Introduction

Foam-Control Geofoam is used in a wide range of structural and civil engineering applications. The selection of the appropriate grade of Foam-Control Geofoam for a specific application is a critical decision to ensure suitable long term performance.

Foam-Control Geofoam is a structural material produced in compliance with ASTM D6817, “Standard Specification for Rigid Cellular Geofoam”. Foam-Control Geofoam is available in 7 standard grades with compressive resistance @1 % strain ranging from 320 to 2,680 psf where the compressive resistance at 1% is the industry accepted allowable stress for the combination of dead and live loads for geofoam.

Disclaimer

This geofoam selection example is being provided to illustrate a simplified method for the calculation of vertical stress on geofoam in a hypothetical example. This simplified method is being provided only as an example and should not be relied upon for the selection of Foam-Control Geofoam for a particular project. In applications where a concrete load distribution slab is used above the geofoam, more advanced load distribution analysis methods such as finite element modeling are recommended.

The selection and/or specification of a Foam-Control Geofoam grade for a specific application should be determined by a qualified civil engineer who is acquainted with all possible aspects of a particular project.

Example

A project is proposed to be built using geofoam with a cross section and load as shown in Figure 1. Foam-Control EPS 22 Geofoam is proposed to be used. Vertical loads must be calculated to ensure Foam-Control EPS 22 Geofoam is appropriate.

Figure 1. Project Section
Analysis Method

A simplified vertical stress distribution model is shown in Figure 2 based on NCHRP published literature\(^1\).

### Load Distribution

<table>
<thead>
<tr>
<th>Component</th>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>$Q$</td>
<td>Loading</td>
</tr>
<tr>
<td>B</td>
<td>$B$</td>
<td>Equivalent width of loading</td>
</tr>
<tr>
<td>$\theta_1$</td>
<td>$1H:1V$ slope</td>
<td></td>
</tr>
<tr>
<td>$\theta_2$</td>
<td>$1H:2V$ slope</td>
<td></td>
</tr>
<tr>
<td>$\theta_3$</td>
<td>$1H:2V$ slope</td>
<td></td>
</tr>
<tr>
<td>$z_1$</td>
<td>Thickness of pavement</td>
<td></td>
</tr>
<tr>
<td>$z_2$</td>
<td>Thickness of base</td>
<td></td>
</tr>
<tr>
<td>$z_3$</td>
<td>Depth within geofoam</td>
<td></td>
</tr>
<tr>
<td>$L_{TG}$</td>
<td>$B + 2z_1 + z_2$</td>
<td>Width of load at top of geofoam</td>
</tr>
<tr>
<td>$L_{BG}$</td>
<td>$B + 2z_1 + z_2 + z_3$</td>
<td>Width of load at bottom of geofoam</td>
</tr>
</tbody>
</table>

Reference

Calculation – Dead Loads

Dead load at top of geofoam:

$$\sigma_{DL\ TG} = z_1 \cdot \gamma_{\text{Pavement}} + z_2 \cdot \gamma_{\text{Base}}$$

where $\gamma_{\text{Pavement}}$ and $\gamma_{\text{Base}}$ = unit weight of pavement and base, respectively

$$\sigma_{DL\ TG} = 1 \text{ ft} \cdot 145 \text{ lbs/ft}^2 + 2 \text{ ft} \cdot 140 \text{ lbs/ft}^2 = 425 \text{ lbs/ft}^2$$

$$\sigma_{DL\ TG} = (425 \text{ lbs/ft}^2) / (144 \text{ in}^2/\text{ft}^2) = 2.95 \text{ psi}$$

Dead load at bottom of geofoam:

$$\sigma_{DL\ BG} = z_1 \cdot \gamma_{\text{Pavement}} + z_2 \cdot \gamma_{\text{Base}} + z_{\text{GEOFOAM}} \cdot \gamma_{\text{GEOFOAM}}$$

where $\gamma_{\text{Pavement}}$, $\gamma_{\text{Base}}$, and $\gamma_{\text{GEOFOAM}}$ = unit weight of pavement, base, and geofoam, respectively

$$\sigma_{DL\ BG} = 1 \text{ ft} \cdot 145 \text{ lbs/ft}^2 + 2 \text{ ft} \cdot 140 \text{ lbs/ft}^2 + 6 \text{ ft} \cdot 1.35 \text{ lbs/ft}^2 = 433 \text{ lbs/ft}^2$$

$$\sigma_{DL\ BG} = (433 \text{ lbs/ft}^2) / (144 \text{ in}^2/\text{ft}^2) = 3.01 \text{ psi}$$
Calculation – Live Loads

Live load width at top of geofoam:
\[ L_{TG} = B + 2z_1 + z_2 \]
\[ L_{TG} = 1\text{ ft} + 2 \times 1\text{ ft} + 2\text{ ft} = 5\text{ ft} \]

Live load width at bottom of geofoam:
\[ L_{BG} = B + 2z_1 + z_2 + z_3 \]
\[ L_{BG} = 1\text{ ft} + 2 \times 1\text{ ft} + 2\text{ ft} + 6\text{ ft} = 11\text{ ft} \]

Note: Loads are shown calculated at top and bottom of geofoam only here for simplicity, but the load at any depth in geofoam can be calculated following a similar method.
Calculation – Live Loads

Live load at top of geofoam:

\[ \sigma_{LL\ TG} = \frac{Q}{(L_{TG} \times L_{TG})} \]
\[ \sigma_{LL\ TG} = \frac{12500 \text{ lb}}{(5 \text{ ft} \times 5 \text{ ft})} = 500 \text{ lb/ft}^2 \]
\[ \sigma_{LL\ TG} = \frac{(500 \text{ lb/ft}^2)}{(144 \text{ in}^2/\text{ft}^2)} = 3.47 \text{ psi} \]

Live load at bottom of geofoam:

\[ \sigma_{LL\ BG} = \frac{Q}{(L_{BG} \times L_{BG})} \]
\[ \sigma_{LL\ BG} = \frac{12500 \text{ lb}}{(11 \text{ ft} \times 11 \text{ ft})} = 103 \text{ lb/ft}^2 \]
\[ \sigma_{LL\ BG} = \frac{(103 \text{ lb/ft}^2)}{(144 \text{ in}^2/\text{ft}^2)} = 0.72 \text{ psi} \]

Calculation – Total Dead Loads and Live Loads

Total load at top of geofoam:

\[ \sigma_{TL\ TG} = \sigma_{DL\ TG} + \sigma_{LL\ TG} \]
\[ \sigma_{TL\ TG} = 425 \text{ lb/ft}^2 + 500 \text{ lb/ft}^2 = 925 \text{ lb/ft}^2 \]
\[ \sigma_{TL\ TG} = 2.95 \text{ psi} + 3.47 \text{ psi} = 6.42 \text{ psi} \]

Total load at bottom of geofoam:

\[ \sigma_{TL\ TB} = \sigma_{DL\ TB} + \sigma_{LL\ TB} \]
\[ \sigma_{TL\ TB} = 433 \text{ lb/ft}^2 + 103 \text{ lb/ft}^2 = 536 \text{ lb/ft}^2 \]
\[ \sigma_{TL\ TB} = 3.01 \text{ psi} + 0.72 \text{ psi} = 3.73 \text{ psi} \]

Maximum stress on Geofoam is 6.42 psi
EPS 22 with a compressive resistance at 1% strain of 7.3 psi is suitable.