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Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects[1]

This standard is issued under the fixed designation D7180/D7180M; 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.

ε1 NOTE—Units information was editorially corrected in July 2013.

1. Scope

1.1 This guide covers some of the basic considerations for the use of expanded polystyrene (EPS) geofoam in geotechnical projects.

1.2 This guide offers a collection of information and does not recommend a course of action. This guide cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances.

1.3 This guide is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this guide be applied without consideration of a project's many unique aspects.

1.4 The word "standard" in the title of this guide means only that this guide has been approved through the ASTM International consensus process.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.6 *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:*[2]

D4439 Terminology for Geosynthetics

D6817 Specification for Rigid Cellular Polystyrene Geofoam

3. Terminology

3.1 *Definitions*—Terms used in this guide are defined in Terminology D4439.

3.1.1 *geofoam, n*—block or planar rigid cellular foam polymeric material used in geotechnical engineering applications.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *expanded polystyrene, n*—type of foamed plastic formed by the expansion of polystyrene resin beads in a molding process.

3.3 *Acronyms:*

3.3.1 *EPS, n*—expanded polystyrene.

3.3.2 *EPS geofoam, n*—rigid cellular polystyrene geofoam manufactured from EPS.

4. Summary of Guide

4.1 EPS geofoam is commonly used in geotechnical applications when an extremely lightweight material is required. This guide covers some of the considerations that must be evaluated in the design of these projects.

5. Significance and Use

5.1 This guide informs the user of design considerations in the use of EPS geofoam which assist in the determination of the appropriate EPS geofoam for geotechnical applications.

[1] This guide is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.03 on Permeability and Filtration.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5.2 This guide does not preclude the judgment and practice of those competent in geotechnical design.

6. Design Principles

6.1 *Design Considerations:*

6.1.1 *Compressive Properties:*

6.1.1.1 The compressive resistance of EPS geofoam is covered by Specification D6817. The compressive resistance for geofoam is specified in Specification D6817 and includes the compressive behavior of EPS geofoam at 1, 5, and 10 % strain.

6.1.1.2 A typical limit for many EPS geofoam projects is to consider the compressive resistance at 1 % strain. The compressive behavior at 1 % strain is within the elastic region of EPS geofoam and provides acceptable short-term deflections in addition to limiting long-term creep deformation.

6.1.1.3 Creep deformations must be accounted for when long-term loads exceed the compressive resistance at 1 % strain.

6.1.1.4 At a compressive resistance of 5 % strain, EPS geofoam is beyond the elastic behavior region and is in the plastic behavior region.

6.1.2 *Compressive Resistance Testing*—The compressive resistance described in 6.1.1 is determined from the uniform loading of 50-mm [2-in.] cubes at a prescribed loading rate.

6.1.3 *Load Distribution Requirements*—In applications with localized loading exceeding the compressive resistance at 1 % strain, a number of strategies can be used to reduce the effective load on the EPS geofoam. A common method is the use of a concrete slab with suitable reinforcement to distribute the load to levels below the compressive resistance at 1 % strain. A sufficient depth of cover material may also be used to reduce the project loads below the compressive resistance at 1 % strain.

6.1.4 *Subgrade Requirements*—EPS geofoam is usually installed on a relatively planar surface. Subgrade preparation requirements must be specified by the designer.

6.1.5 *Layout*—EPS geofoam is provided in block form. The layout for the materials is often accomplished through the use of multiple layer design. Alternating layers of EPS geofoam are often staggered to avoid differential block-to-block movement. EPS geofoam blocks vary in size for each manufacturer. EPS geofoam block can be supplied as manufactured or trimmed to specified dimensions. Consult the EPS geofoam supplier to determine the dimension of EPS geofoam to optimize block placement and for fabrication options. Multiple EPS geofoam types can be sourced for use in a layered design to improve project costs.

6.1.6 *Tolerances*—Dimensional tolerances are included in Specification D6817.

6.1.7 *Buoyancy*—EPS is a lightweight material with a closed cell structure that does not allow for significant water absorption. The buoyancy must be fully accounted for in designs that include the use of EPS geofoam in submerged applications. This should include the potential for 100-year flood events. Common methods to counteract buoyancy are the use of sufficient overburden or mechanical restraint.

6.1.8 *Thermal Insulation Properties*—The thermal insulating properties of EPS must be considered in areas subject to freezing temperatures. In these areas, a sufficient cover of traditional fill material must be provided above the EPS geofoam to reduce differential surface icing between EPS geofoam and adjacent traditional fill locations.

6.1.9 *Ultraviolet Light Exposure*—EPS geofoam will discolor and yellow when exposed for extended time periods. EPS geofoam expected to be exposed for long periods of time should be covered with an opaque material.

6.1.10 *Flammability*—EPS geofoam is a combustible material. EPS geofoam should be kept away from open flames, welding, sparks, and other possible sources of ignition.

6.1.11 *Exposure to Hydrocarbons*—EPS geofoam is subject to degradation when exposed directly to or to the vapors of many hydrocarbons such as gasoline and diesel fuel. EPS geofoam should be protected from possible exposure to these materials during construction and throughout the design life of the project. This could include possible hydrocarbon soil contaminants that may be present before construction. EPS geofoam can be protected from hydrocarbons by the use of a hydrocarbon-resistant geomembrane or through other physical barriers.

6.2 *Quality Control:*

6.2.1 *Certification*—Project specifications shall include third-party certification to Specification D6817 requirements or as required by project needs.

6.2.2 *Field Sampling*—Field sampling shall be specified to ensure ongoing dimensional tolerances and density. A minimum frequency of density checks at the site shall be specified to coordinate with material shipments. Third-party testing of Specification D6817 compressive resistance properties before project initiation and at regular intervals throughout the project is also recommended.

7. Keywords

7.1 EPS; EPS geofoams; expanded polystyrenes; geofoams; rigid cellular polystyrenes

BIBLIOGRAPHY

The references listed below provide additional information on the use of EPS geofoam in geotechnical projects.

Note—These reference documents were developed before Specification D6817 and therefore may include EPS geofoam property values in conflict with Specification D6817. Specification D6817, as developed through the ASTM International consensus process, is the recommended standard specification for EPS geofoam.

(1) *Geofoam Stabilization of an Embankment Slope—A Case Study of Route 23A in the Town of Jewett, Greene County*, Geotechnical Engineering Bureau, New York Department of Transportation, Albany, NY, 1998.

(2) Horvath, J. S., Ph.D., P.E., *Geofoam Geosynthetic*, Horvath Engineering, P.C., Scarsdale, NY, 1995.

(3) NCHRP Report 529, *Guideline and Recommended Standard for Geofoam Applications in Highway Embankments*, Transportation Research Board of the National Academies, Washington, DC, 2004.

(4) Negussey, Dawit, *Slope Stabilization with Geofoam*, Geofoam Research Center, Syracuse University, Syracuse, NY, 2002.