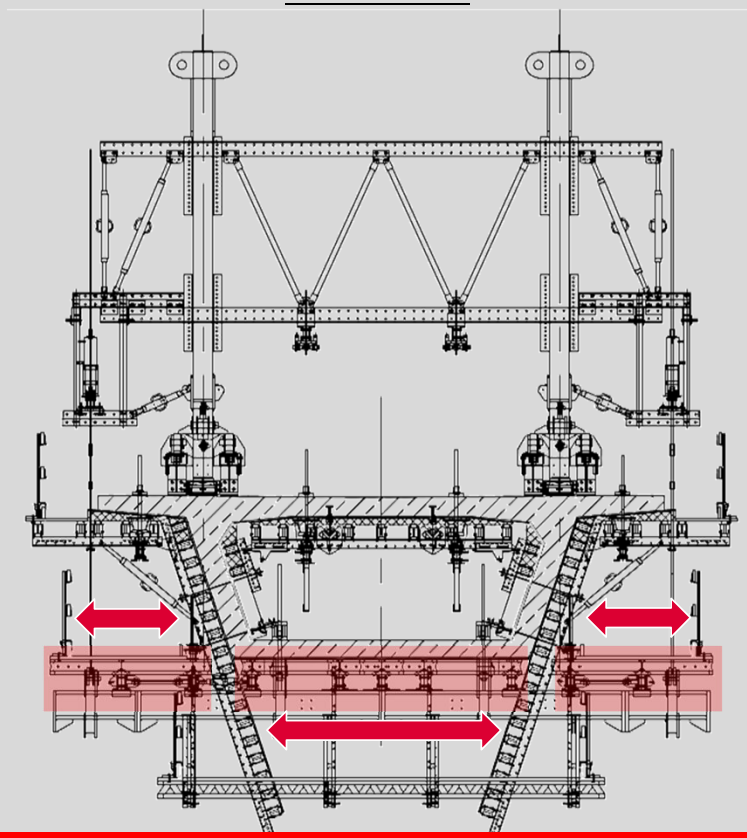
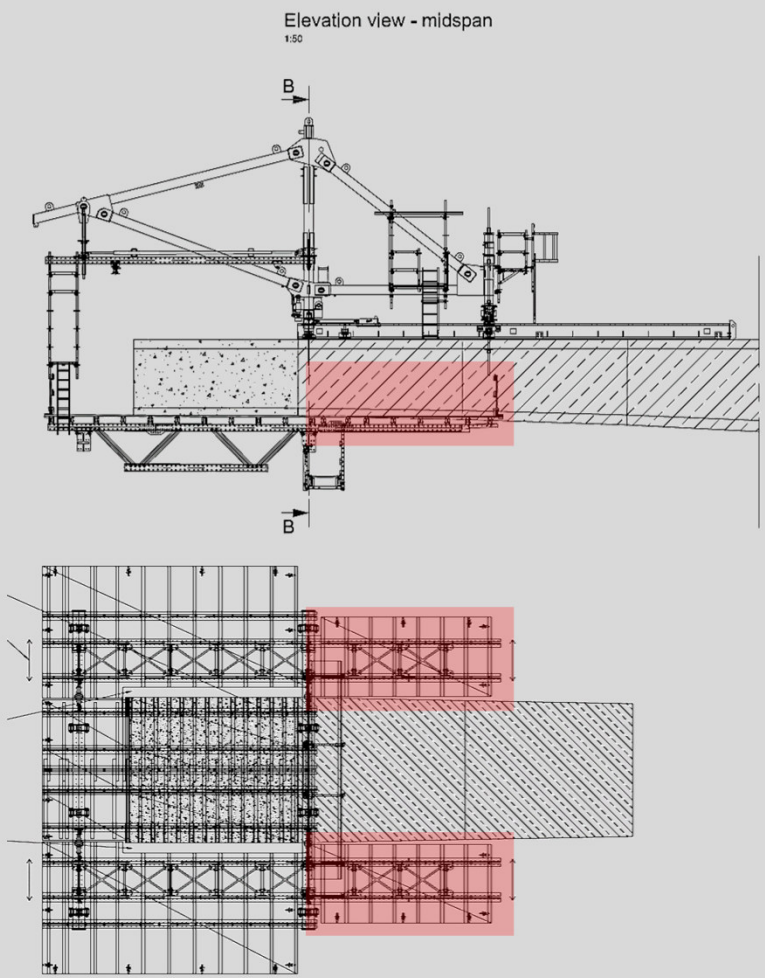
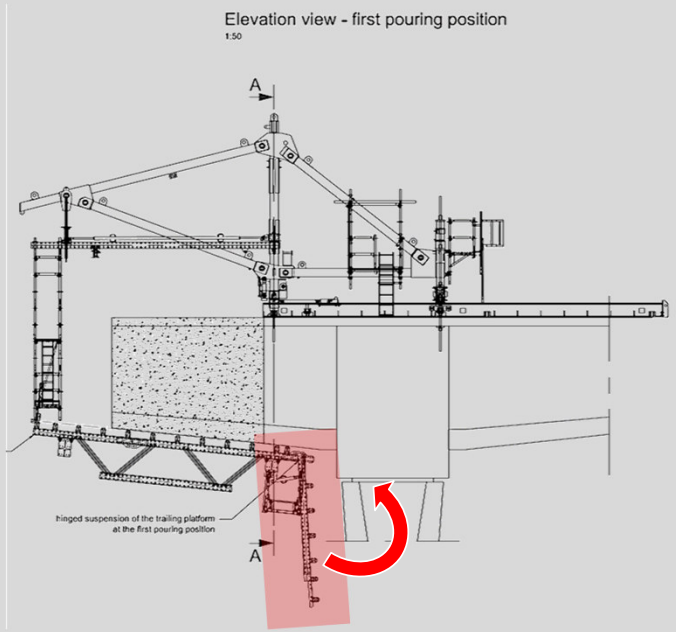


Side walkways to avoid long ties at the bottom

Expandable bottom slab formwork

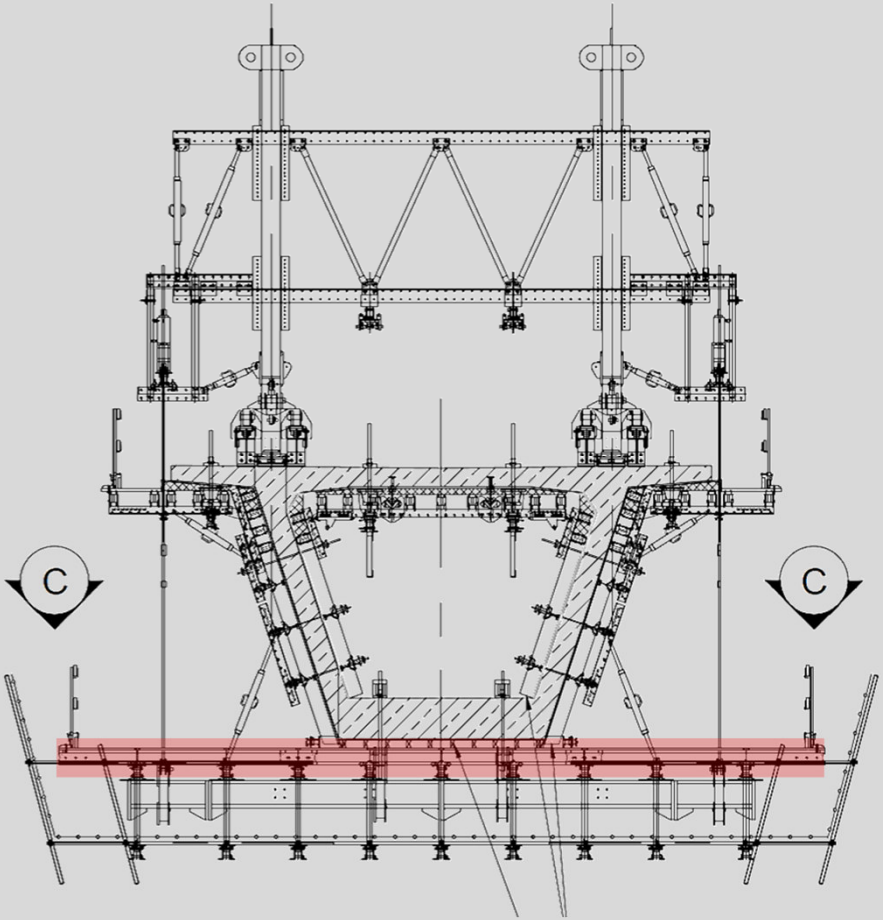
Initial PERI Concept





Final Concept

PIER



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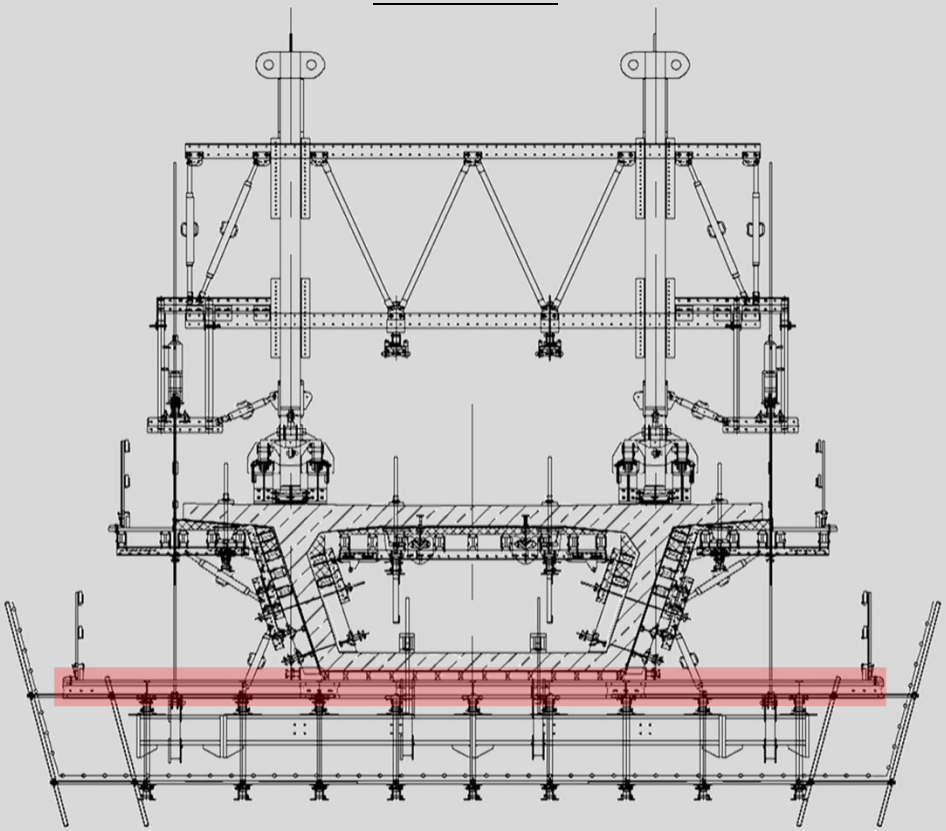


Fully closed planking on bottom platform, no openings

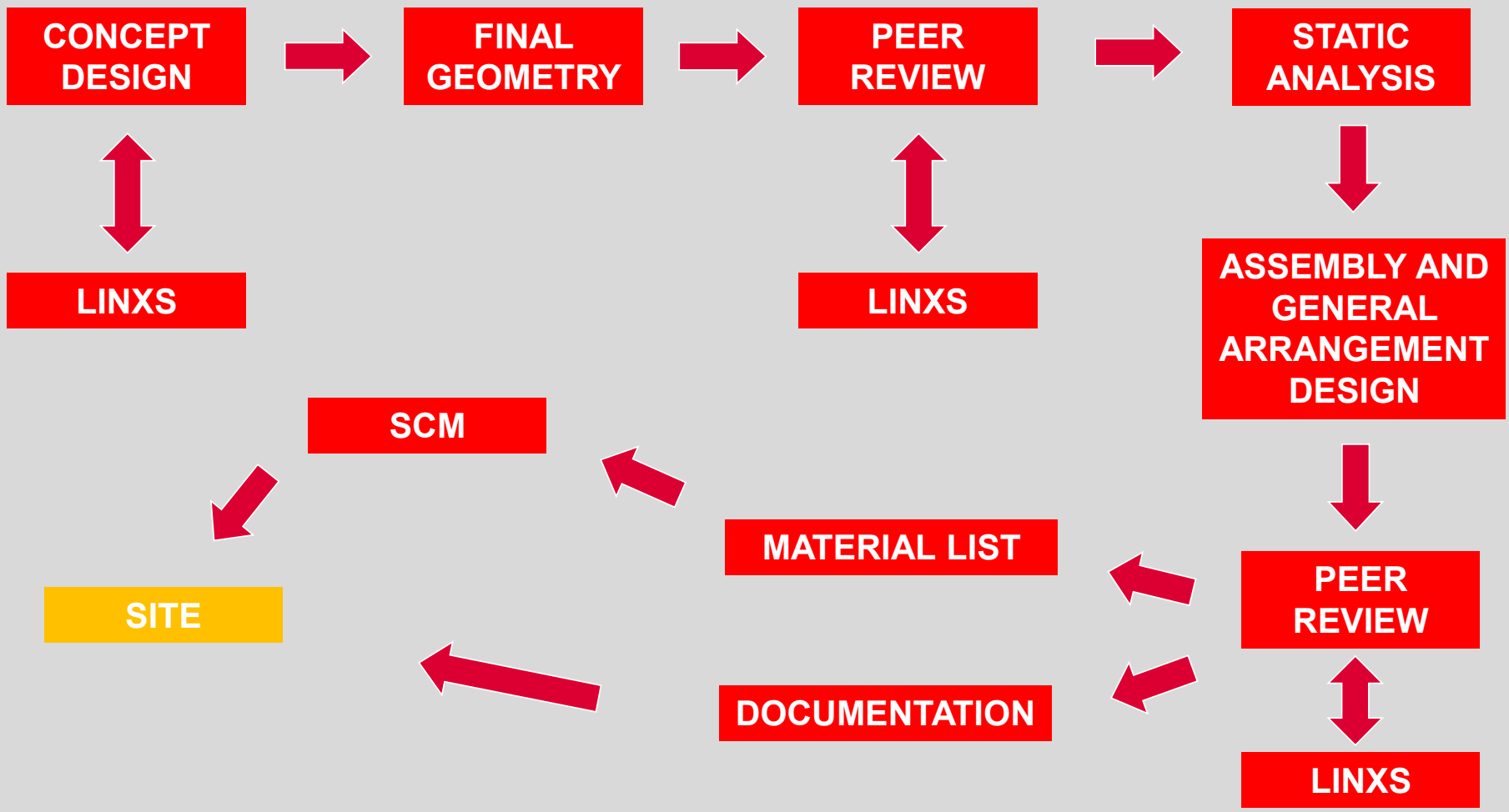

PERI
CONSTRUCTION AREA
1GW1


PERI
HYATT REGENCY
1GW4

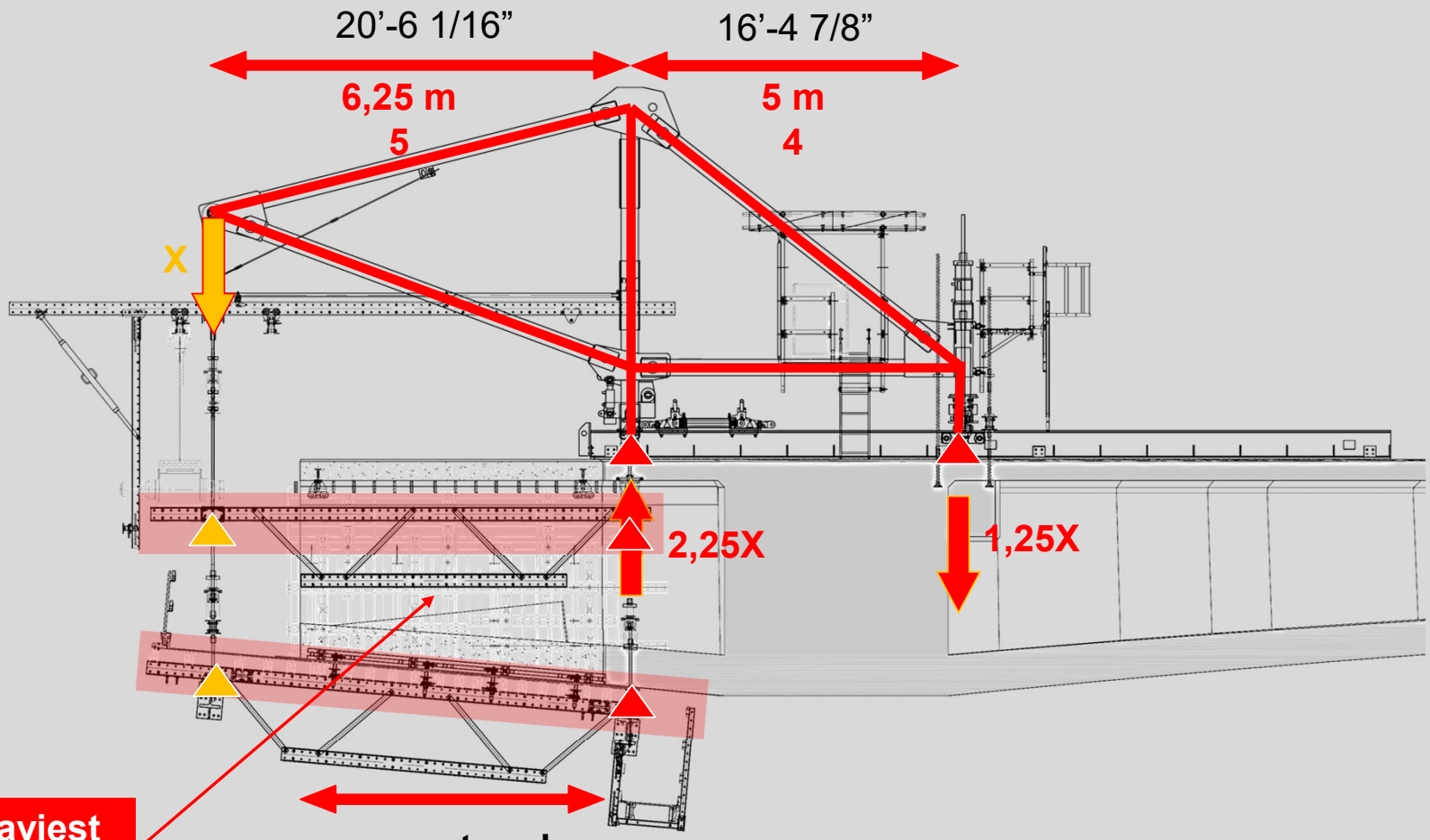

PERI
PERI
Airport
Return
U-TURN
SPEED
LIMIT
35
1GW5

DESIGN

VBC Carriages Design Process

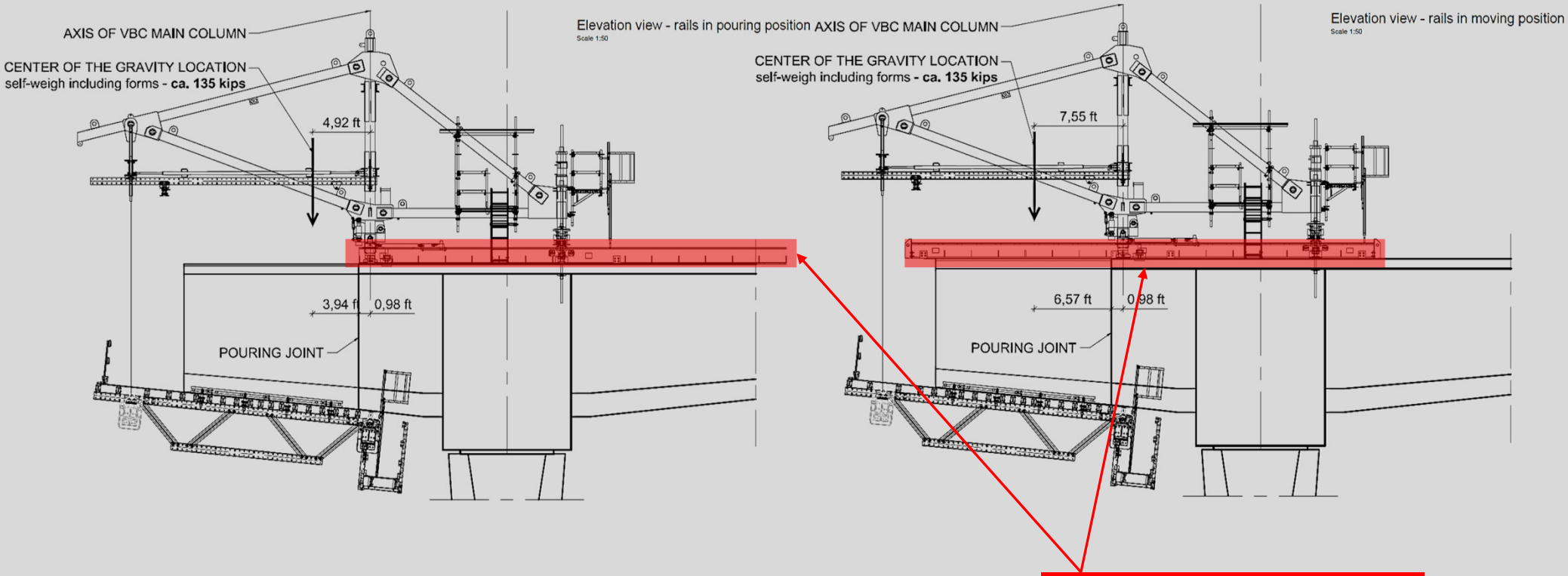


Geometry



1GW5 - The heaviest segment - 170 kips

Center of Gravity and Self-Weight

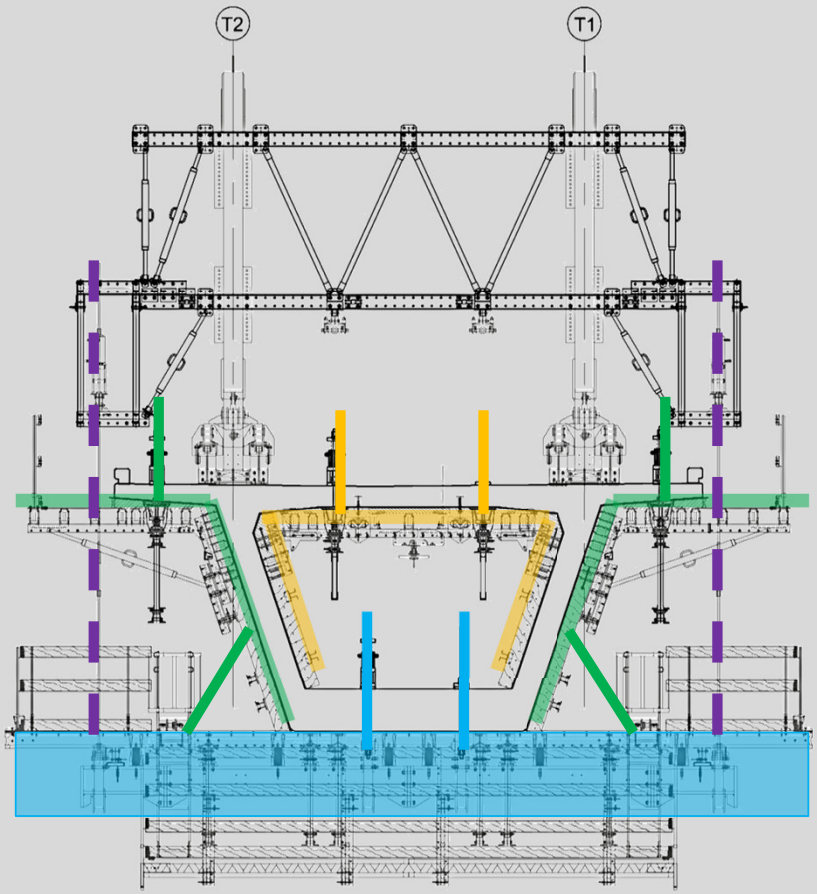


Self-weight including formwork - 135 kips

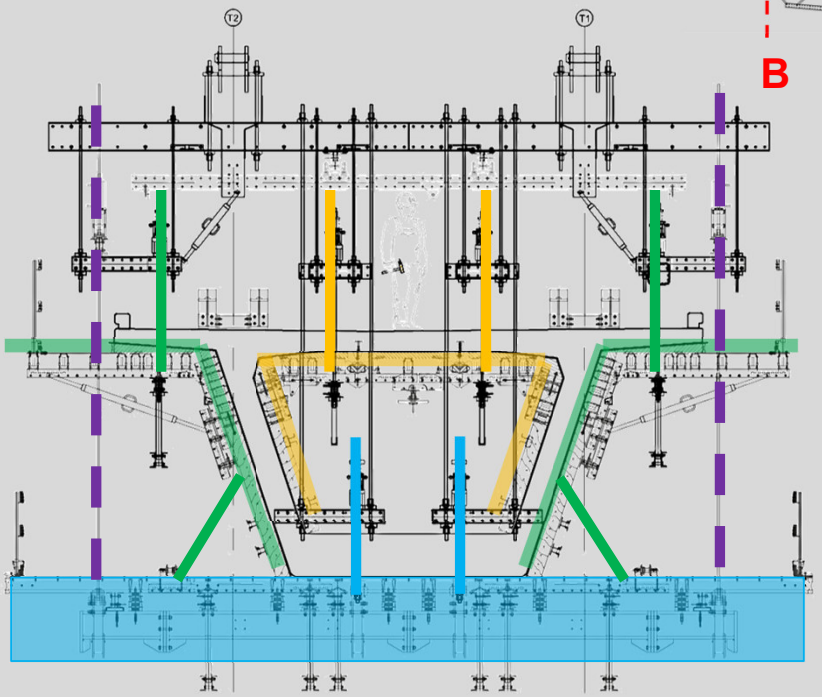
Carrying rail – ca. 20 kips

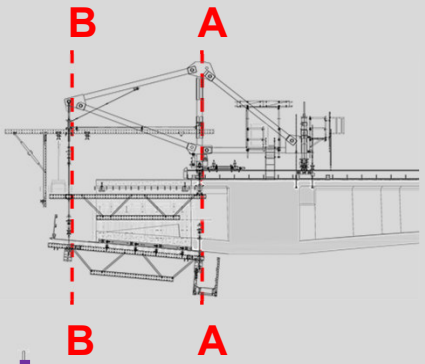
Formwork

A-A



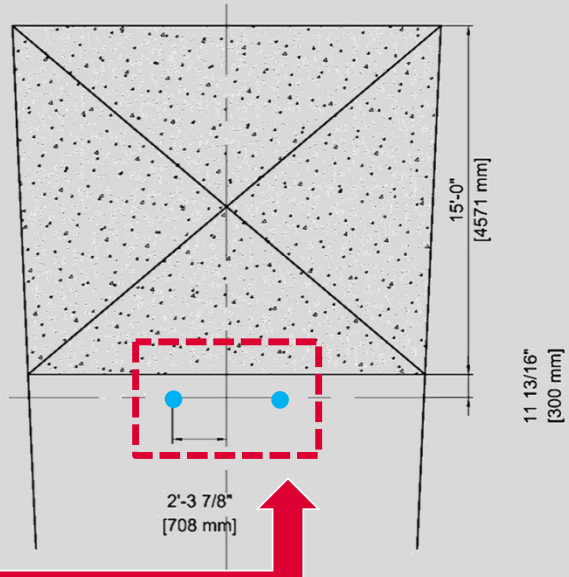
B-B



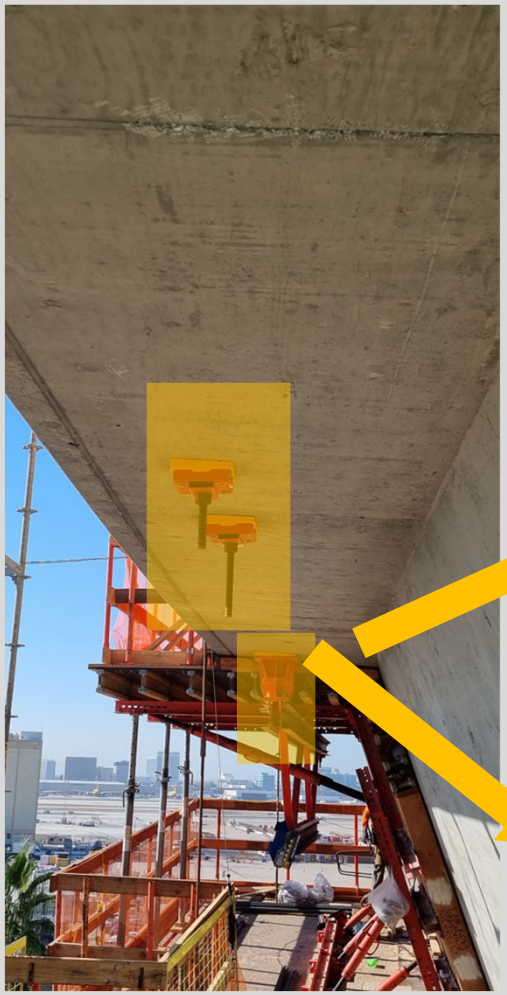


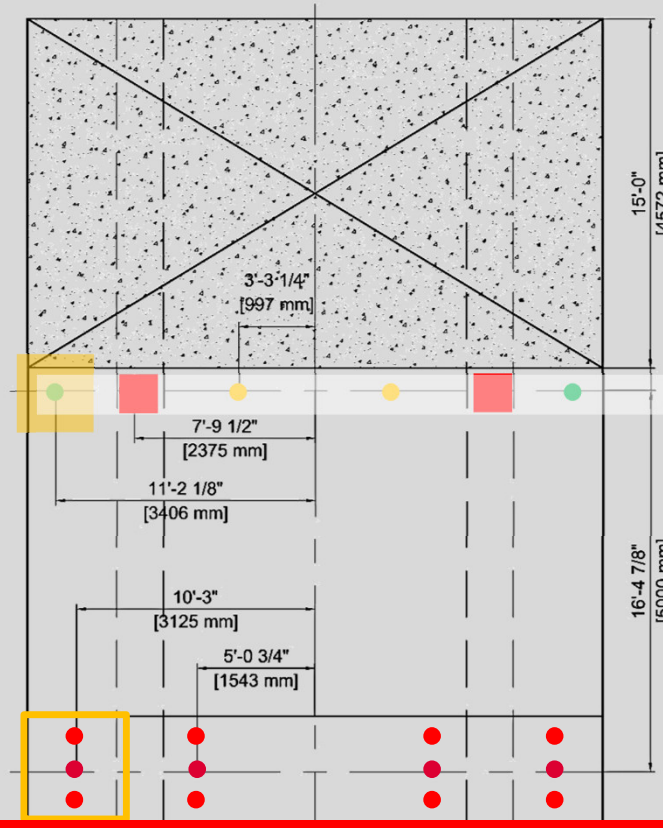
Anchor Points

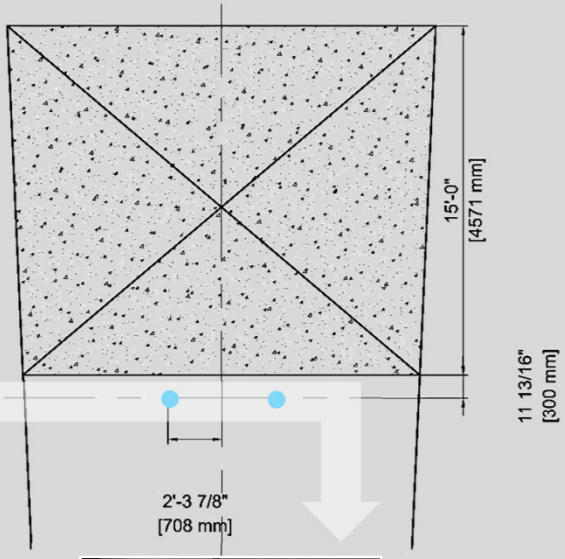
BOTTOM SLAB

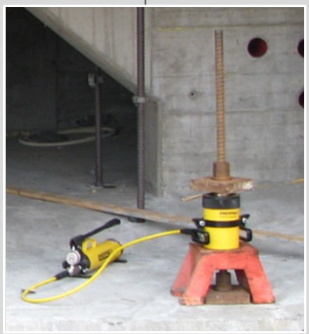


Anchor Points



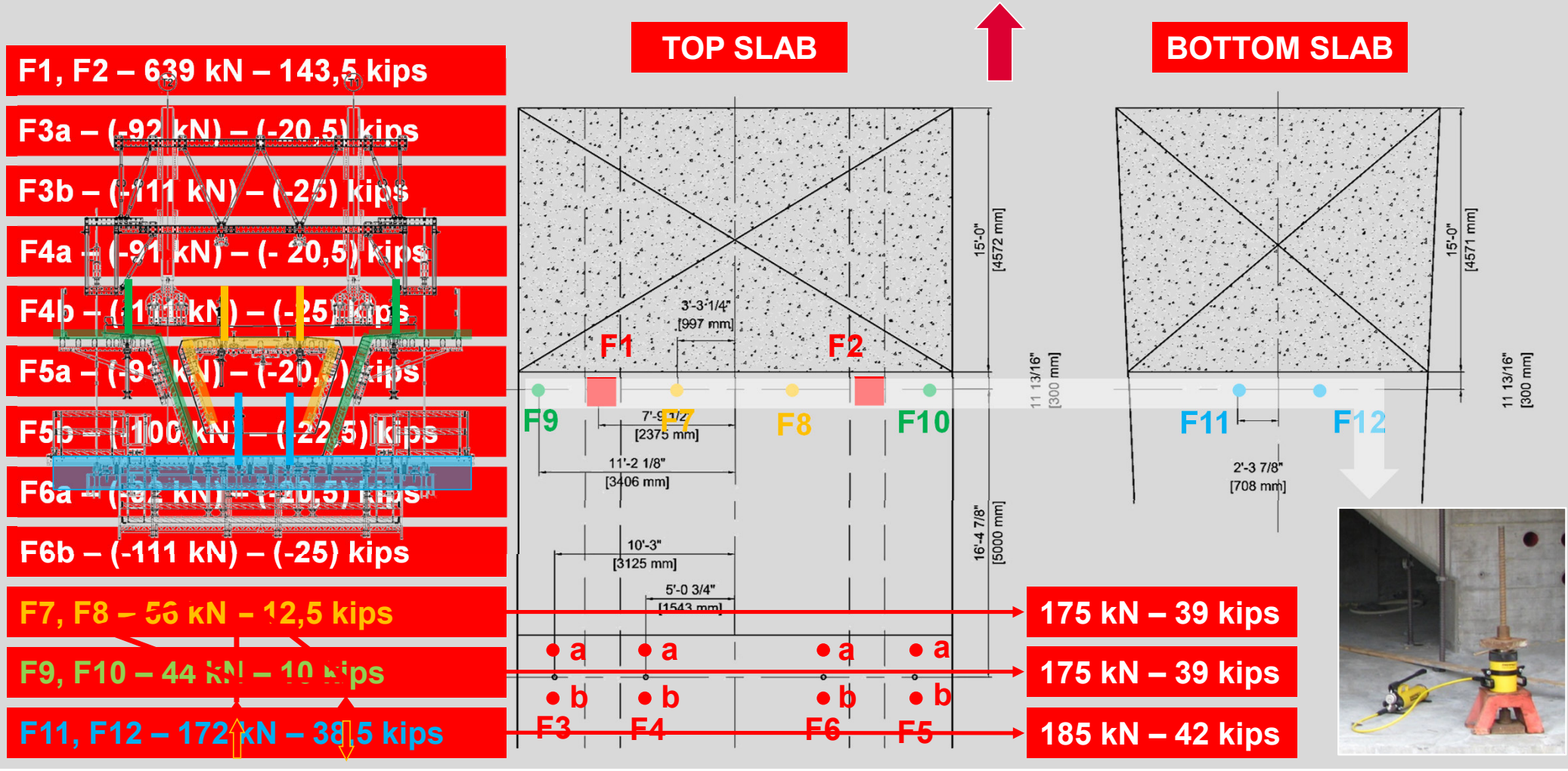




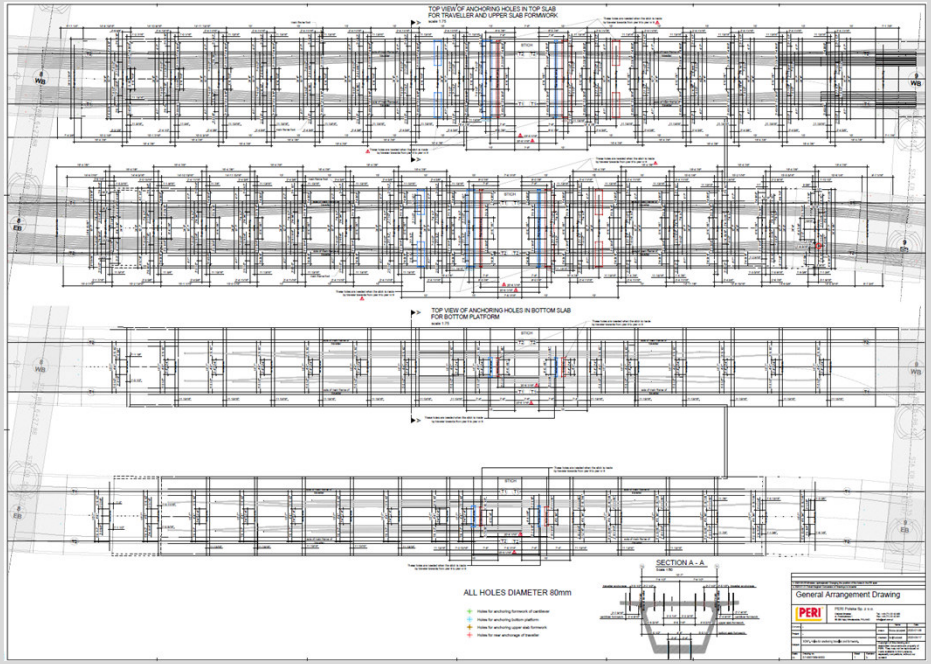


COORDINATED WITH PT LOCATION

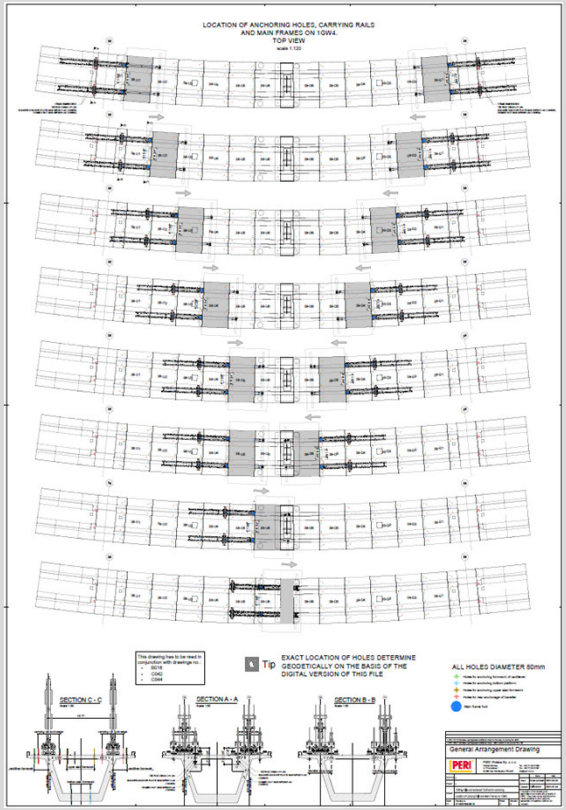
Reaction Forces



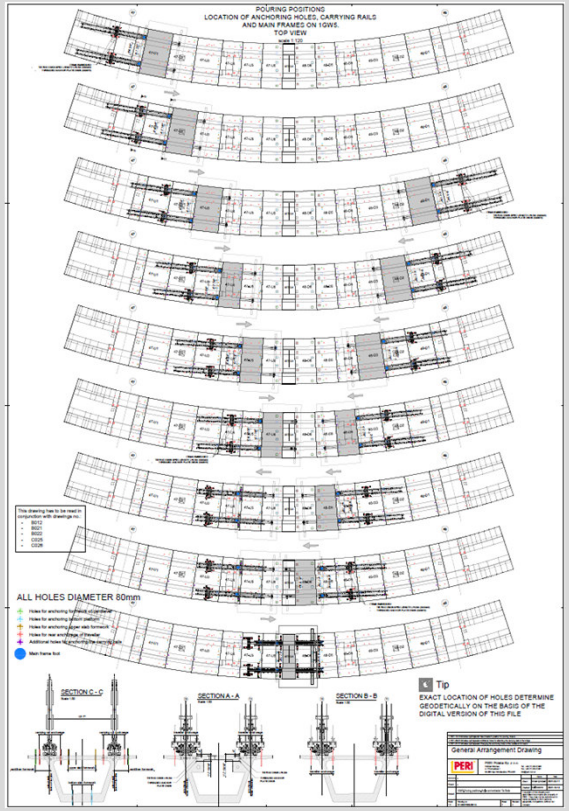
Anchor Points



1GW1



1GW4

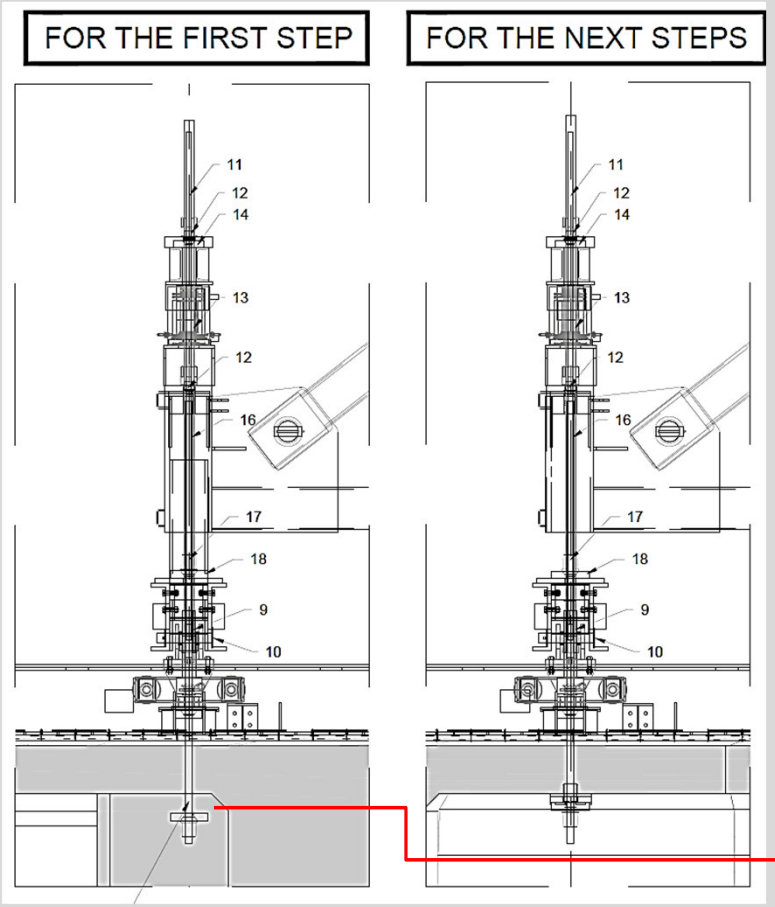


1GW5

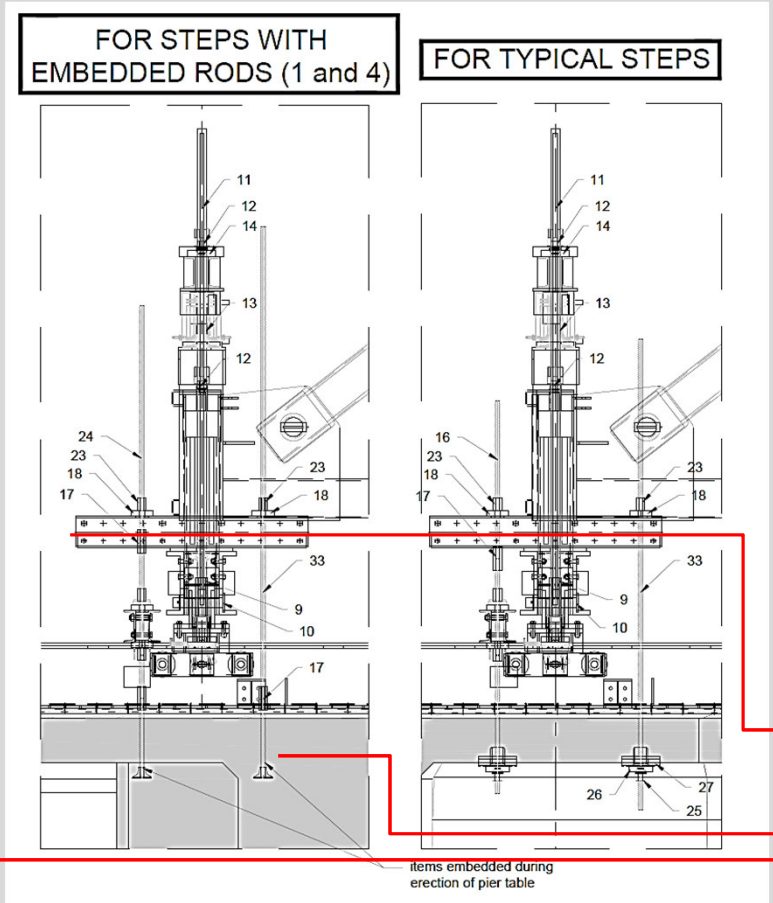
+ carriage position at every pour due to turning

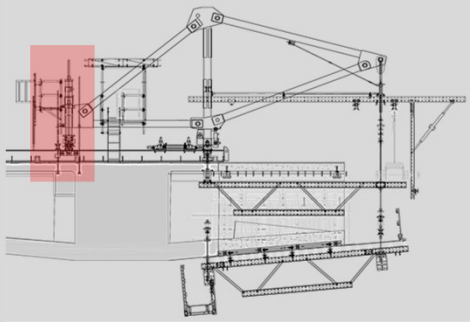
Rear Anchorage

1GW1 and 1GW4



1GW5





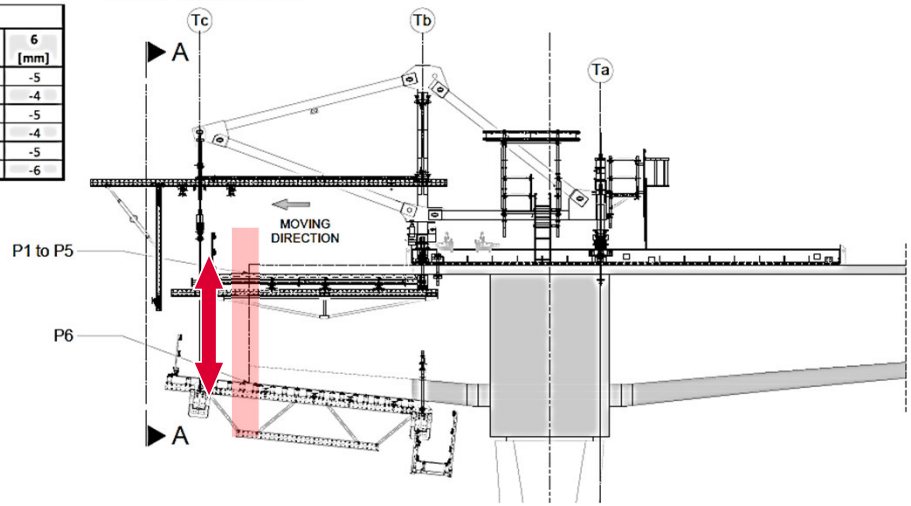
extra beams

embeds

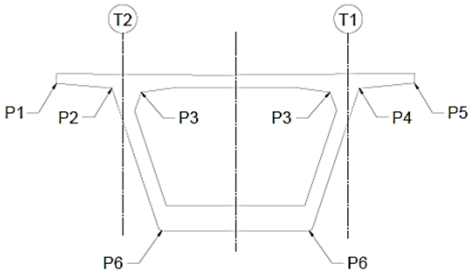
Deflections

POINT	Segment No. 1 [mm]	2 [mm]	3 [mm]	4 [mm]	5 [mm]	6 [mm]
P1	-10	-9	-8	-6	-5	-5
P2	-7	-6	-6	-5	-4	-4
P3	-10	-9	-8	-6	-5	-5
P4	-7	-6	-6	-5	-4	-4
P5	-10	-9	-8	-6	-5	-5
P6	-12	-11	-10	-7	-6	-6

LONGITUDINAL SECTION



DESIGNATED DEFLECTION POINTS
SECTION A - A



GENERAL NOTES

1. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE PROPER ERECTION OF FORMWORK/ SHORING IN ACCORDANCE WITH THE SUPPLIED DRAWING(S), BROCHURE(S), POSTER(S), INSTRUCTIONS FOR USE, ASSEMBLY INSTRUCTIONS, CATALOG(S), COVER SHEET(S), AND SAFETY GUIDELINES. THE CONTRACTOR SHOULD CONTACT PERI ENGINEERING IMMEDIATELY FOR CLARIFICATION IN THE EVENT OF ANY PERCEIVED CONFLICT.
2. THIS DWG SHEET IS NOT A STAND-ALONE DOCUMENT. IT MUST BE USED IN CONJUNCTION AND COMPLY WITH ALL OTHER PAGES AND DOCUMENTS REFERENCED WITHIN THE DRAWING SET.
3. THE CONTRACTOR IS SOLELY RESPONSIBLE TO VERIFY ALL DIMENSIONS FOR THE PROPER ERECTION AND ADJUSTMENT OF FORMWORK/SHORING TO ENSURE THE FINAL CONCRETE DIMENSIONS AND ELEVATIONS SATISFY THE CONTRACTUAL DOCUMENTS. ANY DIMENSIONS PROVIDED, INCLUDING BUT NOT LIMITED TO PROPJACK EXTENSIONS, ARE INTENDED FOR USE BY THE CONTRACTOR IN THE PRESETTING OF EQUIPMENT.
5. CONTRACTOR IS RESPONSIBLE TO IMMEDIATELY REPORT IN WRITING ANY AMENDMENTS(S)/ CHANGE(S) TO, OR DEVIATION(S) THAT OCCUR WITHOUT PERI'S KNOWLEDGE, REVIEW, AND/ OR APPROVAL (AS APPLICABLE).
6. PERI IS NOT RESPONSIBLE FOR THE DESIGN AND PERFORMANCE OF MATERIAL, EQUIPMENT, ITEMS, OR COMPONENTS SUPPLIED BY OTHERS INCLUDING BUT NOT LIMITED TO: FOOTINGS, WALLS, SLABS, REBAR, ANCHORS, PLYWOOD, LUMBER, ETC.
7. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE SUPPLY AND PROPER DESIGN OF BOXOUTS, BULKHEADS, BUILD-UPS, SLAB EDGES, AND BEAM SIDES U.N.O. THIS SHALL INCLUDE THE INTERACTION AND/OR LOAD FROM THESE ELEMENTS ONTO PERI EQUIPMENT.

a 2021-06-08 Zoheir Meghari Detailed Rear reactions

General Arrangement Drawing

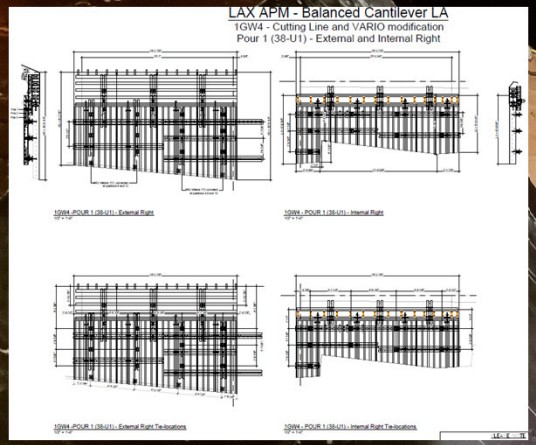
PERI Formwork Systems, Inc.
800 W Cermak Road Suite 212
Chicago IL 60616
Phone: +1 312-876-7788
Fax: +1 312-888-9040
info@peri-usa.com
www.peri-usa.com

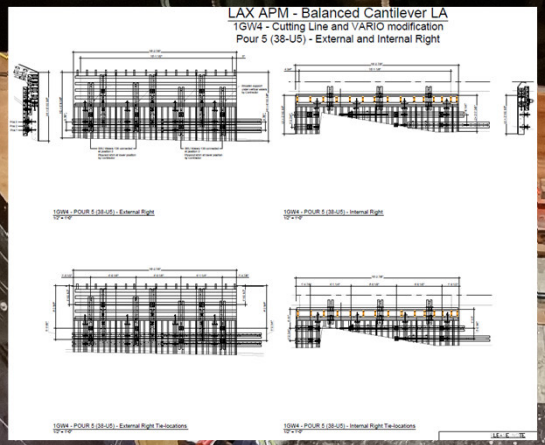
		Name	Date
Company	-		
Project	-	drawn: Zoheir Meghari	2021-05-24
Subject	Pre-camber of the cantilever carriage for 1GW5	checked: Eric Tarty	2021-06-08
Scale 1/- or -/-	Drawing-no. 57-0007569-B019	Sheet 1	Revision a

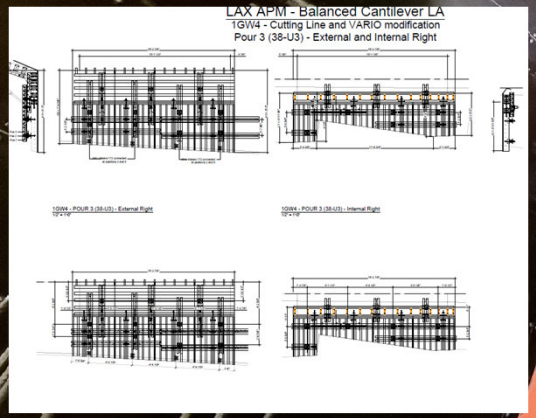
Max. deflection – 12 mm – 15/32”

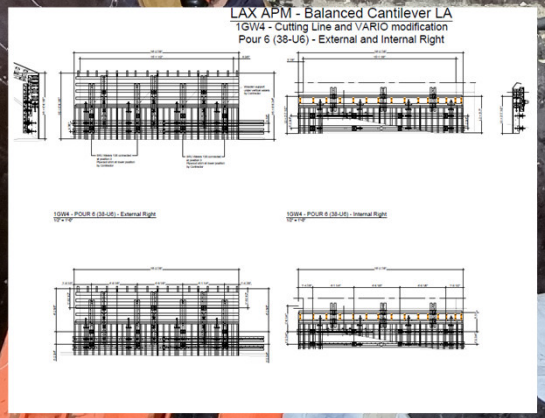
Min. deflection – 4 mm – 5/16”

Wall Formwork Adjustment at Every Pour

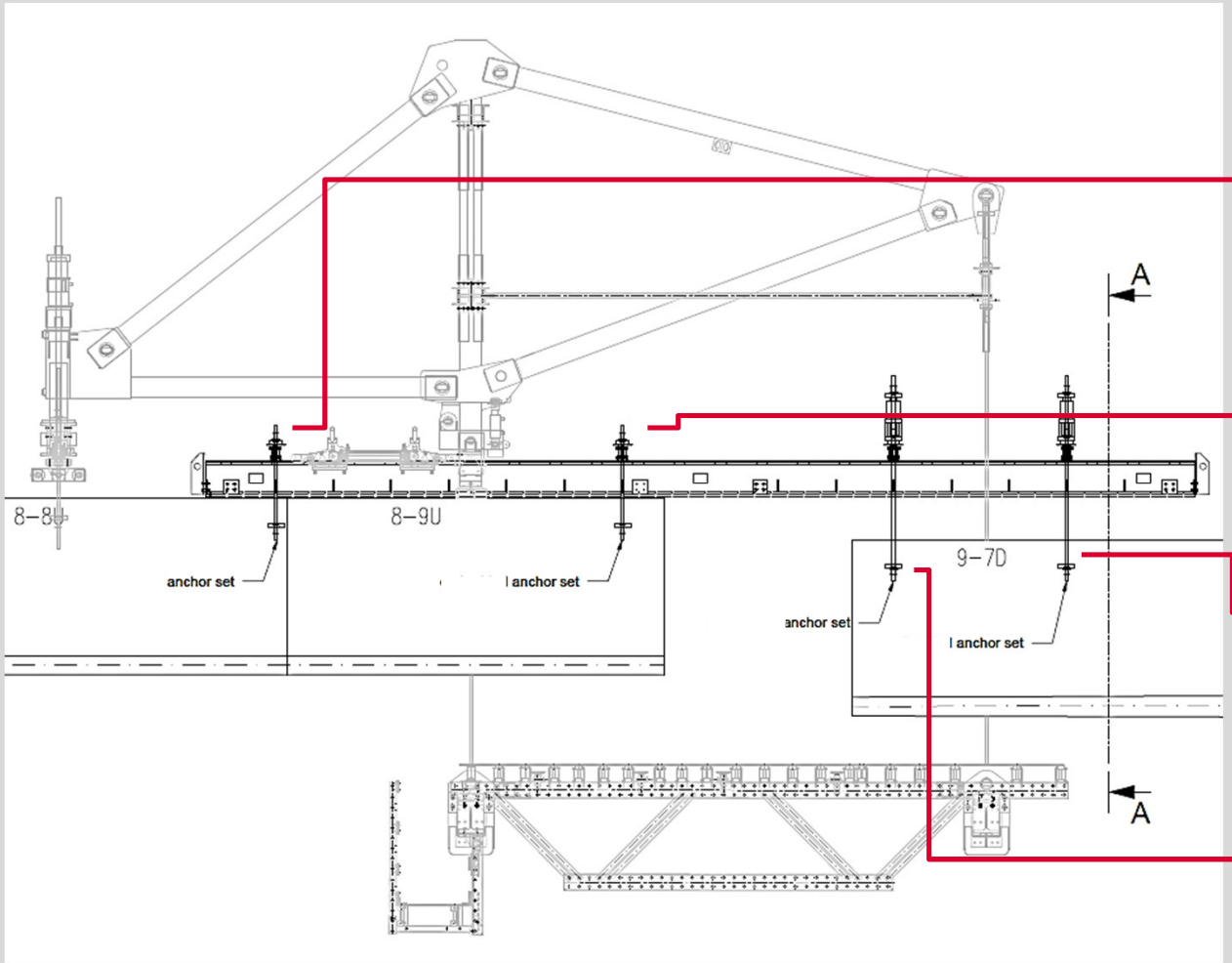


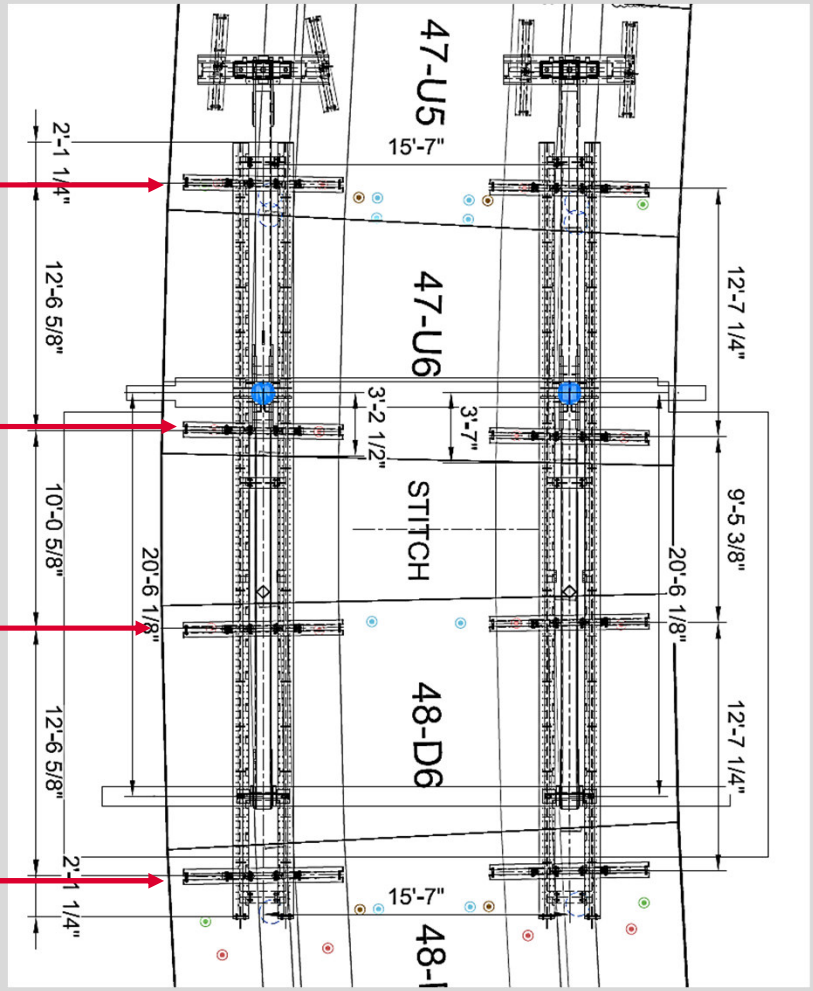


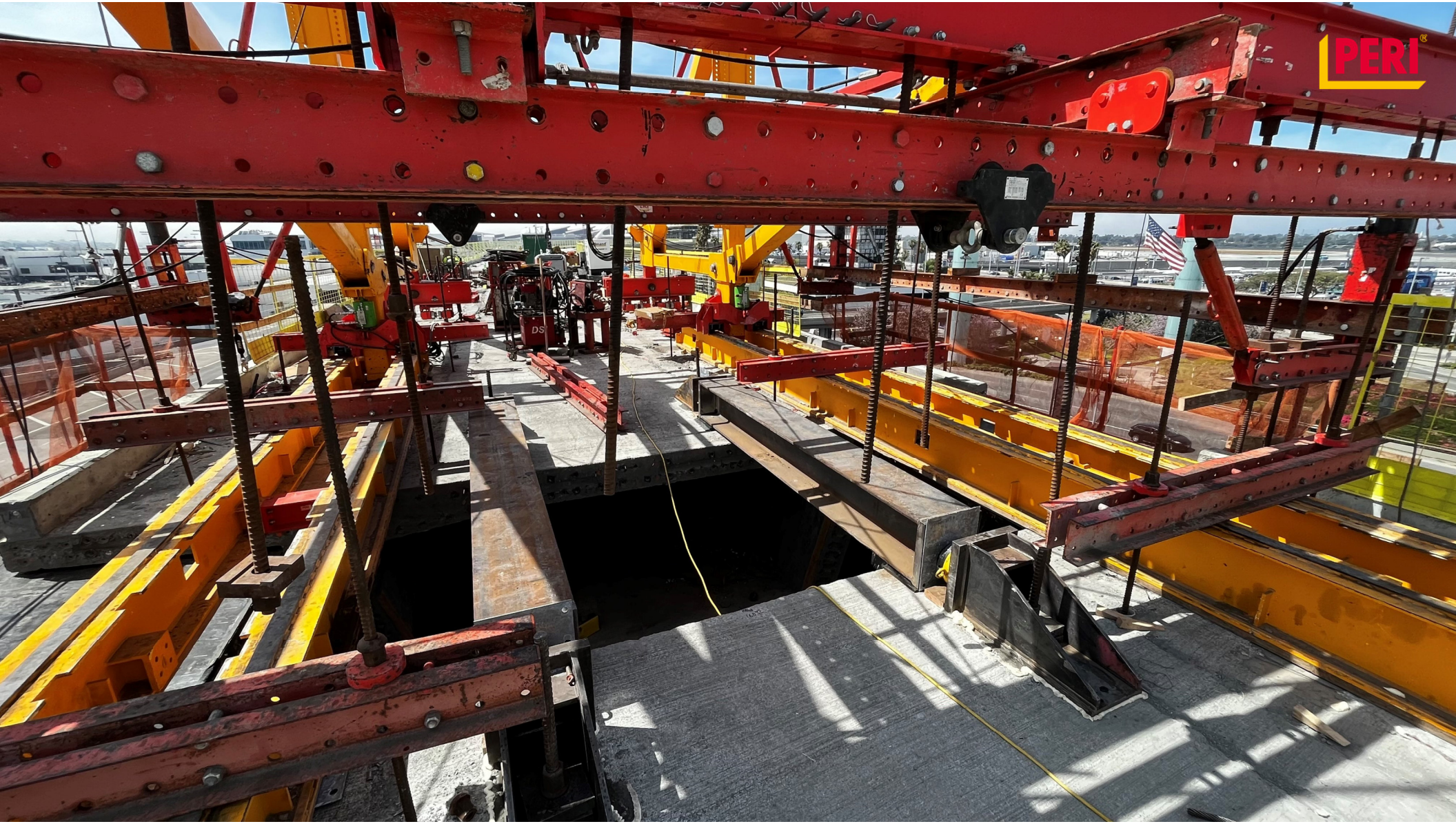




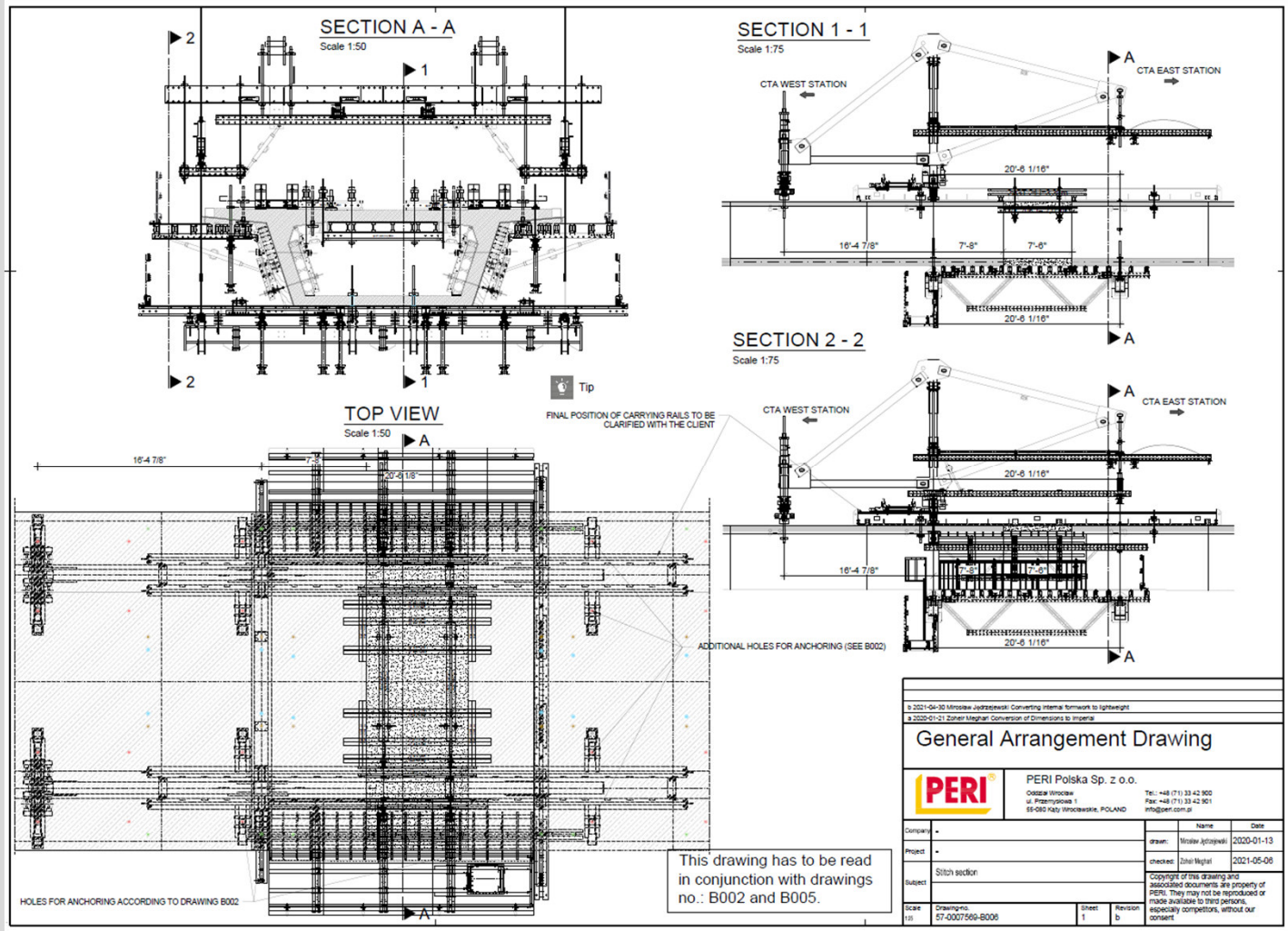
Connection Leveling for Closure Pour

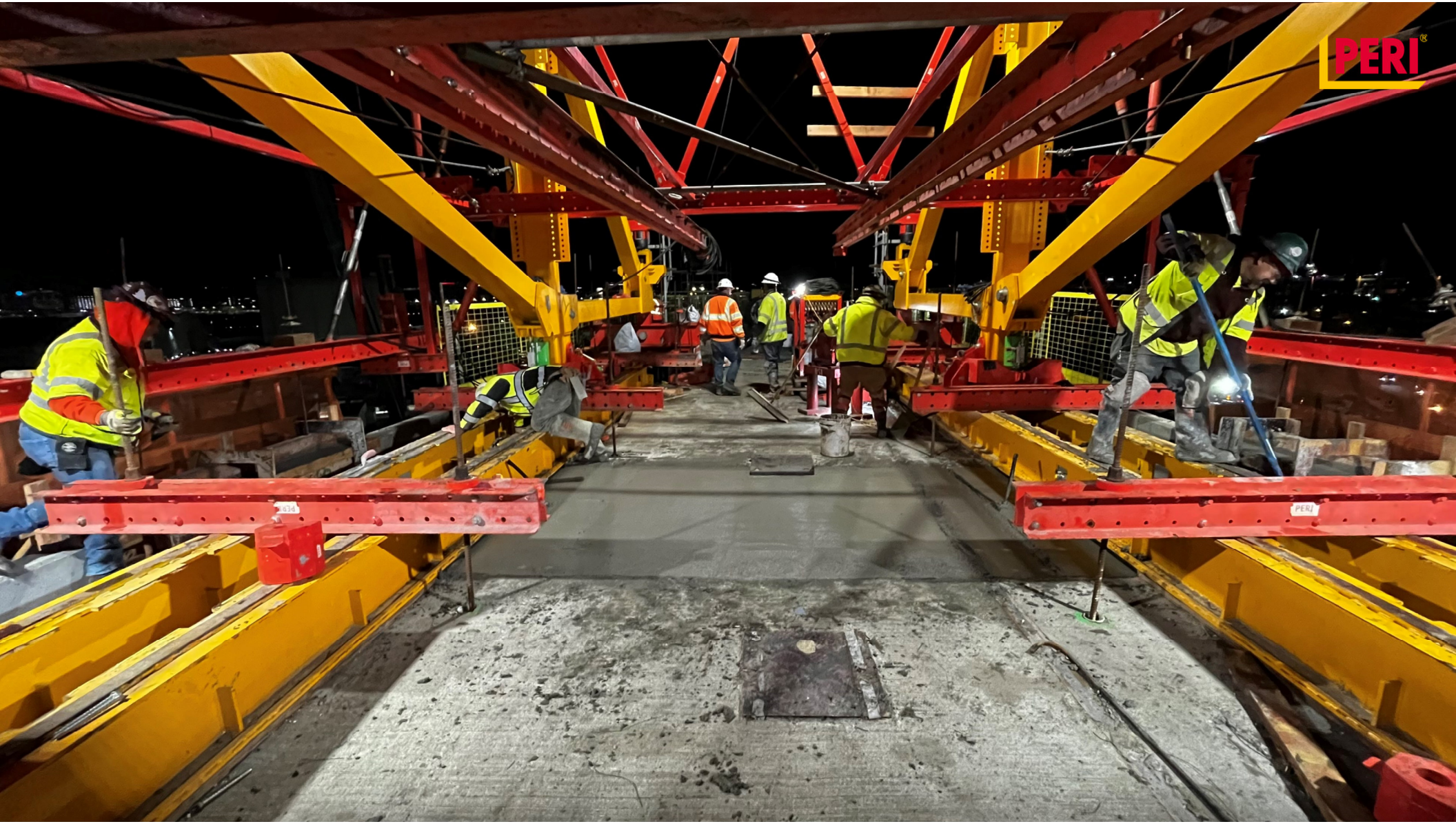





PERI

Closure Pour Concreting

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UNITED

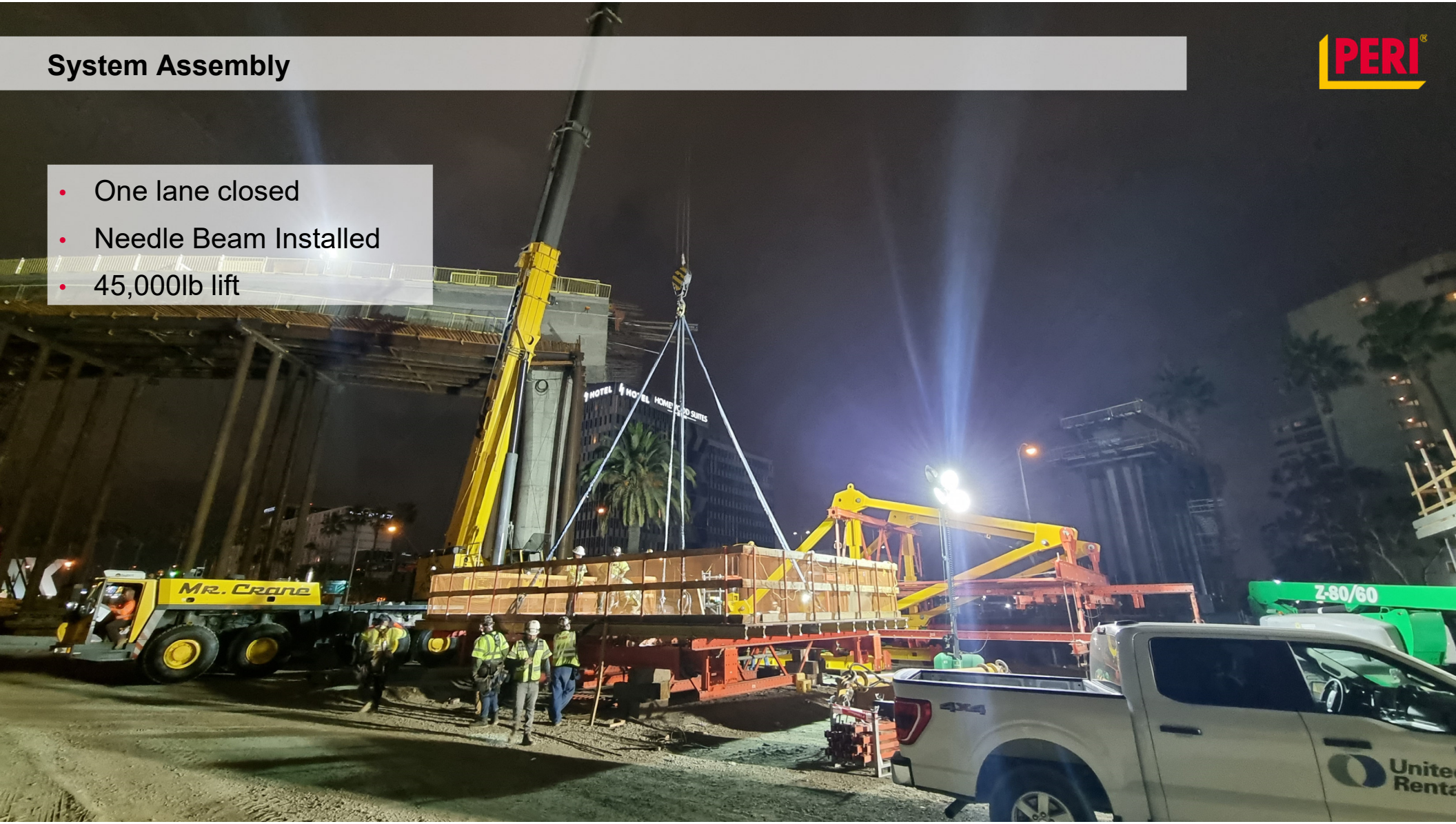
ASSEMBLY AT 1GW5

System Assembly

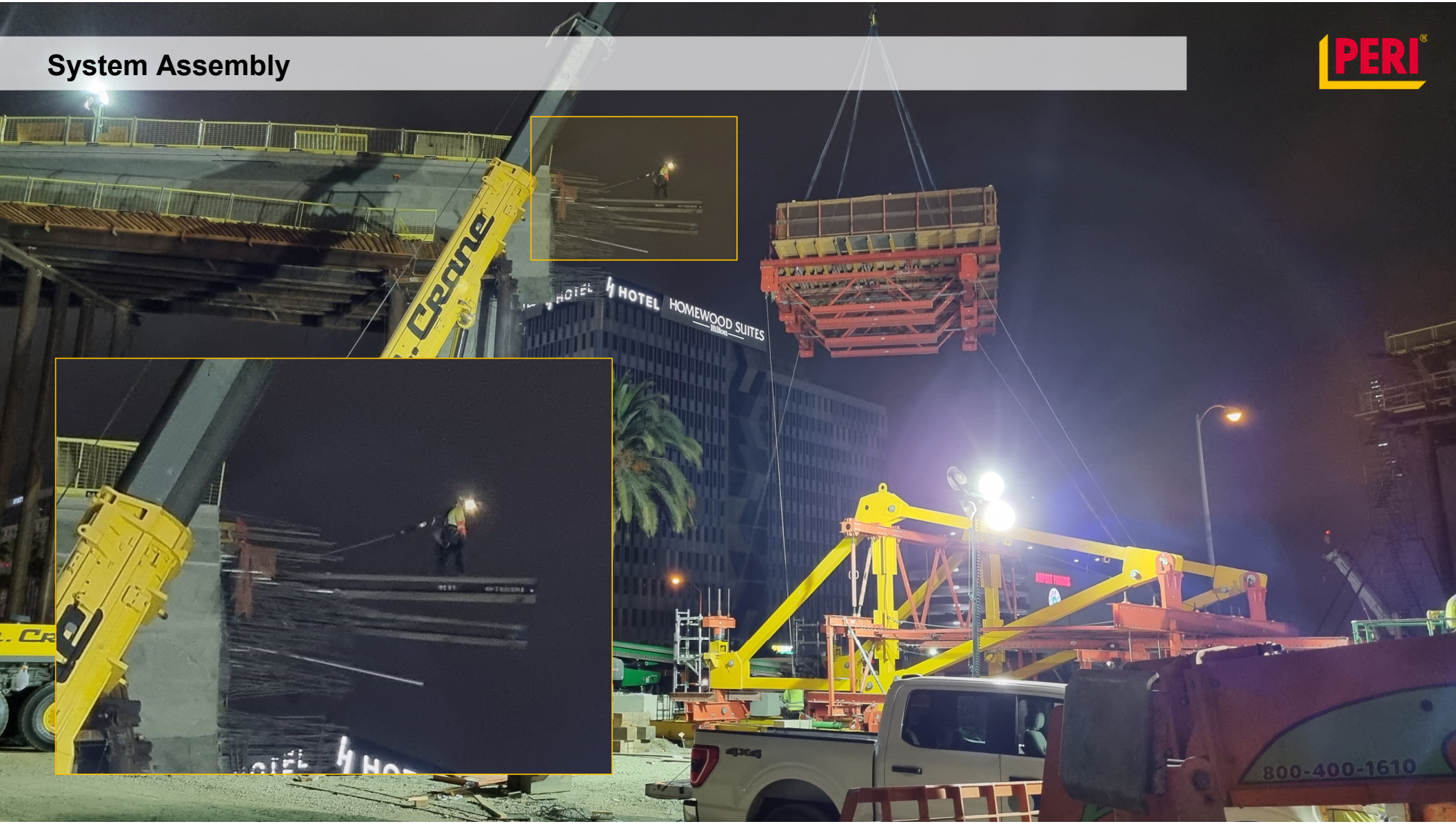
- Preassemble on ground

System Assembly

- One lane closed
- Needle Beam Installed
- 45,000lb lift



System Assembly



System Assembly

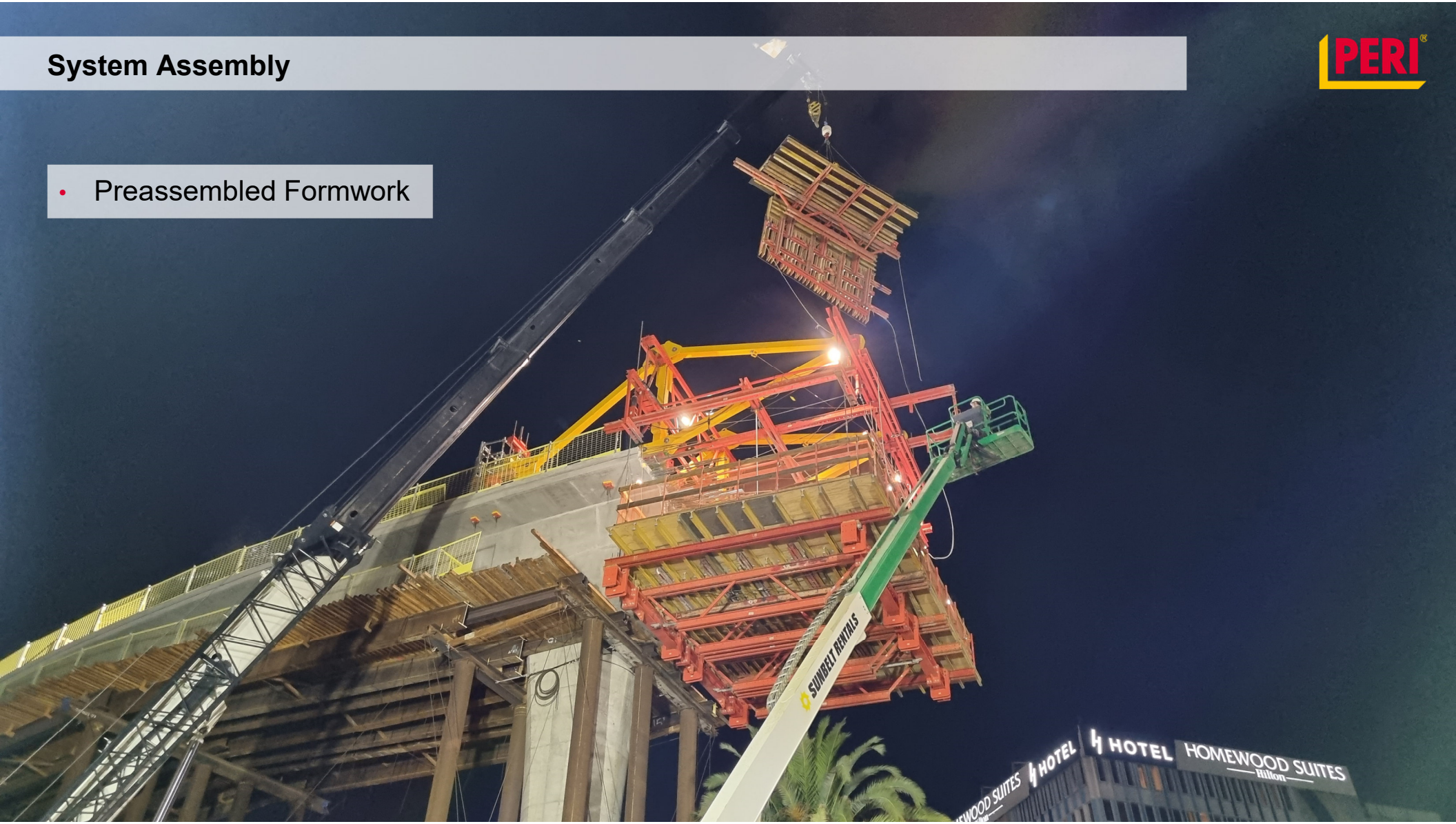
- 44,000lb lift
- C.O.G. Calculation

System Assembly

- Temp Counterweights

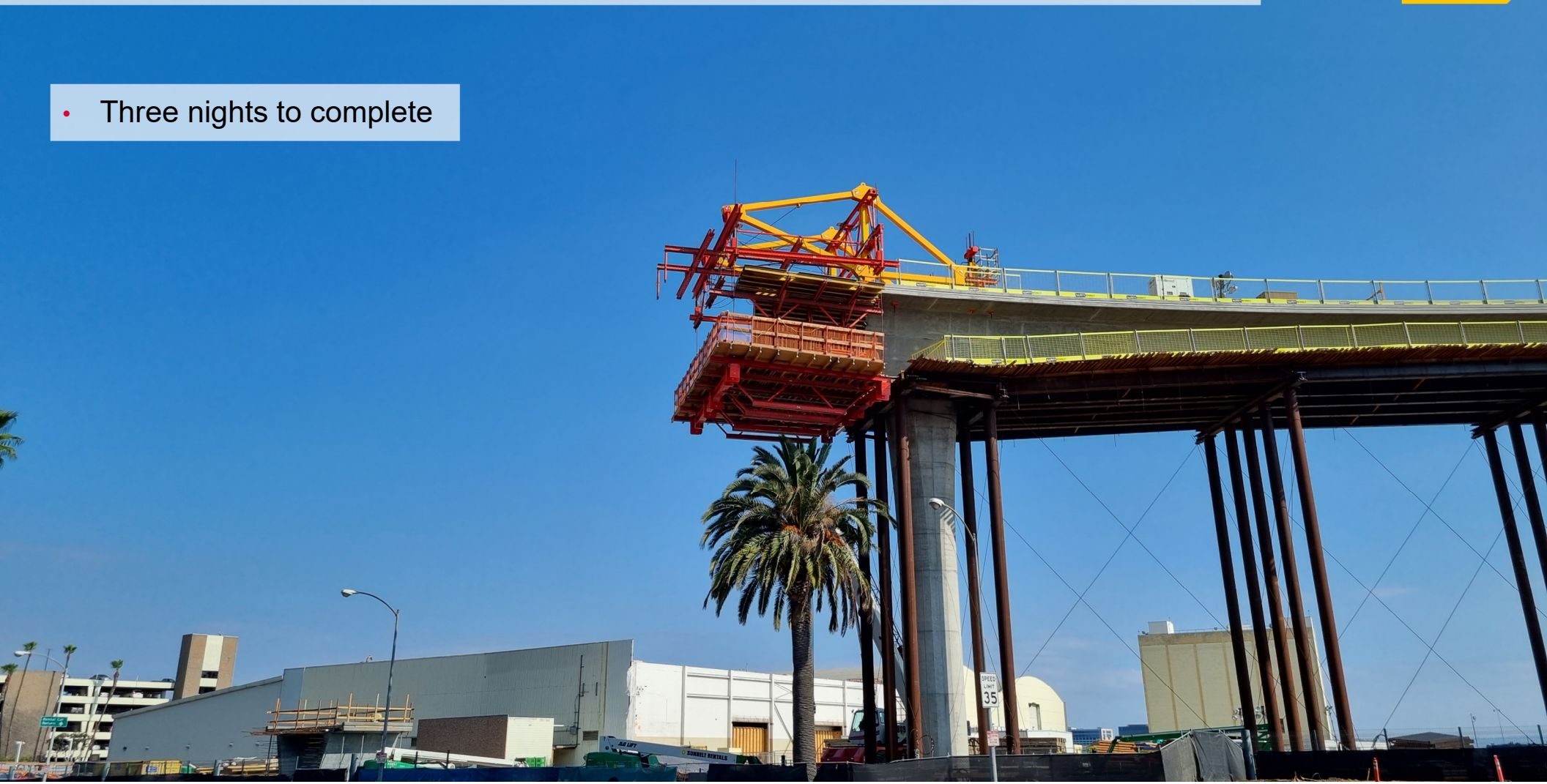
System Assembly

- Preassembled Formwork



System Assembly

- Three nights to complete



Lifting Plan Coordination

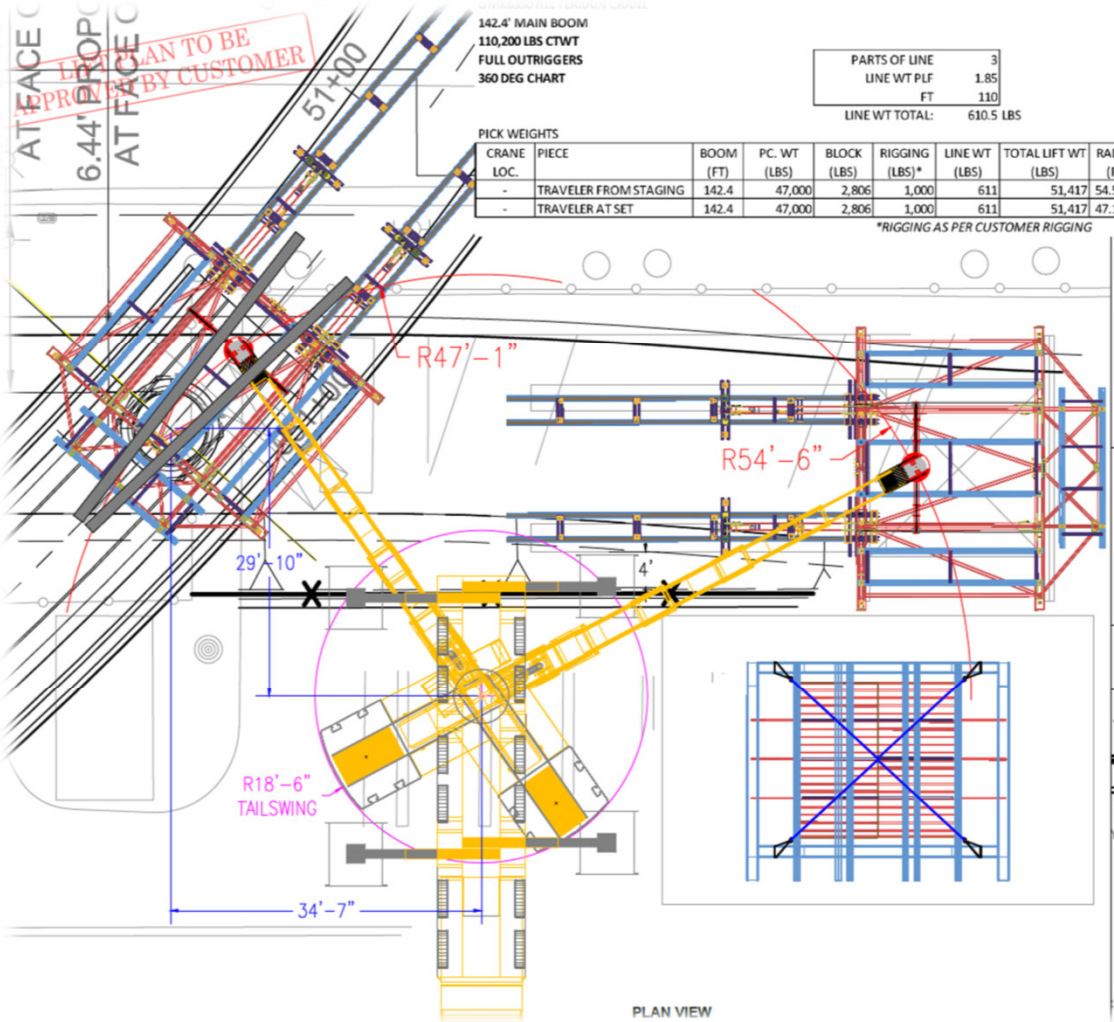
142.4' MAIN BOOM
110,200 LBS CTWT
FULL OUTRIGGERS
360 DEG CHART

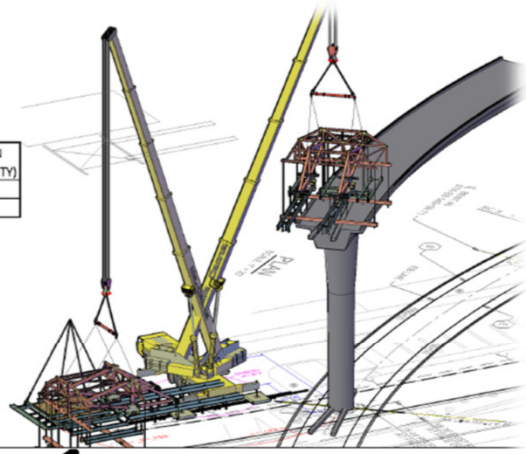
PARTS OF LINE	3
LINE WT PLF	1.85
FT	110
LINE WT TOTAL:	610.5 LBS

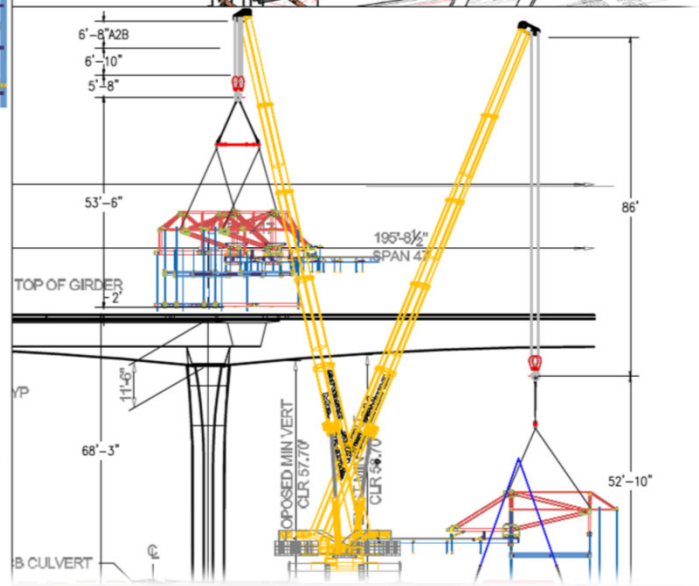
PICK WEIGHTS

CRANE LOC.	PIECE	BOOM (FT)	PC. WT (LBS)	BLOCK (LBS)	RIGGING (LBS)*	LINE WT (LBS)	TOTAL LIFT WT (LBS)	RADIUS (FT)	CAPACITY (LBS)	MARGIN (% CAPACITY)
-	TRAVELER FROM STAGING	142.4	47,000	2,806	1,000	611	51,417	54.5(55)	83,000	61.9%
-	TRAVELER AT SET	142.4	47,000	2,806	1,000	611	51,417	47.1(50)	94,000	54.7%

*RIGGING AS PER CUSTOMER RIGGING







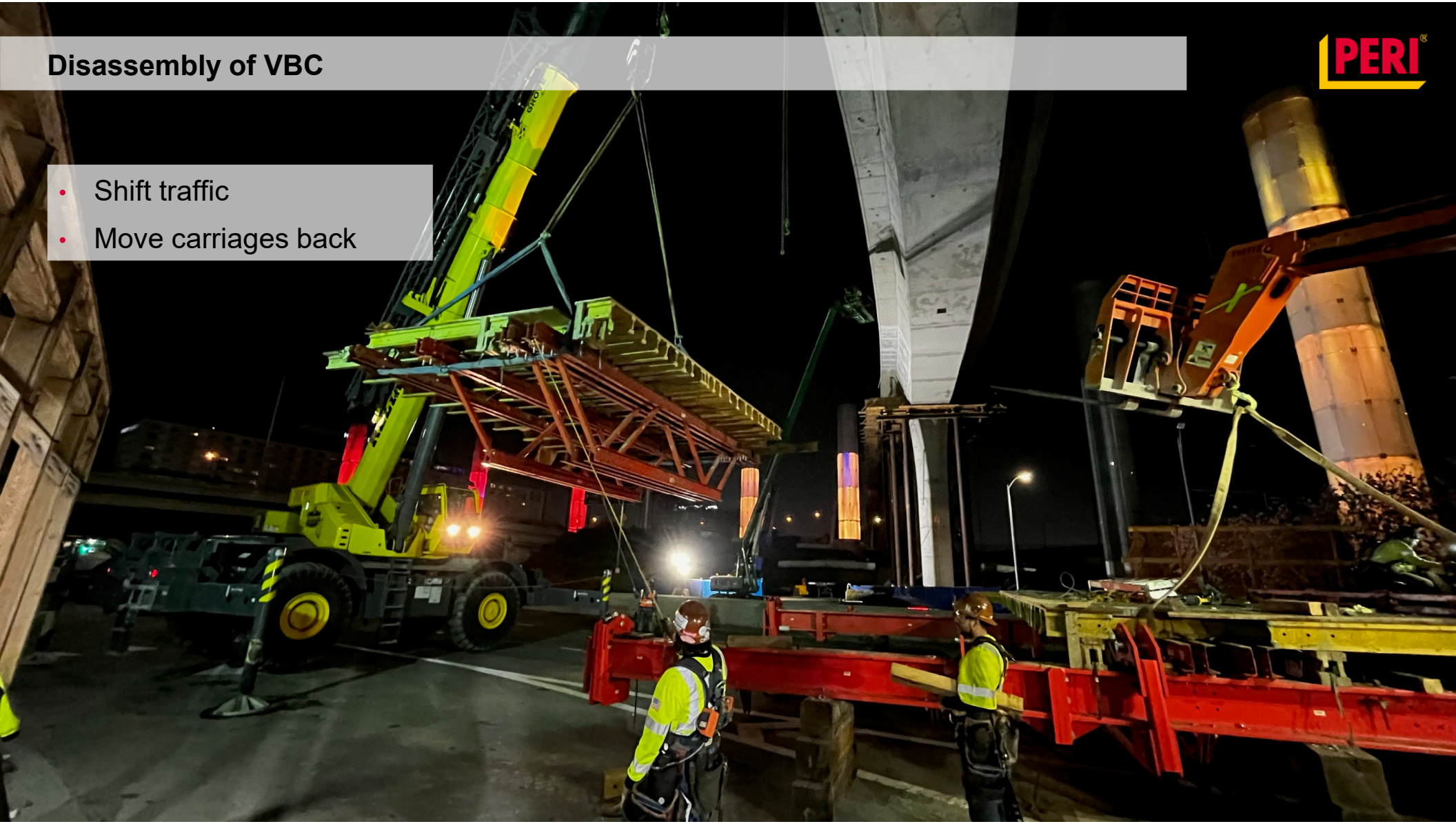
DISASSEMBLY AT 1GW5

Disassembly of VBC

- Shift traffic
- Move carriages back

Disassembly of VBC

- Shift traffic
- Move carriages back



Disassembly of VBC

- Back launch carriages
- Disassemble at pier

THANK YOU, FOR YOUR ATTENTION Q&A