



Designation: D 6684 – 01

Standard Specification for Materials and Manufacture of Articulating Concrete Block (ACB) Revetment Systems¹

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1. Scope

1.1 The purpose of this Standard is to provide specifications for articulating concrete block (ACB) revetment system structural components, material composition and physical properties, manufacturing methods and testing requirements.

1.2 *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 requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

- C 33 Specification for Concrete Aggregates²
- C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens²
- C 42 Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete²
- C 67 Test Methods for Sampling and Testing Brick and Structural Clay Tile³
- C 140 Test Methods of Sampling and Testing Concrete Masonry Units and Related Units³
- C 150 Specification for Portland Cement⁴
- C 207 Specification for Hydrated Lime for Masonry Purposes⁴
- C 331 Specification for Lightweight Aggregates for Concrete Masonry Units²
- C 595 Specification for Blended Hydraulic Cements⁴
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete²
- C 666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing²
- C 1262 Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units³

D 4533 Test Method for Trapezoid Tearing Strength of Geotextiles⁵

D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles⁵

D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products⁵

2.2 Other Documents:

American Association of State Highway Transportation Officials (AASHTO), 1995, "Standard Specification for Geotextiles," AASHTO Designation M 288, February.

Koerner, R.M., 1998, "Designing With Geotextiles," 4th Edition, Prentice-Hall Publishers, Englewood Cliffs, N.J. p. 761.

3. Terminology

3.1 Definitions:

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

4. Significance and Use

4.1 An articulating concrete block system is comprised of a matrix of individual concrete blocks placed together to form an erosion-resistant revetment with specific hydraulic performance characteristics. The system includes a filter layer compatible with the subsoil which allows infiltration and exfiltration to occur while providing particle retention. The filter layer may be comprised of a geotextile, properly graded granular media, or both. The blocks within the matrix shall be dense and durable, and the matrix shall be flexible and porous.

4.2 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 subgrade while remaining interconnected by virtue of geometric interlock and/or additional system components such as cables, ropes, geotextiles, or geogrids.

¹ This specification is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.25 on Erosion and Sediment Control Technology.

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² Annual Book of ASTM Standards, Vol 04.02.

³ Annual Book of ASTM Standards, Vol 04.05.

⁴ Annual Book of ASTM Standards, Vol 04.01.

⁵ Annual Book of ASTM Standards, Vol 04.13.

4.3 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. Block systems are available in either open-cell or closed-cell configurations.

5. Materials and Manufacture

5.1 *Materials Specifications: Cementitious Materials*—Materials shall conform to the following applicable ASTM standards:

Portland Cements	C 150
Blended Cements	C 595
Hydrated Lime Types	C 207
Pozzolans	C 618

5.2 Aggregates shall conform to the following ASTM specifications, except that grading requirements shall not necessarily apply:

Normal Weight	C 33
Light Weight	C 331

5.3 *Physical Properties*—At the time of delivery to the work site, the units shall conform to the physical requirements prescribed in Table 1.

5.3.1 In addition to Table 1, when freeze-thaw durability testing is required, such testing shall be performed in accordance with Test Methods C 67, C 666, or C 1262, at the direction of the Owner. The number of freeze-thaw cycles and the corresponding weight loss criterion for pass-fail determination shall be specified by the Owner along with the test method.

5.4 *Geotextile Filter*—The geotextile filter shall be in compliance with the project specifications, in consideration of its compatibility with the underlying soil subgrade. Minimum strength requirements are provided in Table 2.

5.4.1 *Geotextile*—Subsoil compatibility assessment shall include functional requirements for permeability, particle retention, and resistance to clogging. Physical property requirements for permittivity, aperture size, percent open area, and UV stability should be based on site-specific soil characteristics, site conditions, and construction techniques. Applicable references for conducting compatibility assessments include:

Koemer, R.M., 1998, “Designing With Geotextiles,” 4th Edition, Prentice-Hall Publishers, Englewood Cliffs, N.J. p. 761.

5.5 *Revetment Cable and Fittings*:

5.5.1 For cabled systems, the revetment cable or rope and fittings shall be designed to provide adequate strength and durability characteristics to facilitate lifting and placing of large mattresses.

5.5.2 Fittings such as sleeves, clamps and stops shall be as required by the manufacturer. Selection of cable or rope and fittings shall be made in a manner that insures a safe design factor for mats being lifted from one or both ends. Consideration shall be taken for the bending of the cables or ropes around hooks or pins during lifting. Revetment cable or rope, splice fittings, sleeves and stops shall be selected so that the cable or rope and all connections result in a minimum factor-of-safety of 5.0 with respect to lifting.

5.5.3 For those systems performance tested with, and that rely on cables, ropes, or other non-concrete components to maintain the block-to-block interconnection, the cables, ropes, and/or non-concrete components shall also meet the design life of the project.

5.6 *Block Production*:

5.6.1 Articulating concrete blocks may be produced at a block plant or onsite using either wet-cast or dry-cast production techniques, provided that the composition and physical characteristics of the furnished units meet the requirements of 5.1-5.3.

5.7 *Matrix Assembly*:

5.7.1 *Non-Cabled System*—Non-cabled articulating concrete block systems are typically palletized, cured, and shipped to the job site. Non-cabled systems may also be assembled on, and/or glued to, a high-strength geotextile fabric which is used to carry the articulated block mattress.

5.7.2 *Cabled System*—Cabled articulating concrete block revetment systems can be assembled into mattresses, typically up to 480 square feet (45 square meters). Whole mat production can occur at the block plant or at the project. The individual blocks are typically placed in their respective matrix positions on a work surface, and the cables or ropes are inserted through the core holes in the block. Once the blocks have been assembled into a mattress, the ends of the cable or rope are secured as necessary based on the characteristics of the system. Wetcast mattresses can be poured with the cables or ropes integral to the blocks both laterally and longitudinally at the time of production. With this method, cable-end sleeves are not necessary.

6. Sampling and Testing

6.1 Manufacturer shall provide test data showing that concrete products manufactured within the previous 24 months of anticipated ACB placement have met the requirements of this Standard.

TABLE 1 Physical Requirements

Minimum Compressive Strength, lb/in ²		Maximum Water Absorption, lb/ft ³		Minimum Density (in air), lb/ft ³	
Average of 3 units	Individual Unit	Average of 3 units	Individual Unit	Average of 3 units	Individual Unit
4,000	3,500	9.1	11.7	130	125

NOTE—For units produced by a wet-cast method, tests shall be conducted in accordance with Test Methods C 39 and C 42. For units produced by a dry-cast method, tests shall be conducted in accordance with Test Methods C 140.