I-64 Southside Widening and High Rise Bridge Project

PARSONS

Concrete Innovations

Presented by Greg Shafer, PE

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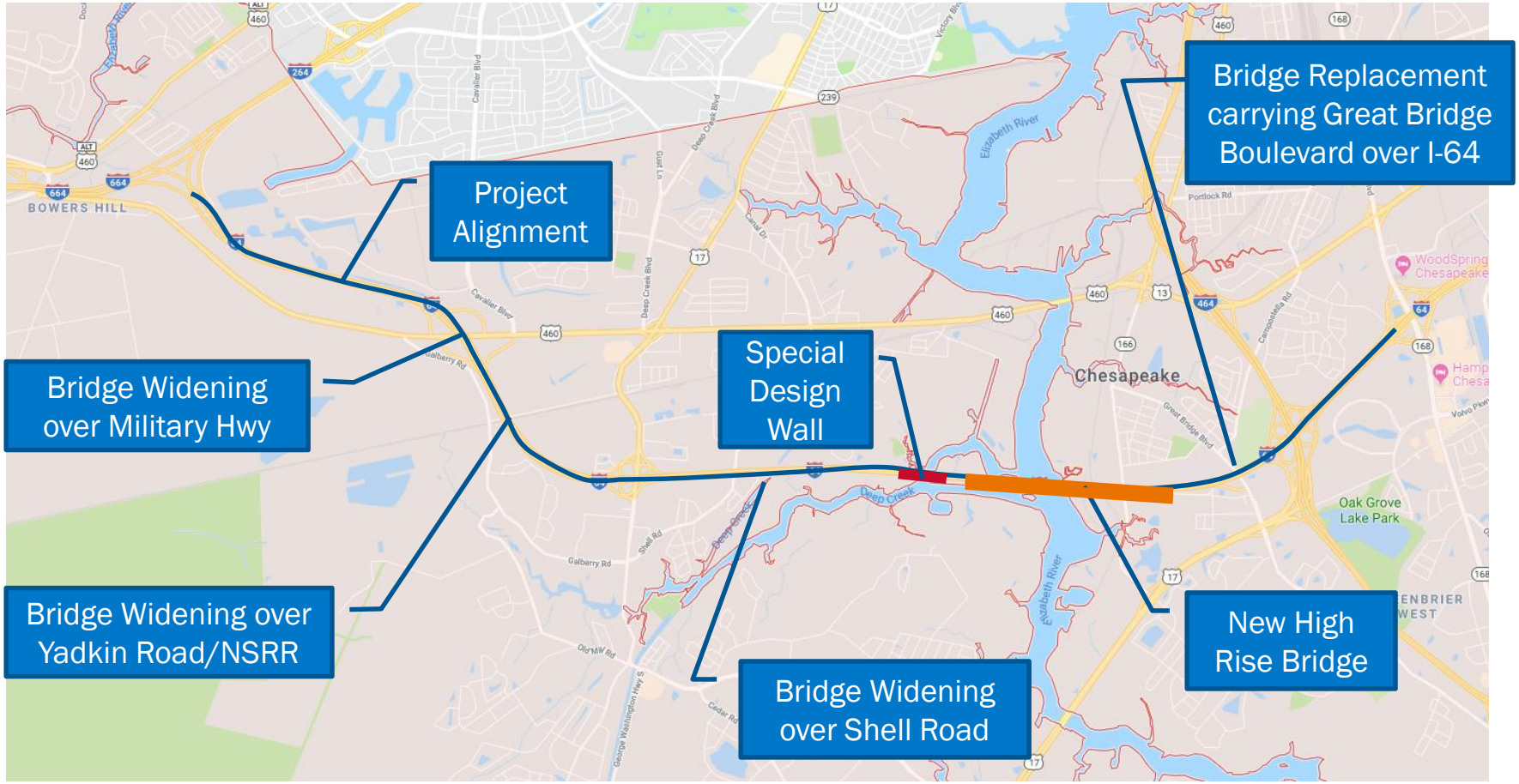
Outline

- Project Description
- High Rise Bridge Overview
- Design Criteria
- Foundations and Substructure
- Superstructure

Design Build Project Overview

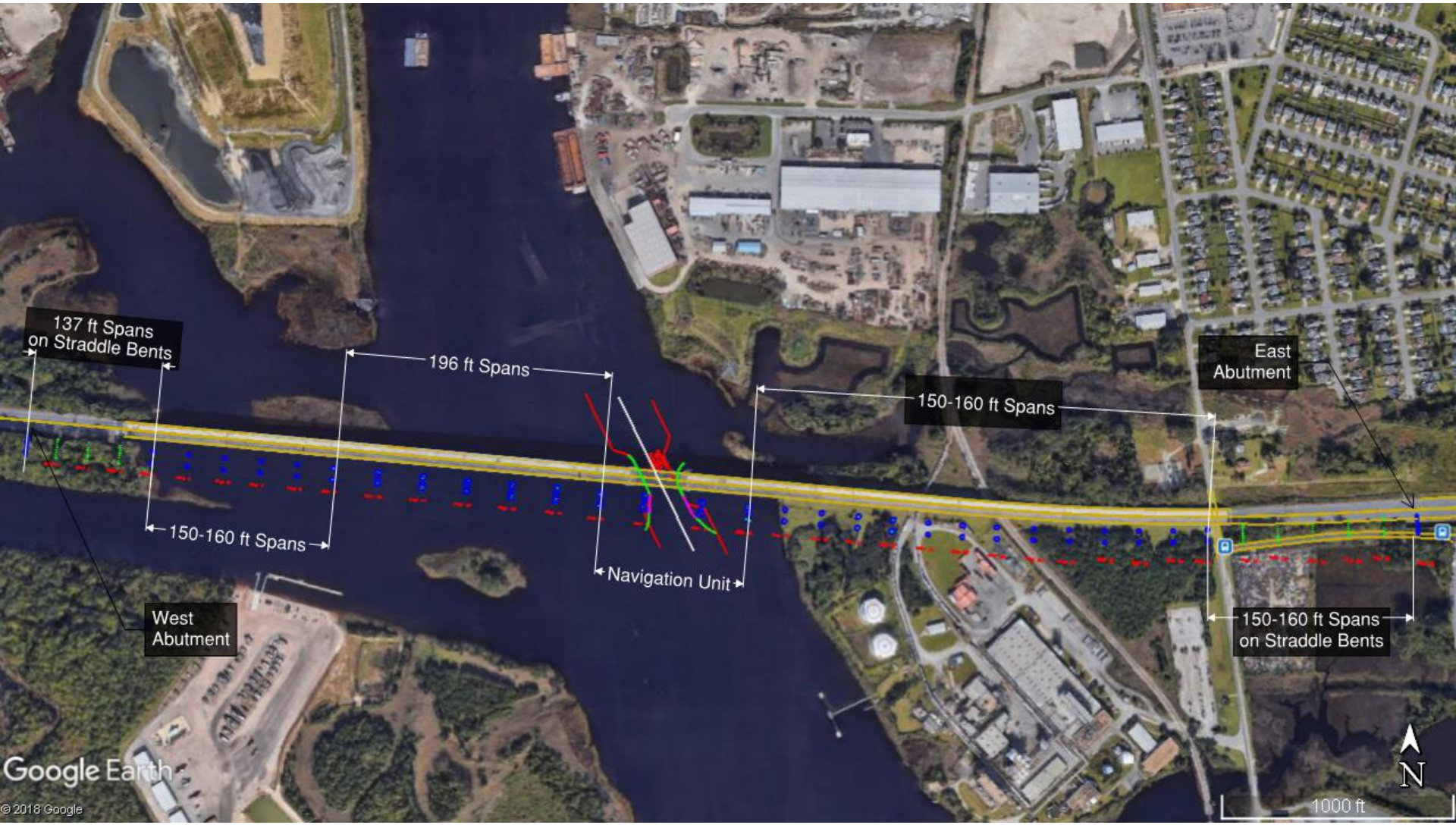
- Five Proposed and Three Shortlisted
- Best value approach
- Alternative Technical Concepts
- Bid Results
  - Granite-Parsons-Corman $410 million
  - Skanska/Archer Western $455 million
  - LMB Constructors $489 million
- Structures Subconsultants
  - RK&K Design of Great Bridge Blvd Bridge
  - Schnabel Geotechnical Engineering
  - Athavale, Lystad & Assoc. Bridge Load Rating

Project Location



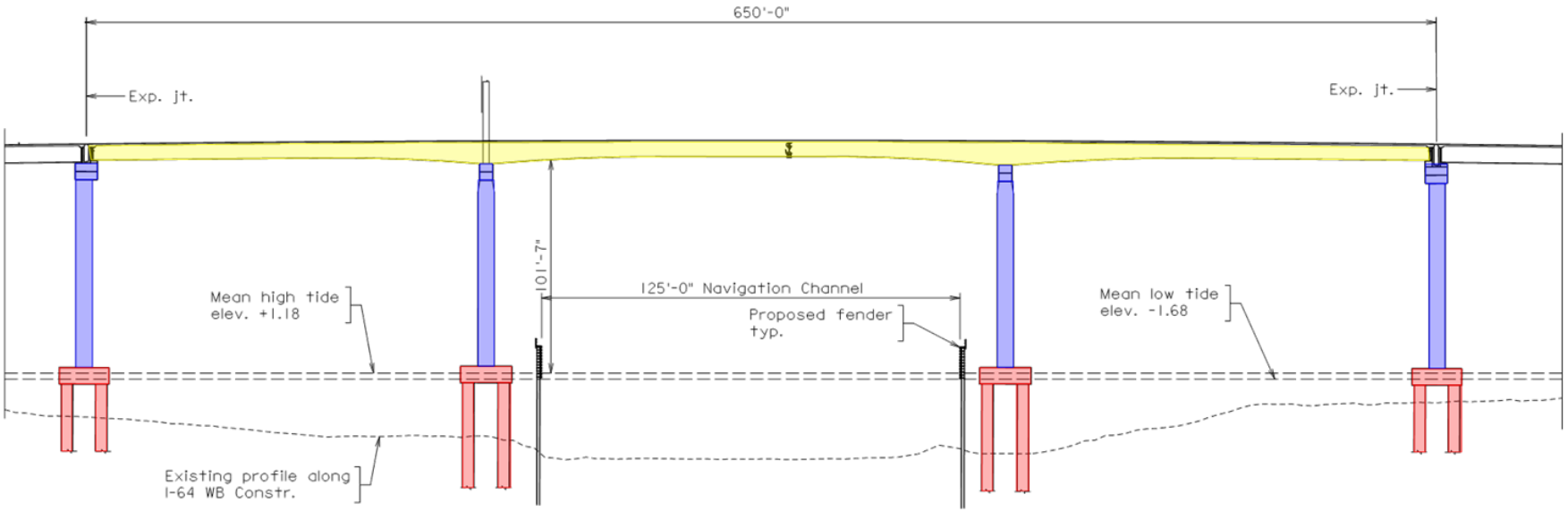
High Rise Bridge Overview

High Rise Bridge

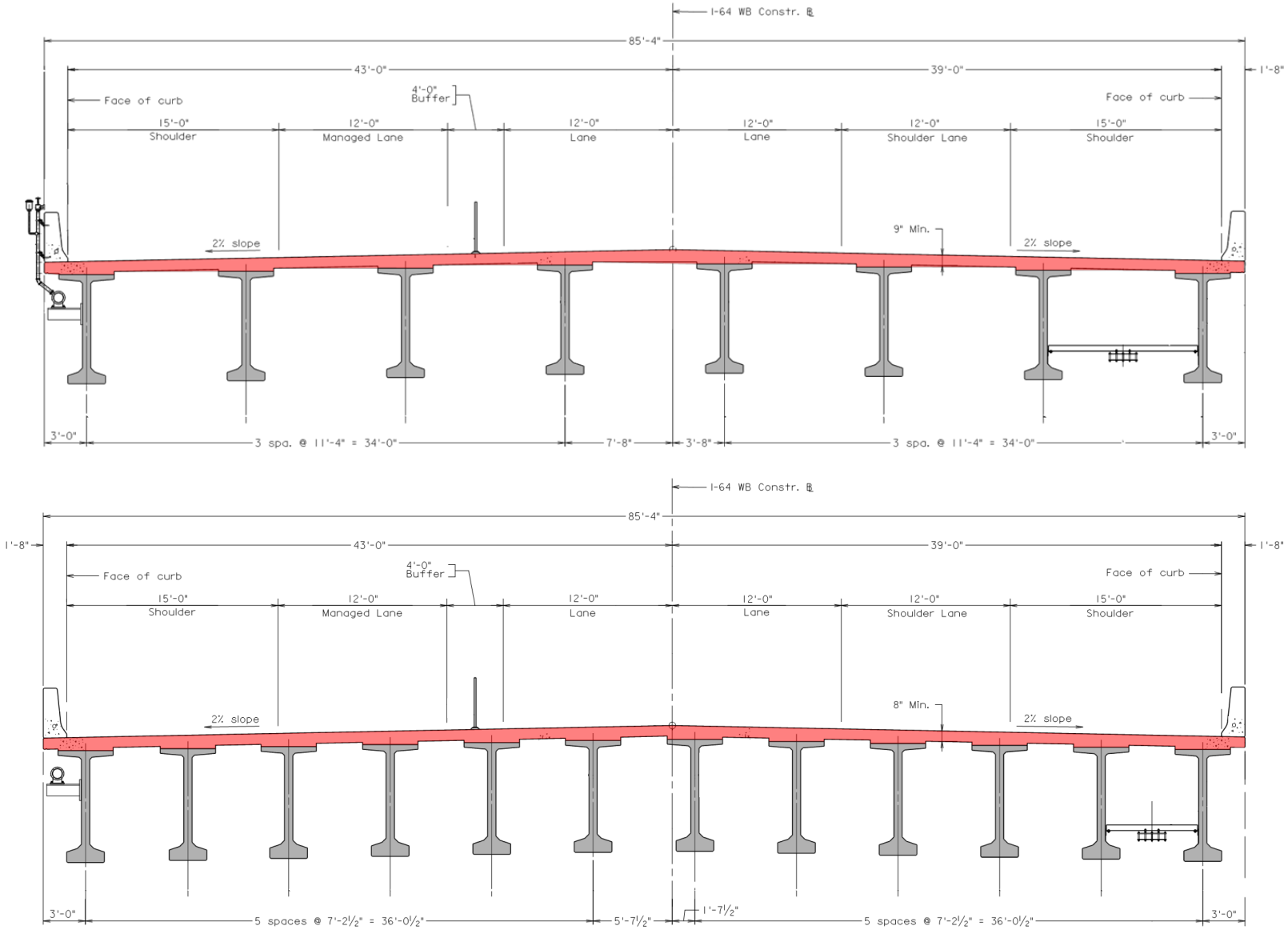


High Rise Bridge

- Seven continuous units varying in length from 653 ft to 1176’
- Prestressed concrete bulb-tee girders comprise 90% of the bridge
- Navigation clearance of 125’ horizontal and 100’ vertical



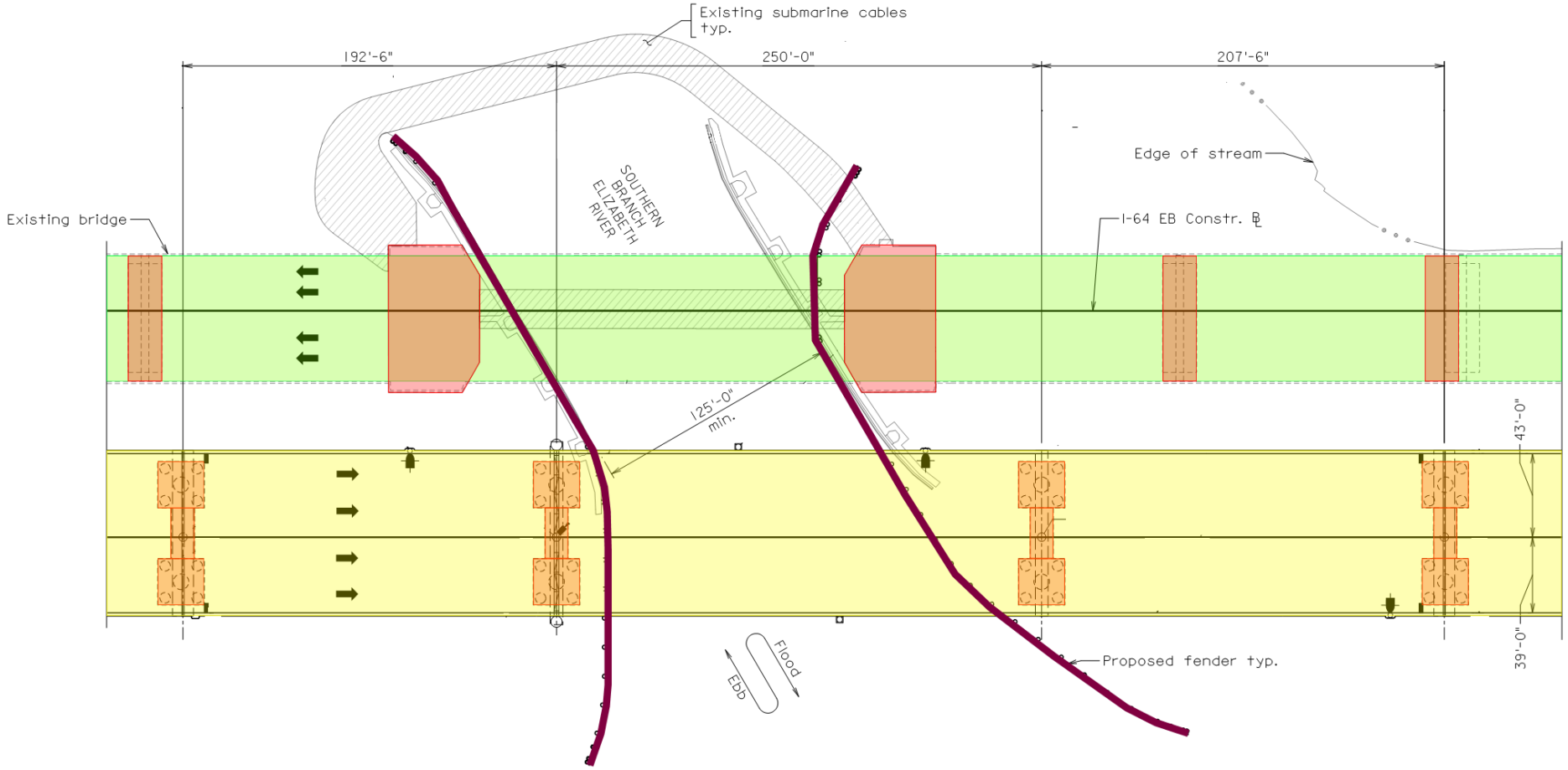
High Rise Bridge



Design Criteria

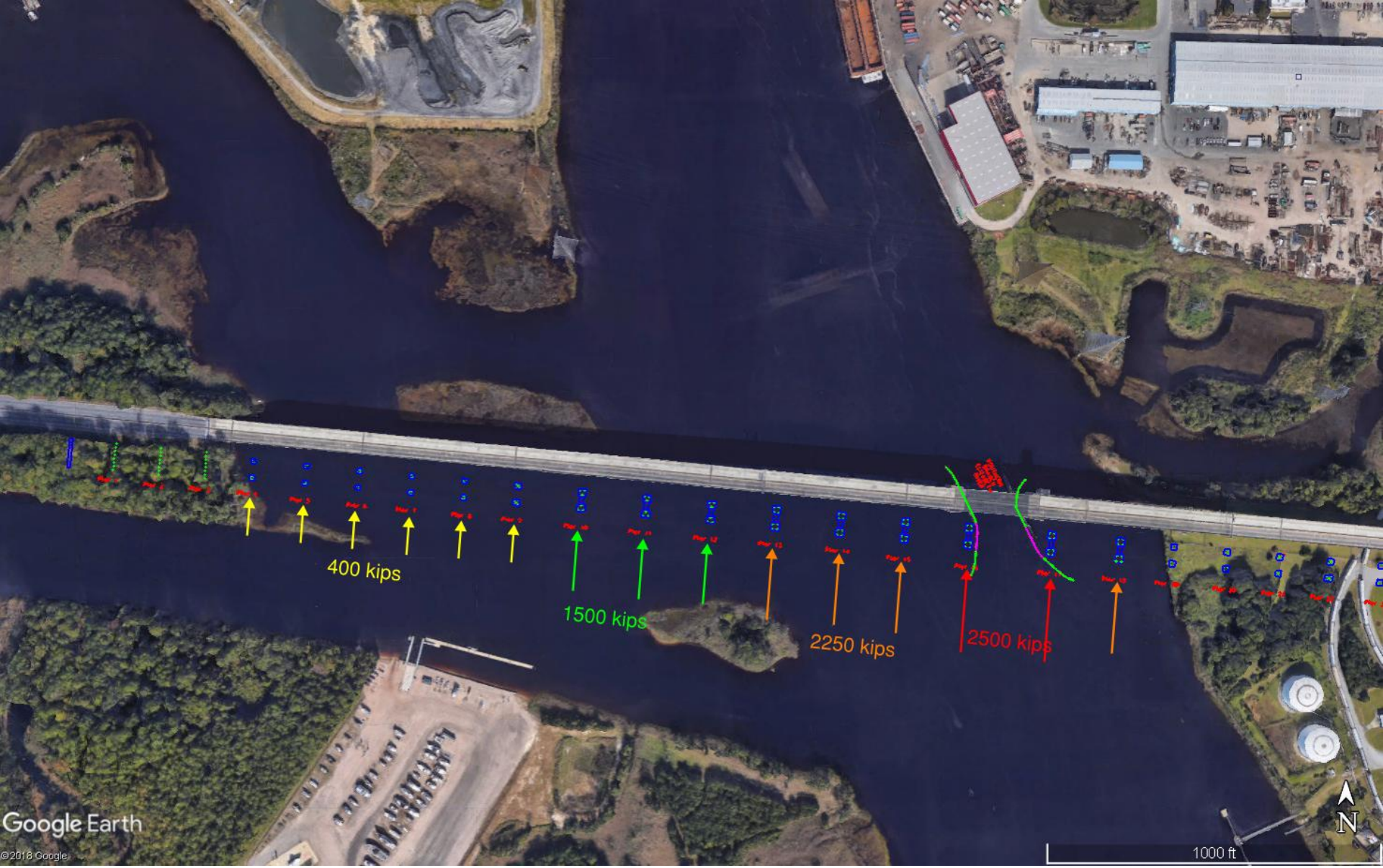
- VDOT Manual of the Structures and Bridge Division
- Vessel impact
- Corrosion protection

Vessel Impact Criteria



Vessel Impact Criteria

- Characteristics of vessel travel
- Number, location and access to piers
- Flood conditions
- Pier impact analysis
- Superstructure impact analysis
- Maximum impact 2500 kips
- Drifting barge 400 kips
- Fender design

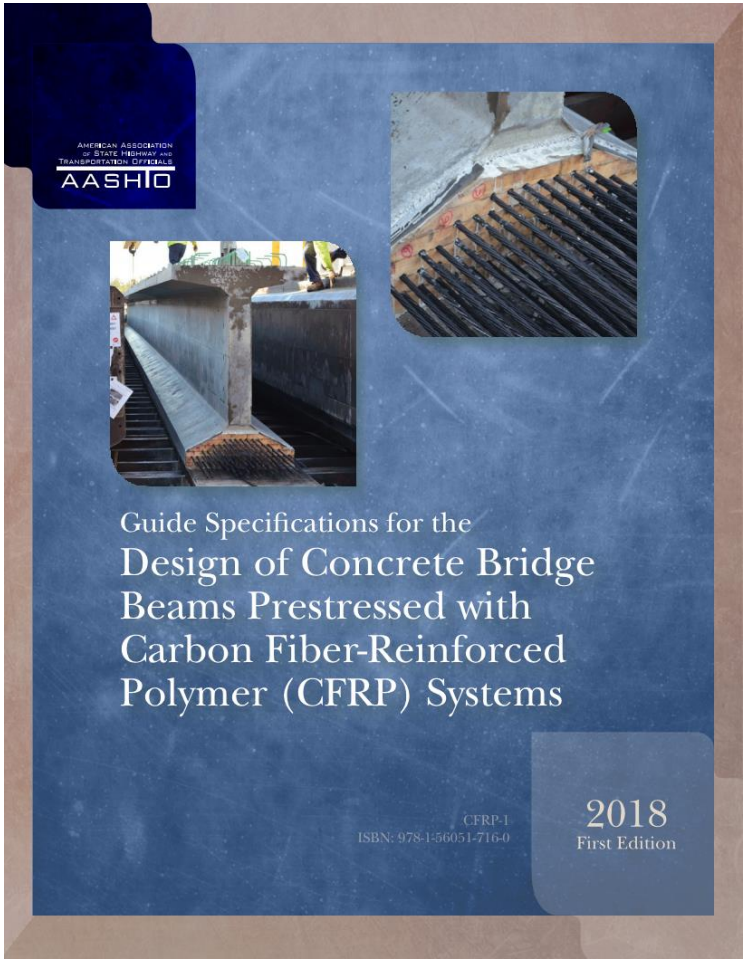

400 kips
1500 kips
2250 kips
2500 kips
Google Earth
©2018 Google
1000 ft
N

Prescriptive Approach to Corrosion Projection

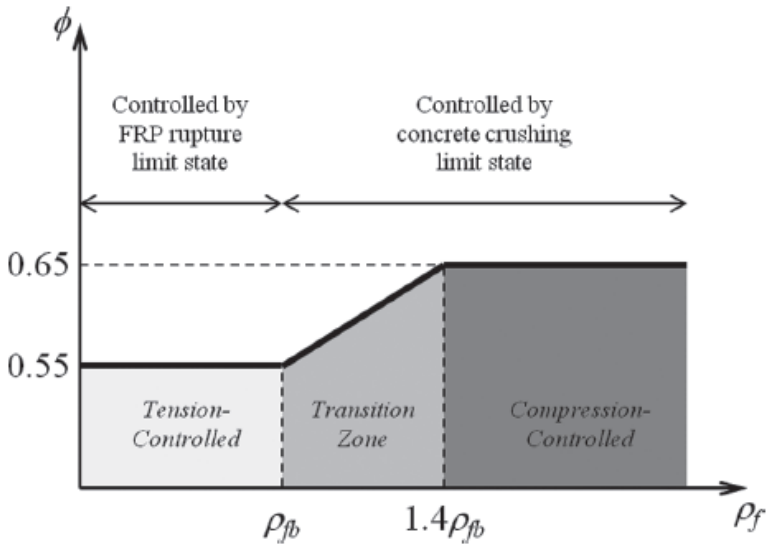
- Cover
- Concrete mix
- Corrosion resistant reinforcing
  - SS or CFRP prestressing in exposed piling
  - MMFX in exposed pile caps/columns
  - SS reinforcing in decks
- Curing

Designing with CFRP Prestressing

- ACI 440.1R-15
- Carbon Fiber Composite Cable (CFCC) as produced by Tokyo Rope
  - Tensile strength of 338 ksi
  - Rupture at 1.5% strain
  - Stiffness of 22,400 ksi
  - Creep rupture at 85% strength
- Similar ductility limitations with stainless steel prestressing



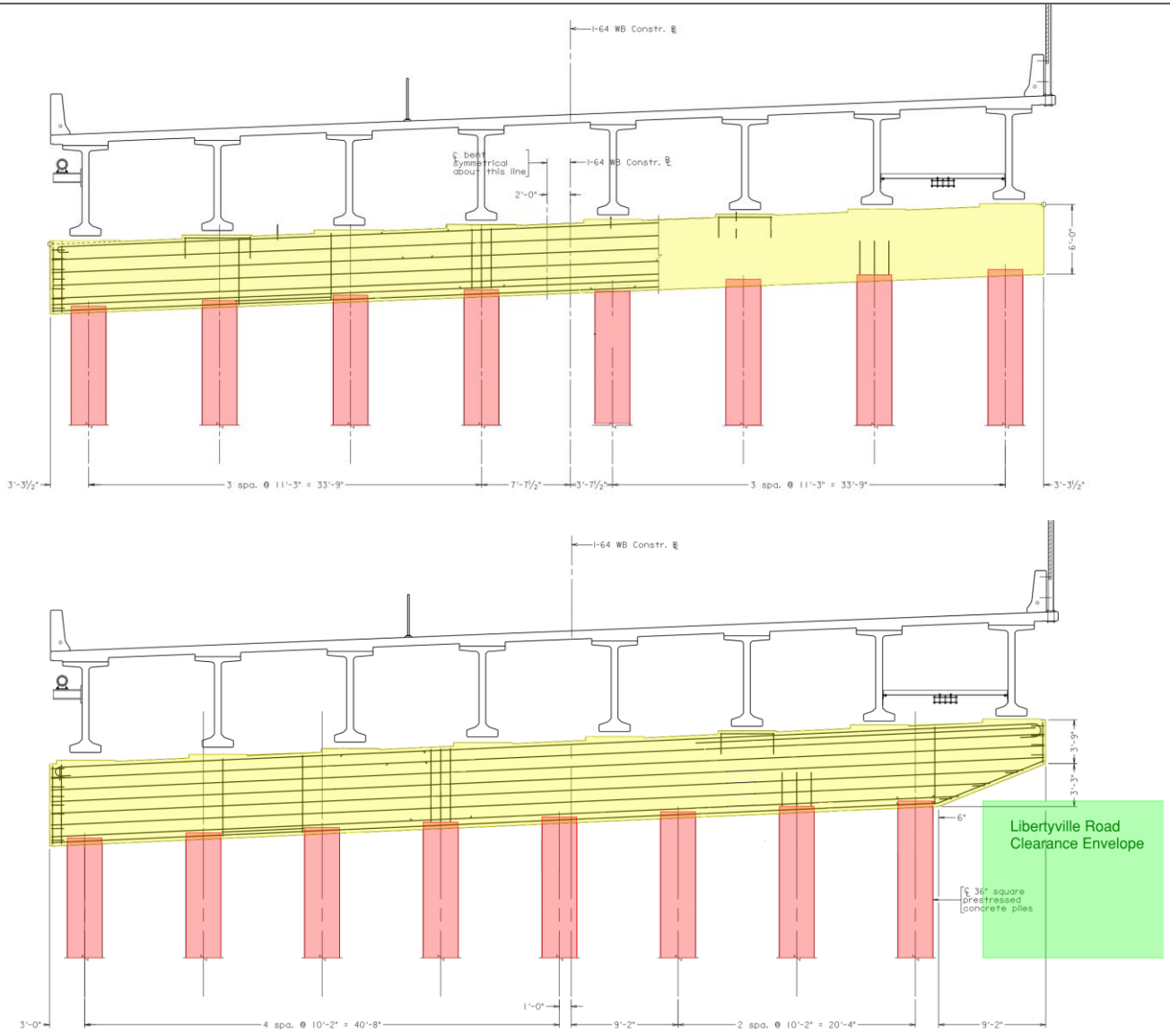
CFRP Pile Design



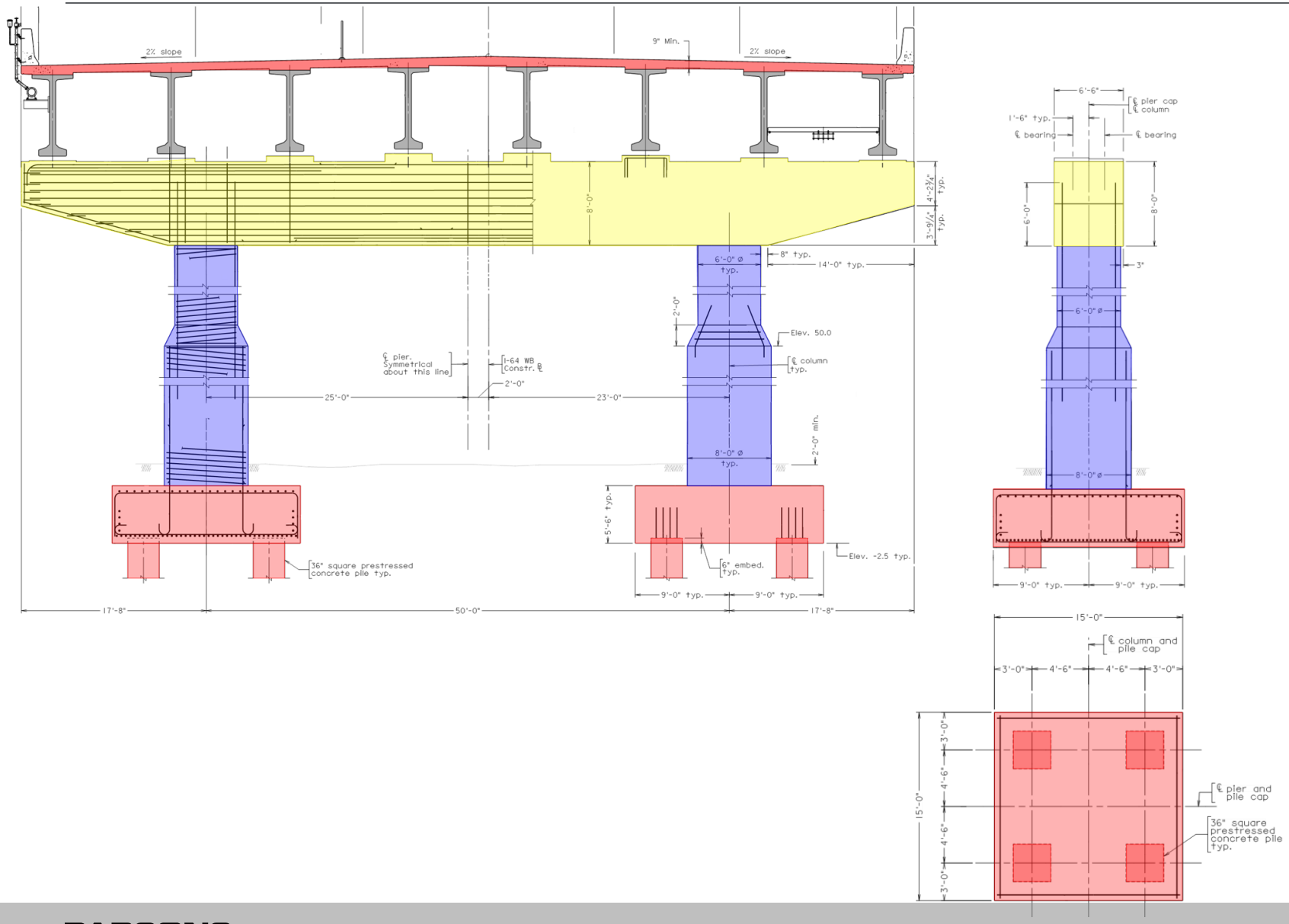
Foundations & Substructure

- Pile Bents
- Land Piers
- River Piers
- Special Piers

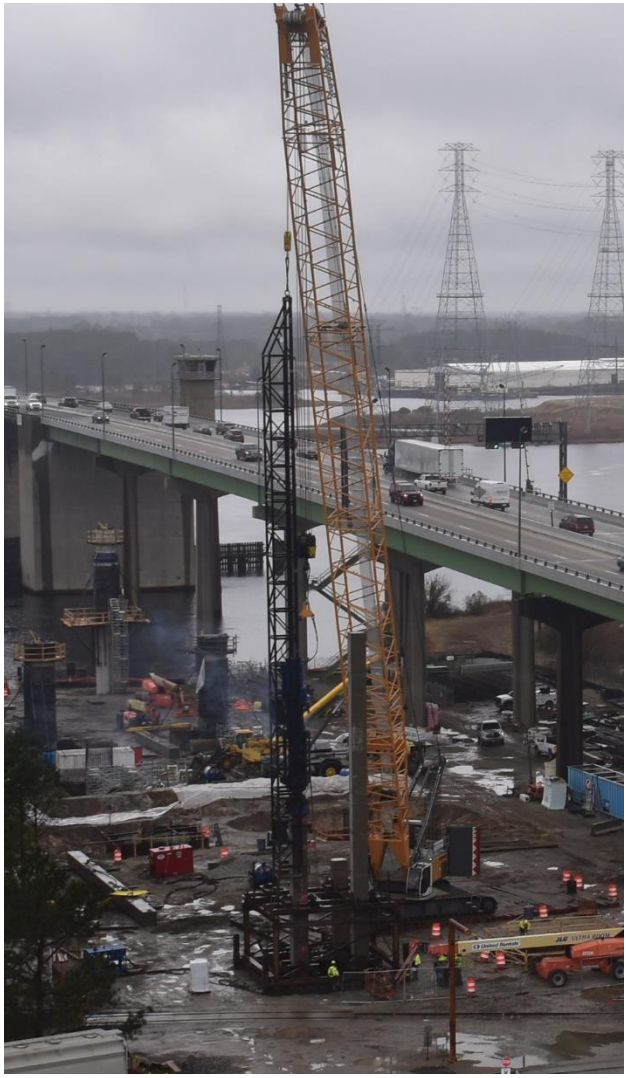
Pile Bents


I-64 WB Constr. ℄
℄ bent symmetrical about this line
I-64 WB Constr. ℄
2'-0"
6'-0"
3'-3½"
3 spa. @ 11'-3" = 33'-9"
7'-7½"
3'-7½"
3 spa. @ 11'-3" = 33'-9"
3'-3½"
I-64 WB Constr. ℄
3'-9"
3'-3"
6"
Libertyville Road
Clearance Envelope
℄ 36" square prestressed concrete piles
3'-0"
4 spa. @ 10'-2" = 40'-8"
1'-0"
9'-2"
2 spa. @ 10'-2" = 20'-4"
9'-2"

Land Piers

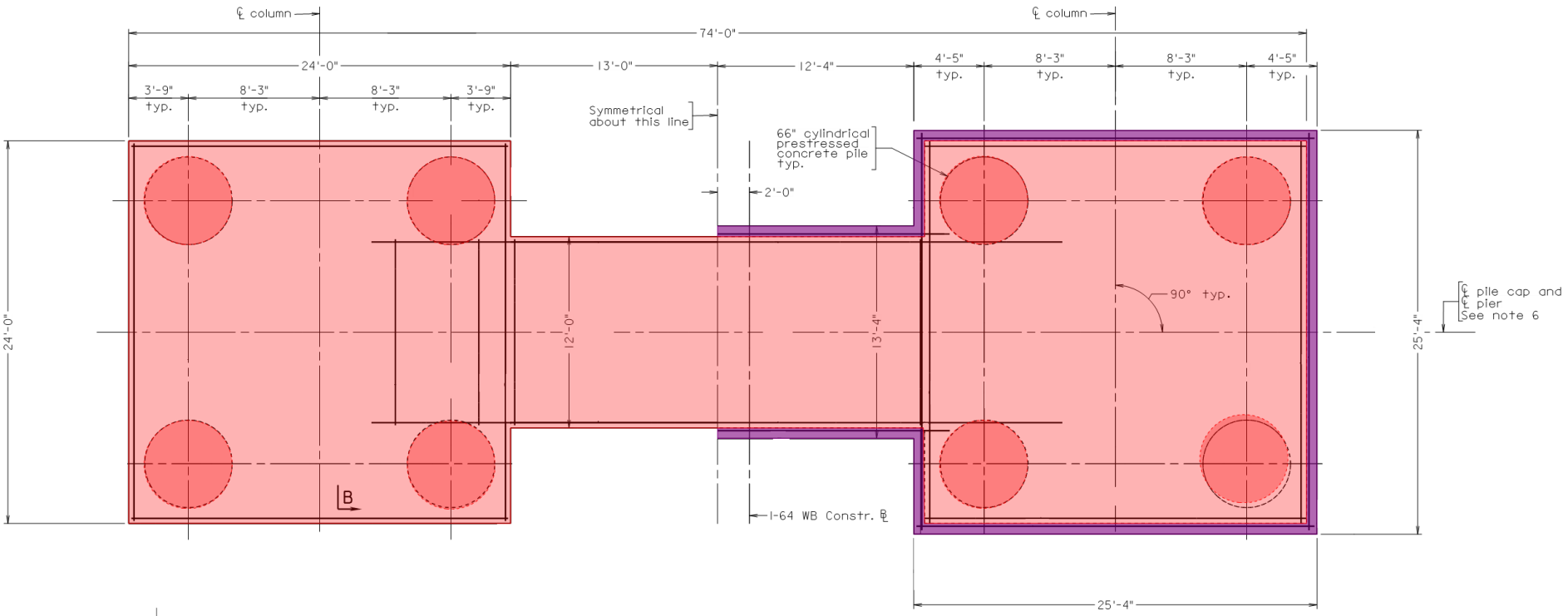

2% slope
9" Min.
2% slope
8'-0"
4'-2¾" typ.
3'-9¼" typ.
6'-0" ø typ.
8" typ.
14'-0" typ.
2'-0"
Elev. 50.0
℄ column typ.
℄ pier. Symmetrical about this line
I-64 WB Constr. ℄
2'-0"
25'-0"
23'-0"
8'-0" ø typ.
2'-0" min.
5'-6" typ.
6" embed. typ.
Elev. -2.5 typ.
36" square prestressed concrete pile typ.
9'-0" typ.
9'-0" typ.
17'-8"
50'-0"
17'-8"
6'-6"
℄ pier cap
℄ column
1'-6" typ.
℄ bearing
℄ bearing
6'-0"
8'-0"
3"
6'-0" ø
8'-0" ø
9'-0" typ.
9'-0" typ.
15'-0"
℄ column and pile cap
3'-0"
4'-6"
4'-6"
3'-0"
15'-0"
3'-0"
4'-6"
4'-6"
3'-0"
℄ pier and pile cap
36" square prestressed concrete pile typ.

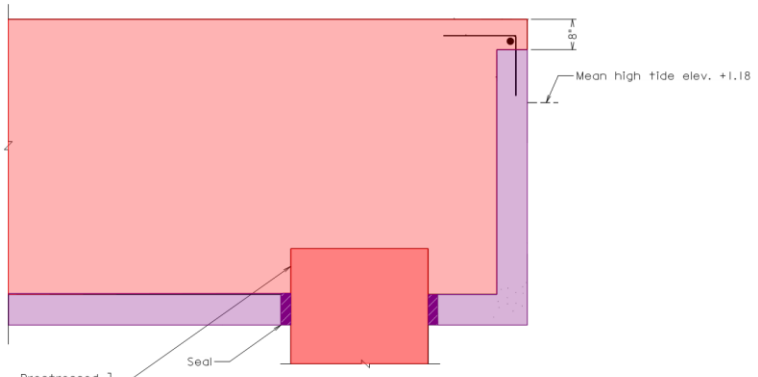
Foundation Construction



Column Construction

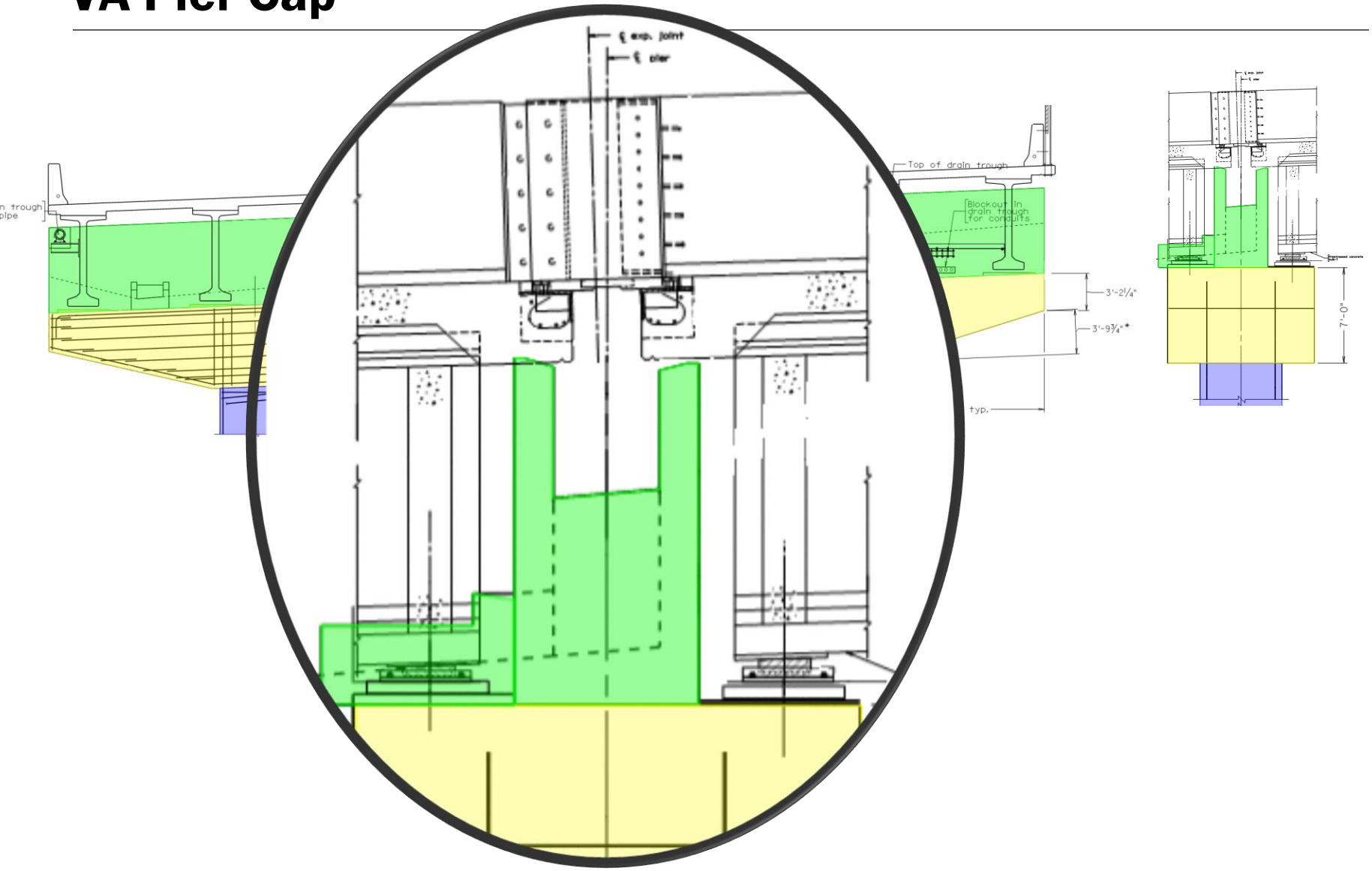
River Piers



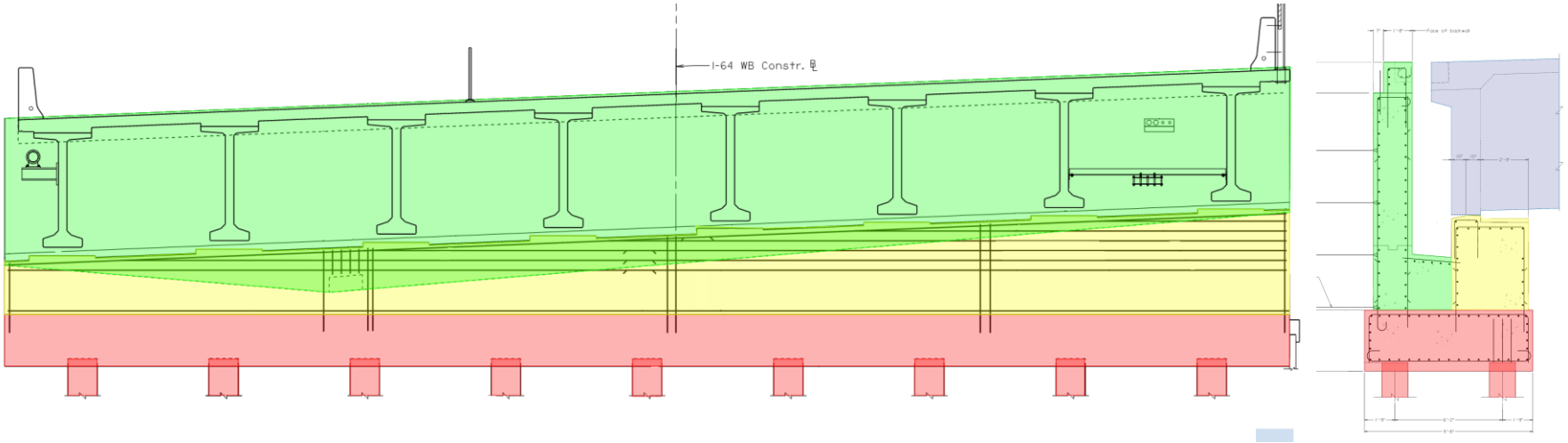


STAY-IN-PLACE PRECAST FORM DETAIL

VA Pier Cap

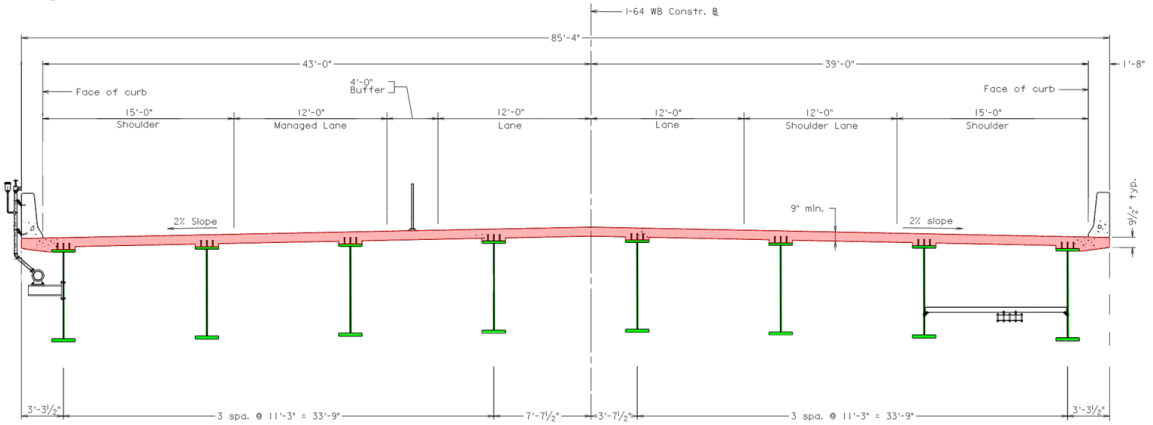

℄ exp. joint
℄ pier
Top of drain trough
Blockout in drain trough for conduits
3'-2¼"
3'-9¾"*
typ.
7'-0"

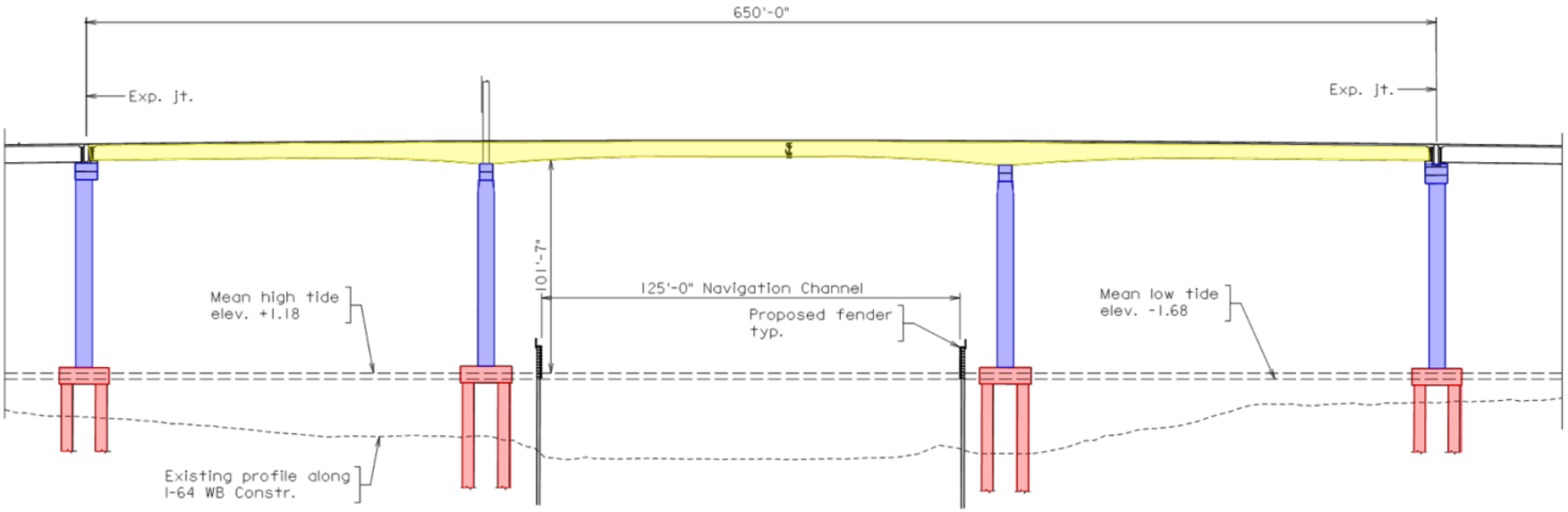
VA Abutment



Superstructure

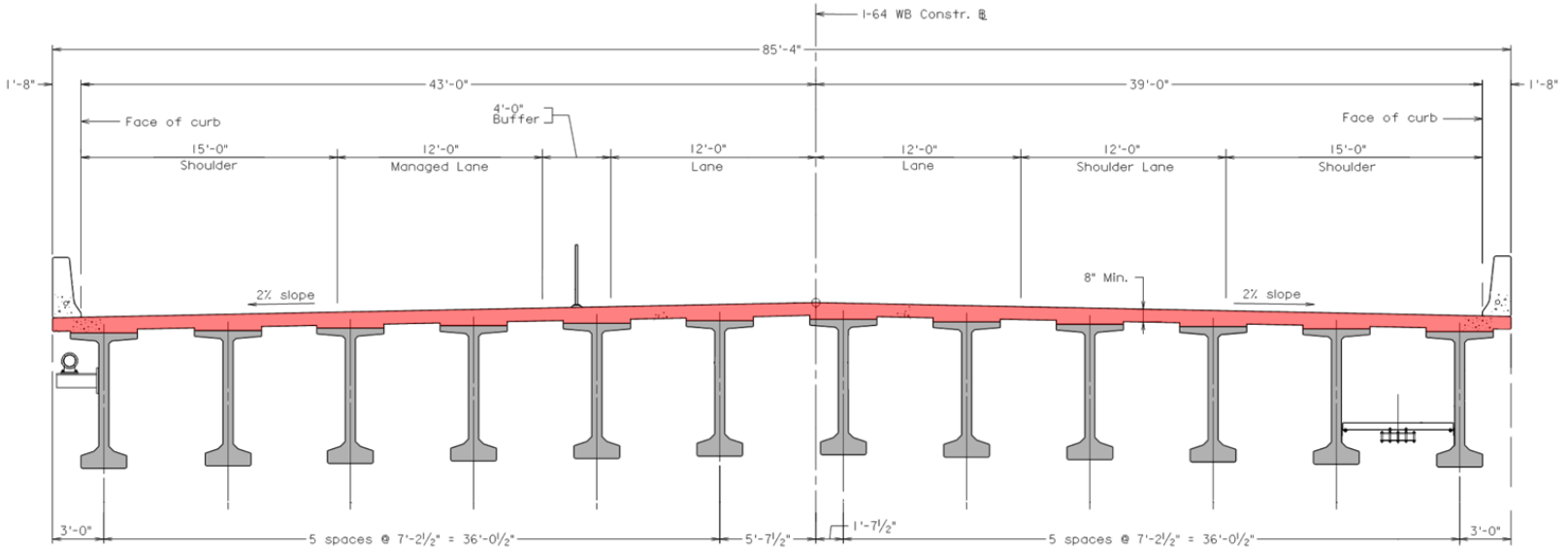
- Options considered for mainspan
  - CIP segmental box girder
  - Spliced prestressed girders
  - Structural steel plate girders



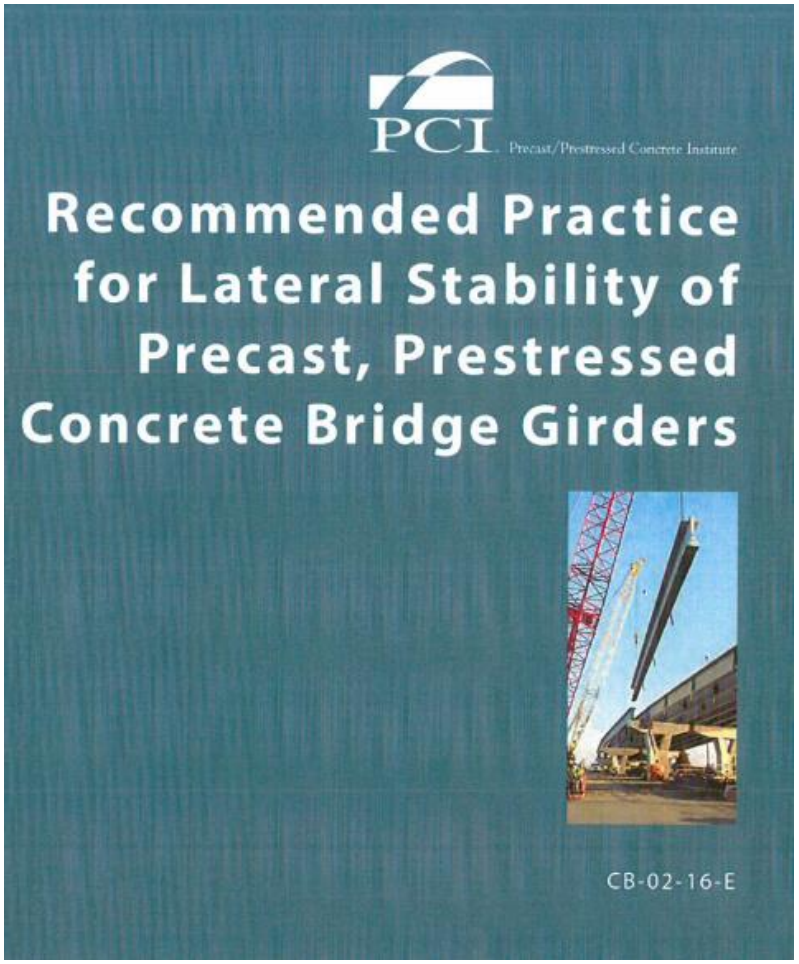


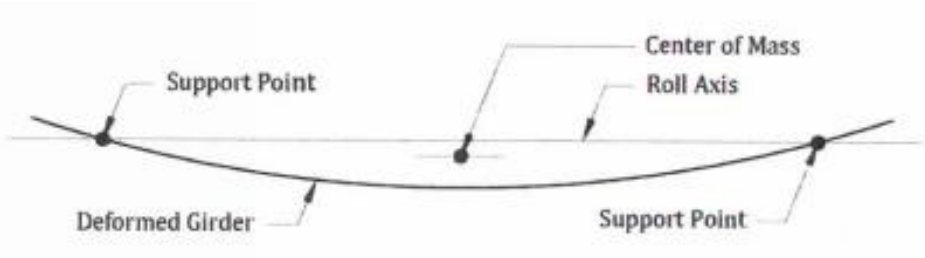
Prestressed Girders

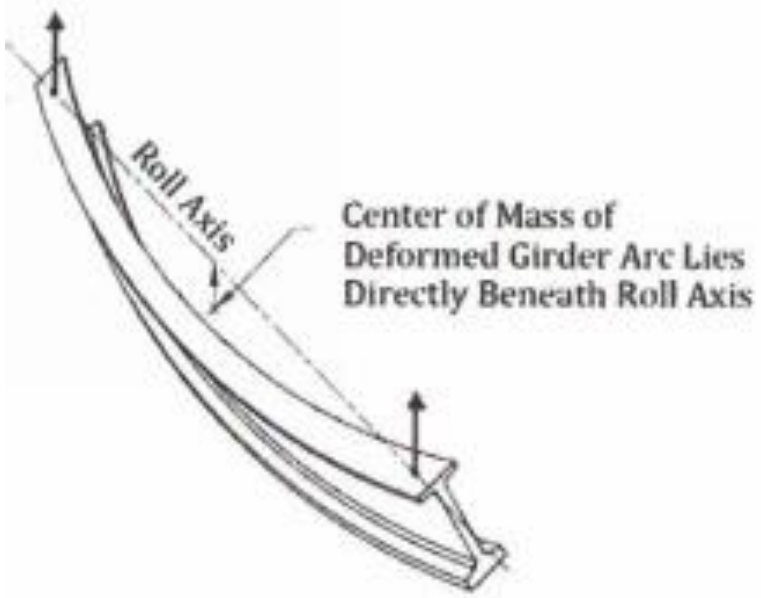
- BT-72 with spans to 137 feet (8 girders @ 11’-4” spacing)
- BT-93 with spans to 160 feet (8 girders @ 11’-4” spacing)
- BT-95 with spans to 196 feet (11 girders @ 7’-2½“ spacing)
- Stainless steel deck reinforcing



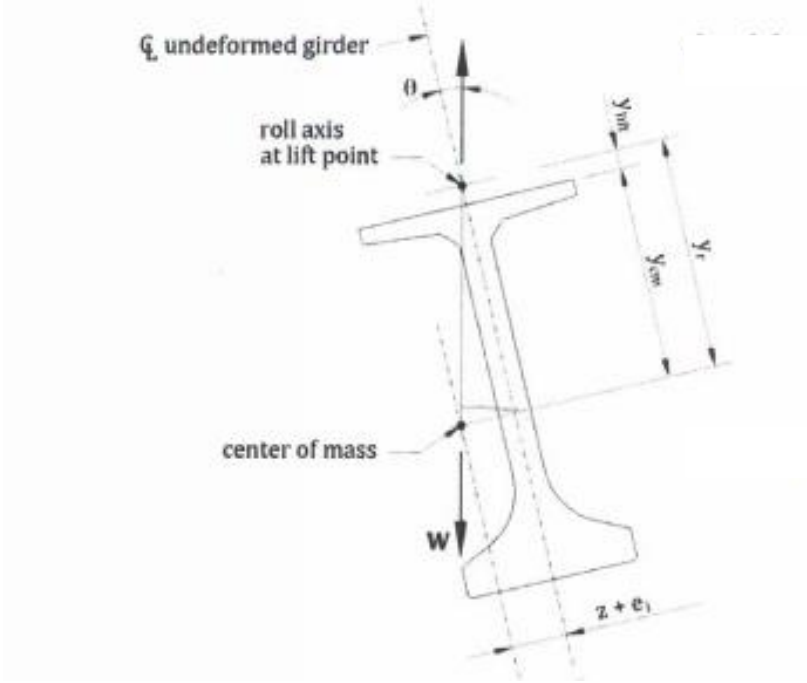
Girder Stability







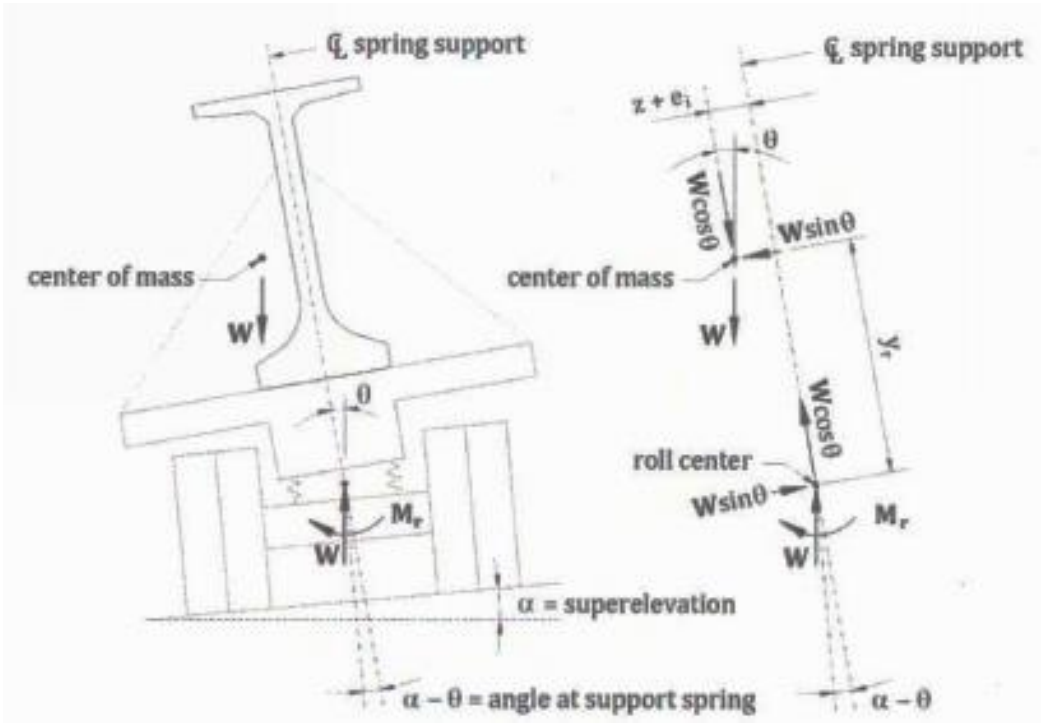
Loads Affecting Girder Stability



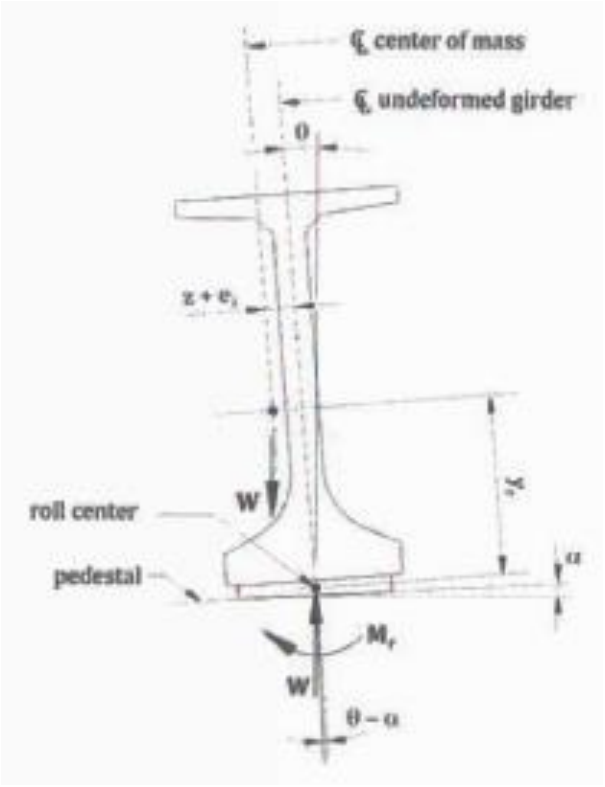
Girder Rotation

Wind

Other Critical Conditions



Girder on Transporter



Girder on Bearings

Wind on Girders After Erection

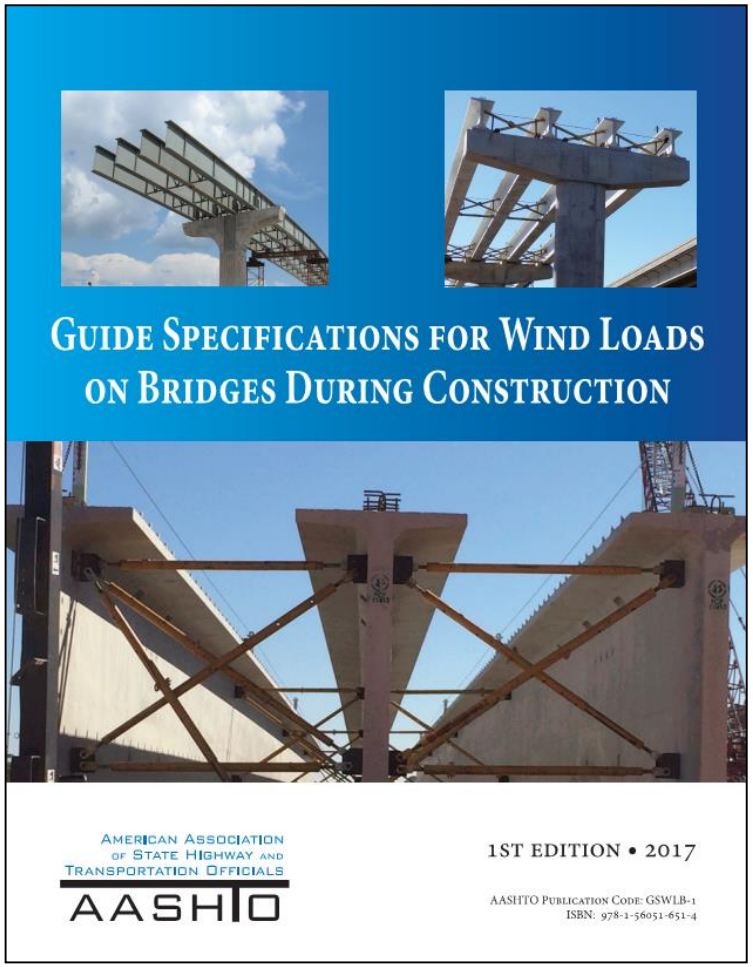


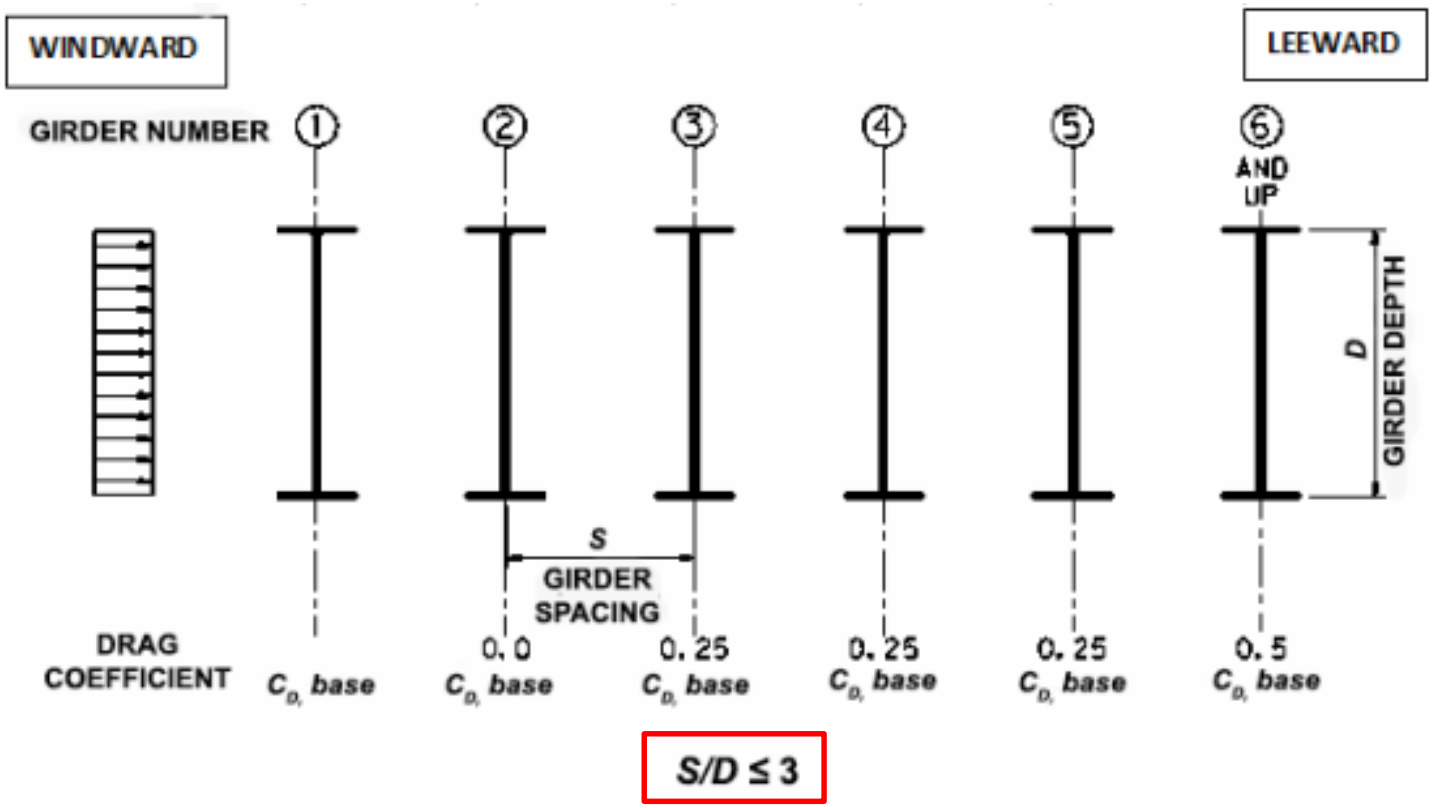
Table 4.2.1-2—Base Drag Coefficient for Bridge Superstructures During Construction

Superstructure Type	Base Drag Coefficient ($C_{D,\,base}$)
Steel Plate Girders	2.2
Rolled I-Beams	2.2
Concrete I-Beams	2.0
Closed and Open Box-Girders	2.1
Round Members	1.0

Table 4.2.1-1—Wind Speed Reduction Factor During Construction, *R*

Superstructure Construction Duration	Wind Speed Reduction Factor during Construction, *R*
0-6 weeks	0.65
6 weeks to 1 year	0.73
>1-2 years	0.75
>2-3 years	0.77
>3-7years	0.84

Wind on Multiple Girders



Summary and Questions