EPS Lightweight Backfill and Landscaping Applications

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EPS Geofoam Advantages

• EPS geofoam can be cut and shaped either at plant or site to create any architectural and landscaping profiles.
• EPS geofoam can be used to create topography without adding significant load to underlying structures and services (e.g., roof gardens for urban buildings).
  • Weight: EPS geofoam is about 100 times lighter than soil and much lighter than other lightweight fills like cellular concrete, shredded tires, pumice, wood chips, etc.
• Despite its low weight, EPS geofoam is strong enough to support traffic and landscaping equipment loads.
  • Compressive Strength: EPS geofoam is engineered for high strength with compressive resistance values of 2 to 15 psi @1% strain. As long as combined dead / live loads do not exceed the compressive strength at 1% strain, the material remains in the elastic range and will not be susceptible to creep or experience plastic yield.
Material Introduction:
What is Expanded-Polystyrene (EPS) Block Geofoam?

**Geofoam** is expanded polystyrene (EPS) or extruded polystyrene (XPS) manufactured into large lightweight blocks. The blocks vary in size but are often 2 m x 0.75 m x 0.75 m. The primary function of geofoam is to provide a lightweight void fill below a highway, bridge approach, embankment or parking lot. EPS Geofoam minimizes settlement on underground utilities. Geofoam is also used in much broader applications, including lightweight fill, green roof fill, compressible inclusions, thermal insulation, and (when appropriately formed) drainage. (Wikipedia)
Molding Process

Plant photos: Sutmoller
Introduction to EPS-Block Geofoam – Block Placement

• **Block dimensions**
  0.6 x 1.2 x 2.4 m
  (2 x 4 x 8 ft)
  varies

• **Density/unit weight**
  18.4 to 45.7 kg/m³
  (1.15 to 2.85 lbs/ft³)

Soil: ~2,000 kg/m³
(125 lbs/ft³)

• **Color**
  White
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EPS Geofoam Advantages (cont.)

- Site preparation is simpler with EPS geofoam because it does not require the surcharging, preloading or staging often necessary with other fills.
- The material is easy for workers to carry and place by hand.
- Geofoam installation does not require much skilled training.
- Custom-sized geofoam blocks to meet project needs can be procured from the manufacturer directly. Workers can trim geofoam at the site using a hot wire cutter or with handsaws.
- Geofoam blocks are laid on a level course of sand or any leveling course material. The blocks are laid in staggered manner so their joints are offset and not located in the same vertical plane. The blocks can be interconnected with either barbed plates or suitable adhesive.
Ease of Transportation and Placement

Photo courtesy of BASF- Kuala Lumpur, Malaysia

Photo source: geojuanjo.blogspot.com

Photo courtesy of http://www.architecture.org/
Primary Uses of EPS Geofoam

- Roadway construction over poor soils
- Roadway widening
- Bridge abutments
- Bridge underfill
- Culverts, pipelines and buried structures
- Compensating foundations
- Rail embankment
- **Landscaping, architectural, green roofs**
- Retaining and buried wall backfill
- Slope stabilization
- Stadium and theater seating
- Leeves
- Airport runway and taxiways
- Foundation for lightweight structures
### Material, Design and Construction Considerations for Landscaping Applications

#### Material Considerations
- EPS Density
- Compressive Strength
- Insect Control
- Flame Resistance
- Moisture Absorption
- Chemical Resistance

#### Design Considerations
- Design Methodology
- Allowable Stress
- Concentrated Loads
- Drainage / Buoyancy
- Seismic Loadings
- Stability of Adjacent Ground
- Settlement
- Bearing Capacity
- Pavement Design

#### Construction Considerations
- Bedding Material
- Compaction
- Handling
- Block Dimensions
- Block Layout & Placement
- Cover and UV protection

#### Quality Assurance/Control
- Specifications / Provisions
- Testing and Sampling
- Inspection
- Corrective Action

Items important for this application are shown in yellow.
Material, Design and Construction Considerations (Additional Explanation for Landscaping Applications)

• **Buoyancy** can be minimized by installing geofoam above the water table and ensuring suitable drainage. In addition, it can be counteracted by placing overlaying soils, pavements, sidewalks to sufficiently offset uplift forces resulting from buoyancy.

• **Chemical resistance** - EPS geofoam does not decompose nor is affected by road salts. Petroleum products and other chemicals can damage EPS, so incorporation of protective layers or barriers is used (e.g., soil cover, concrete slabs, geo-membranes, etc.).

• **Flammability** - EPS is combustible when exposed to an oxygen source, so it is important to cover with non-flammable materials (i.e., soil, etc.) and include a flame retardant. Geofoam is usually isolated by membranes, soils, or pavement in the finished application.
Topics
Landscaping and Architectural Uses

- **Light-weight terrain and terracing**
- Light-weight fill against buildings
- Protective berms against important facilities
- Floor elevations and concrete void fill
- Green roofs and parking structures
- Stadium and theater seating
- Architectural features
Lightweight Terrain and Terracing

- Sand-leveling course
- Landscaping/soil
- Geomembrane/separation layer (if required)
Maggie Daley Park – Chicago, Illinois

http://www.architecture.org/

• Estimated Volume of Geofoam: 70,000 CY

For more information, see

http://maggiedaleyparkconstruction.org/construction.php

http://insulfoam.com/chicagos-maggie-daley-park-is-citys-largest-geofoam-project/


http://www.chicagoarchitecture.org

www.chicagoarchitecture.org
Provo, Utah Tabernacle Reconstruction

Underpinning and support of Exterior walls of historic building during construction.

Artist rendition of completed renovation.
Geofoam placed in elevated terrace areas around structure to reduce weight on foundation soils.
Provo Tabernacle, Typical Detail

- Waterproof the back of all retaining walls per drawings & specs.
- MRAFI 140N fabric or owner approved equal.
- Geofoam

Notes:
1. If foam depth under footing will be less than 6", the contractor at his discretion may extend footing the extra difference.
2. Foam must be used under footing if distance between footing and slab is 6" or greater.

See details on Sheet LS-SP3.7 for site walls.

C.R. 5.8 PSI required foam under all sod & planter beds, see soils plan for soils depth, typ.

See details on Sheet LS-SP3.1 for types of paving details, see civil drawings for finished grades.

C.R. 10.9 PSI required foam under all sidewalks, plaza areas and on deck fence post footing per plan, typ.

See structural drawings for retaining wall footing schedule.

Distance (Y) is a factor of depth from bottom of footing to surface of structural deck below, distance to extend foam found by solving for Y. (X = depth of foam from bottom of footing to top of deck.)

Depth (X) to vary per plans, see architects slab plan, see civil engineer grading plan and see soils plans.

DRAINAGE MAT, PROTECTION BOARD AND WATER PROOFING LAYERS PER SPECS. SEE ARCHITECTURAL AND STRUCTURAL DRAWINGS AND SPECS.

Structural slab, see architectural and structural drawings.

Minimum angle of force distribution.
Two to three layers of EPS 19 Geofoam was installed on the drainage matt. Above the Geofoam a fabric filter was applied to prevent soil from slipping between the cracks of the Geofoam blocks. Two feet of landscaped soil covers the Geofoam. EPS 29 Geofoam was installed under areas where an adjacent roadway passes the capital, which required a higher compressive strength material. Geofoam was also used to create elevation changes for landscaping.
Provo Tabernacle – Construction Photos

Summer 2006, engineers required a light weight void fill material to protect a 20 foot to 40 foot cast-in-place retaining wall from lateral pressure and to provide drainage to eliminate standing water. Water drainage was often a recurring problem prior to the stadium’s renovation.
Landscaping and Architectural Uses

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- Architectural features
Applications: Retaining & buried wall backfill

(EPS Geofoam Applications & Technical Data by EPSIA, 2012)
Inn of the Gods - Reidoso, New Mexico

EPS placed against sides of parking structure to reduce earth pressure on structure and reduce settlement of foundation

U.S. Federal Courthouse, Salt Lake City, Utah

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Sound, Blast and Rockfall Barrier

Sound Barrier

Light weight EPS fill

Light weight EPS can be used as an alternative to traditional fill materials. Given its light weight, embankments can be constructed far steeper than with heavy weight fill materials.

Blast Protection

Air-blast wave front

Soil cover layer

Projectile shelter layer (Reinforced concrete)

Steel plate

Geofoam or Cavity

Stress distribution layer (Concrete)

Support layer
Landscaping and Architectural Uses

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Floor Elevations – Gateway Mall

Project Details

From 2001 to 2007 architects and contractors designed and built a mixed use development in Salt Lake City. The Gateway features 105 stores and 152 residences spanning over 3 million square feet. The ongoing project used Foam-Control® Geofoam as landscape fill in the plaza and garden areas, Geofoam to protect below-grade utilities, stadium seating fill for the theatres, and tapered concrete void fill to create varying floor elevations for ramps in the parking structure.

In addition, the project employed Wall Specification Grade EPS for EIFS systems that covered the exterior of the buildings. EPS Geofoam was selected for The Gateway project for its light weight, versatility, high compressive strength, ability to be easily modified on the jobsite, and its labor and material savings.

The Gateway
• Salt Lake City, UT
• 2001 to 2007
• Geofoam Utility Protection, Landscape Fill & Concrete Fill
• 190,000 Cubic Feet

Architect
MHTN

Engineer
Don Williams
Dunn & Associates Inc.

Contractor
Glen Larsen
Big D Construction
Brian Stewart
EK Bailey Construction
Project Details

Spring 2008, contractors installed EPS Geofoam to elevate the floors in a hard to access basement area of the student union. According to contractor, Gabe Griffin, “Geofoam saved a great deal of time by not having to bring in regular fill material one wheelbarrow at a time.”

Geofoam was also used as a lightweight fill material to protect a below-grade utility tunnel that connected between two parts of the building. The lightweight yet strong Foam-Control® EPS Geofoam reduced soil pressure on the walls and ceilings of the utility tunnel, preventing structural damage.

- Ogden, UT
- Spring 2008
- Geofoam Floor Elevation Fill
- 22,000 Cubic Feet

**Contractor**
Gabe Griffin
Jacobsen Construction

**Architect**
Nick Gaviglio
MHTN Architecture
Concrete Void Fill – Main Street Plaza

Project Details

Summer 2000, engineers required a lightweight fill material to reduce the weight of the Tabernacle’s plaza on a below-grade parking structure. Tapered concrete void fill Geofoam was used in the underground parking garage to create ramps and reduce the volume of costly concrete.

Low density, high strength EPS Geofoam was also used in planter boxes and landscaping above-grade to reduce the weight of the plaza on the 260,000 square foot parking structure below. The plaza features architectural concrete, stone, landscape formations, fountains, statues, and a reflecting pool.

Main Street Plaza
- Salt Lake City, UT
- Summer 2000
- Geofoam Concrete Void Fill & Landscape Fill
- 16,000 Cubic Feet

Architect
MHTN Architects

Contractor
Mike Jones
Jones Excavating
Landscaping and Architectural Uses

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Application: Rooftop Pool Decks

Photos: Sutmoller
Summer 2006, engineers needed a light weight void fill material to reduce the weight of the plaza on a below-grade parking structure. EPS Geofoam helped to reduce 3 million pounds of weight on the parking structure and provided a flat, level surface for the plaza’s landscaping. Below the landscaping, 12 feet of EPS Geofoam was used in the Moran Eye Center project.
Vegetative Roof of Airport Terminal
Landscaping and Architectural Uses

• Light-weight terrain and terracing
• Light-weight fill against buildings
• Protective berms against important facilities
• Floor elevations and concrete void fill
• Green roofs and parking structures
• **Stadium and theater seating**
• Architectural features
Stadium and Theater Seating
Stairs & Ramps

Photos: Sutmoller
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Application Resources

Expanded Polystyrene (EPS) Geofoam Applications & Technical Data

The EPS Industry Alliance
1298 Cronson Boulevard
Suite 201
Crofton, MD 21114
800.607.3772
info@epscentral.org
www.epsmolders.org

Authors: Stark, Bartlett and Arellano, 2012
Available from: www.civil.utah.edu/~bartlett/geofoam