High Performance Below-Grade Building Insulation

EPS: Under-slab / Foundation Insulation and Lightweight Fill

1 LU/HSW

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

Course Description

- Insulation, as a material, is the largest contributor to a building’s energy efficiency
- This course will explore how EPS foundation / slab insulation can be designed into the ‘building envelope’, and help meet latest national and local codes for energy efficiency
- EPS Foundation / slab insulation provides long-term stable thermal protection, and can help lower a building’s energy costs and provide comfortable living spaces for its occupants

Learning Objectives

At the end of this course, participants will be able to

1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made
2. Identify when EPS is specified in relation to energy and building codes through real-life projects
3. Compare EPS insulation's long-term performance with other insulations through research studies
4. Design EPS into engineered below-grade applications to provide long-term stable thermal efficiency
5. Learn how EPS Geofoam can be used as commercial or residential structural fill through real-life projects

Learning Objective 1

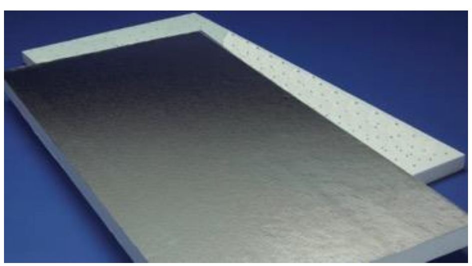
1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made

EPS, a Polystyrene Insulation, is a *CLOSED-CELL* rigid insulation

Polystyrene Bead

Blowing Agent
+ Expansion
+ **Steam**

EPS

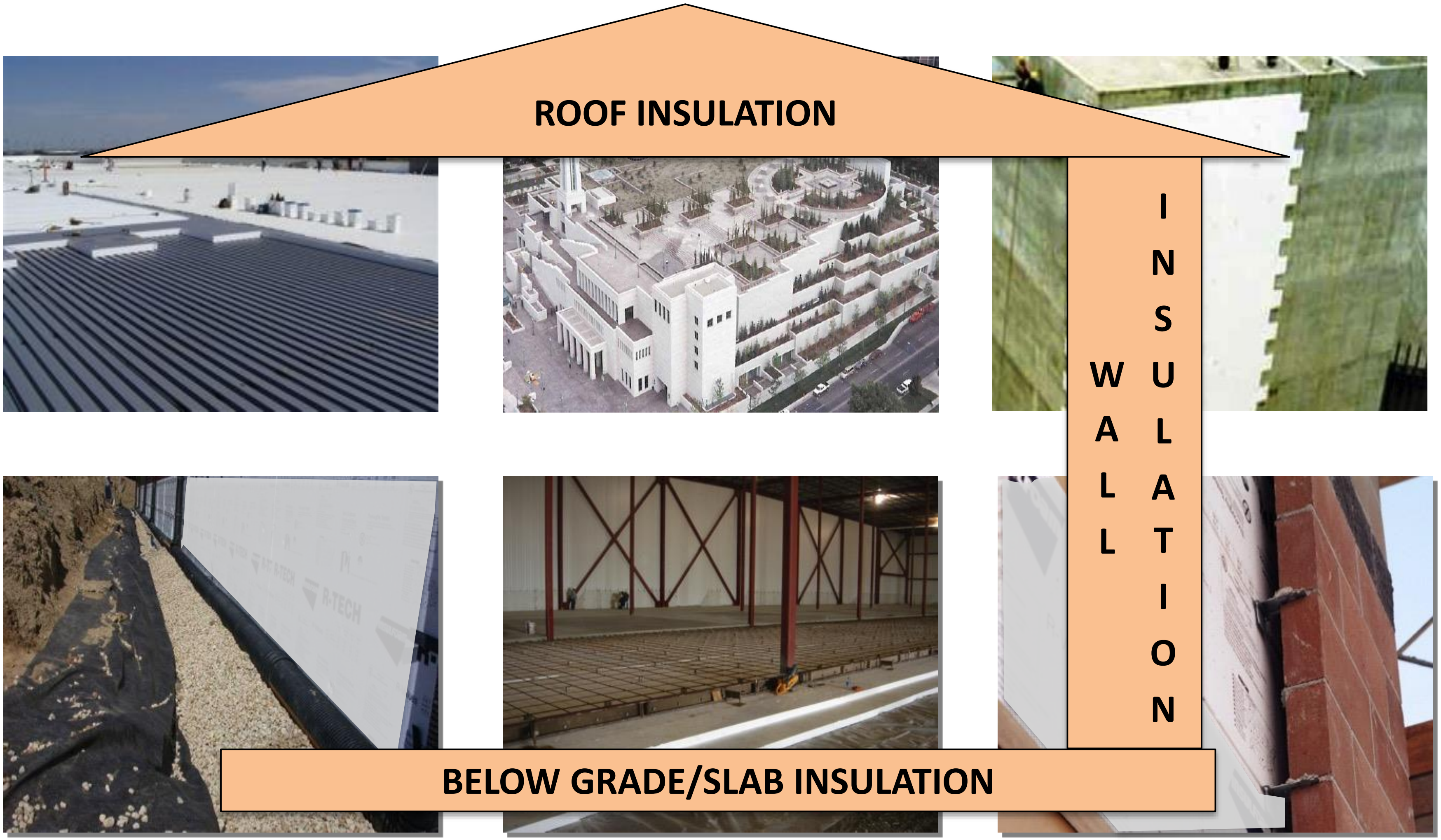


Blowing Agent
+ Extrusion
+ **Dyes**

XPS

Same Raw Material	=	Similar	=	Same Standard
Polystyrene		Physical Properties		ASTM C578

EPS is the most versatile *building envelope* insulation

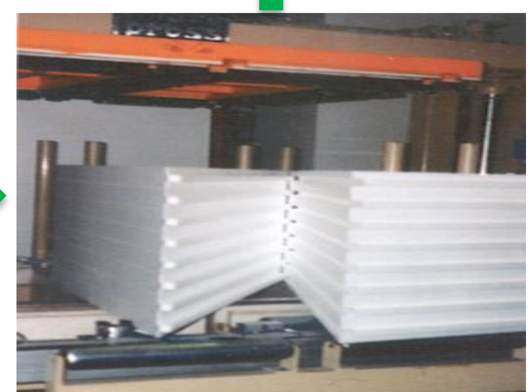


EPS is made in *State-of-the-art* manufacturing facilities

Hi-Tech Mfg Plants & QC

Fused Insulation Blocks

Shaped, Cut or Laminated Insulation Panels



Design & Build to Spec

EPS has extensive *code* recognition

NFPA
National Fire Protection Association

ICC ES
ICC EVALUATION SERVICE

ASTM INTERNATIONAL

C UL US
LISTED

FM
APPROVED

EPS is a safe and Earth-Friendly Product

LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

May contain
Recycled Content

100%
RECYCLABLE
NO FORMALDEHYDE OR HCFCs

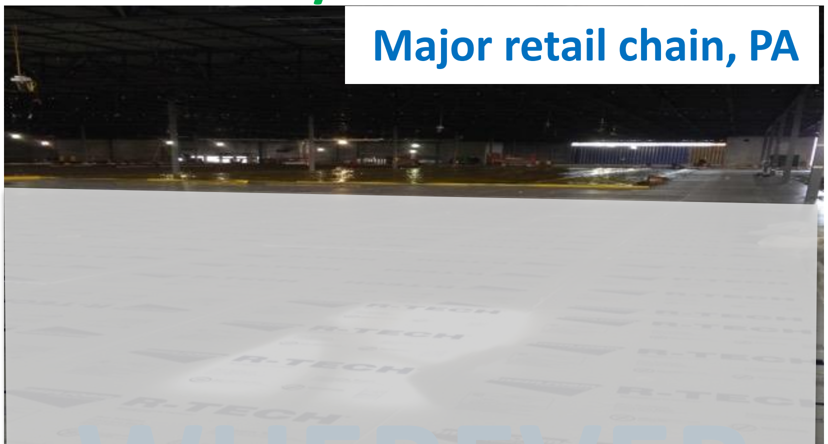
Learning Objective 2

1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made
2. Identify when EPS is specified in relation to energy and building codes through real-life projects

Where can I specify EPS?

Below-slab / Freezer

Major retail chain, PA



Plaza Decks / Inverted Roofs

Large University, WA

WHEREVER you specify XPS

Perimeter / Drainage Board

Newport Beach Civic Center, CA

Geotechnical Fill

Levee in Bothell, WA

Writing EPS into the spec is similar to writing XPS

Why specify EPS? CODES accept EPS' Below-Grade / Under-Slab Performance

International Code Council – Approved Oct 2013

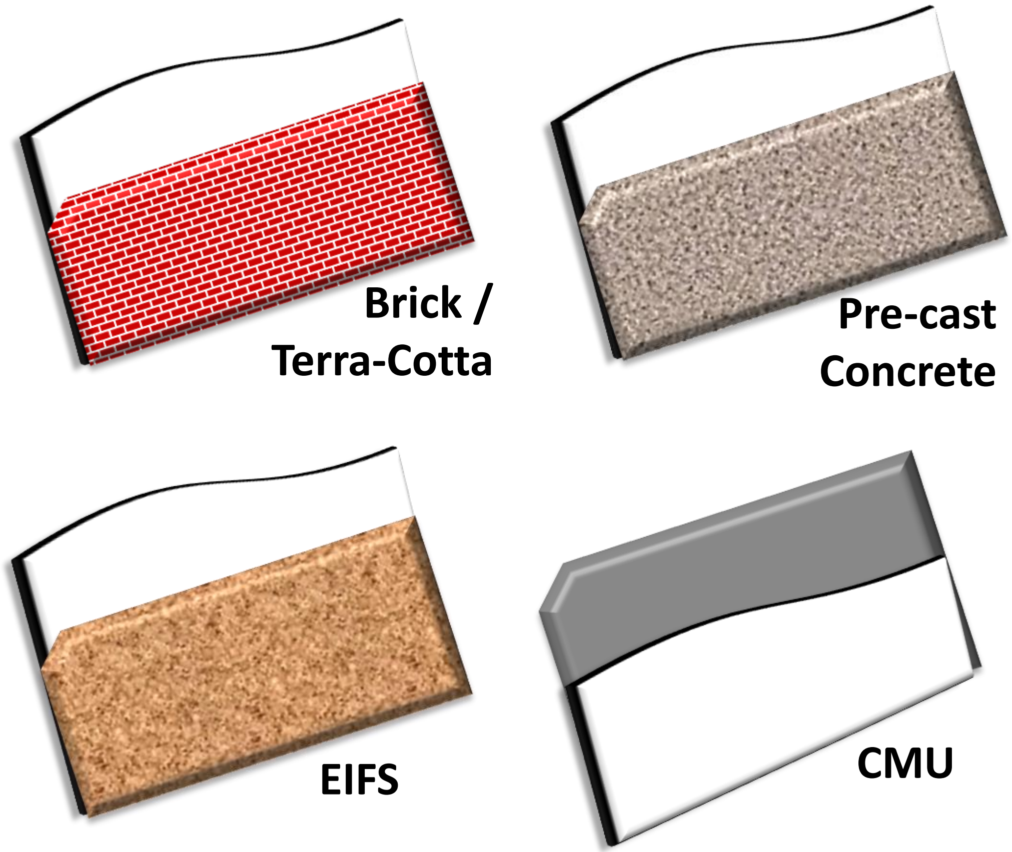
- IRC Table R403.3(1) Footnote E
- In Effect Now: "Horizontal Insulation shall be expanded polystyrene insulation or extruded polystyrene insulation".

American Society of Civil Engineers ASCE 32.0
[Design and Construction of Frost-Protected Shallow Foundation]

ASHRAE (90.1)

Engineered EPS is now widely accepted as a moisture-resistant alternative to XPS

EPS has NFPA Fire Ratings

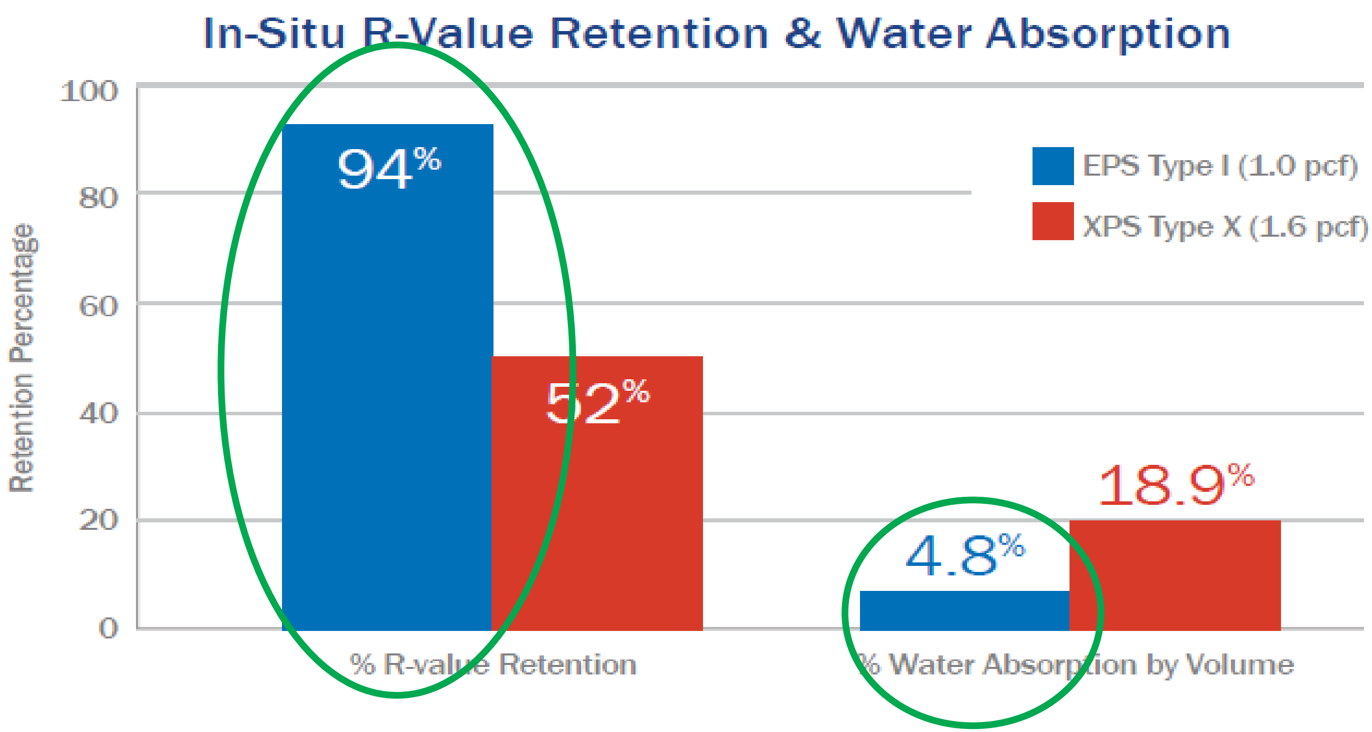


Engineered EPS passes NFPA 285 commercial fire tests across multiple assemblies

Learning Objective 3

1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made
2. Identify when EPS is specified in relation to energy and building codes through real-life projects
3. Compare EPS insulation's long-term performance with other insulations through research studies

Evaluating EPS Performance: LONG-TERM Moisture Resistance



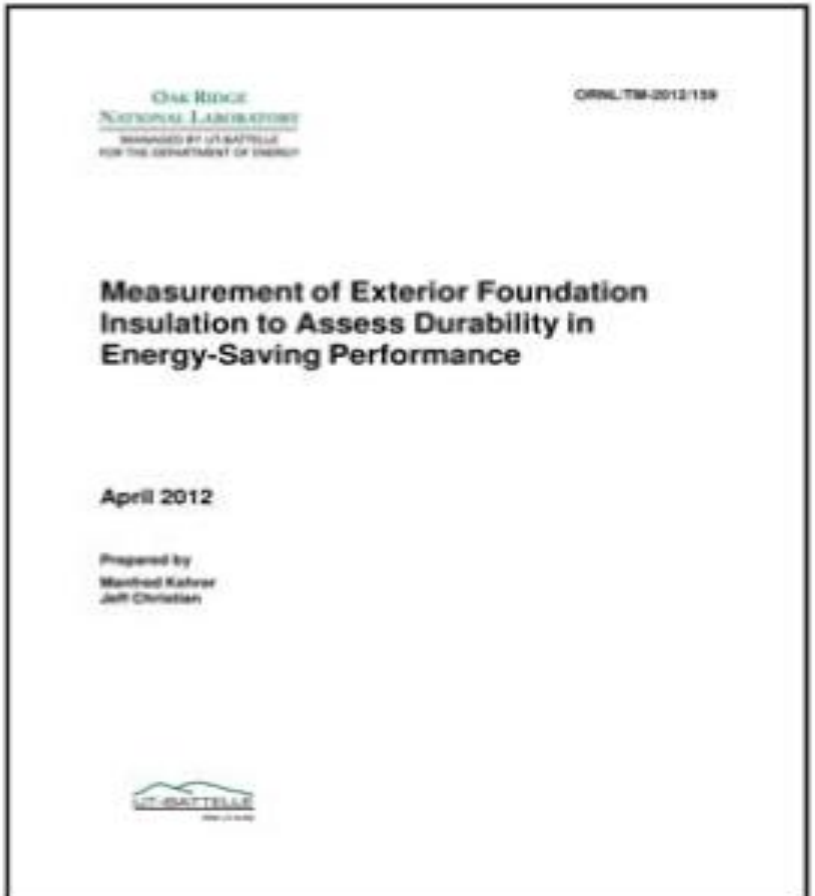
✓ EPS absorbed less water than did XPS

✓ EPS *Retained more R-value* than did XPS

Evaluating EPS Performance: LONG-TERM Moisture Resistance

XPS field samples that were extracted show significant enlargement due to moisture absorption

Evaluating EPS Performance: Independent Research



ORNL/TM-2012/159

Measurement of Exterior Foundation Insulation to Assess Durability in Energy-Saving Performance

April 2012

Prepared by
Manfred Kehrer
Jeff Christian

Oakridge National Lab, 2012

XPS below grade systems can experience a 10-44% loss of energy savings performance when subjected to moisture accumulation in the range of 8% - 16%

In the field, XPS can lose almost *half* its R-value

Evaluating EPS Performance: Independent Research

US Army Corps of Engineers - CRREL Research

1000 days in wetted soil=1.7%

Table II
Moisture gain of EPS by liquid water absorption

Time period	Test conditions	% by volume	Data source
1000 days	Burial in wetted soil	1.7	CRREL (1)
1 day	ASTM C-272	2.5	BASF
7 days	Submersion	3.0	CRREL
7 days	34 ft submersion	3.0	CRREL
90 days	Submersion	6.0	CRREL
550 days	Submersion	7.8	CRREL

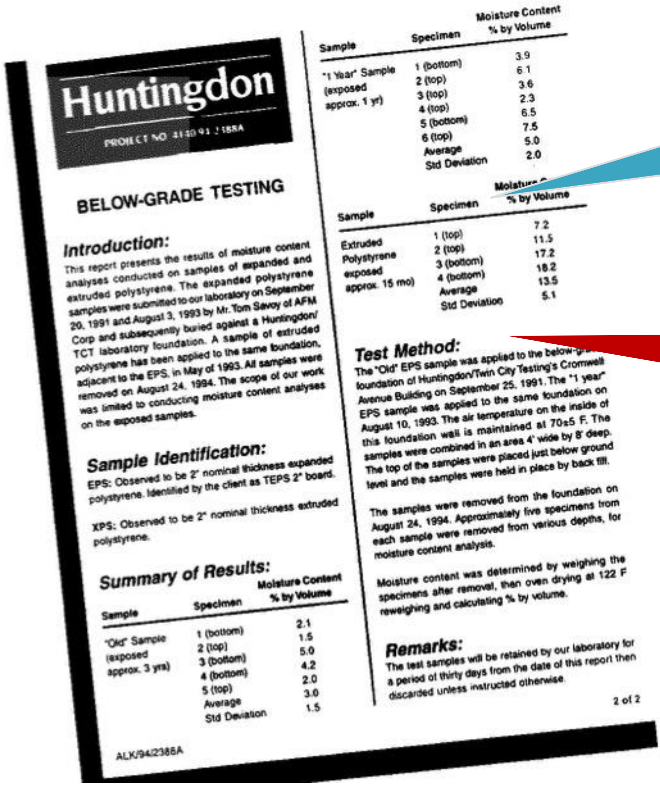
(1) CRREL: Cold Regions Research and Engineering Laboratory of U.S. Army Corps of Engineers

EPS was highly water resistant, thereby maintaining its R-Value

Evaluating EPS Performance: Independent Research

3-year Side-by-Side Study

EPS RESISTS WATER PENETRATION



Huntingdon

PROJECT NO. 4130 91 2188A

BELOW-GRADE TESTING

Introduction:

This report presents the results of moisture content analyses conducted on samples of expanded and extruded polystyrene. The expanded polystyrene samples were submitted to our laboratory on September 20, 1991 and August 3, 1993 by Mr. Tom Savoy of AFM Corp and subsequently buried against a Huntingdon/TCT laboratory foundation. A sample of extruded polystyrene has been applied to the same foundation, adjacent to the EPS, in May of 1993. All samples were removed on August 24, 1994. The scope of our work was limited to conducting moisture content analyses on the exposed samples.

Sample Identification:

EPS: Observed to be 2" nominal thickness expanded polystyrene. Identified by the client as TEPS 2" board.

XPS: Observed to be 2" nominal thickness extruded polystyrene.

Summary of Results:

Sample	Specimen	Moisture Content % by Volume
"Old" Sample (exposed approx. 3 yrs)	1 (bottom)	2.1
	2 (top)	1.5
	3 (bottom)	5.0
	4 (bottom)	4.2
	5 (top)	2.0
	Average	3.0
	Std Deviation	1.5

ALK/942388A

Sample	Specimen	Moisture Content % by Volume
"1 Year" Sample (exposed approx. 1 yr)	1 (bottom)	3.9
	2 (top)	6.1
	3 (top)	3.6
	4 (top)	2.3
	5 (bottom)	6.5
	6 (top)	7.5
	Average	5.0
	Std Deviation	2.0

Sample	Specimen	Moisture Content % by Volume
Extruded Polystyrene exposed approx. 15 mo)	1 (top)	7.2
	2 (top)	11.5
	3 (bottom)	17.2
	4 (bottom)	18.2
	Average	13.5
	Std Deviation	5.1

Test Method:

The "Old" EPS sample was applied to the below-gr foundation of Huntingdon/Twin City Testing's Cromwell Avenue Building on September 25, 1991. The "1 year" EPS sample was applied to the same foundation on August 10, 1993. The air temperature on the inside of this foundation wall is maintained at 70±5 F. The samples were combined in an area 4' wide by 8' deep. The top of the samples were placed just below ground level and the samples were held in place by back fill.

The samples were removed from the foundation on August 24, 1994. Approximately five specimens from each sample were removed from various depths, for moisture content analysis.

Moisture content was determined by weighing the specimens after removal, then oven drying at 122 F reweighing and calculating % by volume.

Remarks:

The test samples will be retained by our laboratory for a period of thirty days from the date of this report then discarded unless instructed otherwise.

2 of 2

EPS Moisture Absorption 5%

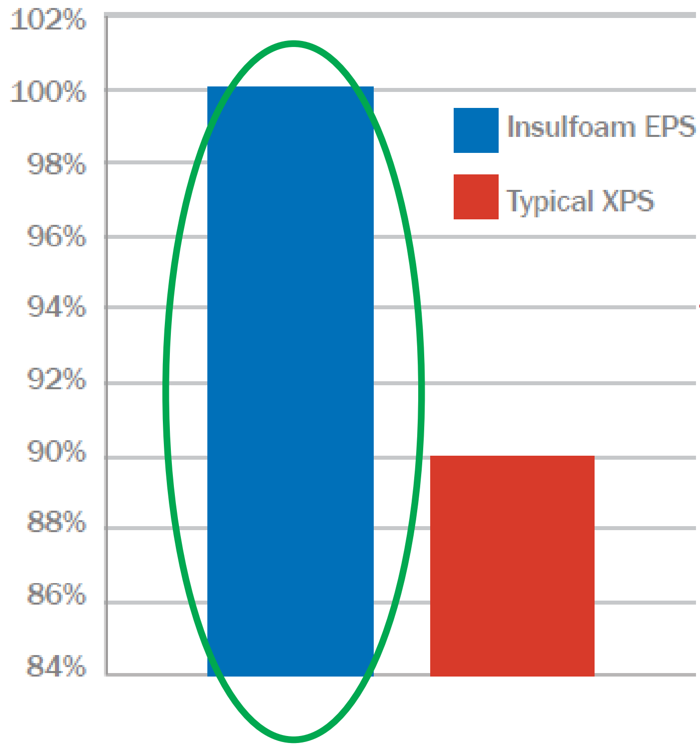
XPS Moisture Absorption 13%

EPS resisted water penetration more than XPS

Evaluating EPS Performance: 100% Warranted R-value

EPS does not off-gas, and therefore does not lose R-value

Only EPS warrants
100% of published R-value
over the long-term



Typical XPS warranty =
90% of published R-value

With EPS, Published R-value = Effective field R-value

Learning Objective 4

1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made
2. Identify when EPS is specified in relation to energy and building codes through real-life projects
3. Compare EPS insulation's long-term performance with other insulations through research studies
4. Design EPS into engineered below-grade applications to provide long-term stable thermal efficiency

Design With EPS - A Highly Customizable Product

R-Value

- Up to **R-5.1**/inch @40F
- Long-term & stable, with 100% thermal warranty

Compressive Strength

- **60** psi or more, down to 10 psi
- Engineered to suit design

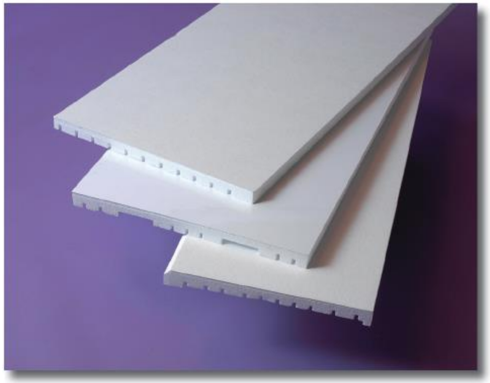
Panel Thickness

- **48"**, down to 1/8"
- Can be tapered

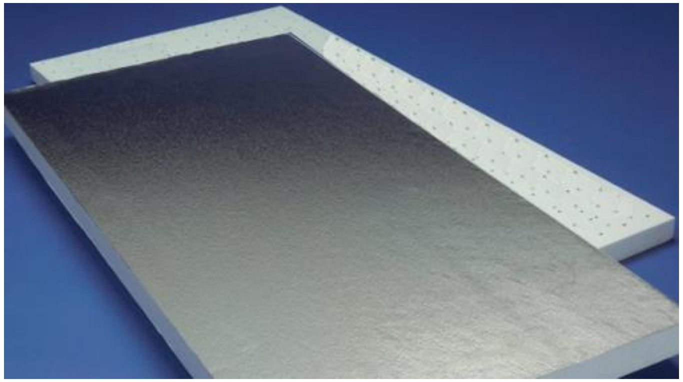
With EPS, you can specify a product that is JUST RIGHT for your design needs

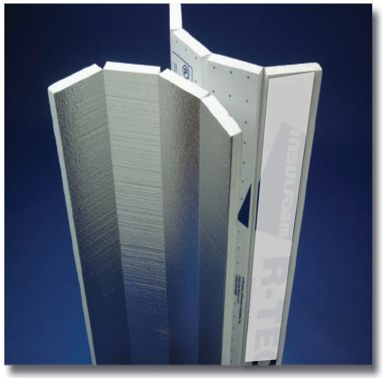
Design: Complete Line of Below Grade Insulation Products

FLAT / TAPERED / DRAINAGE

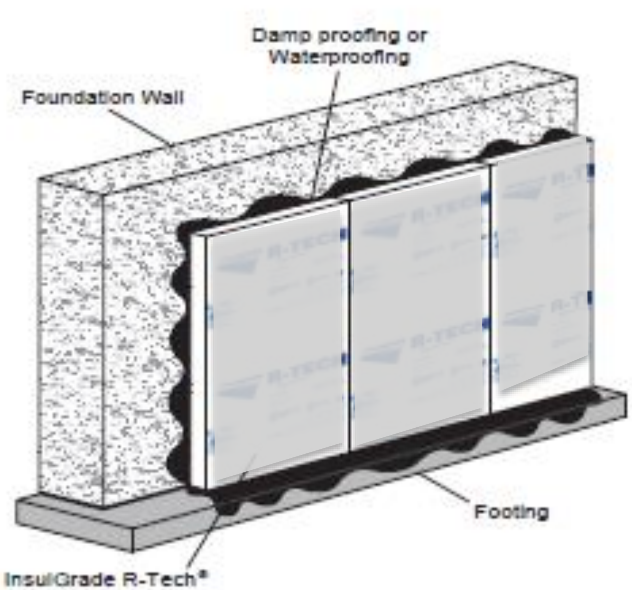


POLYMERIC FACERS FOR *EXTRA* MOISTURE RESISTANCE



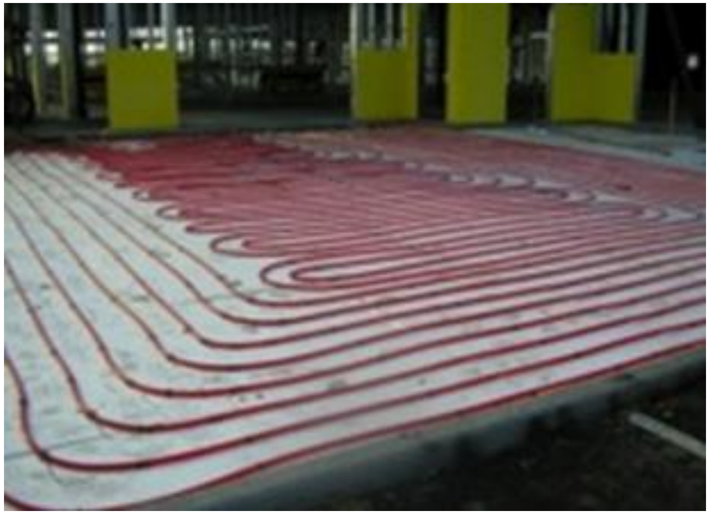


Design: Below Grade / Perimeter



- Installed directly over the primary waterproofing systems
- Protects the waterproofing system during backfilling
- Eliminates air leaks and improves interior comfort levels
- Additional barrier to groundwater infiltration
- Protects foundation during freeze / thaw cycles
- Available with factory-laminated white or reflective polymeric facers

Design: Under Slab



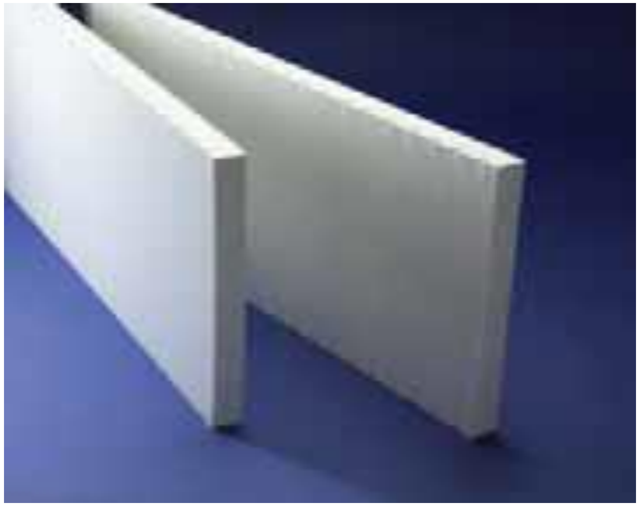
Effectively insulate concrete floor slabs

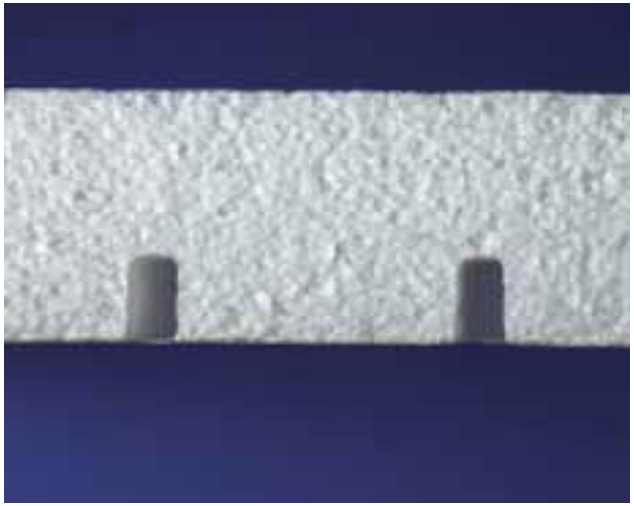
- Compressive strength up to 8,460 pounds per square foot (60 psi), or more
- Available in a wide range of thicknesses and densities

Used in variety of applications:

- Cold Storage / freezer applications
- Commercial projects that include warehouses, wineries
- Radiant-heat floor systems
- Residential multi-tenant housing and condos

Design: Drainage Board





- Combines superior insulating qualities with advanced water drainage capabilities
- High-performance rigid EPS with *advanced filtration facer*
- 1/4˝ drainage channels, 2” o.c. (can be customized)
- Available in 4’ x 8’ panels; thicknesses from 1˝ to 5˝
- Drainage capacity of 5 gallons/min./ft²

Learning Objective 5

1. Understand what is Expanded Polystyrene (EPS) insulation and how it is made
2. Identify where EPS is specified in relation to energy requirements and building codes
3. Compare EPS insulation's long-term performance with other insulations through research studies
4. Design EPS into engineered below-grade applications to provide long-term stable thermal efficiency
5. Learn how EPS Geofoam can be used as commercial or residential structural fill

EPS as Geofoam Lightweight Fill

- "Geofoam" - use of EPS as geotechnical *light-weight* fill
- 100 times *lighter* than soil
- Offers significant design and cost benefits over traditional fill alternatives
- It is covered under a different ASTM standard - D6817 - because it has tighter compression specs
- MasterFormat: Div-03 (Concrete) or Div-07 (Thermal)

		Density lb/ft³, min.	Compressive Resistance, min. psi @ 10% deformation	Flexural Strength, Min., psi
ASTM D6817	**EPS 22**	**1.35**	**19.6**	**40**
ASTM C578	Type II	1.35	15.0	35

Common Residential and Commercial uses of Geofoam

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

MAJOR FASTFOOD CHAIN
FAIRMONT, WV

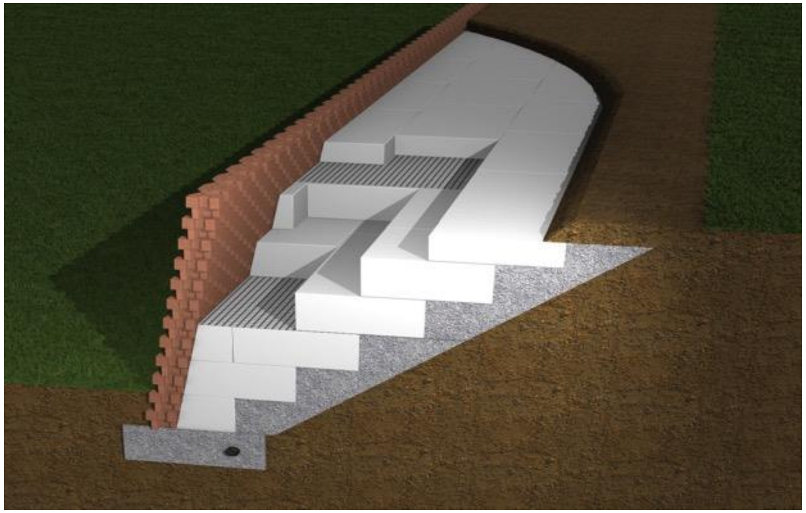
Geofoam speeds the project, reduces concrete pour, requires smaller working spaces, and uses significantly less equipment

UNIVERSITY STUDENT HOUSING
MORGANTOWN, WV

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

Eliminate or Reduce Lateral Loads for

RETAINING STRUCTURES



- 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

WHEATLEY ELEMENTARY SCHOOL
NEW ORLEANS, LA

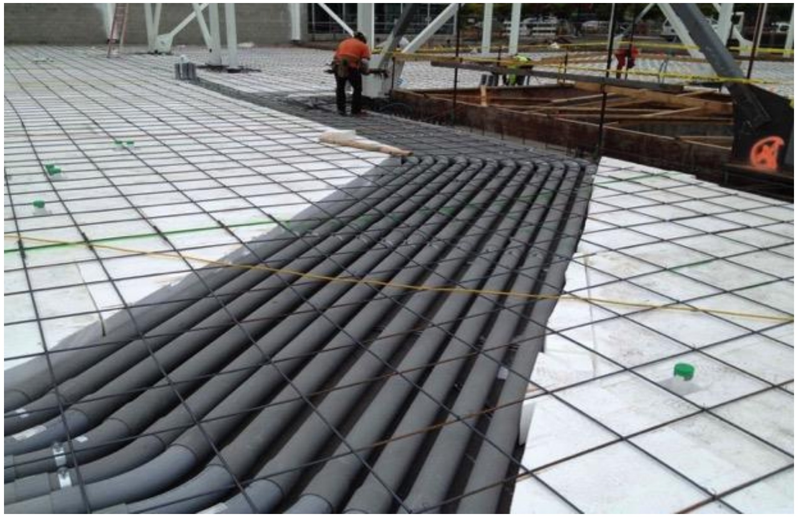
- Heavy Soils + Gravity + H_2O = High Landslide Potential
- Geofoam is up to 100 times lighter than soil
- Using Geofoam reduces the weight <u>and</u> the risk

Lighten the driving block for

SLOPE STABILIZATION

HIGH END RESIDENTIAL HOME, WA

- 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

BURIED UTILITY PROTECTION

- 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

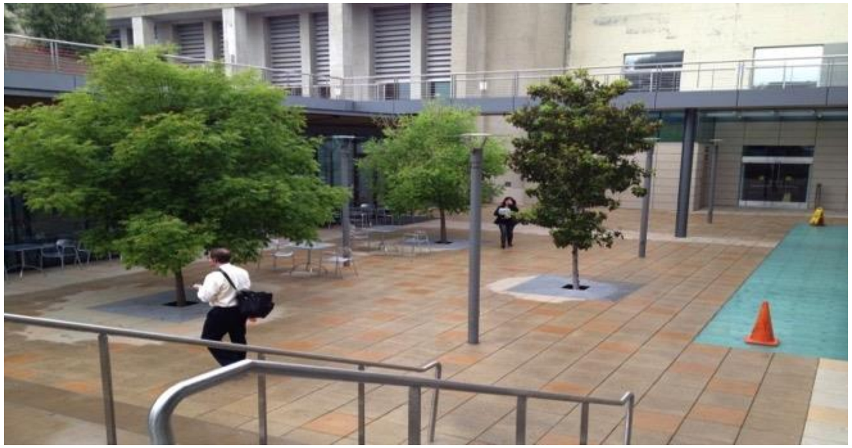
HIGH SCHOOL THEATER SUN PRAIRIE, WI

Thinking Fill? Think Geofoam

Roof Gardens

Pools and Other Features

Landscaping & Fill



Decks & Ramps

Summary and Recap

- EPS is CLOSED-CELL and is made with same raw material as XPS, in hi-tech manufacturing plants
- EPS is chemically stable and does not off-gas
- Codes approve the use of EPS in *horizontal* and *vertical* below-grade applications
- Independent studies and long-term field testing verify the physical property performance of EPS
- EPS can be specified wherever XPS is specified
- EPS Geofoam is used extensively in residential and commercial applications as light-weight fill

Thank you. Questions?

EPS: Under-slab / Foundation Insulation and Lightweight Fill