Florida Department of Transportation

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ANANTH PRASAD
SECRETARY



# STRUCTURES DESIGN BULLETIN 12-06

DATE: March 30, 2012

TO: District Directors of Operations, District Directors of Production, District Design Engineers, District Construction Engineers, District Geotechnical Engineers, District Structures Design Engineers

FROM: Robert V. Robertson, P. E., State Structures Design Engineer

COPIES: Brian Blanchard, David Sadler, David O'Hagan, Larry Jones, Andre Pavlov, Charles Boyd, Tom Andres, Sam Fallaha, Dennis Golabek, Tom Waits, Jonathan Van Hook, Garry Roufa, Peter Lai, Rodrigo Herrera, Rudy Powell, Chris Richter (FHWA), Jeffrey Ger (FHWA), Bob Burleson (FTBA)

SUBJECT: Evaluation of GRS Abutments for Single Span Bridges, Bridges with Simply Supported End Spans and GRS Walls

## REQUIREMENTS

1. Replace January 2012 ***Structures Design Guidelines,*** Section 3.12.12 with the following:

### 3.12.12 Geosynthetic Reinforced Soil (GRS) Walls and Abutments

A. GRS abutments are a shallow foundation and retaining wall option that may significantly reduce the construction time and cost of single span bridges.

B. GRS walls and abutments, like MSE walls, are very adaptable to both cut and fill conditions and can tolerate a greater degree of differential settlement than CIP walls. GRS walls, however, are also not appropriate for all sites.

*Commentary: The use of GRS walls and abutments may be precluded because of insufficient room to place the soil reinforcement, poor insitu soils, locations with excessive stream flow or wave action, etc.*

C. GRS walls and abutments are constructed with coarse aggregate or Graded Aggregate (GAB) backfill, and geosynthetic soil reinforcement.

D. GRS-Integrated Bridge System bridge abutments generally consist of the following:

1. 4000 psi Concrete Masonry Unit (CMU) facing blocks
2. Geosynthetic reinforcement with ultimate tensile strength ≥ 4,800 lb/ft.
3. Geosynthetic reinforcement spacings of less than 12 inches with smaller spacings in different portions of the GRS abutment.
4. GRS backfill may consist of coarse aggregate or GAB.

E. Use of GRS walls and abutments on the Interstate or major 4 lane highways requires the approval of the State Structures Design Engineer. Their use will typically be restricted and not approved for use on water crossings subject to stream flow in excess of 9 ft/sec, or locations with sufficient wave action to displace scour countermeasures.

F. GRS details are shown in the plans.

2. Delete Section 3.13.2.P of the January 2012 ***Structures Design Guidelines***.

3. Add Section 3.13.4 to the January 2012 ***Structures Design Guidelines*** as follows:

**3.13.4 GRS Walls and Abutments**

*Commentary: FHWA Publication **FHWA-HRT-11-026 "Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide"** outlines recommended practice for the design and construction of GRS-IBS. FHWA Publication **FHWA-HRT-11-027 "Geosynthetic Reinforced Soil Integrated Bridge System Synthesis Report"** provides background information and fundamental characteristics of GRS-IBS.*

A. Design GRS abutments in accordance with the LRFD methodology contained in Appendix C of the ***FHWA-HRT-11-026 "Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide***, except as otherwise described in this section.

B. GRS abutments may be used to support single span bridges not exceeding 140 feet and which are not at risk of movement due to transverse loading, uplift, etc. GRS Abutments may also be considered for multi-span bridges with simply supported end spans.

C. Coordinate with the Drainage/Hydraulics Engineer to determine the contraction scour depth with respect to the distance between abutments.

D. Detail the top of the Reinforced Soil Foundation (RSF) at the contraction scour elevation for the design storm or 6 inches below the finished ground surface, whichever is deeper.

E. Ensure the minimum length of the bottom layer of GRS backfill reinforcement "B" is not less than 8 feet.

F. The bottom beam seat reinforcement layer length is 4 ft. to 6 ft. long with a conventional 4 ft. long tail. Subsequent beam seat reinforcement layer lengths are L with a conventional 4 ft. tail.

G. Ensure the thickness of the RSF is 24 inches or 0.25B, whichever is greater.

H. Extend the RSF a distance of at least 24 inches or 0.25B, whichever is greater, in front of the wall facing.

I. Do not exceed the maximum vertical spacing of Geosynthetic Reinforcement as described for each on the following zones:

1. RSF = 12 inches
2. GRS Backfill = height of one course of CMU block or 8", whichever is less.
3. Bearing Bed = 4 inches
4. Beam Seat = 4 inches
5. GRS-GAB Transition = 6 inches
6. Integrated Approach = 6 inches

J. Use actual dimensions of CMUs and soil reinforcement thicknesses when designing, detailing and specifying elevations in the GRS-IBS.

K. GRS Walls are designed as GRS Abutments but without the "Bearing Bed Zone" or "Beam Seat Zone" shown in the Developmental Design Standard D6025.

L. Ensure the Abutment Width and Wingwall Lengths accommodate a whole number of facing blocks. Half width blocks may be used at the end of the wingwalls in order to accommodate the interlacing of blocks at the corner with the abutment walls

M. Based on testing by the State Materials Office, assume the following GRS backfill design values of:

1. Graded Aggregate (GAB) $\gamma$NAT = 140 pcf, $\varphi$f = 38 deg, C = 0.
2. Coarse aggregate (#57 or #67 stone) $\gamma$NAT = 115 pcf, $\varphi$f = 38 deg, C = 0

N. For the RSF, use a woven geotextile listed in Design Standards Index 501 and approved for use in Steepened Slopes applications (Usage 1 or 3) with a minimum ultimate tensile strength of 4800 lb/ft in both the machine and cross directions and a maximum Apparent Opening Size (AOS) of 0.035 in.

O. For GRS backfill reinforcement, use a biaxial geogrid or woven geotextile reinforcement consisting of structural geosynthetics listed in the Design Standards Index 501 and approved for use in Steepened Slopes applications (Usage 1 or 3) with a minimum ultimate tensile strength of 4800 lb/ft in both the machine and cross directions.

## COMMENTARY

This bulletin amends and supersedes Structures Design Bulletin C11-05.

## IMPLEMENTATION

Modify current and future GRS abutment and wall designs to accommodate the additional and modified provisions included herein. Developmental Design Standard D6025 is available for presenting details of GRS-IBS for flat slab bridges in project plans. A Developmental Design Standard for beam bridges will be forthcoming. Construct GRS walls and abutments in accordance with Developmental Specification 549.

## CONTACT

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Attachments