FULLY PRECAST CONCRETE BRIDGE SYSTEM FOR ACCELERATED CONSTRUCTION

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Acknowledgements
Outline

• Background
• Objectives
• Project Description
  • Substructure
  • Superstructure
• Component Fabrication
• Bridge Construction
• Lessons Learned
Background: Location

Belden-Laurel
NH-20-6(105); C.N. 31342

ADT < 2000
Replace 6.8 miles
Background: Old Structure

- 3 Span Steel Girder – 100’ total
- Original Construction 1938. Widened in 1972
- Scour issues temporarily repaired in 2013
- Deck test in 2015 shows high chlorides
Background: Condition
Objectives

• Expand on ABC features previously done in Kearney
  • Add precast rails to precast deck panels
  • Simplify deck-to-girder connections
  • Provide non-post-tensioned option using UHPC

• Utilize new ABC features
  • Precast abutment caps
  • Precast wing walls
  • Precast grade beams
  • Precast approach slabs

• Minimize road closure period
Review: Kearney East Bypass
Project Description

- Simple Span NU 1100 – 130’
Substructure

Plan View of Abutment Cap, Wing Wall, and Grade Beam
Elevation View of Abutment Cap
Cross Section of Abutment Cap at CMP
E Girder "C"

Place four S501 @ 1' - 5/8" ctrs. (Place to avoid HSS tubing)

Place three S501 @ 1' - 7" ctrs. = 3'-2"
(Place to avoid pocket liners)

6" (Typ.)

S501 (Typ.)

2'-6" (Typ.)

No. 5 Bars equally spaced (Typ.)
(Place 5 between interior girders and 4 outside exterior girders)
(Top and Bottom) (36 req'd.)

6-0.6" Φ strands (Place as shown) (Top)
6-0.5" Φ strands (Place as shown) (Bottom)

S590 (BF) 6 Req'd. (Typ. each Post)
S591 (FF) 7 Req'd. (Typ. each Post)
HSS Tubing

NU Deck Panel

S501

Concrete Adhesive

NU 1100 Concrete Girder

Backer Rod

Fill joint opening with UHPC concrete.

8 1/2"

6"

8 1/2"

6"

2 1/4"

2 1/4"

1/2"

1/2"

1/3"

1/3"

3/4"

3/4"

△ Backer Rod to be pressed in joint opening

6"

No. 5 Bar (Typ.)

Concrete Adhesive
Shear Pocket

Shear Connector

After the shim shots have been calculated, adjust the nut/washer assembly to the proper height. Cut off excess threaded rod above the nut and tack weld the nut to the structural washer.
6 -0.5 in. top strand

HSS 12.75x0.25

4 in. diameter grouting hole

5 - 5/8 in. studs

1'-0 3/4"

6-0.5 in. bottom strands

Embedded metal tabs @ 18 in. spacing

4-0.6 in. strands

12-0.6 in. deflected strands

Bent plate welded to metal tabs

1 1/2" diameter A193 grade B7 coil rods @ 48"

52-0.6 in. strands

4 debonded strands

3'-7 3/8"

4'-5 1/8"
Fill opening between rails with UHPC-2iksi concrete.

Rail

Dimensions and Reinforcement Typical
At The Exterior NU Deck Panels

Exterior NU Deck Panel Length = 12'-6'/4"
Span Length = 12'-5"
Approach and Paving Sections

approach section to NU deck panel connection at end of floor

longitudinal joint on paving and approach slabs

fill joint with SCC
no. 5 bars @ 12" ctrs.

no. 5 bars @ 12" ctrs.

no. 5 bars

end of floor

c. abutment

no. 5 bar

6" gap

no. 5 bar

exterior NU-deck panel

approach slab

6½"

no. 8 bar

fill gap with uhpc 21ksf

abutment turndown

1½" preformed joint filler

* STEEL TROWEL TO A SMOOTH FINISH on the top of the backwall for placement of two SBS Modified Asphalt Base Sheets.
Component Fabrication

• 7 NU1100 Girders
• 22 Full-depth deck panels with Rail
• 2 Abutment Cap
• 4 Wing Walls
• 2 Grade Beams
• 8 Approach Slabs
Construction

• Installing prefabricated components:
  • Abutment Caps
  • Wing Walls
  • Grade Beams
  • Prestressed Concrete Girders
  • Deck Panels with Rail
  • Approach Slabs

• Connecting components using CIP:
  • Self-Consolidating Concrete (SCC)
  • Ultra-High Performance Concrete (UHPC)
  • High-Early Strength Concrete (HESC)
1. Fill Longitudinal Joint above Girder D with HESC
2. Fill Remaining Girder Haunches with SCC
3. Fill Transverse Joints with UHPC
Filling Joints Between Approach and Paving Panels

1. Fill Transverse Joint at End of Floor with UHPC
2. Fill Pockets above Grade Beam with SCC
3. Fill Longitudinal Joints with SCC
Lessons Learned

1. The round shear pocket and single rod shear connectors were easy to fabricate and erect. However, rod elevation need to be measured accurately to ensure adequate embedment without spalling the pocket concrete.

2. Using compressible material to form the haunch is acceptable for haunch thickness less than 6 in. SCC pressure tends to push away the form in thicker haunches.
Lessons Learned

3. Extending panel bars into the transverse joints beyond the joint lips makes moving the panels out of sequence very difficult.

4. Several simplifications could be done to the precast back wall and wing walls, such as using bigger spacing between pile openings, eliminating studs welded to CMP, minimizing reinforcement inside the openings, using constant thickness in wing walls, adding more turnbuckles to adjust wall alignment.