IBRD, EDC and ABC Initiatives
Case Study Boone County
Nebraska

Fouad Jaber, Assistant State Bridge Engineer
Nebraska Department of Roads
ABC-UTC WEBINAR
June 30th, 2015
Innovative Bridge Research and Development (IBRD)

- Folded Plate Girders Developed at the University of Nebraska
Every Day Counts Initiatives

• Geosynthetic Reinforced Soil-Integrated Bridge System
• Accelerated Bridge Construction
• Prefabricated Bridge Elements and Systems
• Ultra-High Performance Concrete Connections for Prefabricated Bridge Elements
PROJECT FACTS:

- School Bus Route
- Design Load: HL-93
- Roadway Classification: Off System-County Road
- GRS Design Method: FHWA GRS-IBS Interim Implementation Guide (FHWA-HRT-11-026)
- Q100 = 2200 CFS
- General Scour of 4 ft at Q100
- Girder design/fabrication was the responsibility of UNL
- Girder to be delivered within 150 mile radius of the bridge location
Plan and Profile
DETAILS OF ABUTMENTS SECTIONS
ABUTMENT SHEET

PLAN OF GEOSYNTHETIC REINFORCED SOIL ABUTMENT

ELEVATION OF GEOSYNTHETIC REINFORCED SOIL ABUTMENT

NOTES:

1. All plans, sections, and details are shown at 1/8" scale for reference.
2. All dimensions are in feet and inches.
3. Geosynthetic layers shall be placed as shown in the plan and sectional views.
4. Reinforcement details shall meet or exceed the requirements of the standard specifications.
5. All materials shall be tested and approved by the owner's representative.

STATE OF NEBRASKA - DEPARTMENT OF TRANSPORTATION

1001 F Street, Lincoln, NE 68508
www.dot.ne.gov
ABUTMENT DETAILS

ISOMETRIC VIEW OF GIRDERS SEAT
Not to Scale
GIRDER SEAT @ ABUTMENTS

**Diagram Description:**
- Concrete Girder Seat
- 4" Polystyrene
- Concrete Filled CMU with Rebar
- No. 4 bar
- Primary Geosynthetic Reinforcement Layers
- Intermediate Reinforcement Layer (Typ.)
- Wrap 4'-0" Geosynthetic Reinforcement Tail (Typ.)
- Bearing Bed Reinforcement (Typ.)

**Detail A**
Scale 1" = 1'-0"
Road couldn’t be closed till Sept 15 30 working days to reopen.
Girders were delivered on July 1\textsuperscript{st}
Girder were blocked to match final
Shored Construction
No Girder camber
Continuous un-yielded support
Deck Units was formed to be poured at once
Deck Overhang Forming
Lifting devices.
8 inch UHPC closure pour

Form Set retarder painted over forms

Exposed aggregate finish
Power washed 12-24 hrs after pour
Deck Placement
Deck Placement
8 inch UHPC closure pour

Straight bars – 8” opening
Used on this project

Headed bars – 12” opening
From another project
Geosynthetic Reinforced Soil-Integrated Bridge System (GRS-IBS)-Footing
GRS-IBS - Granular material filling to build 2 ft RFS (Reinf. footing System)
GRS-IBS CMU Wall first layer
½” sand layer to help level
GRS-IBS
completed first CMU Wall layer
GRS-IBS – Each layer is 8” thick compacted granular material
GRS-IBS – red scour line
Placing Girder/Deck Units. Two cranes and four trucks were used
Placing Girder/Deck Units
Excellent Alignment between units
Placing Girder/Deck Units
It took about 2 1/2 hrs.
UHPC Connections for Prefabricated Bridge Elements using 3.5 cu.ft. mixer to batch 3 CuYd
UHPC – Quality control

Steel Fibers
All Ingredients measured

All batches tested
UHPC
21KSI 28 days, 12ksi 4 days strength
UHPC – Joint forming

- Formed 1/8” high joints
- Chimneys @ 8 ft spacing
UHPC. Materials flows good. Bridge has 2” drop from end to end.
UHPC- Grinding the 1/8” high joint using floor grinder to grind flush
UHPC - Before and After grinding.
Voids filled with non-cement grout
Water Test of UHPC Closure Pour
NE LTAP for time lapse photos
Open to traffic
November 19th, 2014
Costs

- Bridge Only Cost (Minus Girders): $455,000
  - GRS Abutments: $265,000
  - UHPC: $200/lin ft total of: $38,500
  - Folded Plate Girders: $90,000 delivered to the site
  - Class 47BD-4000 Concrete: $2300/cu yd total of: $108,000
  - Epoxy Coated Reinforcing Steel: $3.0/lb total of: $30,000

- Engineers Estimate: $400,000
Conclusions and Lessons Learned

- **EXCAVATION**
  - No room to excavate. There was no bridge there (40 “ CMP pipe) therefore more excavation

- **RFS**
  - It was the most difficult part since the access was limited for abutment excavation.
  - No room for U-shaped abutment. Straight or Flared 45 degree wings would have worked better

- **GRS**
  - New and untraditional construction therefore more risk and more expensive.
  - This type of abutment does not pay for carpenters and the iron workers and crane operator

- **Pre-topped Bridge Deck**
  - Forming and pouring as whole unit will save time and money
  - Could’ve chosen further staging area but trucking will cost more than renting

- **UHPS**
  - Painting the forms with set-retarder worked well.
  - Using foam to form the keyway would’ve been better during stripping.
  - Waiting for the UHPS to reach 10 ksi to grind is too long and too hard to grind.
  - Used floor grinder to grind the joints

- **Contractor overall impression**
  - The contractor mentioned that it’s very interesting project and wasn’t that difficult to build.
  - If he has to do it again the cost will be way more economical since he has built one.
  - Contractor mentioned they can built this system in 14 working days if they have to or maybe less.
Special Thanks
Simon Contractors
NDOR District 3
NDOR Construction
Boone County
FHWA
Thank you