ACH
FOAM TECHNOLOGIES

Get Green. Go White.

Polish-American Engineers Association

Presenter

Jim Nugent – ACH Foam Technologies

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708-363-2164

www.achfoam.com

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- Blocks
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- EIFS
- Garage Door
- Geofoam
- ICF Plank
- Laminated
- Roofing
- SIPs
- Radiant Floor Panels
- UltraScreen
- Shape Molding

Industrial

- Blocks
- Non-EPS Foam
- EPS Beads
- ICF Contract
- Loose Fill
- OEM
- Packaging
- Insulated Containers
- RV
- Tooling
- Shape Molding
- Lost Foam

PRODUCT LINE

LEARNING UNIT TOPICS

Geofoam

Basics & Applicaions

AIA Continuing Education
Provider #K155

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Certificates for non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

AIA CES Program

Review the History of Geofoam

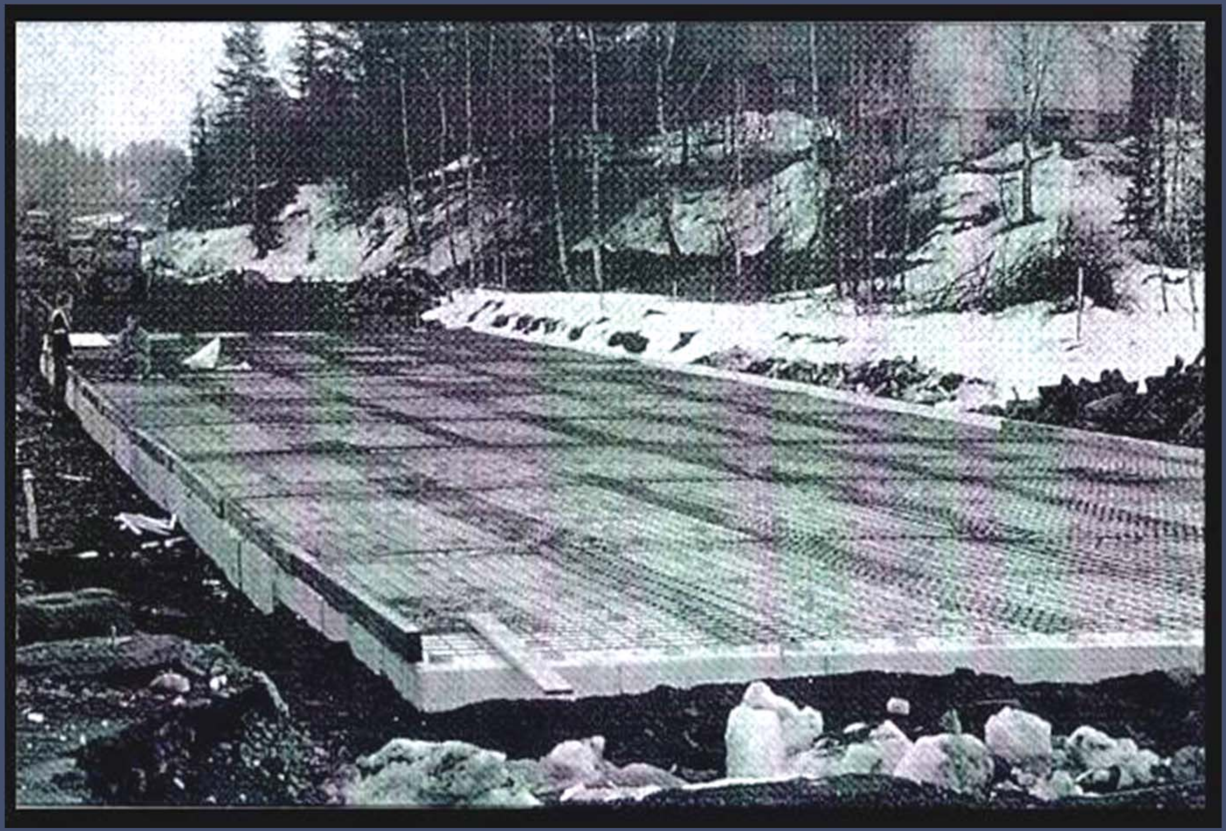
Understand the properties of Geofoam & How it Solves Engineering and Geotechnical Problems

Become familiar with Geofoam Applications & Physical Properties

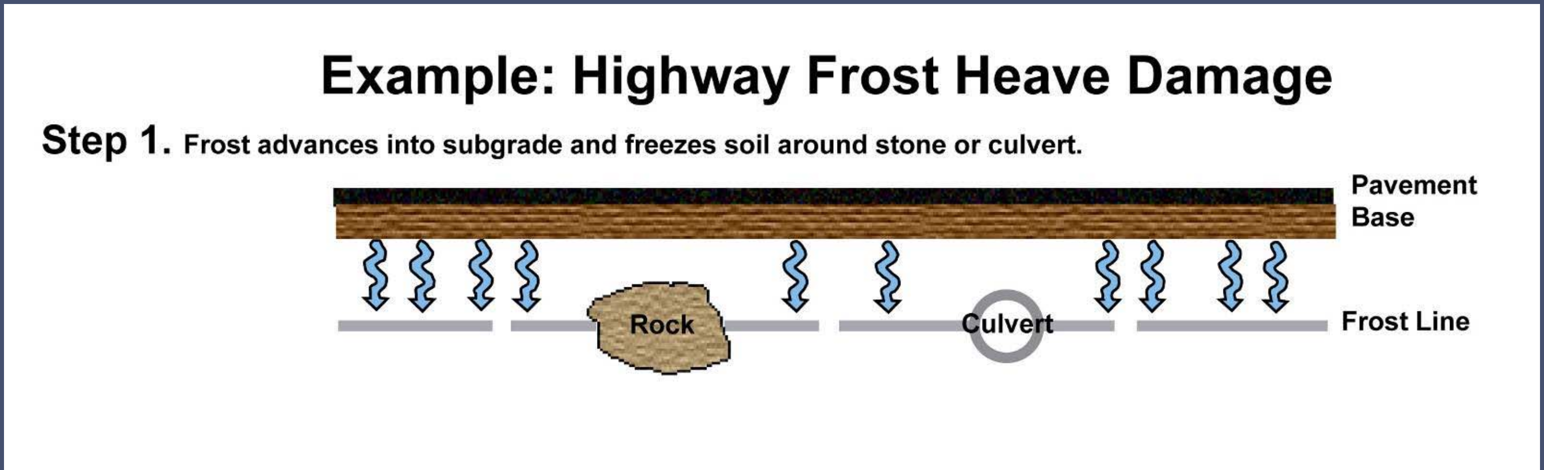
Review Design and Installation Considerations

Objectives

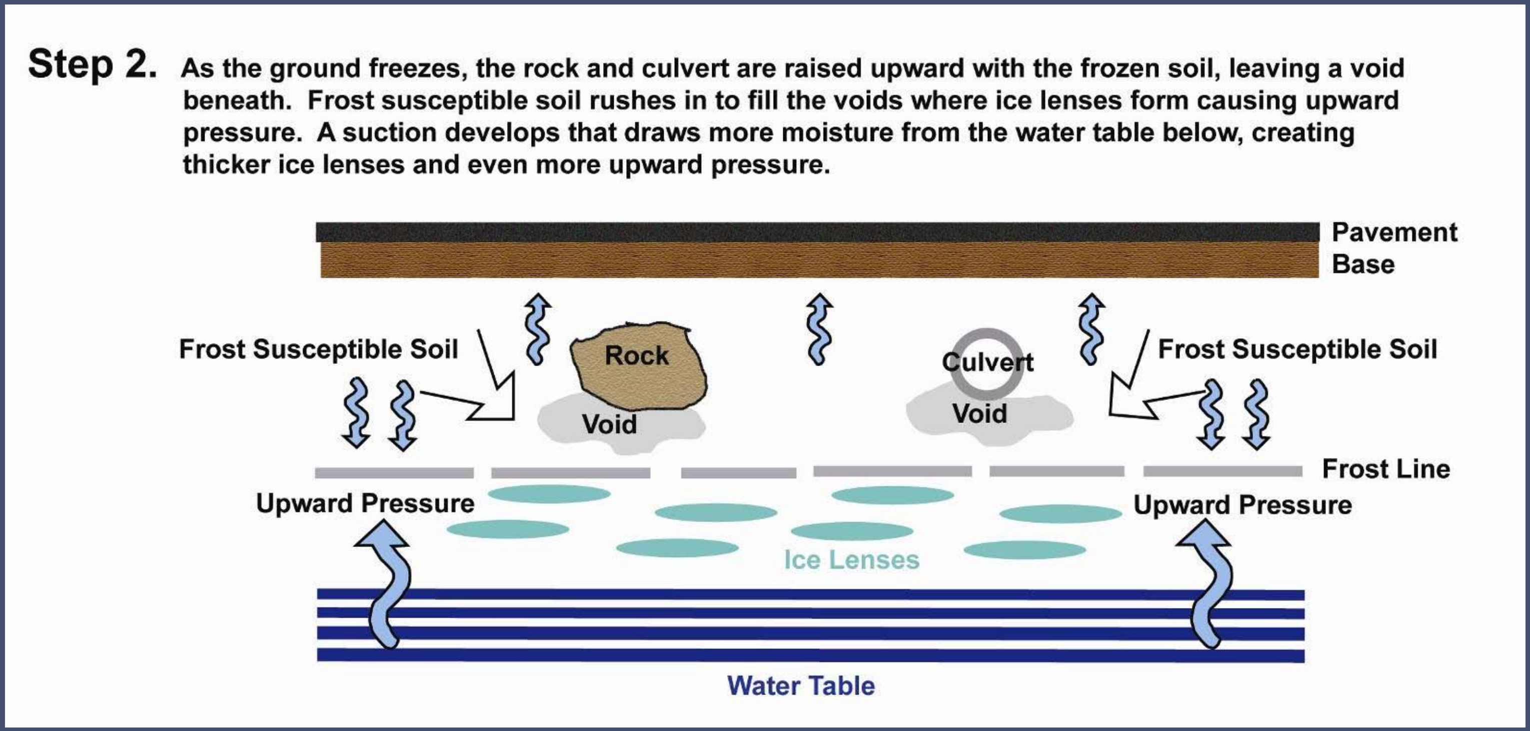
History of Geofoam



Flom Bridge 1972 Norway


Example: Highway Frost Heave Damage
Step 1. Frost advances into subgrade and freezes soil around stone or culvert.
Pavement
Base
Rock
Culvert
Frost Line

The Problem


Step 2. As the ground freezes, the rock and culvert are raised upward with the frozen soil, leaving a void beneath. Frost susceptible soil rushes in to fill the voids where ice lenses form causing upward pressure. A suction develops that draws more moisture from the water table below, creating thicker ice lenses and even more upward pressure.
Pavement
Base
Frost Susceptible Soil
Rock
Void
Culvert
Void
Frost Susceptible Soil
Frost Line
Upward Pressure
Upward Pressure
Ice Lenses
Water Table

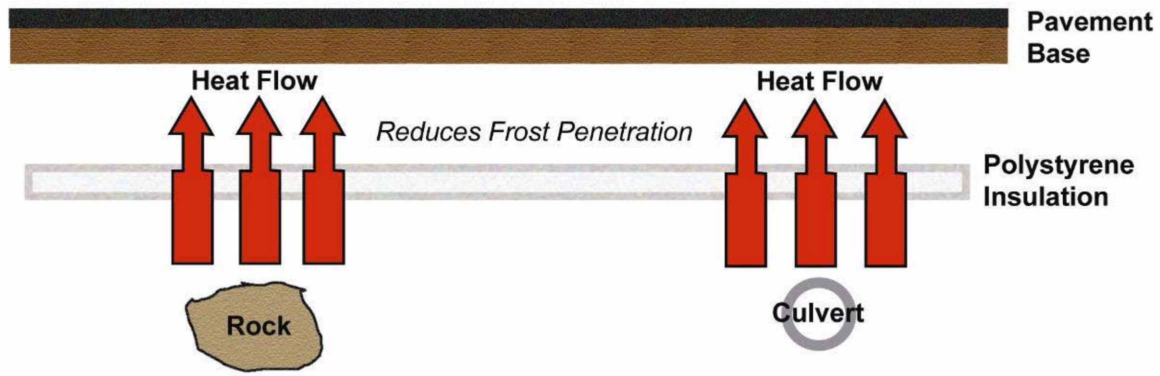
The Problem

Step 3. When thawing occurs, the smaller grained soils slide into the voids preventing the rock and culvert from returning to their original position. They thus move upward resulting in frost heave damage to the roadway.

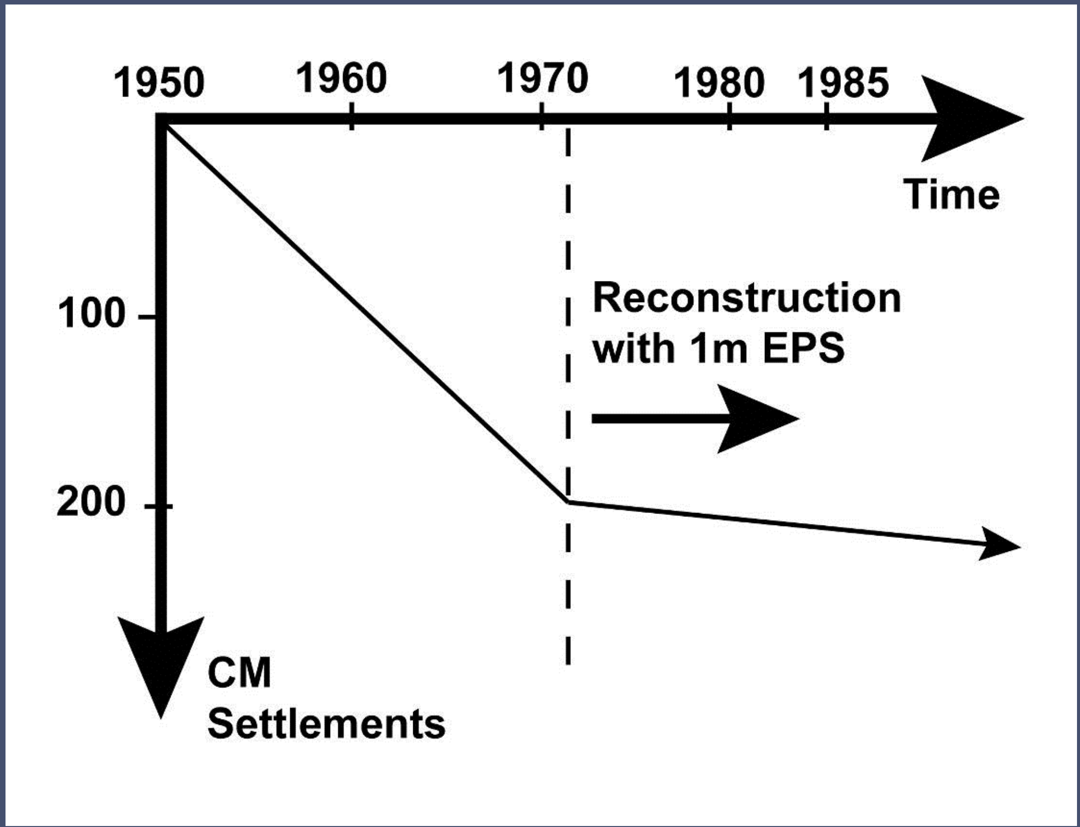
Highway Frost Heave Damage

The Problem

Step 4. Placing polystyrene below the roadway reduces frost penetration and freezing of subgrade, frost-susceptible soils and creates flat, even heat flow.



The Solution


1950
1960
1970
1980
1985
Time
100
200
Reconstruction
with 1m EPS
CM
Settlements

Flom Bridge

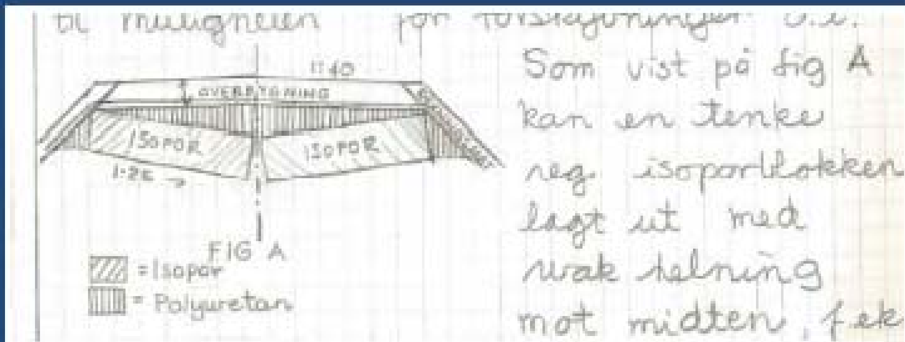


Figure 3. Excavation of the first EPS embankment at Flom bridge (EPS and polyurethane as protective layer).

Flom Bridge

Carousell Mall Syracuse, NY

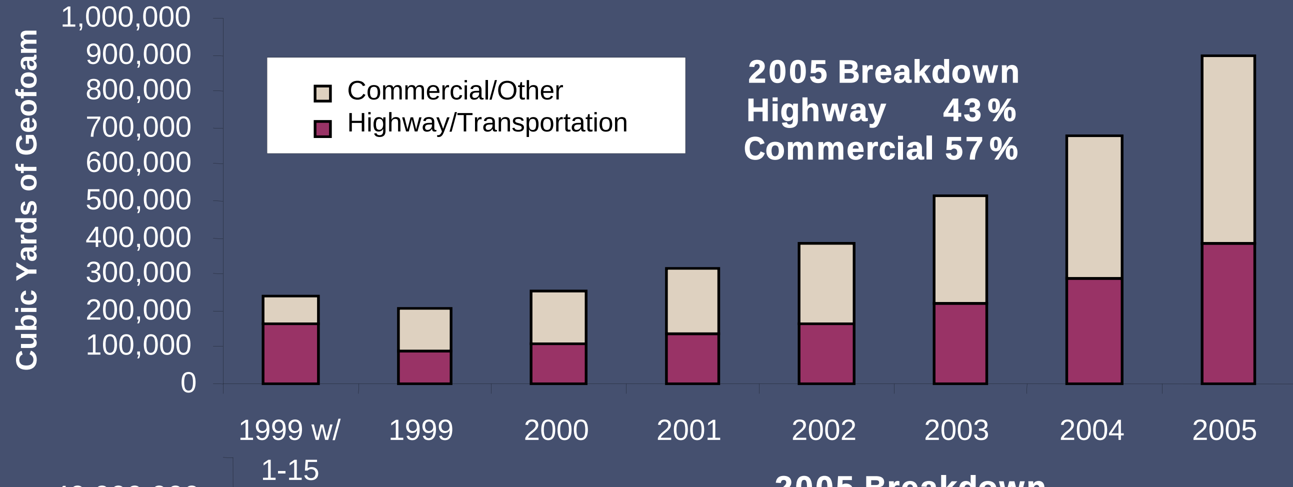
Constructed in 1990

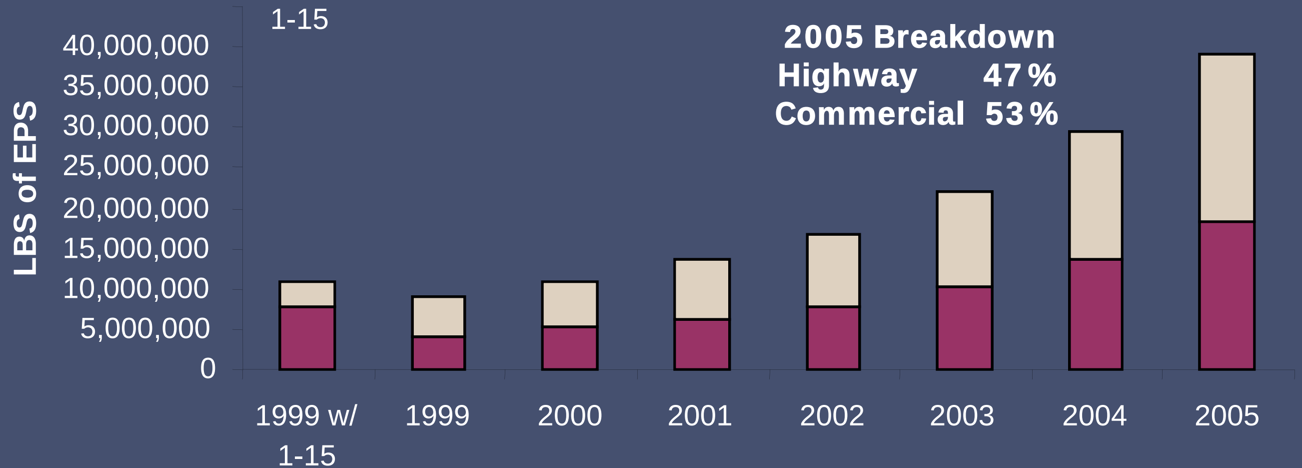
Unstable soil conditions made the project not suitable for normal construction

Unstable soils were removed

28,000 CU Meters of GeoFoam were placed below the foundation

Zero net load





<u>US Estimated Market Size</u>

- Between 35-45 Million Lbs of EPS
- About 900,000 y^3 of Geofoam
- About 8% of total EPS construction sales
- 28% CAGR since 1999 without I-15
- 24% CAGR with I-15

Geofoam Usage – 1999 to 2005

Problem Solver

• A geotechnical product used in fill applications where a lightweight material is required to reduce stress on underlying soils or lateral pressures to retaining walls, abutments or foundations.

• Is a cellular plastic material that is strong, but has a very low density – 1 percent of traditional earth materials.

• Geofoam has been used in engineering and geotechnical applications worldwide for more than 30 years.

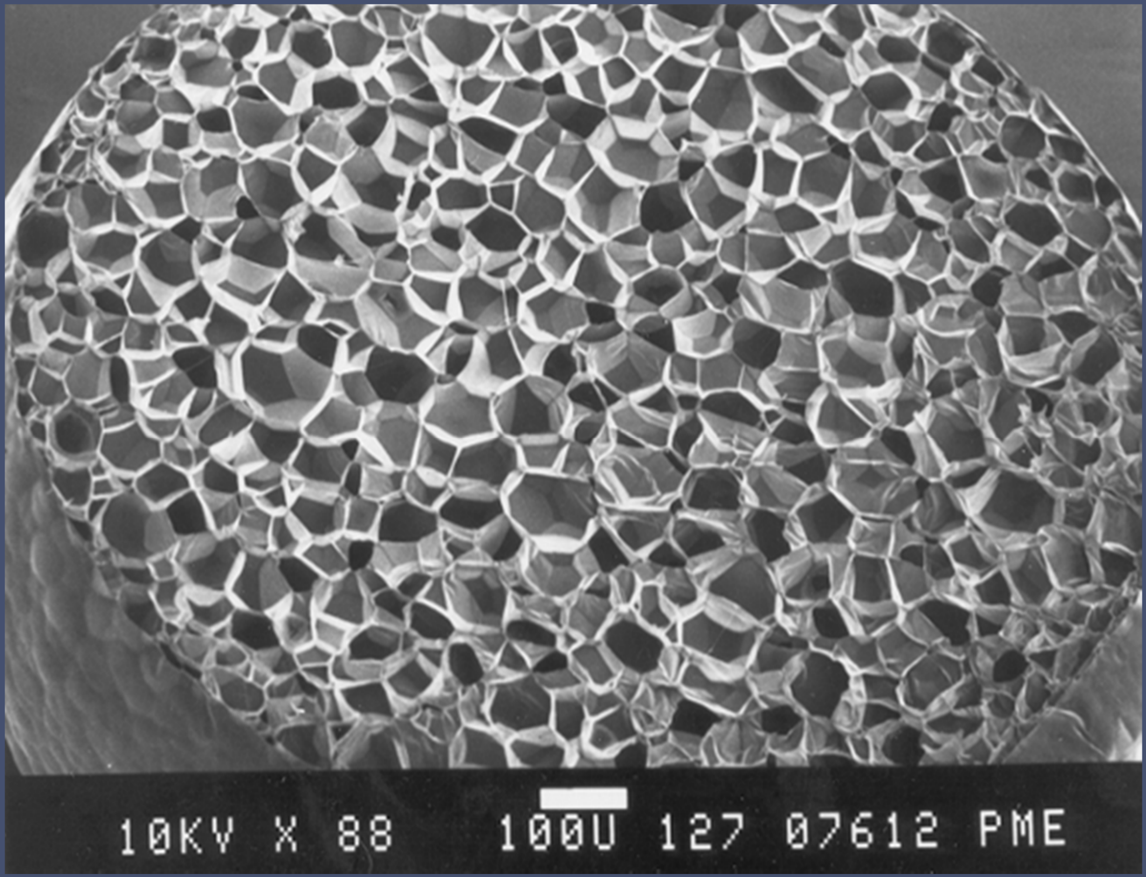
What is EPS Geofoam?

Weight Comparisons

Regular Fill	120-130 LB/F3
Sand	106 LB/F3
Saw Dust	60 LB/F3
EPS 39	2.40 LB/F3*
EPS 19	1.15 LB/F3*

*other engineered densities available

Manufacturing Process



What is EPS?

- High Strength
- Predictable Performance No Settlement
- Densities Engineered for Applications
- Low Water Absorption
- Economical
- Easily Modified on Jobsite
- Variety of Sizes & Shapes
- Termite Resistance
- Environmentally Friendly

Benefits of Geofoam

Below-Grade Parking Structure near Downtown Chicago created unusable above grade space for buildings, parks and city amenities.

City planners wanted to build a cutting-edge facility for cultural events and free public use.

Problem: Unusable Above-Grade Space

Geofoam was specified to reduce the load on the below-grade parking structure.

Solution: Geofoam for Green Roof

Geofoam helped to transform 24.5 acres into a public city park that included an ampethiture, fountains and beautifully landscaped gardens.

Millennium Park, Chicago

Fort Hays, KS

Fort Hayes Student Union was in need of updating. Prior to renovation the student union was used for entertaining and office spaces. As the university grew so did the need for more office space, as well as an area for formal gatherings.

Problem: Floor Elevation Changes

Geofoam was specified rather than compacted fill for its speed of installation, ease of handling and ability to be easily modified to meet design requirements.

Solution: Geofoam for Easy Installation & Handling

Geofoam created floor elevation changes for stairs, ramps and stages without making costly changes to the building's structure.

Intermountain Medical Center – Murray, UT
Width of foundation reduced from 30” to 18”

A light weight fill was needed to reduce lateral pressure on a footing wall which extended 25 feet below grade.

Problem: Reduce Lateral Pressure

The reduction of earth pressure allowed a much thinner wall to be built, saving tens of thousands of dollars and considerable time.

Solution: Geofoam Foundation Stabilization Fill

Geofoam Applications

Left - I-15 Expansion
Salt Lake City, UT

Right - Window Rock Highway, UT

Embankment and Slope Stabilization

I-15 Expansion Salt Lake City, UT
Part of the preparations for the 2002 Winter Olympics

Reduce Settlement to Protect Buried Utilities

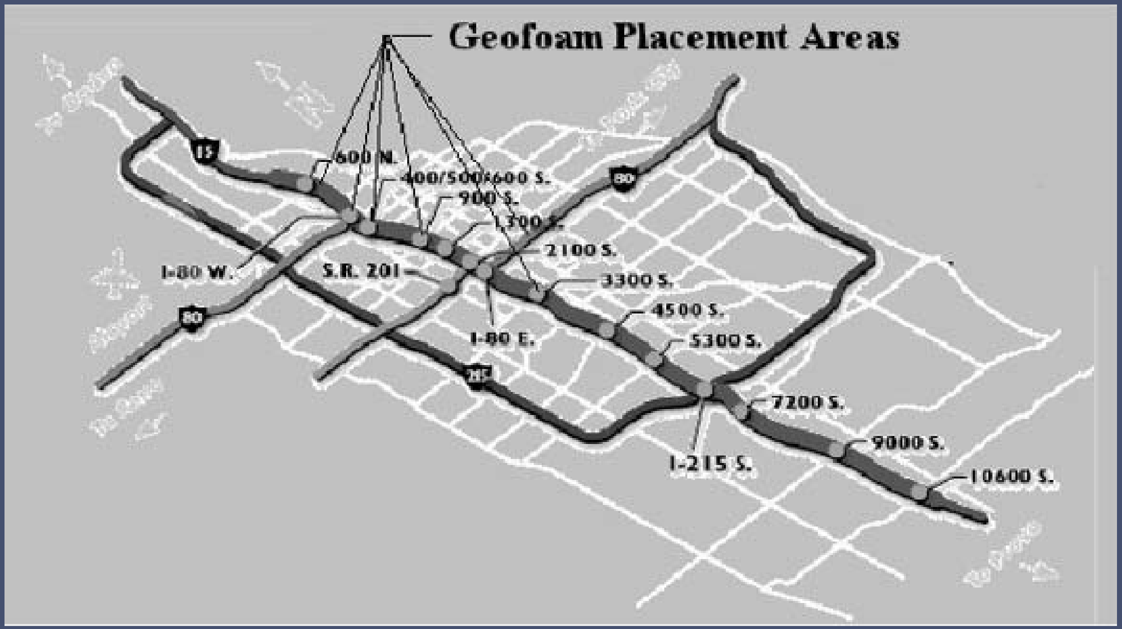
Improve Slope Stability of Embankments

Rapid Construction in Time Critical Areas

I-15 Project: Problem

Geofoam

ASTM D6817 Type EPS 19
100,000 Cubic Meters
Insect Treated
32 1/4” thick and a small amount of 16” material



I-15 Project: Solution

Settlement Reduction, Utility Protection, Speed of Construction

Geofoam Embankment from State St. to 200 W. Along Interstate I-80, Salt Lake City, Utah

I-15 Project: Arial View

California Academy of Sciences – San Francisco, CA
Load Reduction over Parking Garage

Fidelity Towers Kansas City, MO
Asphalt Roof Converted in to Usable Outdoor Space

Green Roofs & Landscapes

LDS Conference Center
Salt Lake City, UT
Project reduced the use of potting soil and concrete
22,000,0000 pounds of weight reduction

GREEN ROOFS & LANDSCAPES

Soldier Field,
Chicago, IL

Green roof & Landscape Installation

Union Pacific Depot Restoration
Salt Lake City, UT

Floor Elevation

Floor Elevation

Stadium Seating

Stadium Seating

Judge Memorial High School
30-40’ retaining walls at far end of the field

Retaining Structures

Plumas Forest – Oroville CA
GeoFoam allowed for installation of culverts for run off

Slope Stabilization

Hillside Foundation Stabilization

Parkwood Place Park City, UT
Reduced foundation pressure

Foundation Stabilization

Hanging Lake, CO
Compressible Inclusion
Protected tunnel from falling debris

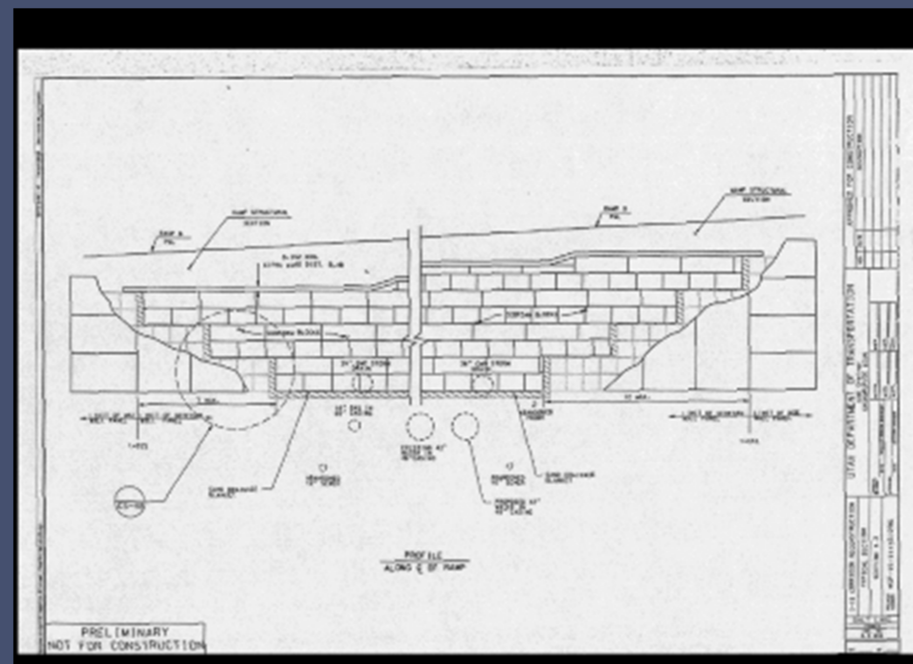
EROSION CONTROL

Left Quartzite, AZ

Right Alton IA

Culvert Protection

I-15 Expansion Salt Lake City, UT
72’ fiber optic cable protected
$3,000,000 savings



Utility Protection

Concrete Void

Bridge Abutment

Lightweight Void Fill

Structural Fill

Bridge Approach Fill

Retaining Walls

Side Hill Stabilization

Vibration & Sound Dampening

Levees & Berms

Application Summary

Design Considerations

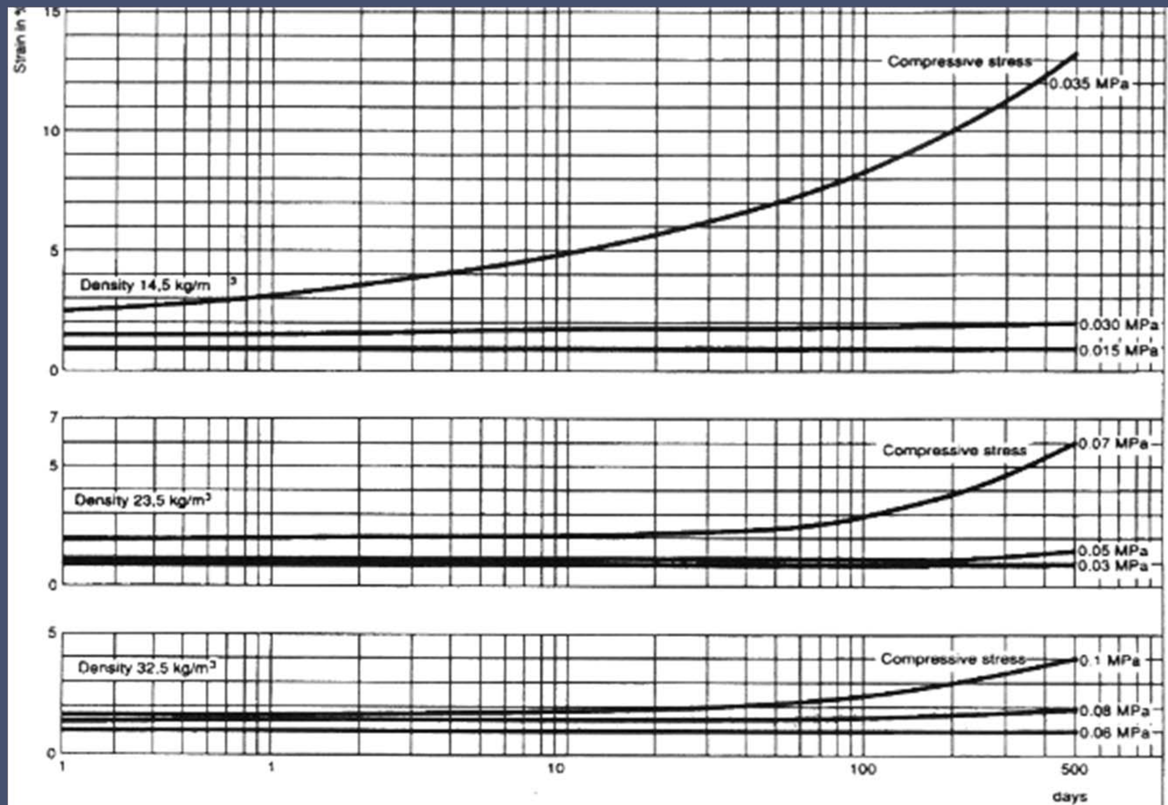
Geofoam Properties								
TYPE-ASTM D6817		EPS 12	EPS 15	EPS 19	EPS 22	EPS 29	EPS 39	EPS46
Density, min.	lb/ft³ (kg/m³)	0.70 (11.2)	0.90 (14.4)	1.15 (18.4)	1.35 (21.6)	1.80 (28.8)	2.40 (38.4)	2.85 (45.7)
Compressive Resistance @ 1% deformation, min.	psi psf (kPa)	2.2 320 (15)	3.6 520 (25)	5.8 840 (40)	7.3 1050 (50)	10.9 1570 (75)	15.0 2160 (103)	18.6 2680 (128)
Elastic Modulus, min	psi (kPa)	220 (1500)	360 (2500)	580 (4000)	730 (5000)	1090 (7500)	1500 (10300)	1860 (12800)
Flexural Strength, min.	psi (kPa)	10.0 (69)	25.0 (172)	30.0 (207)	40.0 (276)	50.0 (345)	60.0 (414)	75.0 (517)
Water Absorption by total immersion, max.	Volume %	4.0	4.0	3.0	3.0	2.0	2.0	2.0
Oxygen Index, min.	Volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Buoyancy Force	lb/ft³ (kg/m³)	61.7 (990)	61.5 (980)	61.3 (980)	61.1 (980)	60.6 (970)	60.0 (960)	59.5 (950)
Additional Properties for Compressible Applications								
Compressive Resistance @ 5% deformation, min.	psi psf (kPa)	5.1 730 (35)	8.0 1150 (55)	13.1 1890 (90)	16.7 2400 (115)	24.7 3560 (170)	35.0 5040 (241)	43.5 6260 (300)
Compressive Resistance @ 10% deformation, min	psi psf (kPa)	5.8 840 (40)	10.2 1470 (70)	16.0 2300 (110)	19.6 2820 (135)	29.0 4180 (200)	40.0 5760 (276)	50.0 7200 (345)

Geo Foam Standard ASTM D6817

EPS Properties									
Property			Type XI	Type I	Type VIII	Type II	Type IX	Type XIV	Type XV
Nominal Density		lb/ft³ (kg/m³)	0.75 (12)	1.00 (16)	1.25 (20)	1.50 (24)	2.00 (32)	2.50 (40)	3.00 (48)
Density[1], min.		lb/ft³ (kg/m³)	0.70 (12)	0.90 (15)	1.15 (18)	1.35 (22)	1.80 (29)	2.40 (38)	2.85 (46)
Design Thermal Resistance per 1.0 in. thickness	75°F	°F·ft²·h/Btu (°K·m²/W)	3.22 (0.57)	3.85 (0.68)	3.92 (0.69)	4.17 (0.73)	4.35 (0.77)	4.35 (0.77)	5.10 (0.90)
	40°F	°F·ft²·h/Btu (°K·m²/W)	3.43 (0.60)	4.17 (0.73)	4.25 (0.75)	4.55 (0.80)	4.76 (0.84)	4.76 (0.84)	4.85 (0.85)
Compressive Strength[1] @ 10% deformation, min.		psi (kPa)	5.0 (35)	10.0 (69)	13.0 (90)	15.0 (104)	25.0 (173)	40.0 (256)	60.0 (414)
Flexural Strength[1], min.		psi (kPa)	10.0 (69)	25.0 (173)	30.0 (208)	35.0 (242)	50.0 (345)	60.0 (414)	75.0 (517)
Water Vapor Permeance[1] of 1.0 in. thickness, max., perm			5.0	5.0	3.5	3.5	2.5	2.5	2.5
Water Absorption[1] by total immersion, max., volume %			4.0	4.0	3.0	3.0	2.0	2.0	2.0

Insulation Standard ASTM C578

Results of Typical Unconfined Axail Compression Creep Tests on Block-Molded EPS



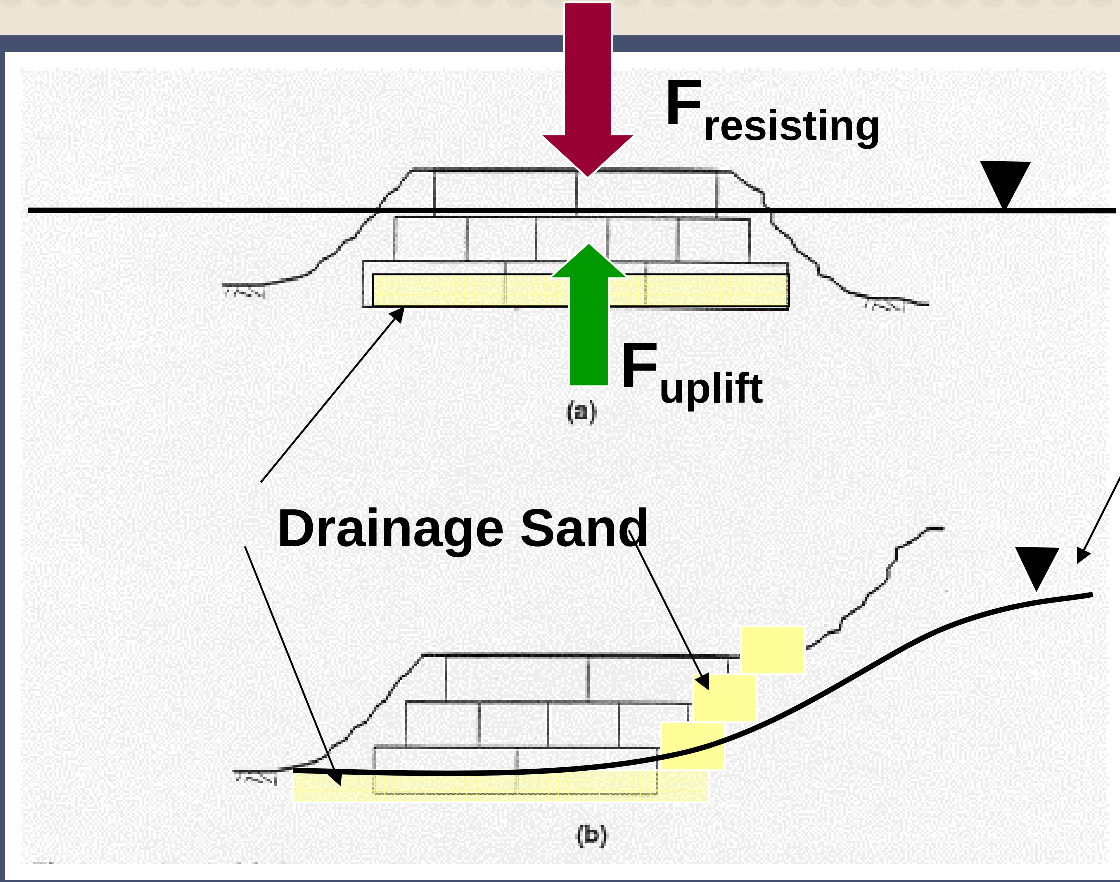
Allowable Stress & Creep

Stress Allowed to Achieve Maximum 1% Strain

Type	Density	Stress (PSI)	Stress (PSF)
EPS 15	0.90 lb/f^3	3.6	520
EPS 19	1.15 lb/f^3	5.8	840
EPS 22	1.35 lb/f^3	7.3	1050
EPS 29	1.80 lb/f^3	10.9	1570
EPS 39	2.40 lb/f^3	15.0	2160
EPS 46	2.85 lb/f^3	18.6	2680

Rule of Thumb; in buoyancy situations 1ft of foam below water = 2ft of cover

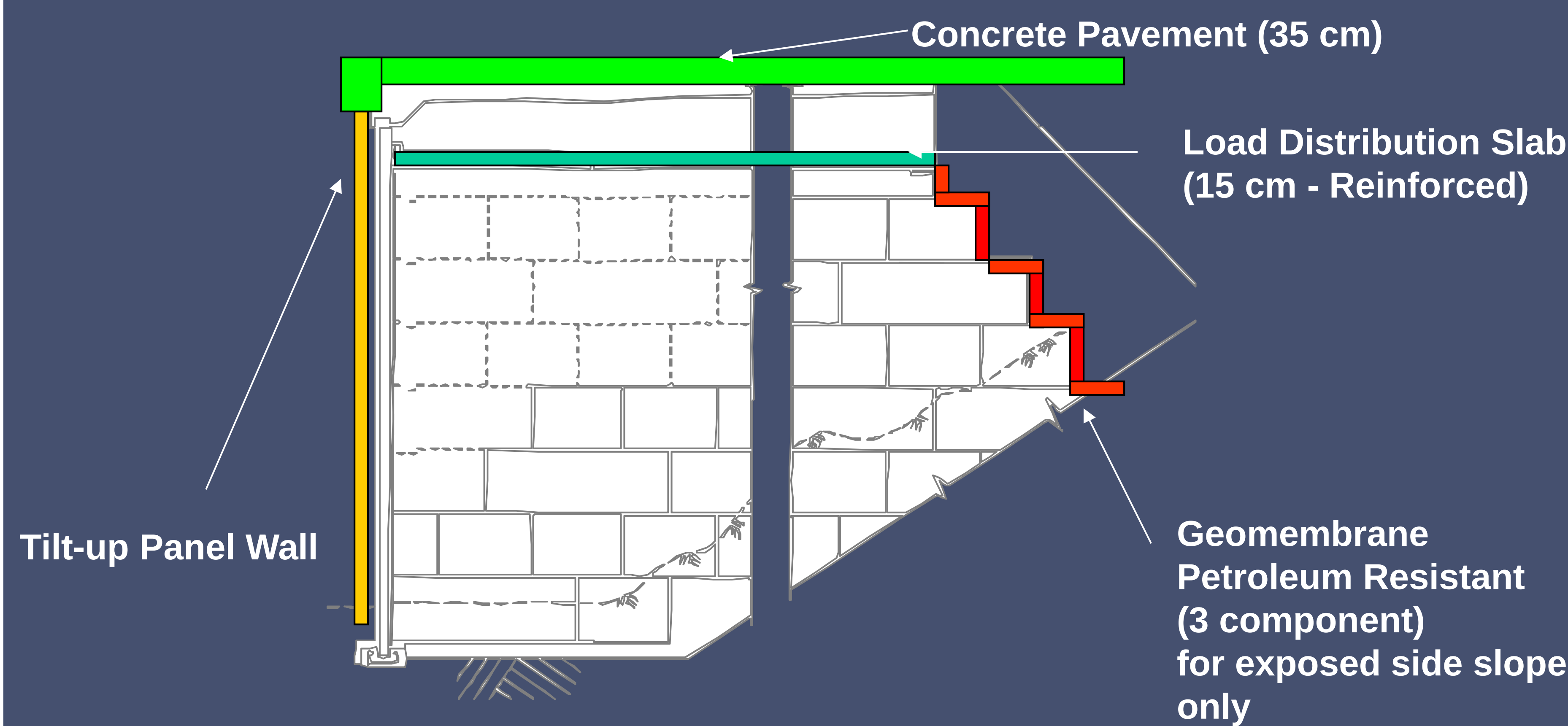
100-year design flood event



groundwater

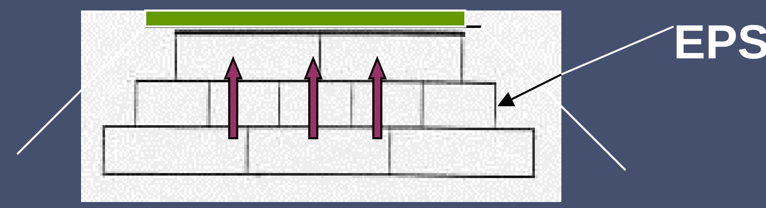
$$F_{resisting} = 1.3 \times F_{uplift}$$

BOUYANCY



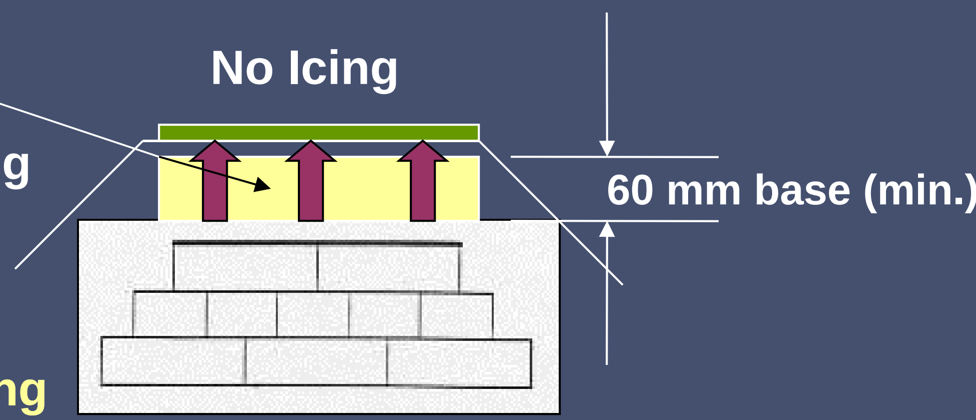
Chemical Attack- Protective Barrier

Good Heat Transfer



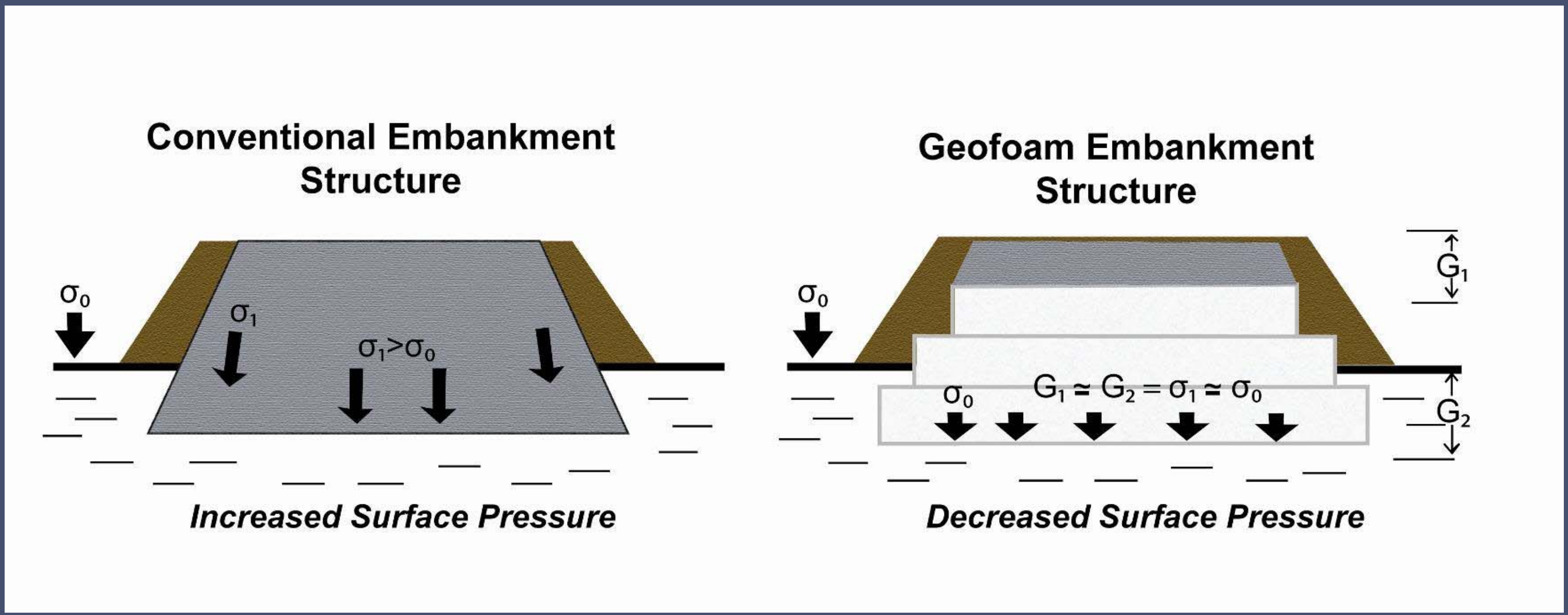
Poor Heat Transfer

Base material has heat capacity and prevents pavement from icing as rapidly.



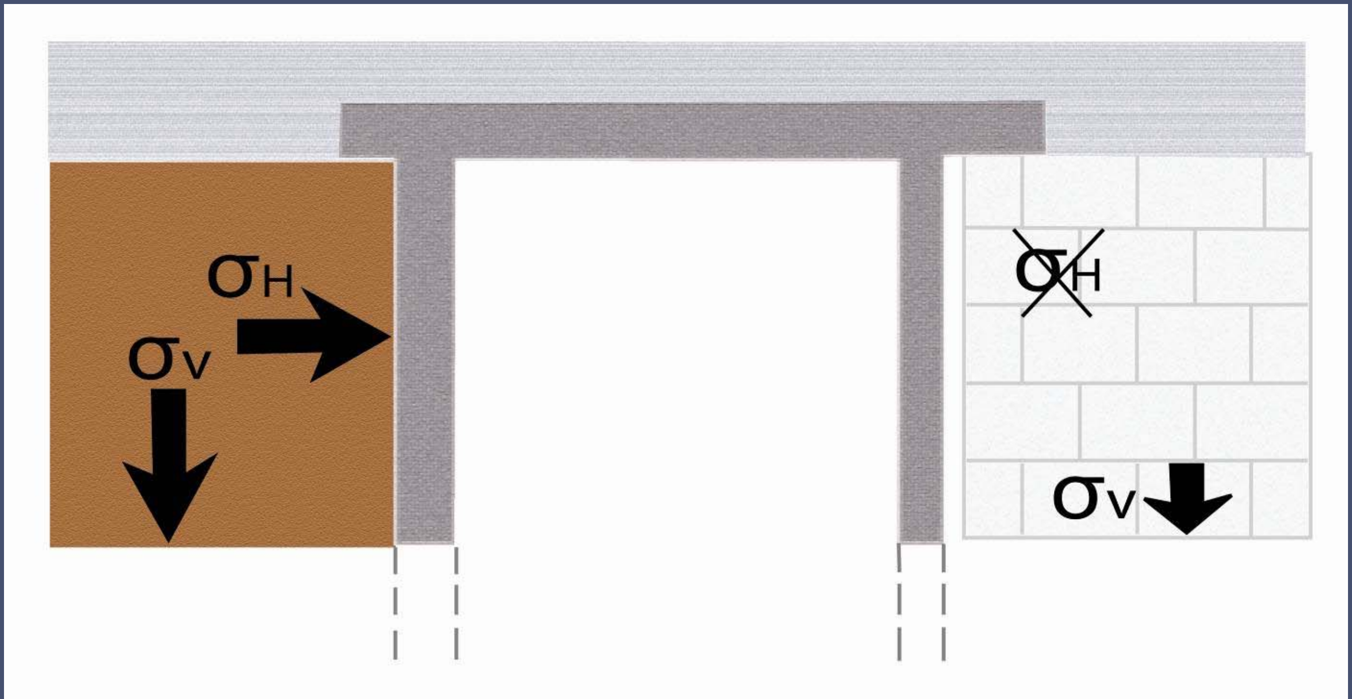
Proper Design to Prevent Icing

Differential Icing – Cold Regions Only

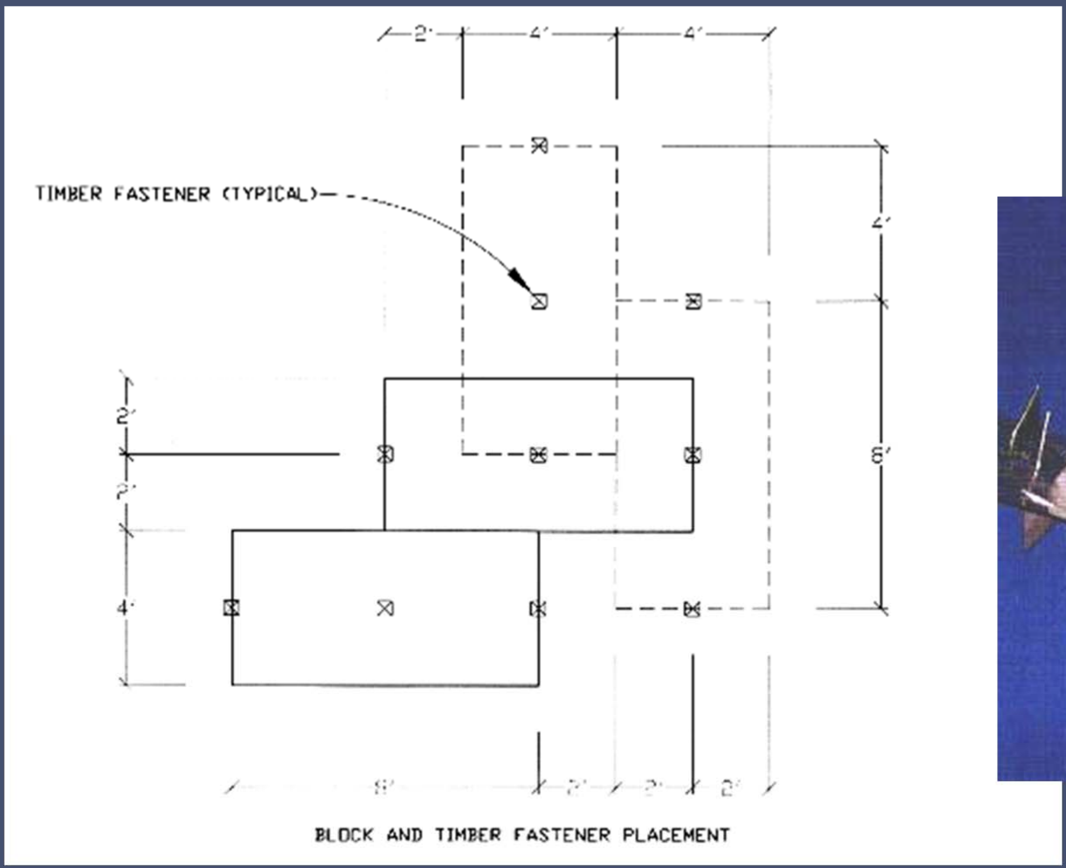


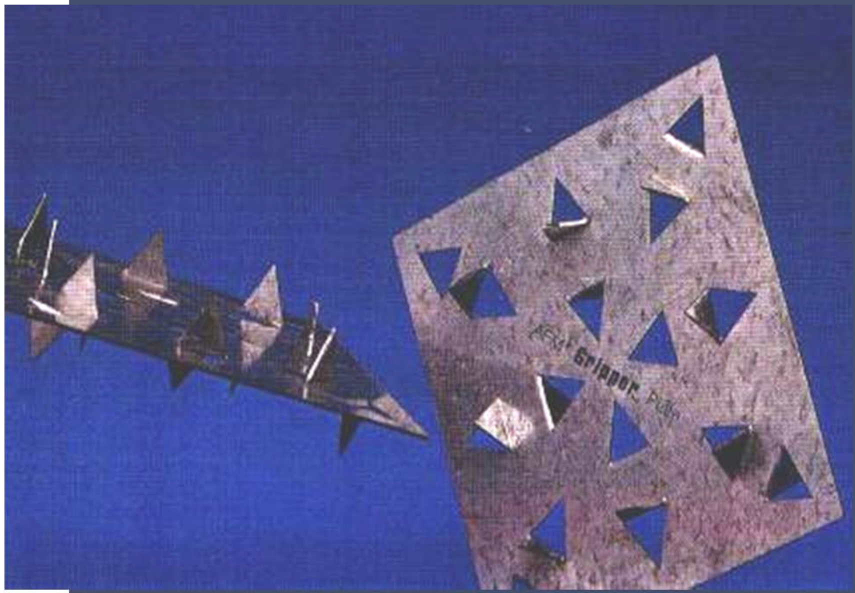
Vertical Force Reduction

With Geofoam no horizontal forces act on the bridge abutment and supporting walls



Horizontal Force Reduction





Gripper Plates

Geofoam is Combustible and Must Be Protected Against Open Flame or Heat

Material Specification should include:

“Flame Retardant Additive and a UL Certification of Classification as to External Fire Exposure and Surface Burning Characteristics.”

Geofoam can be manufactured with a proven and safe additive that effectively resists termites

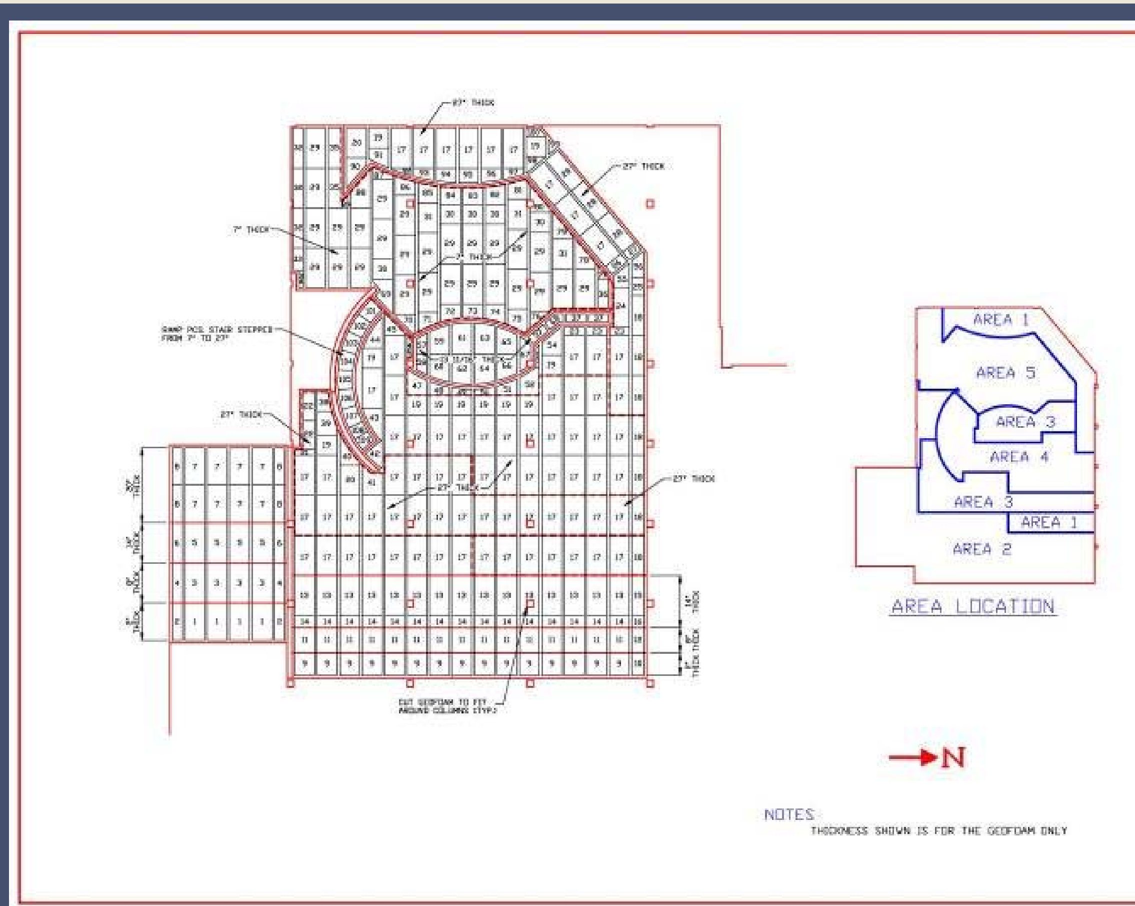
Extruded Polystyrene

Untreated EPS

Termite Resistant Treated EPS Geofoam

Termite Resistant Geofoam

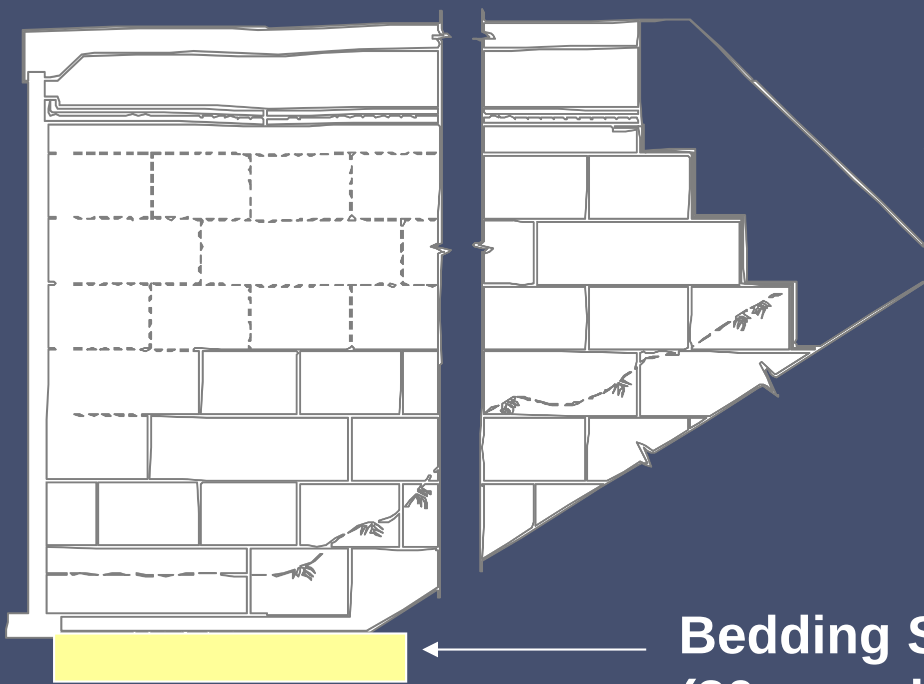
Geofoam Installation



Installation Planning

Bedding Sand Function

- free draining sand or fine gravel
  - provides leveling course
  - provides drainage



Bedding Sand (20 cm min.)

Leveling Course

Delivery to Site

Delivery to Site

1st Layer

Staggered Seams

Install to Create Ramp or Curved Wall

Easy to Handle

Easy to Modify on Jobsite

Compaction & Placement at Downdrains

Gripper Plate Placement

Load Distribution Slab

Foundation Wall Installation

Questions?

This Concludes the AIA
Continuing Education Program

Kerasotes Theatre

Application

7,785 cubic yards (210,200 cubic feet) of Type I Foam-Control® EPS Geofoam with 15% recycled content was specified as stadium seating and light weight floor fill for the Kerasotes Theatre in South Loop Chicago, Illinois.

Project Details

Summer 2009, construction of the 90,000 square foot, 16 screen Kerasotes movie theatre was well under way. The Kerasotes theatre is located on the third floor of the Roosevelt Collection building, making the weight of the theatre a concern for engineers.

The theatre design incorporated high ceilings in the auditoriums and traditional height ceilings in the hallways. The use of Geofoam beneath the stadium seating reduced the weight of the theatre on the structure below and also acted as concrete floor fill to reduce the ceiling height in the hallways.

A total of 62 truck loads of 199,690 cubic feet of square cut Foam-Control® EPS Geofoam and 10,510 cubic feet of tapered cut EPS Geofoam were used in the completion of the Kerasotes Theatre.

Additional ACH Products

Wall Specification Grade EPS in an Exterior Insulation Finish System.

Geofoam

Kerasotes Theatre
- South Loop Chicago, IL
- Summer 2009
- Geofoam Stadium Seating & Light Weight Floor Fill
- 7,785 Cubic Yards

Project Manager
Steve Turner
Stadium Savers, LTD

Architect
James Clay

Contractor
Timothy F. Hanifin
Graycor Construction Co., Inc.

Grove Terrace

Application

250 cubic yards of EPS 15 Geofoam was used as retaining wall stabilization fill along Grove Terrace road in Dubuque, Iowa.

Project Details

Spring 2008, heavy rains caused the retaining wall along Grove Terrace road to collapse, resulting in limestone blocks tumbling into the roadway below, prompting the closure of West 11th Street. Engineers selected Geofoam for its high compressive strength and because it had already been used in newly constructed areas of West 11th Street.

The limestone blocks were restored and used in the construction of the new retaining wall. This was the first time the design team had worked with Geofoam. As a result of the project's success, two other retaining walls have been fixed using Geofoam as the retaining wall's stabilization fill.

Geofoam has been used for over 30 years in the construction industry for its light weight, high compressive strength, predictable material behavior and ability to reduce lateral or bearing loads. Other fill materials such as foamed concrete, waste tires, soil, woodchips or wood fiber have higher densities but are variable in their makeup, have limitations in handling and can be weather sensitive, requiring staged construction, preloading, surcharging and draining.

Geofoam

Grove Terrace
- Dubuque, IA
- Fall 2008
- Geofoam Retaining Wall Stabilization Fill
- 250 Cubic Yards

Engineer
Robert Schiesl
City of Dubuque

Dennis Waugh
IIW Engineers & Surveyors

Contractor
Mike Portzen
Portzen Construction

Metra 35th Street Station

Application

31,300 cubic feet of Foam-Control® EPS Geofoam with Perform Guard® termite resistant treatment was installed as stairway and ramp fill for the Metra's 35th Street Station platform at the Chicago White Sox Stadium.

Project Details

During the 2010 design phase of the 35th Street Station, architects had safety concerns with the elevation of the concrete in order to comply with the Americans with Disabilities Act (ADA). In addition, the aggressive construction schedule would make conventional soil material an unviable fill material due to the amount of settlement time required.

As a result, architects turned to EPS 12 Geofoam to solve their design challenges and shorten the construction time. According to Dan Orlich, Metra's Construction Manager, "a great amount of time and labor was saved by not having to compact the lifts of traditional fill. Compensating for the drains within the ramp cells was a snap because on site cutting of the Geofoam was so easy."

Meeting tight construction schedules has been a key benefit for ACH Foam Technologies' Geofoam use in many projects. John Grskovich explains, "John Burns Construction continues to use ACH Foam Technologies because they are so responsive to our schedules."

Geofoam

Metra 35th Street Station
- Chicago, IL
- Spring 2011
- Geofoam Stairway & Ramp Fill
- 31,300 Cubic Feet

Contractor
John Grskovich
John Burns Construction Co

Architect
Jason Stanley
Skidmore, Owings & Merrill

Engineer
George Cussen
Kenny Construction Company