



Standard Practice for Installation of Articulating Concrete Block (ACB) Revetment Systems¹

This standard is issued under the fixed designation D 6884; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 The purpose of this standard is to provide recommended guidelines for the proper installation of articulating concrete block (ACB) revetment systems.

1.2 This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace standard of care by which adequacy of a given professional service must be judged, nor should this document be applied without considerations of a project's many unique aspects. The word "standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 33 Specification for Concrete Aggregates²

C 698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort³

3. Terminology

3.1 *Definitions:*

3.1.1 *articulating concrete block (ACB) revetment system, n*—a matrix of interconnected concrete block units for erosion protection. Units are connected by geometric interlock, cables, ropes, geotextiles, geogrids, or a combination thereof, and typically include a geotextile underlayment for subsoil retention.

4. Summary of Practice

4.1 The proper installation of articulated concrete block revetment systems is essential to the adequate functioning and performance of the system during the design hydrologic event. This standard provides guidelines for maximizing the correspondence between the design intent and the actual field-finished conditions of the project.

4.2 This standard addresses the preparation of the subgrade, geotextile placement, block system placement, backfilling and finishing, and inspection.

5. Significance and Use

5.1 This standard is intended for use by designers and contractors to assist in understanding the importance of proper installation of articulating concrete block revetment systems in order to achieve suitable hydraulic performance and maintain stability against the erosive force of flowing water.

5.2 An articulating concrete block system is comprised of a matrix of individual concrete blocks placed together to form an erosion-resistant overlay with specific hydraulic performance characteristics. The system includes a geotextile underlay compatible with the subsoil that allows hydraulic infiltration and exfiltration to occur while providing particle retention. The blocks within the matrix shall be dense and durable and the matrix shall be flexible and porous.

5.3 Articulating concrete block systems are used to provide erosion protection to underlying soil materials from the forces of flowing water. The term "articulating," as used in this standard, implies the ability of individual blocks of the system to conform to changes in the subgrade while remaining interconnected by virtue of block interlock and/or additional system components such as cables, ropes, geotextiles, or geogrids.

5.4 The definition of articulating concrete block systems does not distinguish between interlocking and non-interlocking block geometries, between cable-tied and non-cable-tied systems, between vegetated and non-vegetated systems or between methods of manufacturing or placement. Furthermore, the definition does not restrict or limit the block size, shape, strength, or longevity; however, guidelines and recommendations regarding these factors are incorporated into this standard. This standard does not specify size restrictions for

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² *Annual Book of ASTM Standards*, Vol 04.02.

³ *Annual Book of ASTM Standards*, Vol 12.01.

individual block units. Block systems are available in either open-cell or closed-cell varieties.

5.5 The installation of articulated concrete block systems shall be performed so as to maintain intimate contact between the blocks, the geotextile filter and the subgrade that the system is intended to protect.

6. Procedure

6.1 *Subgrade Preparation:*

6.1.1 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 ACB system and the underlying grade. Termination between the articulating concrete block revetment system and a concrete slab, wall or similar structure, shall be secured in a manner which prevents soil migration.

6.1.2 The subgrade soil conditions shall meet or exceed the required material properties described in 6.1.4. prior to placement of the block. Soils not meeting the requirements shall be removed and replaced with acceptable material.

6.1.3 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. Where it is impractical, in the opinion of the Engineer, to dewater the area to be filled, over-excavations shall be backfilled with approved backfill material.

6.1.4 When placing in the dry, the areas to receive the ACB 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 and the bottom surface of the ACB system. 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 uniformly compacted to a minimum of 90 percent of Standard Proctor density (Test Method D 698). Should the subgrade surface for any reason become rough, corrugated, uneven, textured or traffic marked prior to ACB 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 in. (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 in. (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.

6.2 *Placement of Geotextile:*

6.2.1 Immediately prior to placing the geotextile and ACB 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.

6.2.2 The geotextile shall be placed so that upstream strips overlap downstream strips and so that upslope strips overlap downslope strips. Overlaps shall be in the direction of flow wherever possible. The longitudinal and transverse joints shall be overlapped at least 3 ft (91 cm) for below-water installations and at least 1.5 ft (46 cm) for dry installations. If a sewn seam is to be used for the seaming of the geotextile, the thread to be used shall consist of high strength polypropylene or polyester and shall be resistant to ultraviolet radiation. 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. Granular filters may be used in place of, or in combination with, the geotextile per the Engineer's design drawings and specifications.

6.3 *Placement of Articulating Concrete Block System:*

6.3.1 The articulating concrete block system shall be placed on the geotextile in such a manner as to produce a surface in accordance with 6.3.3 that achieves intimate contact with the geotextile.

6.3.2 Placement of the ACB system, whether as mats or by hand, shall be performed to ensure that the individual blocks lie in intimate contact with the geotextile and subgrade. For blocks within a mat and blocks that are hand placed, the joint spacing between adjacent blocks is to be maintained so that binding of blocks does not occur and so that block to block interconnection is achieved. 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, geotextile, and subgrade is maintained and block to block interconnection is achieved.

6.3.3 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 ACB installation, the ACB placement shall begin at the upstream section and proceed downstream. If an ACB system is to be installed starting downstream and proceeding in the upstream direction, a contractor option is to construct a temporary toe trench at the front edge of the ACB system to protect against flow which could otherwise undermine the system during flow events. On sloped sections where practical, placement shall begin at the toe of the slope and proceed upslope. Block placement shall not bring block-to-block interconnections into tension. Individual blocks within the plane of the finished system shall not exceed a 0.5 in. (13 mm) protrusion or greater protrusion than the tolerance referenced in the contract documents.

6.3.4 If assembled and placed as large mats, the ACB mats can be attached to a spreader bar to aid in the lifting and

placing of the mats in their proper position with a crane or backhoe. The mats shall be placed side by side and/or end to end, so that the mats abut each other. Mat seams or openings between mats that are 2 in. (50 mm) or greater in the matrix shall be filled with grout. Whether placed by hand or as mats, distinct grade changes shall be accommodated with a well-rounded transition (that is, minimum radius per specific system characteristics). However, if a discontinuous revetment surface exists in the direction of flow, a grout seam at the grade change location shall be provided to produce a continuous, flush finished surface.

6.4 Termination Trenches:

6.4.1 Termination of blocks shall be in excavated trenches which shall be properly backfilled with approved material flush with the top of the finished surface of the blocks (see 6.1.4). 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.

6.5 Anchor Penetrations:

6.5.1 Anchor penetrations through the geotextile shall be grouted with approved material to prevent migration of subsoil through the penetration point.

6.6 Finishing:

6.6.1 The open area of the articulating concrete block system is typically either backfilled with suitable soil for revegetation, or with $\frac{3}{8}$ to $\frac{3}{4}$ in. (10 to 20 mm) diameter crushed stone. 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 in. (25 to 50 mm) to account for backfill material consolidation.

6.7 Inspection:

6.7.1 The subgrade preparation, geotextile placement and ACB system installation, and overall finished condition including termination trenches shall be inspected.

7. Keywords

7.1 articulating concrete block (ACB) revetment systems; erosion control; geotextile; subgrade; termination trenches; toe-ins

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