


<p>SUPERSEDED BY EB 23-024 EFFECTIVE 8/3/23</p>		<p>New York State Department of Transportation ENGINEERING INSTRUCTION</p>	<p>EI 14-018</p>								
<p>Title: SPECIAL SPECIFICATION FOR GRS ABUTMENT FOR GEOSYNTHETIC REINFORCED SOIL – INTEGRATED BRIDGE SYSTEM (GRS-IBS)</p>											
<p>Target Audience:</p> <table border="0"> <tr> <td><input type="checkbox"/> Manufacturers (18)</td> <td><input type="checkbox"/> Surveyors (33)</td> </tr> <tr> <td><input checked="" type="checkbox"/> Local Govt. (31)</td> <td><input checked="" type="checkbox"/> Consultants (34)</td> </tr> <tr> <td><input checked="" type="checkbox"/> Agencies (32)</td> <td><input checked="" type="checkbox"/> Contractors (39)</td> </tr> <tr> <td></td> <td><input type="checkbox"/> _____ ()</td> </tr> </table>		<input type="checkbox"/> Manufacturers (18)	<input type="checkbox"/> Surveyors (33)	<input checked="" type="checkbox"/> Local Govt. (31)	<input checked="" type="checkbox"/> Consultants (34)	<input checked="" type="checkbox"/> Agencies (32)	<input checked="" type="checkbox"/> Contractors (39)		<input type="checkbox"/> _____ ()	<p>Approved:</p> <p><i>Robert L. Sack</i> 20 Aug 14 _____ Date</p> <p>Robert L. Sack, P.E. Deputy Chief Engineer (Research)</p>	
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ADMINISTRATIVE INFORMATION:

- This Engineering Instruction (EI) is effective beginning with projects submitted for the letting of January 8, 2015.
- This EI does not supersede any other issuance.
- Disposition of issued materials: The information transmitted by this issuance will reside in the Special Specifications directory of the Toolbox Server

PURPOSE: The purpose of this EI is to issue special specification 554.7000NN17 (US Customary) and 554.70 NN17 (Metric) GRS Abutment for Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS).

TECHNICAL INFORMATION:

- The Department routinely utilizes Geosynthetically Reinforced Soil System (GRSS) for retaining walls. A GRSS is an internally stabilized fill structure faced with either welded wire forms (typically used for temporary walls), geocells, or timbers. A GRSS is comprised of earth backfill, extensible (geosynthetic) reinforcing elements used for internal stabilization and surface protection to resist erosion. For wall applications, the surface protection is the permanent facing elements (excluding precast units) or a geotextile face wrap which typically includes welded wire forms remaining from the installation operation.
GRSS technology has evolved considerably and FHWA has developed this into the Geosynthetic Reinforced Soil Integrated Bridge System (GRS-IBS) that blends the roadway into the superstructure. GRS-IBS includes a:
 - Reinforced soil foundation,
 - GRS abutment, and
 - GRS integrated approach.
- GRS-IBS is a unique application of GRSS technology in the specific context of bridge abutments. GRS-IBS bridge abutments are built to support a bridge on the granular fill directly behind the block face. GRS-IBS can be used to integrate the bridge structure with the bridge approach to create a jointless bridge system. GRS-IBS uses adjacent concrete box beams or void slabs supported directly on GRS abutments without a concrete footing or elastomeric pads. The bridge has no CIP concrete or approach slab. A typical cross section of the approach to the GRS-IBS shows a compacted geosynthetically reinforced soil mass directly behind the bridge beams to form the approach way and to create a smooth transition from the roadway to the bridge.

- The Geotechnical Engineering Manual (GEM-28) *Guidelines for the Design and Construction of Geosynthetic Reinforced Soil Integrated Bridge System* is being issued concurrently via EB 14-030.
- PIN Approval: The Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) special specification is to be approved on a project-by-project basis. Designers must send their request for approval to the Design Quality Assurance Bureau (DQAB) through the Regional Special Specification Coordinator as per Highway Design Manual (HDM) Chapter 21. The Office of Structures and Geotechnical Engineering Bureau will review the applications.

TRANSMITTED MATERIALS:

- The following new special specifications:
 - Item 554.7000NN17 GRS Abutment for Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) (US Customary)
 - Item 554.70 NN17 GRS Abutment for Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS) (Metric)

BACKGROUND: The Geotechnical Engineering Bureau (GEB) provides earthwork and foundation engineering services for the design and construction of Departmental projects statewide. To span a feature in conflict with the geometry of a proposed roadway, the Department typically analyzes and designs a linked system of the (1) structure, (2) foundation and (3) soil underlying and surrounding the foundation.

The Federal Highway Administration (FHWA) has developed a low-cost, fast-construction technique that blends a portion of the typical structure and foundation elements together by using a soil composite mass via a Geosynthetically Reinforced Soil System (GRSS).

In addition to expanding the use of GRSS technology within Departmental designs, sponsors of all locally administered Federal-aid transportation projects in New York State (except for cities with populations greater than three million) must use NYSDOT design standards for all projects regardless of highway system. Locals are utilizing the GRS-IBS system to reap the benefits of this replacement technique, currently without NYSDOT guidance or specifications.

CONTACT: Questions or comments regarding this issuance should be directed to Randall J. Romer, P.E., of the Geotechnical Engineering Bureau at (518) 457-4714, randy.romer@dot.ny.gov. Questions or comments regarding the technical aspects of the special specification should be directed to Don Dwyer, P.E., of the Geotechnical Engineering Bureau at (518) 457-4724, don.dwyer@dot.ny.gov.

ITEM 554.7000NN17- GRS ABUTMENT FOR GEOSYNTHETIC REINFORCED SOIL – INTEGRATED BRIDGE SYSTEM (GRS-IBS)

DESCRIPTION

This work shall consist of furnishing and installing a geosynthetic reinforced soil (GRS) abutment, as part of a geosynthetic reinforced soil integrated bridge system (GRS-IBS), to the lines and grades designated in the contract documents.

Definitions

Geosynthetic Reinforced Soil (GRS): Alternating layers of compacted granular fill reinforced with geosynthetic reinforcement (e.g., geotextiles, geogrids). The primary reinforcement spacing in GRS is less than or equal to 12 in. (8 in. typ.).

GRS mass or GRS structure: A composite mass built with GRS that creates a freestanding, internally supported structure with reduced lateral earth pressures with considerable strength. This design permits the use of lightweight modular blocks and the elimination of mechanical connections between blocks and the reinforcement. A GRS mass is not rigid and is therefore tolerant to differential foundation settlement.

GRS-IBS: A unique application of GRS technology in the specific context of bridge abutments. GRS-IBS bridge abutments are built to support a bridge on the granular fill directly behind the block face. GRS-IBS is used to integrate the bridge structure with the bridge approach to create a jointless bridge system. GRS-IBS includes a:

- Reinforced Soil Foundation (RSF),
- GRS abutment, and
- GRS integrated approach.

MATERIALS

Concrete block facing units – Provide concrete wall units meeting the requirements of either §704-06 *Precast Concrete Wall Units* or §704-07 *Drycast Concrete Wall Units*.

1. **Block Size** – Provide concrete wall facing units with a nominal height dimension of 8 in. to correspond to the geosynthetic reinforcement layering system identified in the contract documents.

Provide concrete wall facing units for the beam seat with a nominal height dimension of 4 in. to correspond to the geosynthetic reinforcement layering system identified in the contract documents.

2. **Block Composition** – Provide concrete wall facing units that include solid face concrete blocks, hollow core concrete blocks and corner and coping blocks as identified in the contract documents. For manufacturers on the Approved List supplying only solid blocks, modify the top three courses of concrete block facing units in the abutment to address susceptible movement from the lack of weight of successive layers. Provide units that accept No. 4 rebar to pin them together as shown in the contract documents.

Backfill material –

1. **RSF and Integrated Approach** – Provide graded aggregate base backfill material of one of the following types:

A. Type A. Material meeting the requirements of §733-04 *Subbase Course, Type 2*.

B. Type B. Material meeting the requirements of §733-04 *Subbase Course, Type 4*.

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2. **GRS Abutment** – Provide GRS backfill material of one of the following types:
- A. **Type A.** Material meeting the requirements of §733-04 *Subbase Course, Type 2.*
 - B. **Type B.** Material meeting the requirements of §733-04 *Subbase Course, Type 4.*
 - C. **Type C.** Material consisting of crushed stone conforming to §703-02 *Coarse Aggregate, Size Designation 1A.*
 - D. **Type D.** Material consisting of crushed stone conforming to §703-02 *Coarse Aggregate, Size Designation 2.*

Geosynthetics –

- 1. **RSF and Integrated Approach** – Provide geotextile reinforcing elements meeting the requirements of §737-07 *Geogrids.*
- 2. **GRS Abutment** – Provide geogrid or geotextile reinforcing elements meeting the requirements of §737-07 *Geogrids.*

Geosynthetic Warning Markers –

- 1. **Signs** – Provide warning signs. These will be 7 in. x 10 in. (minimum) fiberglass. Include warning information as follows:

WARNING
Internally Stabilized Fill Structure
DO NOT EXCAVATE
Call Regional Office of NYS DOT

For signs installed on concrete units, provide 3/8 in. diameter stainless steel bolt and expansion anchor meeting GSA Specifications FF-S-325 and installed by masonry drill.

- 2. **Marking Tape** – Provide polyethylene material 3 in. wide, 4 mil. thick. Include warning markings.

Concrete block wall fill – Provide concrete conforming to the requirements of Section 501, *Portland Cement Concrete-General, Class A.*

Flashing – Provide flashing, such as 4 in. by 1.5 in. aluminum fascia (or equivalent), to serve as a drip edge under the superstructure within the clear space.

Polystyrene Foam board – Provide polystyrene foam board conforming to AASHTO M 230, Type VI.

Reinforcing steel bar – Provide deformed No. 4 (0.5 in. diameter) bars that conform to AASHTO M31M or ASTM A615. The bars shall be epoxy coated conforming to AASHTO M 284M.

Asphaltic coating – Provide a shop-installed asphaltic coating on the concrete beam such that, when embedded between the GRS abutment and the wing wall, the embedded concrete is sealed.

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CONSTRUCTION DETAILS

Submittal. Submit the geogrid and/or geotextile reinforcing element certifications, verifying that the material meets the requirements of §737-07 *Geogrids* for the specified long term design tensile strength shown in the contract documents, to the Engineer prior to start of work. Begin work only after receiving the Engineer's approval.

Supply on-site technical assistance from a representative of the geosynthetic reinforcing element manufacturer until such time as outside consultation is no longer required, but for a minimum of 2 days.

Storage of Geosynthetic. Store and protect geosynthetic materials in accordance with the manufacturer's recommendations prior to installation.

Pre-Operation Meeting. A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCES written approval and after the Pre-Operation Meeting is held.

Supply on-site technical assistance from a representative of the designated designer during the beginning of the installation until such time as outside consultation is no longer required.

Excavation and Disposal. Excavate in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

Reinforced Soil Foundation (RSF). Prior to erection of the GRS abutment for the GRS-IBS, the foundation will be inspected and approved by the Engineer.

1. Placement Area Foundation Preparation. Prepare the foundation area under the GRS abutment level for a width equal to, or in excess of, the reinforcing element length. Prior to wall system construction, compact this area to a minimum of 90% of Standard Proctor Maximum Density. Treat all soils found to be incapable of being satisfactorily compacted because of moisture content, in a manner directed by the Engineer, in conjunction with the recommendations of the Departmental Geotechnical Engineer. Remove any unsuitable material within the foundation area.

Construct the RSF, consisting of graded aggregate base material encapsulated in geosynthetic reinforcement placed perpendicular to the abutment face to protect it from possible erosion. Measure and size the reinforcement sheets to fully enclose the RSF on three sides: the face and the two wing wall sides.

Place the RSF graded aggregate base material from the face to the back in order to roll folds or wrinkles to the free end of the reinforcement layer. Compact the graded aggregate base material to a maximum compacted layer thickness of 6 in. Grade, level, and compact the graded aggregate base material before encapsulating the RSF. When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements contained in *Compaction* in Section 203 *Excavation and Embankment*. Density tests are not required for the acceptance of these courses.

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Place the first layer of the reinforcement on the upstream side of the abutment with subsequent layers, if needed, overlapped a minimum of 3 ft. on the top of the preceding layer.

For GRS abutments adjacent to water, overlap the reinforcement sheets a minimum of 3 ft., starting with the first layer on the upstream side of the RSF. Orient all overlap sections in the area of the RSF to prevent running water from penetrating layers of reinforcement.

Ensure the wrapped corners of the RSF are tight and without exposed soil within the RSF to complete the encapsulation.

GRS Abutment.

1. Backfill.

Place the GRS backfill onto the geosynthetic reinforcing elements in such a manner that no damage occurs. Progress placement of backfill materials so as to minimize the development of slack in the reinforcing element.

Compact the GRS backfill to a minimum of 95% of Standard Proctor Maximum Density in accordance with the requirements contained in *Compaction* in Section 203 Excavation and Embankment. Adjust the moisture content of the compacted backfill materials to within 2 percent of the optimum moisture content.

Construct the GRS mass using compacted lifts of 8 in., which are equal to the facing block size.

Allow only hand operated equipment within 3 ft. of the face so as not to damage or dislocate the facing blocks. Reduce lift thickness, if necessary, to achieve required compaction.

Compact the top 5 ft. of the abutment to 100% of Standard Proctor Maximum Density in accordance with the requirements contained in *Compaction* in Section 203 Excavation and Embankment.

2. Geosynthetic Reinforcement.

Place and secure the primary and secondary reinforcing element in accordance with the manufacturer's recommendations, in continuous strips without joints, seams or connections throughout the embedment length, to the line, grade and orientation shown in the contract documents. Place the geosynthetic reinforcement so that the strongest direction (i.e. machine direction) is perpendicular to the abutment facing.

Treat 100 percent of the embedment area with reinforcement, based on the designated minimum reinforcement length, unless otherwise shown in the contract drawings.

Adjacent sections of the geosynthetic reinforcement do not need to be overlapped except when exposed in the wrap-around face system, at which time, overlap or mechanically connect the reinforcement rolls per the manufacturer's requirements.

Place reinforcing elements to lay flat with no creases and pull taut to remove any slack prior to placement of backfill. Place geosynthetic reinforcement directly on the compacted horizontal fill surface. Position the reinforcement uniformly on the compacted reinforced soil from the connection to the wall to the free end of the reinforcing elements.

Extend the geosynthetic reinforcement between the layers of the concrete block facing units. Cover a minimum of 85 percent of the top surface of the concrete block facing unit with geosynthetic reinforcement. Remove any excess reinforcement material showing through the face in accordance with the manufacturer's directions.

A minimum GRS backfill layer of 6 in. shall be placed on the geosynthetic prior to operating any vehicle over it.

Place bearing reinforcement beds behind the concrete block facing unit at 4 in. spacing in the top five layers of the GRS abutment, or as determined by the design and detailed in the contract documents.

In the superelevation case, the reinforcement layers become stair-stepped in the upper wall layers as the superelevation of the abutment is constructed. In such situations, terminate the reinforcement along the angle surface of the superelevation. Designate the termination of each layer of the reinforcement across the abutment wall from low to high elevations in the GRS wall reinforcement schedule.

Install GRS-IBS identification markers. Place the marking tape at the highest possible elevation that will not damage the tape (e.g. 6 in. below top of subbase elevation). Install the marking tape on top of the reinforced backfill area, parallel to the abutment face in rows at 5 ft. intervals until the back edge of the reinforced backfill area is reached. Place the warning sign directly below the BIN plaque. Drill two, 5/16 in. diameter, holes for mounting, located 1/2 in. from the ends of the sign and 3 1/2 in. from the top of the sign. Secure the sign using anchorage appropriate for the supporting material.

Concrete Block Facing Units. Handle and assemble the concrete block facing units in accordance with the designer's instructions and the contract documents. Erect the facing units conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer's installation manual.

1. Leveling Layer. Set the first course of the facing block level and to grade. A thin leveling layer of fine aggregate, which shall not exceed 0.5 in., may be used on the top of the RSF to facilitate construction of the first course of the facing block. If the leveling layer required exceeds 0.5 in., a mortar or grout shall be placed in the gap between the RSF and the first concrete block facing unit course.

Begin the concrete block facing unit construction at the lowest portion of the excavation, with each layer placed horizontally. Place the concrete block facing units side by side and in full contact with the installed leveling layer. Completely construct and clean each concrete block facing unit layer of any debris and fill material prior to placing the next layer of geosynthetic

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reinforcement and concrete block facing unit. Maintain a stretcher or running bond between courses of blocks to ensure that the joints between the blocks are offset with each row.

If a scour countermeasure, such as stone fill, is used, geotextile bedding material shall be placed under the countermeasure and anchored between the first and second course of the concrete block facing unit. Scour countermeasures and geotextile bedding will be paid for under their respective items.

Carefully move concrete block facing units displaced out of required alignment during construction back into position by methods that will not cause damage to the concrete block facing units or other work. Replace any damaged concrete block facing units to retain the new wall integrity at no additional cost to the State.

In superelevations, trim the top course of concrete block facing unit beneath the superstructure to match the elevation difference and clear space across the abutment.

Stagger facing wall and wing wall courses to form a tight interlocking stable corner.

Fill the top three courses of concrete block facing units with Class A concrete, pin with No. 4 steel bar, and embed with a minimum of 2 in. cover.

Beam Seat. The beam seat shall be constructed directly above the bearing bed reinforcement zone to ensure that the superstructure bears on the GRS abutment, not the wall facing block, and provides the necessary clear space between the superstructure and the wall face.

Establish the block elevation beneath the bearing area and pin the concrete block facing units on the abutment wall face.

Construct the beam seat to the dimensions shown in the contract documents and as follows:

1. Place precut 4 in. thick polystyrene foam board on the top of the bearing bed reinforcement. For grading purposes and to ensure the proper clear space height and drainage (crown in bridge), a thin layer of backfill may be placed beneath the foam board. Butt the foam board against the back face of the concrete block facing unit.
2. Set 4 in. solid concrete blocks on top of the polystyrene foam board across the entire length of the bearing area. The back edge of the top concrete block facing unit holds the 4 in. concrete block in place during compaction.
3. Use the first 4 in. wrapped layer of compacted fill as the thickness to the top of the polystyrene foam board.
4. Place the second 4 in. wrapped layer of compacted fill to the top of the 4 in. solid block, creating the clear space. The top of this layer controls the beam elevation.
5. Before folding the final wrap, grade the surface aggregate of the beam seat slightly high (about 0.5 in.) to aid in seating the superstructure and to maximize contact with the bearing area.

6. Install aluminum flashing drip edge prior to setting the bridge beams. Place precut 4 in. thick polystyrene foam board on top of the filled-in top course of the concrete block facing units, positioned directly in front of the 4 in. solid concrete blocks. Place the flashing in between the bottom of the beams and the polystyrene foam board. Hold the flashing in place by the pressure of the beams on the solid concrete blocks. The length of the flashing shall extend beyond the outside edge of the bridge beams and be trimmed to fit against the parapets.

Placement of Superstructure. A crane positioned on the GRS abutment for placement of the superstructure shall have the outrigger pads sized within the capacity of the GRS mass. The outrigger pads shall be sized for a maximum pressure of 4,000 psf near the face of the abutment wall, with greater loads able to be supported with increasing distance from the abutment face.

Place an additional layer of geosynthetic reinforcement between the beam seat and concrete beams to provide additional protection of the beam seat.

Set the beams square and level. Do not drag the beams over the beam seat surface.

Construct the wing walls and parapets after the superstructure is set. The concrete block facing unit in the parapet wall shall be trimmed or saw cut for a custom fit against the beam edge to prevent the loss of fill material. If the gap between the superstructure and the facing block is difficult to fill using thin slices of cut block, a mortar mix shall be used to close the space.

Approach Integration. Construct the road and superstructure interface to minimize settlement in front of the bridge beams and eliminate the bump at the end of the bridge.

Integrate the approach as shown in the contract documents and as follows:

1. Trim a geotextile reinforcement sheets to provide the planned length after it is wrapped, and place it behind the beam end. The width of the sheet shall be sufficient to allow for wrapping of the sides after the fill layer is placed and compacted.
2. Place and compact graded aggregate base material to a maximum compacted layer thickness of 6 in. Add a secondary layer of reinforcement on top of the 6 in. lift, and then place and compact graded aggregate base material to a maximum compacted layer thickness of 6 in. Fold back the reinforcement sheet to wrap the compacted fill layer and smooth wrinkles.
3. Repeat steps 1 & 2 until approximately 2 in. from the top of the beam grade.

If lateral spreading of the fill in the integrated approach is an issue (e.g., wing walls are not sufficient to confine the fill at the sides), the reinforcement sheets comprising the wrapped layers shall be folded over along the sides and perpendicular to the bridge.

When preloading is identified in the contract documents to minimize post-construction deformation or settlement within the GRS mass, preload the abutment before paving.

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The top layer of reinforcement should be kept approximately 2 in. below the beam grade to allow a layer of aggregate cover to be placed to protect the reinforcement from contact with hot mix asphalt.

Extend paving fabric 3 ft over the beam approach interface to bridge the gap and provide an interface to accommodate thermal movement, minimize surface water infiltration, and prevent cracks in the road.

METHOD OF MEASUREMENT

This work will be measured as each GRS abutment satisfactorily installed as part of the GRS-IBS.

BASIS OF PAYMENT

The unit price bid for each GRS abutment within the GRS-IBS shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work including the concrete block facing units, the RSF backfill and geosynthetics, the GRS backfill and geosynthetics as well as the polystyrene foam board and flashing, and the Integrated Approach backfill and geosynthetics.

Payment for the prestressed concrete beam superstructure and roadway surface will be made under their respective items.

NOTE: NN denotes serialized pay item, see §101-02.

Each Item represents the pay quantity for a unique Structure at a unique location in the contract.

ITEM 554.70 NN17- GRS ABUTMENT FOR GEOSYNTHETIC REINFORCED SOIL – INTEGRATED BRIDGE SYSTEM (GRS-IBS)

DESCRIPTION

This work shall consist of furnishing and installing a geosynthetic reinforced soil (GRS) abutment, as part of a geosynthetic reinforced soil integrated bridge system (GRS-IBS), to the lines and grades designated in the contract documents.

Definitions

Geosynthetic Reinforced Soil (GRS): Alternating layers of compacted granular fill reinforced with geosynthetic reinforcement (e.g., geotextiles, geogrids). The primary reinforcement spacing in GRS is less than or equal to 300 mm (200 mm typ.).

GRS mass or GRS structure: A composite mass built with GRS that creates a freestanding, internally supported structure with reduced lateral earth pressures with considerable strength. This design permits the use of lightweight modular blocks and the elimination of mechanical connections between blocks and the reinforcement. A GRS mass is not rigid and is therefore tolerant to differential foundation settlement.

GRS-IBS: A unique application of GRS technology in the specific context of bridge abutments. GRS-IBS bridge abutments are built to support a bridge on the granular fill directly behind the block face. GRS-IBS is used to integrate the bridge structure with the bridge approach to create a jointless bridge system. GRS-IBS includes a:

- Reinforced Soil Foundation (RSF),
- GRS abutment, and
- GRS integrated approach.

MATERIALS

Concrete block facing units – Provide concrete wall units meeting the requirements of either §704-06 *Precast Concrete Wall Units* or §704-07 *Drycast Concrete Wall Units*.

1. **Block Size** – Provide concrete wall facing units with a nominal height dimension of 200 mm to correspond to the geosynthetic reinforcement layering system identified in the contract documents.

Provide concrete wall facing units for the beam seat with a nominal height dimension of 100 mm to correspond to the geosynthetic reinforcement layering system identified in the contract documents.

2. **Block Composition** – Provide concrete wall facing units that include solid face concrete blocks, hollow core concrete blocks and corner and coping blocks as identified in the contract documents. For manufacturers on the Approved List supplying only solid blocks, modify the top three courses of concrete block facing units in the abutment to address susceptible movement from the lack of weight of successive layers. Provide units that accept No. 13 rebar to pin them together as shown in the contract documents.

Backfill material –

1. **RSF and Integrated Approach** – Provide graded aggregate base backfill material of one of the following types:

- A. **Type A.** Material meeting the requirements of §733-04 *Subbase Course, Type 2*.
- B. **Type B.** Material meeting the requirements of §733-04 *Subbase Course, Type 4*.

2. **GRS Abutment** – Provide GRS backfill material of one of the following types:

- A. **Type A.** Material meeting the requirements of §733-04 *Subbase Course, Type 2.*
- B. **Type B.** Material meeting the requirements of §733-04 *Subbase Course, Type 4.*
- C. **Type C.** Material consisting of crushed stone conforming to §703-02 *Coarse Aggregate, Size Designation 1A.*
- D. **Type D.** Material consisting of crushed stone conforming to §703-02 *Coarse Aggregate, Size Designation 2.*

Geosynthetics –

- 1. **RSF and Integrated Approach** – Provide geotextile reinforcing elements meeting the requirements of §737-07 *Geogrids.*
- 2. **GRS Abutment** – Provide geogrid or geotextile reinforcing elements meeting the requirements of §737-07 *Geogrids.*

Geosynthetic Warning Markers –

- 2. **Signs** – Provide warning signs. These will be 180 mm x 250 mm (minimum) fiberglass. Include warning information as follows:

WARNING

Internally Stabilized Fill Structure

DO NOT EXCAVATE

Call Regional Office of NYS DOT

For signs installed on concrete units, provide 9.5 mm diameter stainless steel bolt and expansion anchor meeting GSA Specifications FF-S-325 and installed by masonry drill.

- 2. **Marking Tape** – Provide polyethylene material 75 mm wide, 100 µm thick. Include warning markings.

Concrete block wall fill – Provide concrete conforming to the requirements of Section 501, *Portland Cement Concrete-General, Class A.*

Flashing – Provide flashing, such as 100 mm by 38 mm aluminum fascia (or equivalent), to serve as a drip edge under the superstructure within the clear space.

Polystyrene Foam board – Provide polystyrene foam board conforming to AASHTO M 230, Type VI.

Reinforcing steel bar – Provide deformed No. 13 (12.7 mm diameter) bars that conform to AASHTO M31-10 or ASTM A615M-12. The bars shall be epoxy coated conforming to AASHTO M 284-09.

Asphaltic coating – Provide a shop-installed asphaltic coating on the concrete beam such that, when embedded between the GRS abutment and the wing wall, the embedded concrete is sealed.

CONSTRUCTION DETAILS

Submittal. Submit the geogrid and/or geotextile reinforcing element certifications, verifying that the material meets the requirements of §737-07 *Geogrids* for the specified long term design tensile strength shown in the contract documents, to the Engineer prior to start of work. Begin work only after receiving the Engineer's approval.

Supply on-site technical assistance from a representative of the geosynthetic reinforcing element manufacturer until such time as outside consultation is no longer required, but for a minimum of 2 days.

Storage of Geosynthetic. Store and protect geosynthetic materials in accordance with the manufacturer's recommendations prior to installation.

Pre-Operation Meeting. A Pre-Operation Meeting will be held between the Engineer, Contractor, Regional Geotechnical Engineer, Geotechnical Engineering Bureau and other appropriate Department representatives to discuss the Contractors proposed construction methods. Begin work only after receiving the DCES written approval and after the Pre-Operation Meeting is held.

Supply on-site technical assistance from a representative of the designated designer during the beginning of the installation until such time as outside consultation is no longer required.

Excavation and Disposal. Excavate in accordance with the applicable requirements of Section 206 *Trench, Culvert and Structure Excavation* and the details specified in the contract documents.

Reinforced Soil Foundation (RSF). Prior to erection of the GRS abutment for the GRS-IBS, the foundation will be inspected and approved by the Engineer.

- 1. Placement Area Foundation Preparation.** Prepare the foundation area under the GRS abutment level for a width equal to, or in excess of, the reinforcing element length. Prior to wall system construction, compact this area to a minimum of 90% of Standard Proctor Maximum Density. Treat all soils found to be incapable of being satisfactorily compacted because of moisture content, in a manner directed by the Engineer, in conjunction with the recommendations of the Departmental Geotechnical Engineer. Remove any unsuitable material within the foundation area.

Construct the RSF, consisting of graded aggregate base material encapsulated in geosynthetic reinforcement placed perpendicular to the abutment face to protect it from possible erosion. Measure and size the reinforcement sheets to fully enclose the RSF on three sides: the face and the two wing wall sides.

Place the RSF graded aggregate base material from the face to the back in order to roll folds or wrinkles to the free end of the reinforcement layer. Compact the graded aggregate base material to a maximum compacted layer thickness of 150 mm. Grade, level, and compact the graded aggregate base material before encapsulating the RSF. When the moisture content is within the limits for proper compaction, compact the material in accordance with the requirements contained in *Compaction* in Section 203 *Excavation and Embankment*. Density tests are not required for the acceptance of these courses.

Place the first layer of the reinforcement on the upstream side of the abutment with subsequent layers, if needed, overlapped a minimum of 1 m on the top of the preceding layer.

For GRS abutments adjacent to water, overlap the reinforcement sheets a minimum of 1 m, starting with the first layer on the upstream side of the RSF. Orient all overlap sections in the area of the RSF to prevent running water from penetrating layers of reinforcement.

Ensure the wrapped corners of the RSF are tight and without exposed soil within the RSF to complete the encapsulation.

GRS Abutment.

1. Backfill.

Place the GRS backfill onto the geosynthetic reinforcing elements in such a manner that no damage occurs. Progress placement of backfill materials so as to minimize the development of slack in the reinforcing element.

Compact the GRS backfill to a minimum of 95% of Standard Proctor Maximum Density in accordance with the requirements contained in *Compaction* in Section 203 Excavation and Embankment. Adjust the moisture content of the compacted backfill materials to within 2 percent of the optimum moisture content.

Construct the GRS mass using compacted lifts of 200 mm, which are equal to the facing block size.

Allow only hand operated equipment within 1 m of the face so as not to damage or dislocate the facing blocks. Reduce lift thickness, if necessary, to achieve required compaction.

Compact the top 1.5 m of the abutment to 100% of Standard Proctor Maximum Density in accordance with the requirements contained in *Compaction* in Section 203 Excavation and Embankment.

2. Geosynthetic Reinforcement.

Place and secure the primary and secondary reinforcing element in accordance with the manufacturer's recommendations, in continuous strips without joints, seams or connections throughout the embedment length, to the line, grade and orientation shown in the contract documents. Place the geosynthetic reinforcement so that the strongest direction (i.e. machine direction) is perpendicular to the abutment facing.

Treat 100 percent of the embedment area with reinforcement, based on the designated minimum reinforcement length, unless otherwise shown in the contract drawings.

Adjacent sections of the geosynthetic reinforcement do not need to be overlapped except when exposed in the wrap-around face system, at which time, overlap or mechanically connect the reinforcement rolls per the manufacturer's requirements.

Place reinforcing elements to lay flat with no creases and pull taut to remove any slack prior to placement of backfill. Place geosynthetic reinforcement directly on the compacted horizontal fill surface. Position the reinforcement uniformly on the compacted reinforced soil from the connection to the wall to the free end of the reinforcing elements.

Extend the geosynthetic reinforcement between the layers of the concrete block facing units. Cover a minimum of 85 percent of the top surface of the concrete block facing unit with geosynthetic reinforcement. Remove any excess reinforcement material showing through the face in accordance with the manufacturer's directions.

A minimum GRS backfill layer of 150 mm shall be placed on the geosynthetic prior to operating any vehicle over it.

Place bearing reinforcement beds behind the concrete block facing unit at 100 mm spacing in the top five layers of the GRS abutment, or as determined by the design and detailed in the contract documents.

In the superelevation case, the reinforcement layers become stair-stepped in the upper wall layers as the superelevation of the abutment is constructed. In such situations, terminate the reinforcement along the angle surface of the superelevation. Designate the termination of each layer of the reinforcement across the abutment wall from low to high elevations in the GRS wall reinforcement schedule.

Install GRS-IBS identification markers. Place the marking tape at the highest possible elevation that will not damage the tape (e.g. 150 mm below top of subbase elevation). Install the marking tape on top of the reinforced backfill area, parallel to the abutment face in rows at 1.5 m intervals until the back edge of the reinforced backfill area is reached. Place the warning sign directly below the BIN plaque. Drill two, 8 mm diameter, holes for mounting, located 13 mm from the ends of the sign and 90 mm from the top of the sign. Secure the sign using anchorage appropriate for the supporting material.

Concrete Block Facing Units. Handle and assemble the concrete block facing units in accordance with the designer's instructions and the contract documents. Erect the facing units conforming to the lines, grades, and typical sections shown on the contract documents and in accordance with the designated manufacturer's installation manual.

1. Leveling Layer. Set the first course of the facing block level and to grade. A thin leveling layer of fine aggregate, which shall not exceed 13 mm, may be used on the top of the RSF to facilitate construction of the first course of the facing block. If the leveling layer required exceeds 13 mm, a mortar or grout shall be placed in the gap between the RSF and the first concrete block facing unit course.

Begin the concrete block facing unit construction at the lowest portion of the excavation, with each layer placed horizontally. Place the concrete block facing units side by side and in full contact with the installed leveling layer. Completely construct and clean each concrete block facing unit layer of any debris and fill material prior to placing the next layer of geosynthetic

reinforcement and concrete block facing unit. Maintain a stretcher or running bond between courses of blocks to ensure that the joints between the blocks are offset with each row.

If a scour countermeasure, such as stone fill, is used, geotextile bedding material shall be placed under the countermeasure and anchored between the first and second course of the concrete block facing unit. Scour countermeasures and geotextile bedding will be paid for under their respective items.

Carefully move concrete block facing units displaced out of required alignment during construction back into position by methods that will not cause damage to the concrete block facing units or other work. Replace any damaged concrete block facing units to retain the new wall integrity at no additional cost to the State.

In superelevations, trim the top course of concrete block facing unit beneath the superstructure to match the elevation difference and clear space across the abutment.

Stagger facing wall and wing wall courses to form a tight interlocking stable corner.

Fill the top three courses of concrete block facing units with Class A concrete, pin with No. 13 steel bar, and embed with a minimum of 50 mm cover.

Beam Seat. The beam seat shall be constructed directly above the bearing bed reinforcement zone to ensure that the superstructure bears on the GRS abutment, not the wall facing block, and provides the necessary clear space between the superstructure and the wall face.

Establish the block elevation beneath the bearing area and pin the concrete block facing units on the abutment wall face.

Construct the beam seat to the dimensions shown in the contract documents and as follows:

1. Place precut 100 mm thick polystyrene foam board on the top of the bearing bed reinforcement. For grading purposes and to ensure the proper clear space height and drainage (crown in bridge), a thin layer of backfill may be placed beneath the foam board. Butt the foam board against the back face of the concrete block facing unit.
2. Set 100 mm solid concrete blocks on top of the polystyrene foam board across the entire length of the bearing area. The back edge of the top concrete block facing unit holds the 100 mm concrete block in place during compaction.
3. Use the first 100 mm wrapped layer of compacted fill as the thickness to the top of the polystyrene foam board.
4. Place the second 100 mm wrapped layer of compacted fill to the top of the 100 mm solid block, creating the clear space. The top of this layer controls the beam elevation.
5. Before folding the final wrap, grade the surface aggregate of the beam seat slightly high (about 13 mm) to aid in seating the superstructure and to maximize contact with the bearing area.

6. Install aluminum flashing drip edge prior to setting the bridge beams. Place precut 100 mm thick polystyrene foam board on top of the filled-in top course of the concrete block facing units, positioned directly in front of the 100 mm solid concrete blocks. Place the flashing in between the bottom of the beams and the polystyrene foam board. Hold the flashing in place by the pressure of the beams on the solid concrete blocks. The length of the flashing shall extend beyond the outside edge of the bridge beams and be trimmed to fit against the parapets.

Placement of Superstructure. A crane positioned on the GRS abutment for placement of the superstructure shall have the outrigger pads sized within the capacity of the GRS mass. The outrigger pads shall be sized for a maximum pressure of 190 kPa near the face of the abutment wall, with greater loads able to be supported with increasing distance from the abutment face.

Place an additional layer of geosynthetic reinforcement between the beam seat and concrete beams to provide additional protection of the beam seat.

Set the beams square and level. Do not drag the beams over the beam seat surface.

Construct the wing walls and parapets after the superstructure is set. The concrete block facing unit in the parapet wall shall be trimmed or saw cut for a custom fit against the beam edge to prevent the loss of fill material. If the gap between the superstructure and the facing block is difficult to fill using thin slices of cut block, a mortar mix shall be used to close the space.

Approach Integration. Construct the road and superstructure interface to minimize settlement in front of the bridge beams and eliminate the bump at the end of the bridge.

Integrate the approach as shown in the contract documents and as follows:

1. Trim a geotextile reinforcement sheets to provide the planned length after it is wrapped, and place it behind the beam end. The width of the sheet shall be sufficient to allow for wrapping of the sides after the fill layer is placed and compacted.
2. Place and compact graded aggregate base material to a maximum compacted layer thickness of 150 mm. Add a secondary layer of reinforcement on top of the 150 mm lift, and then place and compact graded aggregate base material to a maximum compacted layer thickness of 150 mm. Fold back the reinforcement sheet to wrap the compacted fill layer and smooth wrinkles.
3. Repeat steps 1 & 2 until approximately 50 mm from the top of the beam grade.

If lateral spreading of the fill in the integrated approach is an issue (e.g., wing walls are not sufficient to confine the fill at the sides), the reinforcement sheets comprising the wrapped layers shall be folded over along the sides and perpendicular to the bridge.

When preloading is identified in the contract documents to minimize post-construction deformation or settlement within the GRS mass, preload the abutment before paving.

ITEM 554.70 NN17- GRS ABUTMENT FOR GEOSYNTHETIC REINFORCED SOIL - INTEGRATED BRIDGE SYSTEM (GRS-IBS)

The top layer of reinforcement should be kept approximately 50 mm below the beam grade to allow a layer of aggregate cover to be placed to protect the reinforcement from contact with hot mix asphalt.

Extend paving fabric 1 m over the beam approach interface to bridge the gap and provide an interface to accommodate thermal movement, minimize surface water infiltration, and prevent cracks in the road.

METHOD OF MEASUREMENT

This work will be measured as each GRS abutment satisfactorily installed as part of the GRS-IBS.

BASIS OF PAYMENT

The unit price bid for each GRS abutment within the GRS-IBS shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work including the concrete block facing units, the RSF backfill and geosynthetics, the GRS backfill and geosynthetics as well as the polystyrene foam board and flashing, and the Integrated Approach backfill and geosynthetics.

Payment for the prestressed concrete beam superstructure and roadway surface will be made under their respective items.

NOTE: NN denotes serialized pay item, see §101-02.

Each Item represents the pay quantity for a unique Structure at a unique location in the contract.