CALCULATION: EXAMPLE 1

Introduction

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

ThermaFoam Geofoam is a structural material produced in compliance with ASTM D6817, "Standard Specification for Rigid Cellular Geofoam". ThermaFoam 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 ThermaFoam 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 ThermaFoam 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. ThermaFoam Geofoam EPS 22 Geofoam is proposed to be used. Vertical loads must be calculated to ensure ThermaFoam Geofoam EPS 22 Geofoam is appropriate.

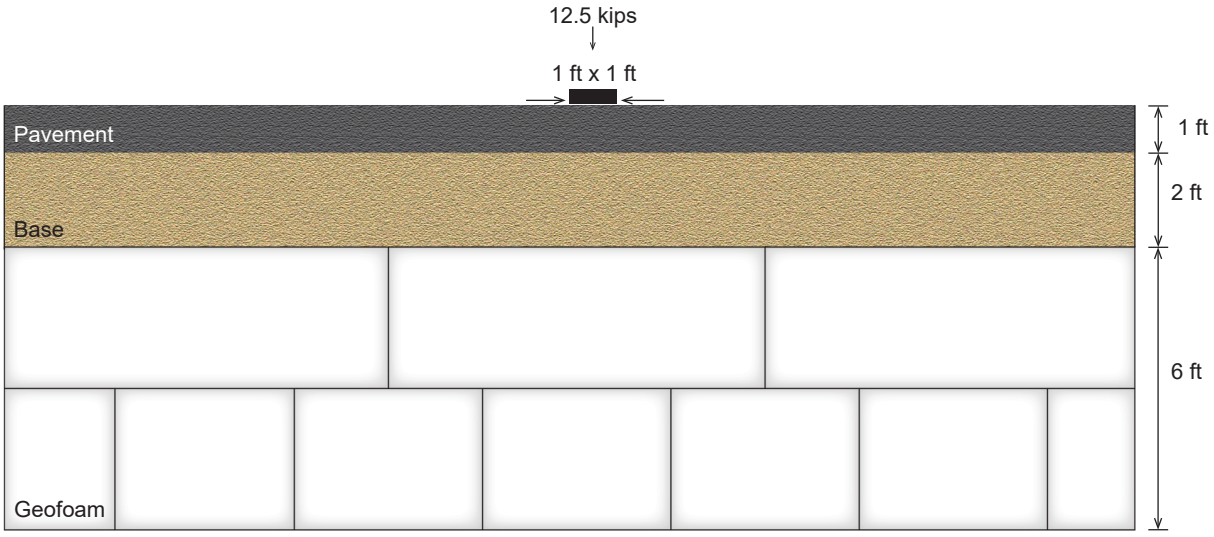

Figure 1. Project Section

Analysis Method

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

Load Distribution

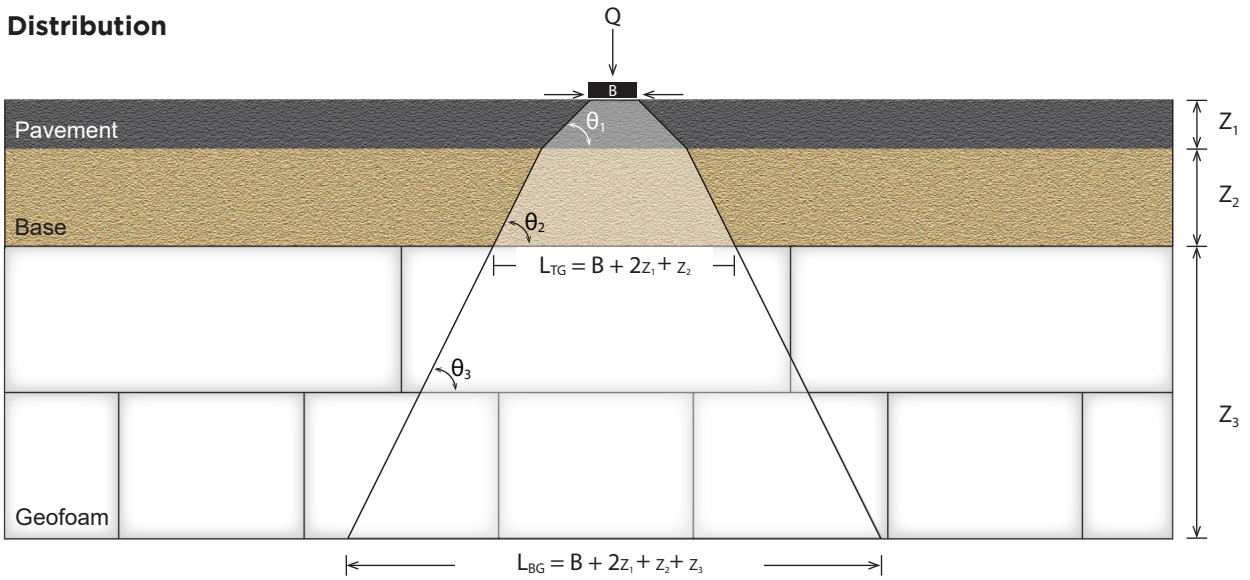

Figure 2. Simplified vertical stress distribution

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

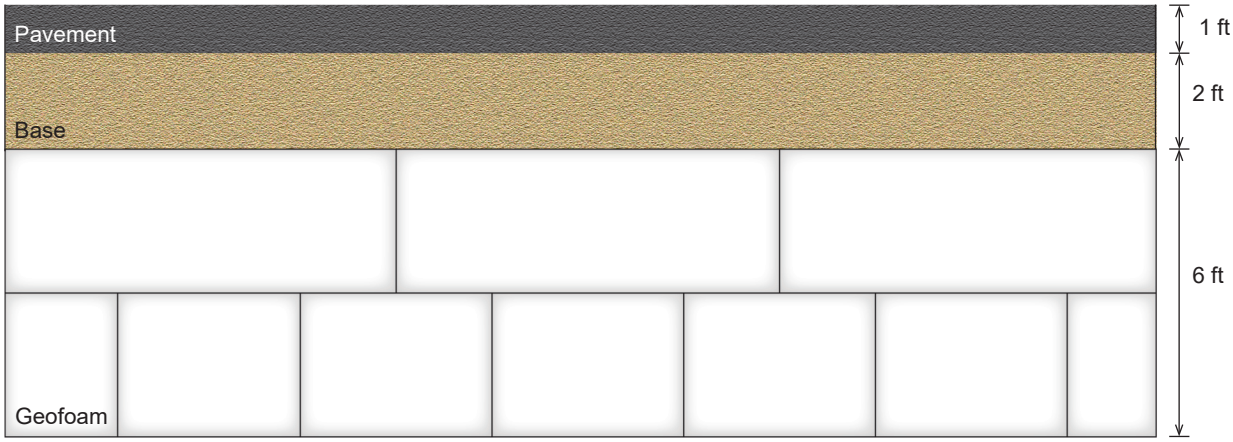

Figure 3. Calculations for dead loads

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

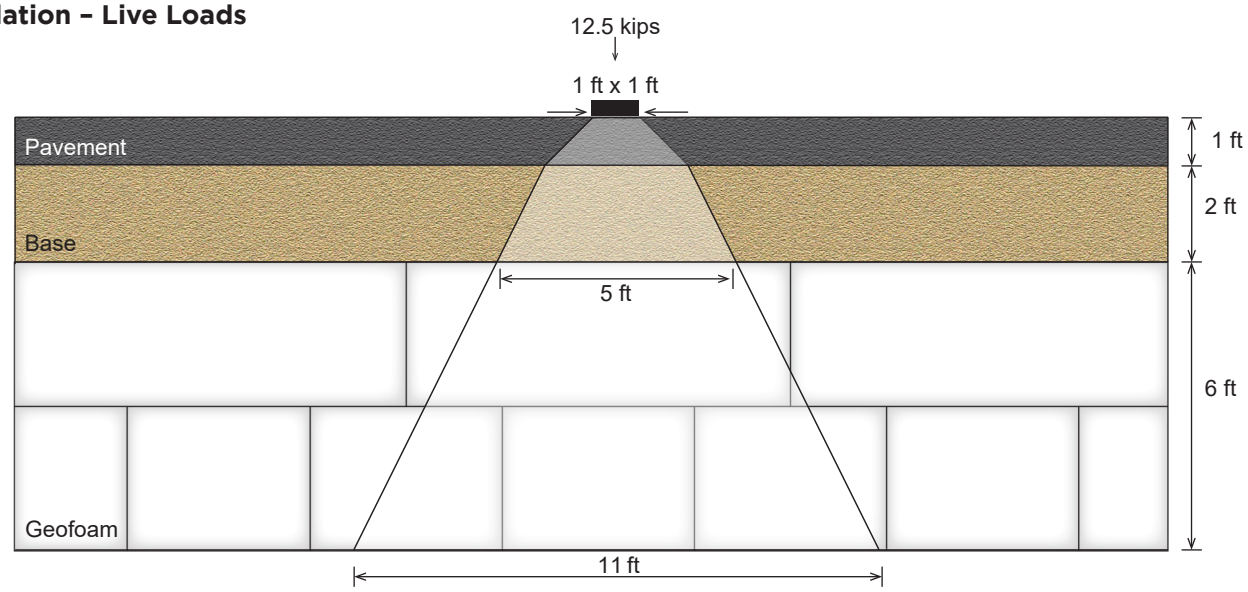

Figure 4. Calculations for live loads

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:

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

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

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

Live load at bottom of geofoam:

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

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

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

Calculation – Total Dead Loads and Live Loads

Total load at top of geofoam:

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

$\sigma_{TL\,TG} = 425\ lb/ft^2 + 500\ lb/ft^2 = 925\ lb/ft^2$

$\sigma_{TL\,TG} = 2.95\ psi + 3.47\ psi = 6.42\ psi$

Total load at bottom of geofoam:

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

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

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

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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