SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

PA Report on Innovative Bridge Designs for Rapid Renewal

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September 16, 2015

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Overview

- Rapid Renewal/ABC background in Pennsylvania
- ABC highlights (types, standards, detour, RULD's, prefab elements, connections)
- Summary of ABC Bridges done recently and in the near future
- Three projects (built in 30 days or less)

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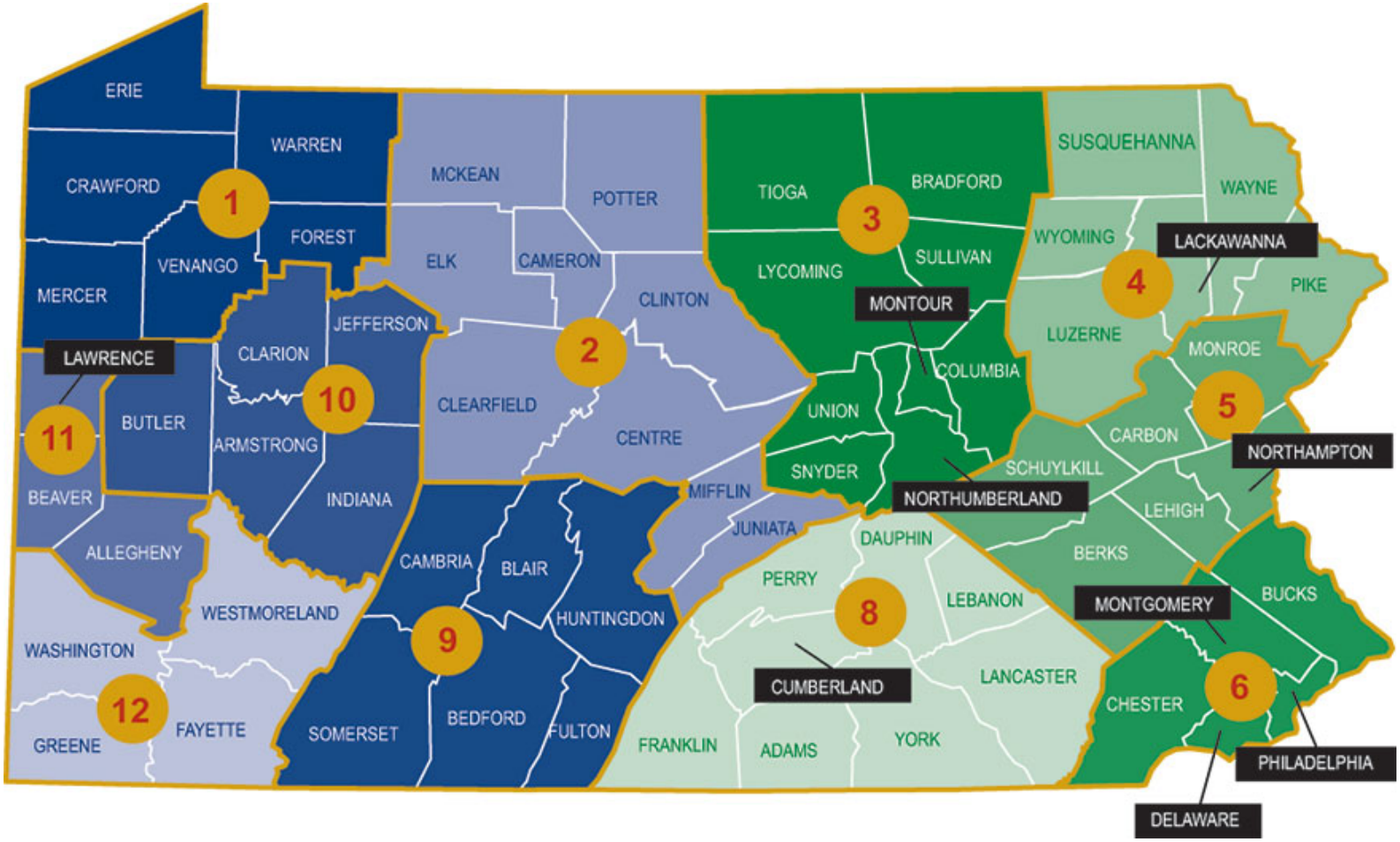
Organization



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Rapid / ABC History in PA

- Incentives/Disincentives/RULD's (Road User Liquidated Damages)
- 1980’s – P/C decks
- 1990’s - Inverset (steel I-beams with P/C Concrete deck)
- 2000’s P/C abutment systems, P/S beams, pier caps, District 6 (Phila) RR truss launch over I-76
- 2012 – 2014 full pre fab/ precast elements built in thirty days or less
- P3 (Public-Private Partnership Project)

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Rapid / ABC History in PA

- Pennsylvania has no ABC policy
- We started out using incentives/ disincentives/ RULD's
- Bridges getting done fast but we paid extra dollars and contractors weren’t always getting done early (asking for and getting extensions). We still use A + Bx bidding, lane rental with incentives/ disincentives with limited delay penalties and overall project penalty.

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Recent ABC Development

- Geosynthetic Reinforced Soil (GRS) Abutments
  - PennDOT guidelines issued July 2014
  - Ok for low volume road
- Precast/prefab - **all** elements
  - P/C substructure standards developed by CABA (Central Atlantic Bridge Alliance) approved by PennDOT March 2013
  - P/C Deck standards created & approved by PennDOT Nov 2014

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GRS Abutments

Built in 2 months by contractor

Built in 2 months by Department forces

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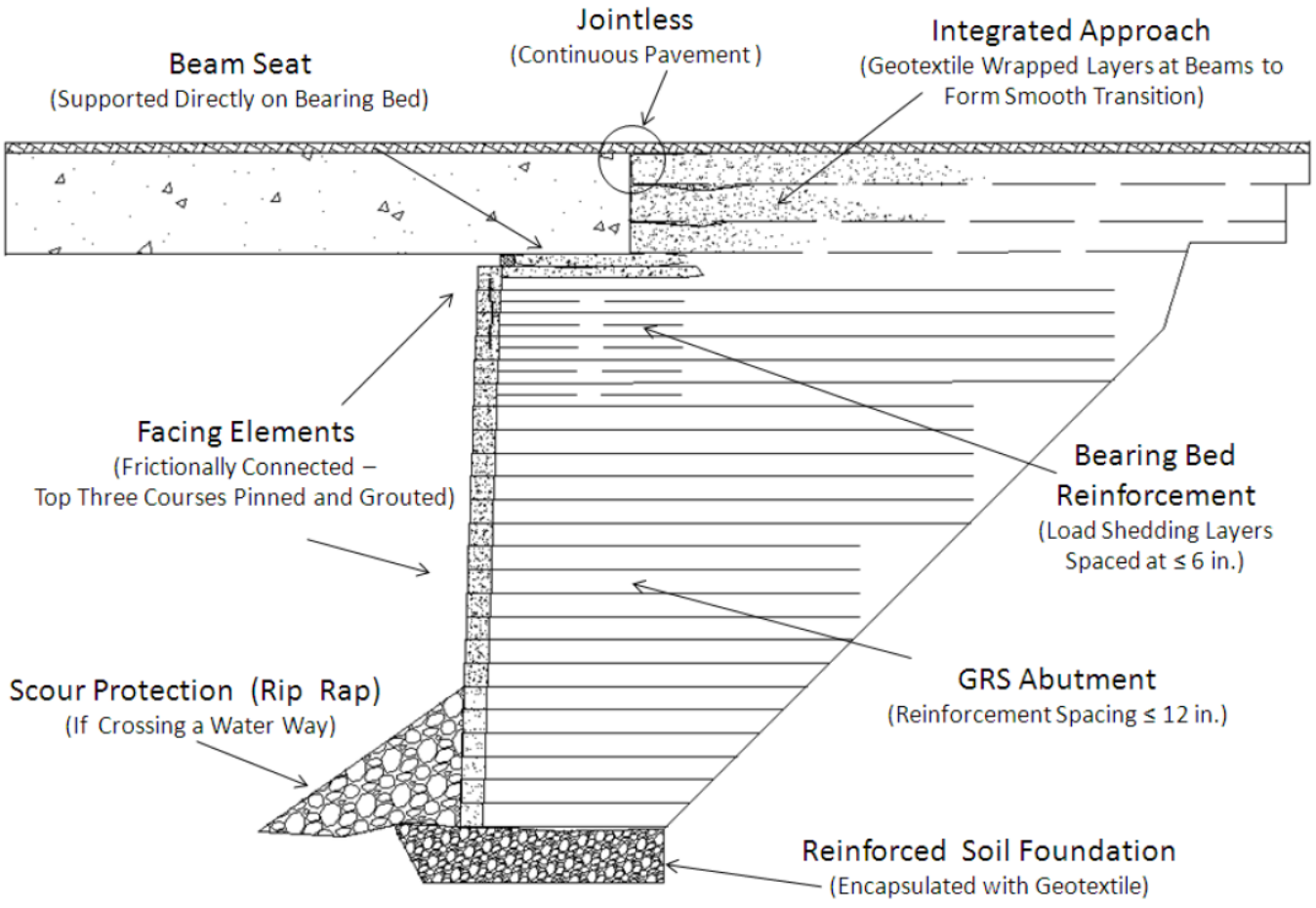
GRS Abutments



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GRS Abutments

Backfilling Geotextile

Finished Abutment

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Precast Elements – Early Concept

- Precast footing, abutments, moment slabs, prestress beams, conventional deck, 21 days non-comp., 6 weeks to do a traditional deck or a day to do an asphalt overlay
- Match-cast, post-tensioned, precast concrete footing and wall panel components
- No moment connection between wall and footing pieces (footings sized to resist vertical loads only)
- Avoided MSE wall or proprietary items
- Multi-level interconnected grid of galvanized steel chains for abutment unit self-stabilization
- GRS backfill to eliminate lateral load on wall panels
- Scour cutoff wall panel for stream environment

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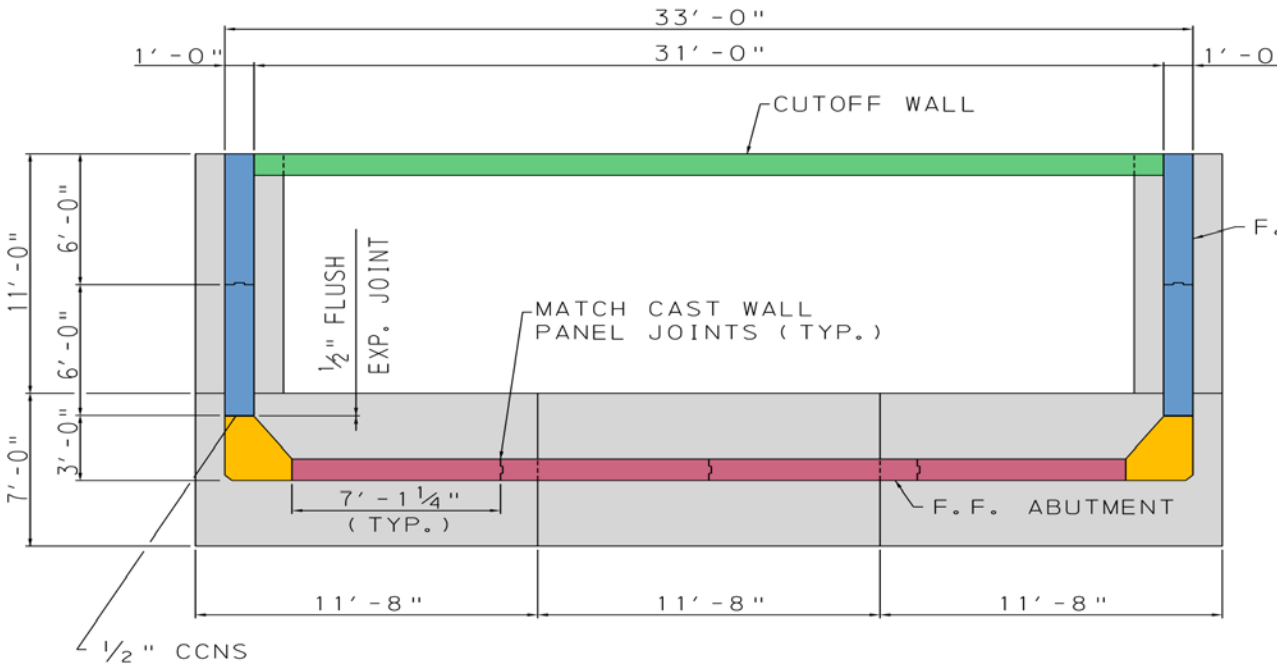
Precast Components



ABUTMENT PLAN

- 8.5’ Max – Shipping Panel Width
- Minimize Weight
- Repetitive Panel Sizes
- Match Casting
- Mostly Table Formwork

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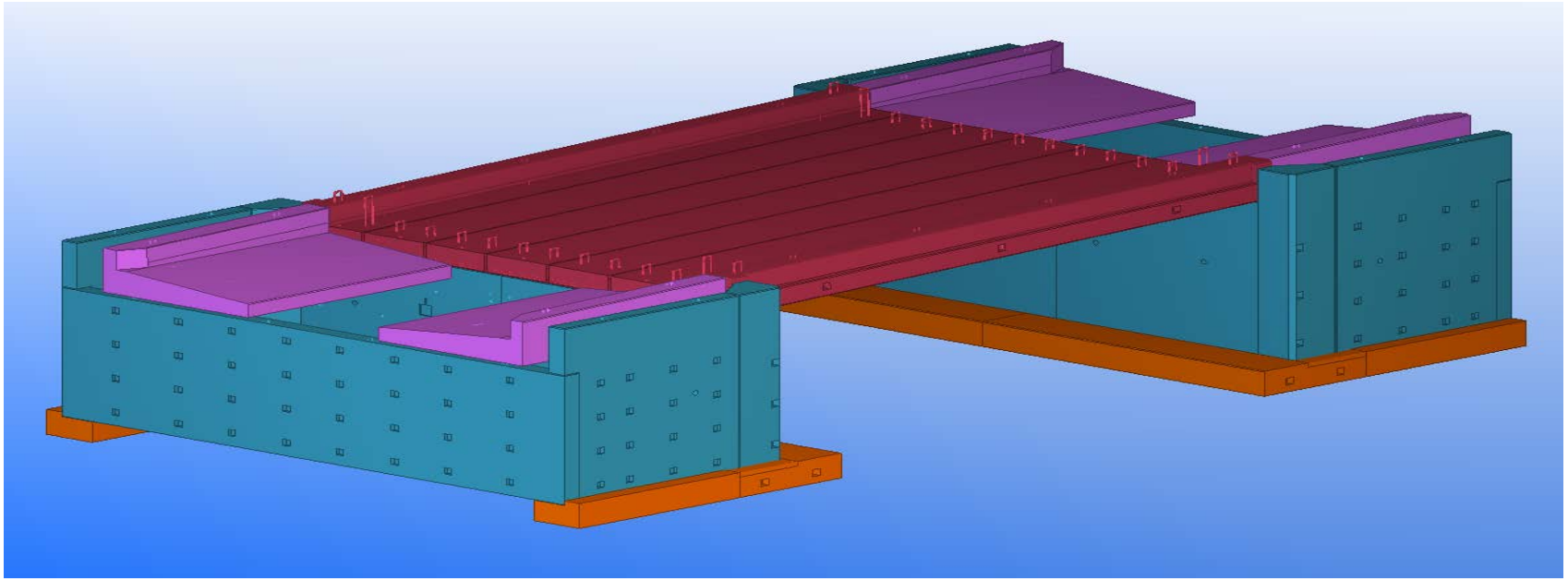
Precast – All Elements



- TEKLA 3-D Model – Fabricator (Newcrete)
- Complete Bridge with Moment Slabs
- 3D very helpful in how all pieces fit together resolves interferences

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Precast Substructure

Preformed Cellular Polystyrene to Absorb Lateral Deformation of Backfill

- Instrumentation
- Geodetect Strip –check movement of GRS fabric
- Earth Pressure Cell – to see if Geogrid was reducing load on wall panels

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Precast Superstructure

- Plank beam (non-voided)
- Deepened shear key
- Epoxy mortar shear key grout (11-12 ksi)
- Addt'l transverse PT

- Two layers of waterproofing on long. jts and FJ overlay with membrane curb to curb
- Drain tubes in membrane to curb
- P/C barrier on fascia cast in shop

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Completed in 21 Days

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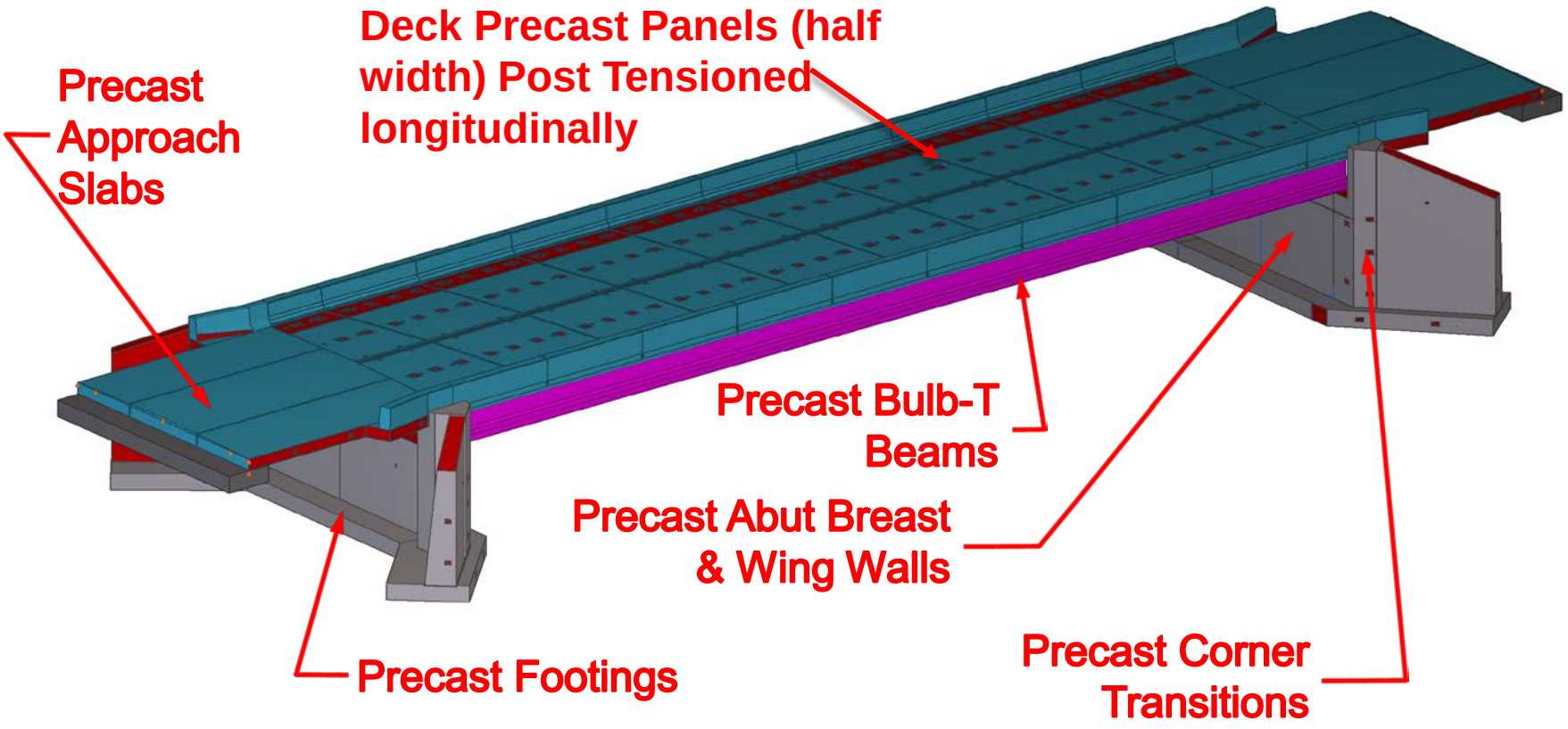
Total Precast Bridge - VE



116 ft. Span 31’-4” Width

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Total Precast Bridge - VE

- Match-cast P/C P/T footing and wall panel components
- Grouted coupler splice connections for footing-to-stem vertical reinforcement bar continuity. 11 ksi @ 28 days strength
- Deck panels one-half width of bridge -- 12’ +/- in length.
- Ultra High Performance Concrete (UHPC) used in transverse and longitudinal closure pours.
- Following completion of transverse closure pours, panels post-tensioned in longitudinal direction to achieve 250 psi compression.
- Leveling bolts used for grade adjustment and load distribution.
- Epoxy grout used to fill beam haunches and shear pockets.

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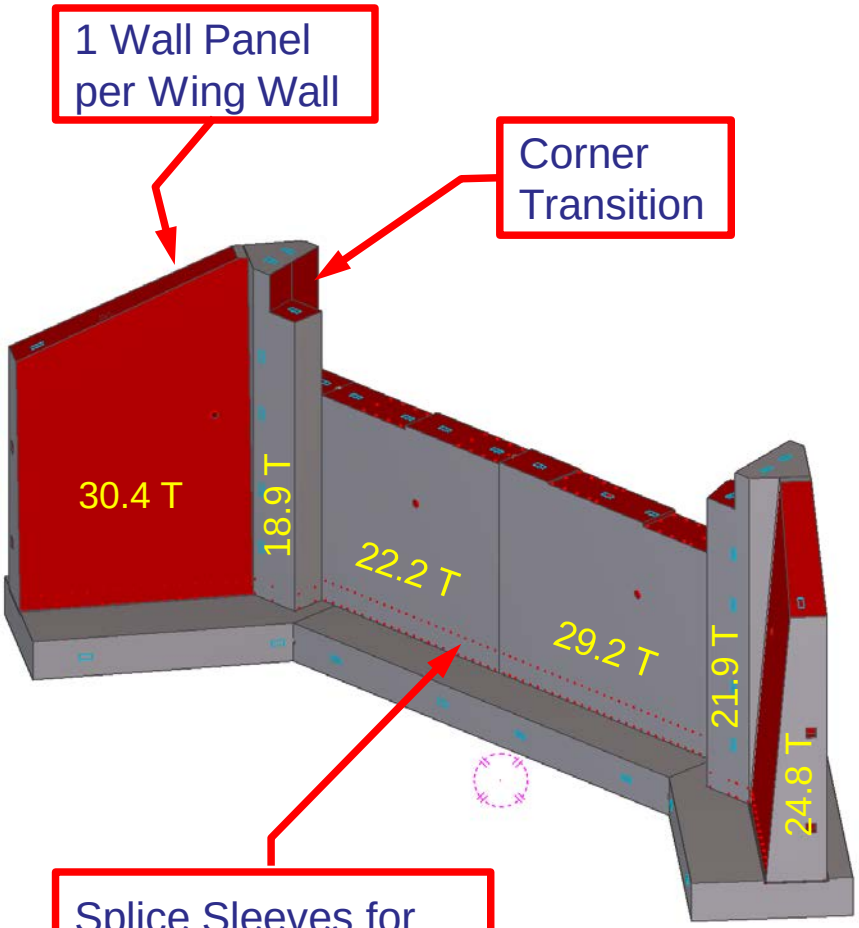
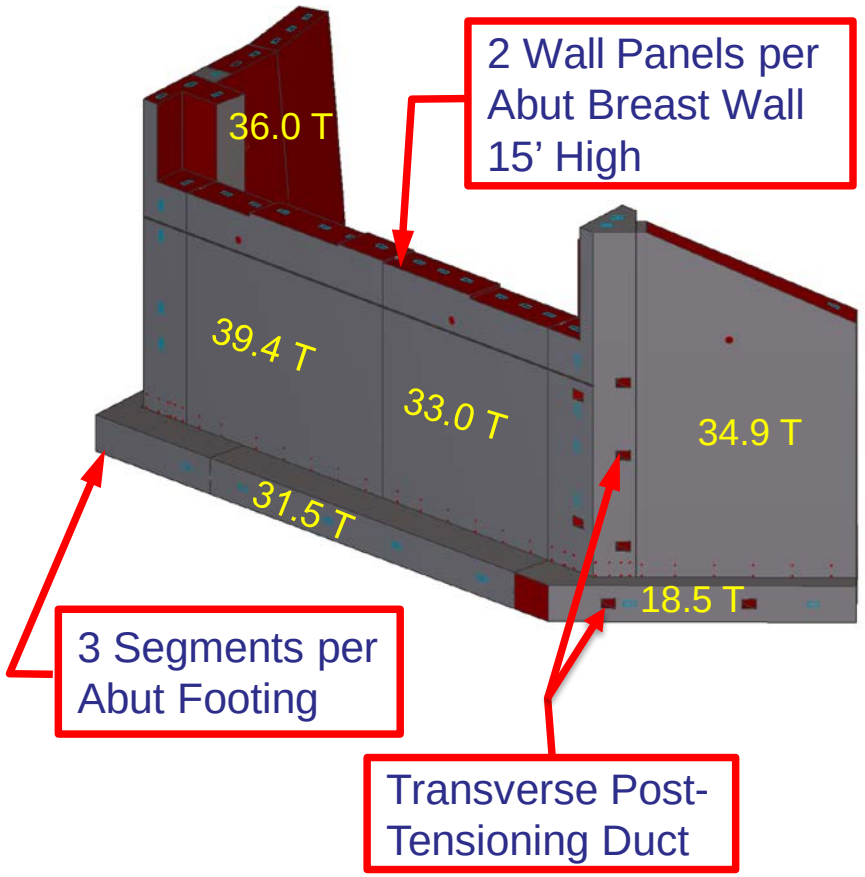
Total Precast Bridge - VE





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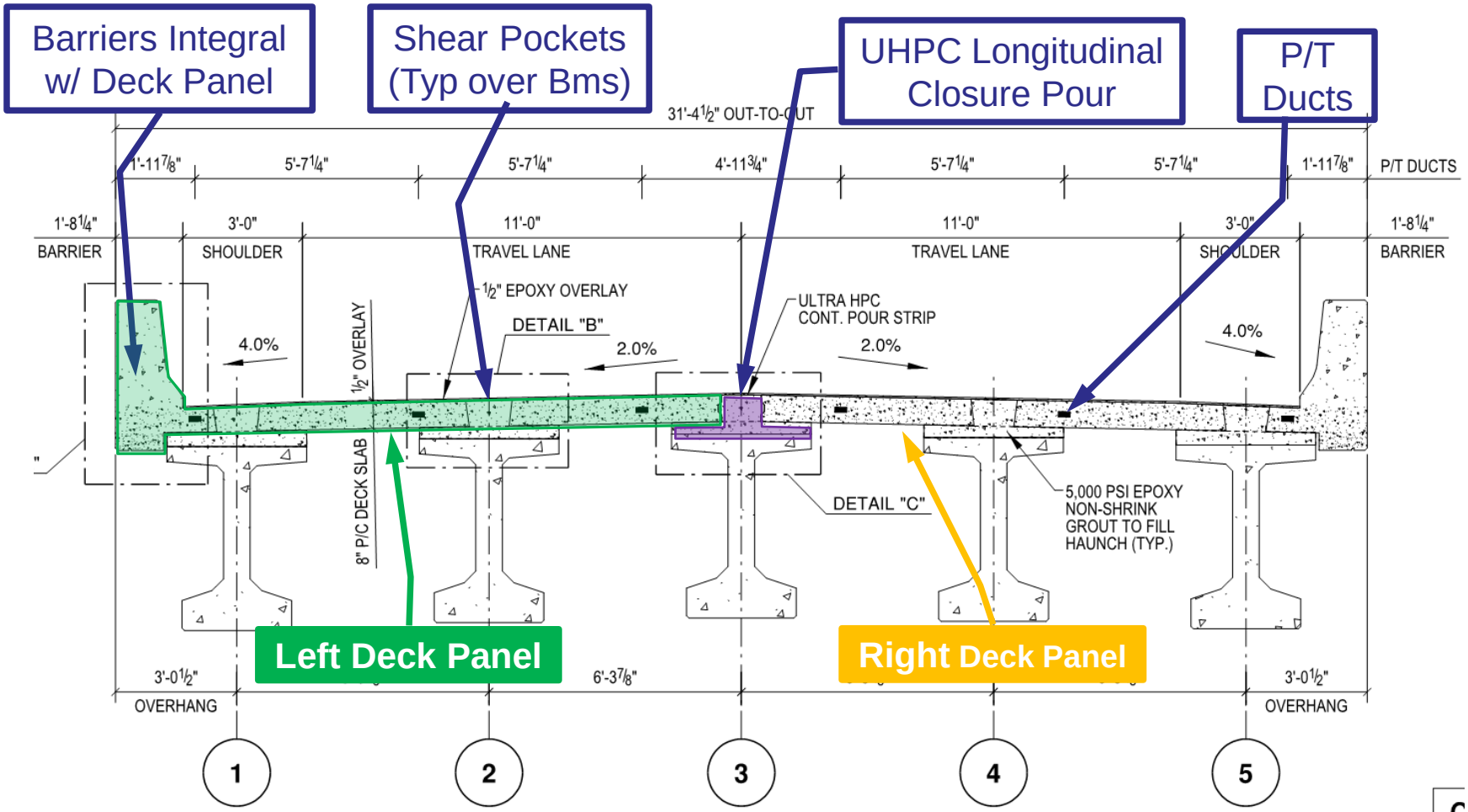

Total Precast Bridge - VE

ABUTMENT FOOTING INSTALLATION

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Total Precast Bridge - VE

ABUTMENT WALL INSTALLATION

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Total Precast Bridge - VE

PRECAST DECK PANELS

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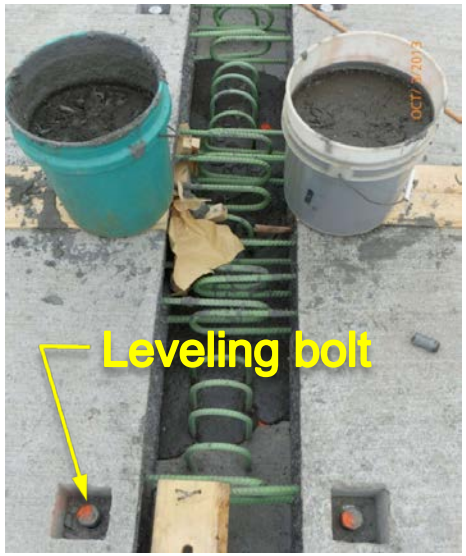
Total Precast Bridge - VE

PRECAST DECK PANELS
UHPC Closure Pours



Transverse Joint Profile

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Total Precast Bridge - VE

PRECAST DECK PANELS
Epoxy Grout in Beam Haunches & Shear Pockets

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Total Precast Bridge - VE

Completed Project
54 Calendar Days
contract commitment
could have opened sooner

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Integral Abutment ABC Bridge

- SR 288, single lane condition. 78’ span, 35’-3” width
- A + Bx Bidding Used
- $36,000/day Incentive/Disincentive
- Pre-Cast Fabrication of Pile Caps, Three (3) Two-Beam Deck Modules, Wing Walls & Approach Slabs
- Pick weights <118K using LW concrete and steel I beams
- Ultra High Performance Concrete closures
- Integral Abutments.
- Goal was to construct in 17 days. Contractor bid 9 days. Actually finished in 7 days.
- abc-utc.fiu.edu -> Tech. Transfer -> Webinar Archives

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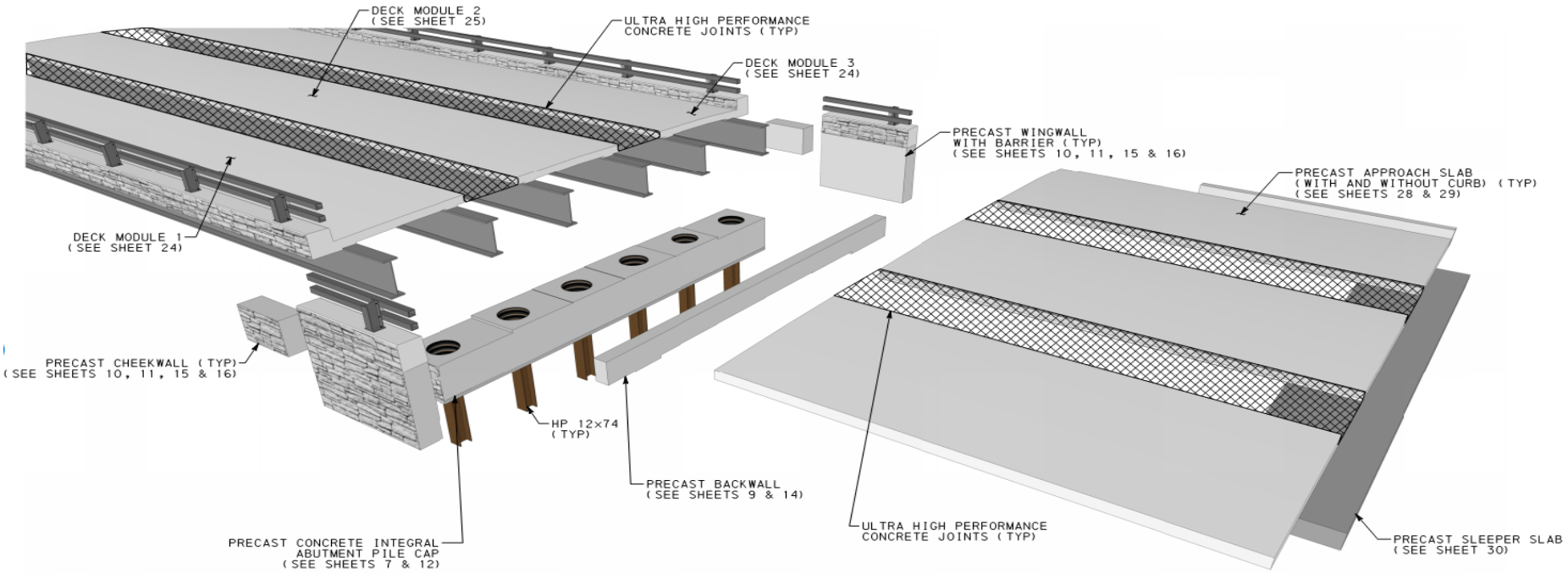
Integral Abutment ABC Bridge



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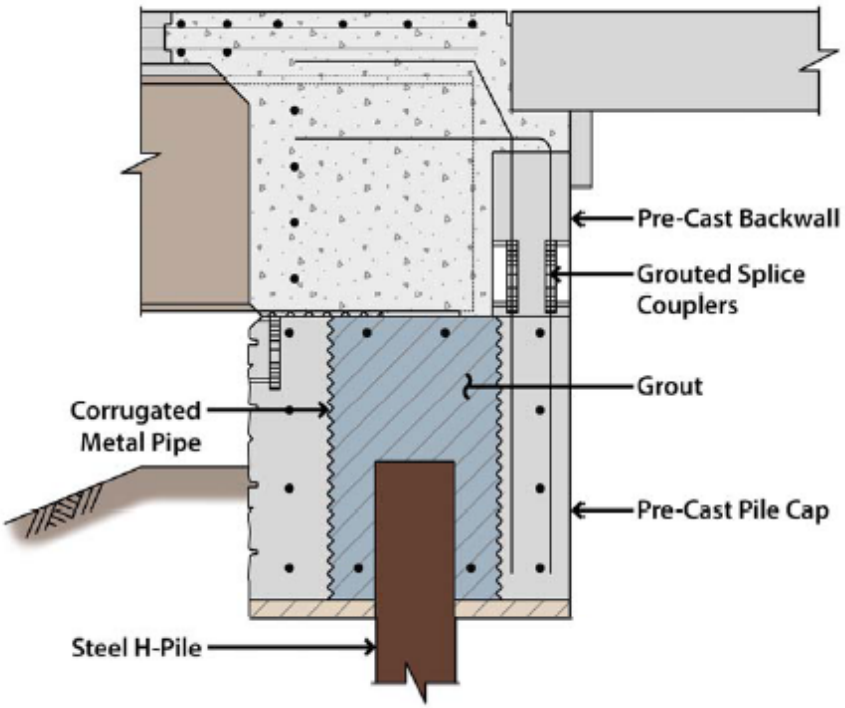
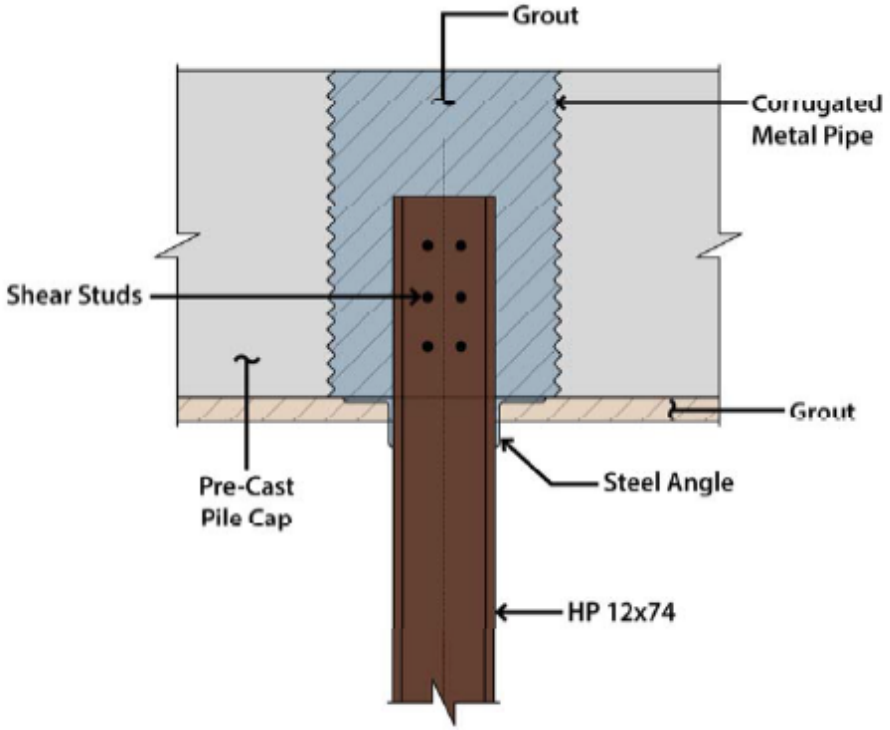
Integral Abutment ABC Bridge





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Integral Abutment ABC Bridge

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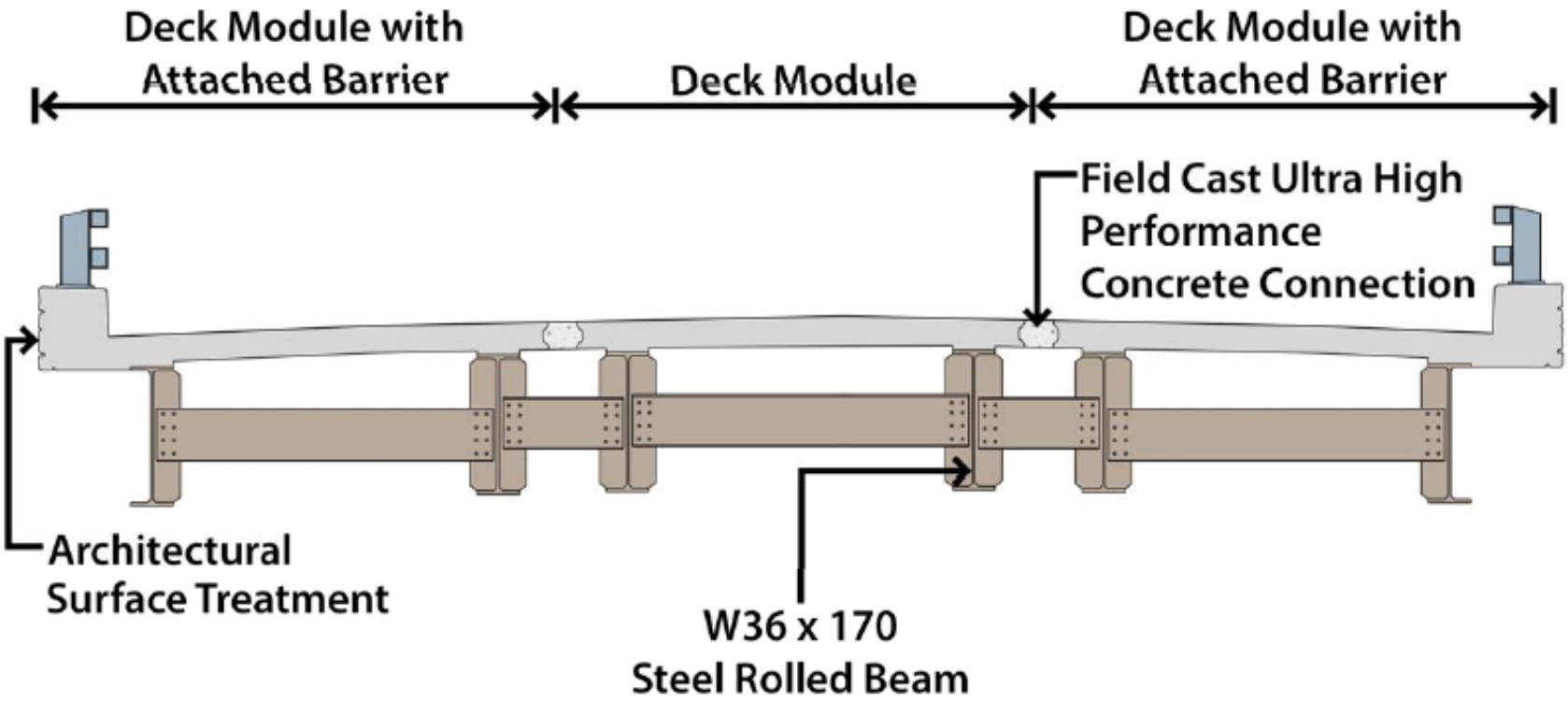
Integral Abutment ABC Bridge



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Integral Abutment ABC Bridge

Beam-Deck Modules were Set in 3 Hours

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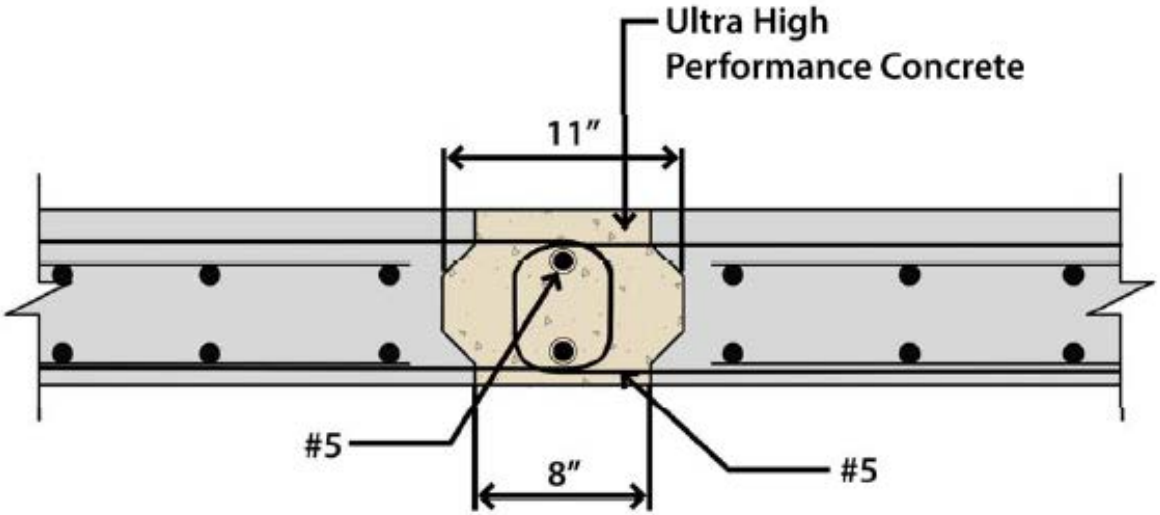
Integral Abutment ABC Bridge



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Integral Abutment ABC Bridge

Approach Slabs

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Integral Abutment ABC Bridge

UHPC Pour

Fiber Board

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Integral Abutment ABC Bridge

Segregation Check

7-10” Desirable – actual 9.4” average

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Integral Abutment ABC Bridge

- Pre-closure - Most piles placed (centerline shift)
- Day 1 - Demo
- Day 2 - Placement of remaining integral abutment piles
- Day 3 - Placement of abutment cap, cheekwalls and wings
- Day 4 - Place 2 beam deck modules
- Day 5 - Placement of sleeper slabs, approach slabs and leveling approach slabs
- Day 6 - Pour UHPC Joints
- Day 7 - Attach guiderail and pave approaches
- Days 8 & 9 (30 days later) - Place epoxy overlay and finish staining barrier

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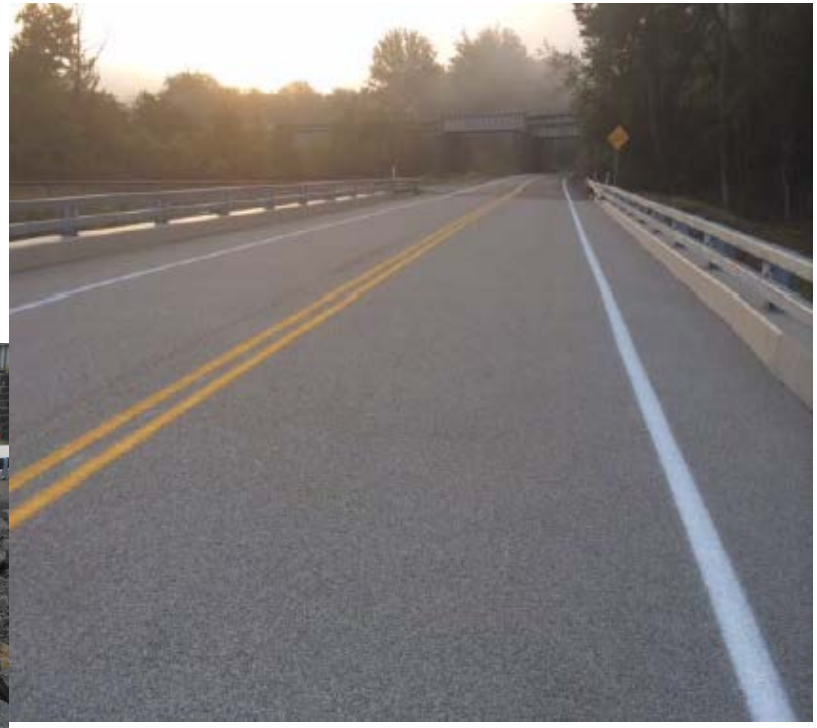
Integral Abutment ABC Bridge



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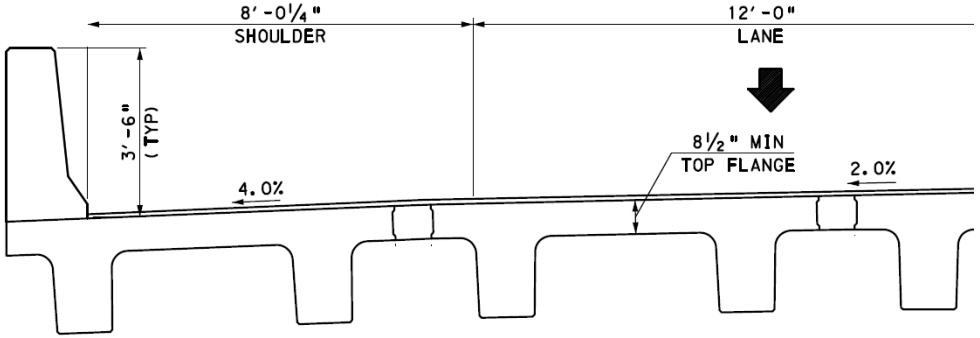
Upcoming Projects

- 6 Bridge Replacements over I-78 (Incent/Disincent)
  - 2 higher ADT I/C bridges with 30 day max
  - 4 others with 60 day max
  - Currently advertised for bidding (bid open 9/17)
- 1-span Integral Abut replacement with full closure from Fri PM to Mon AM
  - Piles driven beforehand under flagging
  - Using P/S NEXT beam sections



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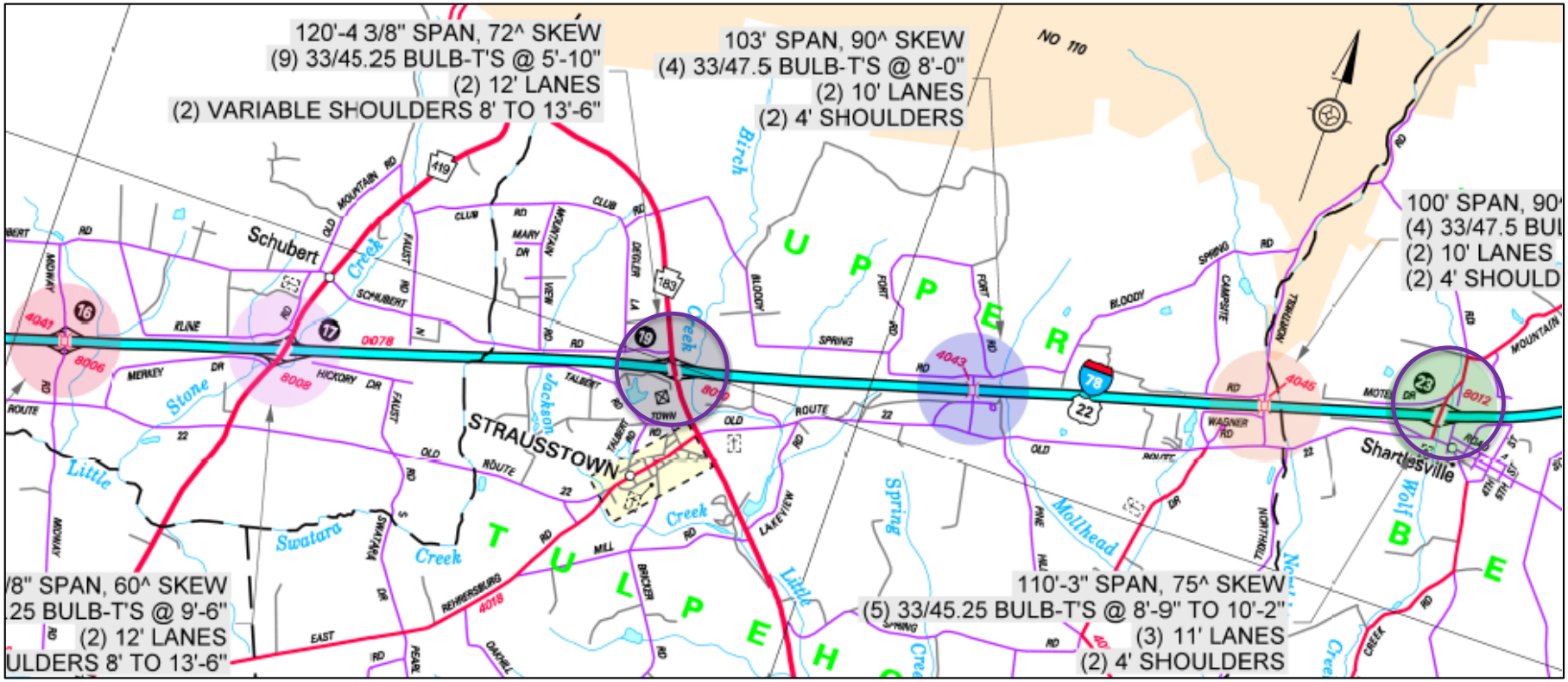
I-78 Underclearance



Corridor with substandard underclearance over Interstate

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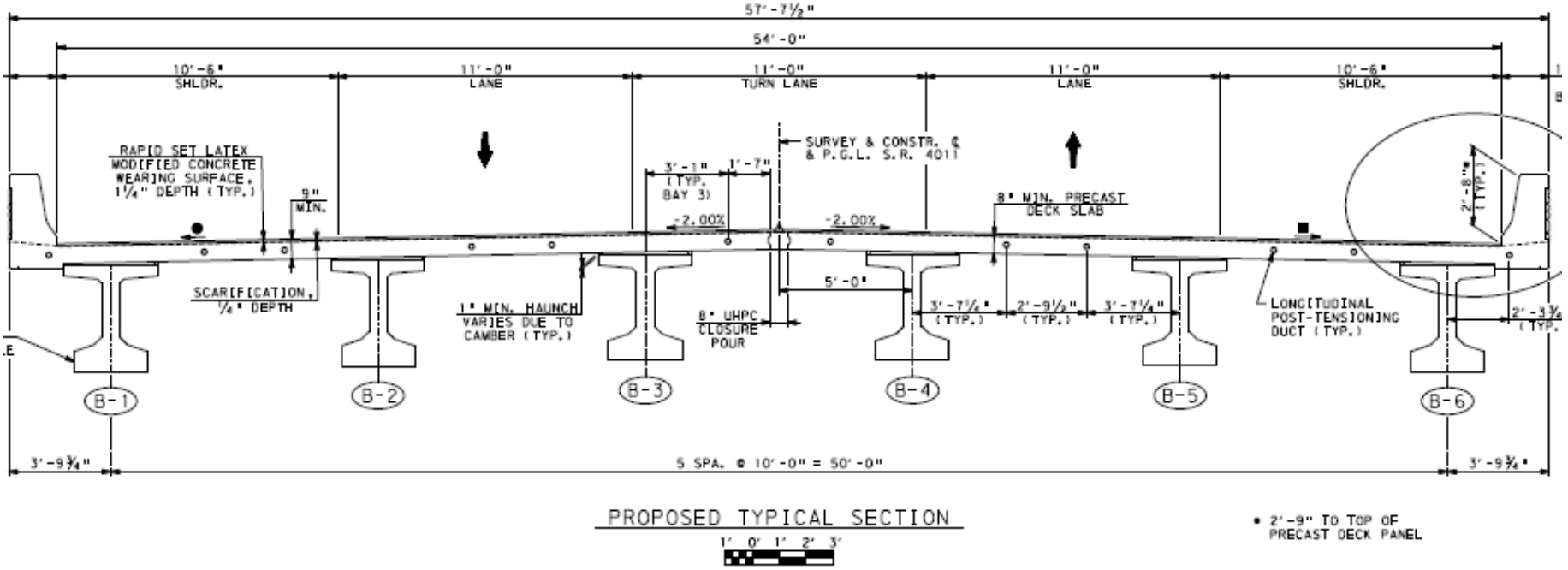
I-78 Underclearance



Using P/S beams with P/C Deck panels

Include longitudinal UHPC closure for wider decks

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I-78 Underclearance

- All precast elements must be dry-fit prior to leaving yard to ensure fit-up in field
- Allowed single-lane conditions and 15-min interval shutdown of Interstate off-peak to place overhead elements
- Currently advertised for 3rd time (bid open 9/17)
  - Bids high in 1st attempt (quick 2015 construction)
  - Bids high & temp runarounds in 2nd attempt – no go
  - Contractors may be unfamiliar/reluctant
  - Fabricator availability (& effort?)
  - Higher risk

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Future Use of ABC

- Where traffic restrictions are problematic
- Where RR flagging is extensive
- Where costs for ABC have smaller premium
- Foresee using the beam-deck module approach, as well as the precast deck with shear pockets
- P3 project just starting construction – will see what approaches they use

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Thank you!

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