Section 35 31 19.20
(1997 Section 02279)

TAPERED, VERTICALLY INTERLOCKING ARTICULATING CONCRETE BLOCK (ACB) SYSTEM

PART 1: GENERAL

1.01 Description

A. Work shall consist of furnishing all material, labor, services and related items to complete the installation of Enviroflex® tapered, vertically interlocking articulating concrete block revetment system.
B. Work includes installing the materials in conformity with the lines, grades, design, and dimensions shown in the construction drawings.

1.02 Related Sections

A. Section 31 10 00 - Site Clearing
B. Section 31 20 00 - Earth moving
C. Section 32 91 13 - Soil Preparation
D. Section 03 30 00 - Cast in place concrete

1.03 Reference Documents

A. ASTM C 33: Std. Spec. for Concrete Aggregates
B. ASTM C 42: Test Method for Obtaining and Testing drilled Cores and Sawed Beams of Concrete
C. ACI 201: American Concrete Institute- Report on Durability
D. ACI 211.3R-02: Guide for Selecting Proportions for No-Slump Concrete
E. ASTM C140: Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
F. ASTM D422: Standard Test Method for Particle-Size Analysis of Soils
G. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
H. ASTM D2487: Standard Practice for Classification of Soils for Engineering Purposes
I. ASTM D4355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
J. ASTM D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity
K. ASTM D4533: Standard Test Method for Trapezoid Tearing Strength of Geotextiles
L. ASTM D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
M. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile
N. ASTM D4833: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
O. ASTM D6241: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
P. ASTM D6684: Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB)Revetment Systems
Q. ASTM D6884: Standard Practice for Installation of Articulating Concrete Block Revetment Systems
R. ASTM D7276: Standard Guide for Analysis and Interpretation of Test Data for Articulating Concrete Block (ACB) Revetment Systems in Open Channel Flow
S. ASTM D7277: Standard Test Method for Performance Testing of Articulating Concrete Block (ACB) Revetment Systems for Hydraulic Stability in Open Channel Flow
T. FHWA-RD-89-199: Hydraulic Stability of Articulated Concrete Block Revetment Systems During Over-Topping Flow

1.04 Submittals/Certification

A. Product Data: Submit manufacturer's product data, including installation instructions.
B. Testing: A report of testing for the Enviroflex® in substantial conformance with FHWA RD-89-199, at the same time as the Enviroflex® and Geotextile Data submittal. The report shall clearly state if the critical shear stress associated with the stability threshold of the Enviroflex® system was derived from laboratory testing that included a sub-block drainage layer as a component of the tested system.
C. Samples: Submit manufacturer's sample of tapered, overlapping articulating concrete block revetment system (if required).
D. Warranty: Submit manufacturer's standard warranty.

1.05 Quality Assurance

A. Installer Qualifications: An experienced installer who has successfully completed installations of revetment systems on projects of similar or larger scope and magnitude.
B. Single Source Responsibility: Obtain one color, type and variety of interlocking and overlapping articulating concrete block revetment system from a single lot manufactured by a single source. Materials shall be available and be consistent in quality, appearance and physical properties without delaying progress of work.
C. Prior to commencing the work of this section, verify the accuracy of layout and grading. Verify that all sub-grades and base and/ or drainage coarse aggregate conditions are as specified. Notify the Engineer of any discrepancies and coordinate the correction of those discrepancies with other trades as necessary.

1.06 Delivery, Storage and Handling

A. Deliver materials to site in manufacturer's original palletized configuration with labels clearly identifying product style number, color, name and manufacturer.
B. Check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
C. Store materials in clean, dry area in accordance with manufacturer's instructions.
D. Protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

1.07 Project Conditions

A. Review installation procedures and coordinate Enviroflex® installation with other work around installation area.
B. All adjacent hardscape, paving, and cut-off walls, required by construction documents shall be completed along with the installation of the Enviroflex® paving mats.
C. Gradients for Enviroflex® interlocking articulating concrete block revetment system can vary from flat to 1.5:1 max slopes. For steeper conditions, consult with a qualified civil and soils engineer.
D. Protect partially completed installation against damage from run-on or other construction traffic when work is in progress.
E. Areas subject to vehicular driving on the articulated concrete block shall be evaluated by the geotechnical engineer for subgrade and road base recommendations.

PART 2: PRODUCTS

2.01 Manufacturer

A. Corporate Headquarters: Soil Retention Products, Inc., 1265 Carlsbad Village Drive, Suite 100, Carlsbad, CA 92008. Phone: 760-966-6090 and 800-346-7995, fax: 760-966-6099, website: www.soilretention.com, e-mail: sales@soilretention.com.

2.02 Interlocking and Overlapping Articulating Concrete Block Revetment System

A. Tapered, Overlapping Articulating Concrete Block Revetment System shall be manufactured with fiber reinforced concrete and not be capable of having one block protrude against direction of flow relative to another block.

		4" ENVIROFLEX	6" ENVIROFLEX
Property	**Unit**	**Value**	**Value**
Specific Weight	lbs./cu. ft.	130 – 150	130 - 150
Compressive Strength	psi	3500 (individual) 4000 (average of 3)	3500 (individual) 4000 (average of 3)
Water Absorption	lbs./cu. ft.	11.7 max (individual) 9.1 (average of 3)	11.7 max (individual) 9.1 (average of 3)
Nominal Dimensions	Inches (l x w x h)	21.5 x 21.5 x 4	21.5 x 21.5 x 6
Net Coverage per Block	sq. ft.	3.21	3.21
Total Block Weight	lbs.	122	174
Unit Block Weight	lbs./sq. ft.	38	54.2
Open Area (nominal)	Percent	21.5	21.5
Fiber Reinforcement Cast in Block	lbs./cu.yd	2.5	2.5
Allowable Unit Protrusion	Inches / block	0	0
Minimum Vertical Interlock	Inches / block	.5	.5

B. Base Aggregate (if required for subgrade improvement or bearing capacity) – Crushed permeable base, crushed miscellaneous base (CMB), crushed aggregate base (CAB), crushed rock or similar structural material normally used as a base course for pavement systems and meeting the gradation and or permeability requirements shown on the drawings

C. Filter Fabric – Appropriate filter fabric by Tencate or equal specified and approved by the engineer

D. Drainage Layer (if required) – Approximately 4" minimum thick layer of angular crushed stone or as specified by the engineer.

E. Biaxial Geosynthetic (if required) – Placed between drainage layer and articulated concrete block in areas with turbulent flow (major grade breaks, bridge piers, pipe outlets, etc.).

F. Infill (if required) - Top soil with seed or gravel as specified by the landscape architect or engineer.

G. Cut Off Wall (if required) - As required by the engineer and specifications and included on the drawings.

PART 3: EXECUTION

3.01 Subgrade Preparation

A. Stable and compacted subgrade soil shall be prepared to the lines, grades and cross sections shown on the contract drawings. Termination trenches and transitions between slopes, embankment crests, benches, berms and toes shall be compacted, shaped and uniformly graded to facilitate the development of intimate contact between the Enviroflex® system and the underlying grade. Termination between the Enviroflex® concrete block revetment system and a concrete slab, wall or similar structure, shall be secured in a manner which prevents soil migration.

B. The subgrade soil conditions shall meet or exceed the required material properties described elsewhere in the document prior to placement of the system. Soils not meeting the requirements shall be removed and replaced with acceptable material. Unsatisfactory soils, soils having excessive in-place moisture content and soils containing clods, roots, sod, brush, or other organic materials shall be removed, backfilled with approved material and compacted. It is recommended that the subgrade be firm and unyielding and uniformly compacted to a minimum of 90 percent of Standard Proctor density (ASTM D 698) [85 percent of Modified Proctor density (ASTM D1557)] or as directed by the engineer of record. Should the subgrade surface for any reason become rough corrugated uneven textured or traffic marked prior to Enviroflex® installation, such unsatisfactory portion shall be scarified, reworked, re-compacted or replaced as directed by the Engineer. Excavation of the subgrade above the water line shall not be more than 2 inches (50 mm) below the grade indicated on the contract drawings. Where such areas are below the allowable grades, they shall be brought to grade by placing and compacting approved material in layers not exceeding 6 inches (150 mm) thick. Where such areas are above the allowable grades, they shall be brought to grade by removing material or reworking existing material and compacting. The subgrade shall be raked, screeded, or rolled by hand or machine to achieve a smooth compacted surface that is free of loose material.

C. Care shall be exercised so as not to excavate below the grades shown on the contract drawings, unless directed by the Engineer to remove unsatisfactory materials. Any excessive excavation shall be filled with approved backfill material and compacted.

D. The areas to receive the Enviroflex® system shall be graded to establish a smooth surface and ensure that intimate contact is achieved between the subgrade surface and the geotextile, and between the geotextile or drainage layer and the bottom surface of the Enviroflex block.

3.02 Placement of Geotextile

A. Immediately prior to placing the geotextile and Enviroflex® system, the prepared subgrade shall be inspected. The geotextile shall be placed directly on the prepared area, in intimate contact with the subgrade and free of folds or wrinkles. The geotextile shall be placed in such a manner that placement of the overlying materials will not excessively stretch or tear the geotextile. After geotextile placement, the work area shall not be disturbed so as to result in a loss of intimate contact between the concrete block, the geotextile, and the subgrade. The geotextile shall not be left exposed longer than the manufacturer's recommendation to minimize potential damage due to ultraviolet radiation.

B. The geotextile shall be placed so that upstream strips overlap downstream strips and so that upslope strips overlap down slope strips. Overlaps shall be in the direction of flow wherever possible. The longitudinal and transverse joints shall be overlapped at least 2 feet. The geotextile shall extend beyond the top, toe and side termination points of the revetment. If necessary to expedite construction and to maintain the recommended overlaps anchoring pins, "U" – staples or weights shall be used.

3.03 Placement of Drainage layer

A. Drainage layer of granular rock shall be spread by rubber tracked equipment and / or screeding. A uniform level surface shall be achieved before placing the block. The depth of the drainge layer should be 4" minimum.

3.04 Placement of Biaxial Geosynthetic (if required)

A. Biaxial geosynthetic is placed with 1-ft overlap in the direction of flow with aperture size equal to or less than the drainage rock gradation size.

3.05 Placement of Tapered Vertically Interlocking Enviroflex® Articulated Concrete Block System

A. The Enviroflex® Concrete Block System shall be placed on the geotextile / drainage layer in such a manner as to produce a surface that achieves intimate contact with the geotextile.

B. Placement of the Enviroflex® system whether done with a grappling device multiple units at a time or individual units placed by hand shall be performed to ensure that the individual blocks have intimate contact and are vertically interlocked. In areas of curvature or grade change,

alignment of an individual block with adjacent blocks shall be oriented such that intimate contact between the block, gravel, geotextile, and subgrade is maintained and block to block interconnection is achieved. Some block cutting and/or reinforced poured concrete of irregular transition sections may be required.

C. Care shall be taken during block installation so as to avoid damage to the geotextile or subgrade during the installation process. Preferably, where the geotextile is laid on the ground prior to the Enviroflex® installation, the Enviroflex® placement shall begin at the downstream section and proceed upstream. On sloped sections where practical, placement shall begin at the toe of the slope and proceed up-slope. Vertical overlap shall be maintained and no protrusions allowed against the direction of flow. Where required by the specifications, joining of structures and adjacent blocks can be accomplished after the blocks have been set in place.

3.06 Termination Trenches

A. Termination of blocks shall be against concrete structures, cut-off walls, or in excavated trenches which shall be properly backfilled with approved material flush with the top of the finished surface of the blocks. The integrity of the trench backfill shall be maintained to ensure a finished surface that is flush with the top surface of the articulating blocks.

3.07 Finishing

A. The open area of the articulating concrete block system is typically either backfilled with suitable soil for revegetation, with ¾ inch diameter crushed stone, or left bare. Backfilling with soil or granular fill within the cells of the system shall be completed as soon as practicable after the revetment has been installed. When topsoil is used as a fill material above the normal waterline, overfill by 1 to 2 inches to account for backfill material consolidation.

3.08 Field Quality Control

A. The Owner shall engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction control testing during construction when required by the contract documents.

B. Qualified and experienced technicians and engineers shall perform testing and inspections services.

C. As a minimum, quality assurance testing should include subgrade preparation, geotextile placement and Enviroflex® system installation, and overall finished condition including termination trenches shall be inspected.

PART 4: MEASUREMENT AND PAYMENT