

# BR 1-366 on Chesapeake City Road: DelDOT's First GRS-IBS Bridge

Presenter:

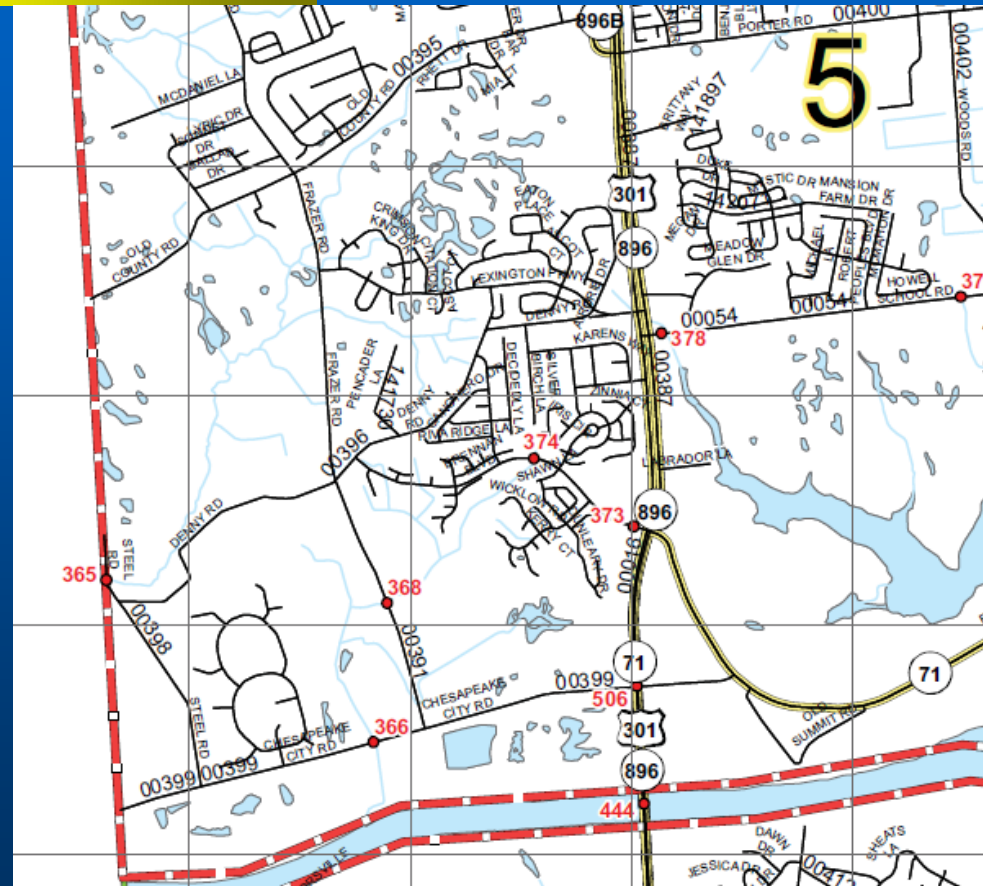
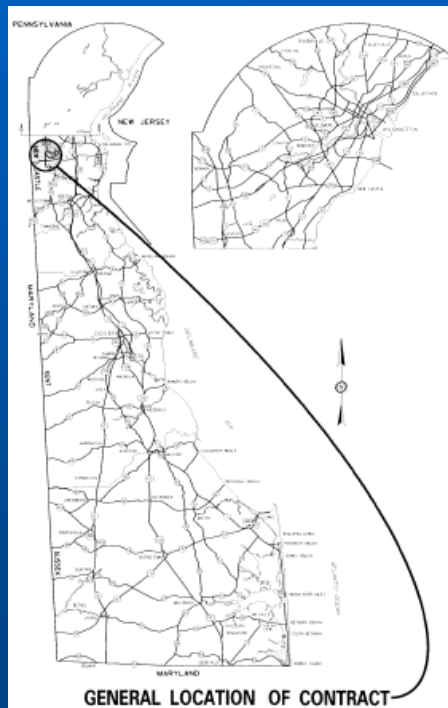
Barry Benton, P.E.

Assistant Director, Bridge

February 14, 2014



# Location



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# Original Bridge

- **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



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East Approach



# Original Bridge



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South Elevation

# Original Bridge



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General View West Abutment

# Design Considerations

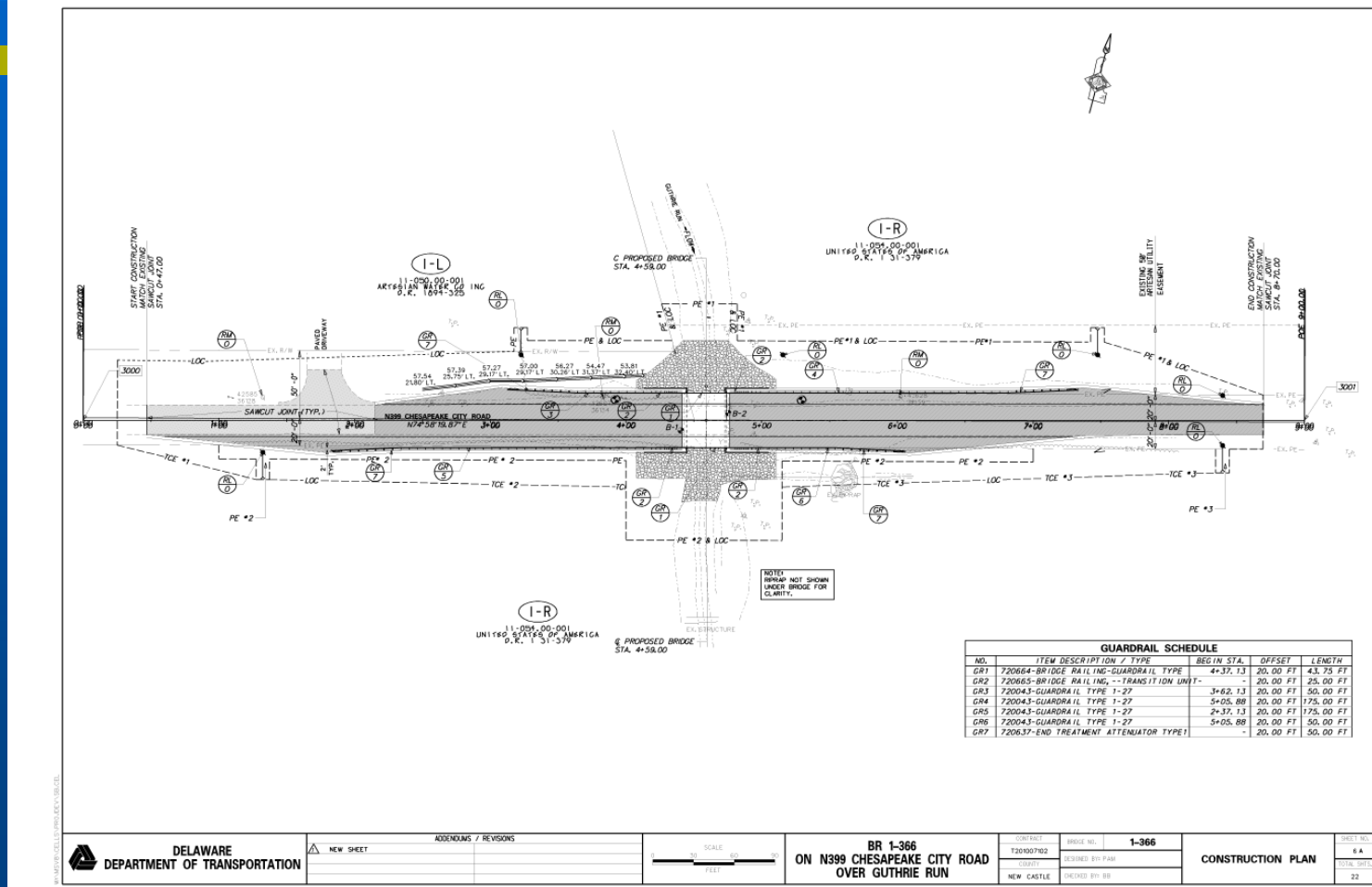
- **Rapid Construction**

- **Major Collector with 2094 ADT (2010).**
- **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

- **Good soil**
  - **Sandy material with high blow counts.**
  - **Suitable for shallow foundation.**
  - **Major Collector with 2094 ADT (2010).**
- **Hydraulics**
  - **Short-span structure appropriate.**
- **Roadway Geometry**
  - **Tangent alignment and no skew with stream**

# Project Information



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# 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 abutment bridge selected.

# Structure Selection



GRS-IBS? What do all those letters mean?

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U.S. Department  
of Transportation  
Federal Highway  
Administration

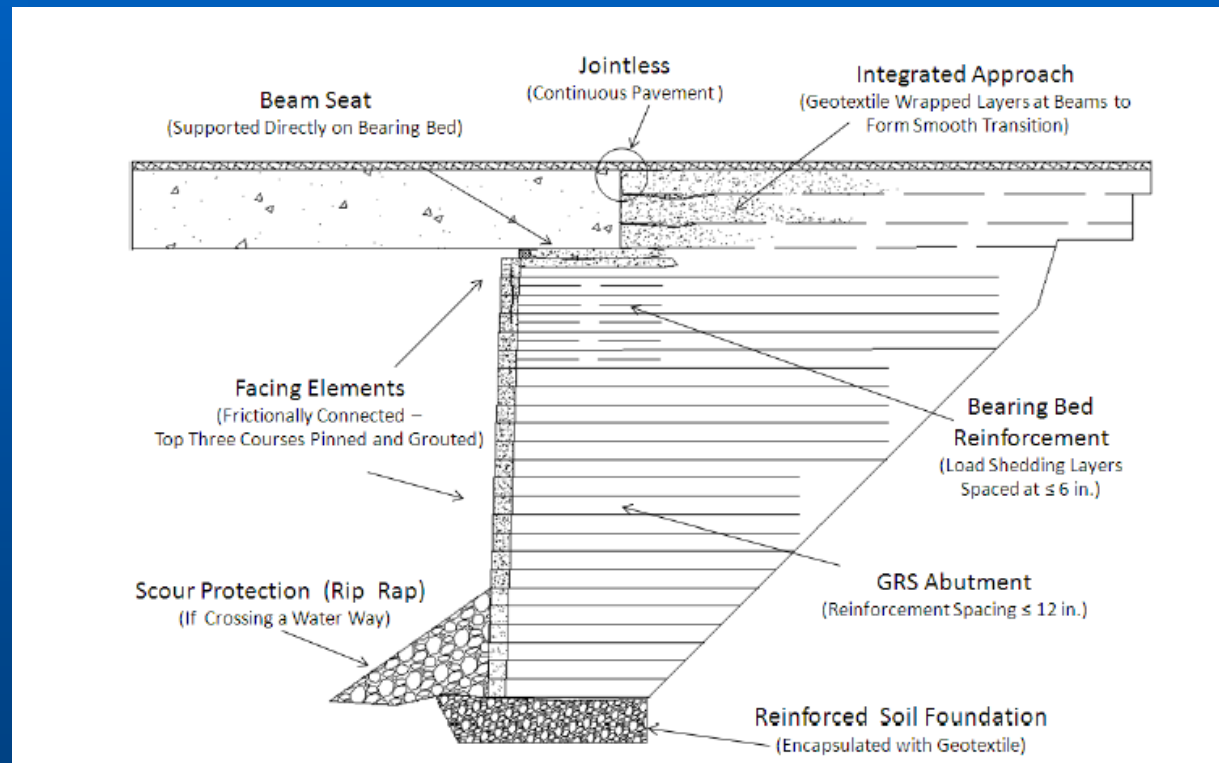


# GEOSYNTHETIC REINFORCED SOIL INTEGRATED BRIDGE SYSTEM

# Structure Selection

- **GRS – Geosynthetic Reinforced Soil**
  - An engineered fill of closely spaced (<12”) alternating layers of compacted granular fill material and geosynthetic reinforcement.
- **IBS – Integrated Bridge System**
  - A fast, cost-effective method of bridge support blending the roadway into the superstructure using GRS technology.

# Structure Selection



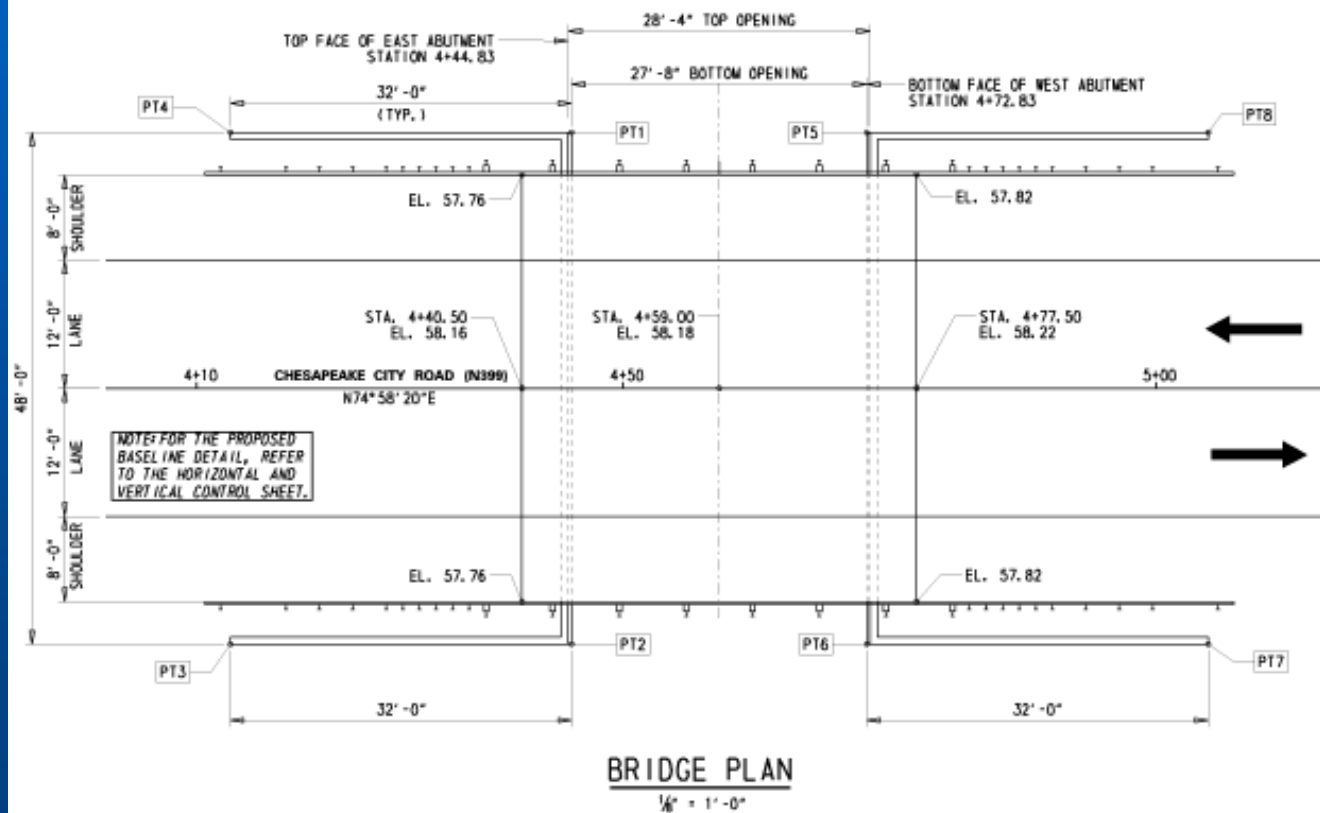
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# Structure Selection

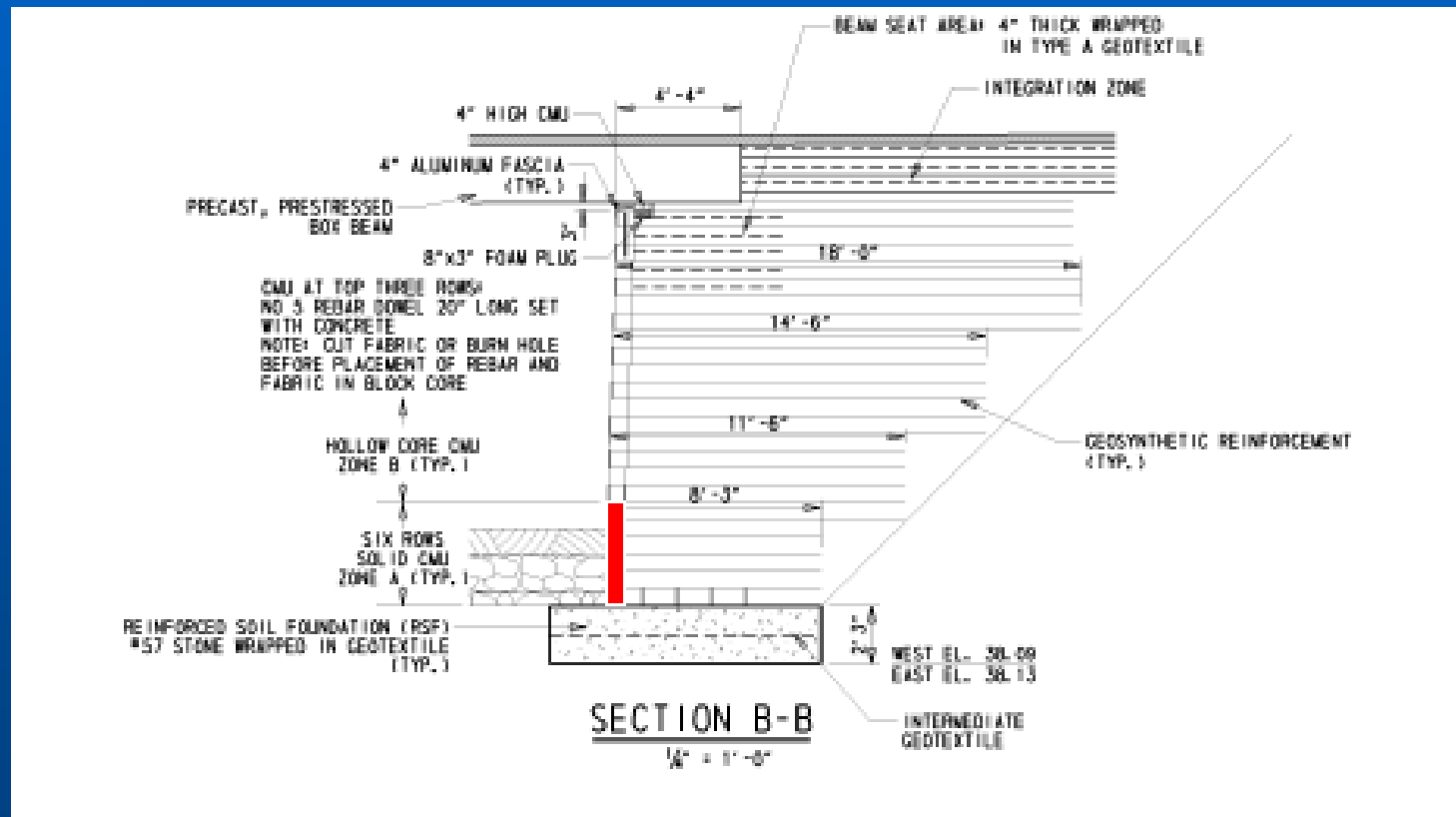
- **GRS-IBS** the new “it” structure as part of FHWA’s *Every Day Counts* and *Every Day Counts 2* initiatives.
- **DelDOT** received an Innovative Bridge Research and Deployment grant from FHWA for \$300,000.

# Structure Selection



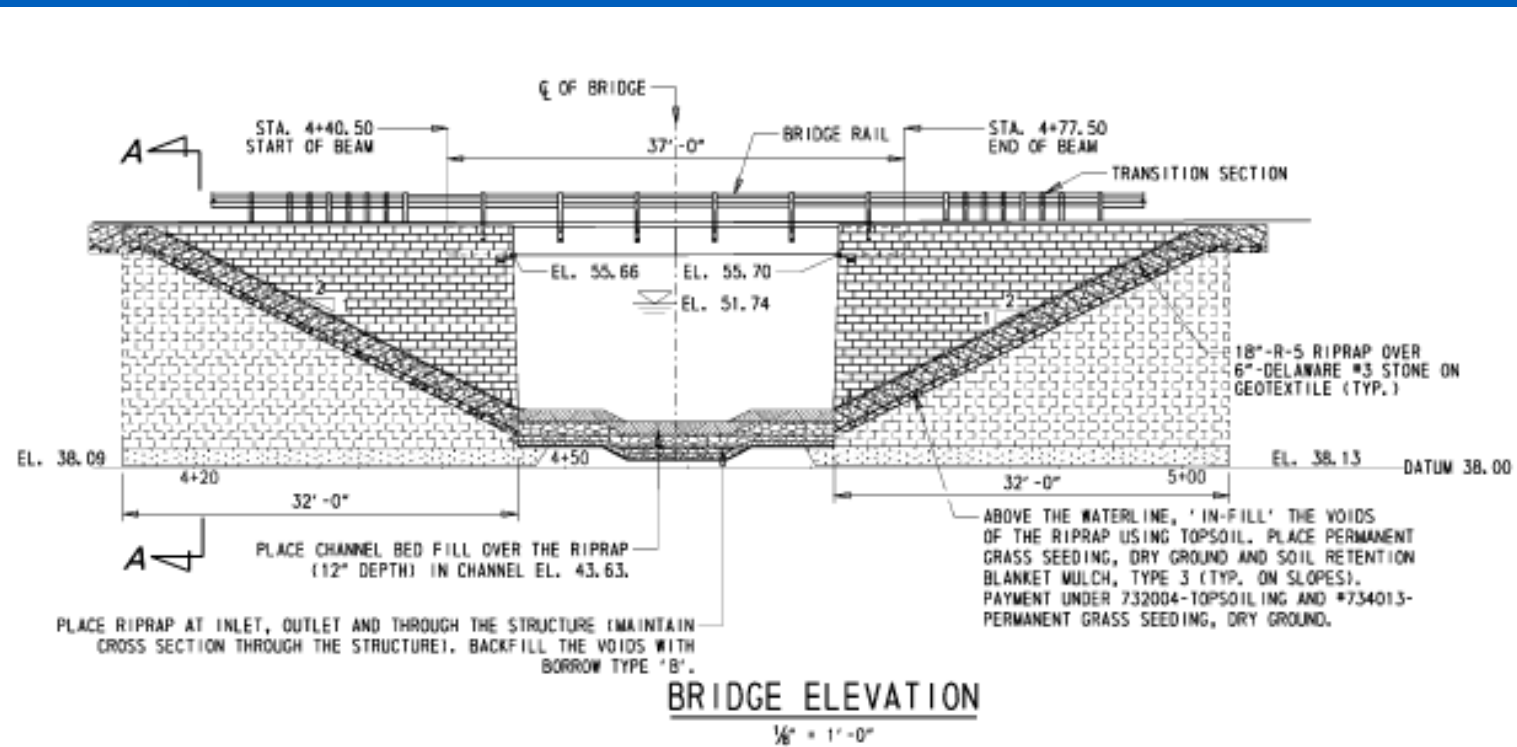
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# Structure Selection



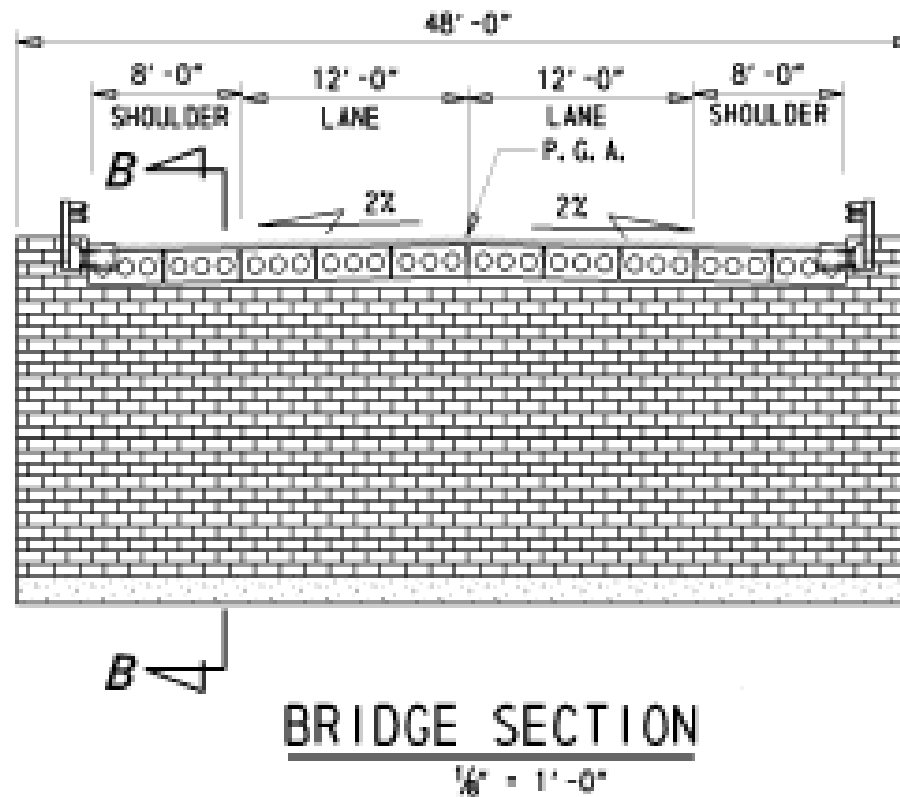
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# Structure Selection



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# Structure Selection



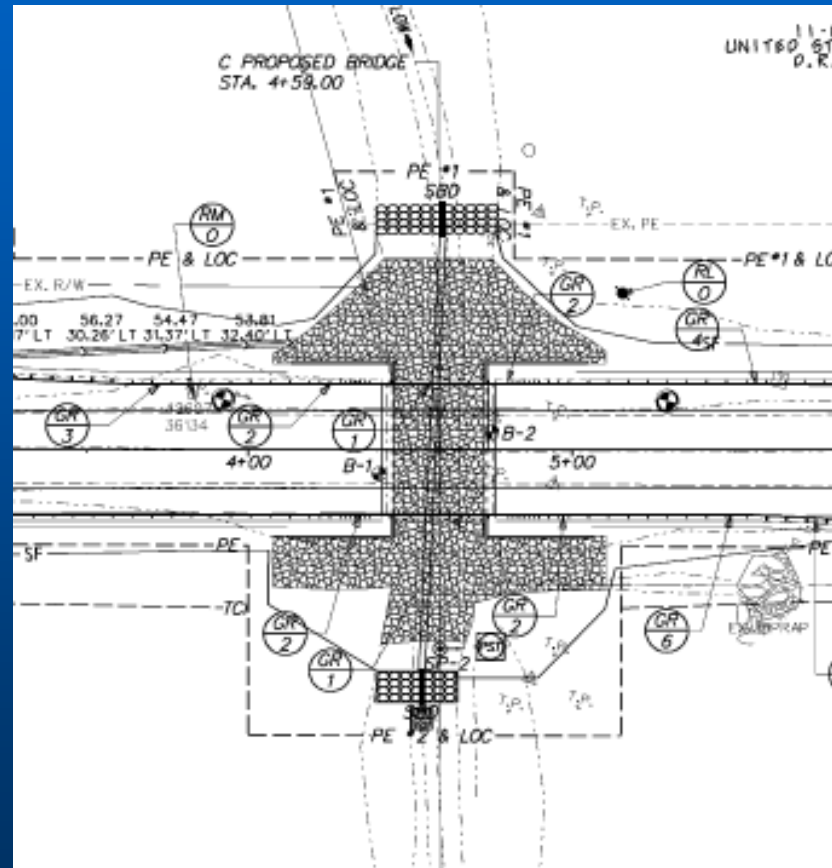
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# Structure Selection

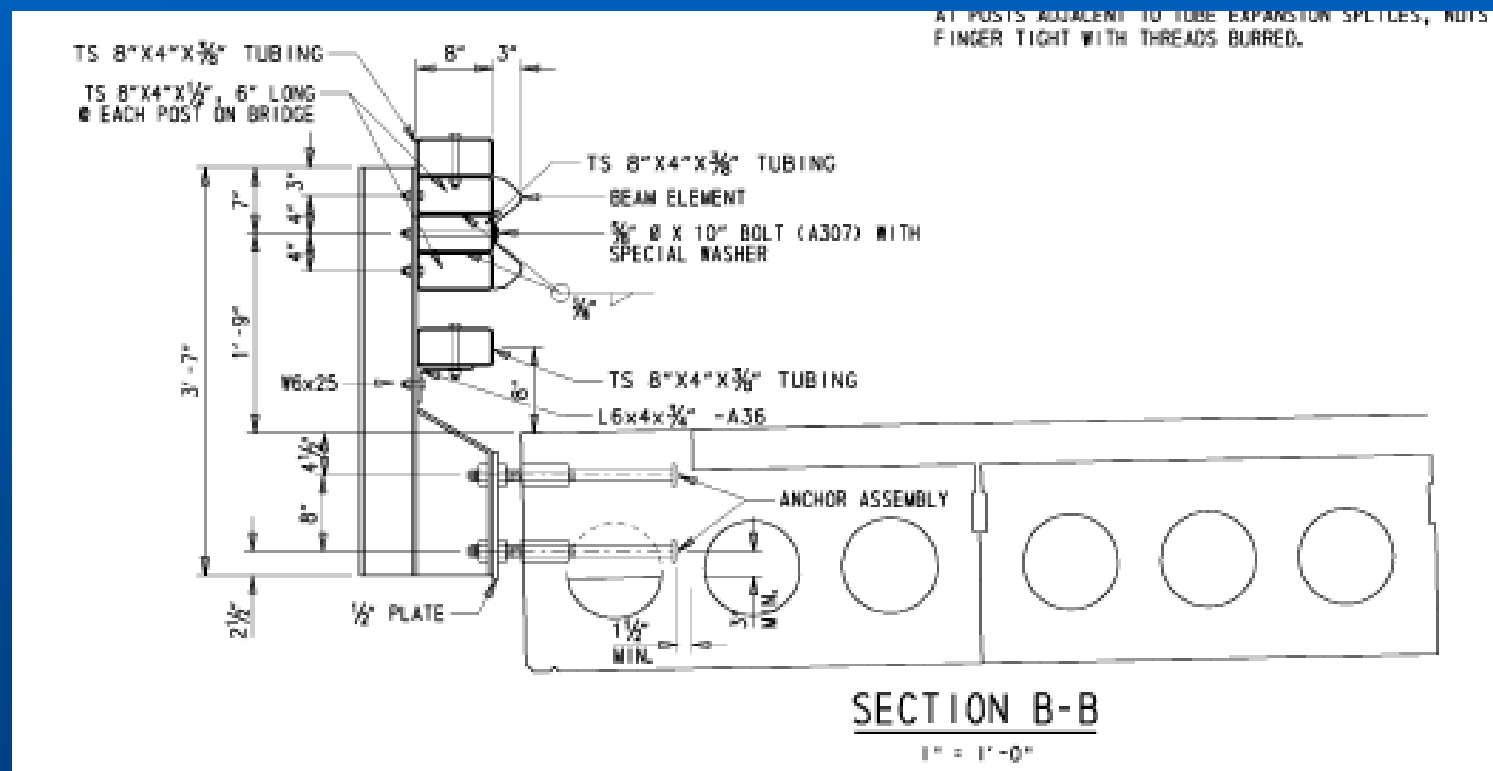
- The backfill is extremely important.
- FHWA recommends either a well graded or an open graded material.
- For this project, the open graded material was used.
- A #89 stone was specified. We ended up using a select #8 stone.

# Stream Diversion



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# Barrier Connection



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# Cost

- **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

## 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

## **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**

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# Cost

## **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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# Research Component

- We have 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.



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# Research Component



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# Final Product



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# Inventory Inspection



**East Abutment with Broken Blocks (Looking South)**

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# Inventory Inspection



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

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# Inventory Inspection



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

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# Lessons Learned

- **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.**

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# Questions?



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