



**ABC WORKSHOP  
DELDOT/ FHWA  
9/17/2015  
DOVER DELEWARE**

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PennDOT District 11-0**

## ▶ Talking Points:

- ABC History/ Policy in Pennsylvania
- Summary of ABC Bridges done recently and in the near future
- ABC highlights (when to use ABC, detour, RULD's, prefab elements, connections)
- Three projects (built in 30 days or less)

## ▶ ABC History in Pennsylvania

- Incentives/ disincentives/ RULD's (Road USGER Liquidated Damages)
- 1980's precast decks
- 1990's Inverset (steel I beams with precast concrete deck)
- 2000's precast abutment systems, p/s beams, pier caps, SMPT move in District 6, Philadelphia railroad bridge over SR 376
- 2012 – 2014 full pre fab/ precast elements built in thirty days or less
- P3 (Public-Private Partnership Project)

## ABC

- 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) so we are doing more end date contracts. We still use A + Bx bidding, lane rental with incentives/ disincentives with limited delay penalties and overall project penalty.
- We also have to put a ceiling on total incentive you pay out (Ft. Pitt Blvd) \$23,000,000 estimate/ \$34,000,000 actual bid
- We still do Non-ABC, Non prefab/ precast end date contracts – in district 11-0 we have done 8 bridges in 28 to 60 days
- RULD's can't be too high SR288, Main Street in Wampum, PA (7 days) 36000/ day RULD's Contractor \$324,000 to do a temporary run around – we said no

## > 1980's

- Precast deck panels were used with post tension in one direction and keyways
- Once in use, water was getting into the joints between panels corroding/ deteriorating keyways/ post tensioning after only **10 years** causing deck panels to move under traffic
- As a result we had to place 5" overlays over top of the deck panels to stop the movement

## > 1990's

- Inverset (steel I beams with precast deck material), 2 projects in District 11-0, Pittsburgh
- Silicon joint used between modules still holding up well, considering placed between 1992 through 1997

## 2000's

- Precast abutments stem on cast in place– footing (experimental job in 11-0 Millers Run road at Koppers Plant)
- Precast beams CIP deck
- Millers Run Road Bridge is working well

## > 2012 to 2014

- If we have 8 to 9 mile detours on a project – looking to do ABC
- GRS Abutments
- Precast/ prefab element **all** elements

## > 2014-2015

- In 2014-2015, PennDOT will have let at least 26 ABC bridges for \$70 mill. (P/C deck replacements, Pre-Fab and Non Pre-Fab superstructure replacements, full Pre-Fab replacements, box culverts). Ranging in cost from \$600k- \$6.5 million each (Avg-\$2.6 million, average RULDS, \$47k, Construction Range 7 days to 2.5 months (average- 3-4 weeks)).
- Construction issues- Asking for temporary runarounds and bidding temporary bridges eliminate risk, extra costs for ABC 8% -30%- average about 15%), Reduced time (4 months for a Full Pre cast job, whole seasons eliminated for major phased construction) and cost savings due to elimination of phased construction (\$5 million in Philadelphia area)



## ➤ 2016 and beyond

- 2016 -Super replacements on existing abutments as long as substructure shows no signs of distress and newer superstructure within 110% of existing super (SR 30 over Bessemer Ave., Allegheny County in – 1 weekend).
- 2017-FHWA \$400,000 grant to use an SPMT. SPMT project Shaler Street over West End Bypass in Pittsburgh– build as much as possible before demo including abutments, piers, caps, bearings. Build super nearby replace 2 spans over 2 weekends. Also, additional full Pre FAB projects planned throughout the state

## ► GRS Abutments

SR 2011 Potter County built in 2 months by contractor



SR 318 Mercer County built in 2 months by department forces





## ▶ GRS Abutments



SR 3071 Allegheny County built in 8 months by department forces

# GRS Abutments

First abutment completion date: 10/7/2011



Start date 10/5/2011





# ▶ GRS Abutments

Second Abutment Completion Date: 10/11/2011  
Two Abutments – 8 Days



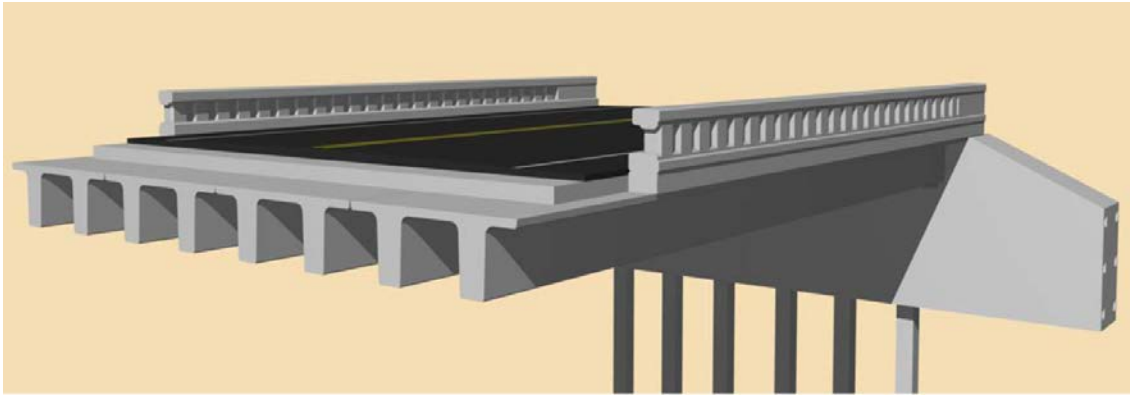
Timber Super Being placed

## ➤ P3 (Public-Private Partnership Project)

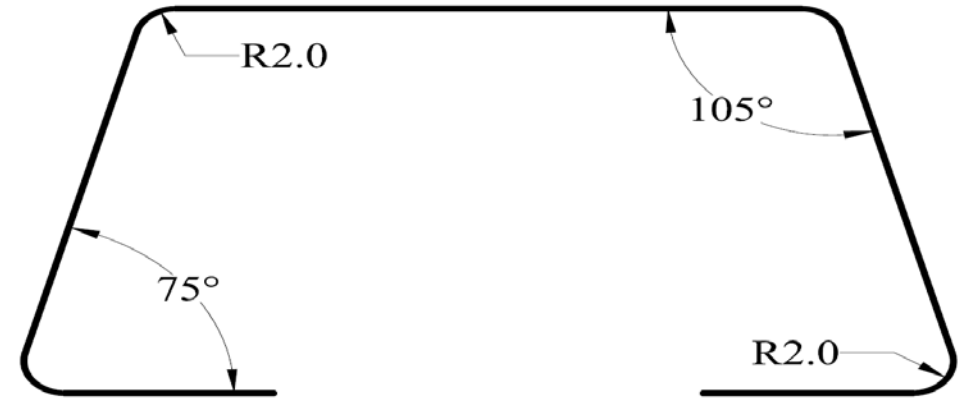
- Pre-cast substructure
- Next 'D' Beam with full deck
- Folded Plate girder



## Next Beam



## Folded Plate Girder



**Fig. 1** Typical cross section for the Folded Plate Bridge System. Dimensions vary based on span length.



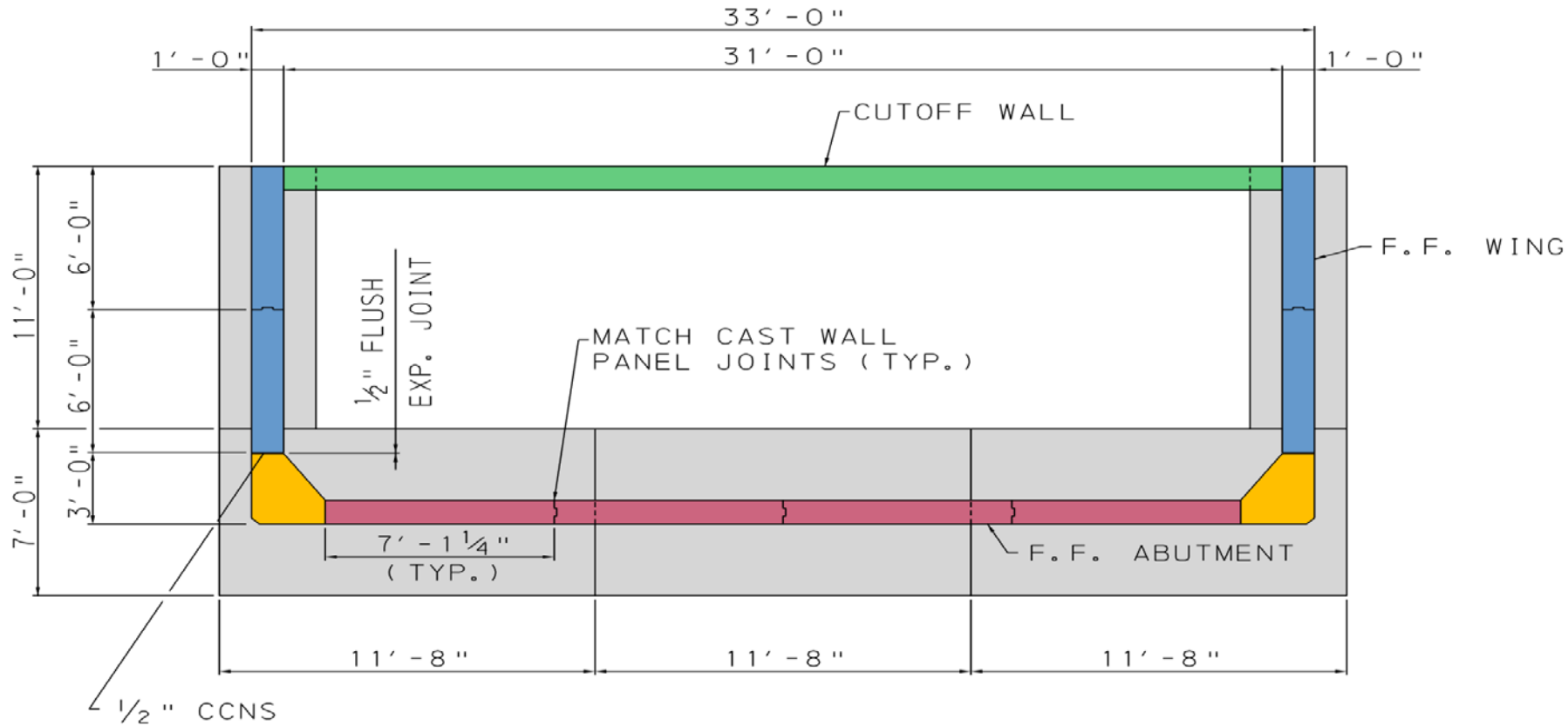
## ➤ Design Concept District 9-0 Project (middle of state)

- 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
- Use P/S concrete adjacent beams w/ & w/o concrete deck
- Scour cutoff wall panel for stream environment





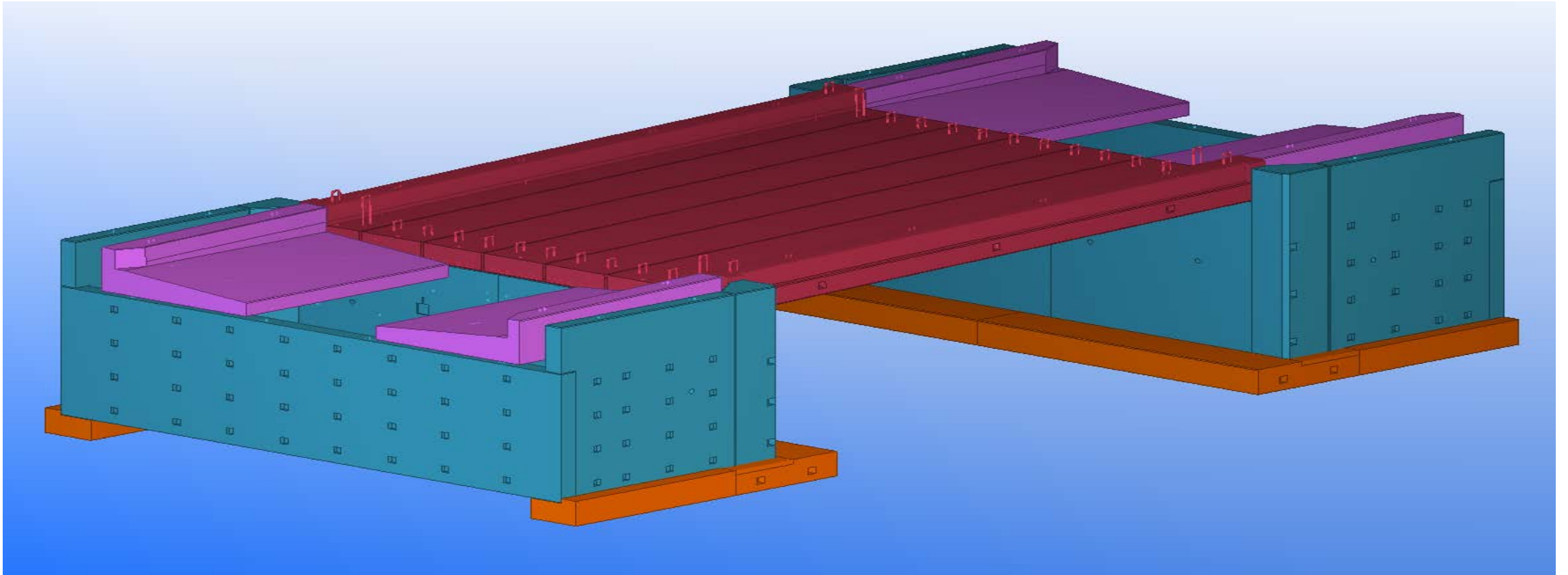
# Precast Components



ABUTMENT PLAN

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

## ► Precast Components



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

# ▶ Precast Footings & Walls

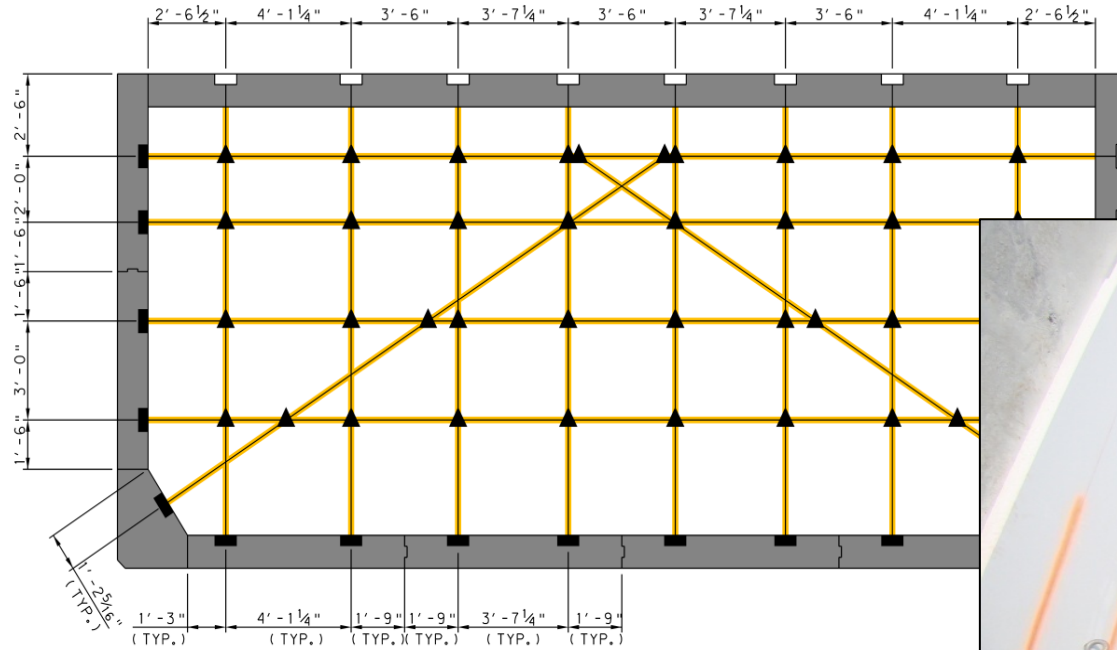


- **Preformed Cellular Poly-styrene to Absorb Lateral Deformation of Backfill**

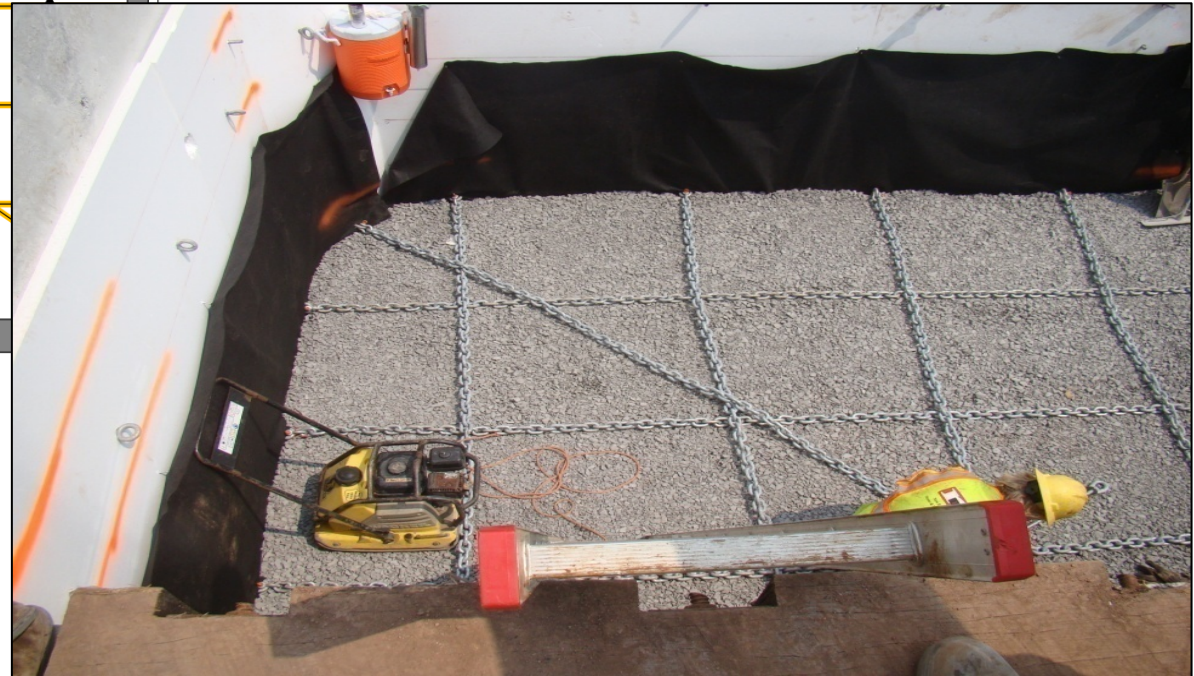


- **Instrumentation**
- **Geodetect Strip – Geogrid to check forward movement of GRS fabric**
- **Earth Pressure Cell – to see if Geogrid was in reducing load on wall panels**

# Galvanized Steel Chain



CHAIN LAYOUT





# Superstructure

- Plank beam (non-voided)
- Deepened shear key
- Epoxy mortar shear key grout (11-12 ksi)
- Additional transverse post tensioning



- Two layers of membrane waterproofing on longitudinal joints and FJ overlay with membrane curb to curb
- Drain tubes cut into membrane to curb
- Precast barrier on fascia beam cast separately at FAB shop

# ▶ Completed Structure in 21 Days



## ➤ VE Total Precast Bridge another District 9-0 Project

### Total Precast Bridge

Ashcom Cove Creek Bridge

Bedford Co SR 1004-001

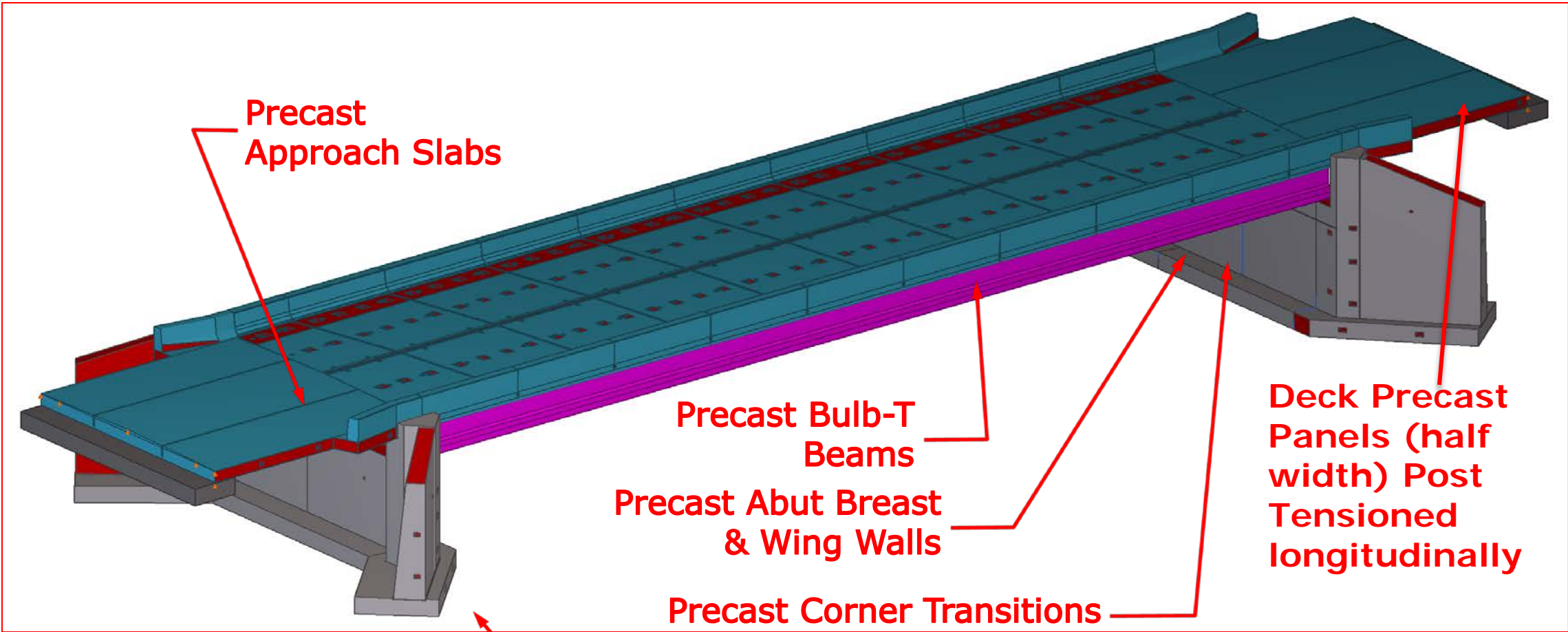
Replicated Cast-in-Place Design

116 ft. Span

31'-4" Width



# VE Total Precast Bridge



Precast Footings

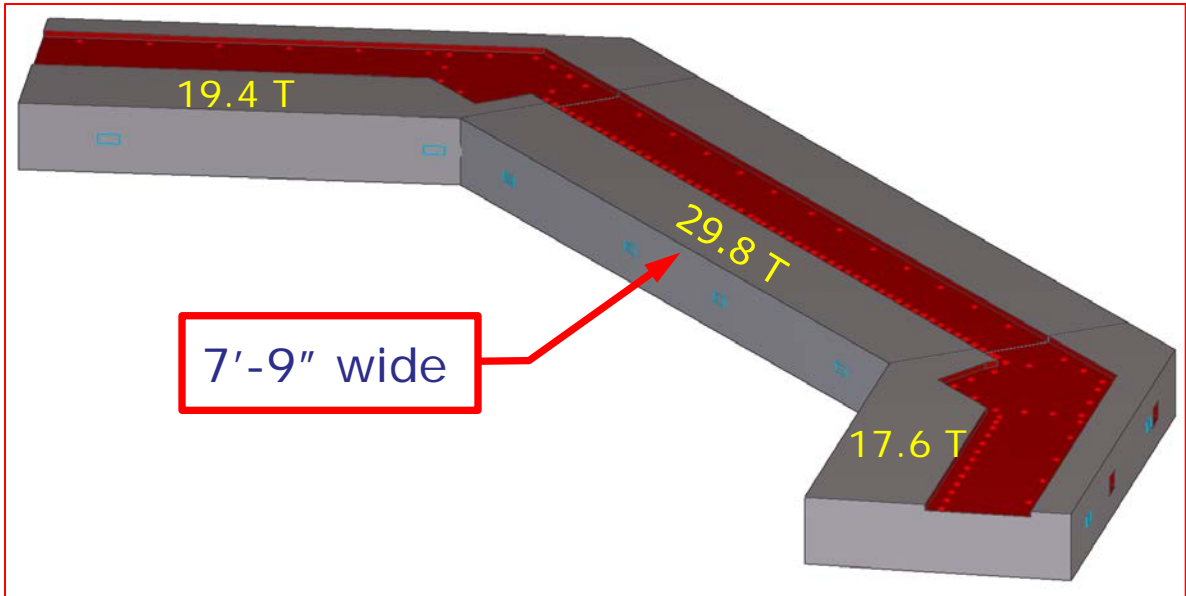
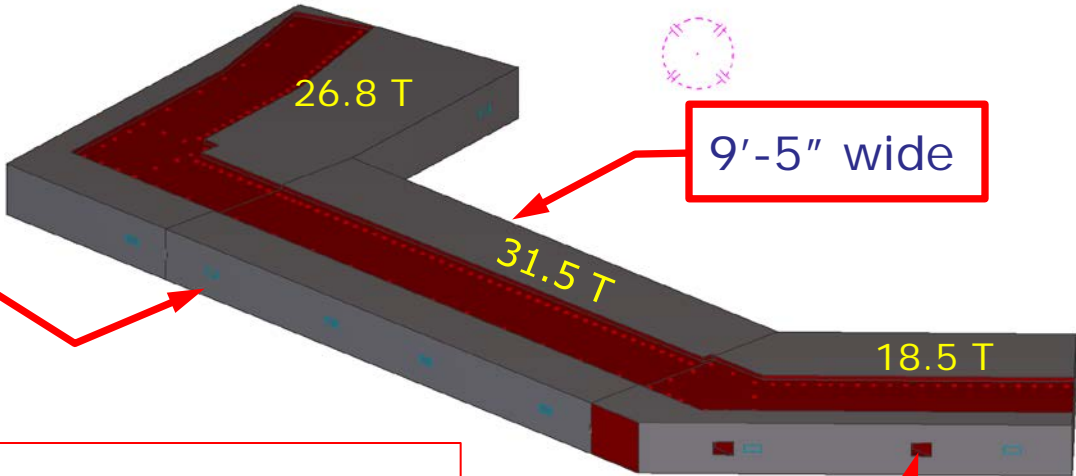
## ➤ VE Total Precast Bridge

- Match-cast, post-tensioned, precast concrete footing and wall panel components
- NMB (NISSO Master Builder) grouted coupler splice connections for footing-to-stem vertical reinforcement bar continuity
- SS Mortar® by BASF splice sleeve grout main connection footing to stem, male/female threaded connection with grouted NMB. 11 ksi @ 28 days strength
- Deck panels one-half width of bridge -- 12' +/- in length.
- Lafarge Ductal 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.
- Dayton Superior J55 epoxy grout used to fill beam haunches and shear pockets.

# VE Total Precast Bridge

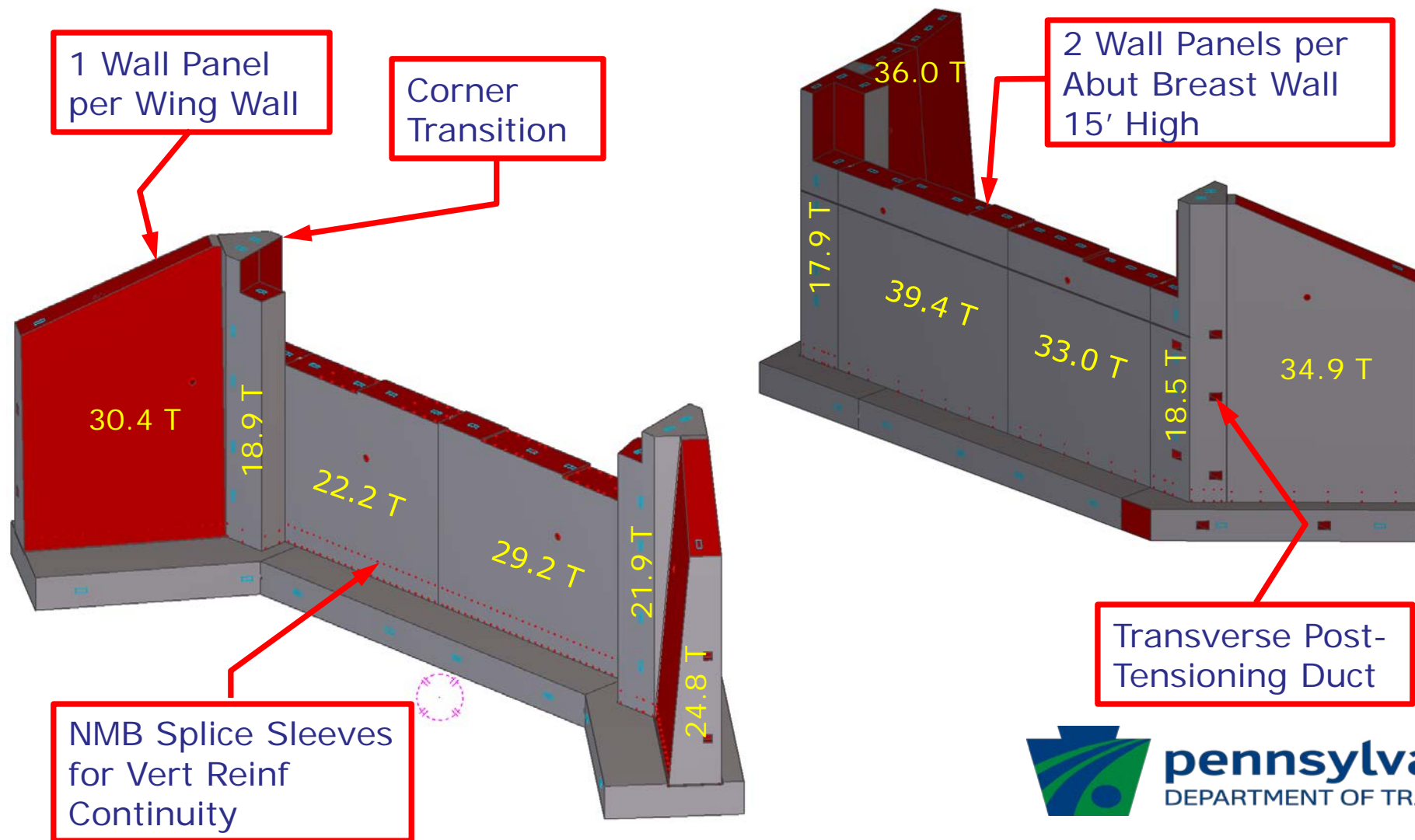
3 Segments per  
Abut Footing

Max Segment  
Weight = 31.5 tons

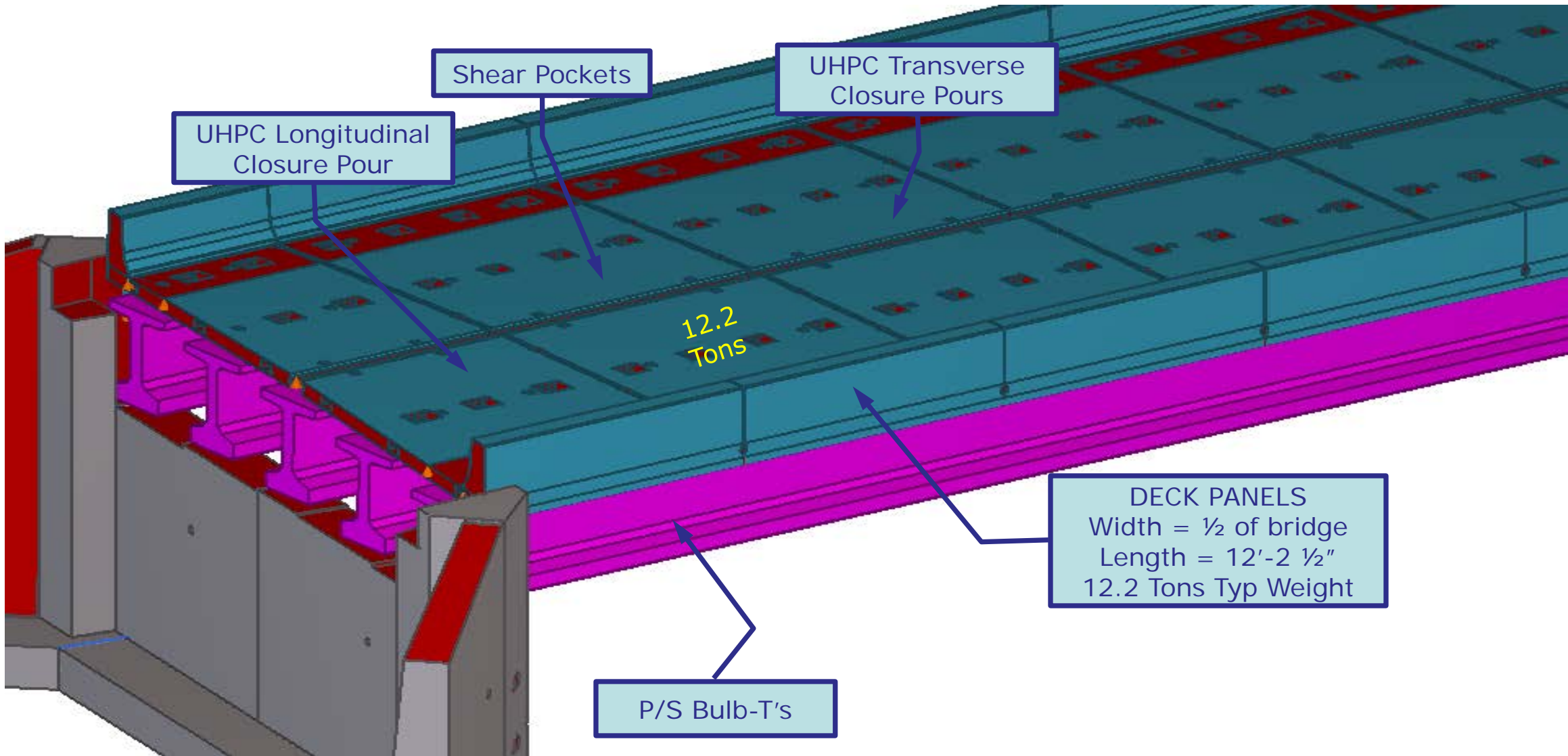


Transverse Post-  
Tensioning Duct

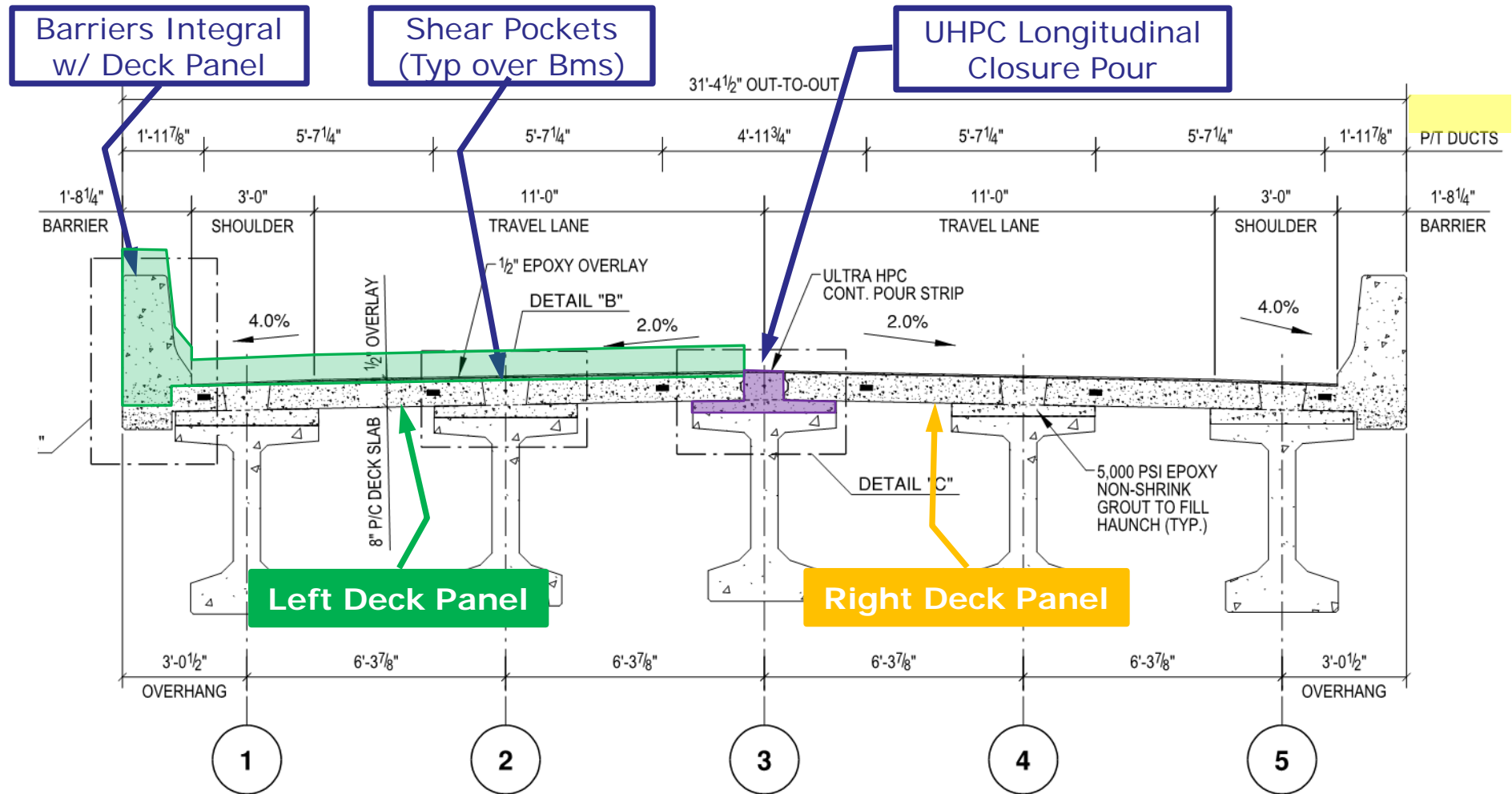
# VE Total Precast Bridge



# VE Total Precast Bridge



# VE Total Precast Bridge



## ➤ VE Total Precast Bridge - Timeline

| Days    | Activities  |
|---------|---|
| 1 - 3   | Set-up detour; install causeway; demo existing super & Abut 1       |
| 3 – 5   | Excavate for new Abut 1; install shoring @ Abut 2                   |
| 9       | Install new Abut 1; demo existing Abut 2; excavate new Abut 2       |
| 10      | Backfill new Abutment 1   |
| 11      | Install new Abutment 2  |
| 12 – 16 | Backfill new Abut 2; place scour protection; prep for setting beams |
| 17      | Set prestressed concrete beams                                      |
| 18 – 20 | Set deck panels; form & reinforce intermediate & end diaphragms     |
| 22 – 23 | Pour diaphragms; form deck panel transverse shear keys              |
| 24      | Form beam haunches  |
| 25 – 26 | Place UHPC in transverse deck joints                                |
| 29      | Post-tension deck panels  |
| 30 – 31 | Construct approach slab sleeper slab; grout PT ducts                |

## ➤ VE Total Precast Bridge - Timeline

| Days    | Activities   |
|---------|--|
| 32 – 33 | Set approach slabs   |
| 36      | Re-prep haunches; begin work on roadway approaches             |
| 37 – 38 | Place epoxy grout in beam haunches & shear pockets             |
| 39      | Place UHPC in deck longitudinal closure joint.                 |
| 40 – 44 | Clean-up deck  |
| 45 – 53 | Epoxy deck patches; strip haunch formwork; addt'l roadway work |
| 54      | OPEN BRIDGE  |



# ▶ VE Total Precast Bridge



ABUTMENT – FOOTING INSTALLATION

# ▶ VE Total Precast Bridge



ABUTMENT – WALL INSTALLATION

# ▶ VE Total Precast Bridge



ABUTMENT – COMPLETED PRECAST ASSEMBLY

# ▶ VE Total Precast Bridge



PRECAST DECK PANELS

# ▶ VE Total Precast Bridge



PRECAST DECK PANELS

# VE Total Precast Bridge



**PRECAST DECK PANELS  
UHPC Closure Pours**



**Transverse Closure  
Pour**

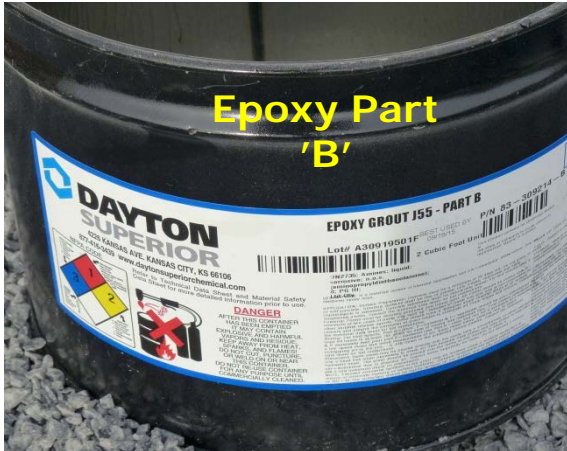


**Transverse Joint  
Profile**



**Haunch  
Formwork**

# ▶ VE Total Precast Bridge



**PRECAST DECK PANELS  
Epoxy Grout in Beam Haunches & Shear Pockets**

# ▶ VE Total Precast Bridge



Completed Project  
54 Calendar Days – contract  
commitment could have opened sooner





➤ Integral Abutment ABC Bridge District 11-0 (Western PA)

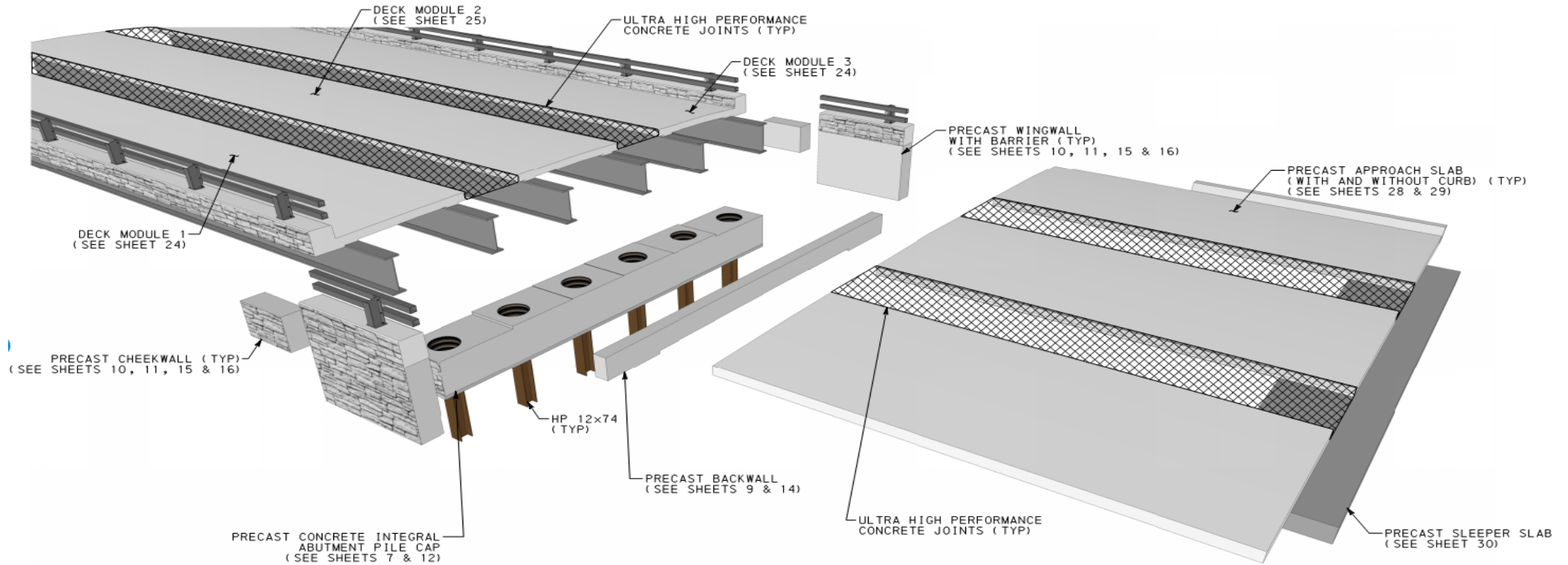
**Wampum Run Bridge  
Lawrence Co SR 288-L10  
7 Days Construction**

**78 ft. Span  
35'-3" Width**

## ▶ Integral Abutment ABC Bridge

- Project Let 4/10/2014.
- Low Bid \$1,685,859 – High Bid \$2,638,695 (\$200,000 extra for ABC – 1 beam line & UHPC joint)
- A + Bx Bidding Used
- \$36,00/day Incentive/Decentive
- Existing Bridge – concrete arch restricted to one lane with a 12 mile detour when the bridge is closed.
- Pre-Cast Fabrication of Pile Caps, Three (3) Two-Beam Deck Modules, Wing Walls & Approach Slabs
- Pick weights kept to 118,000 using light weight concrete and steel I beams
- Constructed from 8/18/14 through 8/24/14.
- Goal was to construct in 17 days. Contractor bid 9 days. Actually finished in 7 days.

# SR 288-L10 Wampum Precast Components





# SR 288-L10 Wampum Existing Bridge



## SR 288-L10 Wampum Time Line – 7 Day Closure

- Day 1 - Demo
- Day 2 - Replacement 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

# ▶ SR 288-L10 Wampum Piles for Integral Abutment Cap Placement





# ▶ SR 288-L10 Wampum Precast Pile Cap



# SR 288-L10 Wampum 550 Ton Crane



Used to set beam/ deck modules and abutment 2 cap

Took 3 shifts to set up 550 ton crane with a 220 ton crane  
Came in on 9 trucks





# ▶ SR 288-L10 Wampum Beam-Deck Modules



Beam-Deck Modules were Set in 3 Hours

# SR 288-L10 Wampum Approach Slabs





# SR 288-L10 Day 6 Saturday 8/23/2014 UHPC Joints Continued

UHPC Concrete



Add Mixtures and Ice

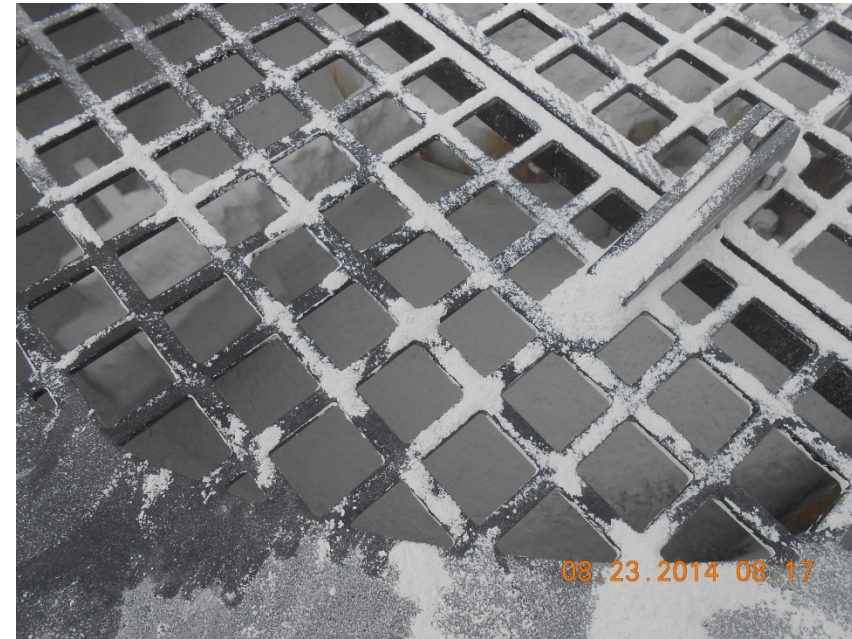


# SR 288-L10 Day 6 Saturday 8/23/2014 UHPC Joints Continued

Ice



Mixer





# SR 288-L10 Day 6 Saturday 8/23/2014

## Segregation Check





# SR 288-L10 Day 6 Saturday 8/23/2014

## Temperature Check



# SR 288-L10 Wampum | Completed Structure



# ▶ PA 581 10<sup>TH</sup> Street Rapid Bridge Replacement

Accelerated Bridge Construction of PA581 10<sup>th</sup> Street Bridge.

Structure replaced in 2 weekends and two weekends to install a latex overlay



## ➤ Design Concept

- Utilize Existing Substructure
- Use Steel Beams
- Availability of Pre-casting Area in the Bridge
- Selection of Closure Pour Material
- Protection of Closure Joints
- Maintenance and Protection of Traffic

## ▶ Design Build

- Innovation/Flexibility
- Full Responsibility
- Engineering and Construction Management System (ECMS): 89177
- Design Cost:
  - Bridge- \$210,000
  - Maintenance and Protection of Traffic (M & P) - \$50,000
- Construction:
  - Bridge- \$2,600,000
  - M & P-\$125,000
- Construction: 2015

## Cost Differential

- Conventional construction: ~ \$150-\$200/SF
- \$1.5-\$2.0M for bridge superstructure
- Accelerated Construction: \$2.6M
- Differential: \$600K (premium)
- Maintenance and Protection of traffic cost

## ▶ Detour PA581 East to I83 South

SR 0581WB - ADT: 42,544, ADTT: 3,829

SR 0581EB - ADT: 45,235, ADTT: 4,071

SR 0083NB - ADT: 51,000, ADTT: 5,100

SR 0083SB - ADT: 61,000, ADTT: 6,100

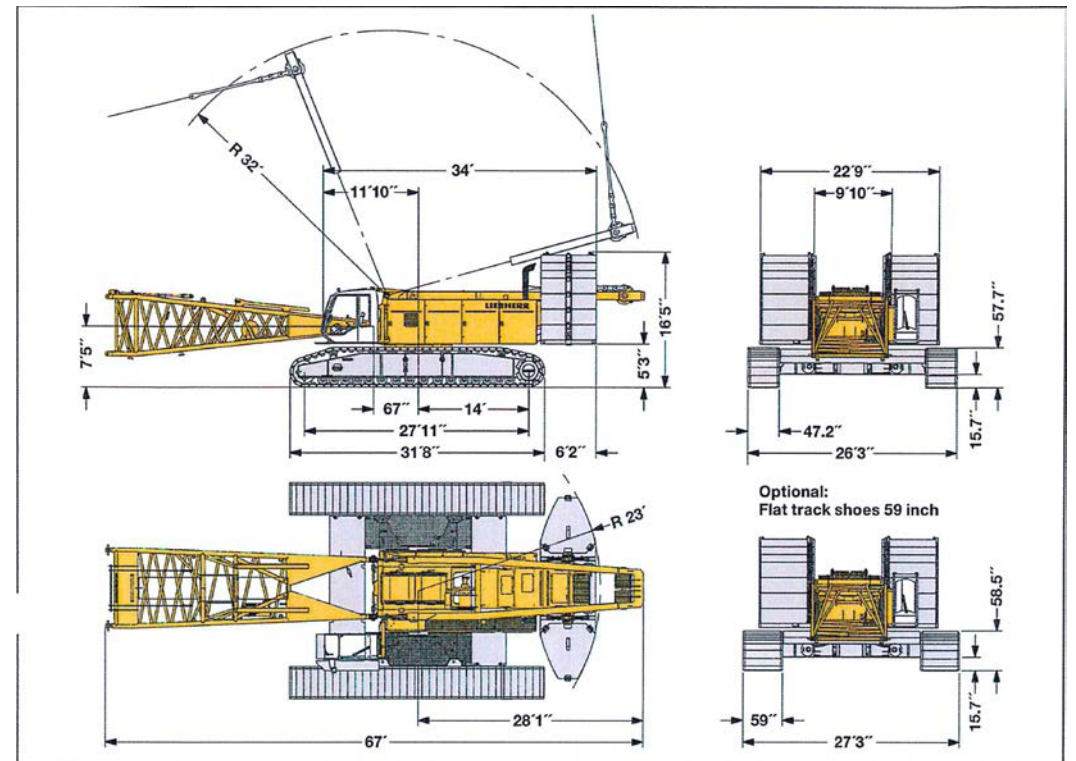


# Summary of Picks- New Superstructure

| Stage | Assembly | Assembly Weight (lbs.) | Rigging Weight (lbs.) | Total Pick Weight (lbs.) |
|-------|----------|------------------------|-----------------------|--------------------------|
| 1     | 1        | 224,130                | 14,602                | 238,732                  |
| 1     | 2        | 190,197                | 14,602                | 204,799                  |
| 1     | 3        | 190,626                | 14,602                | 205,228                  |
| 1     | 4        | 263,580                | 14,602                | 278,182                  |
| 2     | 1        | 227,803                | 14,602                | 242,405                  |
| 2     | 2        | 199,642                | 14,602                | 214,244                  |
| 2     | 3        | 249,650                | 14,602                | 264,252                  |

# Crane Selection

- Liebherr LR 1300 SX Crawler, 273,400 lb. cwt., 125,700 lb. carbody cwt., and 144 ft. boom
- Liebherr LTM 1400-7.1 Hydraulic Truck, 264,600 lb. cwt., 118 ft. boom



# ▶ Prefabricated Superstructure Built Near Bridge Site



# ▶ Cutting Existing Bridge into Section to be Removed by Truck



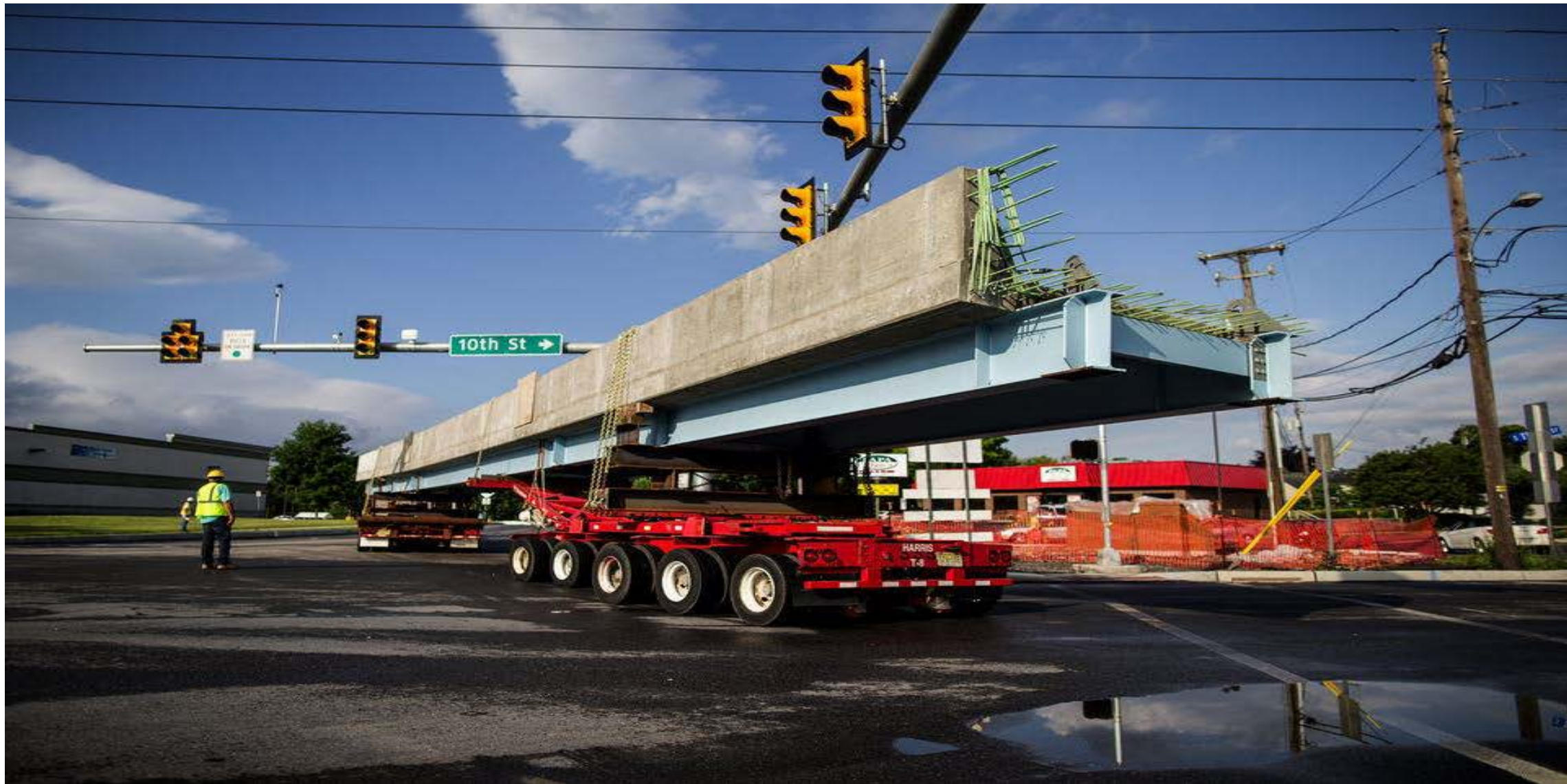


## ▶ Removing existing bridge section



▶ Bridge Section Being Placed on SPMT Crawler to be Transported to Lift Site





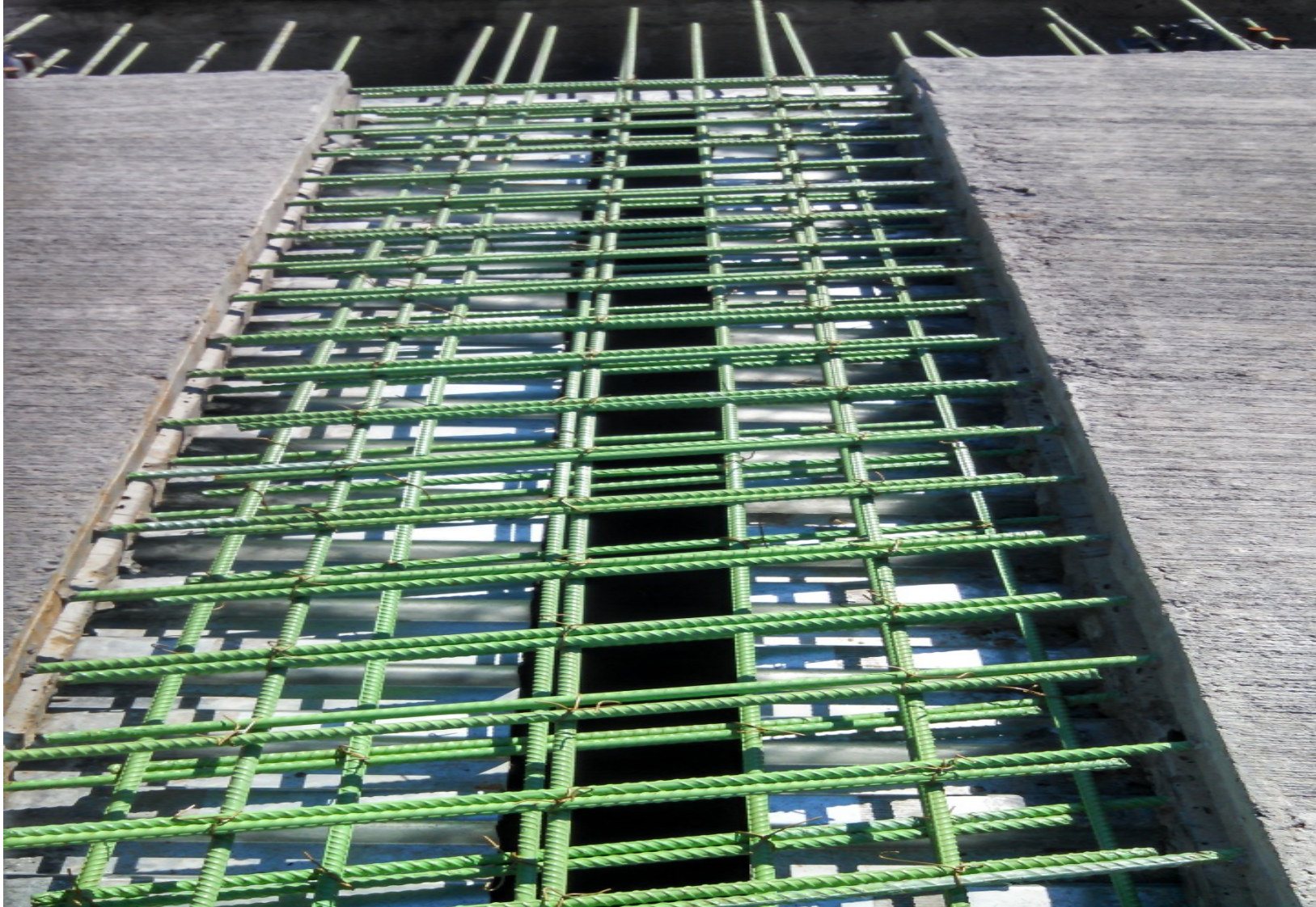
## ▶ Placing New Bridge Section



# ▶ Placing Last Section



## ▶ Typical Joint Section



## ▶ Placing Latex Modified Concrete



# ▶ Finished Bridge

