Geofoam Calculation: Example 1

GEOFOAM

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.

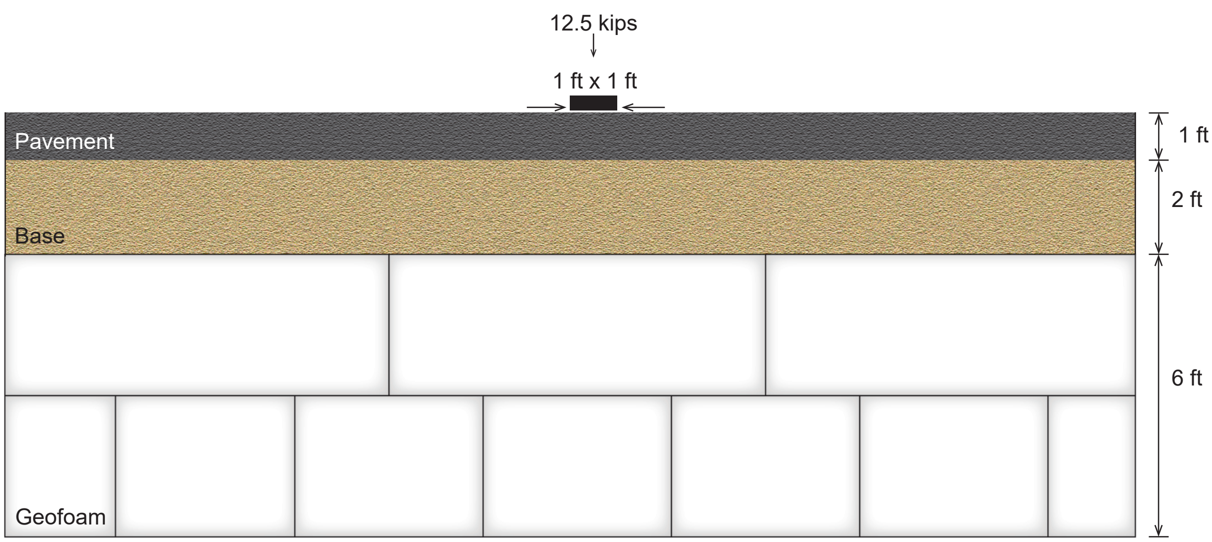

Figure 1. Project Section

Analysis Method

A simplified vertical stress distribution model is shown in Figure 2 based on NCHRP published literature[1].

Load Distribution

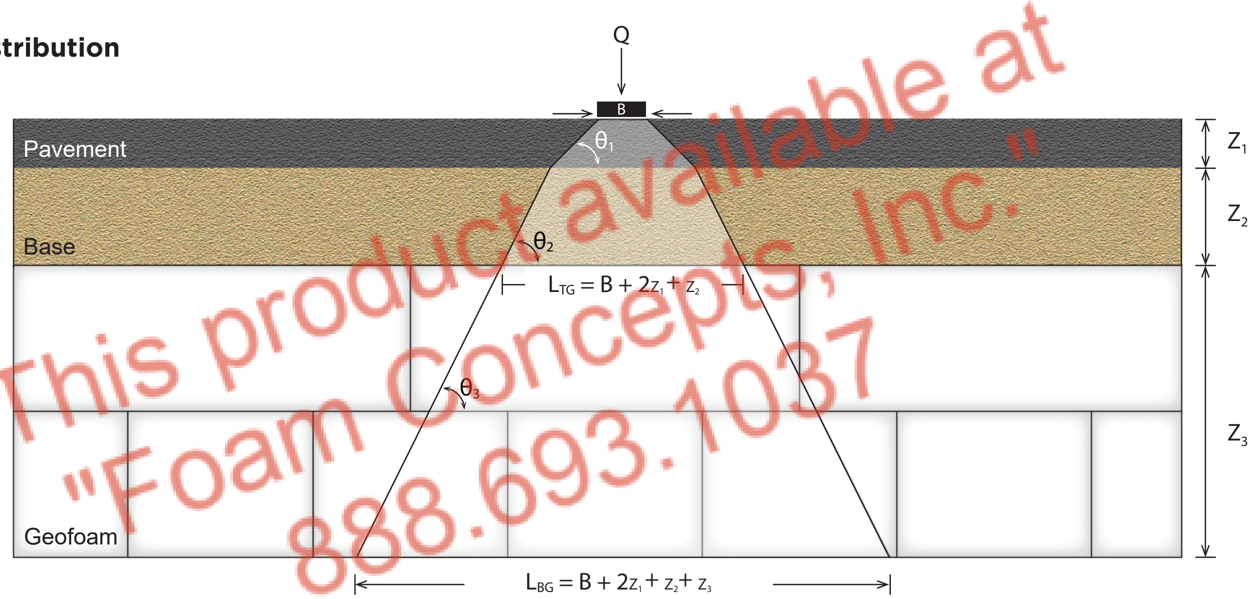

Figure 2. Simplified vertical stress distribution

Q = loading

B = equivalent width of loading

θ_1 = 1H:1V slope

θ_2 = 1H:2V slope

θ_3 = 1H:2V slope

z_1 = thickness of pavement

z_2 = thickness of base

z_3 = depth within geofoam

L_{TG} = width of load at top of geofoam

L_{BG} = width of load at bottom of geofoam

Reference
[1] NCHRP Web Document 65 (Project 24-11) Geofoam Applications in Design and Construction of Highway Embankments, National Cooperative Highway Research Program, July 2004

Calculation – Dead Loads

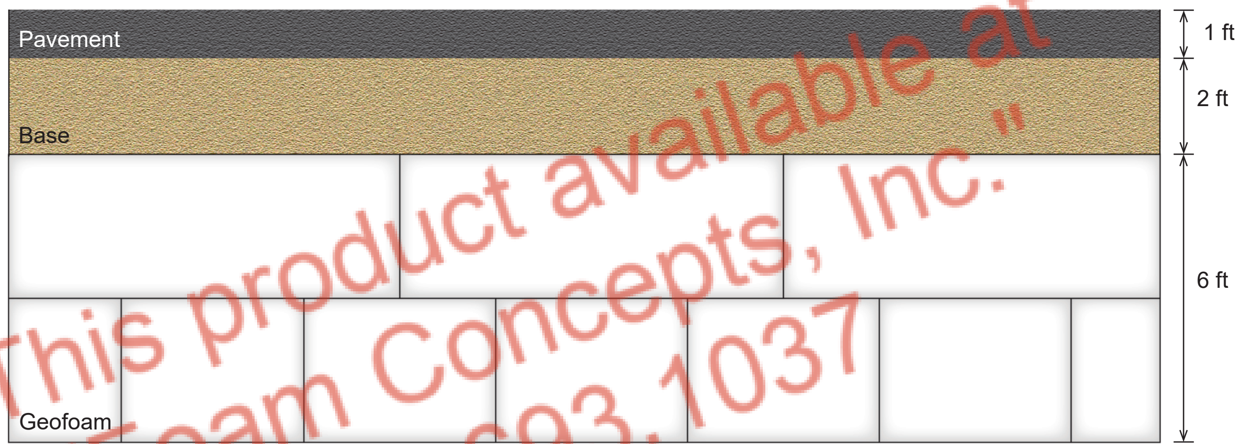

Figure 3. Calculations for dead loads

Dead load at top of geofoam:

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

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

$\sigma_{DL\ TG}$ = 1 ft * 145 lbs/ft^3 + 2 ft * 140 lbs/ft^3 = 425 lbs/ft^2

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

Dead load at bottom of geofoam:

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

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

$\sigma_{DL\ BG}$ = 1 ft * 145 lbs/ft^3 + 2 ft * 140 lbs/ft^3 + 6 ft * 1.35 lbs/ft^3 = 433 lbs/ft^2

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

Calculation – Live Loads

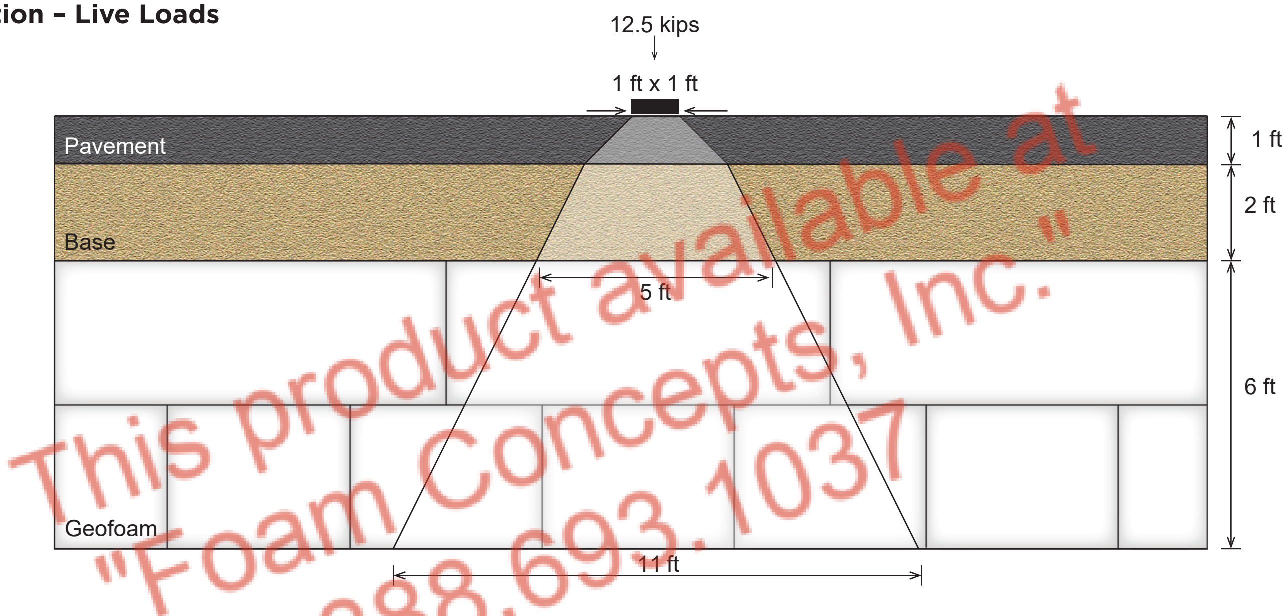

Figure 4. Calculations for live loads

Live load width at top of geofoam:

$L_{TG} = B + 2z_1 + z_2$

$L_{TG} = 1 \text{ ft} + 2 * 1 \text{ ft} + 2 \text{ ft} = 5 \text{ ft}$

Live load width at bottom of geofoam:

$L_{BG} = B + 2z_1 + z_2 + z_3$

$L_{BG} = 1 \text{ ft} + 2 * 1 \text{ ft} + 2 \text{ ft} + 6 \text{ ft} = 11 \text{ ft}$

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:

$$\sigma_{LL\ TG} = Q / (L_{TG} * L_{TG})$$

$$\sigma_{LL\ TG} = 12500\ \text{lb} / (5\ \text{ft} * 5\ \text{ft}) = 500\ \text{lb/ft}^2$$

$$\sigma_{LL\ TG} = (500\ \text{lb/ft}^2) / (144\ \text{in}^2/\text{ft}^2) = 3.47\ \text{psi}$$

Live load at bottom of geofoam:

$$\sigma_{LL\ BG} = Q / (L_{BG} * L_{BG})$$

$$\sigma_{LL\ BG} = 12500\ \text{lb} / (11\ \text{ft} * 11\ \text{ft}) = 103\ \text{lb/ft}^2$$

$$\sigma_{LL\ BG} = (103\ \text{lb/ft}^2) / (144\ \text{in}^2/\text{ft}^2) = 0.72\ \text{psi}$$

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:

$$\sigma_{TL\ TB} = \sigma_{DL\ TG} + \sigma_{LL\ TG}$$

$$\sigma_{TL\ TB} = 433\ \text{lb/ft}^2 + 103\ \text{lb/ft}^2 = 536\ \text{lb/ft}^2$$

$$\sigma_{TL\ TB} = 3.01\ \text{psi} + 0.72\ \text{psi} = 3.73\ \text{psi}$$

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

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