DelDOT and the GRS-IBS Experience

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DelDOT

July 21, 2014
The President!
DelDOT’s Experience

- BR 1-366 on Chesapeake City Road
  - DelDOT’s 1st
- BR 3-140 on Tuckers Road
  - DelDOT’s 2nd

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Original Bridge (BR 1-366)

- Constructed in 1935.
- 29’ span, concrete encased steel beams on masonry abutments.
- Curb to curb width was 24.5’.
- Structurally Deficient (Superstructure NBI 3) and Functionally Obsolete.
Original Bridge (BR 1-366)

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East Approach
Original Bridge (BR 1-366)
Rapid Construction

- Local detour using Denny Road was over 3 miles long.
- Regional detour was over 17 miles long and went through Maryland.
- Phased construction was not practical due to adjacent properties (ACOE and DNREC).
Design Considerations (BR 1-366)

- **Good soil**
  - Sandy material with high blow counts.
  - Suitable for shallow foundation.

- **Hydraulics**
  - Short-span structure appropriate.

- **Roadway Geometry**
  - Tangent alignment and no skew with stream
Structure Selection

- Based on the need to complete the construction quickly, the boring results, and the H&H analysis, a small structure was the best option.
- Typically a precast concrete frame would be the selected structure type.
- However, Every Day Counts!
- GRS-IBS selected.
Structure Selection

- GRS-IBS the new “it” structure as part of FHWA’s *Every Day Counts* and *Every Day Counts 2* initiatives.
- DelDOT received an Innovative Bridge Research and Development grant from FHWA for $300,000. (BR 1-366)
Structure Selection
Structure Selection
Structure Selection

PLACE RIPRAP AT INLET, OUTLET AND THROUGH THE STRUCTURE (MAINTAIN CROSS SECTION THROUGH THE STRUCTURE). BACKFILL THE VOIDS WITH BORROW TYPE 'B'.

ABOVE THE WATERLINE, 'IN-FILL' THE VOIDS OF THE RIPRAP USING TOPSOIL. PLACE PERMANENT GRASS SEEDING, DRY GROUND AND SOIL RETENTION BLANKET MULCH, TYPE 3 (TYP. ON SLOPES). PAYMENT UNDER 732004-TOPSOLING AND #734013-PERMANENT GRASS SEEDING, DRY GROUND.

BRIDGE ELEVATION

1/4" = 1'-0"
Structure Selection
Structure Selection

- Backfill is extremely important.
- FHWA recommends either a well graded or an open graded material.
- For this project, the open graded material was used.
- A #89 stone was specified. We ended up using a select #8 stone.
Stream Diversion
Barrier Connection

At posts adjacent to tube expansion splotes, nuts finger tight with threads buried.

SECTION B-B
1" = 1'-0"
Cost (BR 1-366)

- Project was bid on August 28, 2012.
- Bids were received on September 13, 2012.
- Mumford and Miller Concrete, Inc. was the successful low bidder.
- EE for the project was $727,181.62.
- Low bid value was $737,090.95.
Cost (BR 1-366)

302521 – Granular Embankment
   Quantity = 2,272 CY
   EE = $37/CY       LB = $47.50/CY

713501 – Geosynthetic Reinforcement
   Quantity = 9,220 SY
   EE = $11/SY       LB = $4/SY

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Cost (BR 1-366)

602690 – Solid Concrete Masonry Block
Quantity = 885 SF
EE = $12/SF    LB = $11/SF

602691 – Voided Concrete Masonry Block
Quantity = 2,805 SF
EE = $10.50/SF   LB = $10/SF
Cost (BR 1-366)

302522 – Reinforced Soil Foundation

Quantity = 470 CY

EE = $45/CY       LB = $61/CY

Total Cost of GRS Abutments

EE = $246,706.50

LB = $211,255.00

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We worked with Dr. Chris Meehan and his staff from the University of Delaware throughout the project.

The University verified the design of the GRS abutment components.

They also developed an instrumentation plan to accompany their research.
Research Component (BR 1-366)
Final Product (BR 1-366)
Final Product (BR 1-366)
Inventory Inspection (BR 1-366)

East Abutment with Broken Blocks (Looking South)

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Inventory Inspection (BR 1-366)

East Abutment – ¾” Wide Joint Gap in 2nd Row from Top (Looking Up)

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Inventory Inspection (BR 1-366)

East Abutment – Uneven Battering or Bulging (~8 Feet Below Girders)

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Lessons Learned (BR 1-366)

- First course of block is vital. Must be straight, level and plumb.
- The blocks slide easily if the edges are too smooth. Need a batter to allow for some movement.
- Allow for learning curve. The second abutment was much better than the first.
- Inspectors need to understand how the bridge works.
Round 2 (BR 3-140)
Original Bridge (BR 3-140)

- Constructed in 2001
- Three 6’ CMP
- Two 9’ travel lanes
- 125 ADT (2012)
- Pipes failed during Hurricane Sandy
Original Bridge (3-140)

Downstream

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Structure Selection
Structure Selection
Structure Selection

BREIDGE ELEVATION

NOTE: BEAM SEAT ELEVATIONS GIVEN ARE FOR CENTER OF BEAMS LOCATED ON EITHER SIDE OF BRIDGE CENTERLINE.
Cost (BR 3-140)

- Bids were received on September 13, 2012.
- George & Lynch, Inc. was the successful low bidder.
- Construction began November 18, 2014
  - Solid red block lead time (6-8 weeks)
- EE for the project was $400,000.00
- Low bid value was $419,634.20
Cost (BR 3-140)

302521 – Granular Embankment

Quantity = 911 CY (2,272 CY)
EE = $46.5/CY ($37/CY)
LB = $63/CY ($47.5/CY)

713501 – Geosynthetic Reinforcement

Quantity = 5,465 SY (9,220 SY)
EE = $5.5/SY ($11/SY)
LB = $4.4/SY ($4/SY)
Cost (BR 3-140)

602690 – Solid Concrete Masonry Block

Quantity = 562 SF (885 SF)
EE = $18.75/SF ($12/SF)
LB = $23/SF ($11/SF)

602691 – Voided Concrete Masonry Block

Quantity = 1,260 SF (2,805 SF)
EE = $15/SF ($10.5/SF)
LB = $11/SF ($10/SF)

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Cost (BR 3-140)

302522 – Reinforced Soil Foundation

Quantity = 115 CY (470 CY)
EE = $55/CY ($45/CY)
LB = $73/CY ($61/CY)

Total Cost of GRS Abutments

EE = $108,181.50 ($246,706.50)
LB = $116,620.00 ($211,255.00)

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Lessons Learned (BR 3-140)

- Friction of block with fabric
- Level beam setting
- First coarse setting and Corners
- Material storage

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Lessons Learned (BR 3-140)

- FHWA review
- Lead time
- Block rate
- WATER!
  - Stream diversion and groundwater

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Final Product (BR 3-140)
Final Product (BR 3-140)
Questions?

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