

PRECAST CONCRETE GEOGRID RETAINING WALL

****From Brandon NH 019-3(495)**

- xx. DESCRIPTION. This work shall consist of designing, fabricating, furnishing, and erecting precast concrete geogrid retaining walls at the locations specified and in conformance with the lines and grades shown on the Plans or as directed by the Engineer.
- xx. DESIGN REQUIREMENTS. The design shall be performed in accordance with the AASHTO *Standard Specifications for Highway Bridges* and the design criteria specified in the Plans.
- xx. APPROVED WALL SYSTEMS. The approved wall system for this project is the *Redi-Rock* modular block unit geogrid retaining wall system.

An approved equal to the above may be selected provided it is a precast concrete geogrid retaining wall system appearing on the Agency's approved earth retaining wall system list.

- xx. MATERIALS. Materials shall meet the following requirements:

- (a) Concrete. Concrete for blocks shall meet the following requirements of Section 501 for Concrete, High Performance Class B:

501.02 MATERIALS

501.03 CLASSIFICATION AND PROPORTIONING

501.04 BATCHING, paragraphs 1 and 3 only. The batch plant shall be able to automatically print out the batch quantities.

501.04(b) Testing Laboratory.

501.04(c) Bins and Scales.

501.04(d) Accuracy of Plant Batching.

501.04(e) Storage and Proportioning of Materials.

501.05 MIXING AND DELIVERY. For plants not located in the State of Vermont, the Agency has the option of waiving the requirements of subpart (a)(4) and part (c), paragraphs 1 and 3 only. If the block is cast at the same facility where the concrete is batched, the concrete shall be mixed a minimum of 150 revolutions prior to discharge into the forms. If bagged silica fume is used, the revolutions shall be increased to a minimum of 200.

501.17 CURING CONCRETE. Burlap curing shall be continued until the concrete has reached design strength needed for the block. The concrete shall not be subjected to freezing temperatures prior to achieving design strength.

- (1) Concrete Testing. Concrete will be sampled in accordance with AASHTO T 141; tested for slump in

accordance with AASHTO T 119M/T 119, for air content in accordance with AASHTO T 152, and for compressive strength in accordance with AASHTO T 23. The concrete will be tested once for every 19.1 cubic meters (25 cubic yards) placed.

- (2) Compressive Strength. Specimens shall be standard cylinders made by the Fabricator in accordance with AASHTO T 23. Fabrication of test specimens may be witnessed by an Agency representative.

A minimum of two specimens are required to determine compliance with the 28-day design strength requirement for the block. The specimens shall be cured under the same conditions as the block from the time of casting until the piece is removed from the form. The specimens shall remain with the block until at least 24 hours prior to being tested.

- (3) Fabrication. The blocks for the project shall be fabricated at the same plant. No change in cementitious content or source will be allowed. The Engineer may allow blocks to be cast at other plants if provided with a written request and mix design that uses the same cementitious content and sources.

- (4) Concrete Finish and Color. The available finish and color for the exposed face of the precast concrete blocks shall be selected and approved by the Engineer and the Agency's Project Manager. The Fabricator shall provide a test block of the pattern and color for approval prior to casting all blocks.

- (b) Geogrid. Geosynthetic reinforcement for geogrid shall be a regular network of internally connect polymer tensile elements with aperture geometry sufficient to permit significant mechanical interlock with the surrounding soil and rock. The geogrid structure shall be dimensionally stable and able to retain its geometry under manufacture, transport, and installation. All geosynthetic reinforcement shall be made from the same manufacturer and of the same type, manufacturing process, and polymer. The type and placement location requirements of the reinforcing geosynthetic shall be as shown on the Plans.

- (c) Connector Reinforcement. Connector reinforcement used in the geogrid connection shall be No. 4 epoxy coated deformed reinforcing steel meeting the requirements of Section 507.

- (d) Backfill. Backfill material shall meet the requirements of Section 204 for Granular Backfill for Structures.

xx. SUBMITTALS. The Contractor shall submit a copy of the design computations, one (1) set of Fabrication Drawings, and three (3)

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sets of design drawings. The submittal(s) shall be signed, stamped, and dated by a qualified registered Professional Engineer licensed in the State of Vermont or eligible to practice engineering in the State of Vermont under transient practice provisions of Title 26 VSA, Section 1181a.

Working Drawings and design calculations shall be submitted to the Engineer for review and approval at least 4 weeks before work is to begin and shall include the following:

- (1) Complete design calculations substantiating that the proposed design satisfies the design parameters in the Contract Documents.
- (2) An elevation view of the wall, which shall include the elevation at the top of the wall at all horizontal and vertical break points and at least every 15 m (50 feet) along the face of the wall, all steps in the base pads, the length of soil reinforcing elements, the distance along the face of the wall to where changes in the length of the soil reinforcing elements occur; and an indication of the final ground line and maximum calculated bearing pressures.
- (3) A typical cross-section showing the elevation relationship between ground conditions and proposed grades.
- (4) General notes pertaining to design criteria and wall construction.
- (5) A detail of the connection between the concrete block and the soil reinforcements.
- (6) Other information required in the Contract Documents or requested by the Engineer.

Approval of the Contractor's Working Drawings shall not relieve the Contractor of any of his responsibility under the contract for the successful completion of the work.

xx. PRECAST CONCRETE INSPECTION. Materials furnished and the work performed may be inspected by the Agency.

The Fabricator shall provide a tentative casting schedule to the Engineer and Structural Concrete Engineer for the following casting week a minimum of 3 calendar days prior (a casting week will be Sunday to Saturday). The Fabricator shall also maintain a Quality Control file that shall contain at a minimum the block identification, date and time cast, concrete test results, quantity of concrete used per block, batch quantity printout, cylinder results, and aggregate gradation and moisture.

Advance notification of at least two weeks shall be provided by the Fabricator to the Agency's Engineer and Structural Concrete Engineer concerning the proposed intention to commence work. A minimum of five working days notification must be provided to the Structural Concrete Engineer by the Fabricator to confirm the fabrication start date.

The Inspector shall have the authority to reject any material or work that does not meet the requirements of these specifications.

Prior to shipment of any members, the Materials and Research Engineer will have approved all applicable material certifications required in accordance with Subsection 700.02.

xx. GEOSYNTHETIC REINFORCEMENT PLACEMENT. All materials shall be installed at the proper elevation and orientation as shown in the block wall details on the Plans, or as directed by the Engineer. The geosynthetic reinforcement shall be installed in general accordance with the manufacturer's recommendations, unless otherwise modified by these specifications. The Plans shall govern in any conflict between the two requirements.

- (1) The geosynthetic reinforcement shall be connected to the blocks as specified in the Plans or the manufacturer's installation manual.
- (2) Overlap of the geosynthetic reinforcement in the design strength direction shall not be permitted, except where indicated on the drawings. The design strength direction is that length of geosynthetic reinforcement perpendicular to the wall face and shall consist of one continuous piece of material. Adjacent sections of geosynthetic reinforcement shall be placed in a manner to assure that horizontal coverage shown on the Plans is provided.
- (3) Place only that amount of geosynthetic reinforcement required for immediately pending work to prevent undue damage. After a layer of geosynthetic reinforcement has been placed and the next succeeding layer of backfill material has been placed, the next geosynthetic reinforcement layer shall be installed. The process shall be repeated for each subsequent layer of geosynthetic reinforcement and backfill material.
- (4) Geosynthetic reinforcement shall be placed to lay flat and pulled tight prior to backfilling. Pull geosynthetic reinforcement tight with uniform tension, using a mechanical rake with hinge in the middle, as a tensioning device to remove all wrinkles in the geosynthetic reinforcement. After a layer of geosynthetic reinforcement has been placed, suitable means, such as pins or small piles of backfill material, shall be used to hold the geosynthetic reinforcement in position until the subsequent layer of backfill material can be placed. Under no circumstances shall any construction equipment or vehicles be allowed on the geosynthetic reinforcement before at least 150 mm (6 inches) of backfill material has been placed.
- (5) During construction, the surface of the fill shall be kept approximately horizontal. Geosynthetic reinforcement shall be placed directly on the compacted horizontal surface of backfill material. Geosynthetic reinforcements are to be placed with 100 mm (4 inches) of the design elevations and extend the length as shown on the elevation view unless

otherwise directed by the Engineer. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor.

xx. BACKFILL MATERIAL. The materials and placement of backfill material shall meet the following requirements:

- (1) Backfill material can be placed and spread directly upon the geosynthetic reinforcement. Extreme care shall be taken to prevent wrinkles and/or slippage of geosynthetic reinforcement during fill placement and spreading. When practical, backfill material is to be placed in the direction in which the geosynthetic reinforcement was laid out, to add tensioning. If backfill material must be placed transversely to the roll length, slight (100 mm (4 inch)) overlaps between roll widths, with the top piece of geosynthetic reinforcement being the first to receive fill, will prevent permanent folding of reinforcement. Each backfill material lift shall be compacted to 95 percent in accordance with AASHTO T 99.
- (2) The moisture content of backfill material prior to and during compaction shall be uniform throughout each layer. Backfill material shall have a placement moisture content that is between 98 percent and 100 percent of the optimum moisture content. Backfill material with placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniform and acceptable throughout the entire lift. The optimum moisture content shall be determined in accordance with AASHTO T 99.
- (3) The frequency of sampling of backfill material, necessary to assure gradation control throughout construction, shall be as directed by the Engineer. If 30 percent or more of the backfill material is greater than 19 mm (3/4 inch) in size, AASHTO T 99 is not applicable. For such material, the acceptance criterion for control of compaction shall be either a minimum of 70 percent of the relative density of the material, as determined by ASTM D 4253 and ASTM D 4254 or a method specification (based on a test compaction section) which defines the type of equipment, lift thickness, number of passes of the specified equipment, and placement moisture content.
- (4) The maximum lift thickness after compaction shall not exceed 250 mm (10 inches), regardless of the vertical spacing between the reinforced backfill layers. The Contractor shall decrease this lift thickness, if necessary, to obtain the specified density. Prior to placement of the geosynthetic reinforcement, the elevation after compaction shall be 50 mm (2 inches) above the attachment device elevation from a point approximately 300 mm (12 inches) behind the back face of blocks to the free end of the backfill reinforcements, unless otherwise shown on the Plans.
- (5) Compaction within 1.2 m (4 feet) of the back face of the blocks shall be achieved by at least three passes of a vibratory plate compactor. The specified lift thickness

shall be adjusted as warranted by the type of compaction equipment actually used, but no soil density tests need to be taken within this area. Care shall be exercised in the compaction process to avoid misalignment of the blocks or damage to the attachment devices. Heavy compaction equipment shall not be used to compact backfill within 1.2 m (4 feet) of the wall face.

(6) At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing to direct runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

xx. HORIZONTAL AND VERTICAL CONTROL. Immediately following the erection of the precast concrete geogrid retaining wall, the Contractor shall establish horizontal and vertical survey points at three locations across the top and at mid-elevation of the wall to monitor future movements. These points shall be tied into a minimum of two control markers that are sufficiently removed from the wall so as not to be influenced by any possible wall movement. The control shall be located to allow additional measurements to be made after all construction is complete. A plan with the locations of all survey points and ties, along with the distances and elevations recorded to the nearest 3 mm (one hundredth of a foot) shall be provided to the Engineer within 48 hours of the completion of the precast concrete geogrid retaining wall.

xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Precast Concrete Geogrid Retaining Wall) to be measured for payment will be the number of square meters (square yards) of wall surface area complete and in place in the accepted work, measured as the sum of the areas of panels actually erected in the wall.

xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Precast Concrete Geogrid Retaining Wall) will be paid for at the Contract unit price per square meter (square yard). Payment will be full compensation for designing, fabricating, furnishing, and installing the materials specified, including but not limited to the precast concrete blocks, geosynthetic reinforcement, connector reinforcements, and backfill material; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.675 Special Provision (Precast Concrete Geogrid Retaining Wall)	Square Meter (Square Yard)