ERECTING SOLUTION AND EQUIPMENT for

1-4/LEE ROY SELMON EXPRESSWAY INTERCHANGE BRIDGE

BEIJING WOWJOINT MACHINERY CO.
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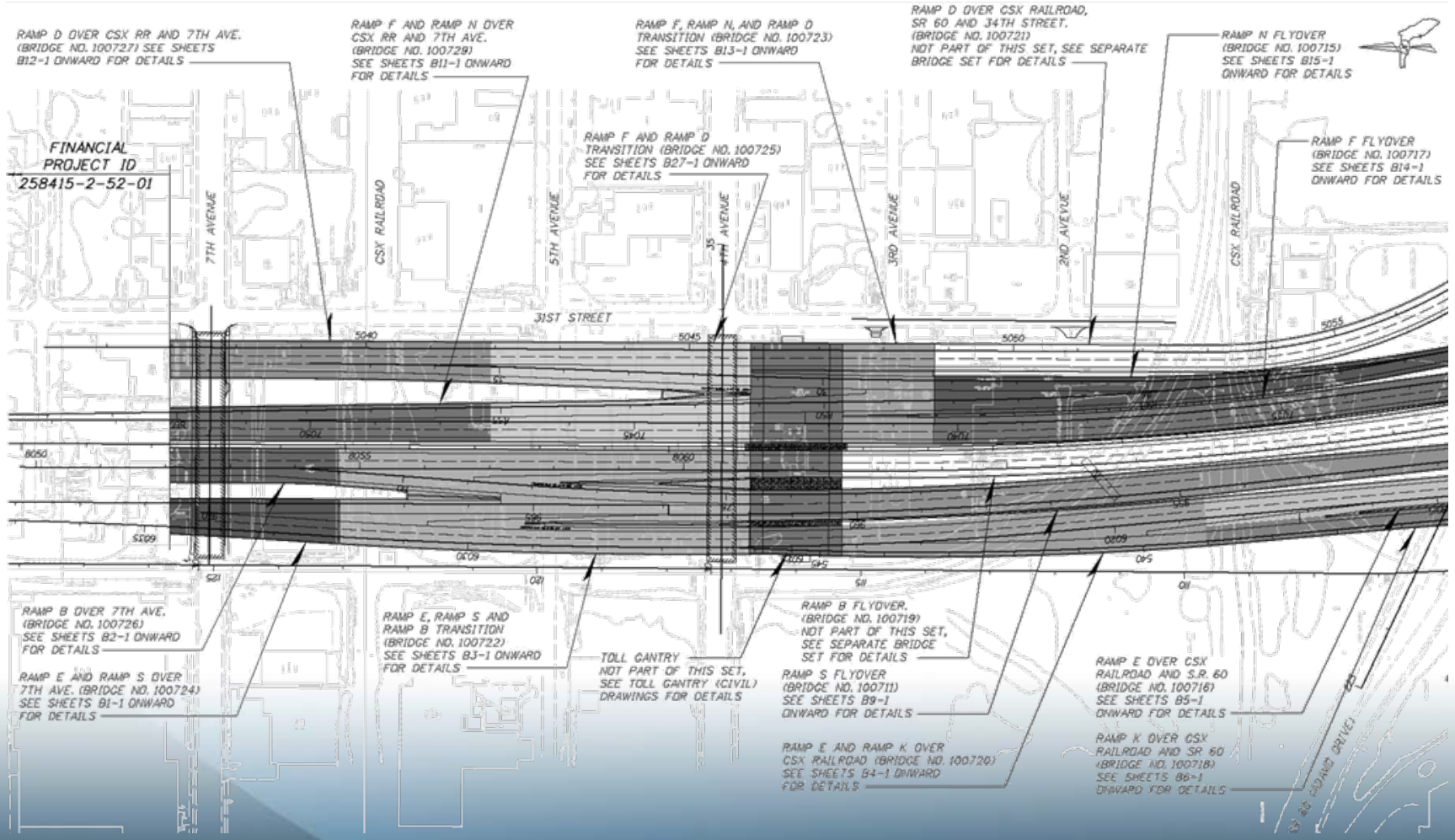
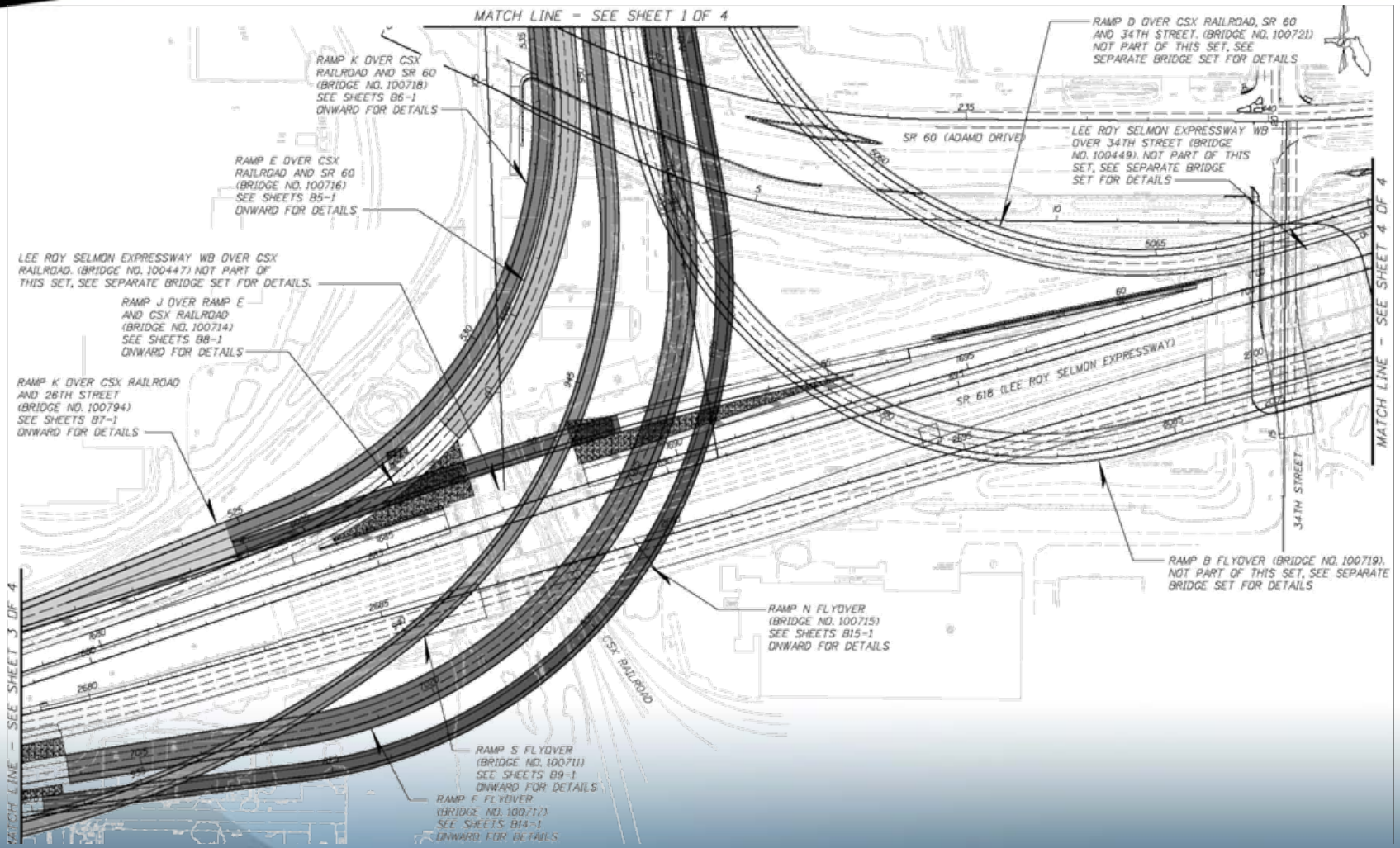
Project Conditions

- I-4/Lee Roy Selmon Expressway Interchange in Tampa, Florida is a multi-level freeway-to-freeway interchange project. It includes 23 bridges; mostly elevated Interchange ramps, with a total approximate length of 12 miles(19.3 km) and approximately 1.5 million SqFt of bridge deck.

Project Conditions



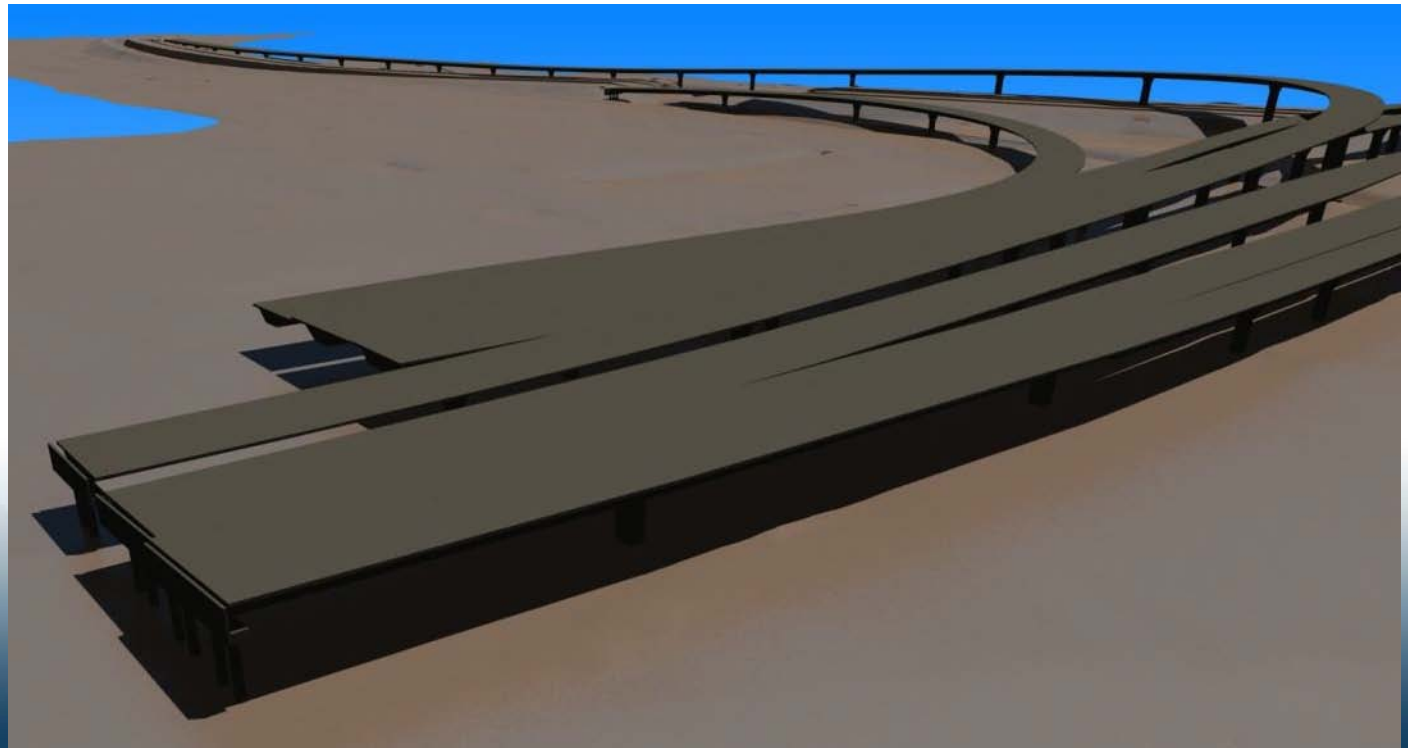
Project Conditions



Project Conditions

Highly complex project

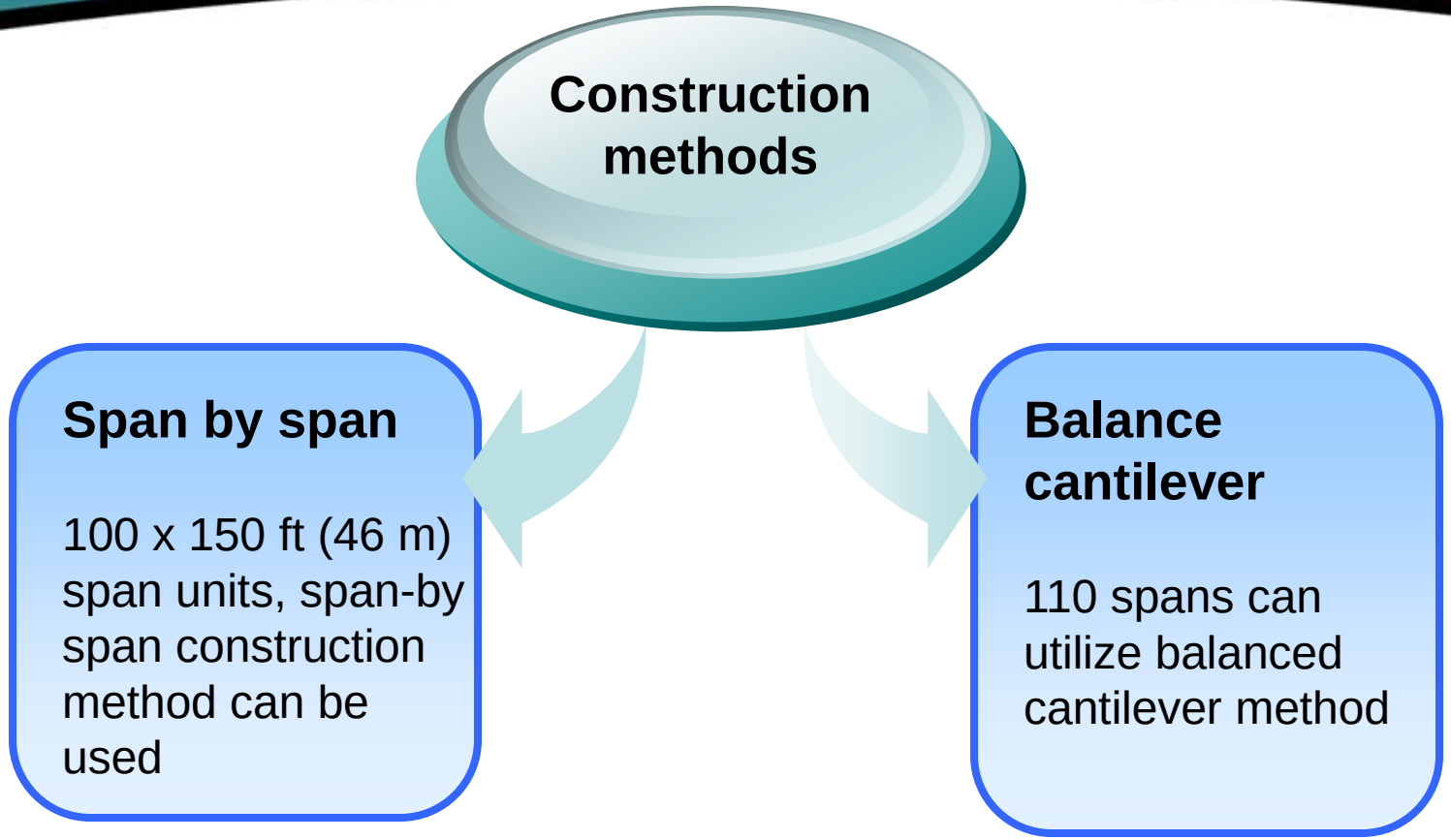
Variable span lengths:	94 ft(29 m) to 260 ft (79 m)
Big difference on pier heights:	18 ft (5.5 m) to 91 ft (28 m)
Curvature:	200 ft (61 m) minimum to straight
Cross slope:	3% to 10%
Bridge deck width:	30 ft (9 m) to 64 ft (19.5 m)
Total number of spans :	210



Analysis

- All the blue lines indicated in the picture represent the bridges that are to be erected.
- However, the work situation on those locations marked as red, yellow and green are very complicated, such as small radius curves, criss-crossings and side by side lines.
- Furthermore, some spans to be built will be located at existing railways or road, where it’s impossible to be erected by the traditional construction method.

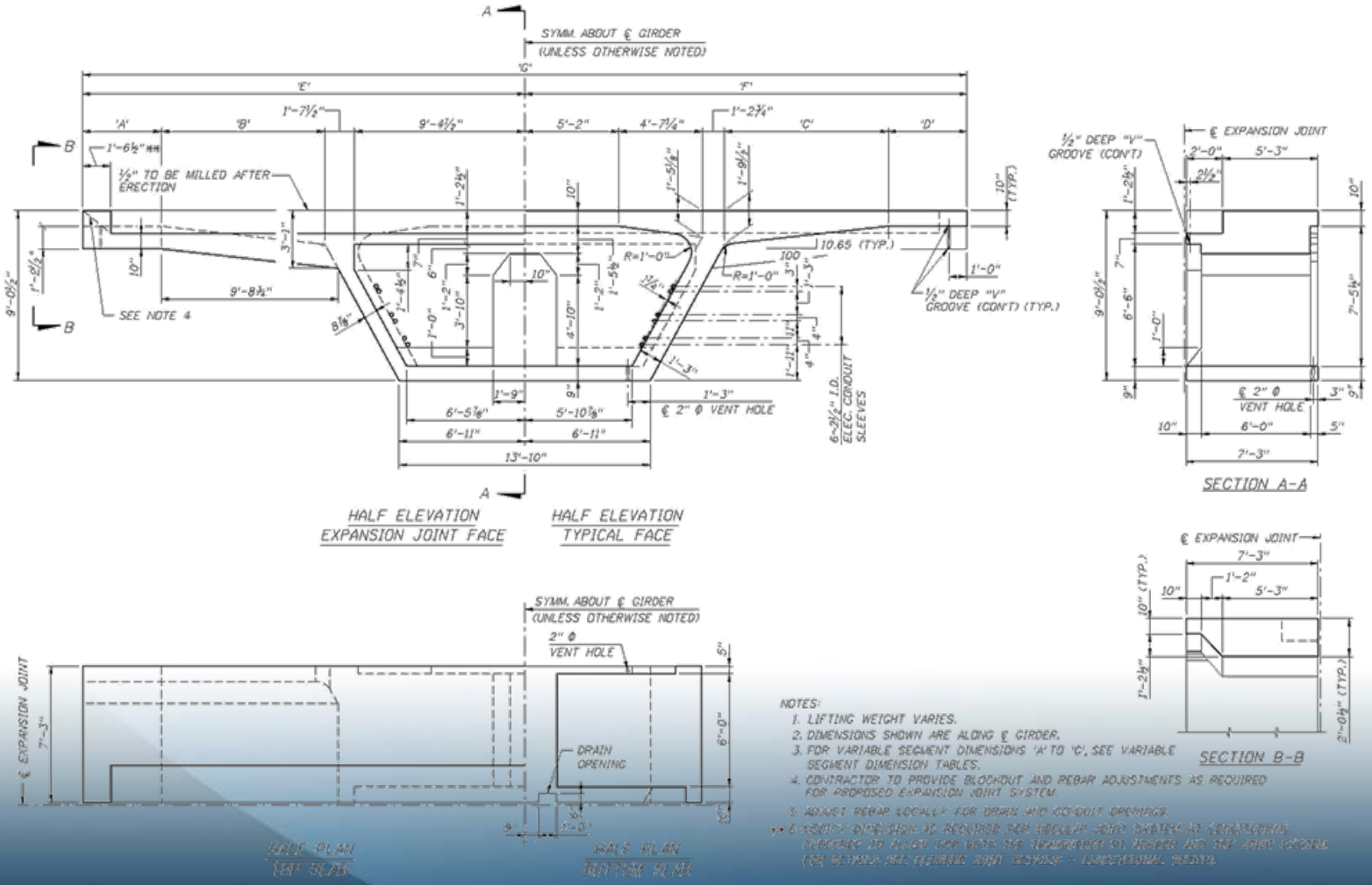
Analysis



- Focus on the construction method of balance cantilever applied to this project.

Analysis

- Dimensions of a typical segment



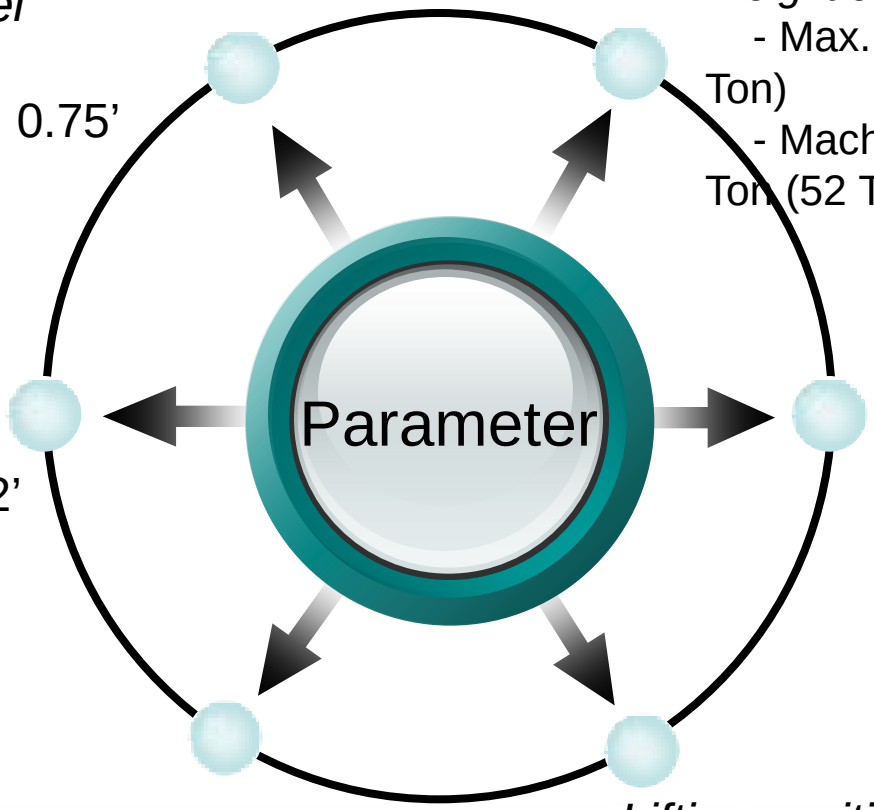
Analysis

Clearance of parallel viaducts

- Min. dimension: 0.75’ (229 mm)

Weight of segments

- Max. weight: 74.4 US Ton (67.5 Ton)
- Machine dead weight <57.3 US Ton (52 Ton)



Curve

- Min. curve: 582’ (177 m)

Dimension of more segments

- Height: 9’ (2.7 m)
- Length: 9.2’ (2.8 m) ~10’ (3 m)
- Width: 28.6’ (8.7 m)~59.3’ (18 m)

Slope

- Max. transversal slope: 10%
- Max. longitudinal slope: 6%

Lifting position Limited

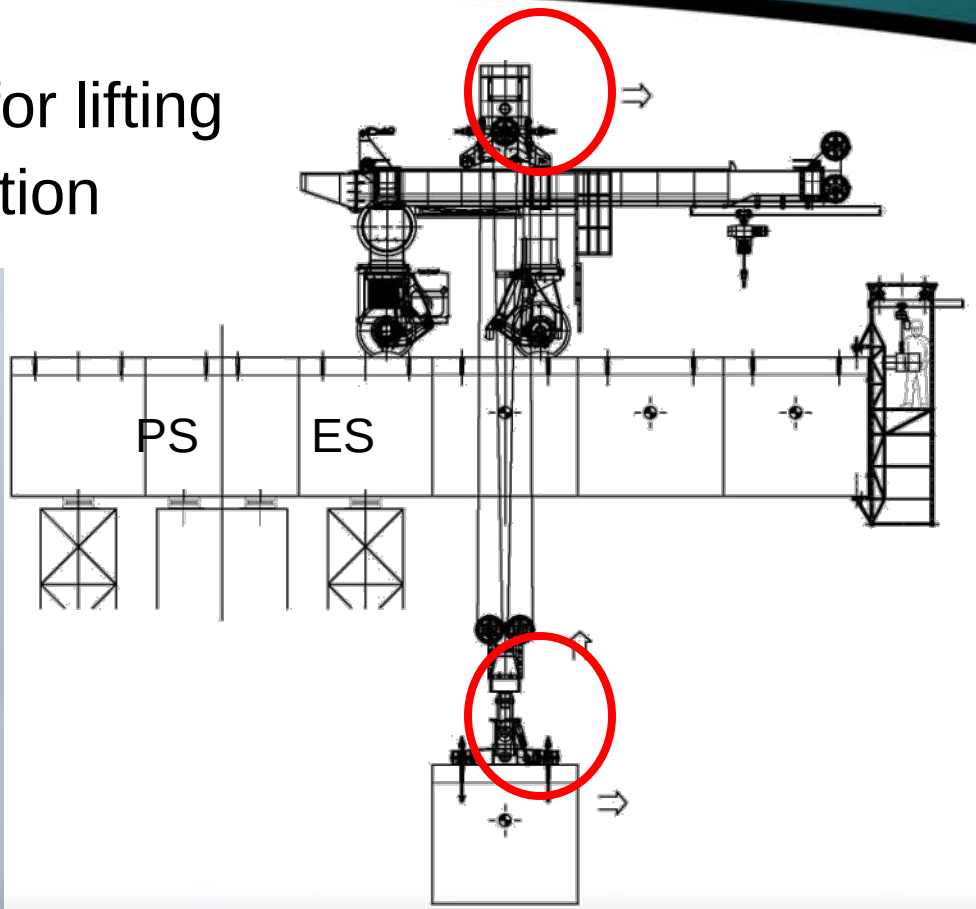
Lift segments closed to pier near CSX railroad track

Proposal and Solution

Confirmed Final Solution

Proposal and Solution

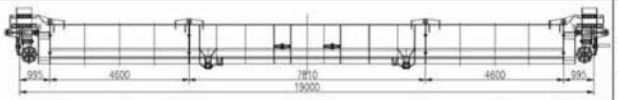
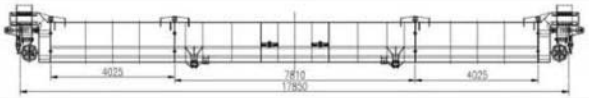
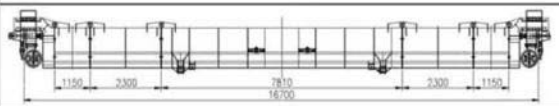
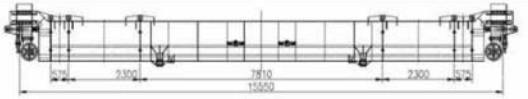
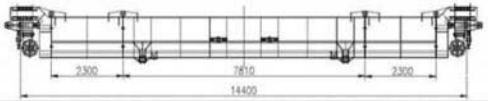
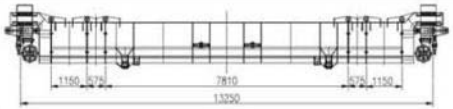
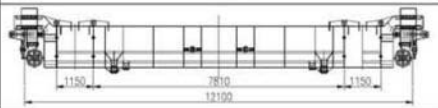
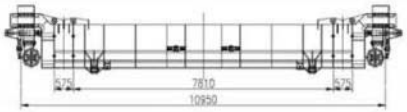
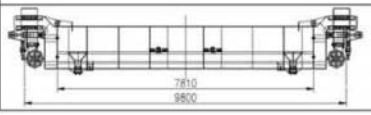
Upper and lower spreaders for lifting segments near pier position



Lift segment and
Move to erecting position

Proposal and solution

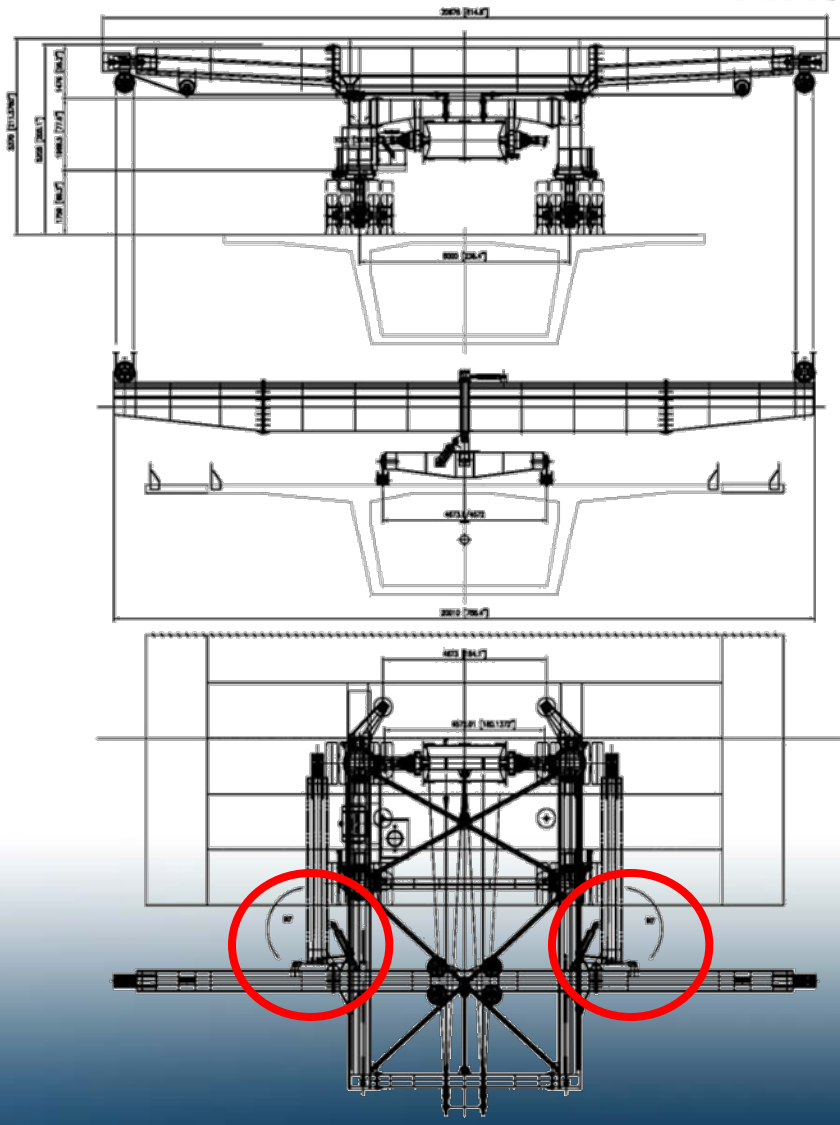
- The upper and lower spreaders can be assembled in different lengths according to the width of various segments.

No.	Upper Spreader Length Configuration	Length(m)	Weight(t)
1		7.81+2(4.6+0.995) =19	9.33
2		7.81+2(4.025+0.995) =17.85	9.03
3		7.81+2(2.3+1.15+0.995) =16.7	9.19
4		7.81+2(2.3+0.575+0.995) =15.55	8.79
5		7.81+2(2.3+0.995) =14.4	8.16
6		7.81+2(0.575+1.15) =13.25	8.02
7		7.81+2(1.15+0.995) =12.1	7.4
8		7.81+2(0.575+0.995) =10.95	6.99
9		7.81+2×0.995 =9.8	6.37

Proposal and Solution

Horizontal foldable arms

- Once the cantilever erection on one pier is completed, we need to transfer the machine from this pier to the next one.
- Making the upper spreader foldable to minimize the overall size of the machine in order to lift the machine without disassembly of machine.
- This solution was denied because it was difficult to push/pull the cantilever spreader arm horizontally due to its dead weight.

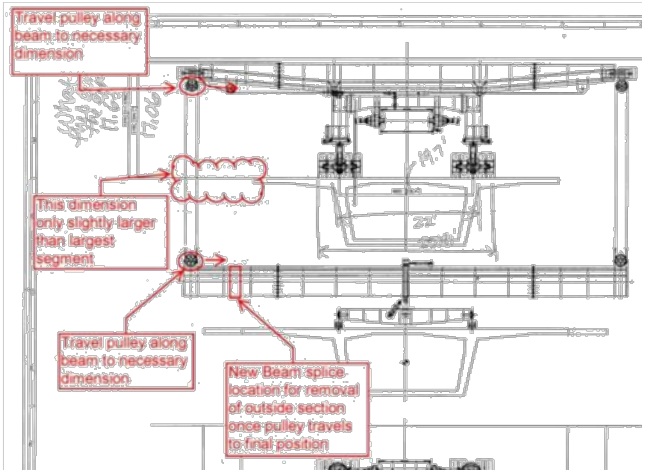


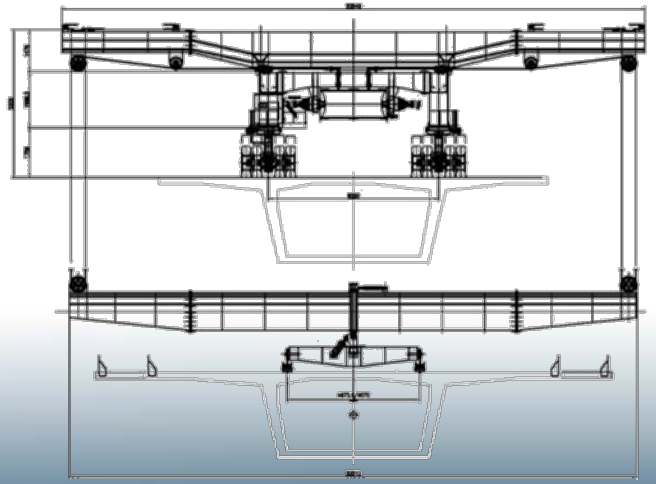
Proposal and Solution

Upper spreader sliding (chains/cylinders)

- According to the client's former requirement (red boxes), we added a sliding device on the pulley blocks of the upper spreader to change the width of the lifting points and to make sure the machine could lift various widths of segments.

- This was also denied because the two ends of the spreader would not be shortened, even if the lifting points were changed. When erecting the viaducts where both sides or one side of the viaduct had been erected, the spreader ends would interfere with erected viaducts.



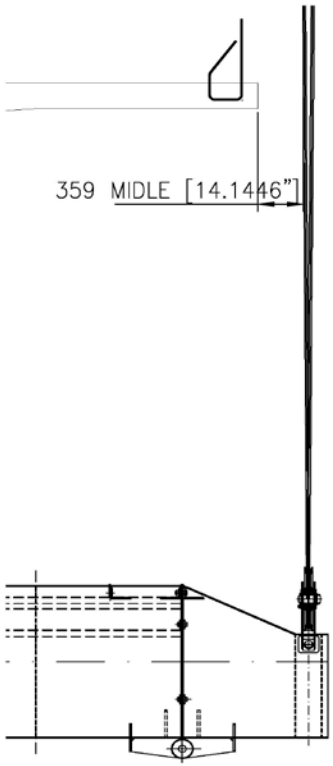


Proposal and Solution

In order to adapt to the narrow space between parallel bridges

Proposal and Solution

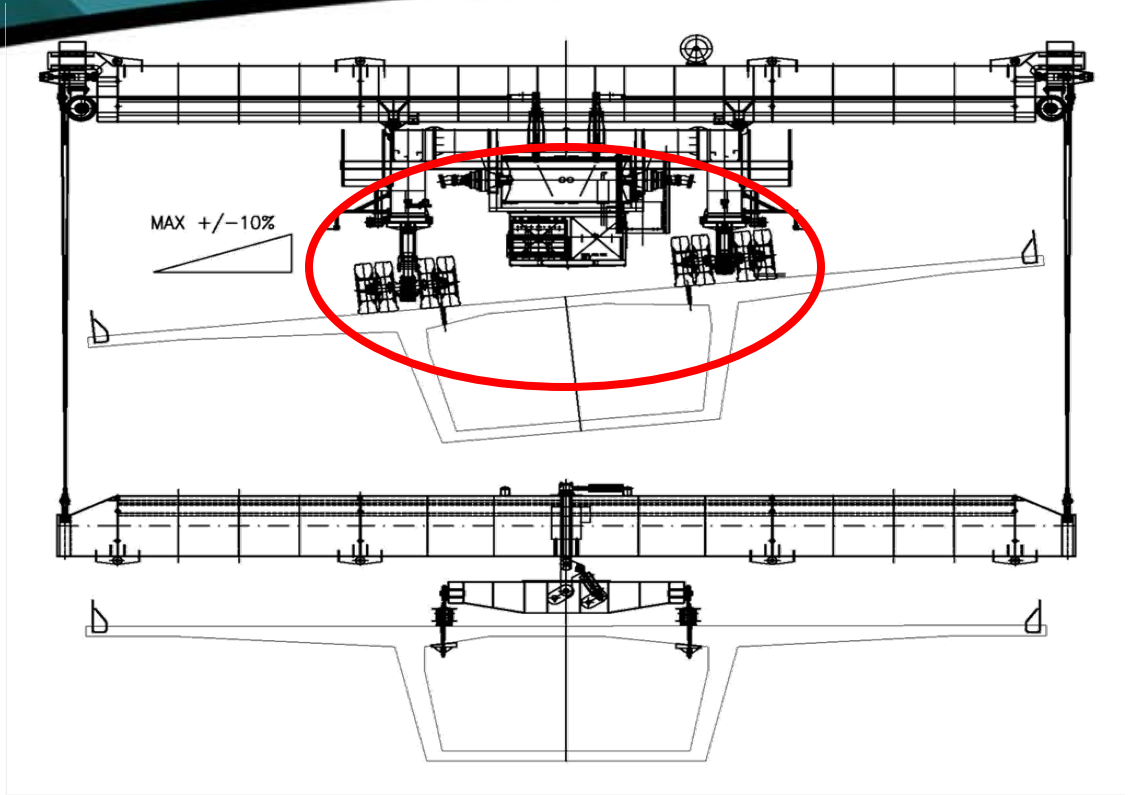
Placing the lower pulleys in a longitudinal direction in order to adapt to the narrow space between the parallel bridges.



Proposal and Solution

Tire shock absorber system for wheel group for moving on the slope deck

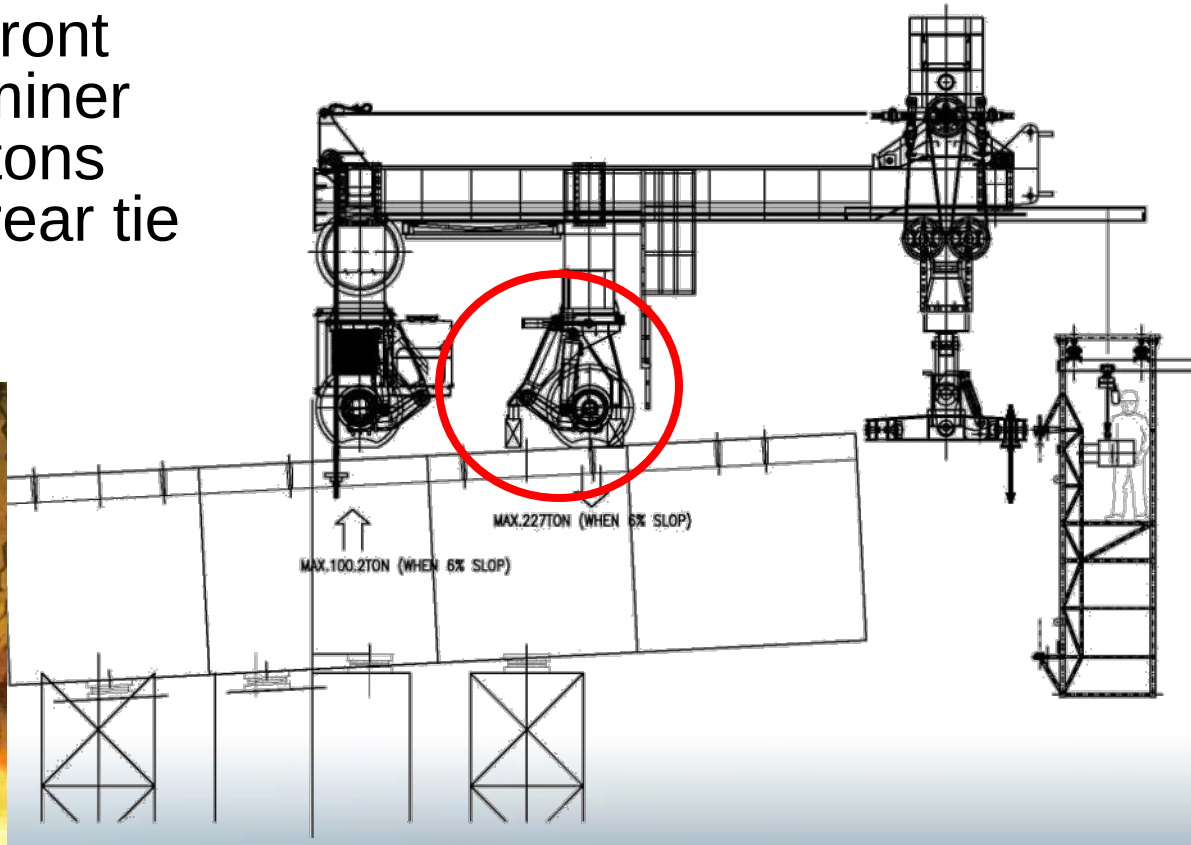
Proposal and Solution



It can work on steep slopes (longitudinal ±6%, transversal ±10%) with the help of the absorption cylinders installed on the rubber tire wheel group.

Proposal and Solution

- Reaction max. 227 Tons (250 US Tons) on front support point and miner reaction max. 100 tons (110 US Tons) on rear tie down point.



Proposal and Solution

Materials

- The reaction on the deck of the highway bridge project should be strictly controlled. Therefore, the segment lifters were made with High Strength Structural Steel to reduce the amount of materials.

Proposal and Solution

Especially the stressing platform was made with a lighter weight material: Aluminum Alloy

Proposal and Solution

Tie down for lifting balance

The length of a typical segment is less than that of pier segment after all.

Proposal and Solution

Tie-down on pier segment

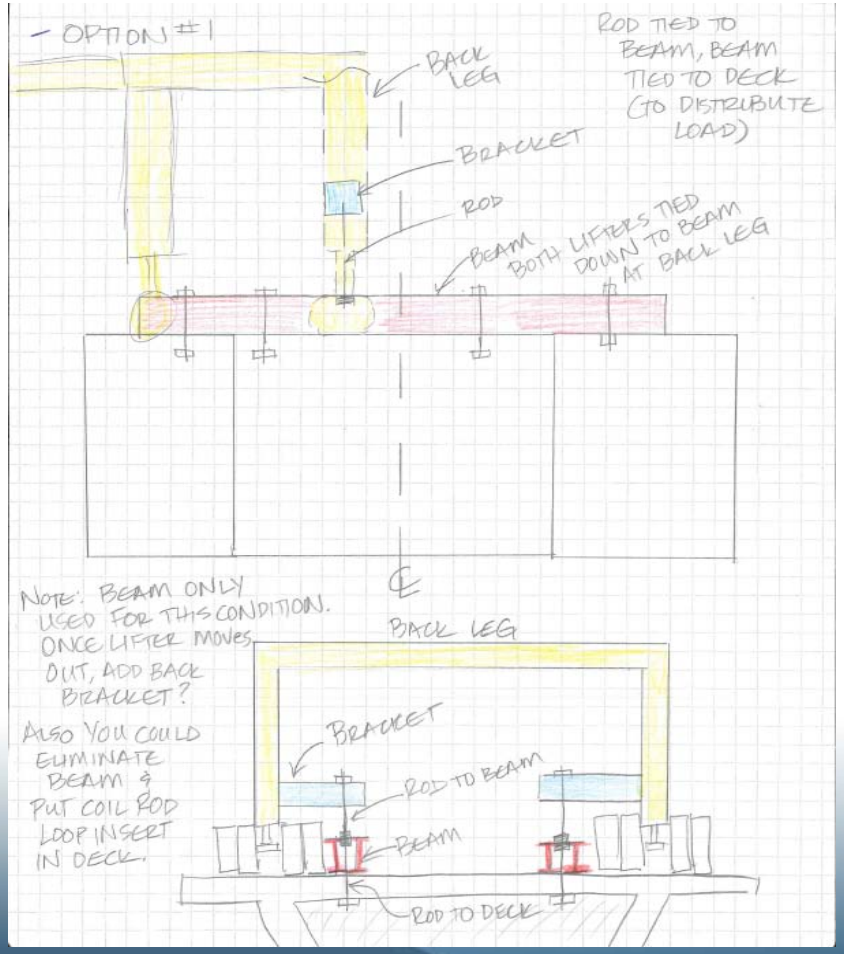
- Two sets of segment lifters are required to start erecting at the same time from the pier extend segment, but the length of 1 PS+ 2 TYP. is too small which creates problems on the machine tie-downs.

- Two kinds of schemes were proposed as you will see on the next page.

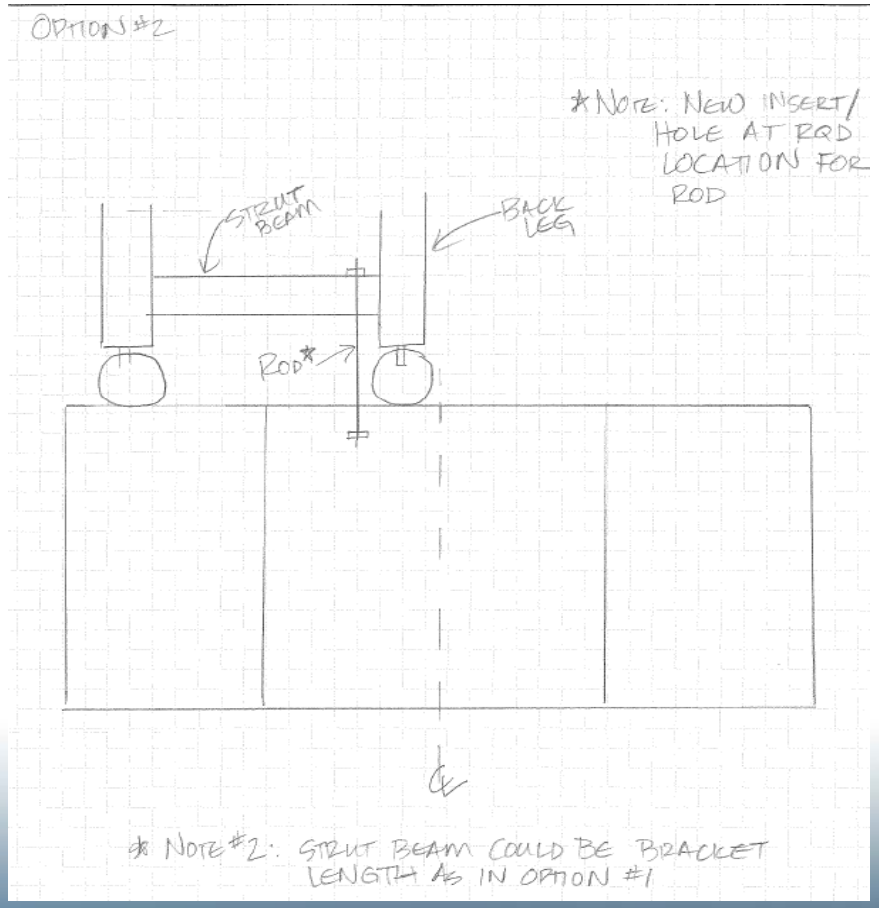
Description	Width of PS + 2 Typ
Ramp F Flyover- Place 24 Segments,Pier 14-8 (BC)	28.66
Ramp N Flyvr - Place 22 Segments, Pier 15-9 (BC)	28.66
Ramp B Flyover- Place 23 Segments,Pier 10-9 (BC)	28.83
Ramp F Flyover- Place 24 Segments,Pier 14-7 (BC)	28.66
Ramp N Flyvr - Place 22 Segments, Pier 15-8 (BC)	28.66
Ramp B Flyover-Place 24 Segments,Pier 10-10 (BC)	28.33
Ramp B Flyover-Place 24 Segments,Pier 10-11 (BC)	29
Ramp N Flyvr - Place 26 Segments, Pier 15-7 (BC)	28.66
Ramp F Flyover- Place 24 Segs, Pier 14-6 (BC)	28.66
Ramp C - Place 18 Segments, Pier C6 (BC)	29
Ramp C - Place 12 Segments, Pier C5 (BC)	29
Ramp C - Place 13 Segments, Pier C4 (BC)	34
Ramp B - Place 16 Segments, Pier B6 (BC)	29
Ramp B - Place 16 Segments, Pier B5 (BC)	29
Ramp B - Place 20 Segments, Pier B4 (BC)	29
Ramp B - Place 20 Segments, Pier B3 (BC)	29
Ramp B - Place 18 Segs, Pier B2 (BC)	29
Ramp C - Place 18 Segments, Pier C3 (BC)	29
Ramp C - Place 12 Segments, Pier C2 (BC)	29
Ramp F Flyover-Place 11 Segments,Pier 14-14 (BC)	28.66
Ramp B Flyover- Place 24 Segments,Pier 10-4 (BC)	29
Ramp S - Place 12 Segments Pier 9-29 (BC)	29
Ramp E&K/CSX - Place 42 Segs, Pier 4-2 (BC)	29.66
Ramp S - Place 12 Segments Pier 9-28 (BC)	29
Ramp E/SR60 - Place 8 Segs, Pier 5-6 (BC)	28.83
Ramp K/60&CSX - Place 7 Segments, Pier 6-9 (BC)	28.66
Ramp F Flyover-Place 10 Segments,Pier 14-13 (BC)	29.33
Ramp N Flyvr - Place 22 Segment, Pier 15-14 (BC)	28.66
Ramp D/34&60th- Place 16 Segments,Pier 16-4 (BC)	28.66
Ramp S - Place 20 Segments Pier 9-25 (BC)	29
Ramp E/SR60 - Place 26 Segments, Pier 5-4 (BC)	28.83
Ramp K/60&CSX - Place 21 Segments, Pier 6-7 (BC)	28.66
Ramp N Flyvr-Place 23 Segments, Pier 15-11 (BC)	28.83
Ramp B Flyover- Place 20 Segments,Pier 10-3 (BC)	29
Ramp S - Place 21 Segments Pier 9-30 (BC)	28.66
Ramp E&K/CSX - Place 44 Segments, Pier 4-3 (BC)	30.33
Ramp F Flyover-Place 18 Segments,Pier 14-15 (BC)	29.33
Ramp N Flyvr - Place 20 Segment, Pier 15-15 (BC)	28.66
Ramp D/34&60th- Place 19 Seg, Pier 16-3 (BC)	28.66
Ramp K/60&CSX - Place 22 Segments, Pier 6-8 (BC)	28.66

The two former options were denied

Option 1



Option 2



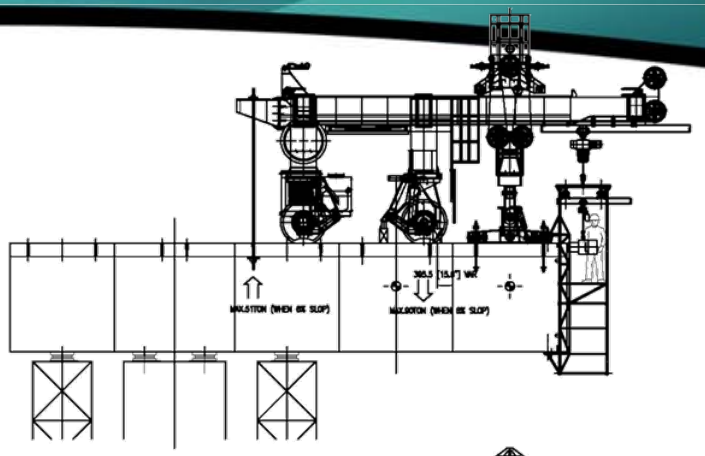
The two former options were denied

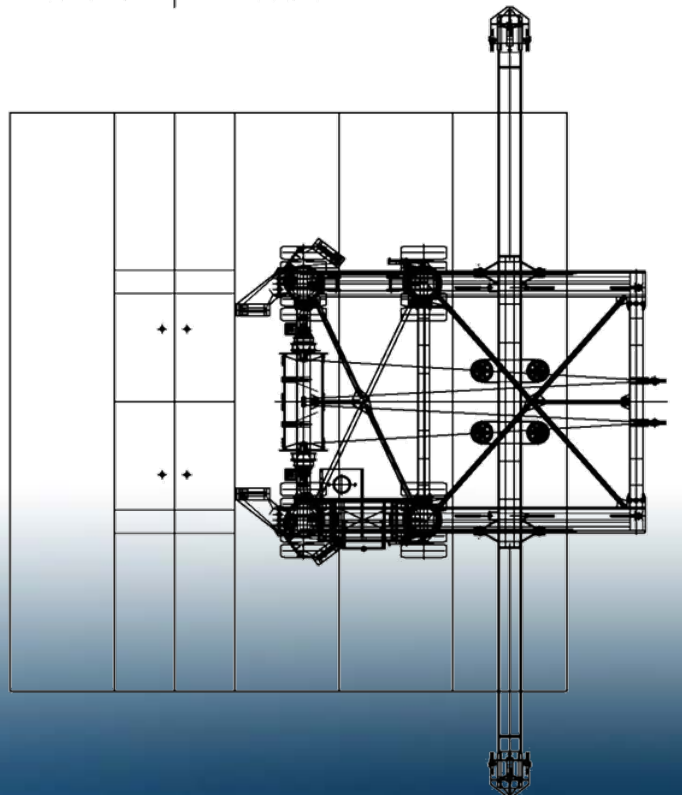
- The lifting holes are under the wheel groups, it is impossible to get the anchor bar through the wheels;
- Both methods will result in large reactions on deck, which the highway bridge cannot bear.

Proposal and Solution

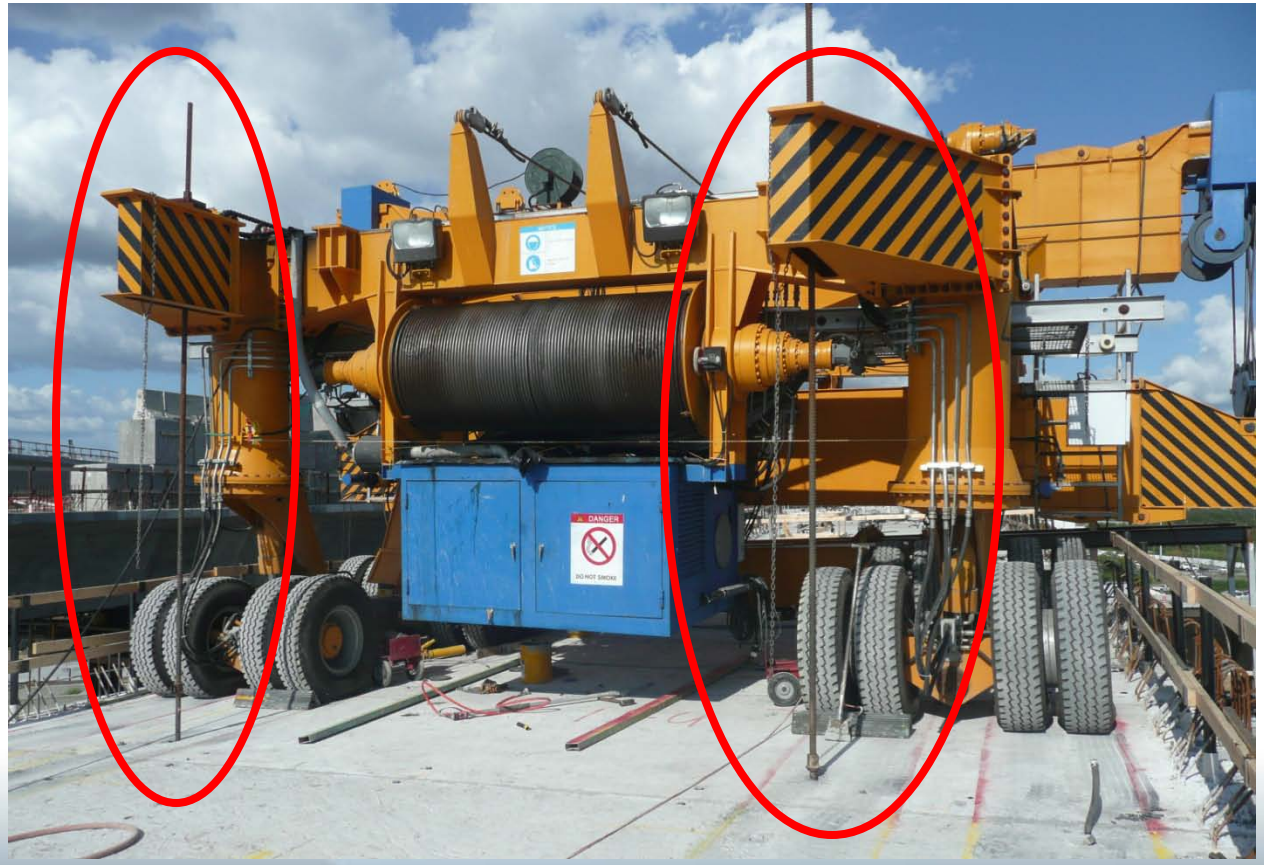
Tie-down on typical segment

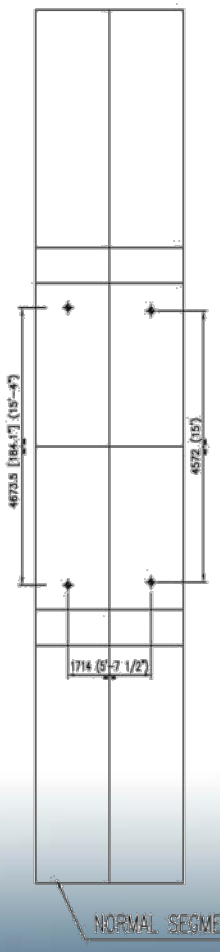
- Except erection on PS and ES, the erection of all the other segments need an anchoring beam to tie down on the lifting hole of segment for reducing the reaction on the deck

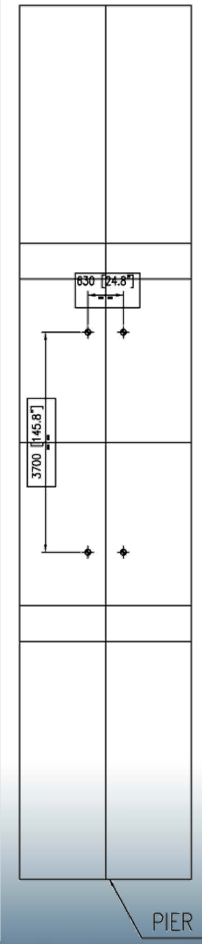




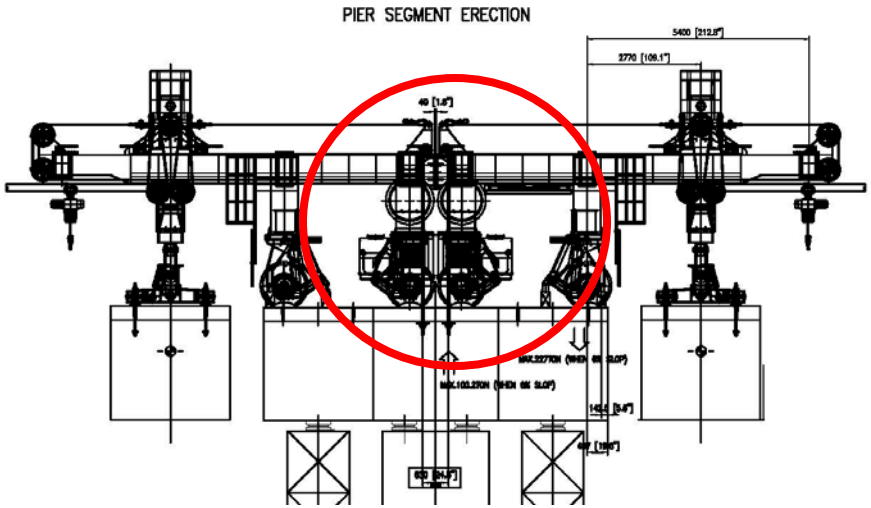
Tie down positions

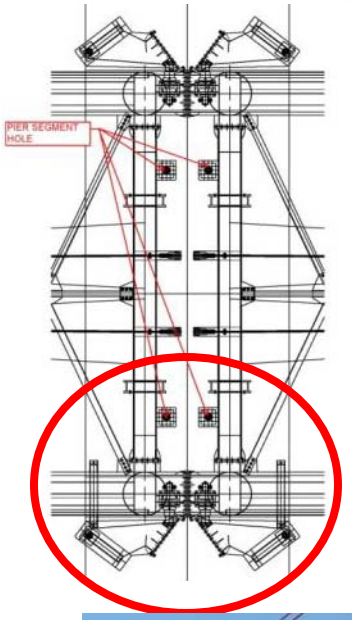






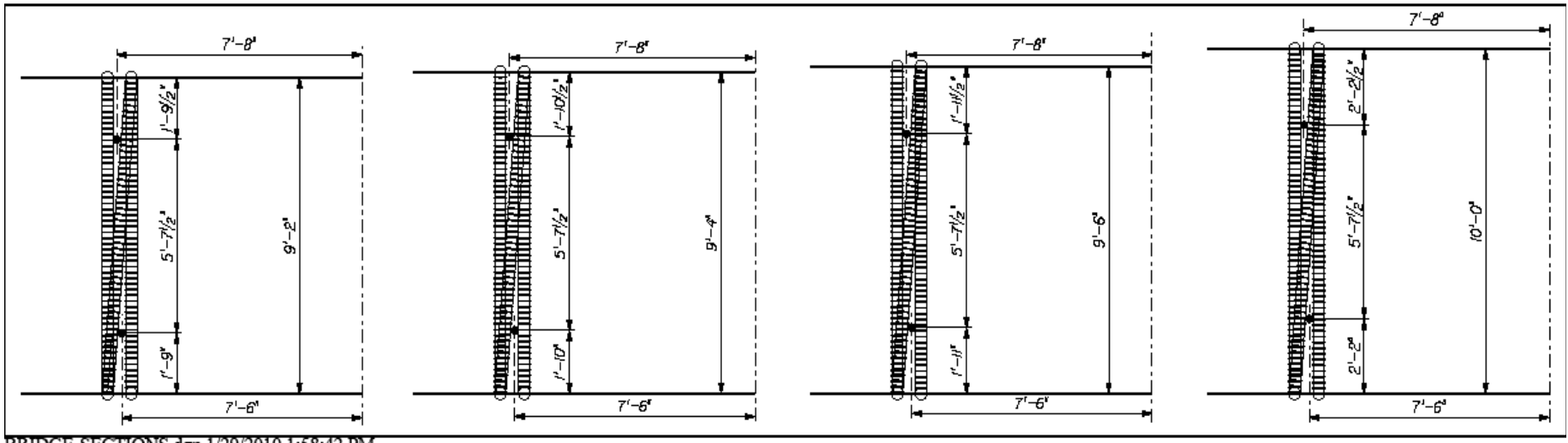
Proposal and Solution





- Tie down position on the pier segment.
- Anchoring beams are folded to the side of the main beam in accordance with the tight space of the first three segments (1 pier segment + 2 typical segment on temporary pier).

Proposal and Solution



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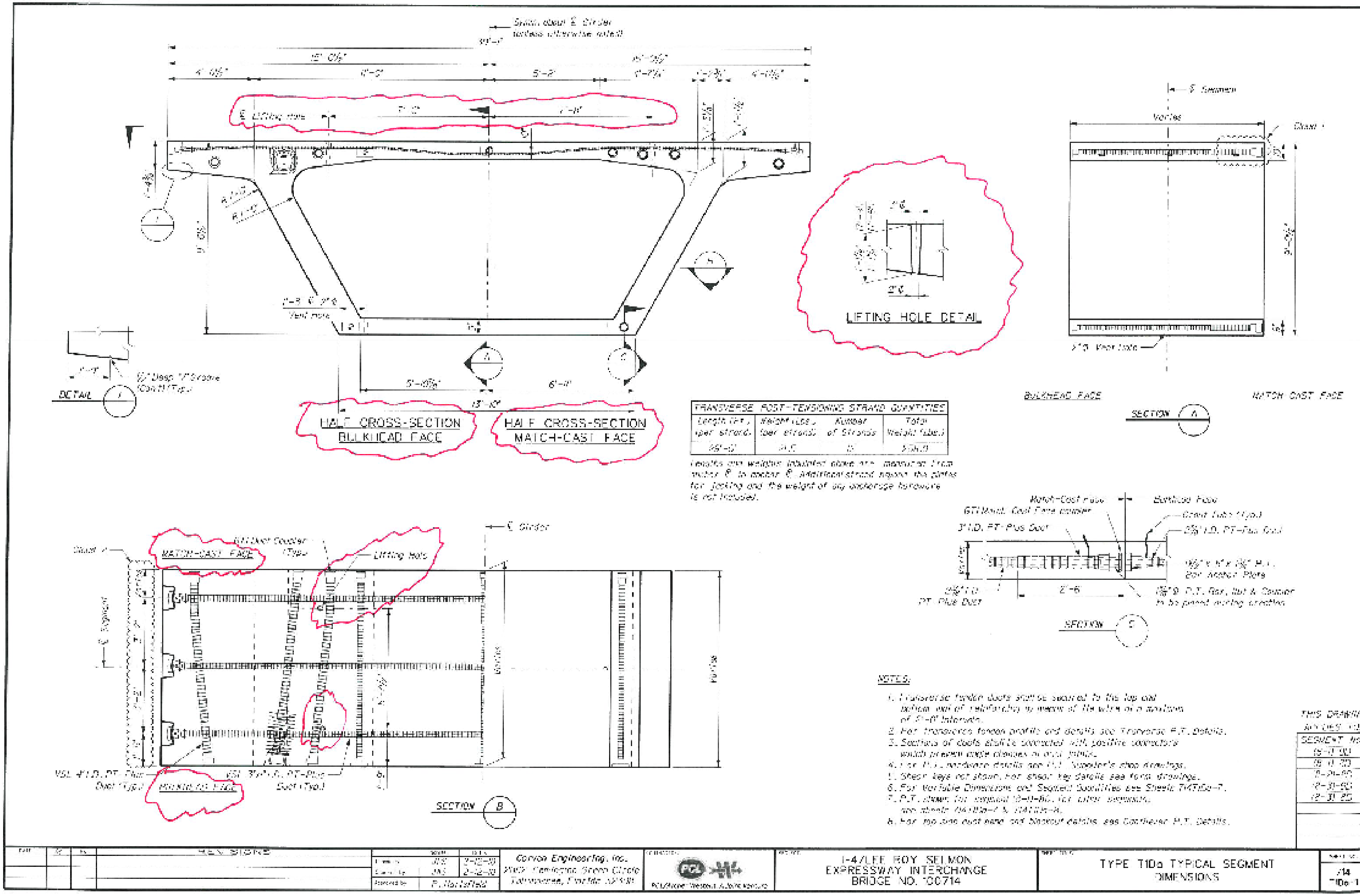


LIFTING HOLE DETAIL
HALF CROSS-SECTION
BULKHEAD FACE
HALF CROSS-SECTION
MATCH-CAST FACE
DETAIL
TRANSVERSE POST-TENSIONING STRAND QUANTITIES
BULKHEAD FACE
MATCH CAST FACE
SECTION A
SECTION C
MATCH-CAST FACE
Lifting Hole
SECTION B
NOTES:
THIS DRAWING
Corven Engineering, Inc.
I-4/LEE ROY SELMON
EXPRESSWAY INTERCHANGE
BRIDGE NO. 100714
TYPE T1Da TYPICAL SEGMENT
DIMENSIONS

Application of Segment Lifter

- The equipment is a stand-alone machine to erect viaducts.

- It is able to hoist concrete segments of road viaduct from the ground near the piers, run on rubber tires on the already erected part of the viaduct, place the segment in perfect contact with the face of the last erected segment and place a stressing platform on the erecting segment.

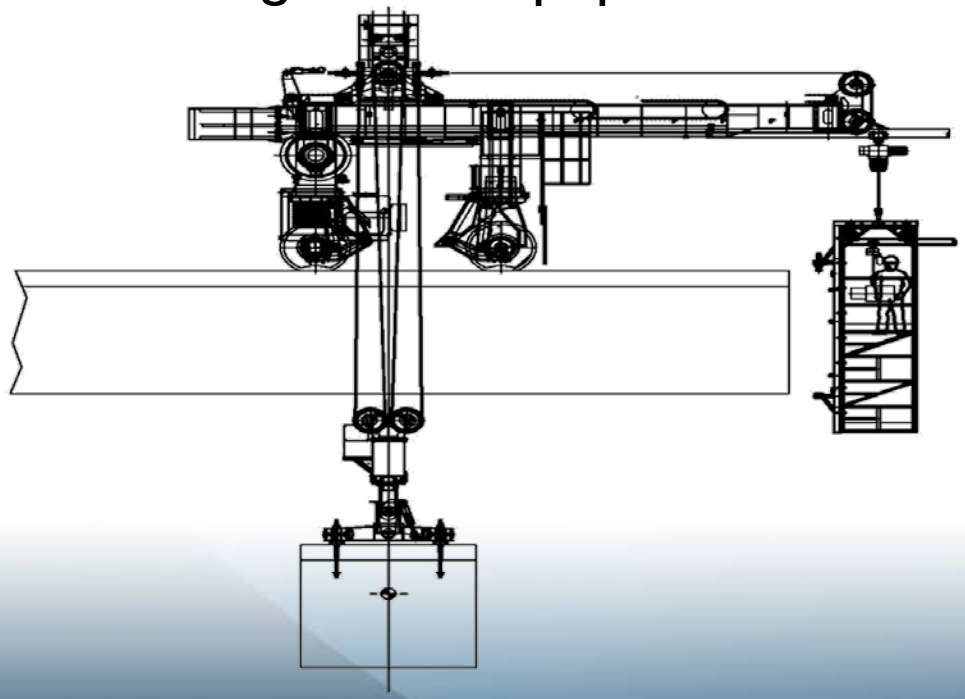
Application of Segment Lifter

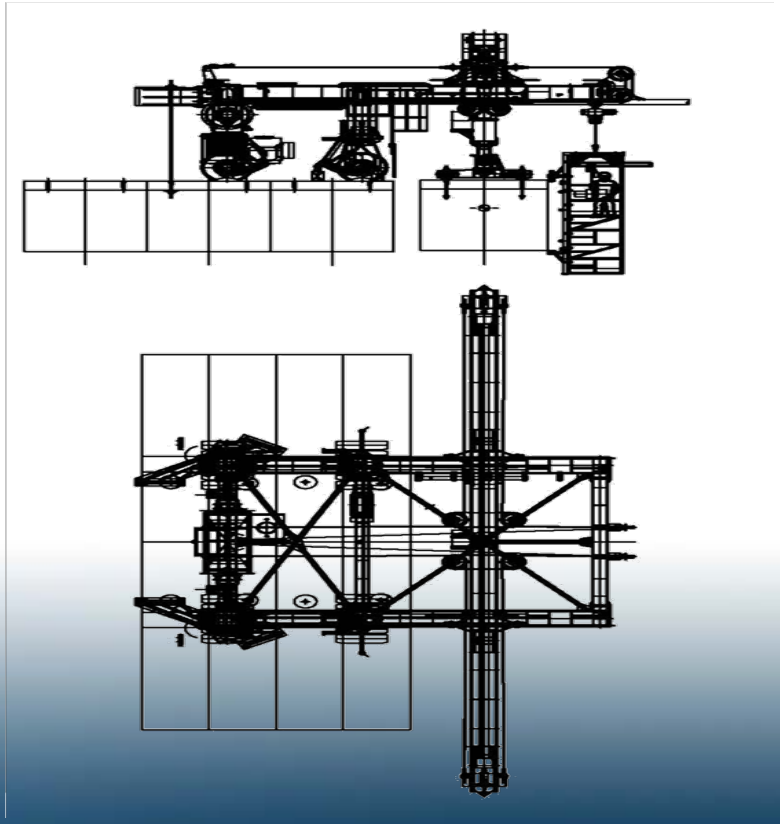
- It is powered by a diesel engine, which gives power through a hydraulic plant to the drive motors, the winch and auxiliary jacks used for finite adjustment.

- The machine is able to adapt the width of the rope tackles in order to not interfere with almost all of the already erected viaducts that run beside.

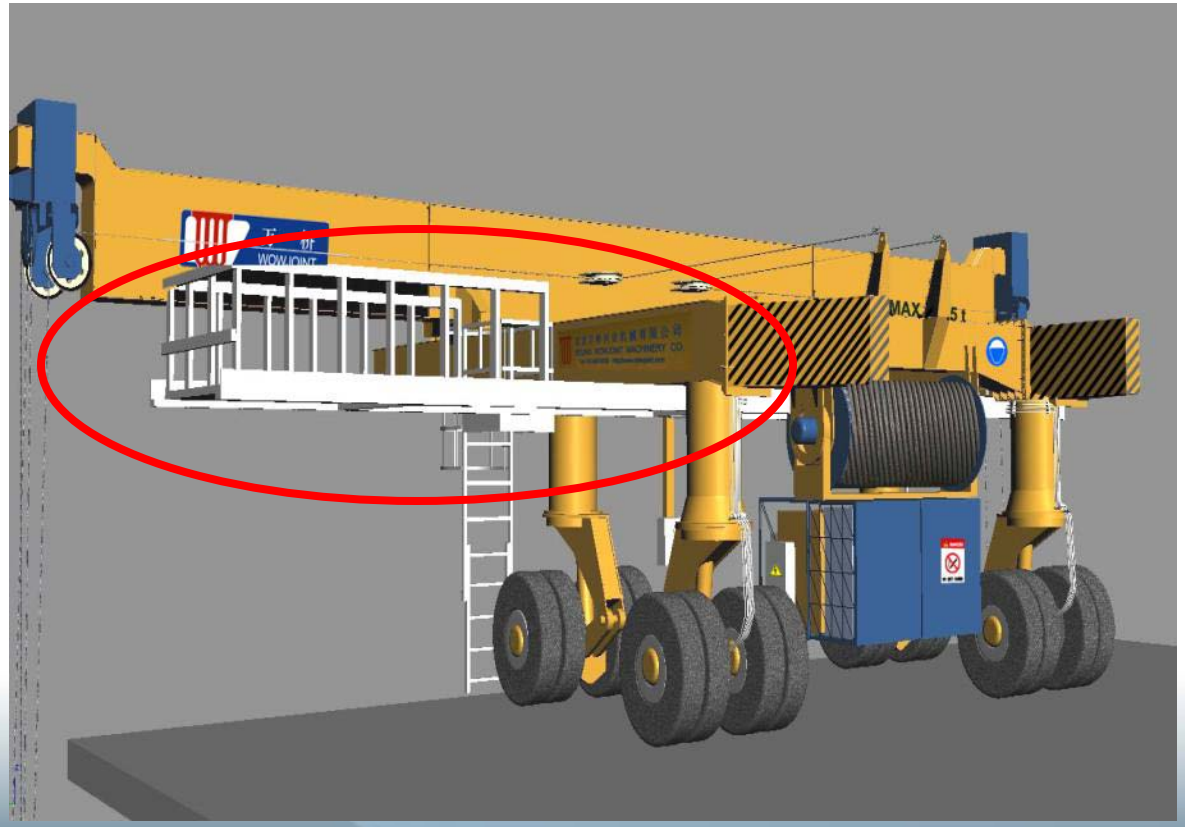
Application of Segment Lifter

- The segment lifter has three functions: transporting, erecting and stressing the segment
- This is better than the traditional construction method using other equipment



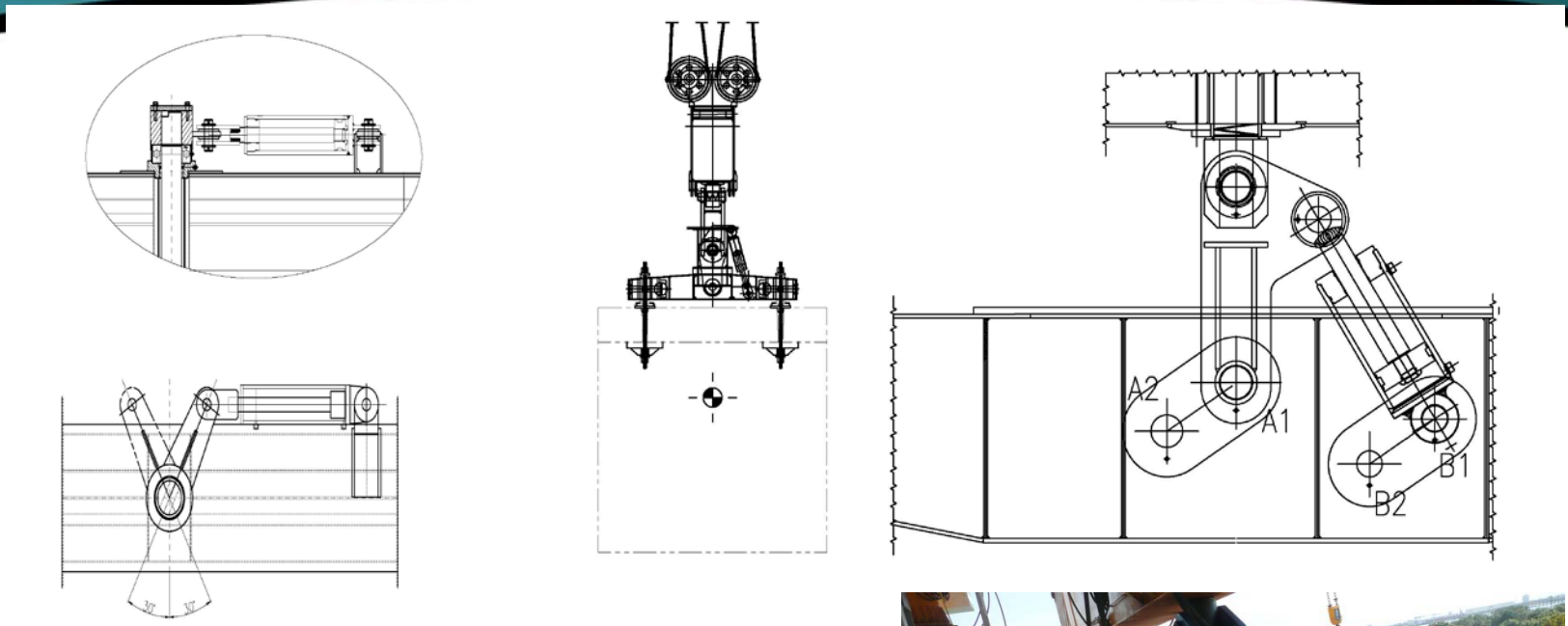


Application of Segment Lifter



- The walkway for replacing the upper removable beams can shift, and the banister can rotate, so the walkway can be hidden under the main longitudinal beams when working.

Application of Segment Lifter



7)The angle of the lower spreader can be adjusted on horizontal, transversal or longitudinal direction.

Practical Application on Jobsite

Segment adjusting and stressing.

Practical Application on Jobsite

- Minimal influence on the normal traffic running on the existing road below the bridge.

Practical Application on Jobsite

Erection on the location with curve.

Preassembly and Testing in Factory

- Due to the special situation of this project, the Segment Lifters could not be tested after they were delivered.
- Built a test form in the plant, which met almost all of the actual conditions on site, then preassembled and tested the Segment Lifters in the factory before delivering.

Preassembly and Testing in Factory

Travelling and loading test on testing ramp way with transversal slope 10% and longitudinal slope 6%.

Preassembly and Testing in Factory

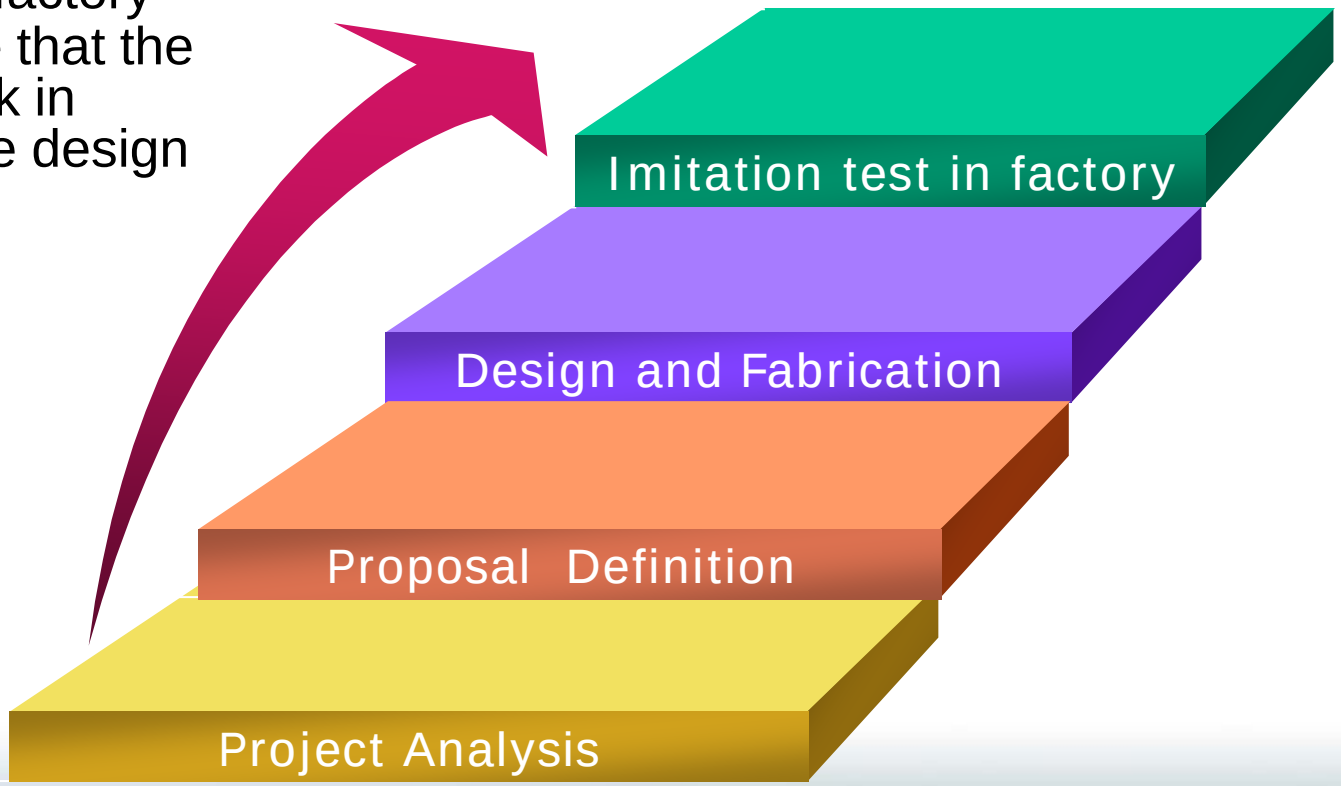
Weighing the complete machine at the factory to confirm the final weight

Preassembly and Testing in Factory

Loading test in plant

- Place weights onto temporary spreaders, the weight of which is equal to the rated load.

All of the previous factory work was to ensure that the equipment can work in accordance with the design requirements.



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Thank you for your time!

QUESTIONS?

This concludes the educational content of this activity

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