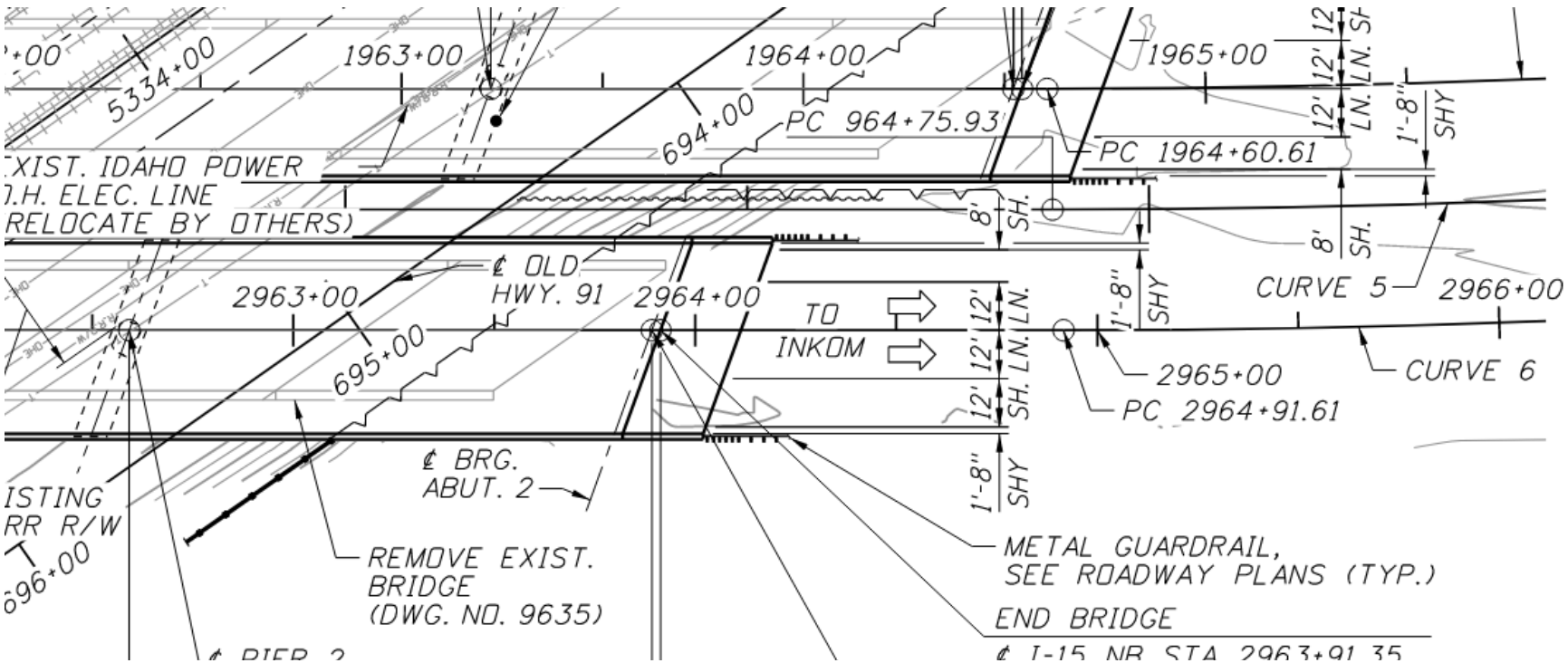


How I Raised My Inkom

Inkom UPRR Bridges

Mike Slegers, PE

1 General Background

2 Goals and Challenges

3 Approach and Concepts Investigated

4 Design Details

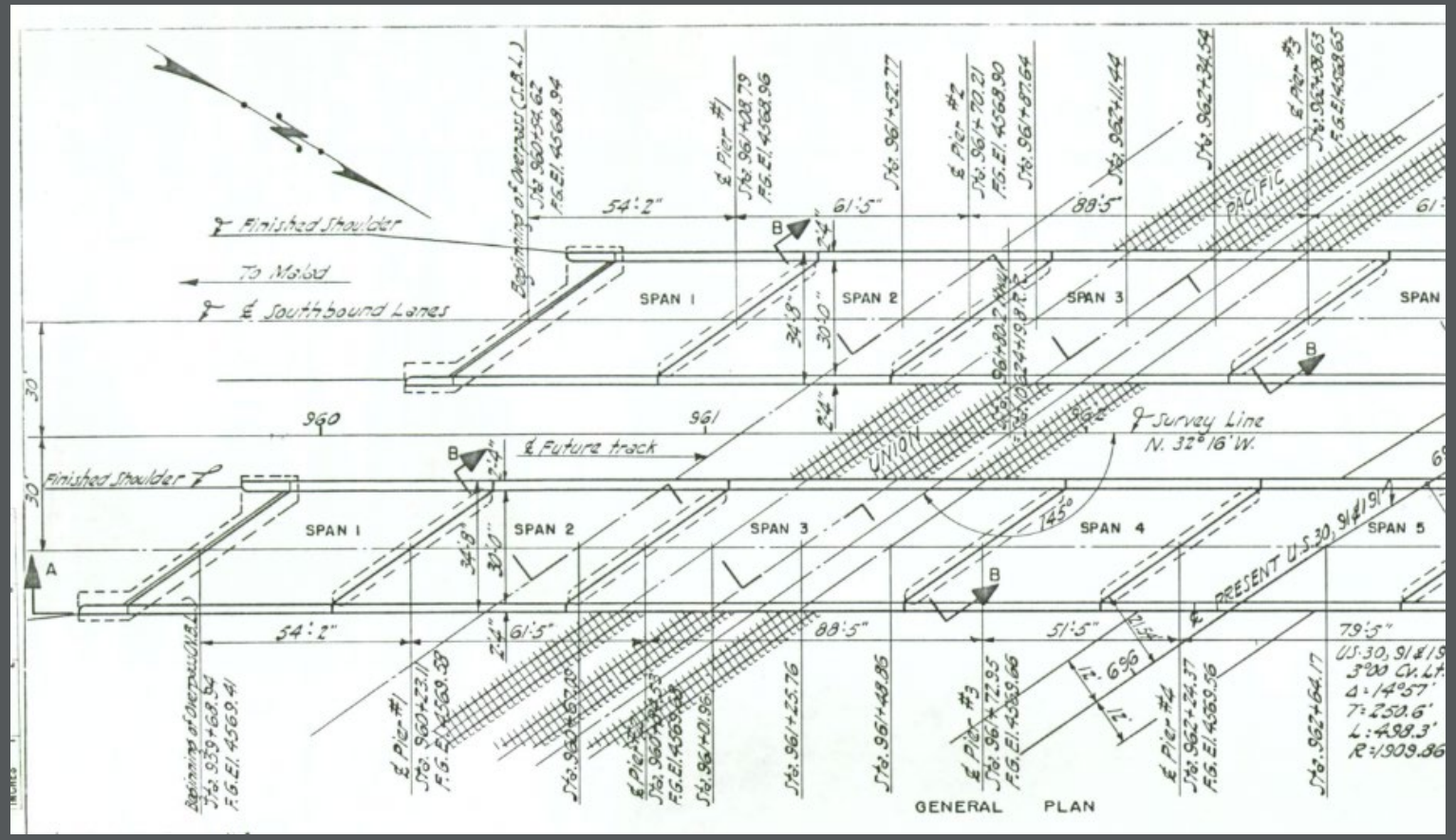
5 Lessons Learned

6 Q&A

1 General Background

Project Team

- Idaho Transportation Department, District 5 - Client
- HDR – Prime consultant




Missoula
NEZ PERCE RESERVATION
Bozema
Nampa
IDAHO
Idaho Falls


Tyhee
Chubbuck
86
SERVATION
Pocatello
15
Portneuf
Inkom
15
McCammon
30

Location

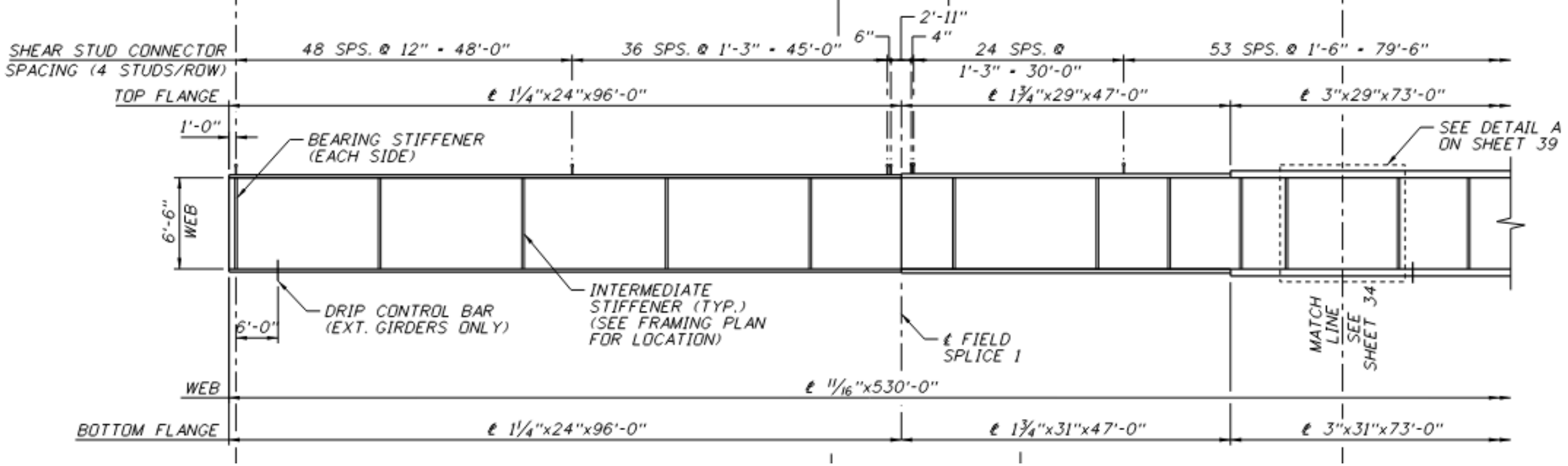
Location

2 Goals & Challenges

Project Need

Challenges

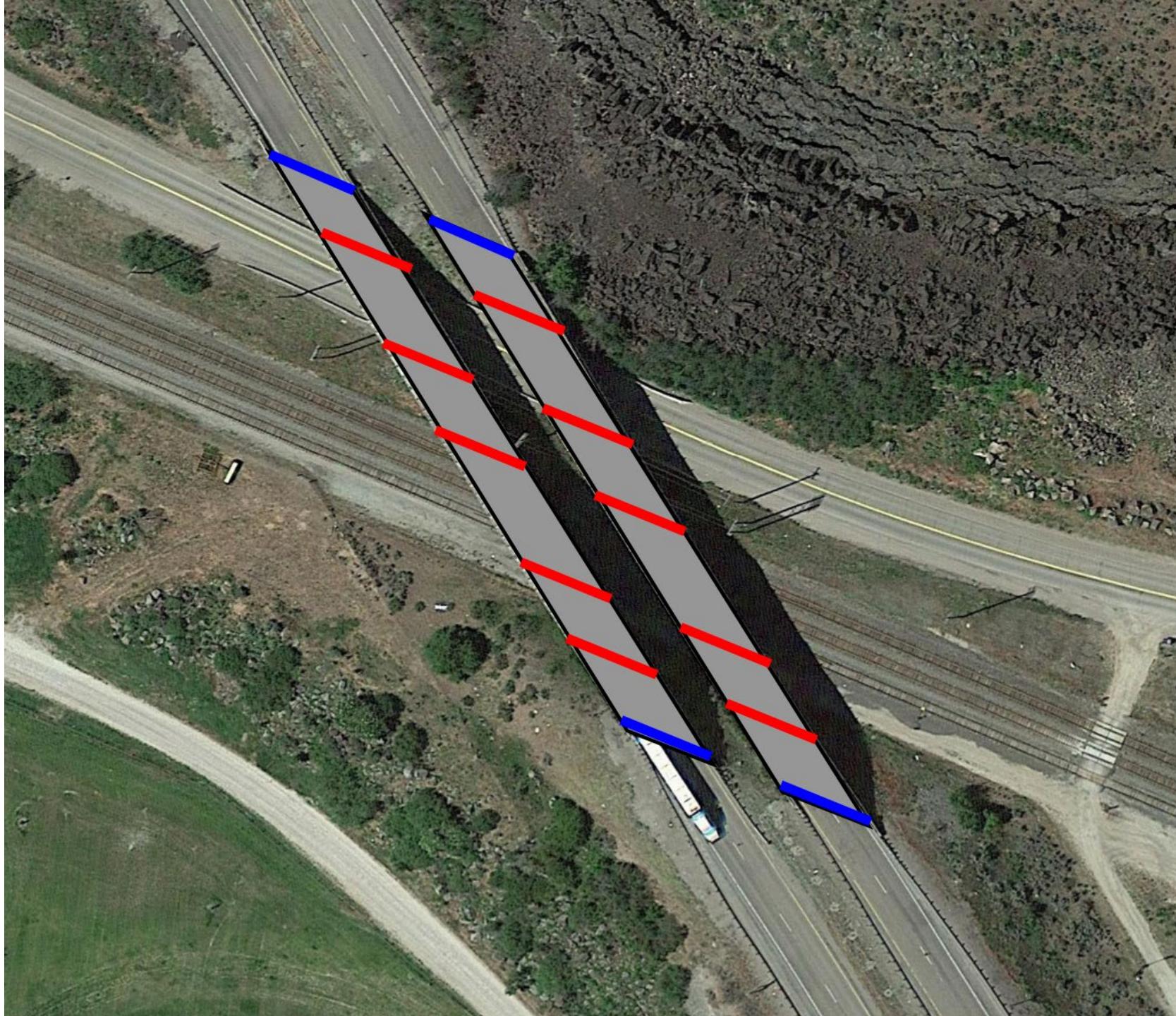
- Skew of railroad tracks
- Vertical clearance of tracks
- UPRR ROW
- Proximity of piers to railroad tracks
- Utilities
- MOT during construction



3 Approach & Concepts Investigated

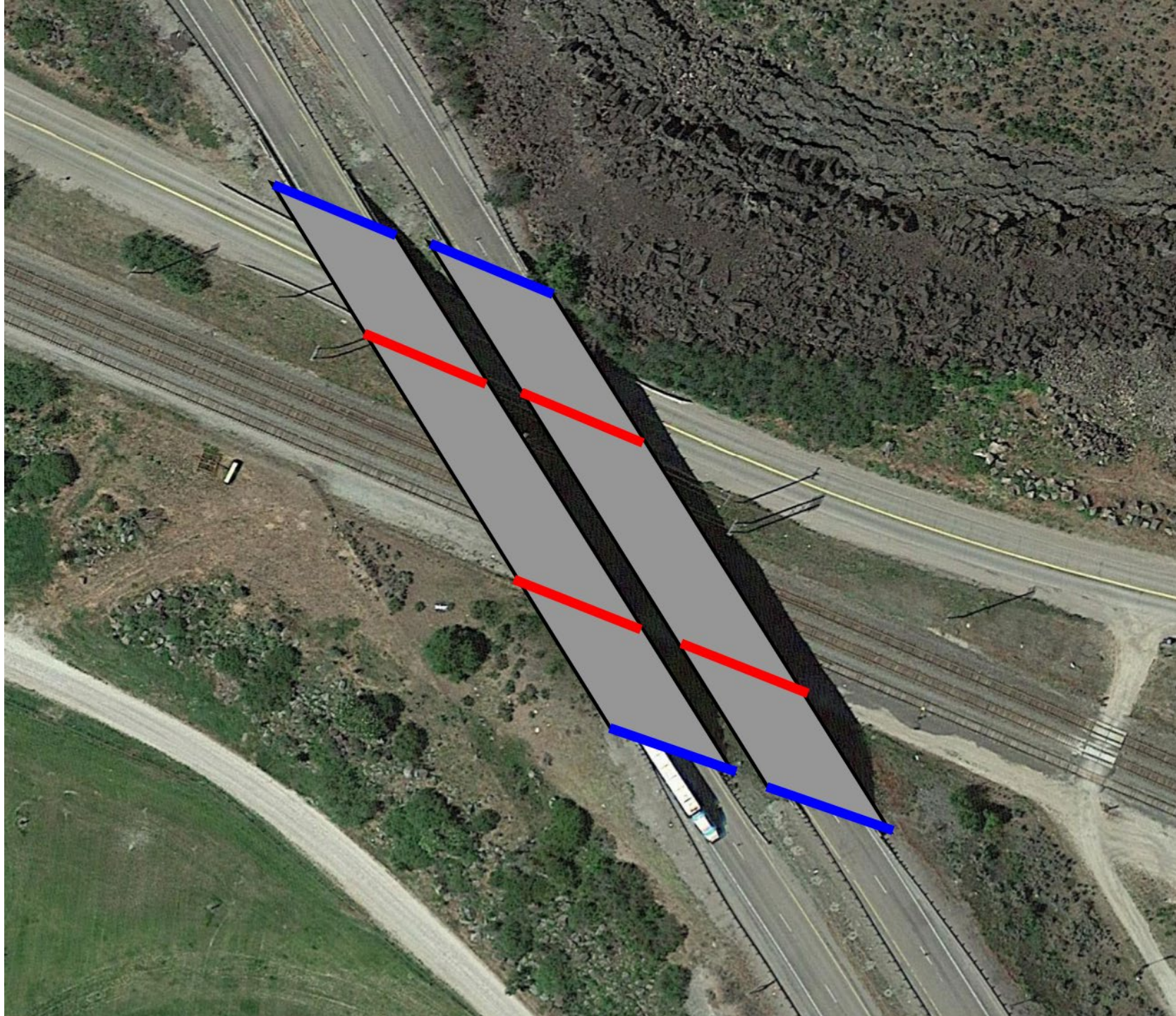
Existing Bridge

- 6 spans
- Concrete piers and girders
- 55 deg skew to tracks
- Low vertical clearance



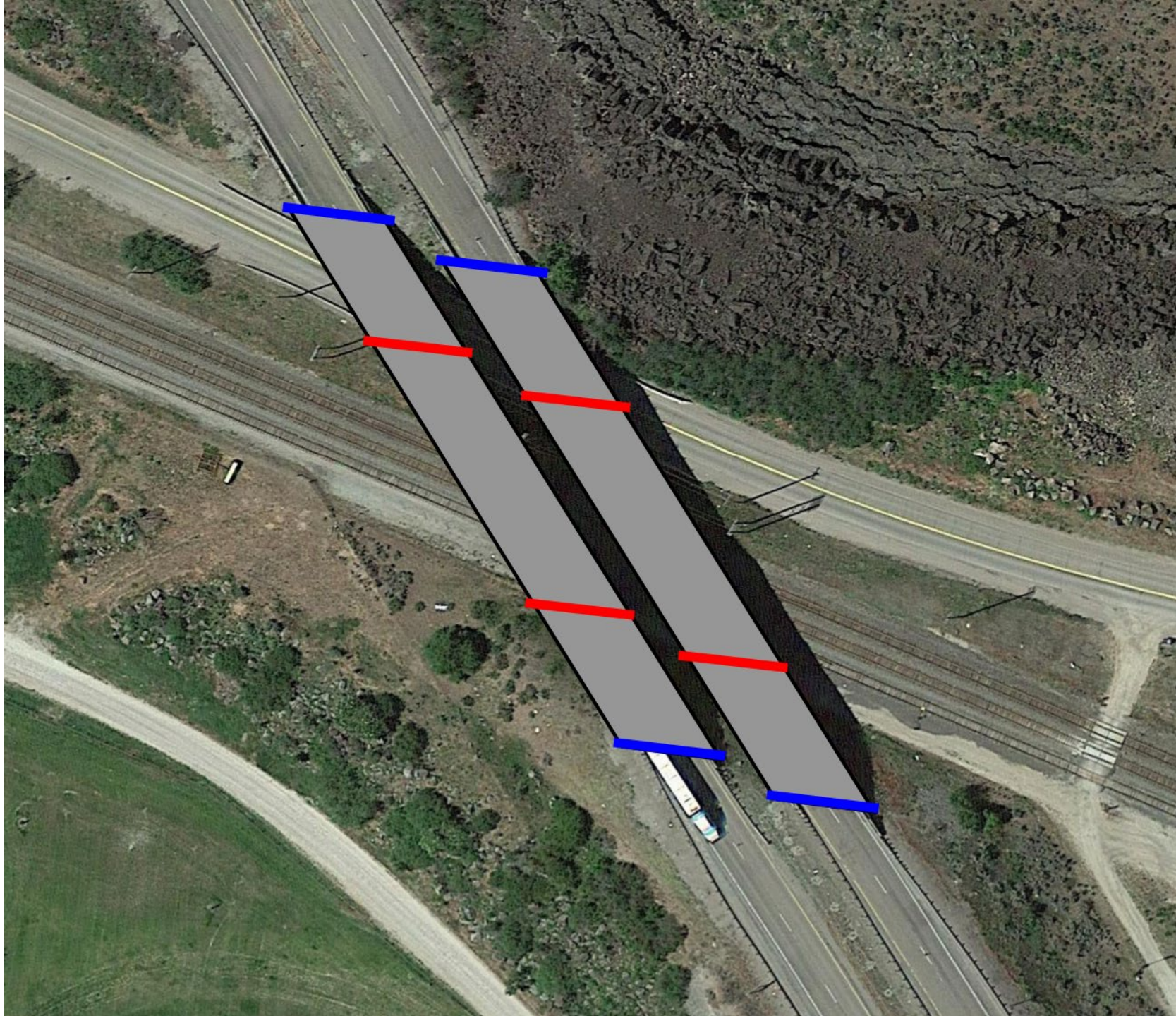
Type Selection

- OPTION A
  - 3-span bridge
  - high skew with conventional piers
  - PRO
    - Shortest bridge length
  - CON
    - most expensive (+5%)
    - large piers and large footprint in UPRR ROW



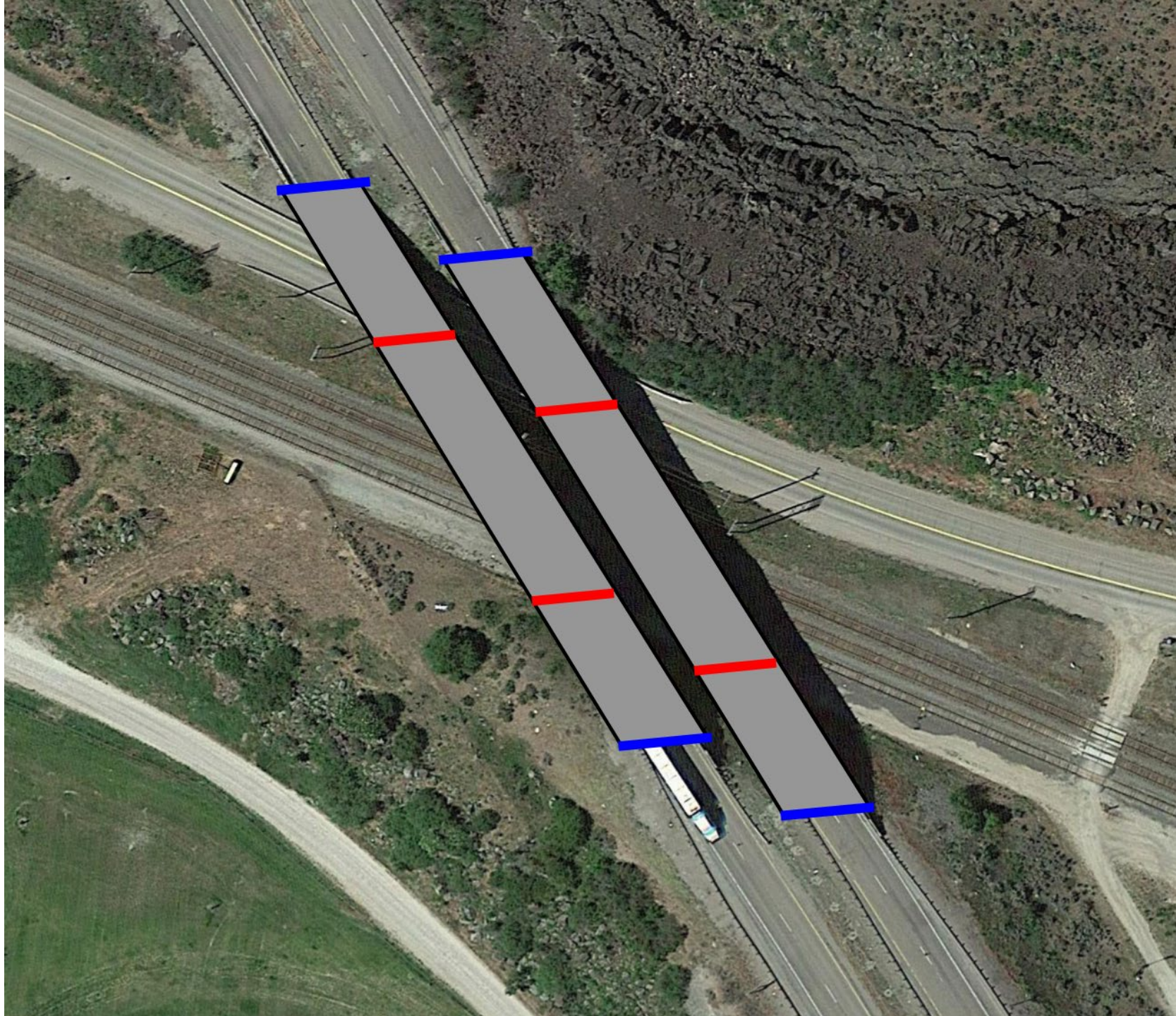
Type Selection

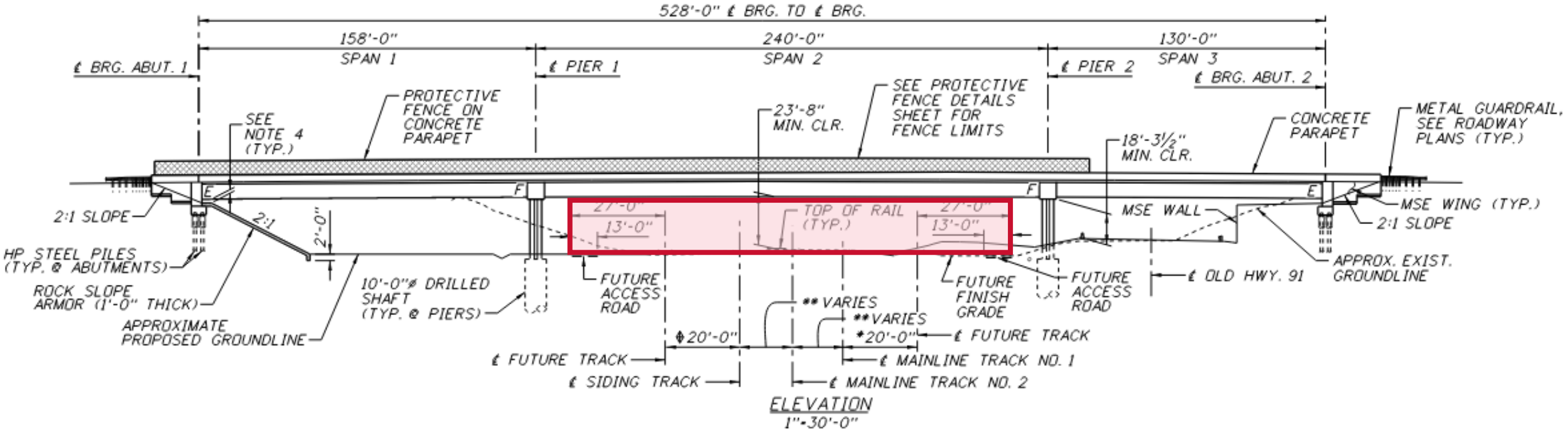
- OPTION B
  - 3-span bridge
  - moderate skew with conventional piers
  - PRO
    - Moderate skew
  - CON
    - also expensive (+5%)
    - Longest span (255ft)



Type Selection

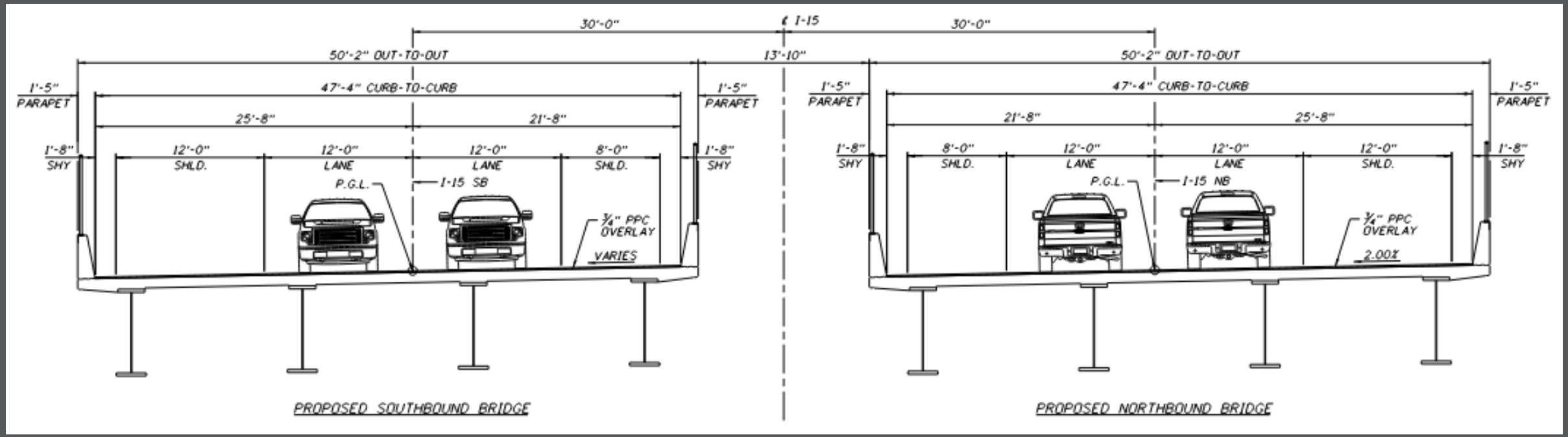
- OPTION C
  - 3-span bridge
  - Mild skew
  - non-conventional piers
  - PRO
    - Shorter main span
    - Smaller pier footprint
  - CON
    - Specialized design
    - Longer overall length



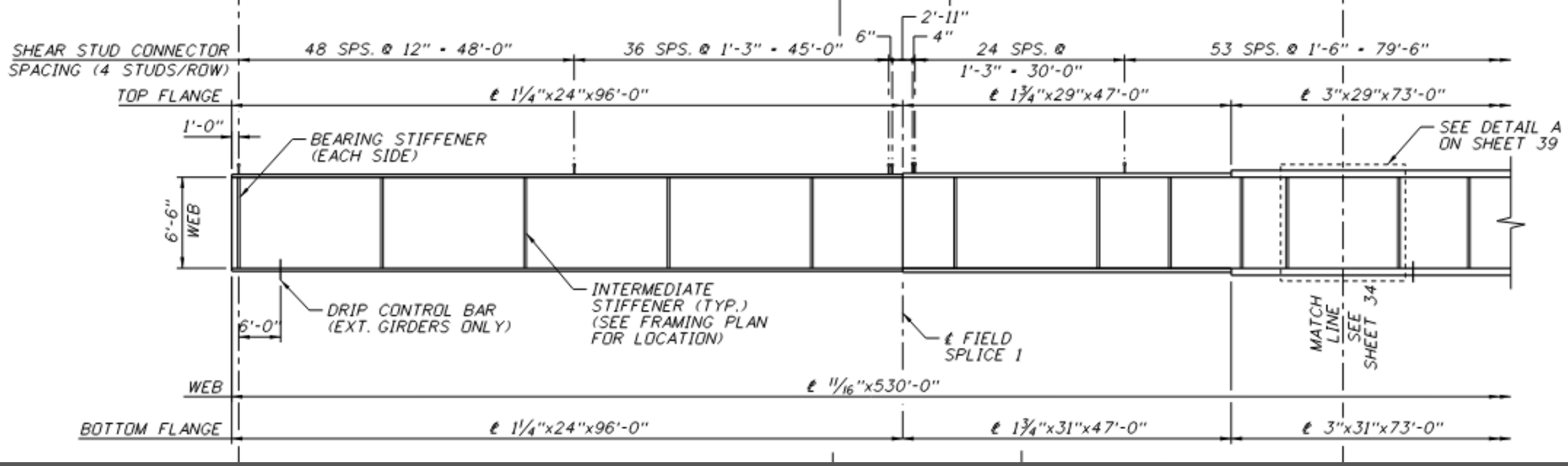


Type Selection

- 3 span steel girder bridge
- 158-240-130 span configuration
- Integral, hammerhead-style piers
- 6.5-ft tall girders; 7.9-ft superstructure
- 23.7’+7.9’-18.9’-4.7’ = 8ft GRADE RAISE



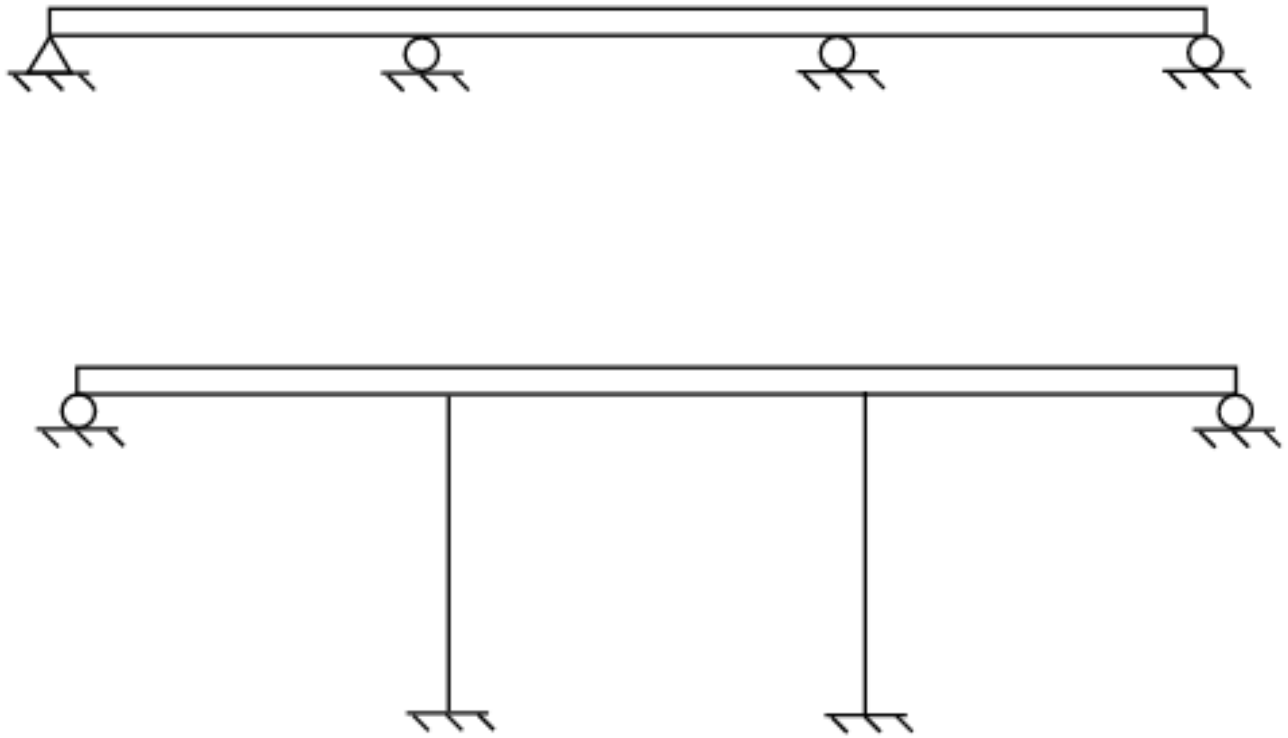
Typical Section



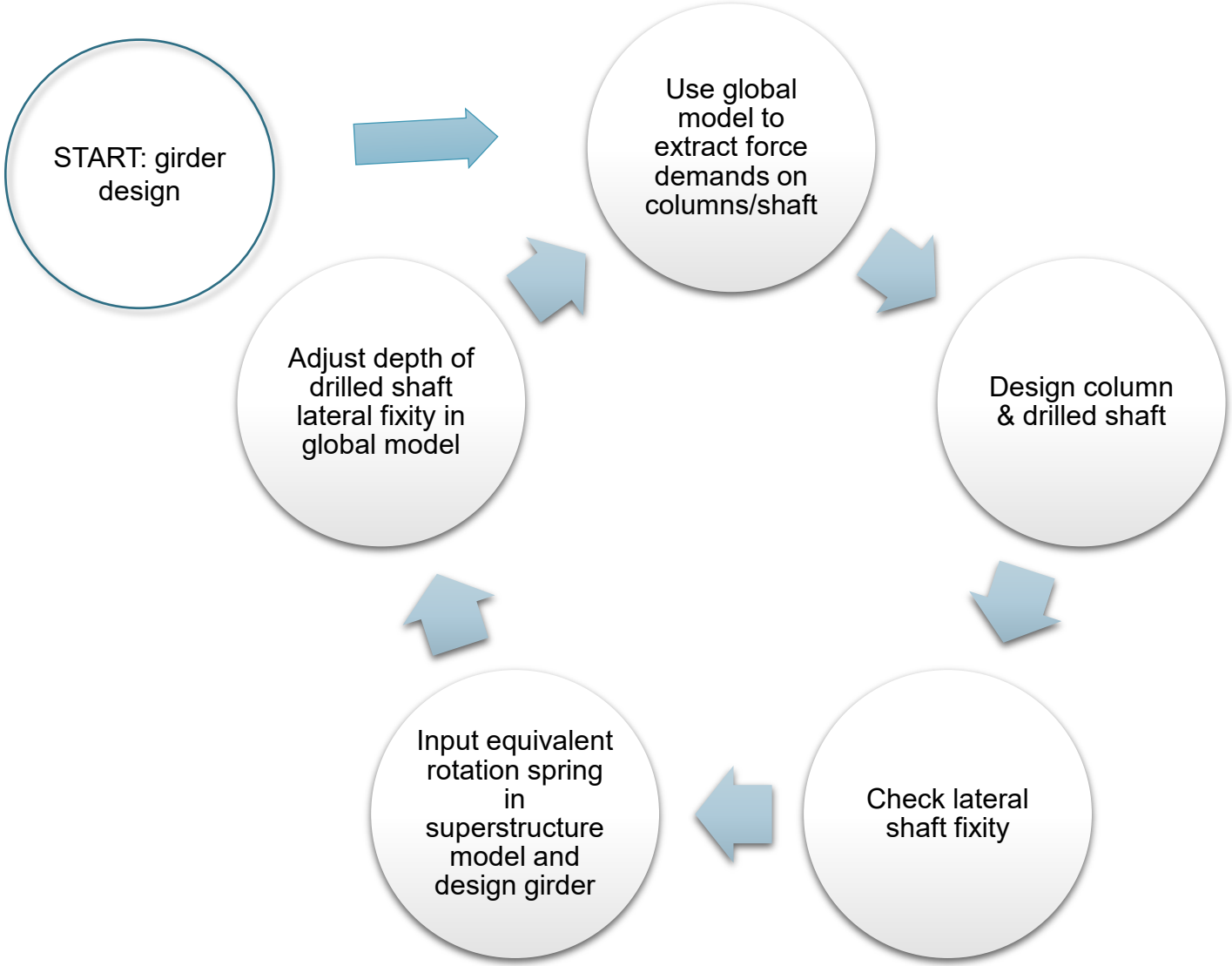
4 Design Details

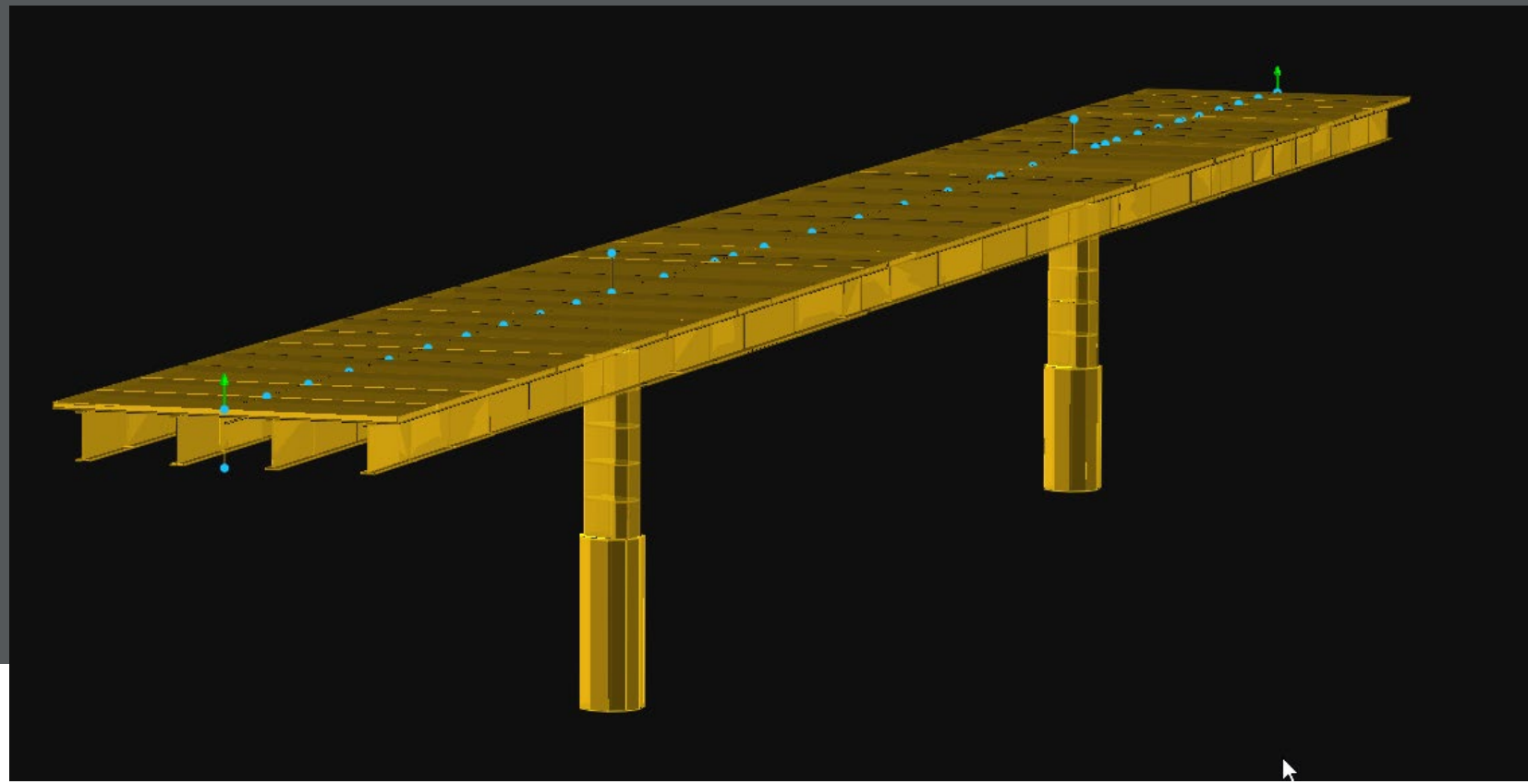
Superstructure Model

- Typical assumption for a 3-span continuous beam



Design Process





Global Modeling

Spline model using beam elements

Drilled shaft fixity

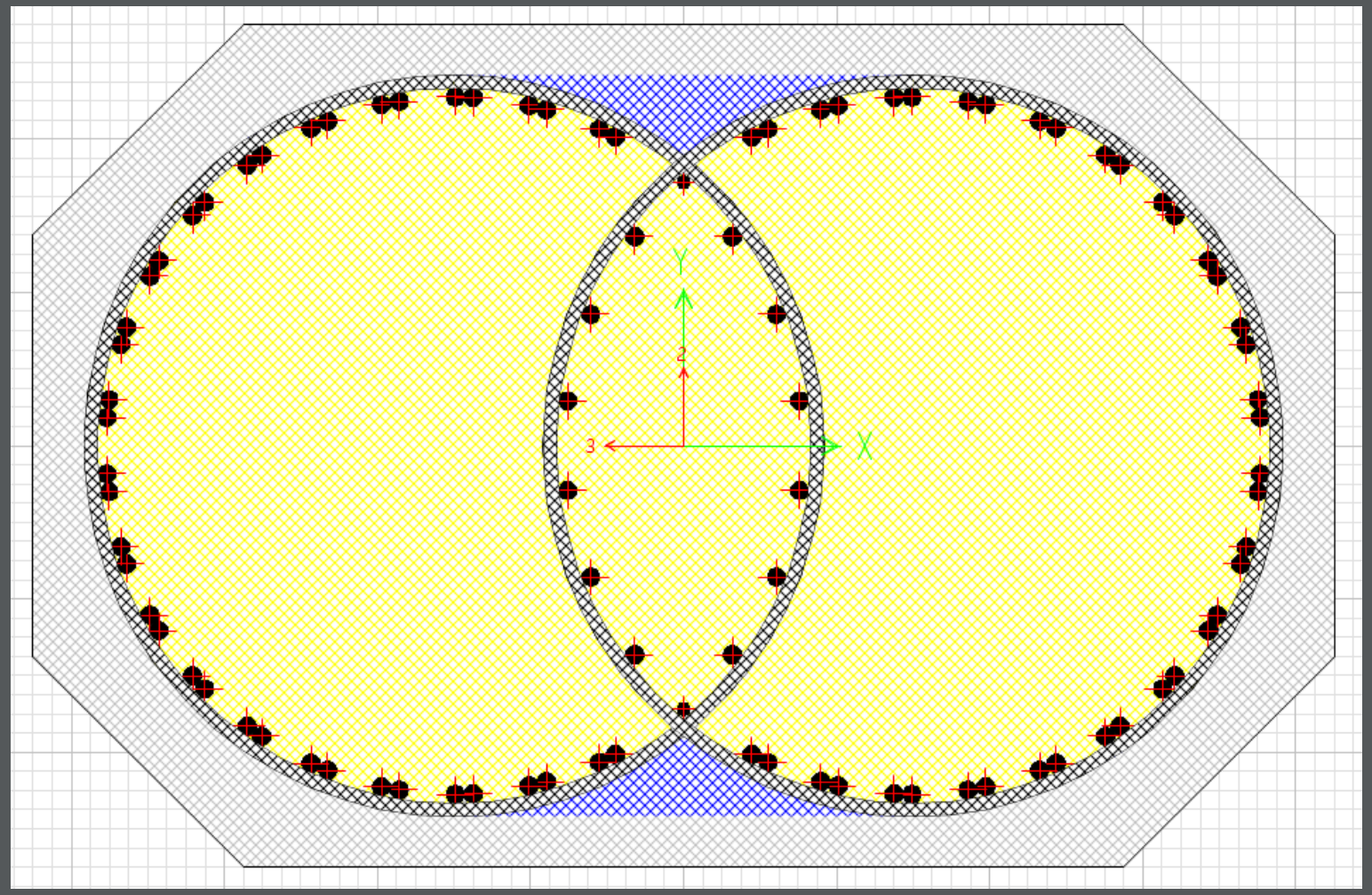
Iterate on column/shaft interface lateral deflection

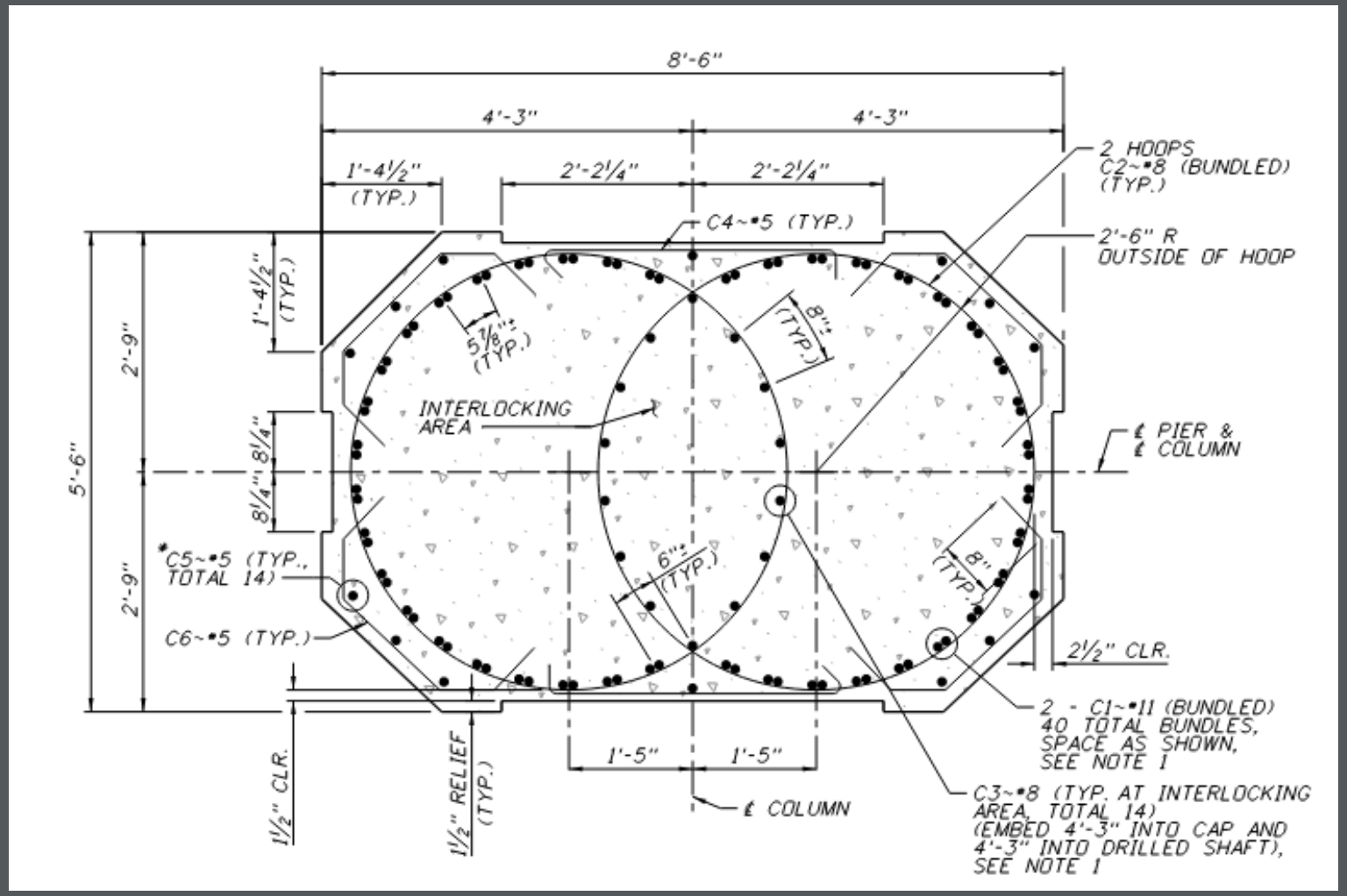
		Pier 1								
					NB		SB			
Iteration #	Shaft Dia. (ft)	Starting DS L(ft)	D	LARSA (in)	Lpile (in)	% diff	Lpile (in)	% diff	Ending DS L (ft)	Ending D
1	*9.84*	*27.46*	*2.8*	**0.566**	**0.440**	22%	**0.426**	25%	**24.57**	**2.5D**
2	*9.84*	*24.57*	*2.5*	**0.508**	**0.603**	-19%			**27.11**	**2.8D**
3	*9.84*	*27.11*	*2.8*	**0.624**	**0.500**	20%			**25.82**	**2.6D**
4	*9.84*	*25.82*	*2.6*	**0.538**	**0.565**	-5%			**26.15**	**2.7D**
5	*9.84*	*25.60*	*2.6*	**0.483**	**0.412**	15%			**24.69**	**2.5D**
6	*9.84*	*24.69*	*2.5*	**0.457**	**0.472**	-3%			**24.90**	**2.5D**
7	*9.84*	*24.69*	*2.5*	**0.462**	**0.472**	-2%			**24.83**	**2.5D**
8	*9.84*	*24.69*	*2.5*	**0.468**	**0.479**	-2%			**24.84**	**2.5D**
9	*9.84*	*24.69*	*2.5*	**0.494**	**0.732**	-48%			**28.07**	**2.9D**
10	*9.84*	*28.07*	*2.9*	**0.630**	**0.559**	11%			**27.30**	**2.8D**
11	*9.84*	*27.30*	*2.8*	**0.567**	**0.473**	17%			**26.22**	**2.7D**
12	*9.84*	*25.98*	*2.6*	**0.548**	**0.565**	-3%	**0.556**	-1%		

Iterations with the modeling

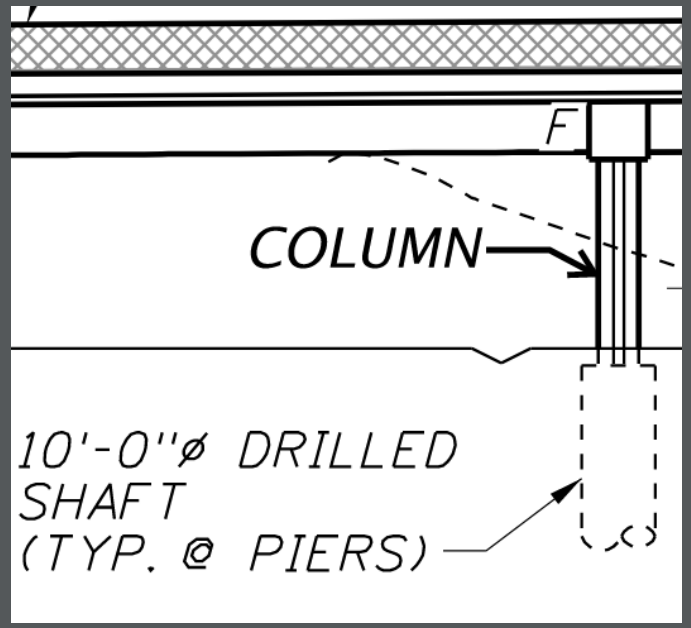
Column Section

- 8.5ft x 5.5ft
- f’c = 5000 psi
- Bundled #11’s vertical steel
- Bundled #8 hoops
- 2 interlocking hoops
- 28ft tall



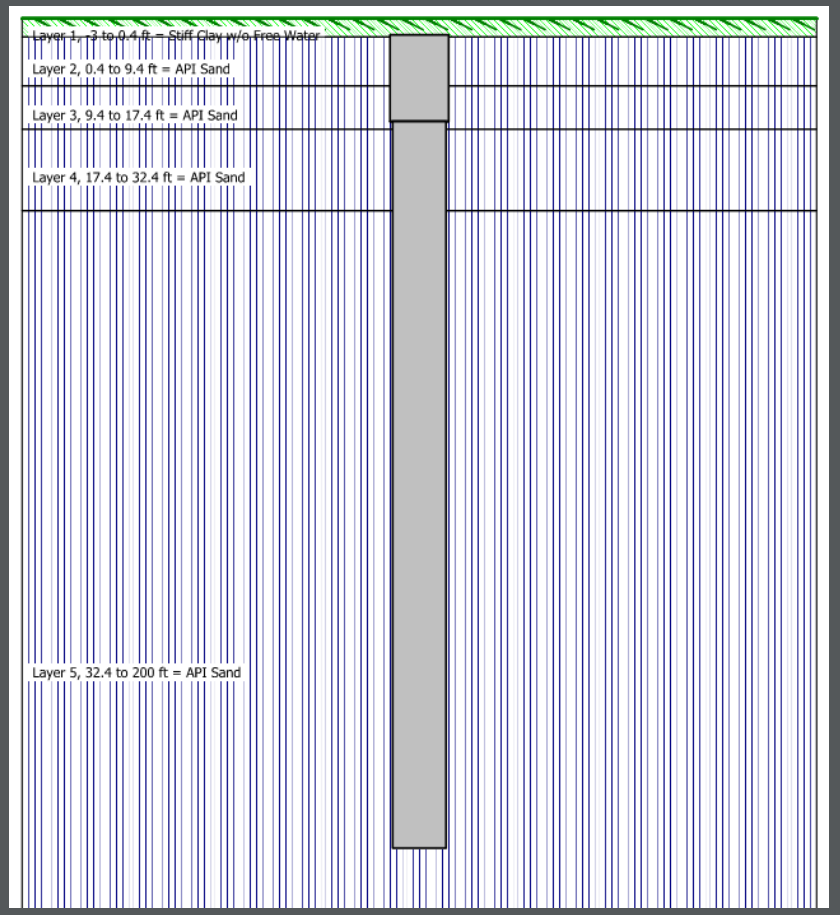


Column Section



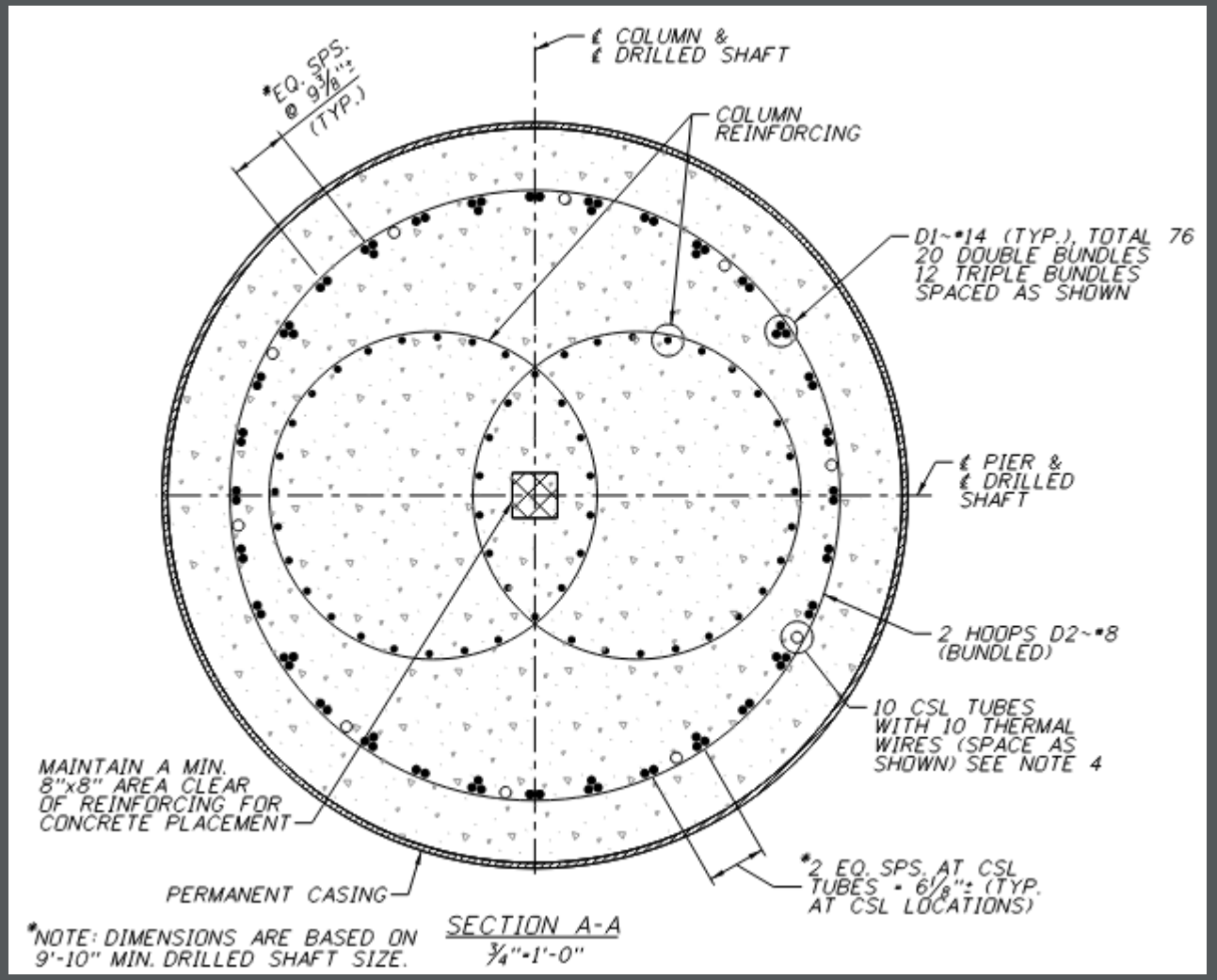
Drilled Shaft Foundation

- Column frames into drilled shaft foundation
- ~111ft shaft length



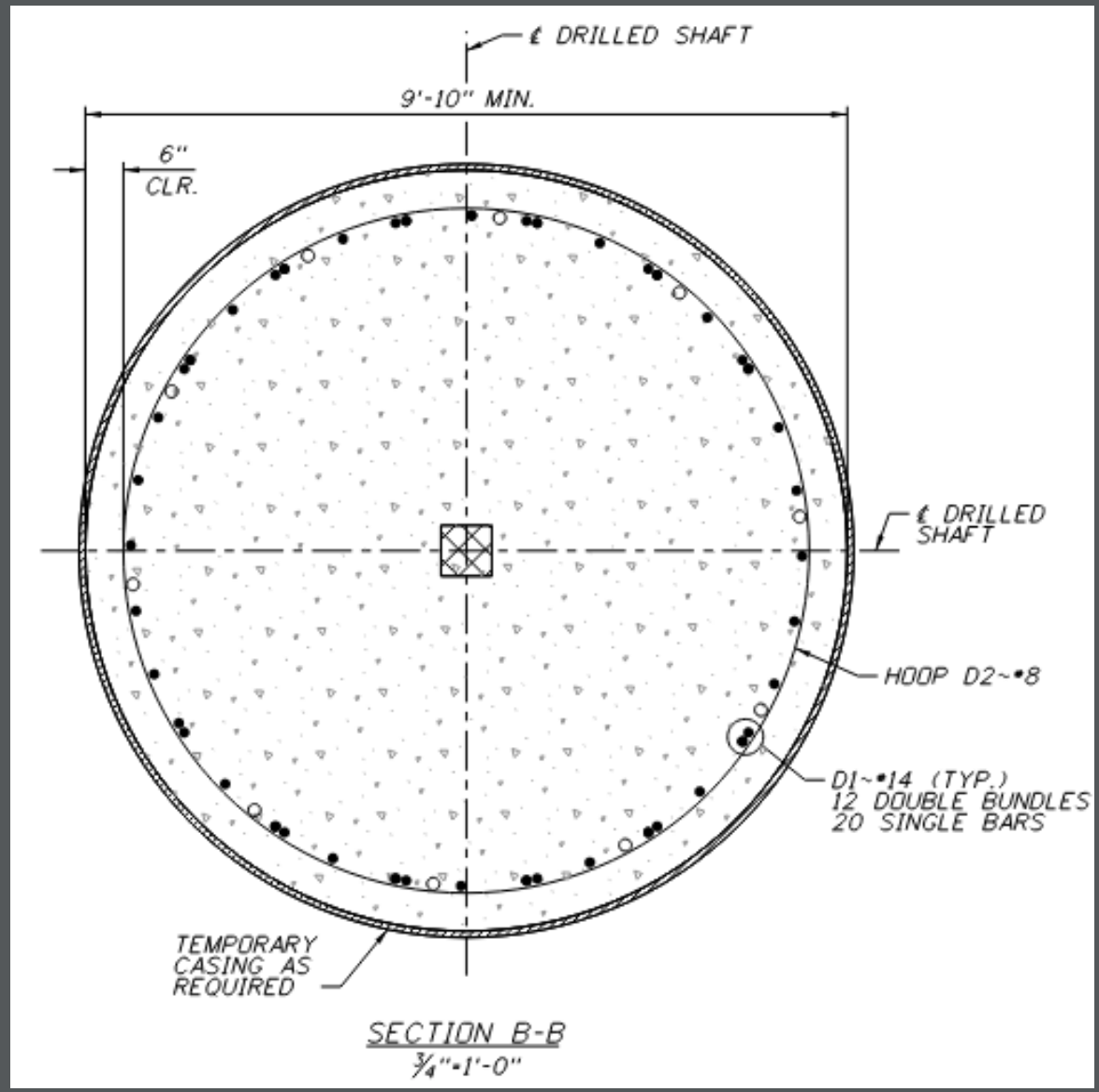
Drilled Shaft Section

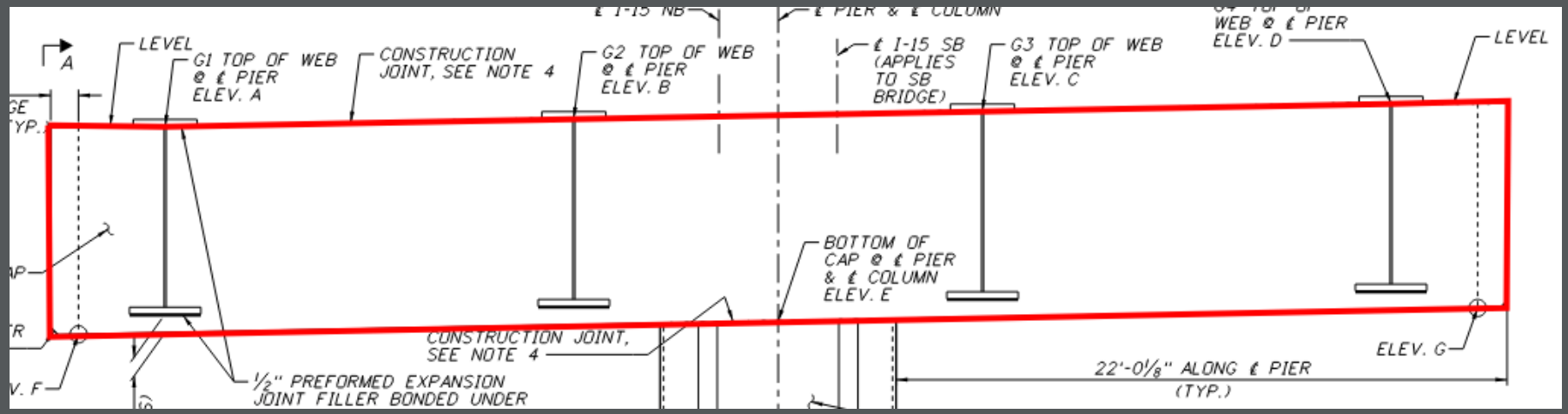
- 3.0m diameter (9.8ft)
- f’c = 4000 psi
- Grade 80 reinforcement
- Upper Section
  - 20 Triple Bundles
  - 12 Double Bundles
  - #14’s - vertical
  - Bundled #8 hoops

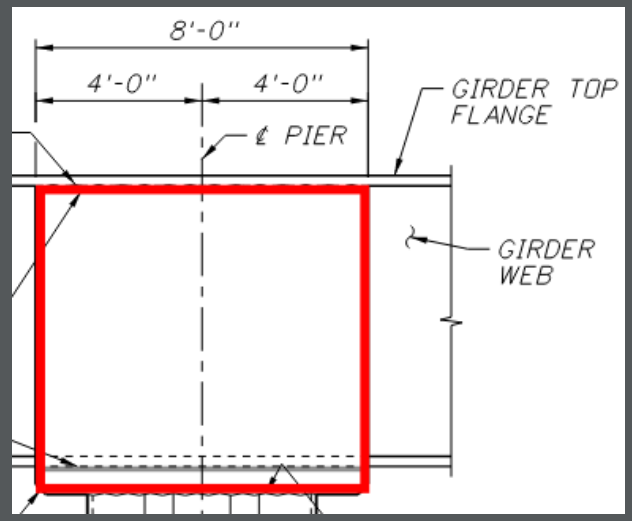


Drilled Shaft Section

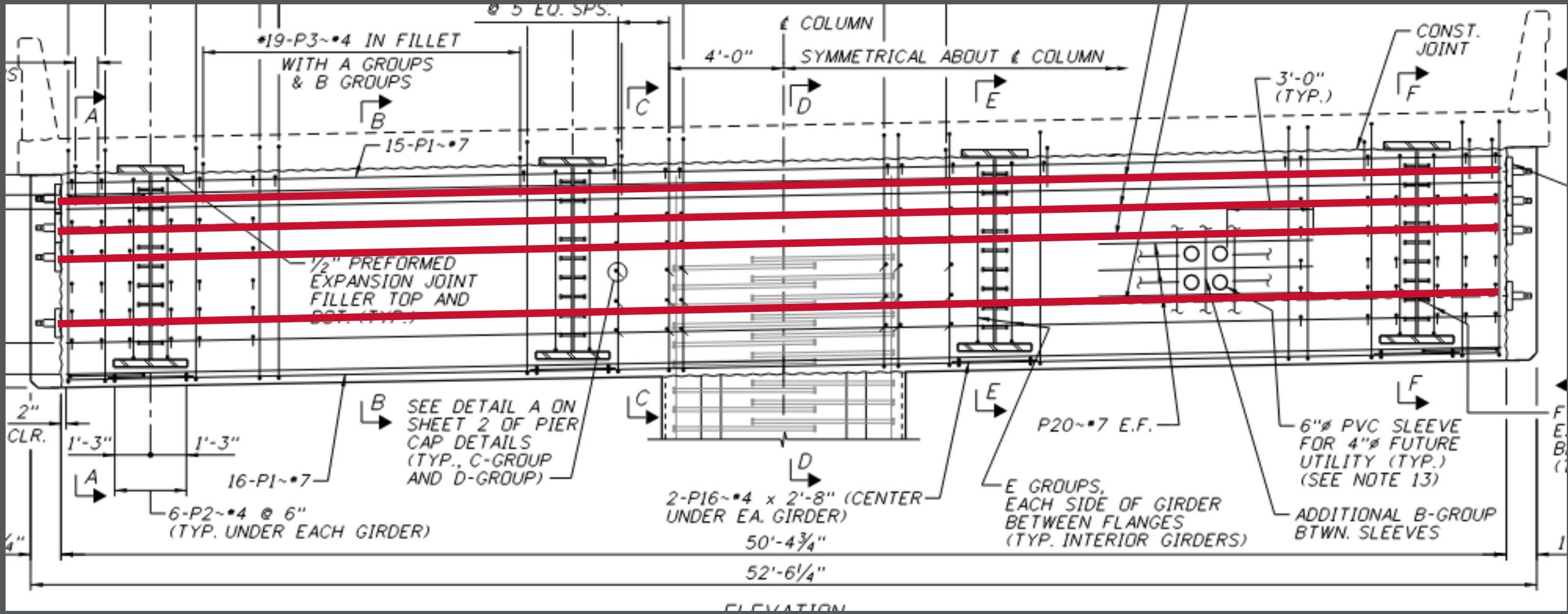
- Lower Section
  - 20 Double Bundles
  - 12 Single bars
  - #14’s - vertical
  - Single #8 hoops



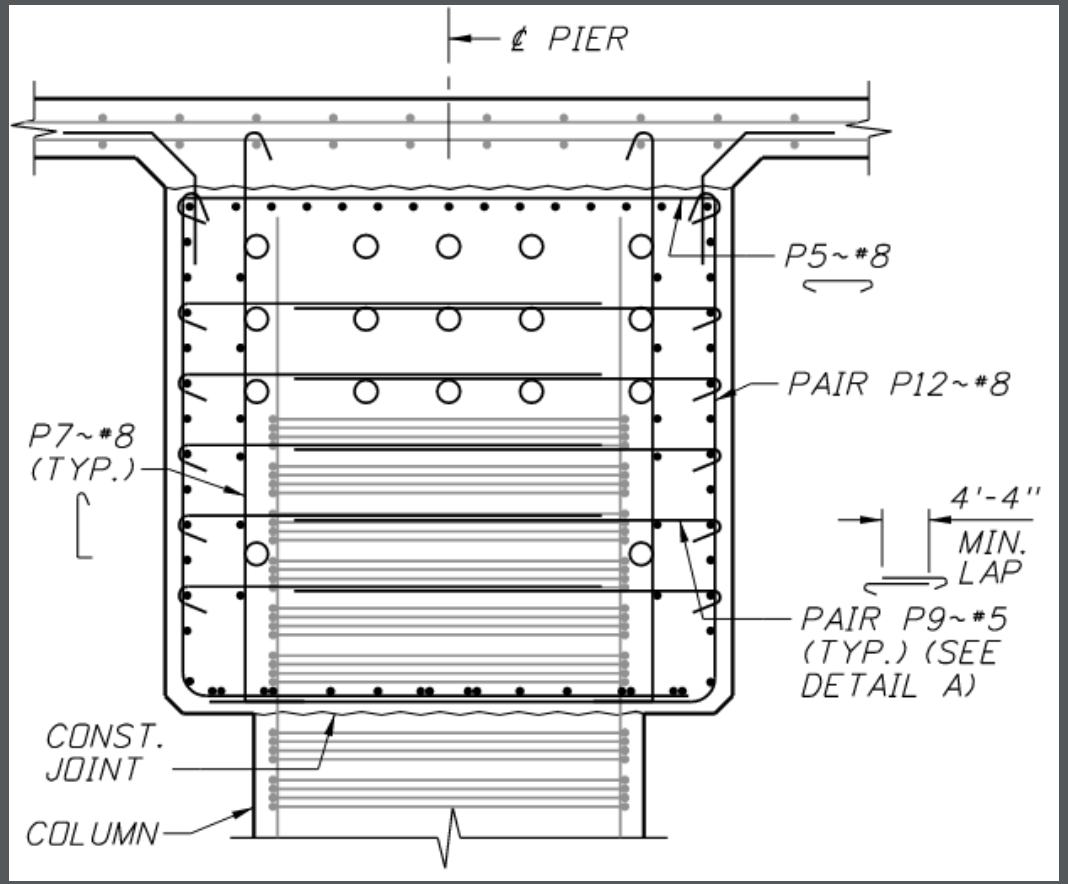




Integral Pier Cap

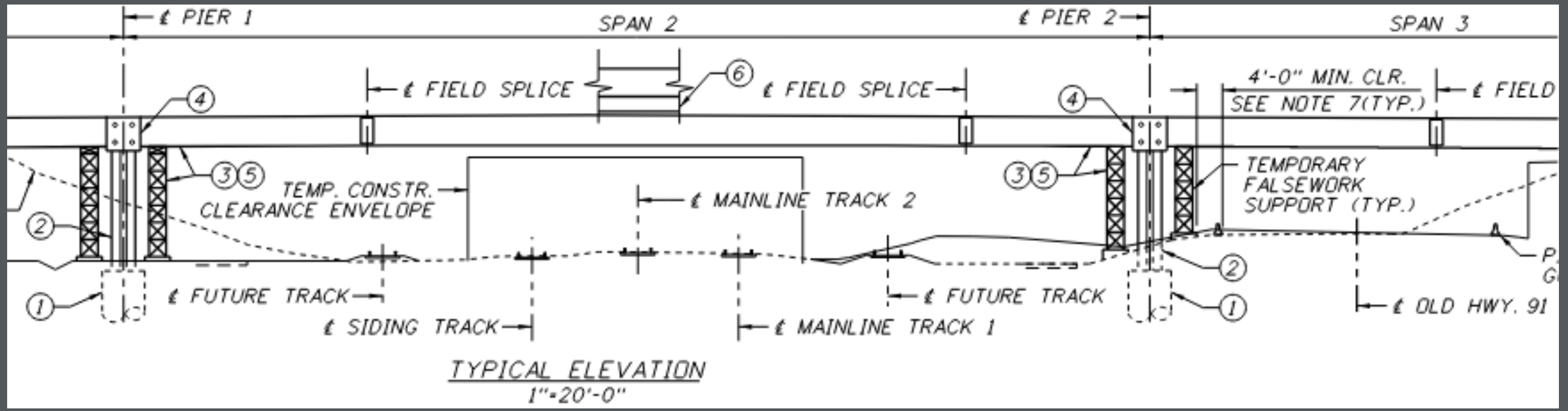


Integral Pier Cap



Integral Pier Cap Details

- f'c = 6000 psi
- 17 High strength post tensioning bars
  - fpu = 150ksi
  - 2 ½" diameter
- Bar jacking force of 542 kips, or 542,000 lbs
- #8 transverse bars for shear and torsion resistance



Construction Sequence

1. Foundation
2. Columns
3. Erect falsework supports
4. Place girders on temp supports
5. Construct pier cap

Challenges Revisited

How were they addressed?

Skew of railroad tracks	Reduced skew by using single column piers
Vertical clearance of tracks	Integral caps; Raise I-15 grade ~8ft; limit superstructure depth
UPRR ROW	Abut 1 and Pier 1 located in ROW; Pier 2 located outside of ROW
Proximity of piers to railroad tracks	Locate piers >27ft from future siding tracks; no crash walls
Utilities	Bury overheads
MOT during construction	Crossovers on I-15; temporary closures on Old 91

05
Lessons Learned

- Check with specialty contractors on specialty design items – they can provide excellent feedback.
- Seek guidance from other governing agencies when client doesn’t have experience/guidance.
- Large member sizes = large equipment; be aware of space

Q & A