Second Bridge to Oak Island

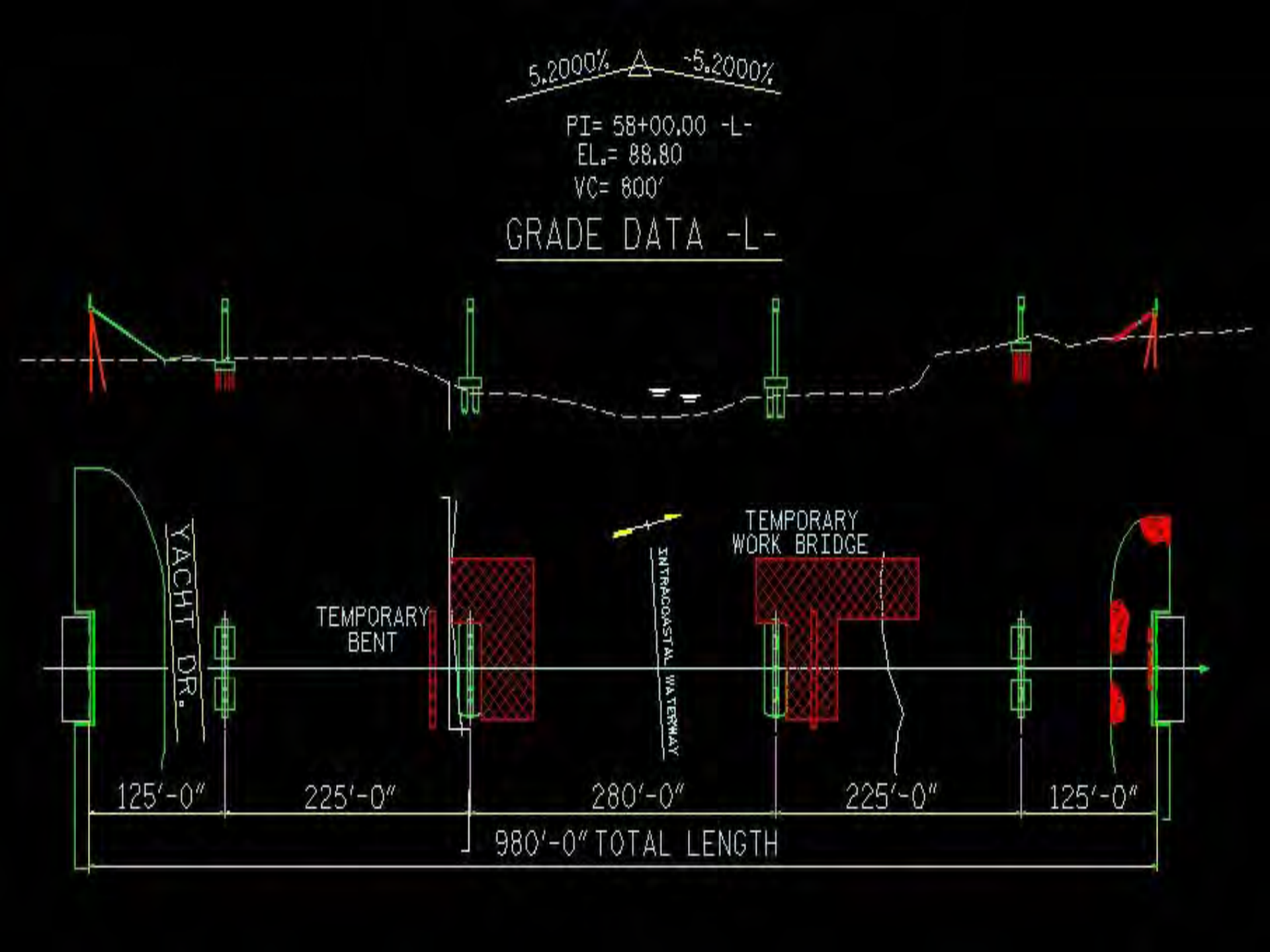
R-2245 Brunswick Co.

Tentative Letting May 2007 ?????

Overview

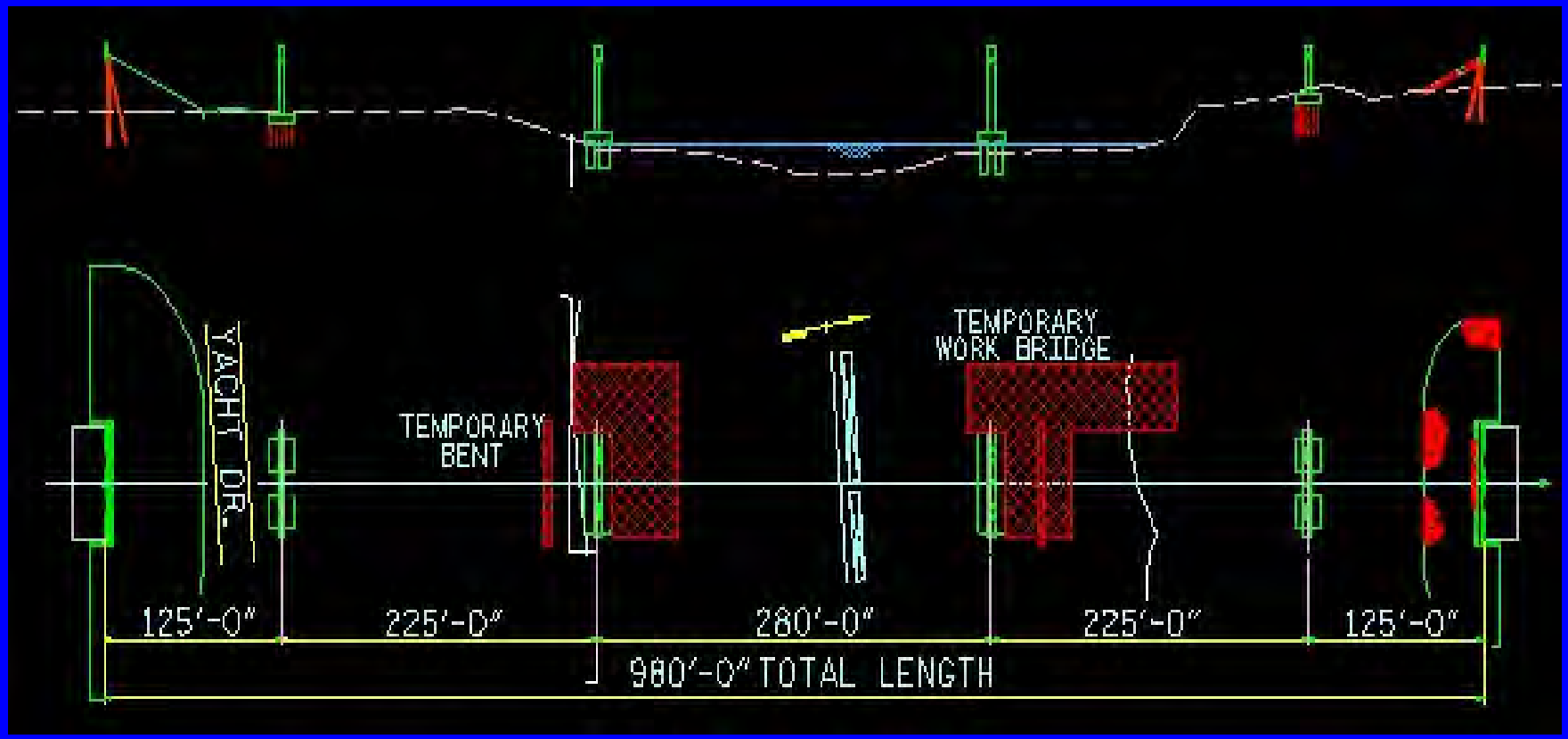
- Bridge Layout
- Girder Design
- Lessons Learned from Virginia Dare Bridge (Manteo Bypass)

Bridge Layout


5.2000%
-5.2000%
PI= 58+00.00 -L-
EL.= 88.80
VC= 800'
GRADE DATA -L-
YACHT DR.
TEMPORARY BENT
INTRACOASTAL WATERWAY
TEMPORARY WORK BRIDGE
125'-0"
225'-0"
280'-0"
225'-0"
125'-0"
980'-0" TOTAL LENGTH

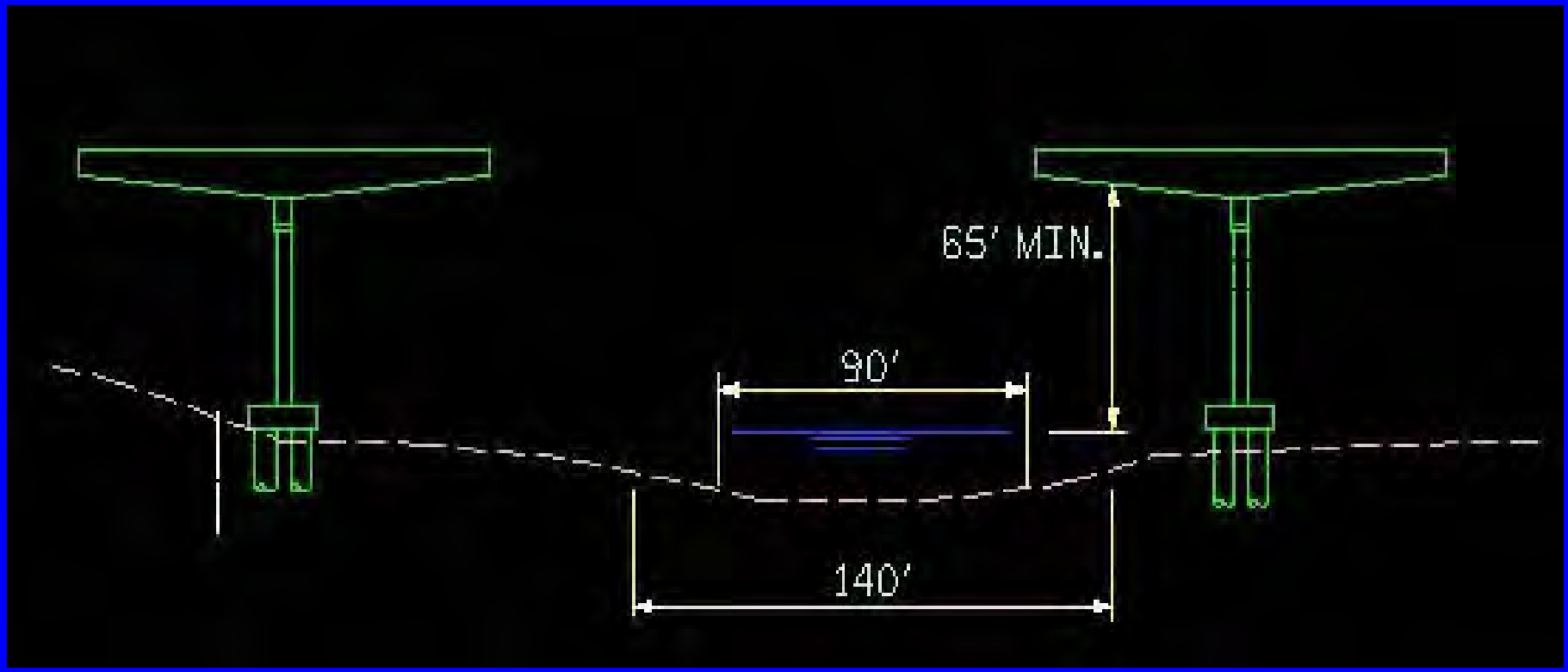
Span Arrangement

- Span A (*125’ simple span*)
- Span B through D (*225’-280’-225’ continuous*)
- Span E (*125’ simple span*)

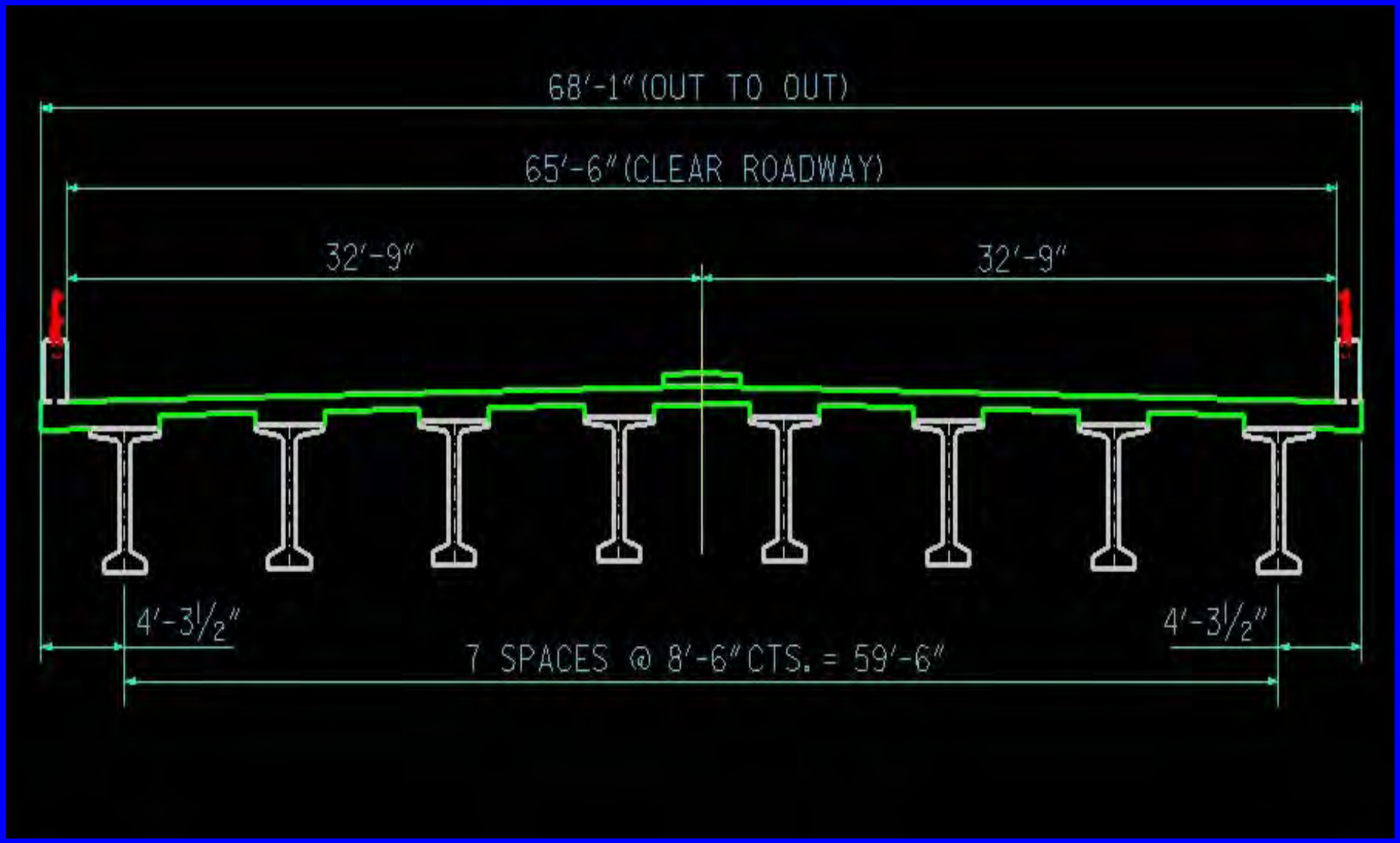


Channel Clearance

- Navigational Channel not centered about main span
- Haunched Girder controlled vertical clearance



Typical Section

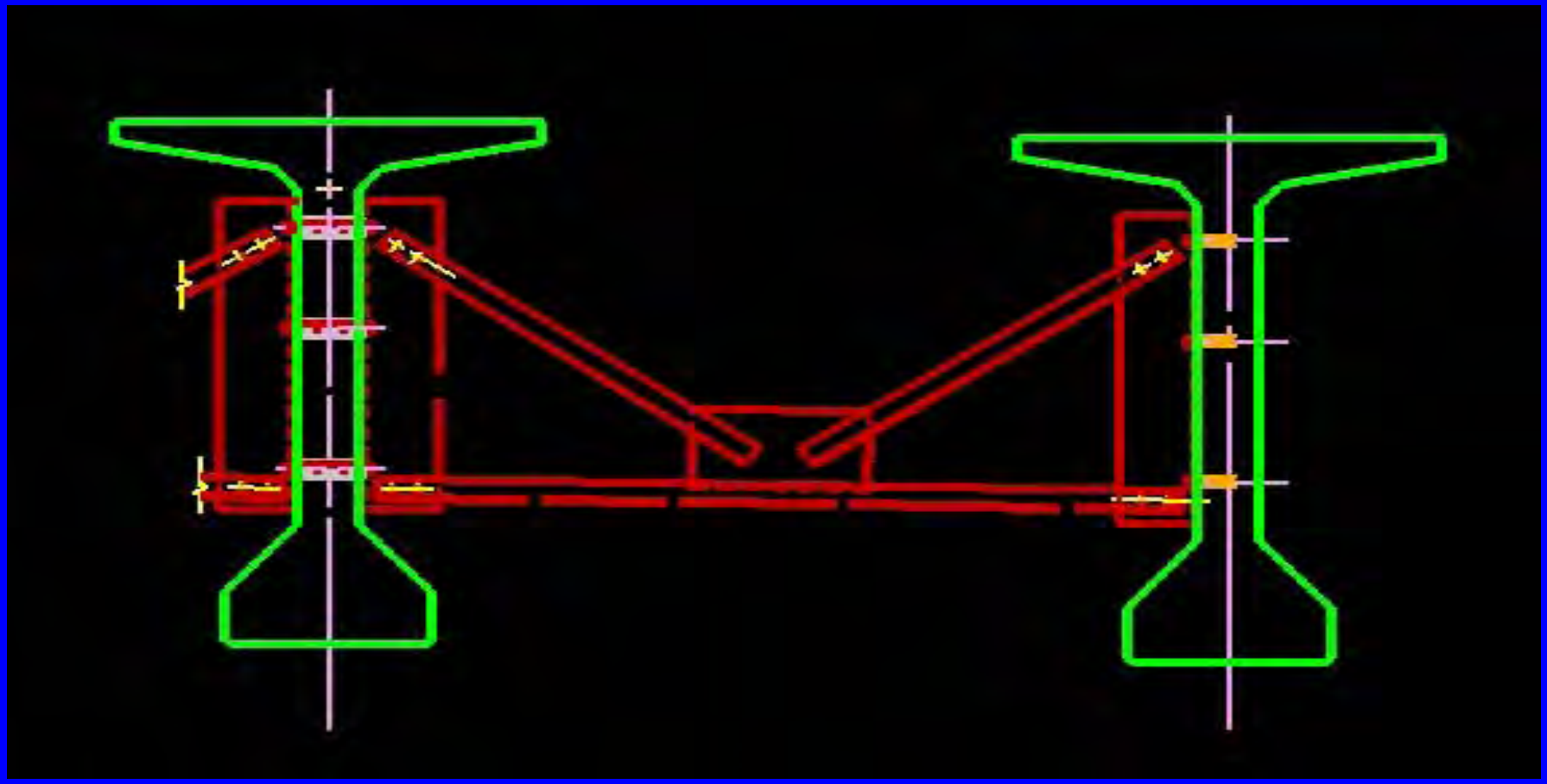


Concrete Deck

- 8 1/2” thickness (lightweight concrete)
- Removable forms for channel spans
- 3” clear cover
  - additional corrosion protection
  - facilitate grinding of the deck
- Epoxy coated reinforcing steel and supports
- Concrete contains calcium nitrite and fly ash

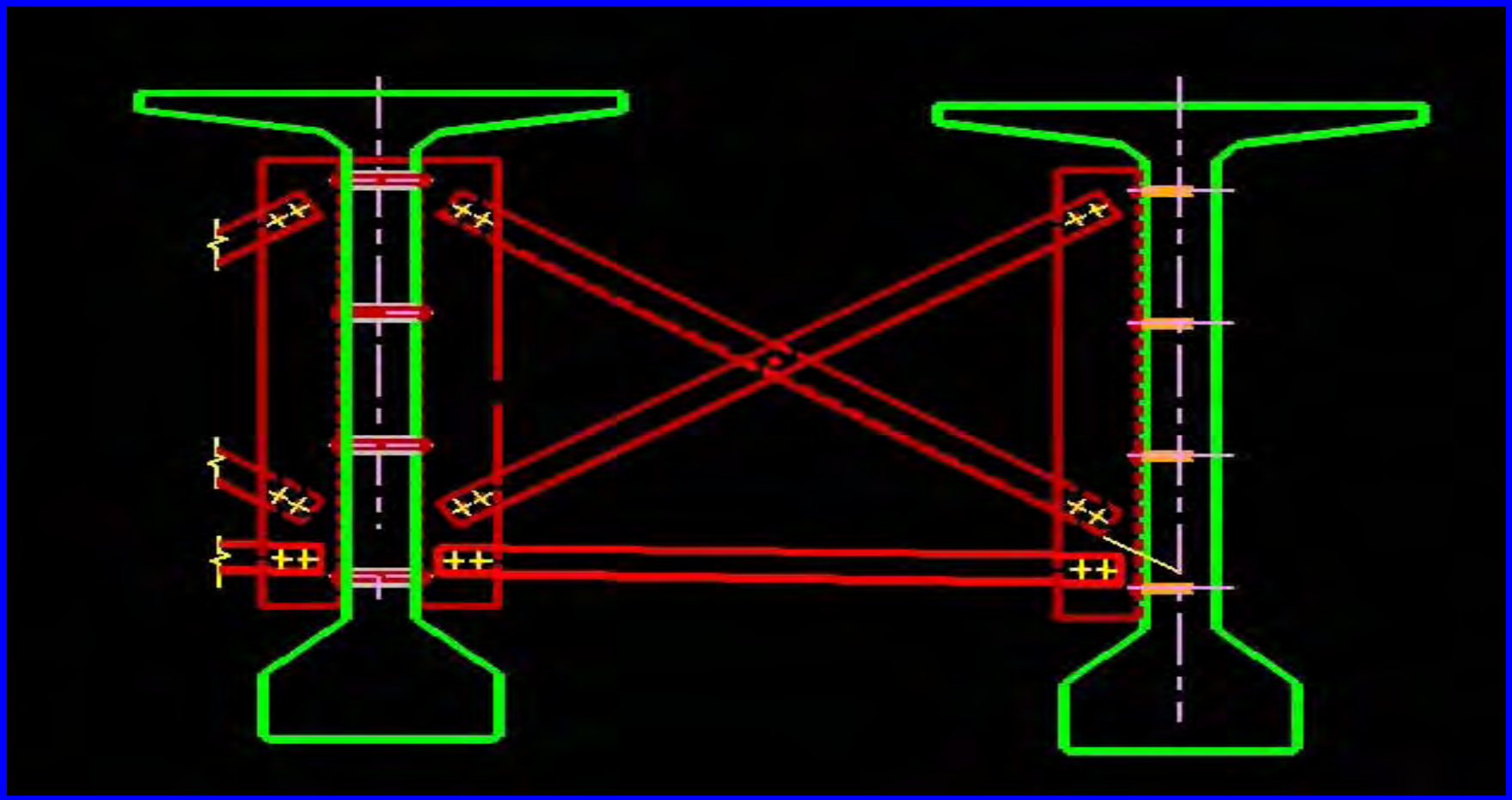
Intermediate Diaphragm

- Metallized for corrosion protection
- Used on 78” Bulb Tee and Modified 78” Bulb Tee



Intermediate Diaphragm

- Metallized for corrosion protection
- Used on Haunched Girders



Girder Design

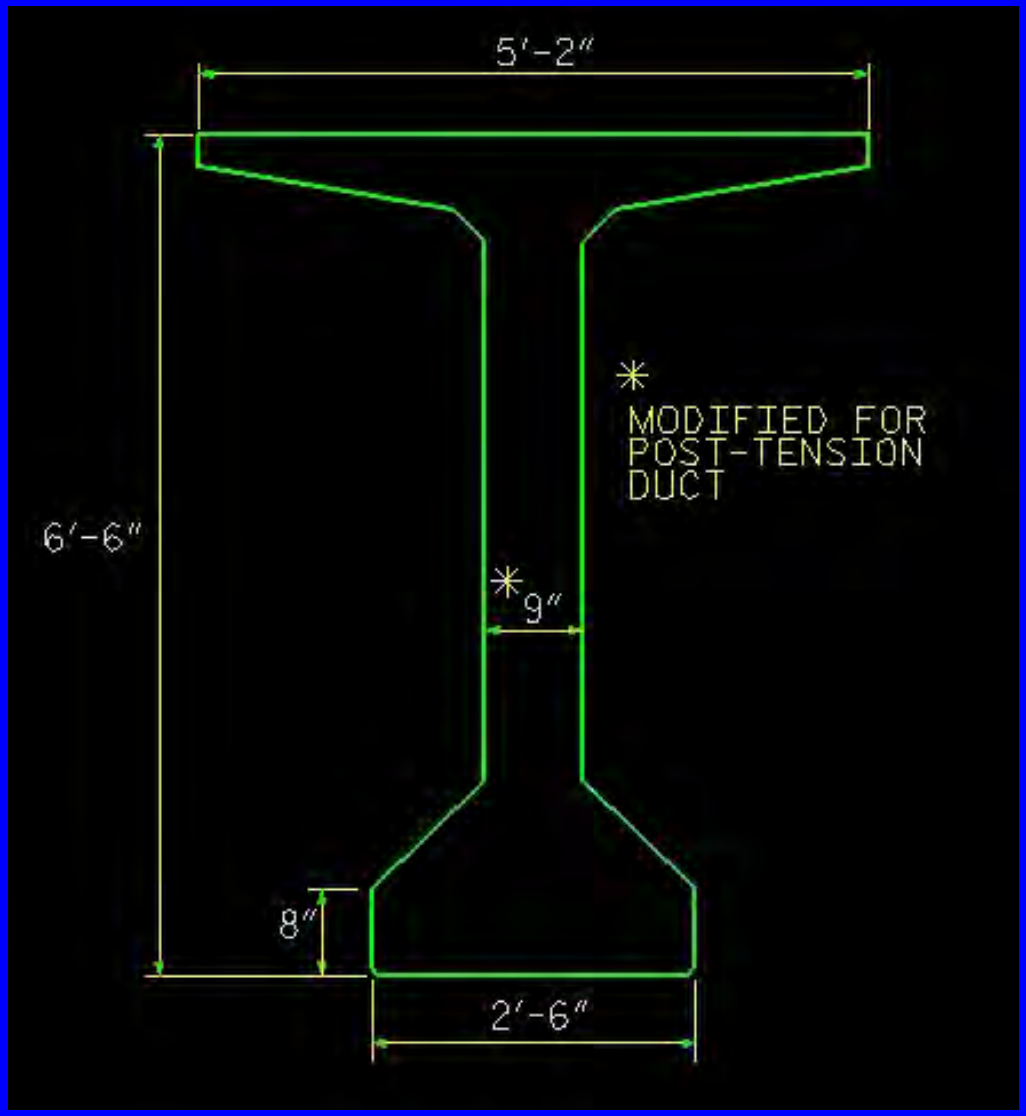
Analysis

- Load Factor Design
- Time-Dependent Staged Construction software
  - IDS BD2 (Presto)
  - Tango
  - Consplice®
  - Others
- Software selected
  - Consplice® by LEAP Software, Inc.

Girder Section

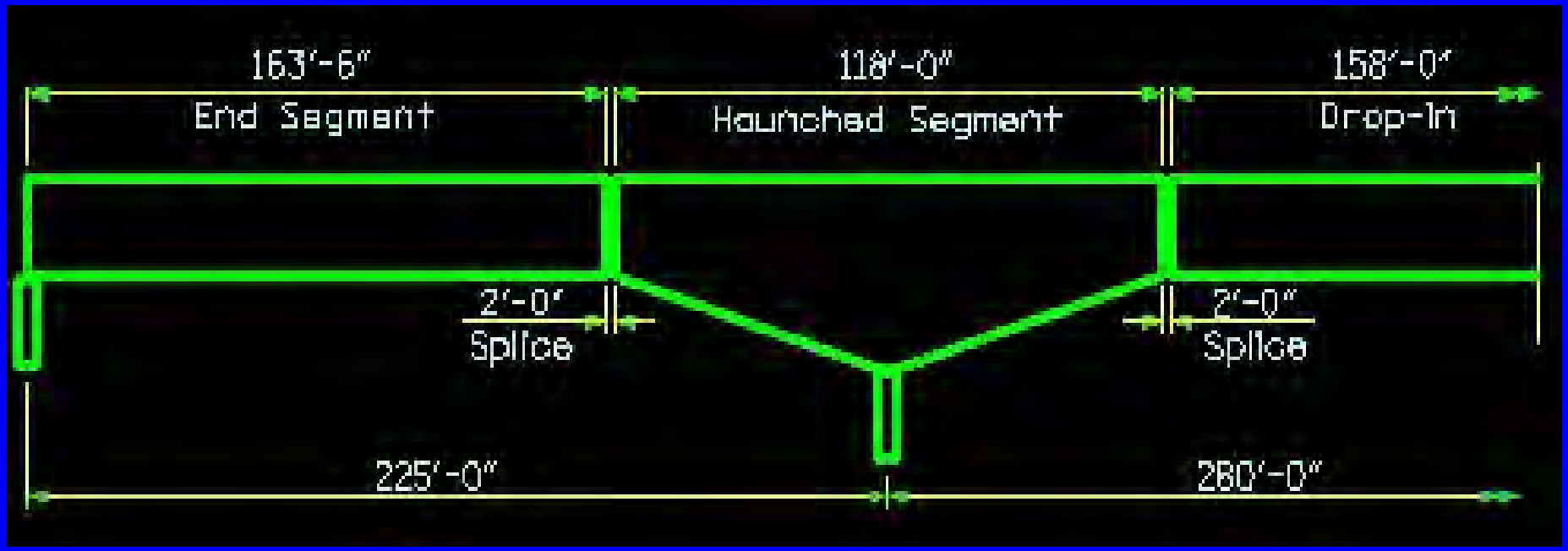
- Girder form spacing increased to accommodate post-tension ducts
- Concrete Strength
  - Initial 5500 psi
  - Final 9000 psi
- Haunched Segment depth
  - 6’-6” to 13’-0”
- Contain Calcium Nitrite

Modified 78” Bulb Tee



Spliced Girder Segments

- One continuous girder line consists of 5 segments
  - *2 End Segments* *163’-6”* *108 tons*
  - *2 Haunched Segments* *118’-0”* *105 tons*
  - *1 Drop-in Segment* *158’-0”* *104 tons*



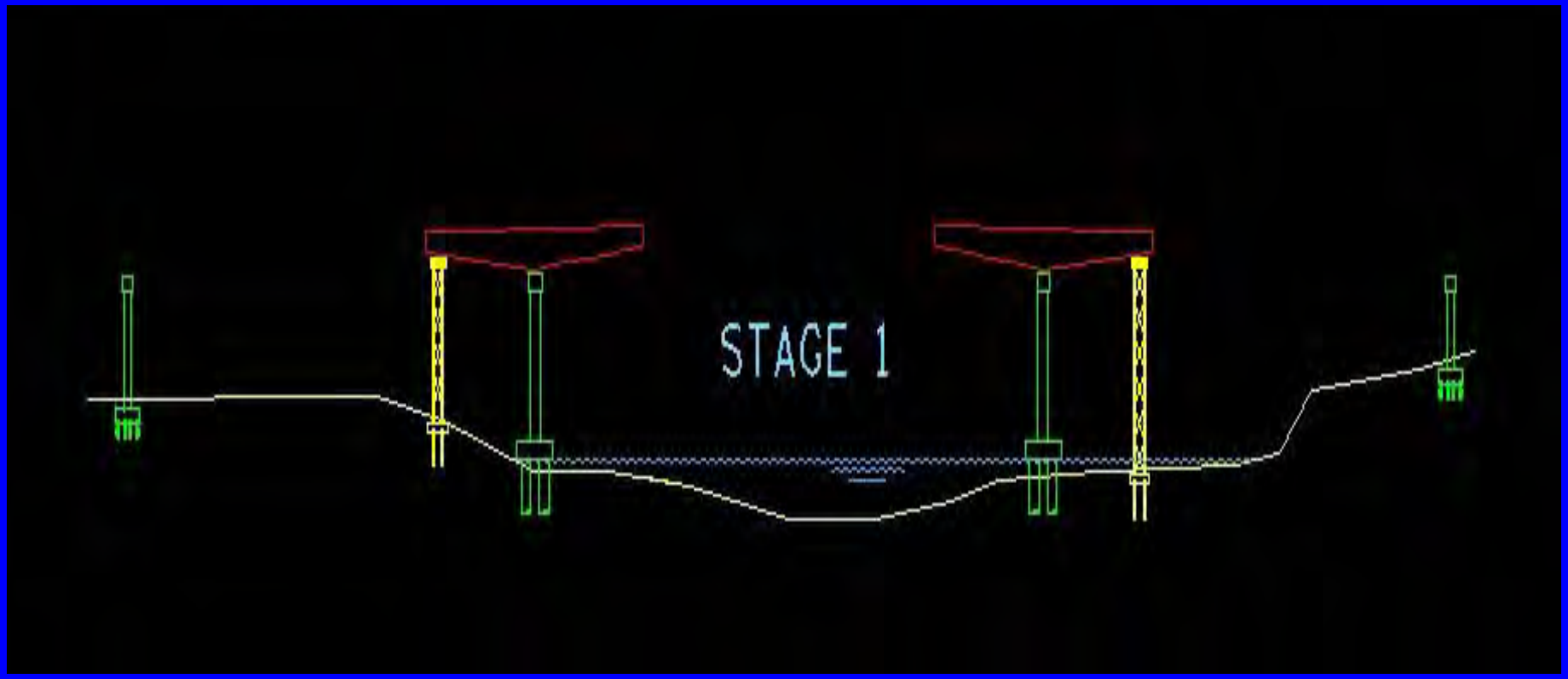
Construction Stages for Computer Model

Staging Detail		Girder Age in Days	
		Slow Paced	Fast Paced
1	Cut strands	2	1
2	Erect Haunched Girders	365	60
3	Erect End Segments	365	60
4	Erect Drop-in Beams	375	70
5	Cast closure splices	385	80
6	Post Tension (Stage 1)	400	94
7	Cast Deck Slab	460	124
8	Post Tension (Stage 2)	480	131
9	Cast Rail	490	133
10	Bridge Open to Traffic	550	163
11	Future Wearing Surface	4,163	4,163
12	Half Life	13,780	13,780
13	End of Service	27,560	27,560

75+ year design life

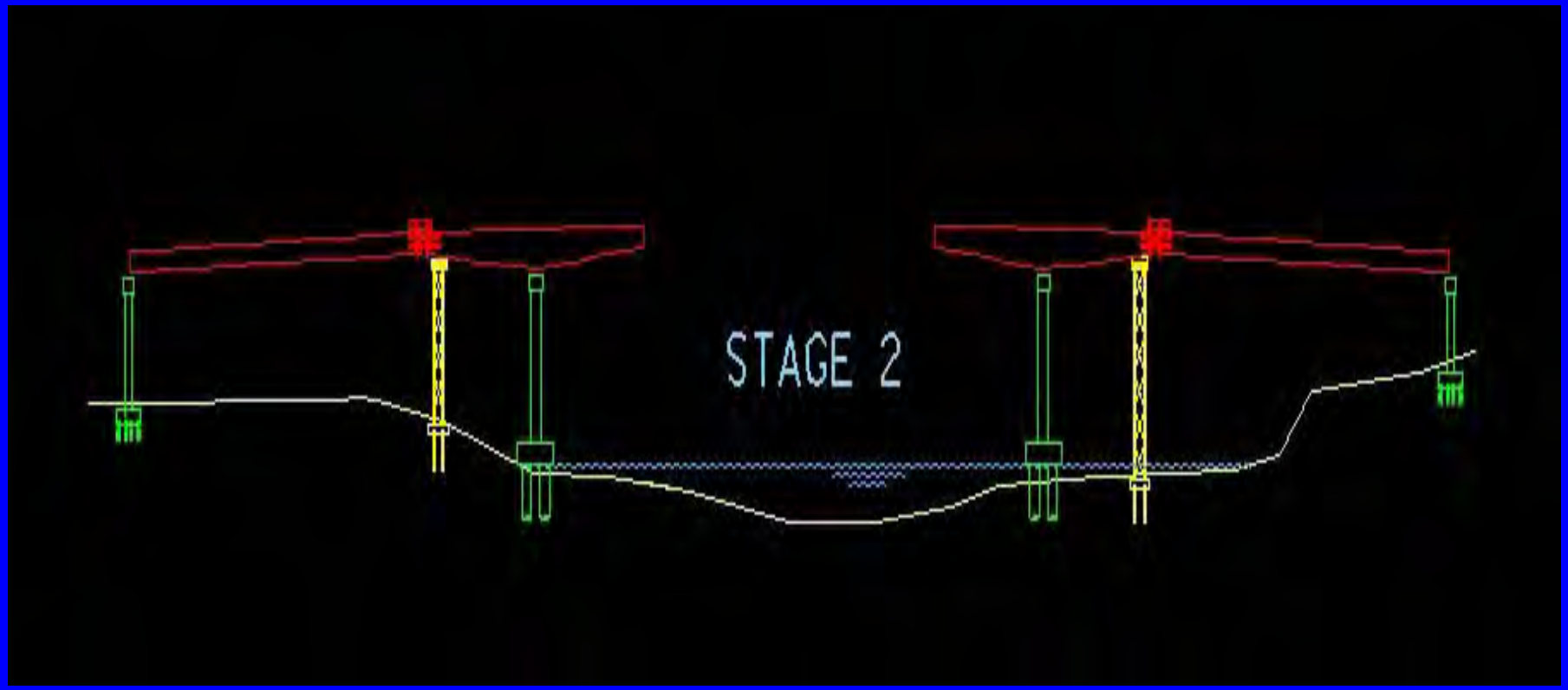
Erection Sequence *(Stage 1)*

- Construct temporary & permanent bents
- Erect and secure Haunched Girders



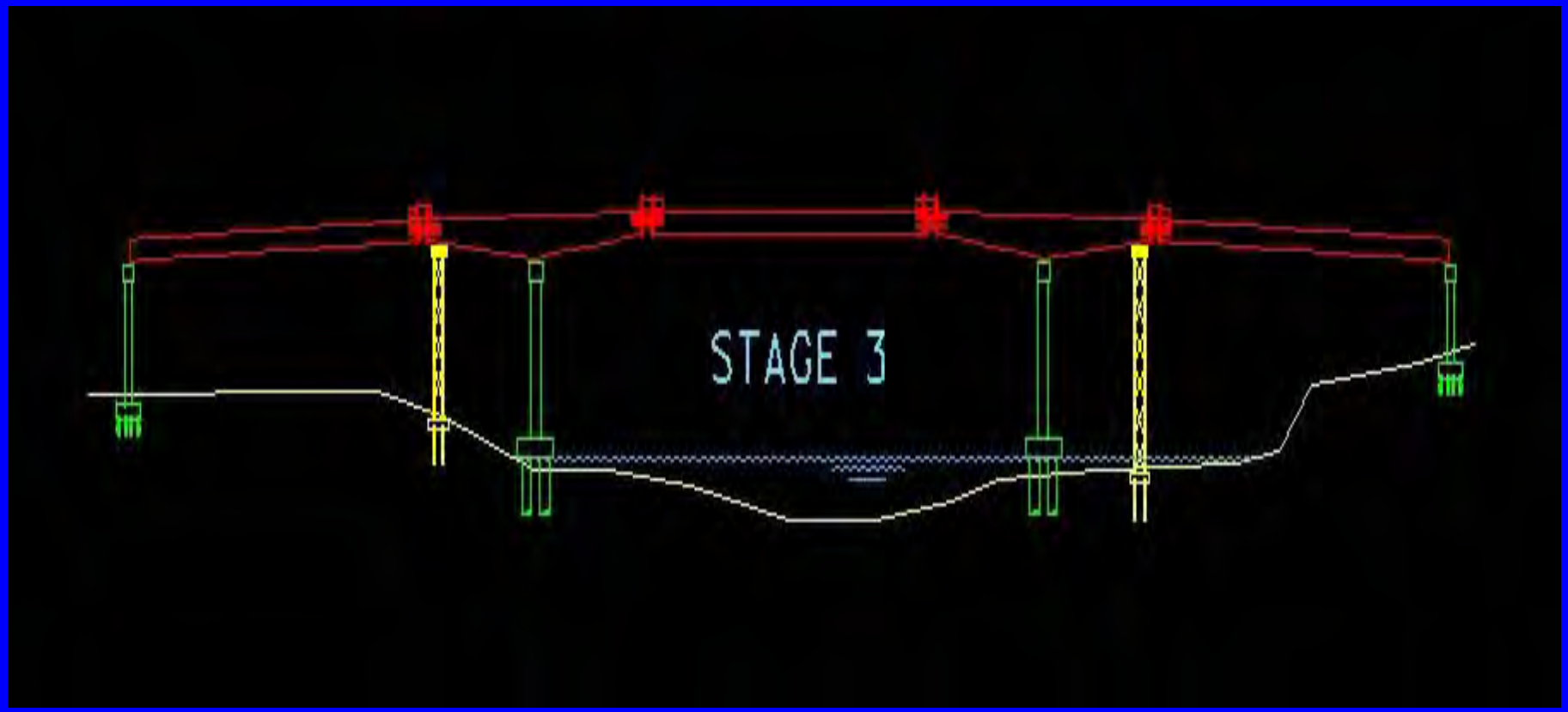
Erection Sequence *(Stage 2)*

- Erect End Segments
- Secure End Segments using strongbacks



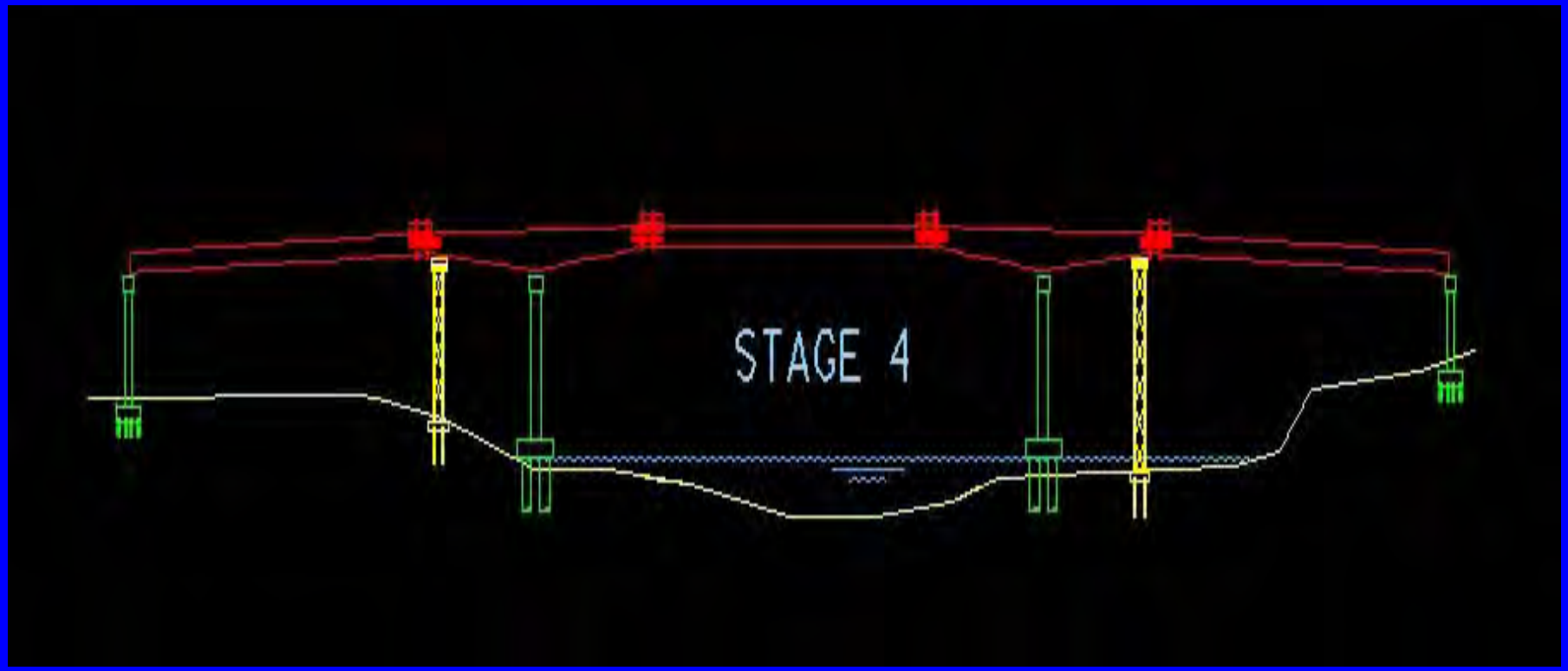
Erection Sequence *(Stage 3)*

- Cast bent diaphragms and place intermediate diaphragms
- Erect Drop-in beams
- Secure Drop-in beams using strongbacks



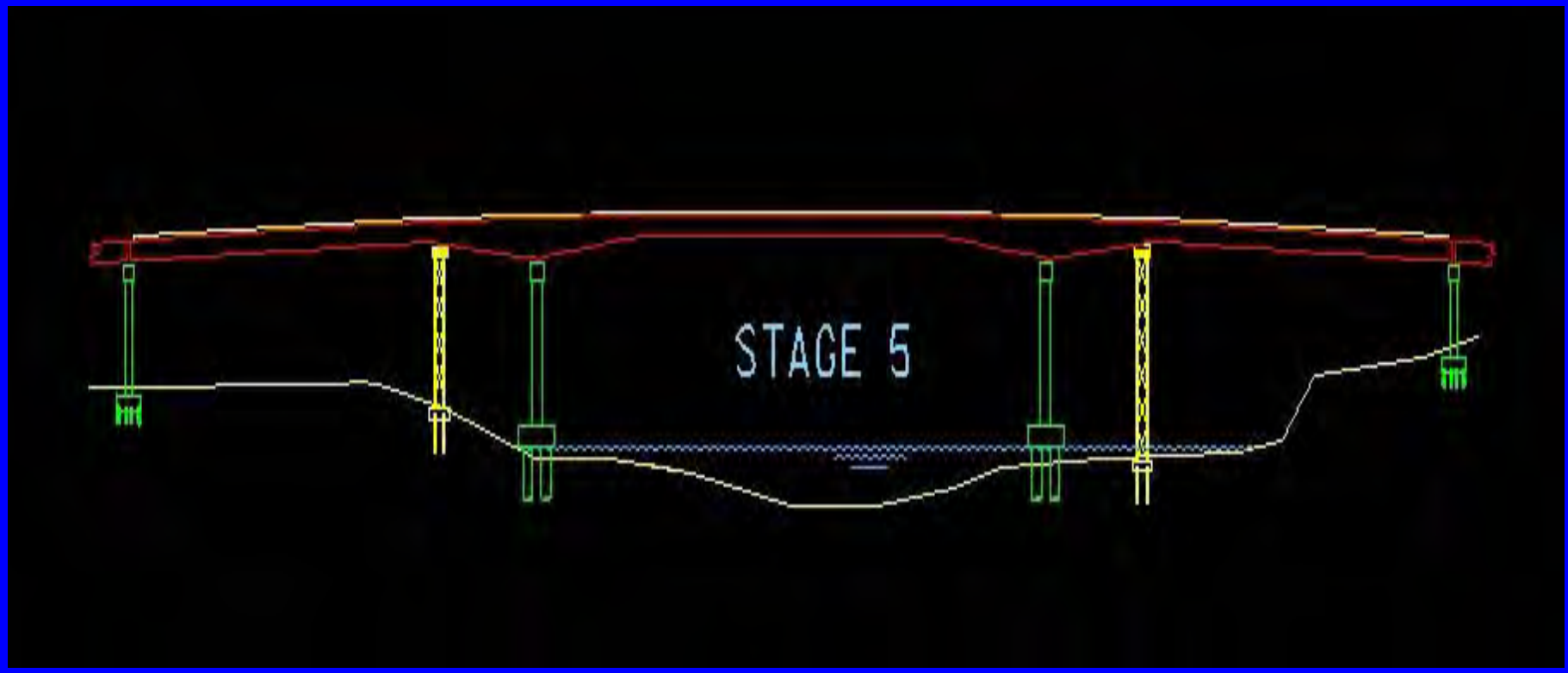
Erection Sequence *(Stage 4)*

- Place remaining intermediate diaphragms
- Cast closure splice diaphragms



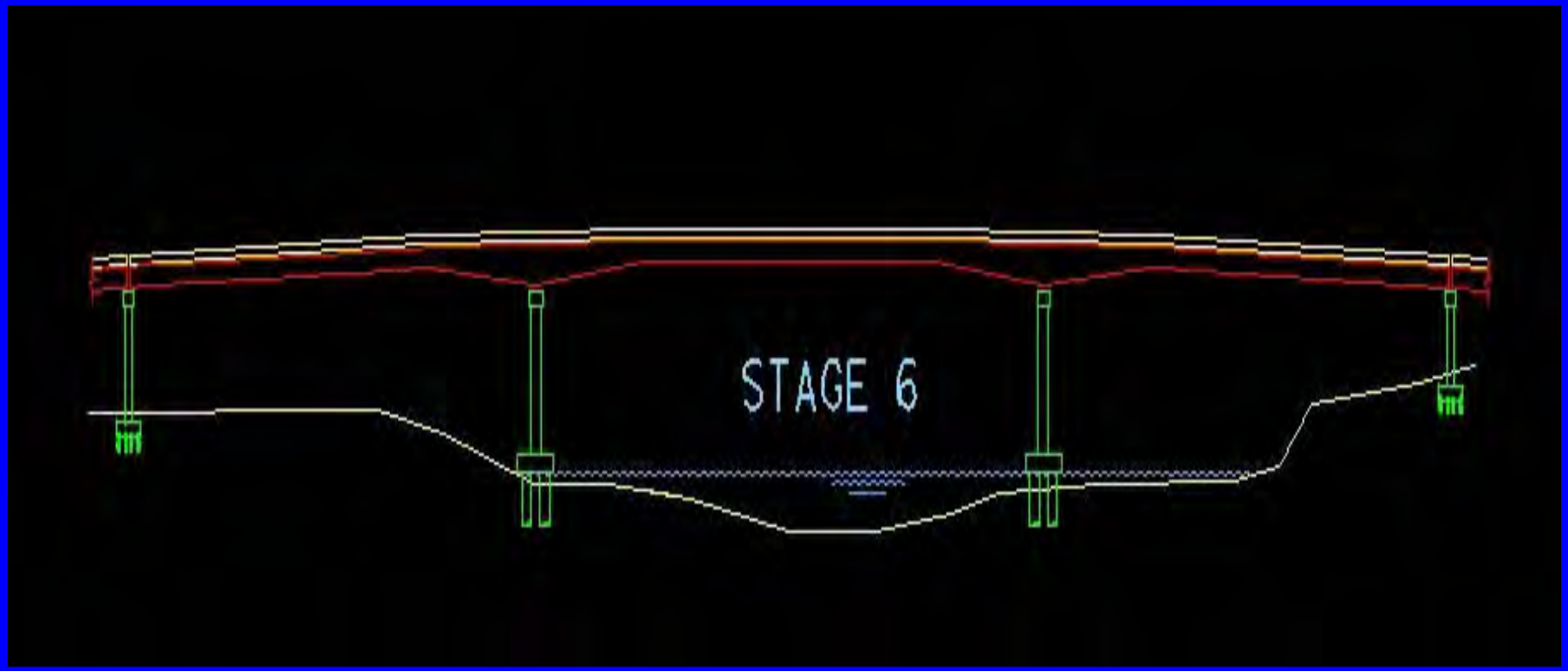
Erection Sequence *(Stage 5)*

- Complete first stage post-tensioning
- Contractor can now erect girders in spans A and E
- Cast spans B through D deck



Erection Sequence *(Stage 6)*

- Complete second stage post-tensioning
- Cast remaining portions of spans B through D deck
- Cast parapet and median



Prestressing Steel

- End Segment
  - 46 strands, 12 debonded
- Haunched Segment
  - 38 strands, 6 debonded
- Drop-in Segment
  - 46 strands, 4 debonded

Build Ups & Deflections

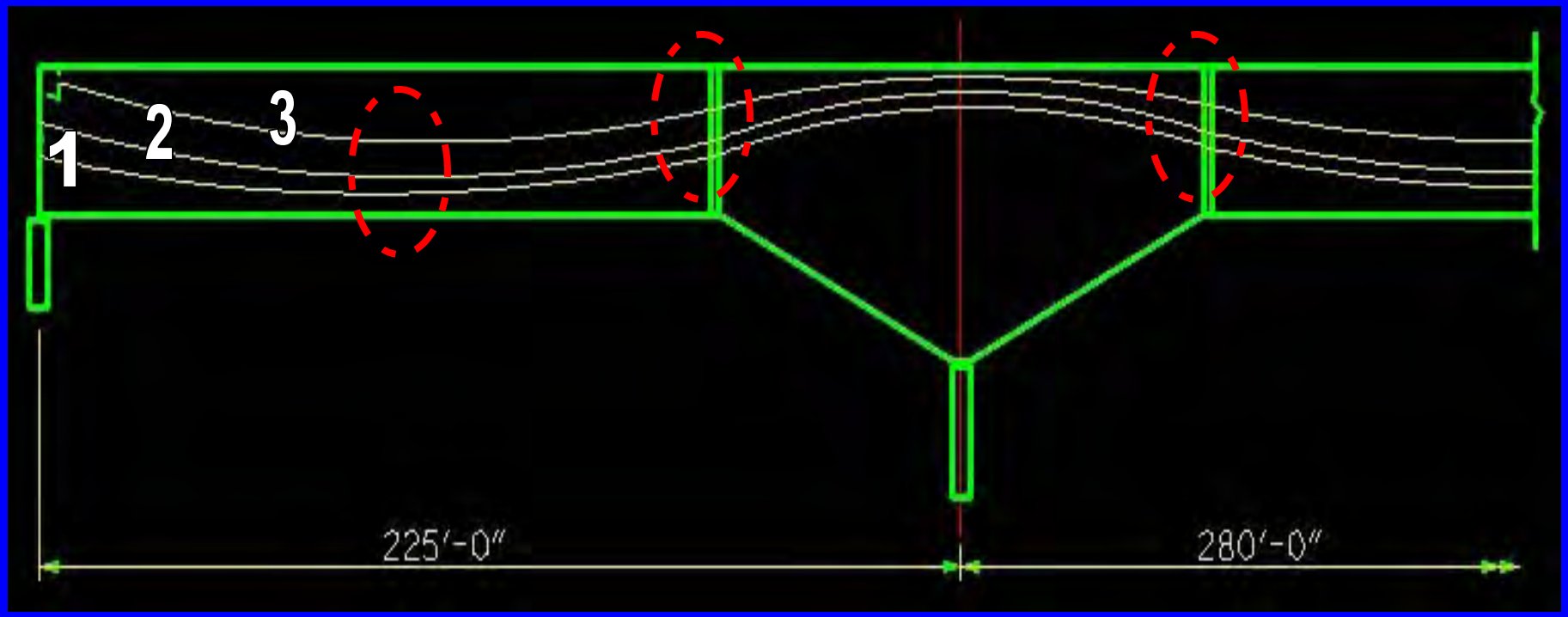
- Girder segments are erected as “short chords” to reduce build ups (Min. build up of 2.5”)
  - *End Segment build up* *6.75”*
  - *Haunched Segment build up* *5.25”*
  - *Drop-in Segment build up* *7.25”*
- More prestressing reduces build up
  - *Watch out for overstressing when PT force applied*
- Temporary tower and bent elevations adjusted
  - *Uplift due to post-tensioning*
  - *Haunched girder deflection from drop-in girder*

Post-Tensioning Tendons

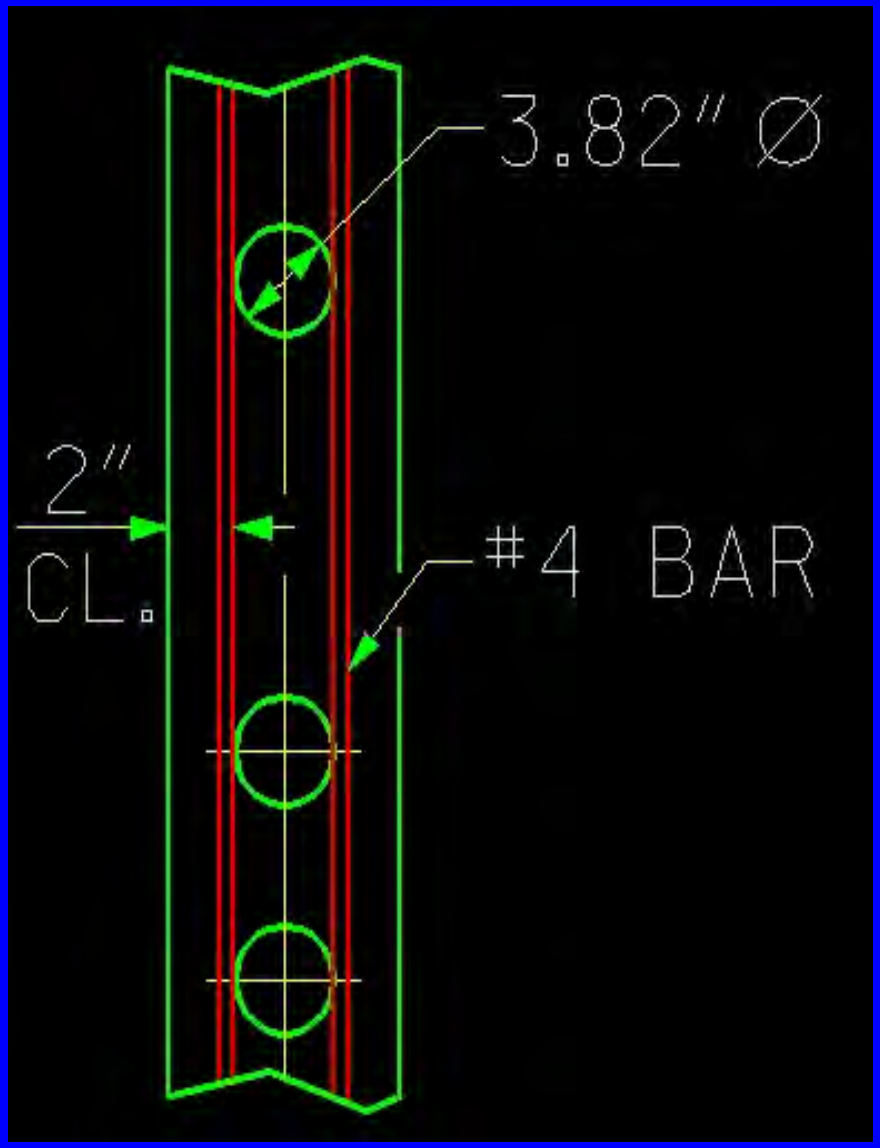
- PT tendons run full length of spans B-D girders
- Three tendons for each girder line
- Tendons contain fifteen 0.6” diameter strands
- Tendons are anchored in End Blocks and stressed from both ends
- Intermediate diaphragms are released before first stage of post-tensioning begins

Tendon Profile

- PT ducts have an 8” minimum spacing
- Tendons 1 and 2 stressed before casting the deck
- Tendon 3 stressed after casting the deck
- Tendon 3 height increased to reduce stressed in concrete

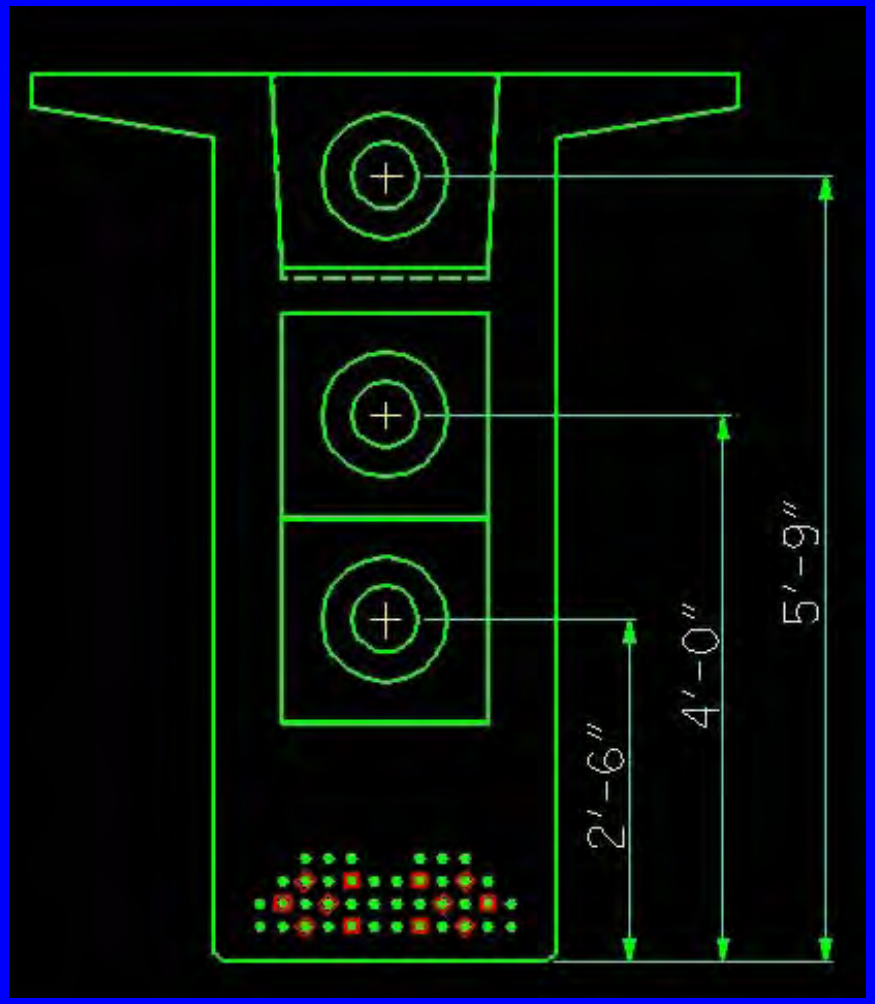


Tendon Diameter vs. Clear Cover



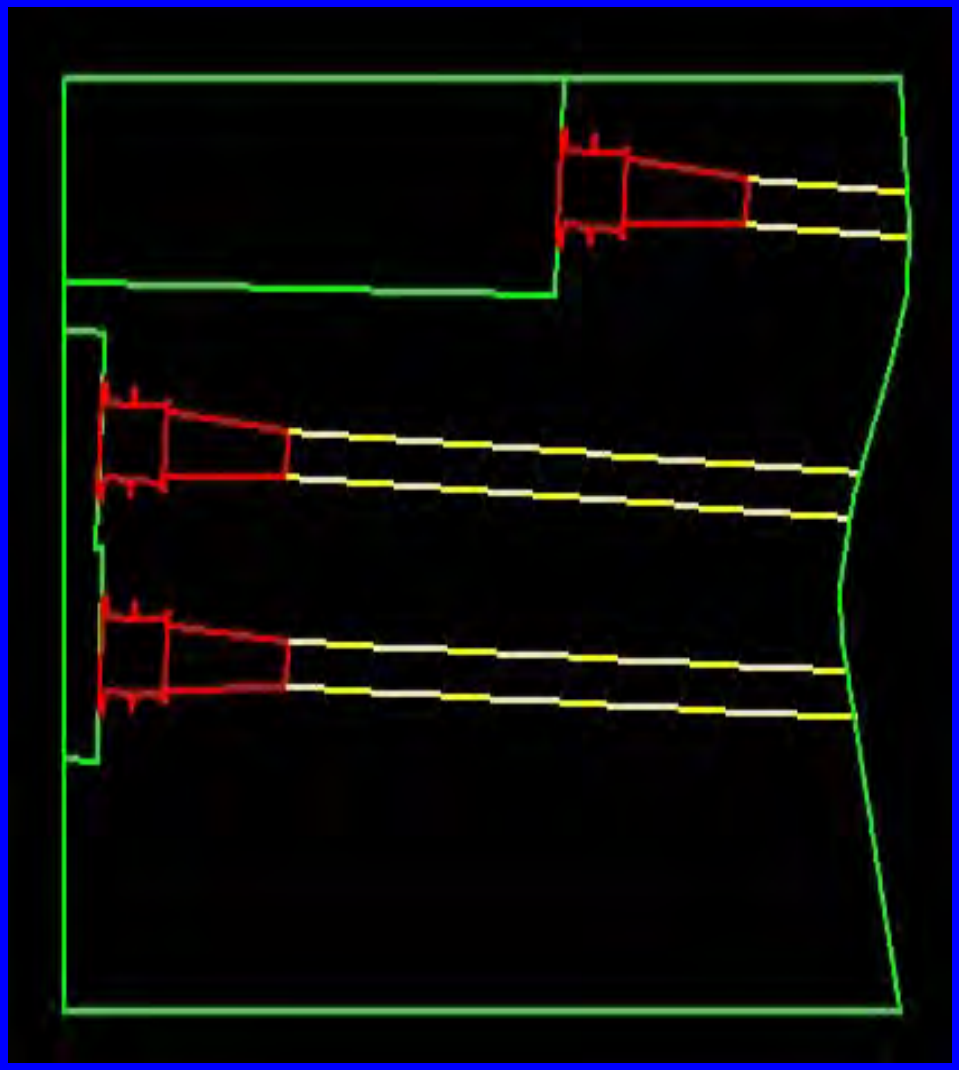
- Area of Duct =10.35 in^2
  - 3.63" inside diameter
- Area of Tendon = 3.26 in^2
- Area of Tendon increased by factor of 2.5 = 8.15 in^2
- Larger duct would reduce 2" clearance

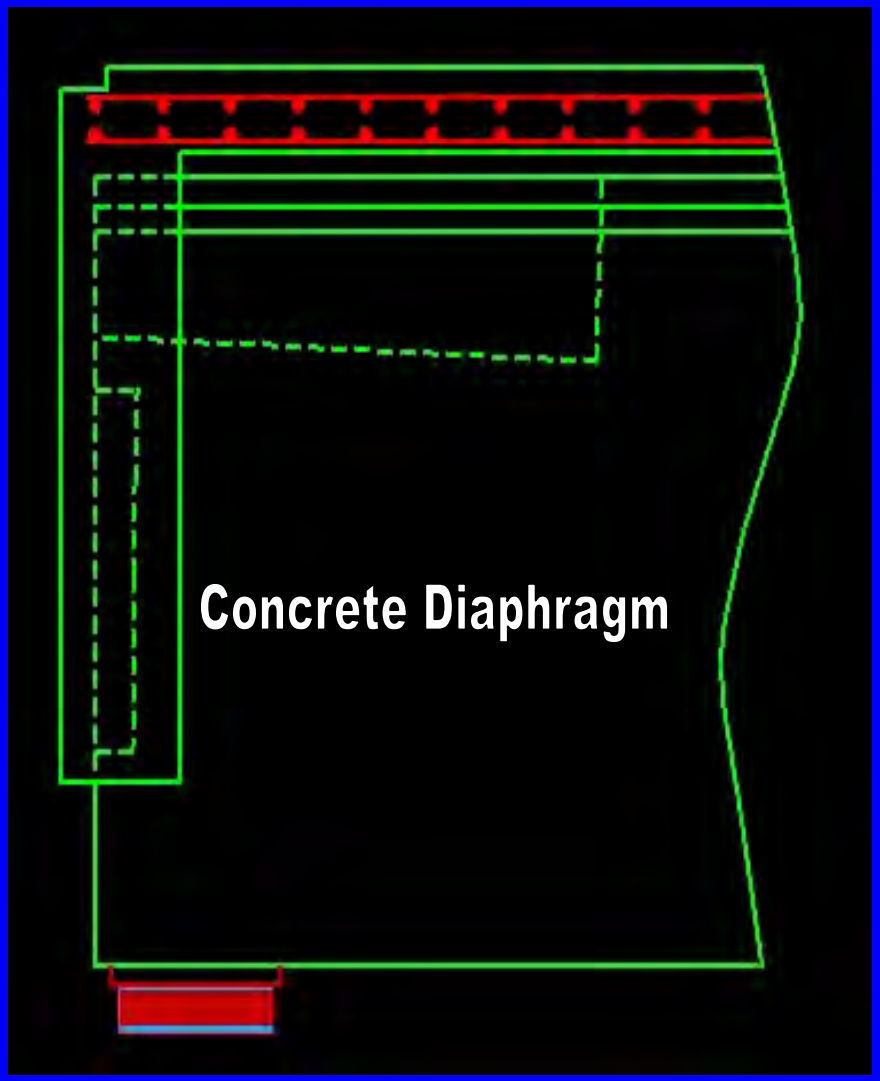
End Block Section



- Investigated multiple post-tensioning supplier requirements for equipment.
- Selected a system supplier
- Sized and located recesses based on that suppliers needs.

End Block Elevation View





Corrosion Protection

- PT ducts are sealed until tendon placement
- Ducts are cleaned using air
- Water soluble oil is not allowed as a lubricant for tendon placement
- Anchorages in end block are protected
  - Recesses are backfilled with non-shrink grout
  - Grout filled recesses are sealed
  - End of girder is encased with concrete diaphragm

Lessons Learned

- Placed a diaphragm at the closure splices
- Used approved pre-packaged grout
- Did not use epoxy coated rebar in girders
- Placed post-tensioning tendons in the web
  - Reduces potential corrosion problems
  - Reduces end block size for PT anchorage