



**SPECIAL PROVISIONS
FOR
FABRIC FORMED CONCRETE REVETMENT MAT**

**Plymouth County
BRFN-140-2(15)--39-75**

**Effective Date
June 21, 2011**

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

090135.01 DESCRIPTION.

This work consists of constructing fabric formed concrete revetment mats.

The fabric formed revetment shall consist of specially woven, double-layer synthetic forms filled with a pumpable, fine aggregate concrete (concrete grout) in such a way as to form a stable revetment of required thickness, weight, and configuration.

The configuration of fabric formed revetment on this project shall be 'Filter Point Mat'.

090135.02 MATERIALS.

A. Concrete Grout for Fabric Formed Revetment.

Materials for fine aggregate concrete (concrete grout) shall meet the requirements of the following Sections of the Standard Specifications:

<u>Item</u>	<u>Section</u>
Portland Cement	4101
Fine Aggregate	4110 or 4112
Water	4102
Admixtures	4103

The concrete grout shall consist of a mixture of Portland cement, fine aggregate, and water so proportioned and mixed as to provide a pumpable slurry. Pozzolan and grout fluidizer may be used at the option of the Contractor.

The consistency of the concrete grout delivered to the concrete pump shall be proportioned and mixed as to have an efflux time of 9 to 12 seconds when passed through the 0.75 inch orifice of the standard flow cone that is described in ASTM C 939.

The concrete grout shall have an air content of not less than 5% nor more than 8% of the volume of the grout. The mix shall obtain a compressive strength of 2,000 pounds per square inch at 28 days.

Mix proportions shall be similar to Article 2507.02 of the Standard Specifications. The Contractor shall supply a mix design to the Engineer that will meet the above requirements. The Contractor shall submit samples of fine aggregate, cement, and fly ash intended for use to the Engineer before the work begins. After the mix has been designated, it shall not be changed without approval of the Engineer.

B. Fabric Forms.

1. Manufacturers and Products.

Acceptable manufacturers and products are as follows:

- Donnelly Fabricators, Inc., 970 Henry Terrace, Lawrenceville, GA 30045, telephone 770.339.0108. Product: Texicon™ Filter Point Lining.
- Hydrotex Synthetics, Inc., 74 Perimeter Center East, Suite 7420, Atlanta, GA 30346-1803, telephone 800.225.0023. Product: Hydrotex™ Filter Point Lining.
- Armorform, Inc., P.O. Box 710, Jefferson, GA 30549, telephone 706.367.4661. Product: Armorform™ Filter Point Mat.
- Or approved equal.

The fabric forms supplied shall meet the details and specifications of the above named products as modified by this specification.

2. Materials.

Fabric forms shall be fabricated to the dimensions shown in the contract documents. The dimensions shown in the contract documents reflect the size of the fabric form after filling with concrete grout and are exclusive of form material in anchor, terminal, or toe trenches unless otherwise noted. The Situation Plan indicates finished dimensions.

The estimated quantities shown in the contract documents reflect the size of the fabric form prior to filling with concrete grout and include form material in anchor, terminal, or toe trenches unless otherwise noted. Where the plan indicates a finished dimension, the fabric form dimension has been adjusted by decreasing the fabric form dimension by 10% in each direction to provide the finished dimension shown following filling with concrete grout.

The fabric forms shall be composed of synthetic yarns formed into a woven fabric. Yarns used in the manufacture of the fabric shall be composed of nylon and/or polyester. Forms shall be woven with a minimum of 50% textured yarns (by weight) to improve adhesion to the concrete grout and to improve filtration. Each layer of fabric shall conform to the physical, mechanical, and hydraulic requirements referenced herein. The fabric forms shall be free of defects or flaws that significantly affect their physical, mechanical, or hydraulic properties.

Fabric used to fabricate the fabric forms shall meet or exceed the values shown for the properties shown in Table 090135.02-1.

Table 090135.02-1: Fabric Form Minimum Property Requirements			
Property	Test Method	Units	Filter Point Mat
Composition of Yarns			Nylon or Polyester
Mass Per Unit Area (double-layer)	ASTM D 5261	oz/yd ²	12
Thickness	ASTM D 5199	mils	25
Mill Width		in	76
Wide-Width Strip Tensile Strength	- Machine	ASTM D 4595	lbf/in
	- Cross	ASTM D 4595	lbf/in
Elongation at Break	- Machine	ASTM D 4595	%
	- Cross	ASTM D 4595	%
Trapezoidal Tear Strength	- Machine	ASTM D 4533	lbf
	- Cross	ASTM D 4533	lbf
Apparent Opening Size (AOS)	ASTM D 4751	U.S. Std. Sieve	40
Flow Rate	ASTM D 4491	gal/min/ft ²	90
Flow Rate Through Filter Point	ASTM D 4491	gal/min/ft ²	7
Notes: 1. Conformance of fabric to specification property requirements will be based on ASTM D 4759. 2. Numerical values represent minimum average roll values (i.e., average of test results from any sample roll in a lot shall meet or exceed the minimum values). Lots shall be sampled according to ASTM D 4354.			

Mill widths of fabric shall be a minimum of 76 inches. Each selvage edge of the top and bottom layers of fabric shall be reinforced for a width of not less than 1.35 inches by adding a minimum of 6 warp yarns to each selvage construction. Mill width rolls shall be cut to the length required, and the double-layer fabric separately joined, bottom layer to bottom layer, and top layer to top layer, by means of sewing thread, to form multiple mill width panels with sewn seams on not less than 72 inch centers.

All factory-sewn seams shall be downward facing upon completion of the revetment. All seams sewn in the factory shall be not less than 90 lbf/in when tested in accordance with ASTM D 4884. All sewn seams and zipper attachments shall be made using a double line of U.S. Federal Standard Type 401 stitch. All stitches shall be sewn simultaneously and be parallel to each other, spaced between 0.25 inches to 0.75 inches apart. Each row of stitching shall consist of 4 to 7 stitches per inch. Thread used for seaming shall be nylon and/or polyester. Field sewing will be permitted only to join the factory assembled fabric form panels together.

Fabric forms shall consist of double-layer woven fabric joined together by spaced, interwoven filter points to form a concrete lining with a finished average thickness of 10 inches, a nominal mass per unit area of 113 pounds per square foot, and a deeply cobbled surface appearance. After the form has been filled with fine aggregate concrete, the filter points shall be on approximately 14 inch spacing when measured along a diagonal. Filter points shall be formed by interweaving the double layer fabric to form water permeable drains and attachment points for the control of concrete lining thickness. The interweaving of the fabric layers shall form an area of double density, high strength, single-layer fabric with an area of approximately 12.2 square inches and a perimeter of approximately 15 inches. All filter points shall be cross shaped and shall have twill weave centers designed to function as drains to relieve hydrostatic uplift pressure.

Grout stops shall be installed at predetermined mill width intervals to regulate the distance of lateral flow of concrete grout. The grout stop material shall be nonwoven filter fabric. The grab tensile strength of the filter fabric shall be not less than 90 pounds-force per inch when tested in accordance with ASTM D 4632.

3. Delivery.

The fabric forms shall be kept dry and wrapped such that they are protected from the elements during shipping and storage. If stored outdoors, they shall be elevated and protected with a waterproof cover that is opaque to ultraviolet light. The fabric forms shall be labeled as per ASTM D 4873.

The Contractor shall submit layout or shop drawings, or both, a minimum of 2 weeks prior to installation. The drawings shall include the dimensions of the fabric form panels, location and type of field seams, and field splicing requirements.

The Contractor shall submit a manufacturer's certificate that the supplied fabric forms meet the criteria of this specification, as measured in full accordance with the test methods and standards referenced herein. The certificates shall include the following information about each fabric form delivered:

- Manufacturer's name and current address
- Full product name
- Style and product code number
- Composition of yarns
- Manufacturer's certification statement

090135.03 CONSTRUCTION.

A. Equipment.

Proportioning and mixing equipment shall meet requirements of Articles 2001.20 and 2001.21 of the Standard Specifications. Sufficient mixing capacity of mixers shall be provided to permit the intended pour to be placed without interruption. All oil or other rust inhibitors shall be removed from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used. The pumping equipment shall have a variable flow rate to provide enough pressure for pumping without breaking the fabric.

B. Site Preparation.

Areas on which fabric forms are to be placed shall be constructed to the lines, grades, contours, and dimensions shown on the plans. All obstructions such as roots and projecting stones shall be removed. Where such areas are below the allowable grades, they shall be brought to grade by placing compacted layers of select material. The thickness of layers and the amount of compaction shall be as specified by the Engineer. Soft and otherwise unsuitable subgrade soils shall be identified, excavated, and replaced with select materials in accordance with the contract documents.

Excavation and preparation of aprons as well as anchor, terminal or toe trenches shall be done in accordance with the lines, grades, contours, and dimensions shown on the plans. Immediately prior to placing the fabric forms, the prepared area will be inspected by the Engineer, and no forms shall be placed thereon until the area has been approved.

C. Fabric Form Placement.

Fabric forms shall be placed on the graded surface approved by the Engineer within the limits shown on the plans. Anchoring of the fabric forms will be accomplished through the use of anchor, terminal, and toe trenches at locations shown on the plans.

Where fabric formed concrete is placed adjacent to a substructure unit, the fabric forms shall be placed so that the filled fabric formed revetment shall be flush with the substructure unit. Extend

unfilled fabric form along substructure unit for a distance of 1 to 2 feet. Placement of the fabric forms prior to filling shall consider the contraction of the fabric form during filling.

Fabric forms shall be tailored in the field to fit around any appurtenances. An opening which is slightly smaller than the object shall be cut in the fabric form and the perimeter of the opening sewn closed. When the fabric form panel is placed, the tailored opening is either slid over or wrapped around the object. When fine aggregate concrete is pumped into the section of the panel with the tailored opening, the form shall fit snugly around the object.

All field seams shall be made using two lines of U.S. Federal Standard Type 101 stitches. Thread used for seaming shall be nylon and/or polyester. All sewn seams shall be downward facing. Zipper seams will be permitted unless noted otherwise in the contract documents. The finished strength of the field seams shall comply with the manufacturer's recommendations. Adjacent fabric forms shall be joined before filling with fine aggregate concrete by field sewing or zipping the two bottom layers of fabric together and the two top layers of fabric together.

When conventional joining of fabric forms is impractical or where called for in the contract documents, adjacent forms may be overlapped a minimum of 3 feet to form a lap joint, pending approval by the Engineer. Based on the predominant flow direction, the downstream edge of the form shall overlap the upstream edge of the next form. In no case will simple butt joints between forms be permitted.

Immediately prior to filling with fine aggregate concrete, the assembled fabric forms will be inspected by the Engineer, and no concrete grout shall be pumped therein until the fabric seams have been approved. At no time shall the unfilled fabric forms be exposed to ultraviolet light, including direct sunlight, for a period exceeding 5 calendar days.

D. Proportioning and Mixing Concrete Grout.

All materials shall be accurately measured by volume or weight as they are fed into the mixer. The quantity of water shall be such as to produce a grout having a pumpable consistency. Time of mixing shall be not less than 1 minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 2 1/2 hours in temperatures below 70°F and for a period not exceeding 2 hours at higher temperatures. If there is a lapse in a pumping operation, the grout shall be recirculated through the pump or through the mixer drum (or agitator) and pump.

E. Concrete Grout Placement.

Following the placement of the fabric forms, small slits shall be cut in the top layer of the fabric form to allow the insertion of the filling pipe at the end of the concrete grout pump hose. These slits shall be of the minimum length to allow proper insertion of the filling pipe. Concrete grout shall be pumped between the top and bottom layers of fabric, filling the forms to the recommended thickness and configuration. Holes in the fabric forms left by the removal of the filling pipe shall be temporarily closed by inserting a piece of nonwoven fabric or similar material. The nonwoven fabric shall be removed when the concrete grout is no longer fluid and the grout surface at the hole shall be cleaned and smoothed by hand.

Concrete grout shall be pumped in such a way that excessive pressure on the fabric forms and cold joints are avoided. A cold joint is defined as one in which the pumping of the concrete grout into a given form is discontinued or interrupted for an interval of 45 or more minutes.

Foot traffic on the filled form shall be restricted to an absolute minimum for 1 hour after filling.

Abutting fabric formed concrete units/mats may be installed immediately after placement of the preceding unit(s).

The freshly pumped fabric formed concrete shall not be washed (sprayed) under pressure with water in an effort to clean or remove spills from its surface. The cement film that bleeds through the top layer of the fabric form shall be maintained through curing on finished surfaces exposed to sunlight. Should the film be removed in these areas, the film shall be repaired by spreading a thin layer of a water-cement paste over the affected area.

After the concrete grout has set, all anchor, terminal, and toe trenches shall be backfilled and compacted, as specified by the Engineer.

F. Manufacturer's Representative.

A manufacturer's representative shall be present for a minimum of 10% of the installation of the fabric form unless the Contractor can prove adequate experience in this technology.

090135.04 METHOD OF MEASUREMENT.

The quantity of Fabric Formed Concrete Revetment Mat will be measured by the Engineer in square yards to the nearest 0.1 foot. The measurement dimensions will not exceed the plan dimensions for the forms except for additions authorized by the Engineer. The measurement will be based on the unfilled fabric form dimension with the form laid flat and will include the area of the form in anchor, terminal, and toe trenches and the area of all forms in an overlap area.

The quantity of Concrete Grout for Fabric Formed Concrete Revetment will be measured in accordance with Article 2507.04 of the Standard Specifications.

090135.05 BASIS OF PAYMENT.

For the quantity of Fabric Formed Concrete Revetment Mat furnished and placed, the Contractor will be paid the contract unit price per square yard for the type and size of form placed as Filter Point Mat 10-inch thick. This payment shall be full compensation for furnishing the forms and all equipment, tools, and labor necessary to place the forms ready for filling with grout and any required work following filling. The work includes, but is not limited to joining field seams, plastic for lap areas, and compensation for the manufacturer's representative during initial placement.

For the quantity of Concrete Grout for Fabric Formed Concrete Revetment furnished and placed to fill fabric forms, the Contractor will be paid the contract unit price per cubic yard. This payment shall be full compensation for filling the forms with grout and for furnishing all materials, equipment, and labor necessary to complete the work.