I-84; Echo Frontage Road, Bridge Replacement Project

Design Perspective; GRS-IBS

Jim Higbee, P.E.
UDOT Geotechnical Engineer

August 18, 2013

Presentation Outline

- GRS-IBS Research
- Geotechnical Investigation
- Geotechnical Design
- Instrumentation Program
- Construction Aspects
- Construction Challenges

GRS-IBS Research

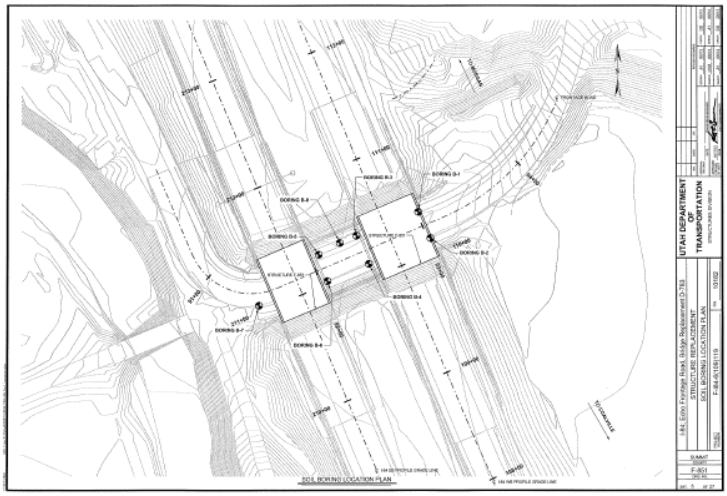
- NCHRP 12-59 Committee- ***Design and Construction Guidelines for Geosynthetic-Reinforced Soil Bridge Abutments with a Flexible Facing*** (2006 Green Report 556)
- NCHRP 12-59(01) Committee (Seismic Design of GRS Abutments)- "Jan 2012 Web-only document", Report 187
- Additional FHWA Research- GRS bents, geotextile spacing and strength, backfill strength, etc.

Geotechnical Investigation

Geotechnical Investigation

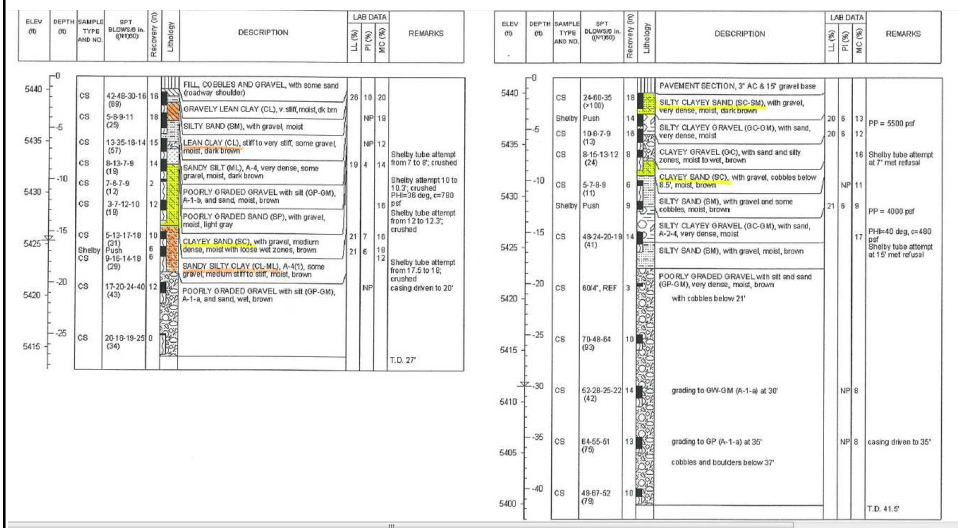
Geotechnical Investigation

Borehole Locations

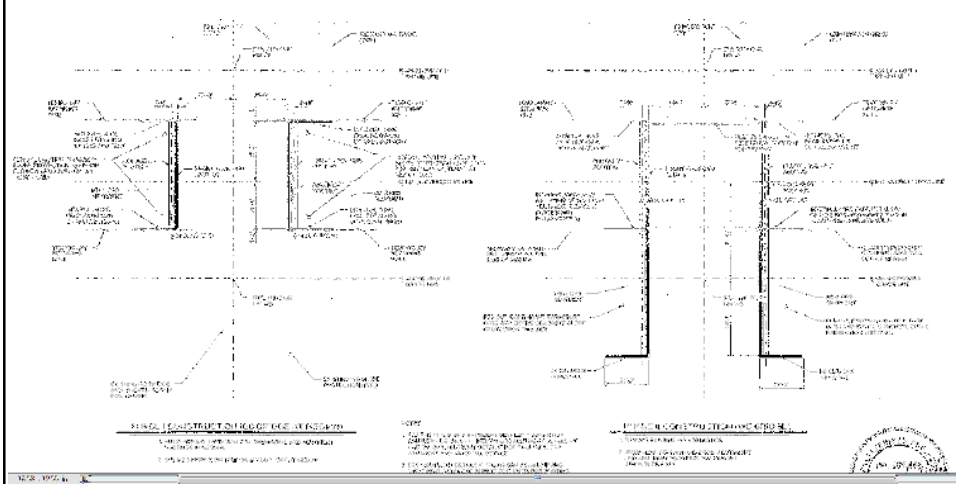


Geotechnical Investigation

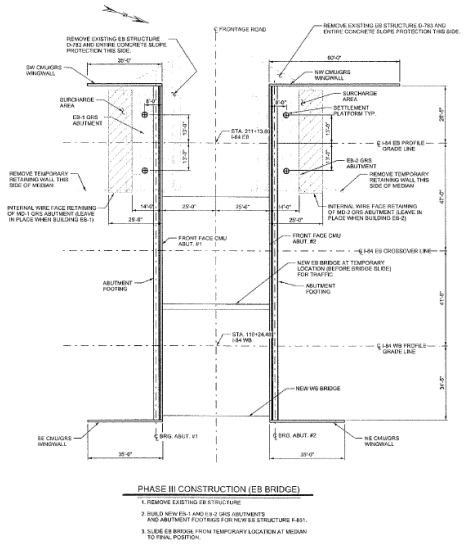
Subsurface Profiles



Geotechnical Design



Geotechnical Design



Geotechnical Design

Parameters

- Loading
  - Dead load 12,000 lbf
  - Live load 7,000 lbf
- Bearing pressure
  - 4,000 psf
- Seismic
  - PHGA = 0.25g
  - Spectral-0.2s = 0.61g, 1.0s=0.34g

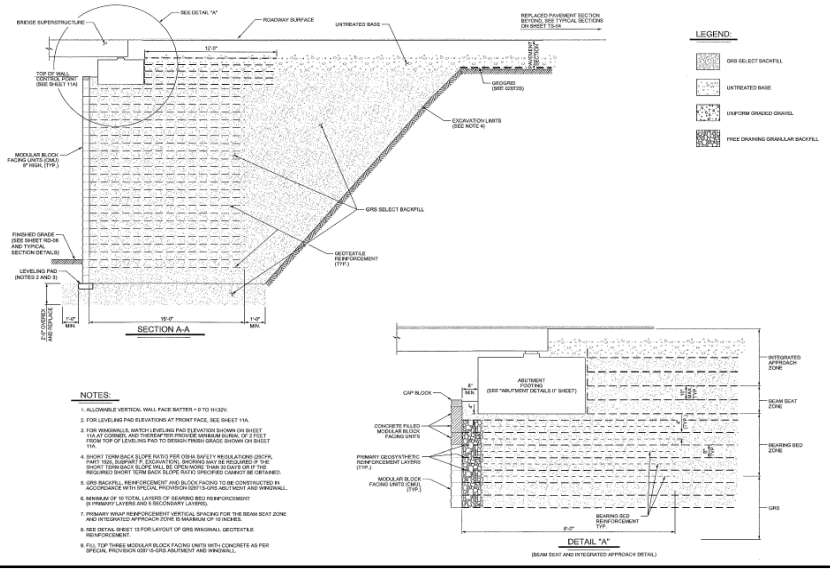
Geotechnical Design

Parameters

- Geotextile
  - FHWA standard 4800 lbs/ft
  - Woven biaxial polypropylene
- Length
  - 0.8*H = 15 ft
- High-quality GRS backfill
  - 42 degrees

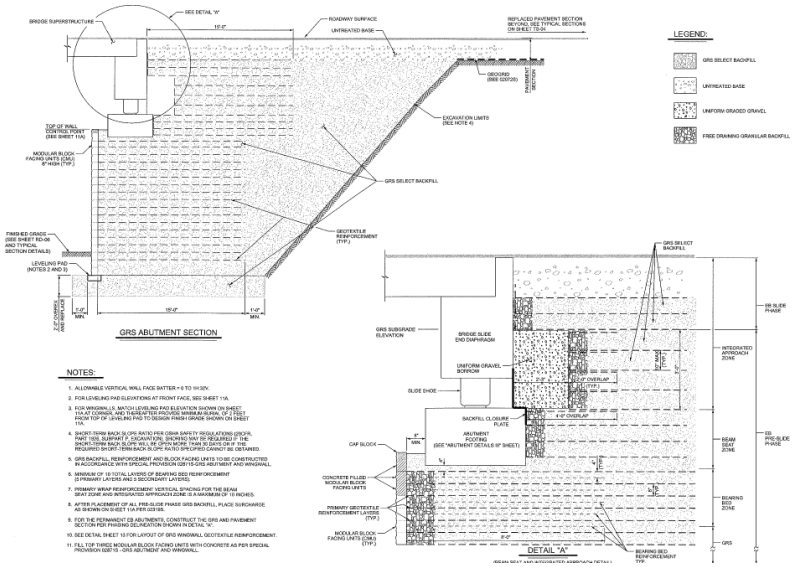
Geotechnical Design

WB Abutments (Standard)



Geotechnical Design

Median/EB Abutments (Non-standard)



NOTES:

1. ALLOWABLE VERTICAL WALL FACE BATTER = 6 TO 1H:32V.
2. FOR LEVELING PAD ELEVATIONS AT FRONT FACE, SEE SHEET 11A.
3. FOR WINGWALLS, MATCH LEVELING PAD ELEVATION SHOWN ON SHEET 11A AT CORNER, AND THEREAFTER PROVIDE MINIMUM BURIAL OF 2 FEET FROM TOP OF LEVELING PAD TO DESIGN FINISH GRADE SHOWN ON SHEET 11A.
4. SHORT-TERM BACK SLOPE RATIO PER OSHA SAFETY REGULATIONS (29CFR, PART 1926, SUBPART P, EXCAVATION). SHORING MAY BE REQUIRED IF THE SHORT-TERM BACK SLOPE WILL BE OPEN MORE THAN 30 DAYS OR IF THE REQUIRED SHORT-TERM BACK SLOPE RATIO SPECIFIED CANNOT BE OBTAINED.
5. GRS BACKFILL, REINFORCEMENT AND BLOCK FACING UNITS TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIAL PROVISION GS8715-GRS ABUTMENT AND WINGWALL.
6. MINIMUM OF 10 TOTAL LAYERS OF BEARING BED REINFORCEMENT (5 PRIMARY LAYERS AND 5 SECONDARY LAYERS).
7. PRIMARY WRAP REINFORCEMENT VERTICAL SPACING FOR THE BEAM SEAT ZONE AND INTEGRATED APPROACH ZONE IS A MAXIMUM OF 15 INCHES.
8. AFTER PLACEMENT OF ALL PRE-SLIDE PHASE GRS BACKFILL, PLACE SURCHARGE AS SHOWN ON SHEET 11A PER GS8185.
9. FOR THE PERMANENT EB ABUTMENTS, CONSTRUCT THE GRS AND PAVEMENT SECTION PER FINISHED SELINEATION SHOWN IN DETAIL "A".
10. SEE DETAIL SHEET 12 FOR LAYOUT OF GRS WINGWALL GEOTEXTILE REINFORCEMENT.
11. FILL TOP THREE MODULAR BLOCK FACING UNITS WITH CONCRETE AS PER SPECIAL PROVISION GS8715 -GRS ABUTMENT AND WINGWALL.

Geotechnical Design

Special Provision

October 16, 2012

SPECIAL PROVISION

PROJECT #F-I84-6(109)119

PIN #10182

SECTION 02871S

GRS ABUTMENTS AND WINGWALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Placement requirements and procedures for constructing Geosynthetic-Reinforced Soil (GRS) abutments and wingwalls for bridges.

1.2 RELATED SECTIONS

A. Section 02056M: Embankment, Borrow, and Backfill

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

1.3 REFERENCES

A. AASHTO T 27: Sieve Analysis of Fine and Coarse Aggregates

B. AASHTO T 90: Determining the Plastic Limit and Plasticity Index of Soils

C. AASHTO T 99: Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12 inch) Drop

D. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

E. AASHTO T 236: Direct Shear Test of Soils Under Consolidated Drained Conditions

F. AASHTO T 267: Determination of Organic Content in Soils by Loss on Ignition

G. AASHTO T 289: Determining pH of Soil for Use in Corrosion Testing

GRS Abutment and Wingwall
02871S - Page 1 of 1

Geotechnical Design

Materials Testing

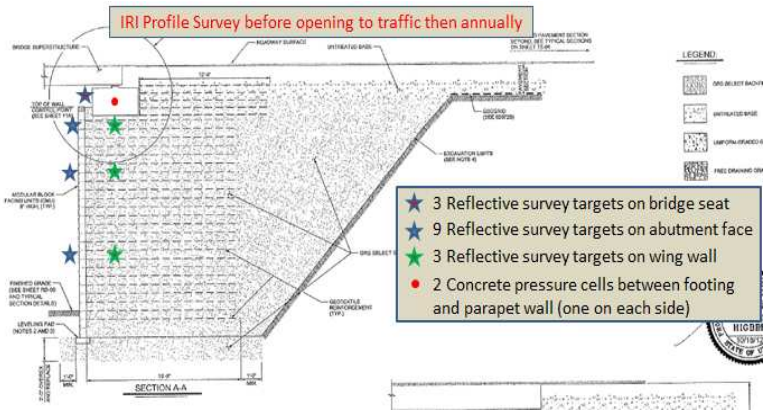
Geotechnical Design

Wingwalls

Geotechnical Design

- Construction Phasing
- WB Bridge-Standard GRS design
- Median and EB Bridge- not-so-standard design
- Special Provision Specification
- Materials and Testing
- Placement
- Wingwalls
- Seismic

Instrumentation Program



Construction Aspects

- Breaking ground
- Subgrade preparation
- Leveling pads
- Facing block
- Backfill placement (compaction)
- Moisture density testing
- Geotextile reinforcement
- Bearing sill/footing

Construction Aspects

- Surcharging and settlement monitoring
- Instrumentation program
- Bridge slide
- Construction phasing
- Construction challenges

Construction Aspects

Breaking Ground

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Construction Aspects

Subgrade Preparation

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Construction Aspects

Leveling Pads

Construction Aspects

Facing Block

Construction Aspects

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Facing Block

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Construction Aspects

Facing Block

Construction Aspects

Backfill Placement (compaction)

Construction Aspects

Backfill Placement (compaction)

Construction Aspects

Backfill Placement (compaction)

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Construction Aspects

Backfill Placement (compaction)

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Construction Aspects

Backfill Placement (compaction)

Construction Aspects

Moisture Density Testing

- < 95% = 14.9%
- 95-98% = 58.6%
- > 98% = 26.5%

Construction Aspects

Geotextile Reinforcement

Construction Aspects

Geotextile Reinforcement

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Construction Aspects

Geotextile Reinforcement

Construction Aspects

Geotextile Reinforcement

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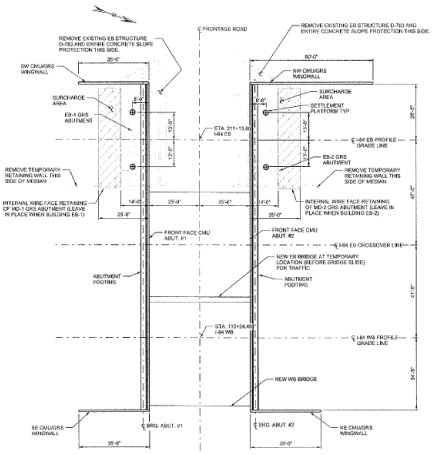
Construction Aspects

Bearing Sill/Footing

Construction Aspects

Surcharging and Settlement Monitoring



Construction Aspects

Surcharging

Construction Aspects

Surcharging

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Construction Aspects

Surcharging

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Surcharging

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Construction Aspects

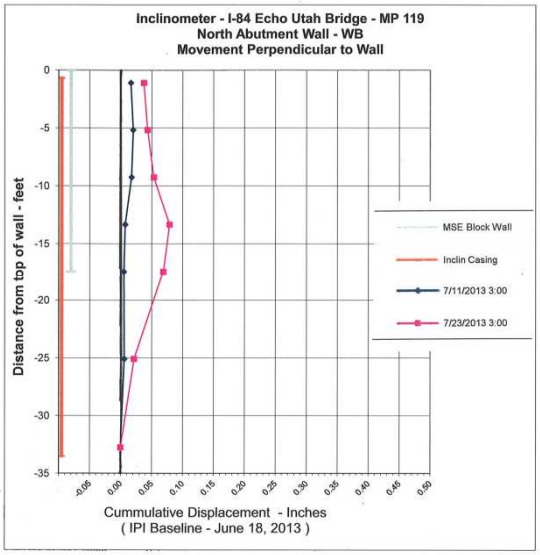
Settlement Monitoring

Construction Aspects

Instrumentation Program

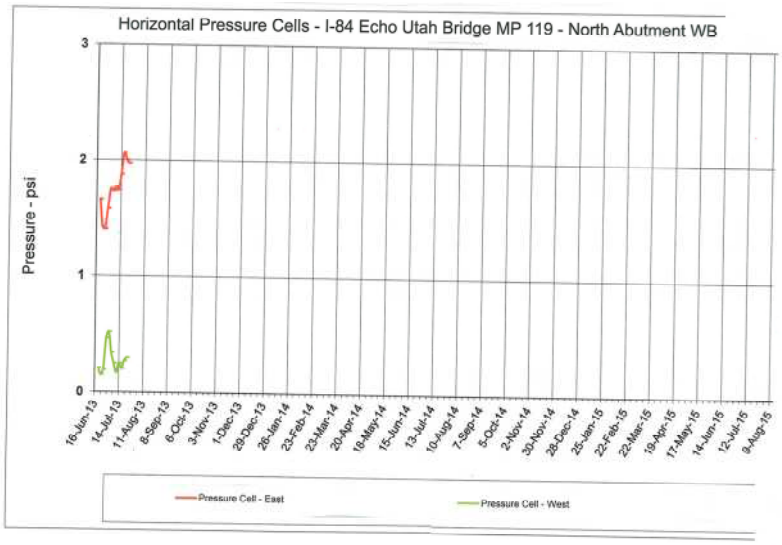
Construction Aspects

Instrumentation Program



Construction Aspects

Instrumentation Program



Construction Aspects

Bridge Slide

Construction Aspects

Bridge Slide

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Construction Aspects

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Bridge Slide

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Construction Aspects

Construction Phasing

Construction Aspects

Construction Phasing

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Construction Aspects

Construction Phasing

Construction Aspects

Construction Phasing

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Construction Challenges

Under-cutting Leveling Pad

Construction Challenges

Sloping Wall Face

ECHO
RENOVATE 80
A UDOT PROJECT
Thank you
UDOT
U.S. Department of Transportation
Federal Highway Administration
HIGHWAYS FOR LIFE