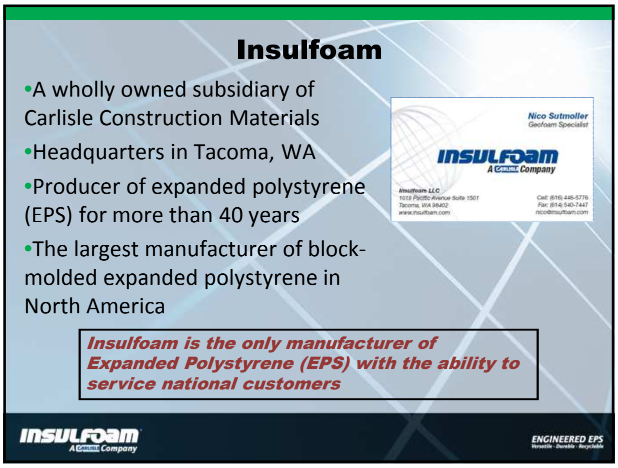
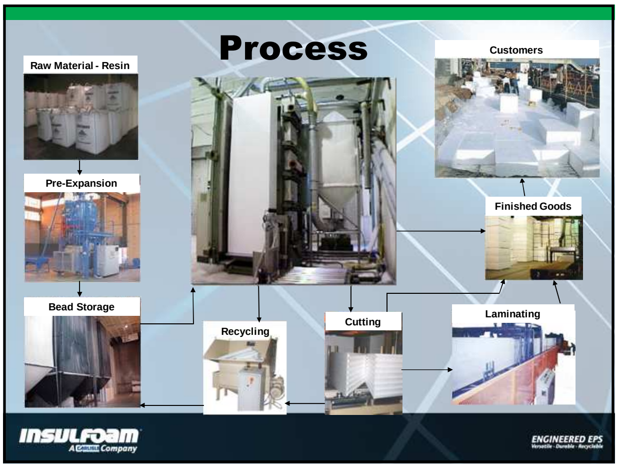
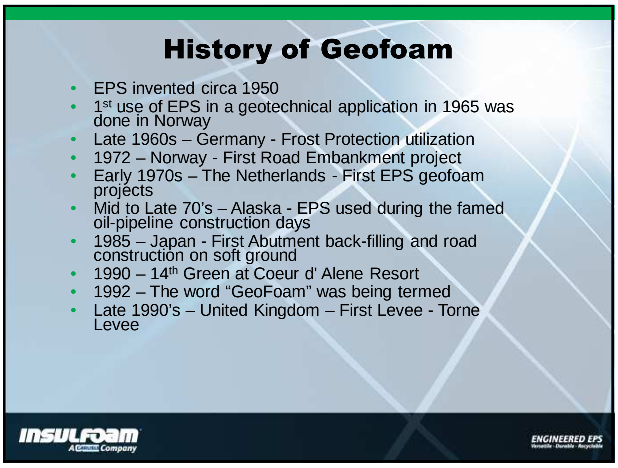

"Geofoam – A Light Weight Fill Alternative"
Geo-Strata
INNOVATIVE GEO-TECHNOLOGIES
RCEP
ENGINEERED EPS


Agenda
Manufacturing Process
History of Geofoam
Geofoam applications/projects
Recent Trends
Standards
Specifications
Placement/handling/installation
INSULFOAM A CARLISLE Company
ENGINEERED EPS


Insulfoam
•A wholly owned subsidiary of Carlisle Construction Materials
•Headquarters in Tacoma, WA
•Producer of expanded polystyrene (EPS) for more than 40 years
•The largest manufacturer of block-molded expanded polystyrene in North America
Nico Sutmoller
Geofoam Specialist
INSULFOAM A CARLISLE Company
Insulfoam is the only manufacturer of Expanded Polystyrene (EPS) with the ability to service national customers
ENGINEERED EPS


Process
Raw Material - Resin
Pre-Expansion
Bead Storage
Recycling
Cutting
Laminating
Finished Goods
Customers
INSULFOAM A CARLISLE Company
ENGINEERED EPS


Family of Products
R-TECH
INSULFOAM A CARLISLE Company
ENGINEERED EPS


History of Geofoam
EPS invented circa 1950
1st use of EPS in a geotechnical application in 1965 was done in Norway
Late 1960s – Germany - Frost Protection utilization
1972 – Norway - First Road Embankment project
Early 1970s – The Netherlands - First EPS geofoam projects
Mid to Late 70's – Alaska - EPS used during the famed oil-pipeline construction days
1985 – Japan - First Abutment back-filling and road construction on soft ground
1990 – 14th Green at Coeur d' Alene Resort
1992 – The word "GeoFoam" was being termed
Late 1990's – United Kingdom – First Levee - Torne Levee
INSULFOAM A CARLISLE Company
ENGINEERED EPS

History of Geofoam

- 1997 - Geofoam Research Center was established
- 2001 - First Geofoam Bridge Approach in the USA- Buffalo Road Bridge, Warsaw, NY
- 2001 - I-15 project
- 2005 - ASTM D6817 released
- 2008 - FHWA New Technology →Functional Technology
- 2010 –Geofoam had been used on State DOT projects in most States
- 2011 – 2nd Geofoam Conference in Oslo

ELIMINATE OR REDUCE LATERAL LOADING ON
RETAINING STRUCTURES

ZERO NET LOADING FOR
SOFT SOIL REMEDIATION

ENGINEERED FOR
SLOPE STABILIZATION

PROTECT AND LIGHTEN THE LOAD ON
BURIED UTILITIES

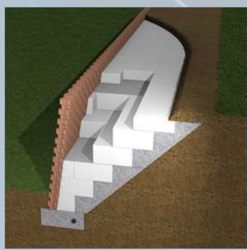
KEEP IT SIMPLE AND FAST WITH
STRUCTURAL VOID FILL
CONCRETE APPLICATIONS

Lighten the Load

5 MAJOR APPLICATIONS TO CONSIDER GEOFOAM

FHWA National Deployment Goal

- EPS geofoam is to be routinely used as a lightweight fill alternative for State DOTs on embankment projects where the construction schedule is of concern.
- By October 2011, all States will have evaluated EPS geofoam as a lightweight fill alternative.



- InsulFoam GF replaces the sliding soil wedge
- Native soils are self supporting when excavated back to the angle of repose
- InsulFoam GF is self supporting
- End result: ZERO lateral load on the retaining structure

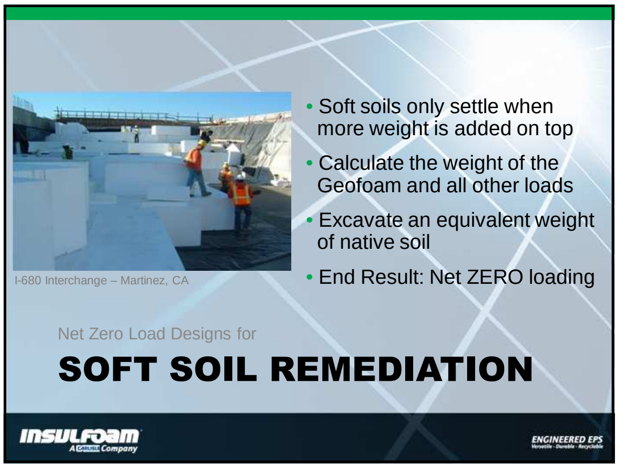
Eliminate or Reduce Lateral Loads for

RETAINING STRUCTURES

Type- ASTM D6817	Units	EPS12	EPS15	EPS19	EPS22	EPS29	EPS39	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** min. @ 1% deformation	psi psf (kPa)	2.2 316.8 (15)	3.6 518.4 (25)	5.8 835.2 (40)	7.3 1051.2 (50)	10.9 1569.6 (75)	15.0 2160.0 (103)	18.6 2678.4 (128)
Compressive Resistance** min. @ 5% deformation	psi psf (kPa)	5.1 734.4 (35)	8.0 1152.0 (55)	13.1 1886.4 (90)	16.7 2404.8 (115)	24.7 3556.8 (170)	35.0 5040.0 (241)	43.5 6264.0 (300)
Compressive Resistance** min. @ 10% deformation	psi psf (kPa)	5.8 835.2 (40)	10.2 1468.8 (70)	16.0 2304.0 (110)	19.6 2822.4 (135)	29.0 4176.0 (200)	40.0 5760.0 (276)	50.0 7200.0 (345)
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)
Oxygen Index, min.	volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Dimensional Stability	(max. %)	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%
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)
Poisson's Ratio	-	.05	.05	.05	.05	.05	.05	.05
Coefficient of Friction	-	.6	.6	.6	.6	.6	.6	.6
Absorption	volume %	< 4.0	< 4.0	< 3.0	< 3.0	< 2.0	< 2.0	< 2.0
Elastic Modulus, min.	psi (kPa)	220 (1500)	360 (2500)	580 (4000)	730 (5000)	1090 (7500)	1500 (10300)	1860 (12800)

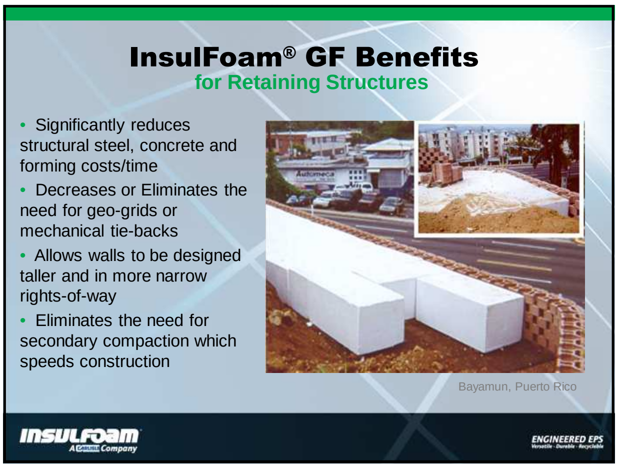
University Student Housing Morgantown, WV


I80 & 148th Street
Waverly, NE
INSULFOAM
ENGINEERED EPS


I-680 Interchange – Martinez, CA
• Soft soils only settle when more weight is added on top
• Calculate the weight of the Geofoam and all other loads
• Excavate an equivalent weight of native soil
• End Result: Net ZERO loading
Net Zero Load Designs for
SOFT SOIL REMEDIATION
INSULFOAM
ENGINEERED EPS


Inn at the Mountain Gods
Mercalero, NM
INSULFOAM
ENGINEERED EPS


I-80/94 & I-65 - Gary, IN
INSULFOAM
ENGINEERED EPS


InsulFoam® GF Benefits
for Retaining Structures
• Significantly reduces structural steel, concrete and forming costs/time
• Decreases or Eliminates the need for geo-grids or mechanical tie-backs
• Allows walls to be designed taller and in more narrow rights-of-way
• Eliminates the need for secondary compaction which speeds construction
Bayamun, Puerto Rico
INSULFOAM
ENGINEERED EPS


I-405 Totem Lake Freeway
Kirkland, WA
INSULFOAM
ENGINEERED EPS

Louis Armstrong Int'l Airport New Orleans, LA



US 101 - Willits, CA

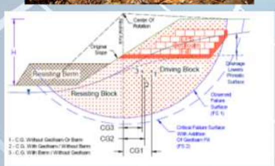
InsulFoam® GF Benefits
for Soft Soil Remediation

- Increases -
  - Speed of installation
  - Productivity
- Decreases -
  - Rights-of-way concerns
  - Traffic closures
  - Heavy equipment costs
  - Soil removal costs
  - Borrow-fill placement
- Eliminates -
  - Surcharging time/cost
  - Soil Settlement
  - Secondary compaction

Port of Longview, WA

US 50 Slide Remediation Montrose, CO


- Heavy Soils + Gravity + H_2O = High Landslide Potential
- Geofoam is up to 100 times lighter than soil
- Using Geofoam reduces the weight and the risk

Lighten the driving block for

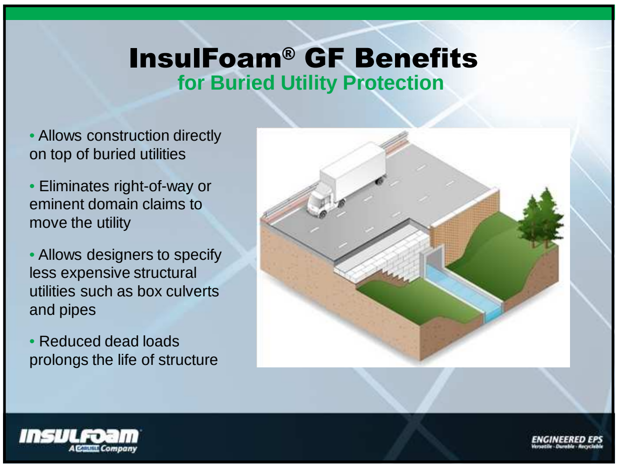
SLOPE STABILIZATION

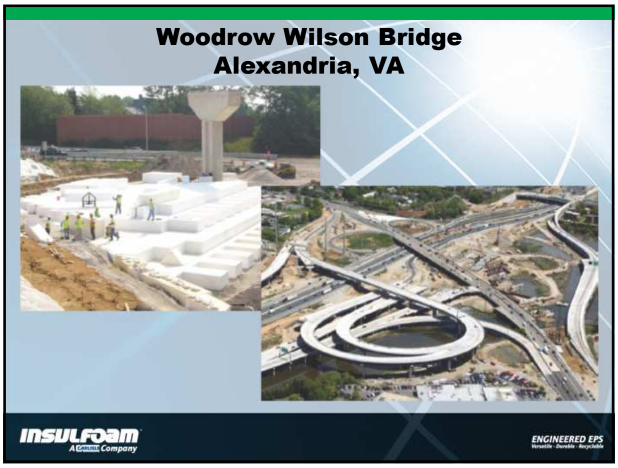
InsulFoam® GF Benefits
for Slope Stabilization

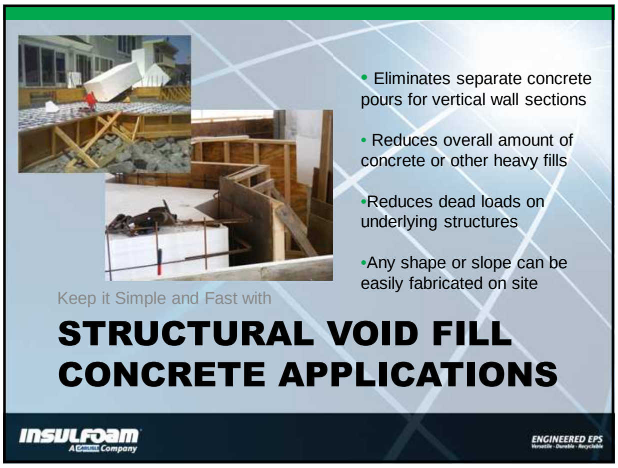
- Increases -
  - Speed of installation
  - Productivity
  - Space for additional traffic lanes
- Decreases -
  - Traffic closures
  - Heavy equipment costs
  - Borrow-fill placement
  - Concerns about future landslide/erosion issues
  - Environmental impact on sensitive hillside jobsites
  - Long-term maintenance and slope failure costs

Hillside Restoration in Japan


• Reduces dead and lateral loads on underground pipes, culverts and tunnels
• Protects utility during seismic activity by reducing axial strain
•Provides high thermal insulation values that protect against severe temperature fluctuations
Protect and lighten the load on top of
BURIED UTILITY PROTECTION
INSULFOAM
ENGINEERED EPS


InsulFoam® GF Benefits
for Buried Utility Protection
• Allows construction directly on top of buried utilities
• Eliminates right-of-way or eminent domain claims to move the utility
• Allows designers to specify less expensive structural utilities such as box culverts and pipes
• Reduced dead loads prolongs the life of structure
INSULFOAM
ENGINEERED EPS


Woodrow Wilson Bridge
Alexandria, VA
INSULFOAM
ENGINEERED EPS


• Eliminates separate concrete pours for vertical wall sections
• Reduces overall amount of concrete or other heavy fills
•Reduces dead loads on underlying structures
•Any shape or slope can be easily fabricated on site
Keep it Simple and Fast with
STRUCTURAL VOID FILL
CONCRETE APPLICATIONS
INSULFOAM
ENGINEERED EPS

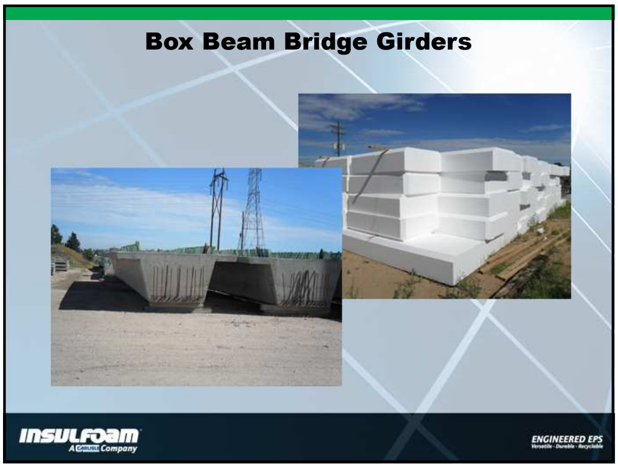

Route 1 & 9 Interchange
Jersey City, NJ
INSULFOAM
ENGINEERED EPS


Union Pacific Depot
Salt Lake City, UT
INSULFOAM
ENGINEERED EPS

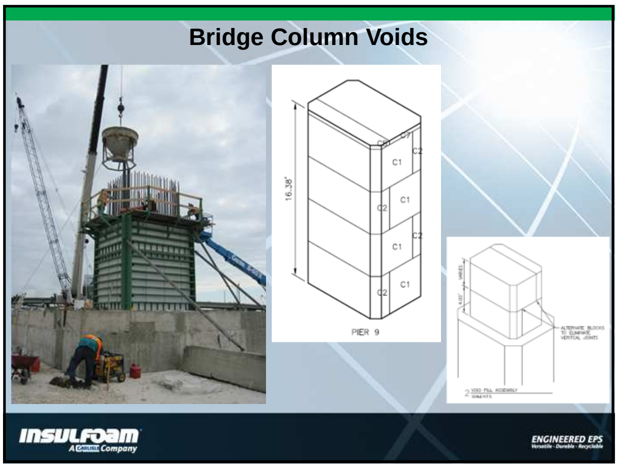

High School Theater
Sun Prairie, WI
INSULFOAM
ENGINEERED EPS


Water Treatment Plants
INSULFOAM
ENGINEERED EPS

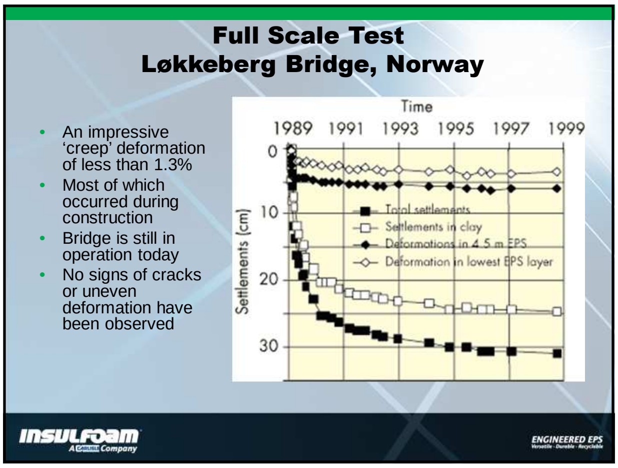

Green Roof Application
INSULFOAM
ENGINEERED EPS

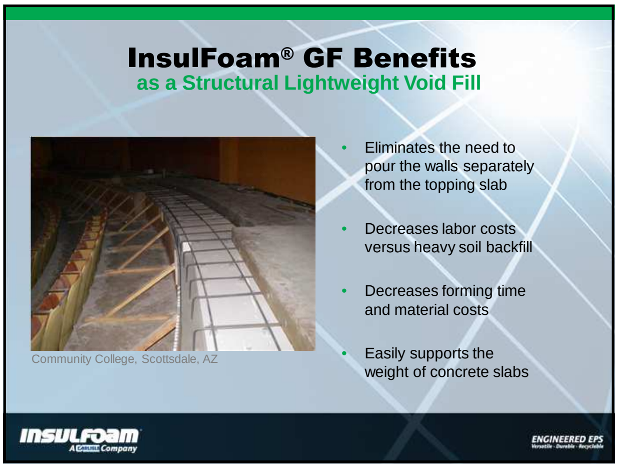

Box Beam Bridge Girders
INSULFOAM
ENGINEERED EPS


Rooftop Pool Decks
INSULFOAM
ENGINEERED EPS

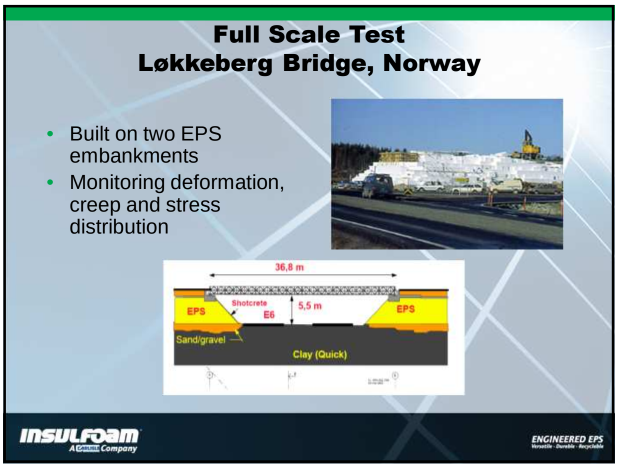

Bridge Column Voids
PIER 9
INSULFOAM
ENGINEERED EPS


Bridge Column Custom Forms
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


Full Scale Test
Løkkeberg Bridge, Norway
An impressive 'creep' deformation of less than 1.3%
Most of which occurred during construction
Bridge is still in operation today
No signs of cracks or uneven deformation have been observed
Time
1989 1991 1993 1995 1997 1999
Settlements [cm]
0
10
20
30
Total settlements
Settlements in clay
Deformations in 4.5 m EPS
Deformation in lowest EPS layer
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


InsulFoam® GF Benefits
as a Structural Lightweight Void Fill
Community College, Scottsdale, AZ
Eliminates the need to pour the walls separately from the topping slab
Decreases labor costs versus heavy soil backfill
Decreases forming time and material costs
Easily supports the weight of concrete slabs
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


Excavated after 24 years
@ Flom Bridge, Norway
Excavation of a 24 year old EPS block from the first EPS Embankment at Flom Bridge (1972)
No signs of material deterioration after 24 years
Above groundwater level <1% water content by volume
Below groundwater level <4% water content by volume
Water pickup over the years in the ground will not affect material strength
If a tendency towards change is to be noted – it would suggest a slight increase in material strength.
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


Full Scale Test
Løkkeberg Bridge, Norway
Built on two EPS embankments
Monitoring deformation, creep and stress distribution
36,8 m
EPS
Shotcrete
E6
5,5 m
EPS
Sand/gravel
Clay (Quick)
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


Recent Trends
UTA TRAX, Salt lake City, UT
INSULFOAM A CARLISLE Company
ENGINEERED EPS Versatile · Durable · Recyclable


Load Distribution Slab within Assemblage
INSULFOAM
ENGINEERED EPS


Sloped vs. Vertical
Rte 1 & 9, Jersey City, NJ
Port of Longview, Longview, WA
INSULFOAM
ENGINEERED EPS

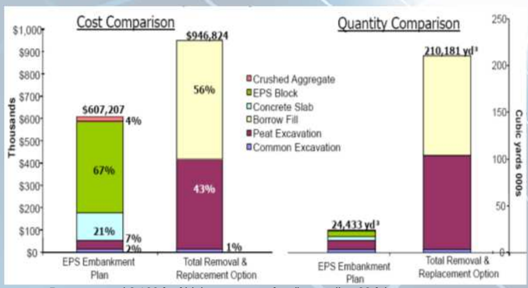

Shotcrete over Geofoam
Topaz Bridge, McCammon, ID
INSULFOAM
ENGINEERED EPS


Levee Applications
North Creek Levee – Bothell, WA
INSULFOAM
ENGINEERED EPS


Bridge Abutments
Grimsøyveien, Norway
INSULFOAM
ENGINEERED EPS

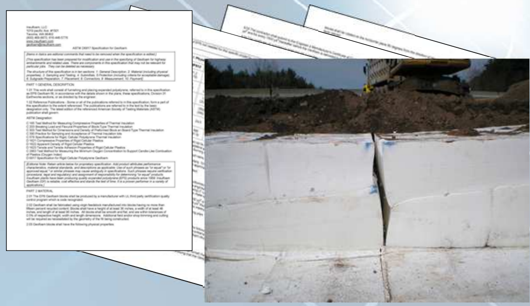

Utilization of Geomembrane
“There is no FHWA “position” on the topic of using geo-membranes with load distribution slabs. I will say that I recommend that states go with one or the other. “
Silas Nichols, P.E., FHWA Senior Bridge Engineer
INSULFOAM
ENGINEERED EPS

Case Study
State Rt. 19, Noble County, IN



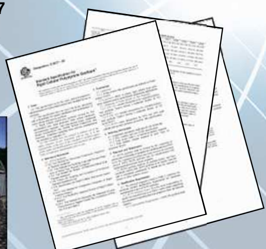
- Reconstructed 3,100 ft of highway, very soft soil extending 38 ft in some areas, continuous maintenance from horizontal movement, causing sheer cracking

InsulFoam GF Specifications



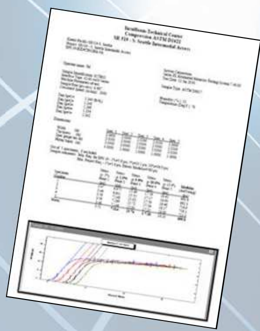
ASTM D6817

Understanding ASTM D6817 (different than ASTM C578)



QC & Compression Testing

ASTM D1621 on 2"cube

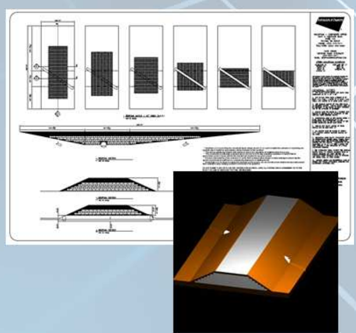


ASTM D6817 vs. C578

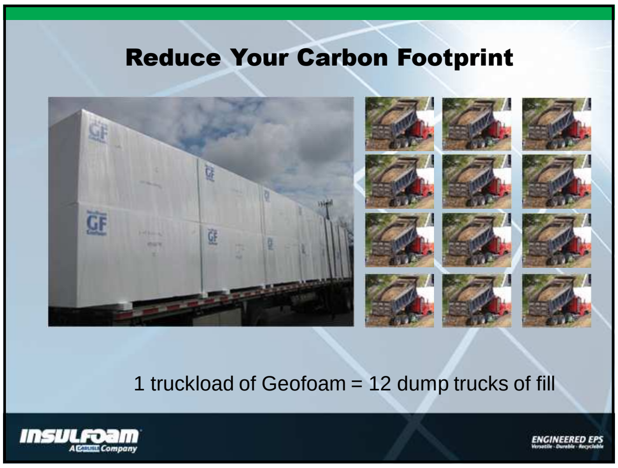
D6817 ↑ Geotechnical — C578 ↑ Insulation

		Density lb/ft³, min.	Compressive Resistance, min. psi @ 10% deformation	Flexural Strength, Min., psi
ASTM D6817	**EPS 15**	**.90**	**10.2**	**25**
ASTM C578	Type I	.90	10.0	25
ASTM D6817	**EPS 19**	**1.15**	**16.0**	**30**
ASTM C578	Type VIII	1.15	13.0	30
ASTM D6817	**EPS 22**	**1.35**	**19.6**	**40**
ASTM C578	Type II	1.35	15.0	35
ASTM D6817	**EPS 29**	**1.80**	**29.0**	**50**
ASTM C578	Type IX	1.80	25.0	50

Insulfoam: Service Sets Us Apart



- Specification assistance
- 3rd party certification testing
- Staffed Technical Center
- Two Geofoam Specialists
- Dedicated CAD drafters
- Layout & Installation shop drawings
- Jobsite visits/startups
- Hot wire cutting tools
- Presentations/Box Lunches
- Value engineering support

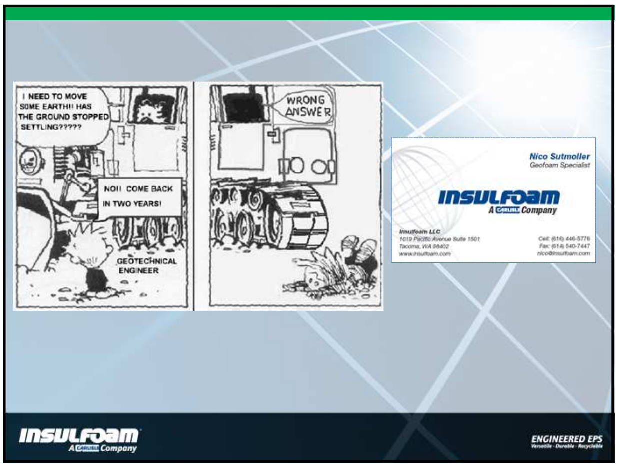

Reduce Your Carbon Footprint
1 truckload of Geofoam = 12 dump trucks of fill
INSULFOAM
ENGINEERED EPS


InsulGrip / INSTA-STIK™
4" x 4" 20 ga. galvanized steel plate
60 lbs designed lateral load per plate
Minimum of two plates per 4' x 8' area
Metal Connectors
moisture cured polyurethane adhesive
works well in a wide range of temperatures
INSULFOAM
ENGINEERED EPS


Handling
INSULFOAM
ENGINEERED EPS


Hot Wire Cutters
INSULFOAM
ENGINEERED EPS


Geofoam Installation
AASHTO EPS 70
INSULFOAM
ENGINEERED EPS


I NEED TO MOVE SOME EARTH!! HAS THE GROUND STOPPED SETTLING?????
NO!! COME BACK IN TWO YEARS!
GEOTECHNICAL ENGINEER
WRONG ANSWER
Nico Sutmoller
Geofoam Specialist
INSULFOAM
A Company
INSULFOAM
ENGINEERED EPS

E X P A N D E D   P O L Y S T Y R E N E

InsulFoam® GF

Soft Soil Remediation

Lateral Load Reduction

Slope Stabilization

Buried Utility Protection

Structural Void Fill

InsulFoam® GF Geofoam

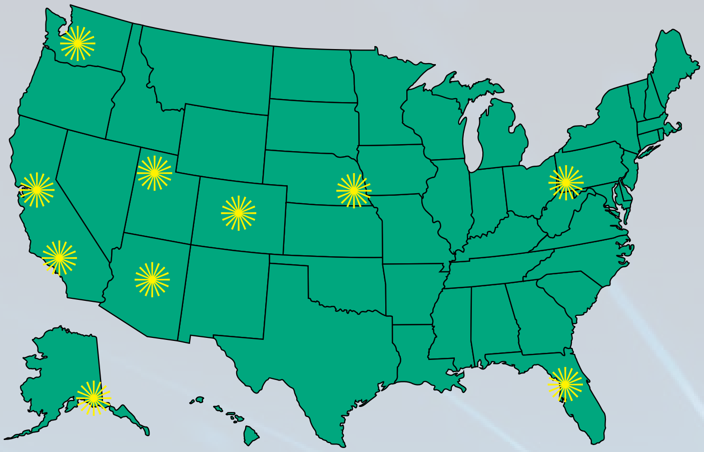
INSULFOAM®
A CARLISLE Company

ENGINEERED EPS
Versatile - Durable - Recyclable

www.insulfoam.com

InsulFoam® GF

InsulFoam® GF is a premium geofoam material manufactured by the largest producer of block-molded EPS in North America. As a division of Carlisle Construction Materials, Insulfoam continues to advance methods in the building and construction industry by providing high-quality, dependable, and long-lasting products which offer unmatched performance and value.



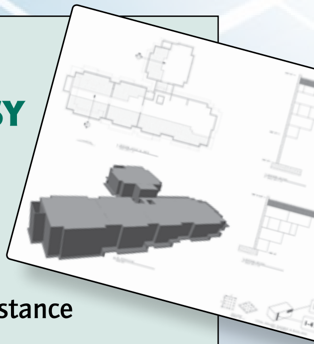
Insulfoam – the only nationwide manufacturer of Geofoam

As a closed-cell expanded polystyrene (EPS) product, InsulFoam GF's lightweight, geo-synthetic fill characteristics offer a cost-effective and environmentally friendly alternative to traditional fill materials. Widely utilized in construction projects as a soil stabilizer, InsulFoam GF is also superb in engineered applications. Its lighter weight precludes surcharging, preloading or staging. InsulFoam GF's superior stability resists insects, mold, decomposition and severe weather conditions, including freeze-thaw cycles and moisture.

FEATURES AND BENEFITS

- Manufactured to meet your job specifications - multiple densities and various block sizes available
- Environmentally Friendly – 100% recyclable, no HCFCs or formaldehyde, will not sustain mold or mildew growth, maintenance free
- Ease of installation – lightweight, no need for heavy equipment, cuts easily with a hot wire or saw
- Weather Resistant – withstands freeze–thaw cycles, moisture and road salts
- Lightweight - minimize preloading, surcharging and staged construction
- Insect and Mold Resistant – can be manufactured with an additive that repels termites and ants

INSULFOAM MAKES IT EASY



- Shop drawings
- Submittals
- Job start-up assistance
- Third-party testing
- Clear and concise product markings
- Ten, state-of-the-art manufacturing facilities

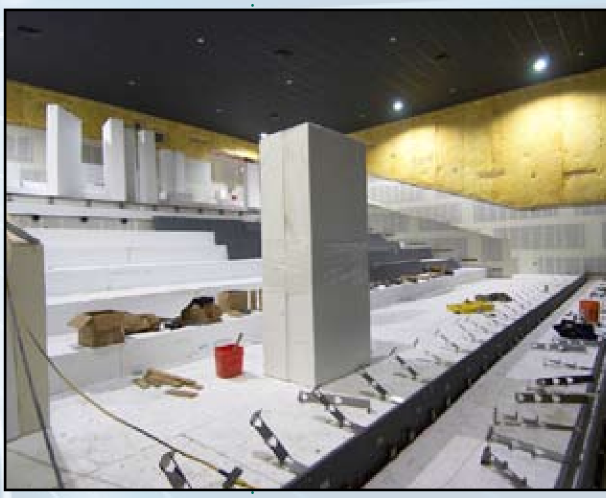
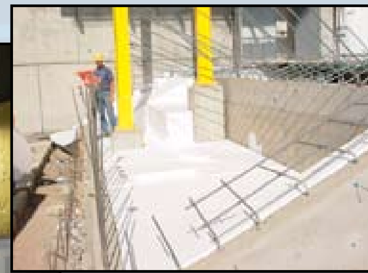
EARTHWORKS & STRUCTURAL

- Retaining Walls
- Berms and Embankments
- Parking Structures
- Foundations
- Loading Docks and Ramps
- Landscaping
- Lightweight Void Fill
- Levees and Dikes
- Buried Utility Protection



ARCHITECTURAL

- Theater and Stadium Seating
- Pools and Pool Decks
- Landscaping
- Retaining Walls
- Lightweight Void Fill
- Concrete Forming
- Garden Roofing


TRANSPORTATION

- Highways and Roads
- Railways
- Airport Runways
- Ramps
- Bridge Approaches
- Retaining Walls



TYPICAL PHYSICAL PROPERTIES OF INSULFOAM GF*

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Compressive Resistance** min. @ 5% deformation	psi psf (kPa)	5.1 734.4 (35)	8.0 1152.0 (55)	13.1 1886.4 (90)	16.7 2404.8 (115)	24.7 3556.8 (170)	35.0 5040.0 (241)	43.5 6264.0 (300)
Compressive Resistance** min. @ 10% deformation	psi psf (kPa)	5.8 835.2 (40)	10.2 1468.8 (70)	16.0 2304.0 (110)	19.6 2822.4 (135)	29.0 4176.0 (200)	40.0 5760.0 (276)	50.0 7200.0 (345)
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)
Oxygen Index, min.	volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0
Dimensional Stability	(max. %)	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%
Buoyancy Force	lb/ft^3 (kg/m^3)	61.7 (990)	61.5 (980)	61.3 (980)	61.1 (980)	60.6 (970)	60.0 (960)	59.5 (950)
Poisson's Ratio	-	.05	.05	.05	.05	.05	.05	.05
Coefficient of Friction	-	.6	.6	.6	.6	.6	.6	.6
Absorption	volume %	< 4.0	< 4.0	< 3.0	< 3.0	< 2.0	< 2.0	< 2.0
Elastic Modulus, min.	psi (kPa)	220 (1500)	360 (2500)	580 (4000)	730 (5000)	1090 (7500)	1500 (10300)	1860 (12800)

* Properties are based on data provided by resin manufacturers, independent test agencies and Insulfoam.
** For InsulFoam GF applications the design load stresses should not exceed 1% strain for combined live and dead loads. PSI x 144 = PSF

Approximate Costs as of 2/21/13:
EPS15: Delivered and installed for about $55 per cubic yard.
EPS29: About twice the cost of EPS15.

CODES AND COMPLIANCES

- Meets or exceeds the requirements of ASTM D6817 *Standard Specification for Rigid Cellular Polystyrene Geofoam*.
- Independent Third-Party testing through Underwriters Laboratories.

Notes:
1) Height limit of Geofoam? None, because there's a width requirement.
2) EPS39 and EPS46 are rarely used and are for very special circumstances.

For installation instructions, specifications, samples and literature go to...

WWW.INSULFOAM.COM

INSULFOAM GF - ENGINEERED APPLICATION PROJECTS

- **Controlling Excessive Soil Settlement** - *Wythe County Hospital, Wytheville, VA*
- **Road Widening** - *IN I80/I65 Indiana DOT project - Gary, IN*
- **Theater Seating** - *Harkins Theater, Denver, CO*
- **Elimination of Lateral Loads** - *Lowe's RFI342, San Francisco, CA*
- **Pool Decks** - *Boran Craig Project, Tampa, FL*
- **Zero Lateral Load on Retaining Wall** - *Dubuque, IA*
- **Lightweight Fill on a Garage Deck** - *Capitol Park, Boise, ID*
- **Load Reduction on a Bridge Abutment** - *I80/148th Street Bridge, Waverly, NE*
- **Bridge Approach** - *Lombard Overpass, Portland, OR*
- **Utility Protection** - *Pulaski Skyway, Jersey City, NJ*
- **Levee Stabilization (Reduction in Loads)** - *North Creek Levee, Bothell, WA*

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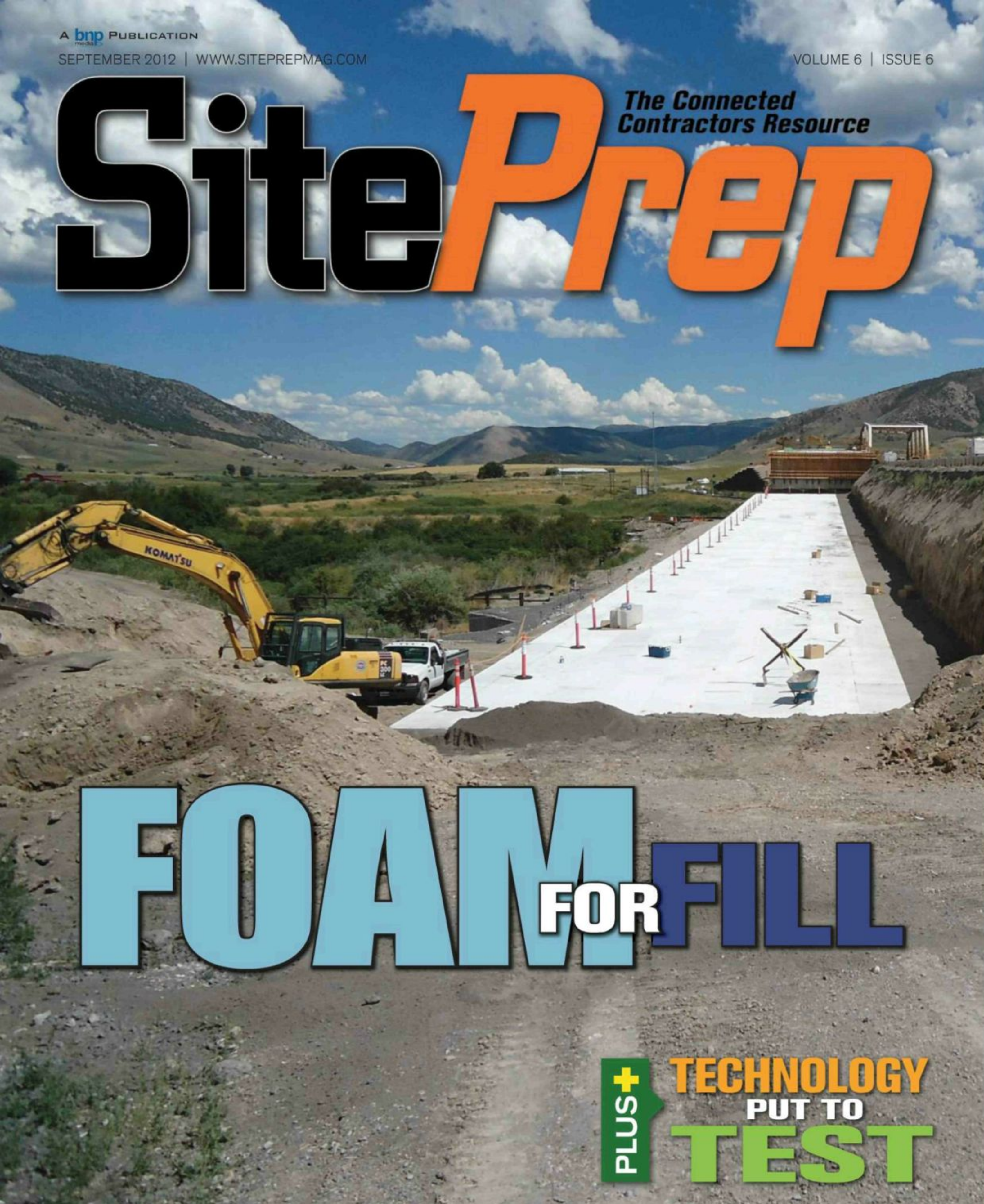
Insulfoam Corporate Headquarters
6004 N. Westgate Blvd. · Suite 120
Tacoma, WA 98406
800.248.5995
Fax: 253.383.7100
geofoam@insulfoam.com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Fill 'Er Up

Lightweight EPS geofoam serves as solid foundation for infrastructure projects.

BY DAVID SHONG AND NICO SUTMOLLER

Ever since humans first began building roads, dikes and other projects, they have commonly used soils for fill. Earthen fills are low cost and abundant, yet they weigh a lot and require heavy equipment to move and compact. Furthermore, like all natural materials, they can be varied and inconsistent, which can induce differential settlement.

Table 1
Weight of select fill materials

Fill	Typical Weight (pounds per cubic foot)
EPS geofoam	1 to 3
Wood chips	15 to 30
Cellular concrete	35 to 100
Shredded tires	38 to 56
Pumice	40
Soil	110 to 120

As an alternative, project teams are increasingly using geosynthetic materials, such as expanded polystyrene (EPS) block geofoam. The Federal Highway Administration (FHWA) describes EPS geofoam as a "lightweight, rigid foam plastic that has been used around the world as a fill for more than 30 years." It is substantially lighter than soil, has predictable stress/strain curves and can be installed during adverse weather.

The FHWA, state DOTs and private engineering firms have specified EPS geofoam for various infrastructure projects. Applications that are suitable for EPS geofoam include roads and highways, bridge approaches, retaining walls, embankments, railways, runways and taxiways, levees, utility lines and other large public works projects. In addition to its lightweight features, EPS geofoam can also help solve some common geotechnical challenges, including soft soil remediation, lateral load reduction upon retaining structures, slope stabilization, buried utility protection and structural void fill.

Taking it Lightly

According to the EPS Industry Alliance, EPS geofoam is approximately 98 percent air, making it much lighter than other fills. It

ABOVE: Contractors install 32 flatbed trucks of EPS19 blocks during the widening of the I-80 and I-65 interchange in Gary, Ind.

weighs only about 1 to 3 pounds per cubic foot— as much as 100 times lighter than soil (see Table 1)— yet is durable and has high, predictable compressive strengths.

Because of its low weight, EPS geofoam is easy to place by hand. Geofoam changes the traditional soil compaction phasing method because it comes out of the manufacturing facility with independently verified elastic modulus values. Additionally, since one truckload contains 120 cubic yards (equal to 12 dump trucks of earthen fill), it can help reduce construction traffic and transportation costs.

EPS geofoam has high load-bearing capacities, with compressive resistance values ranging from a minimum of 316 psf to 2,678 psf at 1 percent deformation, which is considered the conservative elastic limit stress. As long as combined dead/live loads do not exceed 1 percent strain, the material will never creep or experience plastic yield. Geofoam has been succesfully used as a sub-base material for pavement sections that bear the live loads of locomotives and jumbo jets.

Remediating Soft Soils

On sites with soft, compressible foundation soils, such as peat or soft clay, lightweight EPS geofoam can help enable the construction of roads and building foundations.

The embankment construction for Seattle's Alaskan Way Viaduct replacement is one example of how EPS geofoam helped deal with soft soils. The ramps sit on a tide flat the city reclaimed with imported fill more than a century ago. Project engineers had to ensure the new ramps would not induce settlements on the underlying soils, which could impact the stability of adjacent elevated structures. EPS geofoam provided the necessary load support at a low weight and eliminated the need to surcharge the soil.

Another project with similar challenges was the widening of the I-80 and I-65 interchange in Gary, Ind. Located at Lake Michigan's southern end, the site has soft soils from ancient glacial activity. The FHWA recommended a net-zero load calculation of the roadbed to prevent post-construction settlement.

Contractors installed 32 flatbed trucks of EPS19 blocks, which was equivalent to more than 400 dump truck loads of earthen fill. This reduced construction traffic in a highly congested area leading in and out of Chicago, and it helped crews maintain a tight construction schedule. In addition, the project manager reported installation labor rates of approximately 35 cubic yards per man hour.

Cutting Lateral Loads

EPS geofoam can reduce or eliminate lateral loads on retaining structures. The blocks are installed in a manner to replace the sliding soil wedge above the angle of repose. The lower lateral loads can reduce both labor and material costs of the retaining structure by requiring less over-excavation, robust forming, structural steel and concrete wall thickness, and footings. They can also reduce or eliminate geogrids or mechanical tie-backs.

The geofoam used in the Gary, Ind., highway project is equivalent to more than 400 dump truck loads of earthen fill.

Geofoam weighs only about 1 to 3 pounds per cubic foot and is easy to place by hand.

For the widening of the Pacific Street Bridge over I-680 in Omaha, Neb., the contractor excavates the soil between the existing abutment wall and the soldier piles, and extends the existing wall with geofoam.

Use of EPS geofoam also allows for taller walls in more narrow rights-of-way, which can reduce property acquisition time and costs, as well as minimize lane closures and other construction impacts. EPS geofoam can be constructed with a vertical face with much lower-cost fascias that act more like a "fence" then a retaining wall.

The Pacific Street Bridge over I-680 in Omaha, Neb., is one project that relied on EPS geofoam to reduce lateral loads. Typical bridge widening projects require the exisiting abutment walls to be torn down and replaced because they are not designed to withstand the increased lateral loads induced by the fill for the new lanes. By excavating the soil between the existing abutment wall and the soldier piles, the contractor was able to simply form and extend the existing wall. Approximately 2,000 cubic yards of EPS15 geofoam were installed, which allowed the bridge to be reopened to traffic in only three months.

Stabilizing Slopes

In places where landslides are potential risks under roads and railways, EPS geofoam can create stable slopes without needing to change the final slope geometry. Since it is so much lighter than soil, it reduces the weight of a slope's driving block and thereby mitigates the risk of slides. As such, it helps decrease long-term maintenance costs by addressing the root cause of slope failure, which is gravity.

Further, because crews can manually lift and place individual EPS geofoam blocks without heavy earth moving or compaction equipment, it is easier to construct stable slopes on steep or uneven terrain—or where access is difficult.

Among the hillside road projects that utilize the material for slope repair are eight different failures on U.S. 101 in northern California; U.S. 50 near Montrose, Colo.; and Highway 12 near White Pass in Washington.

Protecting Buried Utilities

Many construction projects must account for the presence of existing utilities. For example, in Seattle, contractors used EPS geofoam to build a tightly spiraled ramp on Royal Brougham Way that crossed over large stormwater and sewer mains. One of those was a century-old, brick-lined concrete pipe with timber piles that would have been at risk for failure under heavy soil fills.

A recent study by Dr. Steven Bartlett of the University of Utah concluded that using EPS geofoam as a soil-replacing cover on top of buried pipelines not only reduces in-situ vertical/lateral stresses, but it also decreases axial strain and large bending stresses on the pipe during seismic events.

Filling Structural Voids

EPS geofoam is also used as a structural void fill in concrete forming operations. Crews can fabricate virtually any shape or slope, and the material eliminates separate concrete pours for vertical wall sections and the topping slab. These fills are used in stadium seating in movie theaters and sports arenas, stairways, podiums, loading docks, rooftop pool decks and compartment walls in water treatment plants.

As with other lightweight fills, the unit cost of EPS geofoam can be higher than traditional materials, but as a report prepared for the Transportation Research Board notes, this is "usually more than offset by savings when overall project costs are considered."

When specifiying EPS geofoam, it is important to ensure the material is manufactured to meet the ASTM D6817 "Standard Specification for Rigid Cellular Polystyrene Geofoam." It should be noted that at present only two manufacturers maintain a third-party certifcation program through Underwriters Laboratories (UL) to ensure physical property compliance with this standard.

It is also worth asking the manufacturer about the level of technical support and services they offer, as these vary widely. Some manufacturers can assist project teams with layout and installation shop drawings, value engineering, job start-up, field fabrication tools and training, as well as produce specific block sizes to best fill project geometry.

The next time you need fill for a project, maybe it's time to look beyond the dirt? EPS geofoam can lower the total project cost, provide faster construction sequencing and minimize post-construction settlement. SP

David Shong and Nico Sutmoller are geofoam specialists, who provide a range of support services related to geofoam applications.

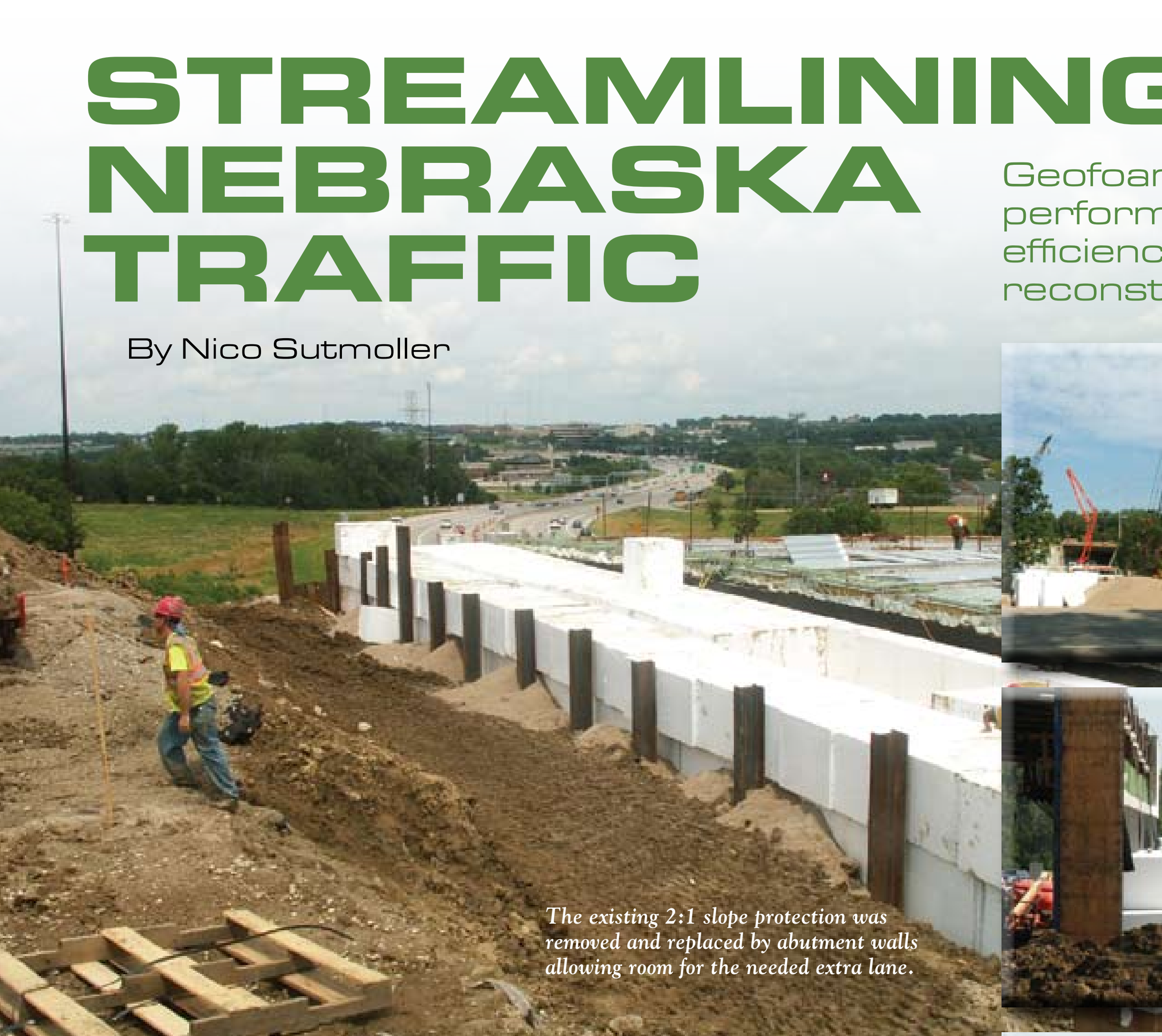
MORE ONLINE

For more information on EPS geofoam, visit www.insulfoam.com, the Syracuse University Geofoam Research Center at http://geofoam.syr.edu or the EPS Industry Alliance at http://epsindustry.org/other-applications/geofoam.

STREAMLINING NEBRASKA TRAFFIC

Geofoam offers performance and efficiency for bridge reconstruction.

By Nico Sutmoller



The existing 2:1 slope protection was removed and replaced by abutment walls allowing room for the needed extra lane.

Known as one of the Top 10 High-Tech metropolitan areas in the nation (as cited by *Newsweek* magazine), the city of Omaha, Nebraska, leads the nation by pursuing the most innovative technologies in virtually every field imaginable, not the least of which is road construction. With more than 100 road construction projects currently under contract, the Nebraska Department of Roads (NDOR) strives to utilize the most effective and efficient construction products in its continuous improvement of the state's road structures.

That is why, when NDOR officials decided to reconstruct the Pacific Street Bridge, they chose to use expanded polystyrene (EPS) geofoam for the below-grade void fill portion of the construction project. By spring of 2008, Pacific Street, which provides commuters with convenient access to and from downtown Omaha, was experiencing significant traffic congestion, decreasing the ease and efficiency of local commutes.

The Pacific Street Bridge, which spans Interstate 680, experienced the heaviest congestion, affecting the flow of both local and regional traffic. It became apparent to NDOR officials that this situation required a remedy that would not only be effective in streamlining the flow of traffic, but could also be completed in a short time frame.

The NDOR decided to widen the bridge by adding one lane, while maintaining the current length of the bridge. Construction, which was managed by Hawkins Construction Company, a local Omaha-based construction contractor, began in March 2008.

In order to build an additional lane without lengthening the bridge, Hawkins had to first construct abutment walls at each end of the bridge. To avoid creating excessive lateral pressures on the new abutments, a lightweight void fill material was needed for filling in the embankments. Because of this requirement, the NDOR chose to use geofoam for this portion of the application.

ABOUT the AUTHOR >

Nico Sutmoller is a geofoam specialist and can be reached at geofoam@insulfoam.com.

After comparing a number of geofoam manufacturers, Hawkins Construction chose to use geofoam manufactured by Insulfoam, the nation's largest manufacturer of block-molded expanded polystyrene.

"It was vital that we use a product that would not increase the amount of lateral load placed on the new abutments," says Omar Qudus, NDOR geotechnical engineer. "We chose to use geofoam because it would do just that, and would enable us to fill the embankments, while still being able to build the additional lane."

As this was the NDOR's first specification of geofoam, Qudus and his team consulted multiple geofoam manufacturers in order to ensure that the geofoam was used correctly and in a way that would enhance both the performance of the bridge and the efficiency of the construction.

"We talked to a number of geofoam manufacturers," says Qudus, "because we wanted to make sure that we were using the geofoam product correctly. Insulfoam provided ample feedback and a detailed specification of how InsulFoam® GF can be used in this type of application."

The construction project required a total of 2,045 cubic yards of type 15 EPS low-density geofoam blocks that were installed as void fill at the bridge abutments.

After pouring the abutment walls, the Hawkins crew installed the geofoam blocks, which not only provided easy handling, but also sped up the installation process. The use of geofoam eliminated both the need for surcharge and the settlement that is experienced with typical fill products, such as soil.

"We used geofoam for this project because we did not have enough time for both the surcharge and settlement that are typical with the application of traditional fill products," says Qudus.

Hawkins' on-site supervisor, Lance Winkler, agreed that the use of geofoam significantly reduced construction time. "With traditional fill products, we typically backfill with sand at 8-inch increments and then compact; with geofoam, we just placed the blocks in position and then backfilled the minimal area that was left with sand. The InsulFoam® GF made installation easier and more efficient."

Installation of a drainage mat was also necessary in order to ensure that any water that might collect around the abutment would drain properly and decrease the potential for any damage that might be caused by moisture penetration. By ensuring that water drained away from the abutment, the drainage mat would also eliminate the horizontal pressure that standing water would create.

The entire construction project was completed by September 2008, a short 6 months after it was started, and the bridge was re-opened to traffic. The use of geofoam in this project not only offered enhanced labor and cost savings, but also provided the increased, long-term stability and superior performance needed for the ever-moving technological hub of Omaha, Nebraska. ◆

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NICO SUTMOLLER – *Geofoam Specialist*

Local 616.446.5776

C 616.446.5776 **F** 614.540.7447

nico@insulfoam.com

6004 N. Westgate Blvde., Suite 120
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