McCORMICK TAYLOR

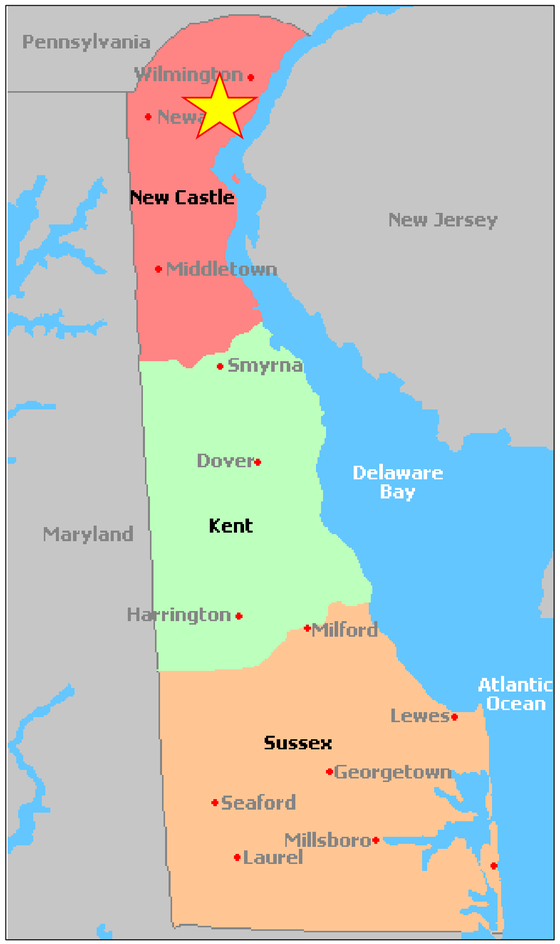
TEAM DelDOT
Transparent Efficient Accountable Measured

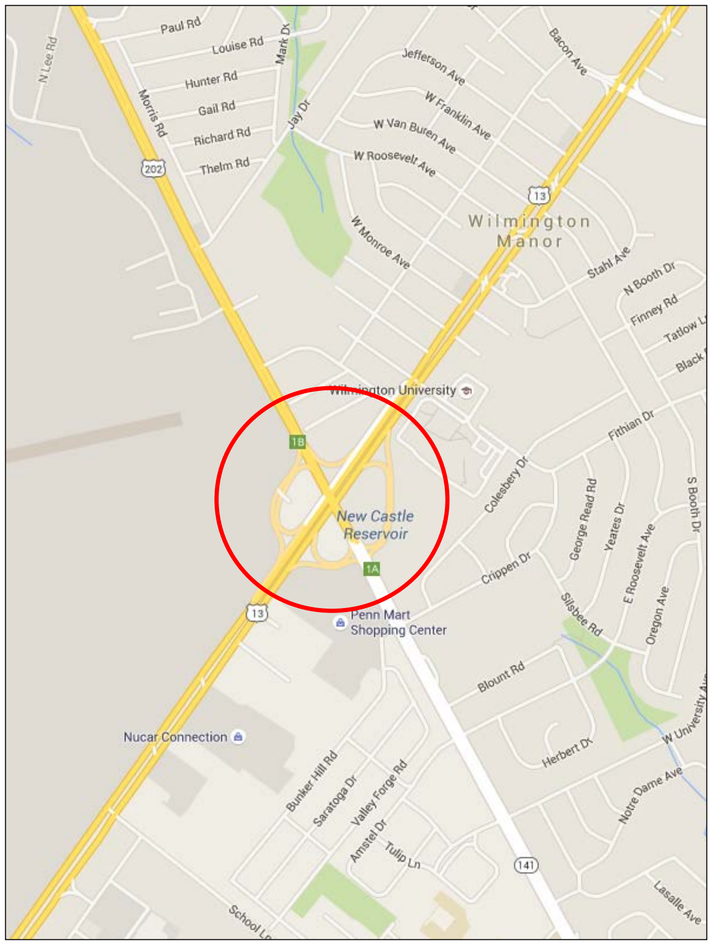
U.S. Department of Transportation
Federal Highway Administration

BR 1-680, New Castle County
SR 141 over US 13
Deck Replacement Using ABC Methods

September 17, 2015

Project Location





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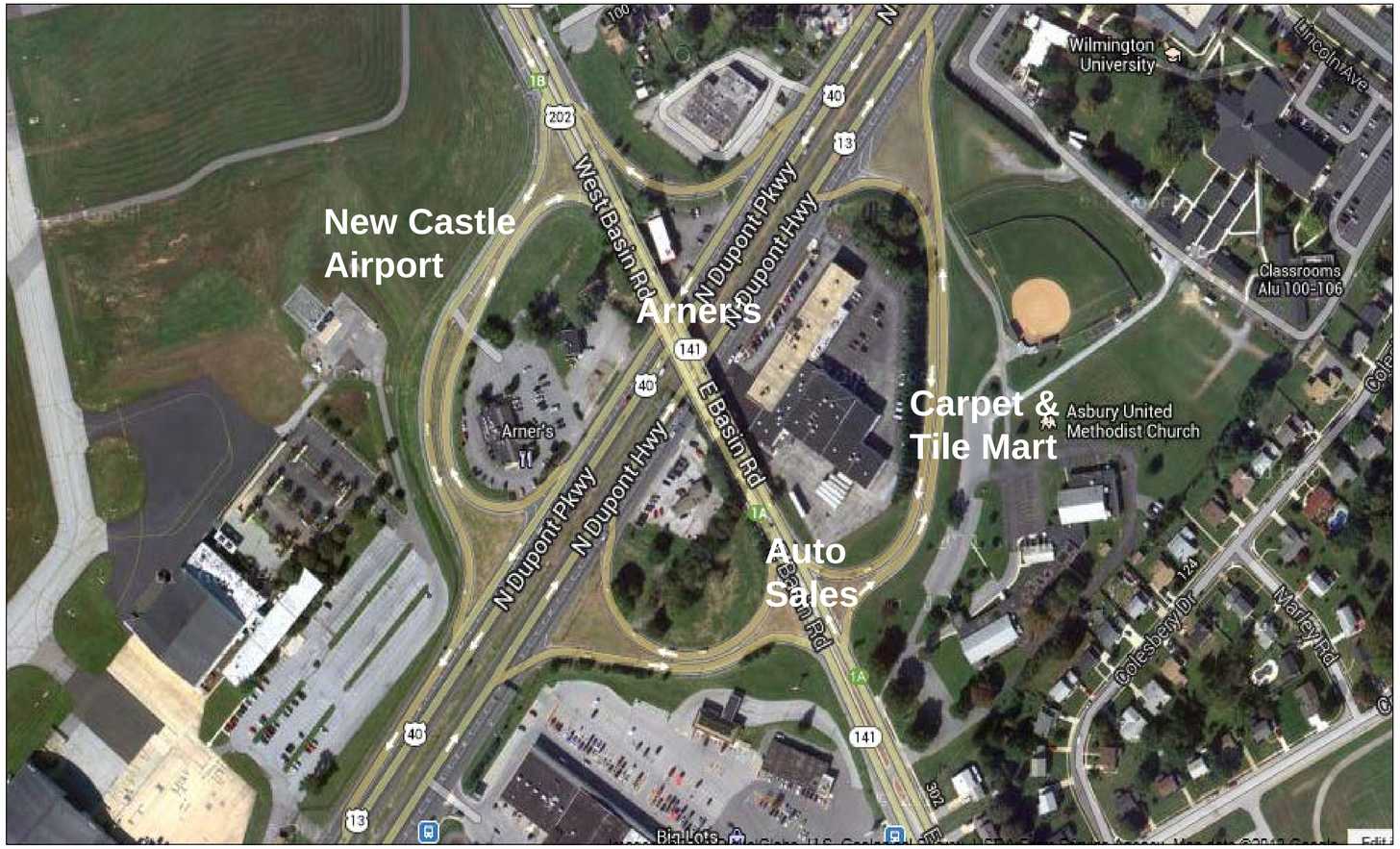


SR 141 over US 13

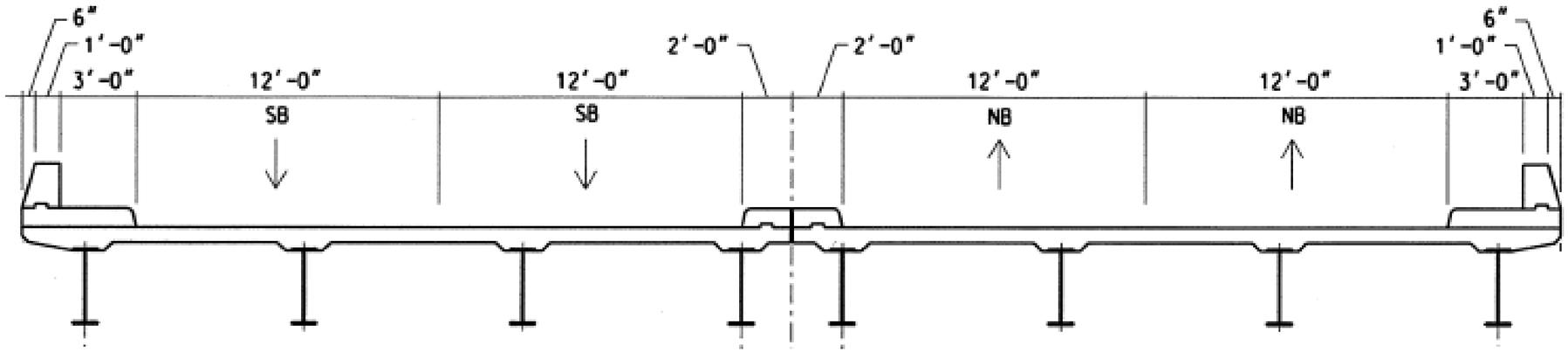
Existing Bridge

- 7-Span Steel Girder Bridge
- 600 feet total length
- 28,000 vehicles/day on bridge

US 13 NB

Existing
Typical Section

Looking NB on SR 141



Existing Bridge Condition

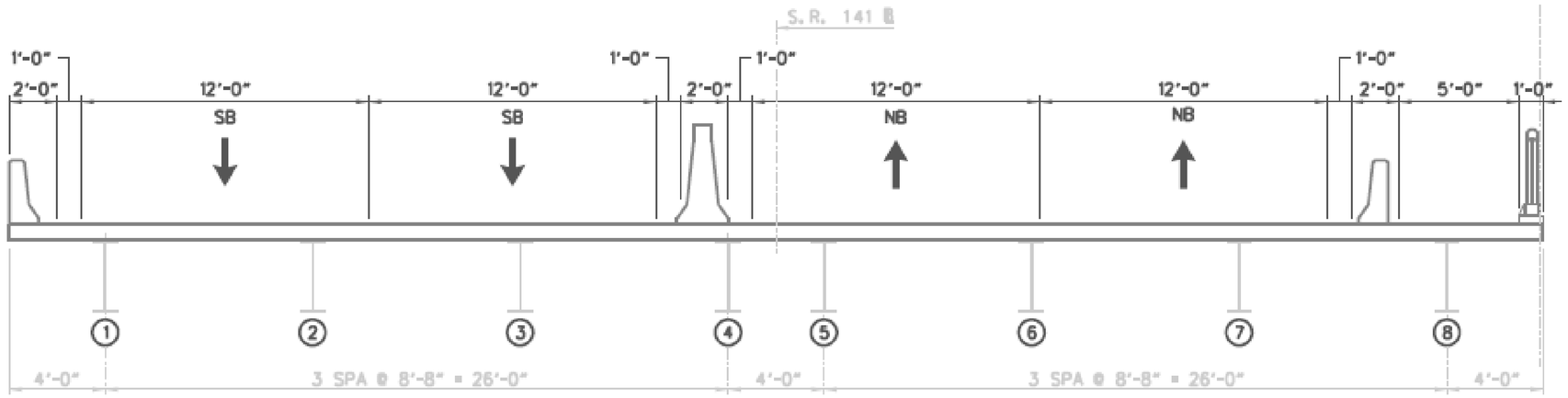
- Sub-standard vertical underclearance

  Beams struck by trucks traveling on US 13
  - Minimum vertical clearance on NB US 13 = 14’-2”
  - Minimum vertical clearance on SB US 13 = 14’-5”

- March 2015 – bridge SB lanes closed for 3 weeks for emergency deck repairs

Full-depth Deck Replacement

- Design for 30-year life
- Increase vertical underclearance to 14’-6”
- Maximize bridge width from 61 feet to 64 feet
- Implement ABC techniques
- Complete construction in 3 weeks



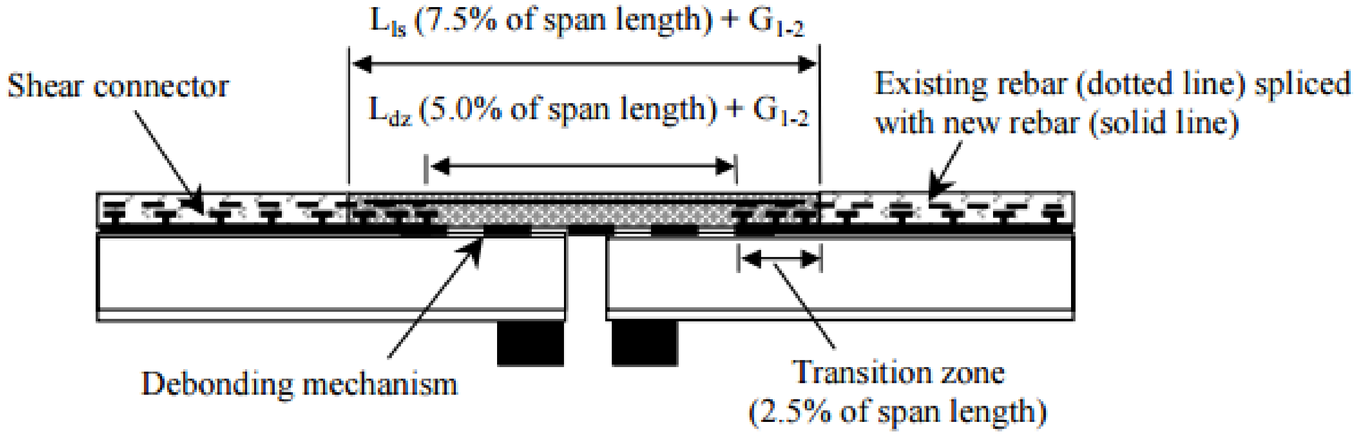
Increase Vertical Underclearance

- Jack existing beams
  - Raise bridge by 4”
- Replace expansion bearings
  - Use elastomeric bearings
  - Use steel bolsters
- Shim fixed bearings

Looking SB on US 13

Eliminate/Reduce Existing Deck Joints ??

- Use Link Slabs
  - Not feasible
  - Excessive link slab length
  - Cannot accommodate shear connectors



Ref: web.stanford.edu

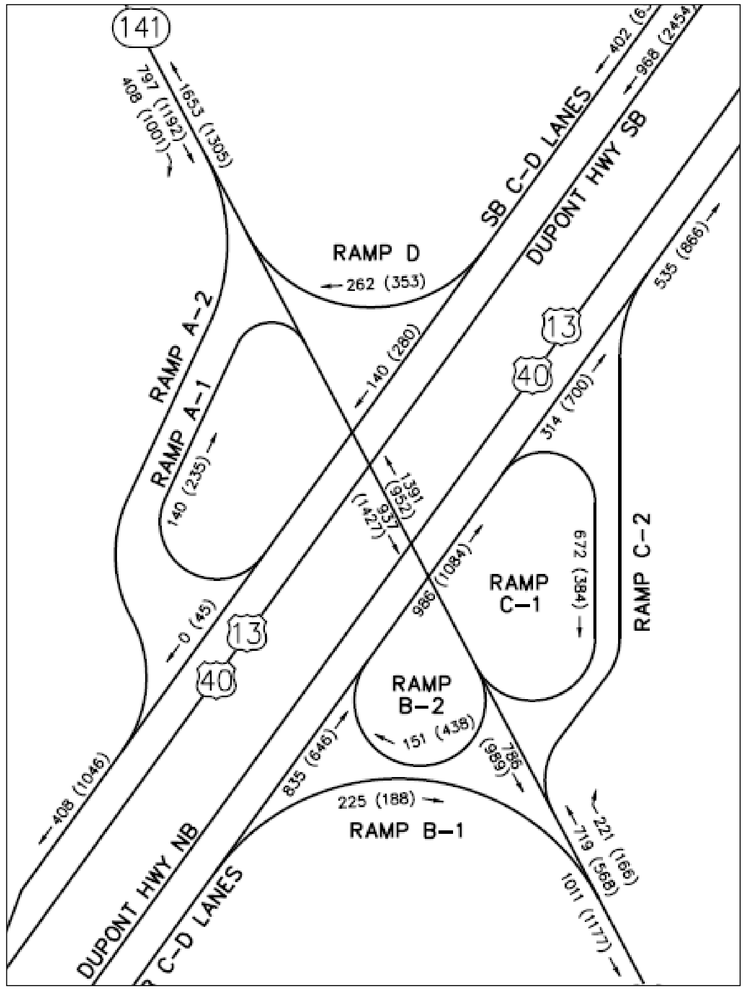
Why ABC?

- Minimizes impact to traffic

  High traffic volumes at SR 141/US 13 Interchange

  - South of Interchange ADT = 20,798 vehicles/day
  - North of Interchange ADT = 38,413 vehicles/day

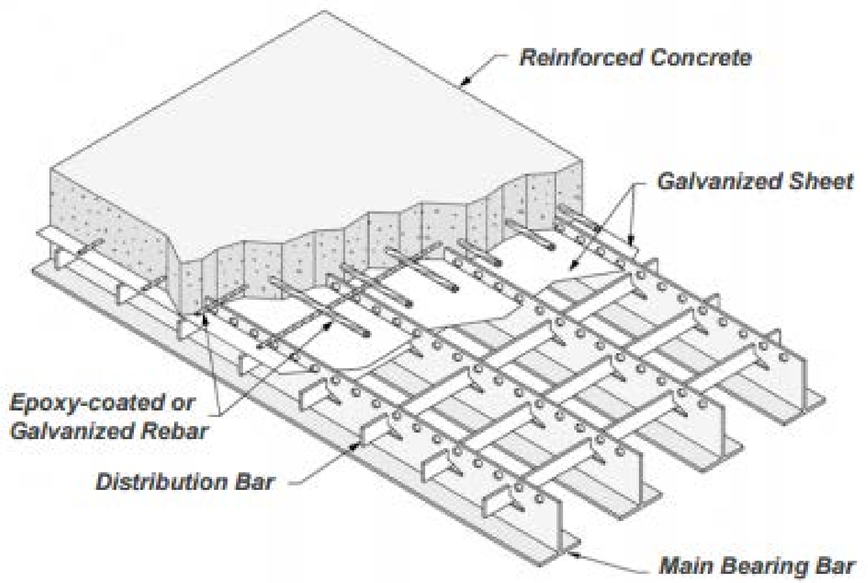
- Construction time significantly reduced



Evaluated ABC Deck Alternatives

- Full-depth precast concrete panels
  - Panel size controlled by shipping length and weight
  - Typical lengths range 8-12 feet
  - Available in light-weight concrete

- Precast grid deck panels
  - 30-50% lighter than concrete panels
  - Requires many CIP joints
  - Not as durable
  - Available in light-weight concrete



Exodermic™ Deck System.

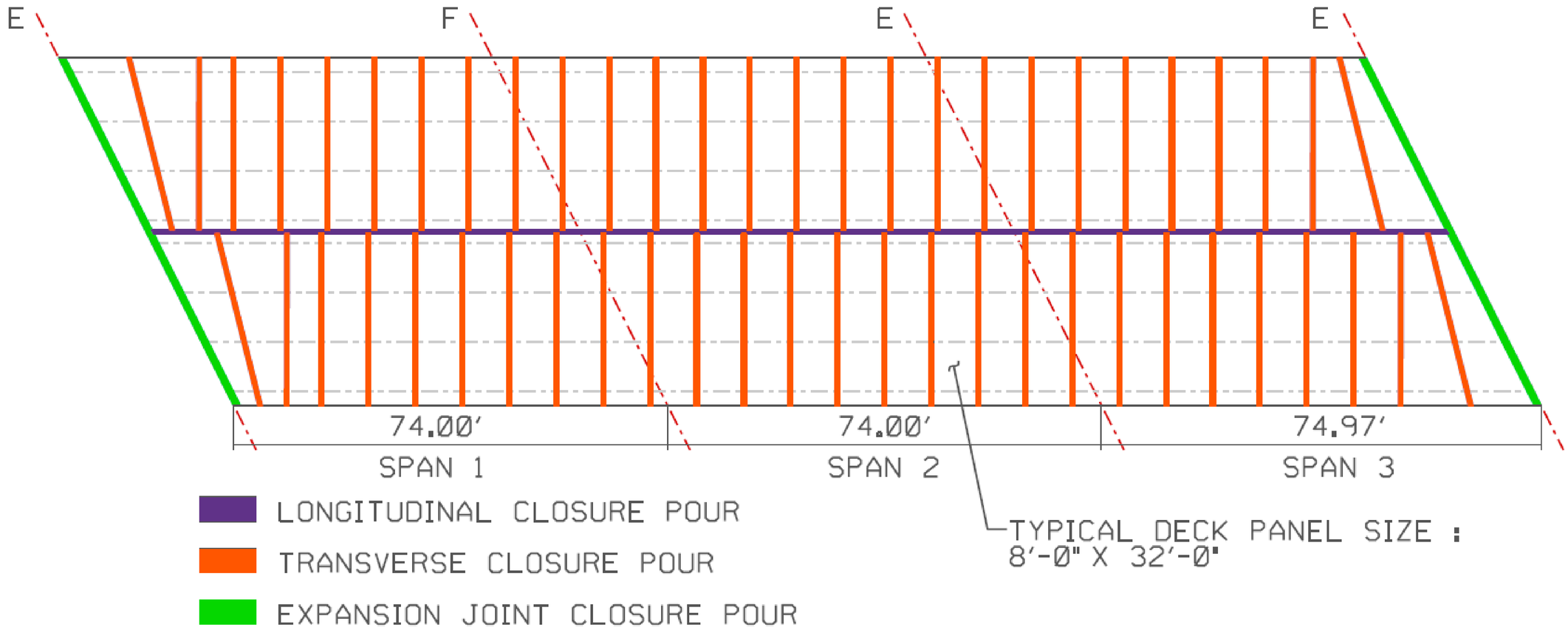
Filled Grid Deck - Ref: D.S. Brown

Load Ratings - BRASS

- Existing typical section
  - Dual superstructures
  - Inside exterior girders are critical
  - Ratings of 0.9

- Proposed typical section
  - Single superstructure
  - Inside exterior girders become interior girders
  - All proposed ratings exceed 1.0

BR1-680 Concept – Full-Depth Precast Deck Panel Layout



Precast Concrete Deck Panel Project

- TXDOT Live Oak Creek Bridge
  - Very similar geometry to BR1-680
  - 700’ total length
  - Precast panels 8’x32’
  - No longitudinal post-tensioning

Ref: TXDOT

Ref: TXDOT

Precast Concrete Deck Panel Project

- Utah DOT I-70 Bridge over Eagle Canyon
  - 491’ total length
  - Precast panels 14’x34’
  - Longitudinal post-tensioning
  - Lightweight concrete

Ref: Utah DOT

Ref: Utah DOT

Evaluated Closure Pour Alternatives

- Ultra High Performance Concrete (UHPC)
  - f ’c = 21,700 psi
  - Increased durability, Low permeability
  - Typical closure pour width = 8”
  - $5,000 / CY

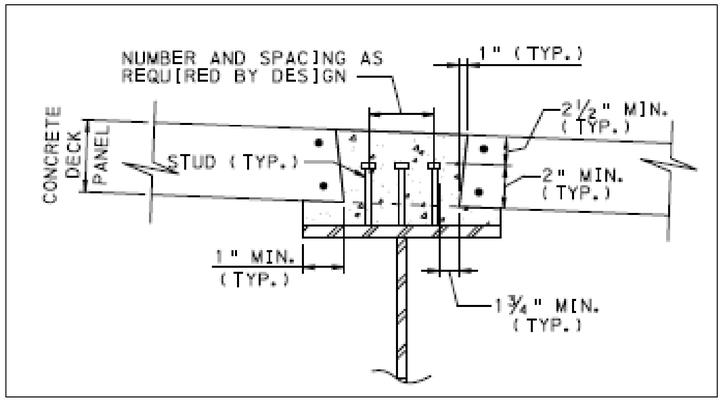
UHPC – Hawk Lake Bridge (Ontario, Canada)
Ref: Precast.org

- Rapid Set Concrete
  - f ’c = 3,000 psi in 3 hours
  - Potential cracking
  - Typical closure pour width = 2-3 feet
  - $650 / CY

UHPC Joint
Ref: Accelbridge.com

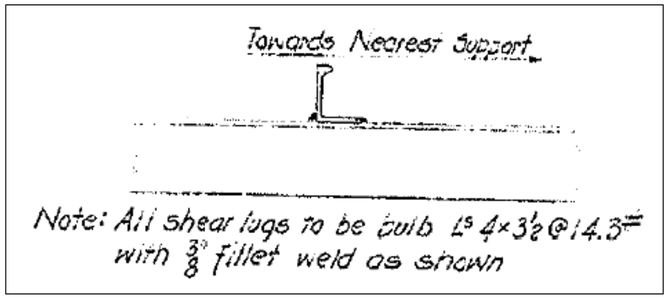
Shear Connectors

- Full-depth Shear Pockets
  - Replace existing shear connectors
  - 2 shear pockets per beam line per panel

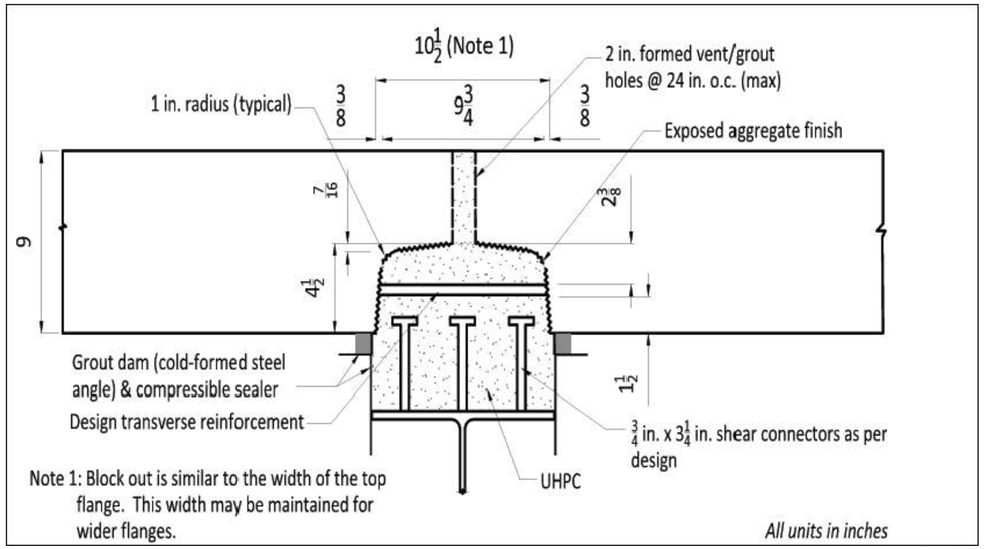


PennDOT detail - BD-605M

- Partial-Depth Shear Block Out
  - Keep existing shear connectors
  - Block outs extend full length of bridge



Existing Shear Lug detail



Bridge Expansion Joints

- Deck Joints at Pier 3 and Pier 5
- Delcrete Strip Seal alternative
  - 4” movement classification
  - Open to traffic 1-2 hours after installation
  - 20-25 year life expectancy

Ref: D.S. Brown

Evaluated Deck Overlays

- Epoxy Polymer
  - 3-6 hour cure time
  - 10-15 year life
- Rapid Set Latex Modified Concrete (RSLMC)
  - 4 hour cure time
  - 20 year life
- Polyester Polymer Concrete (PPC)
  - 2 hour cure time
  - 30 year life

Oregon DOT Eagle Creek Viaduct – PPC Overlay
Ref: Kwik Bond Polymers

Project with PPC Overlay

- NJDOT Route 35 over Shark Creek
  - PPC used to create smooth riding surface after deck experienced settlement
  - Overlay thickness varied from ¾” to 4”

Ref: Kwik Bond Polymers

Ref: Kwik Bond Polymers

Project with PPC Overlay

- San Francisco Oakland Bay Bridge - Skyway Segment
  - 300,000 vehicles/day

Ref: CalTrans

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THANK YOU.

Questions?