November 18, 2016

SPECIAL PROVISION

SPECIFICATION 983 - GEOSYNTHETIC REINFORCED SOIL INTEGRATED BRIDGE SYSTEM (GRS – IBS)

983-1 DESCRIPTION

983-1.01 Scope

a. This work shall consist of the construction and furnishing materials for Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) in conformity with the lines, dimensions, typical sections, design and construction criteria and other details shown on the plans, standard plans and in accordance to these specifications or as established by the Engineer.

b. This item shall also include any materials and all incidentals required for the proper completion of the GRS-IBS.

c. A complete set of installation and construction procedures shall be submitted by the Contractor for approval by the engineer prior to the beginning of the works. This procedure shall be strictly followed during the GRS-IBS construction.

d. Each word, sentence, section or article of this document is independent. Not applying parts of it does not imply that it cannot be enforced afterwards nor invalidates the remaining provisions.

983-1.02 Reference Documents to be used for the Construction of this item.

a. Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide, FHWA-HRT-11-026 with latest Interim Revisions.

b. AASHTO Load and Resistance Factor Design (LRFD) Bridge Construction Specifications, 3th Edition with 2010 and 2011 Interim Revisions or Latest Edition.

983-2 MATERIALS

983-2.01 General -

The Contractor shall make all necessary arrangements to purchase or manufacture the concrete masonry units (CMU), reinforcing geosynthetic, attachment devices, concrete filler, and all other necessary components. Materials not conforming to this section of the specifications shall not be used without written consent from the Engineer.

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983-2.02 Hollow Concrete Masonry Unit (CMU) -

The hollow CMU blocks shall meet the ASTM C-90 with a maximum water absortion rate of 5%. The nominal dimensions of the hollow CMU block including the 3/8-in (9.5 mm.) mortar joint shall be 8-in x 8-in x 16-in (203 mm. x 203 mm. x 606 mm.). Hollow CMU blocks shall be furnished within the following tolerances:

a. Height of each individual block within 1/16-in (1.59 mm) of the specified dimension.
b. Length and width of each individual block within 1/8-in (3.18 mm) of the specified dimension.
c. Minimum face shell thickness of 1¼ -in (32 mm) and a web thickness of ¾-in (19 mm)

Concrete for hollow CMU blocks shall comply with a minimum unconfined compressive strength f'm = 4,000 psi. This block shall be used exclusively in the last top three layers at the bearing zone of the GRS structure. The Contractor QC testing shall be conducted at a qualified laboratory. Hollow CMU blocks acceptance shall be by *certificate of compliance.* The Authority reserves the right to perform random sampling and testing on a lot basis in accordance with ASTM C-140 to verify compliance with this document. The Authority may reject the hollow CMU blocks based on the results obtained.

983-2.03 Solid Concrete Masonry Unit (CMU) -

The solid CMU blocks shall meet the ASTM C-90 with a maximum water absorption rate of 5%. The nominal dimensions of the hollow CMU block including the 3/8-in (9.5 mm.) mortar joint shall be 8-in x 8-in x 16-in (203 mm. x 203 mm. x 606 mm.). Solid CMU blocks shall be furnished within the following tolerances:

a. Height of each individual block within 1/16-in (1.59 mm) of the specified dimension.
b. Length and width of each individual block within 1/8-in (3.18 mm) of the specified dimension.

Concrete for solid CMU blocks shall comply with a minimum unconfined compressive strength f'm = 4,000 psi. This block shall be used in the entire GRS structure unless otherwise specified in this document. The Contractor QC testing shall be conducted at a qualified laboratory. Solid CMU blocks acceptance shall be by *certificate of compliance*. The Authority reserves the right to perform random sampling and testing in accordance with ASTM C-140 to verify compliance with this document. The Authority may reject the hollow CMU blocks based on the results obtained.

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983-2.04 Geosynthetic Fabric

The geosynthetic fabric shall consist of a regular network of connected geotextile of longitudinal and transverse polymer (polyethylene, polypropylene or polyester resin) with a minimum required ultimate tensile strength of 4,800 lb/ft in both directions and a minimum tensile strength at 2% of strain greater than the maximum service load applied to the reinforcement in both directions, as specified in the construction plans. Minimum ultimate tensile strength and minimum tensile strength at 2% of strain shall be determined as per ASTM D-4595. Geotextiles shall comply with Specification 712-7 – Geotextiles – Stabilization and Filter Fabrics.

983-2.05 Selected GRS Abutment Backfill

The granular material used in the structure volume shall be free from organic or otherwise deleterious materials and shall conform to the following gradation limits as determined in the Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide. The minimum backfill angle of internal friction shall be of 38 degrees, and it shall be determined by a Direct Shear Test as per ASTM D-3080. If a minimum friction angle of 38 degrees is not obtained by using the standard direct shear box, a new direct shear box shall be used with a size of 10 times the maximum particle size being tested, using the full gradation of the material. If the GRS-IBS will be in a submerged condition, the backfill gradation shall be opened-graded.

Table 983-1: GRS abutment backfill properties

Backfill	Parameter	Testing Frequency
Well-graded	*Maximum Grain Size:* ½ in to 2 in *U.S. Sieve Size – Percent Passing No.200 (AASHTO T-11):* ≤ 12 *Plasticity Index (AASHTO T-90):* PI ≤ 6 *Soundness (AASHTO T-104):* The backfill shall be substantially free of shale or other poor durability particles. It shall have a magnesium sulfate loss of less than 30 percent after four cycles (or a sodium value less than 15 percent after 5 cycles.	2 per abutment or pier

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Backfill	Parameter	Testing Frequency
Open-graded	*Maximum Grain Size:* ½ in to 2 in *U.S. Sieve Size – Percent Passing No.200 (AASHTO T-11):* ≤ *5* *Plasticity Index (AASHTO T-90):* PI ≤ 6 *Soundness (AASHTO T-104):* The backfill shall be substantially free of shale or other poor durability particles. It shall have a magnesium sulfate loss of less than 30 percent after four cycles (or a sodium value less than 15 percent after 5 cycles.	2 per abutment or pier

983-2.06 Reinforcing Steel

The #4 rebars shall be Grade 60 as per AASHTO M31 (ASTM A-615) inserted inside the top 3 rows of hollow CMU blocks and corner CMU blocks.

983-2.07 Concrete Filler

Concrete filler shall be Class IV with f'c = 4,000 psi (General Use) and Permeability Level 1, with a maximum nominal aggregate size of ½-in (13 mm) following all the requirements of Specifications 934 - Structural Concrete.

983-2.08 Foam Board

Foam board shall be of polystyrene conforming to AASHTO M230, type VI, having a minimum compressive strength of 10 psi.

983-2.09 Flashing

A 4-in (100 mm) by 1.5-in (38 mm) aluminum fascia or equivalent shall be used to serve as a drip edge under the superstructure within the clear space to shed potentially corrosive fluids off of the dry cast block and to prevent animals form burrowing into the abutment.

983-2.10 Asphaltic Coating

An asphaltic coating shall be shop installed on concrete beam when embedded between the GRS abutment and the wing wall to seal the embedded concrete.

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983-3 CONSTRUCTION REQUIREMENTS

983-3.01 Delivery, Storage and Handling

The contractor shall check the materials upon delivery to ensure that the proper material has been received. The contractor shall prevent contamination of the materials with extraneous matters. Rolled Geosynthetic may be laid flat or stood on end for storage. All plastic materials shall be protected from ultra-violet radiation by covering them with appropriate means such as tarpaulin, heavy paper, opaque plastic, etc. at all periods of shipment and storage.

983-3.02 Wall Excavation

Excavation for the GRS-IBS shall be performed in accordance to the requirements of Specification 206 - Excavation for Structures. The same geotextile fabric used as primary reinforcement shall be placed between the excavation and the GRS-IBS from the bottom of the RSF to the top of the Integrated Approach to avoid the migration of fines. The geotextile shall comply with Specification 712-7 – Geotextiles – Stabilization and Filter Fabrics.

983-3.03 Compaction and Placement of Backfill Soil Material

The GRS-IBS abutment well-graded backfill material shall be compacted a minimum of 95 percent of the maximum dry density according to AASHTO-T-99 and ± 2 percent optimum moisture content. In the bearing reinforcement zone, compact to 100 percent of the maximum dry density according to AASHTO-T-99. Only hand-operated compaction equipment is allowed within 3-ft. (0.91 m.) of the wall face. Reinforcement extends directly beneath each layer of CMU blocks, covering ≥ 85% of the full width of the block to the front face of the wall, or otherwise as indicated in the construction plans. If an opened-graded backfill is used, it shall be compacted on each reinforcement layer using suitable compaction equipment capable of compacting 8-in. (0.10 m.) layers until there is no visible evidence of further compression. A minimum of 4 passes shall be applied per layer.

983-3.04 Geosynthetic Reinforcement Placement

The geosynthetic taught shall be pulled to remove any wrinkles and lay flat prior to placing and compacting the backfill material. Slices should be staggered at least 24-in. apart and splices are not allowed in the bearing reinforcement zone. No equipment is allowed directly on the geosynthetic. A minimum 6-in. (0.15 m.) layer of granular fill shall be placed prior to operating only rubber-tired equipment over the geosynthetic at speeds

less than 5 miles per hour with no sudden braking or sharp turning. The maximum spacing of geosynthetic reinforcement within the GRS structure shall not exceed 8 in (0.20 m.) or the CMU block height. The maximum spacing of geosynthetic reinforcement in any other zone within GRS-IBS shall not exceed 12 in (0.30 m.). Reinforcement shall cover a 100 percent of the embedment area unless otherwise specified in the construction plans. Any excess reinforcement material showing through the facing shall be removed in accordance with the manufacturer's recommendations.

983-3.05 Reinforced Soil Foundation (RSF) Construction

The RSF should be encapsulated in geotextile reinforcement on all sides with minimum overlaps of 3-ft (0.91 m.) to prevent water infiltration. Wrapped corners need to be tight without exposed soil. The RSF backfill material shall be placed in lifts less than 12-in. (0.30 m.) in compacted height. Grade and level the top of the RSF prior to final encapsulation, as this will serve as the leveling pad for the CMU blocks of the GRS abutment.

983-3.06 GRS Wall Face Alignment

The level alignment of the CMU block rows shall be checked at least every other layer of the GRS abutment. Any alignment deviations greater than 0.25 in. (0.0064 m.) shall be corrected.

983-3.07 Beam Seat Placement

The thickness of the beam seat shall not be less than 20-in. (0.51 m.) or five layers. It consists of a minimum of five 4-in. (0.10 m.) lifts of wrapped reinforcement. Place a precut 4-in. (0.10 m.) thick foam board on the top of the bearing bed reinforcement but against the back face of the CMU block. Set half-height or full height (depending on wall height and required clear space) solid CMU blocks on top of the foam board. Wrap two approximately 4-in. (0.10 m.) lifts across the beam seat. Before folding the final wrap, in may be necessary to grade the surface aggregate of the beam seat slightly high, to about 0.5 in. (0.013 m.), to aid in seating the superstructure and to maximize contact with the bearing area. The bearing seat reinforcement spacing shall be half the spacing of the primary reinforcement.

983-3.08 Superstructure Placement

The crane used for the placement of the superstructure can be positioned on the GRS-IBS abutment provided the outrigger pads are sized for less than 4,000 psf near the face of the abutment wall. Greater loads could be supported with increasing distance from

the abutment face if checked by the Engineer. An additional layout of geosynthetic reinforcement can be placed between the beam seat and the concrete or steel beams to provide additional protection of the beam seat. Beams square shall be set and level without dragging across the beam seat surface. The applying bearing pressure by the superstructure at the bearing area shall not exceed 4,000 psf.

983-3.09 Integrated Approach Placement

Following the placement of the superstructure, the geotextile reinforcement layers are placed along the back of the superstructure, built in maximum lift heights of 12-in. (0.30 m.) (maximum vertical spacing of reinforcement ≤ **12-in**). The top of the final wrap should be approximately 2-in (0.050 m.) below the geosynthetic to protect it from hot mix asphalt.

983-4 METHOD OF MEASUREMENT

983-4.01 Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) will be measured by the square meter of wall surface area plus the projected frontal area of the Reinforced Foundation Soil (RSF), completed, in place and accepted by the Engineer. The area will be bounded by the bottom elevation of the RSF to the top elevation of the Integrated Approach and the length of wall, as determined by field measurements.

983-4.02 The unit of measurement for GRS-IBS shall include:

a. Furnishing and installing and/or erecting all elements required by the GRS-IBS including but not limited to CMU blocks, geosynthetic soil reinforcement, attachment devices, reinforcing steel, concrete filler, foam Board, flashing, asphaltic coating, penetrations such as pipes and other utilities, all materials associated with the beam seat assemble, and any other GRS-IBS incidentals.

c. All costs including any other material, labor, and machinery related to the construction of the GRS-IBS.

983-4.03 Any excavation required for the construction of the GRS-IBS retaining will be measured and paid under the provisions of Specification 206 - Excavation for Structures.

983-4.04 Any backfill required between the projected plane of the geosynthetic reinforcement and cut-slope surface will not be measured directly for payment but shall be

considered a subsidiary obligation. This material shall be of the same gradation used for the GRS-IBS.

983-5 BASIS OF PAYMENT

983-5.01 The completed and accepted quantities of Geosynthetic Reinforced Soil Integrated Bridge System, measured as provided above, will be paid for at the contract unit price per unit of measurement as provided below. Such price and payment shall constitute full compensation for all labor, supervision, transportation, materials, equipment, and all incidentals required for the construction and erection of the system, to the lines and grades shown on the plans and approved by the Engineer.

983-5.02 Payment will be made under:

Pay Item	Pay Unit
Geosynthetic Reinforced Soil Integrated Bridge System	Square Meter