TECHNICAL NOTE #100

EPS Geofoam Interface Coefficient of Friction

Physical Properties of Expanded Polystyrene (EPS) Geofoam

Recently we were asked in an RFI (Request For Information) from a contractor about what friction coefficient they should assume for Geofoam-to-Geofoam interfaces. The following technical note attempts to provide additional light on this topic.

Disclaimer

Like all of our competitors we are familiar with, Cellofoam North America Inc. is an expanded polystyrene foam manufacturer and not an engineering consulting firm. Thus, it is beyond our scope as a manufacturer of EPS Geofoam to provide design services on the specific use for our product. Users of our Geofoam should obviously consult with appropriate engineering experts to determine the exact type or specifications of Geofoam required for their project to meet structural and other design requirements as well as jurisdictional building codes. We expect purchasers to use Geofoam in accordance with existing industry standard practices, such as those defined in ASTM D7180, *Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects*.[i]

Cellofoam EPS Geofoam

Cellofoam produces EPS Geofoam in many different types and specifications, manufactured to meet ASTM D6817, *Standard Specification for Rigid Cellular Polystyrene Geofoam*.[ii] We produce Geofoam with compressive resistance at 1% strain ranging from approximately 3.6 psi to 18.6 psi.[iii] Our Geofoam typically comes in block sizes and can easily be cut on-site with hot-wire tooling or saws. We also offer pre-cut taper options to fit your project's requirements. Cellofoam's EPS Geofoam has been used on a very broad range of projects including slope stabilization, highway and road, retaining walls, parking structures, landscaping, pool decks, and cinema seating that require a lightweight structural fill solution. It is ideal for use in commercial building, construction, and roadway applications, due, in part, to its high durability, high compressive strength, and lightweight nature.

A Brief Survey of Published Geofoam-to-Geofoam Friction Coefficients

A number of industry researchers have conducted tests to determine the friction coefficient for EPS Geofoam per ASTM D5321, *Standard Test Method for Determining the Coefficient of Friction by the Direct Shear Method*.[iv] A survey of the pertinent literature shows a rather wide range of reported Geofoam-to-Geofoam coefficients of friction. This is likely primarily due to differences in test specimen dimensions, roughness of the EPS surfaces, moisture, UV exposure, applied normal loads, and other factors.

One excellent study (Sheeley and Negussey 2000)[v] investigated the interface friction between Geofoam and various construction materials, including concrete and geomembranes, as well as Geofoam-to-Geofoam in both wet and dry conditions. Results showed density, sample size, stress level, and surface moisture had no significant impact on Geofoam-to-Geofoam interface strengths. At typical stress levels common with Geofoam applications, the study found Geofoam-to-Geofoam friction coefficients to be generally above 0.7 and 0.9 for residual and peak conditions, respectively.

Interestingly, Sheeley and Negussey also looked into use of binder plates and revealed them to have questionable performance in enhancing Geofoam-to-Geofoam interface strength. This supports at least one prior study recommending not to use binder plates in normal Geofoam fill applications. Further, they showed while Geofoam-to-concrete interface strength was much higher than that of Geofoam-to-Geofoam, Geofoam-to-geomembranes interface strength was much lower, to the degree that the authors warned that substitution of a concrete load distribution slab with a geomembrane would provide a much weaker interface.

The EPS Industry Alliance's report, *Expanded Polystyrene (EPS) Geofoam Applications & Technical Data*, gives the coefficient of friction for EPS Geofoam of 0.5 along molded or hot wire cut faces, and states it is higher for blocks with roughly (presumably mechanically) cut faces.[vi] This number appears to be quite conservative, however, as other sources such as the Norwegian Road Research Laboratory reportedly use a coefficient of friction of 0.7 for Geofoam-to-Geofoam and Geofoam-to-subsoil interfaces.[vii] Further, an extremely thorough overview of Geofoam sponsored by the National Academies, *Geofoam Applications in the Design and Construction of Highway Embankments*, reports that the range in Geofoam-to-Geofoam coefficients of friction found in the literature is 0.5 - 0.7, while 0.64 is "the value reported in the most extensive and detailed published study to date..." [viii]

The Bottom Line

The bottom line is that, based on these and other industry test results, while some researchers recommend designers assume a coefficient of friction of 0.6 for a Geofoam-to-Geofoam interface, the jury is still out on what this number should be. Ultimately, however, it is the responsibility of the project engineer to make this determination and use EPS Geofoam in accordance with existing industry standard practices, such as those defined in ASTM D7180.

WARNING: This product is combustible and if exposed to a fire of sufficient heat and intensity may burn rapidly. It should not be left exposed or inadequately protected. Consult specific instructions and applicable building codes for use of this product.

Conyers, GA 888-772-6383 ***Orlando, FL 800-423-3626*** ***Sallisaw, OK 800-864-1518***
Whiteland, IN 800-582-9007 ***Winchester, VA 800-864-1518***

EPS Industry Alliance Member

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[i] ASTM International, ASTM D7180, "Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects," Approved 2005, Reapproved 2013, https://www.astm.org/Standards/D7180.htm.
[ii] ASTM International, ASTM D6817, "Standard Specification for Rigid Cellular Polystyrene Geofoam," Approved 2015, https://www.astm.org/Standards/D6817.htm.
[iii] Please see our technical data sheets for more information.
[iv] ASTM International, ASTM D5321, "Standard Test Method for Determining the Coefficient of Friction by the Direct Shear Method," Approved 2017, https://www.astm.org/Standards/D5321.htm
[v] Sheeley, Michael, and Negussey, Dawit, "An Investigation of Geofoam Interface Strength Behavior," Soft Ground Technology Conference, May 28 - June 2, 2000, Noordwijkerhout, Netherlands.
[vi] Stark, Timothy et al., "Expanded Polystyrene (EPS) Geofoam Applications & Technical Data," The EPS Industry Alliance, December 2011.
[vii] Norwegian Road Research Laboratory (NRRL), Norwegian Public Roads Administration, "Use of Expanded Polystyrene in Road Embankments," Oslo, Norway, August 1992.
[viii] Stark, Timothy et al., "Geofoam Applications in the Design and Construction of Highway Embankments," National Cooperative Highway Research Program, Transportation Research Board of the National Academies, page 2-53, July 2004.