



workshops • seminars • product exhibits

In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

“This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 hours** of credit toward **Building Officials and Residential Contractors** continuing education requirements.”

For additional continuing education approvals, please see your credit tracking card.

## The Challenges of in-field adoption of continuous insulation

1. Water management principles
2. Air management principles
3. Simple dew point calculations
4. Moisture Management
  1. Drainage and Drying = Durability
5. Advance framing principles
6. Labor management
  1. Skill/Training

— SERVICE IS OUR SPECIALTY —

**APPARENTLY  
3 OUT OF 4 PEOPLE  
MAKE UP 75%  
OF THE POPULATION**

# 1. Water management principles ... it's not new



“Rain is always prepared to wreck mischief...by its persistence it undermines the whole strength of building, until it eventually brings ruin and destruction to the whole work.”

“Leon Battista Albrecht (1404-1472)

## Boundary Conditions

$$m_v = \beta (P_{va} - P_{vsurf}) + V_a \rho_v$$

$$\frac{\partial(\rho_m u)}{\partial t} = \nabla \cdot (\rho_m D_\phi \nabla \phi - \delta_p \nabla P_v + \rho_v V_a)$$

**Moisture Balance**

$$\frac{\partial \rho_a}{\partial t} + \nabla(\rho_a V_a) = 0$$

**Air Balance**

**Momentum Balance**

$$\frac{\partial(\rho_a V_a)}{\partial t} + \nabla(\rho_a V_a \cdot V_a) = -\nabla P_a + \nabla \cdot \left( \frac{\mu_a}{K_a} V_a \right) + \rho_a g$$

**Energy Balance**

$$\rho_m C_p \frac{\partial T}{\partial t} = -\nabla(\rho_a C_p V_a T) + \nabla(k \nabla T) + \nabla[L_v(\delta_p \nabla P_v)] - L_{ice} \rho_m u \frac{\partial f_1}{\partial t}$$

## 2. Air management principles

### ***Water water everywhere - Moisture Migration Priorities***

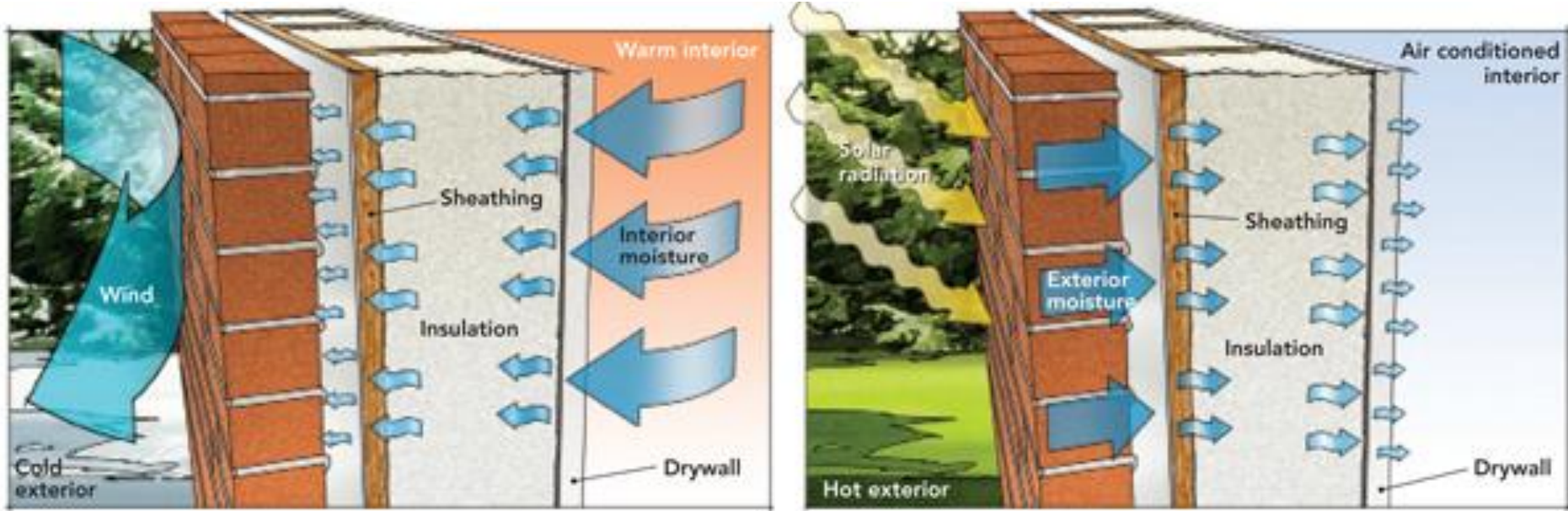
*Significantly more water vapor travels through a wall by air leakage than by diffusion.*

Insight  
Confusion  
About  
Diffusion

An edited version of this Insight first appeared in the ASHRAE Journal.

By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow  
ASHRAE

### 3. Simple dew point calculations it changes it is not simple



## 4. Moisture Management in other words

- Hot to cold
- Water - more to less
- Air/water high pressure to low
- Gravity is down
  - Capillarity (wicking see above)



5. Advance framing principles
6. Labor management  
Skill/Training

# Labor management Skill/Training

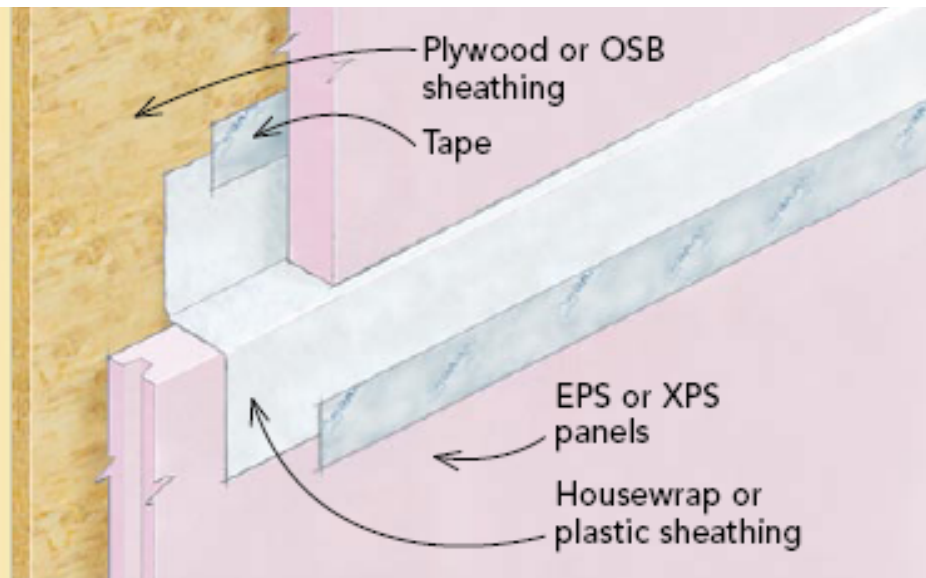




<http://youtu.be/6-65x7IDi40?t=1m>

## Unfaced panels need flashing

The long edges of some expanded- and extruded-polystyrene panels have shiplapped or tongue-and-groove edges. Manufacturers recommend vertical panel installation, with seams sealed with tape. Because I don't trust the bond between the tape and the unfaced panels, I often add a piece of housewrap or plastic sheathing as flashing between the horizontal butt joints to prevent water intrusion.



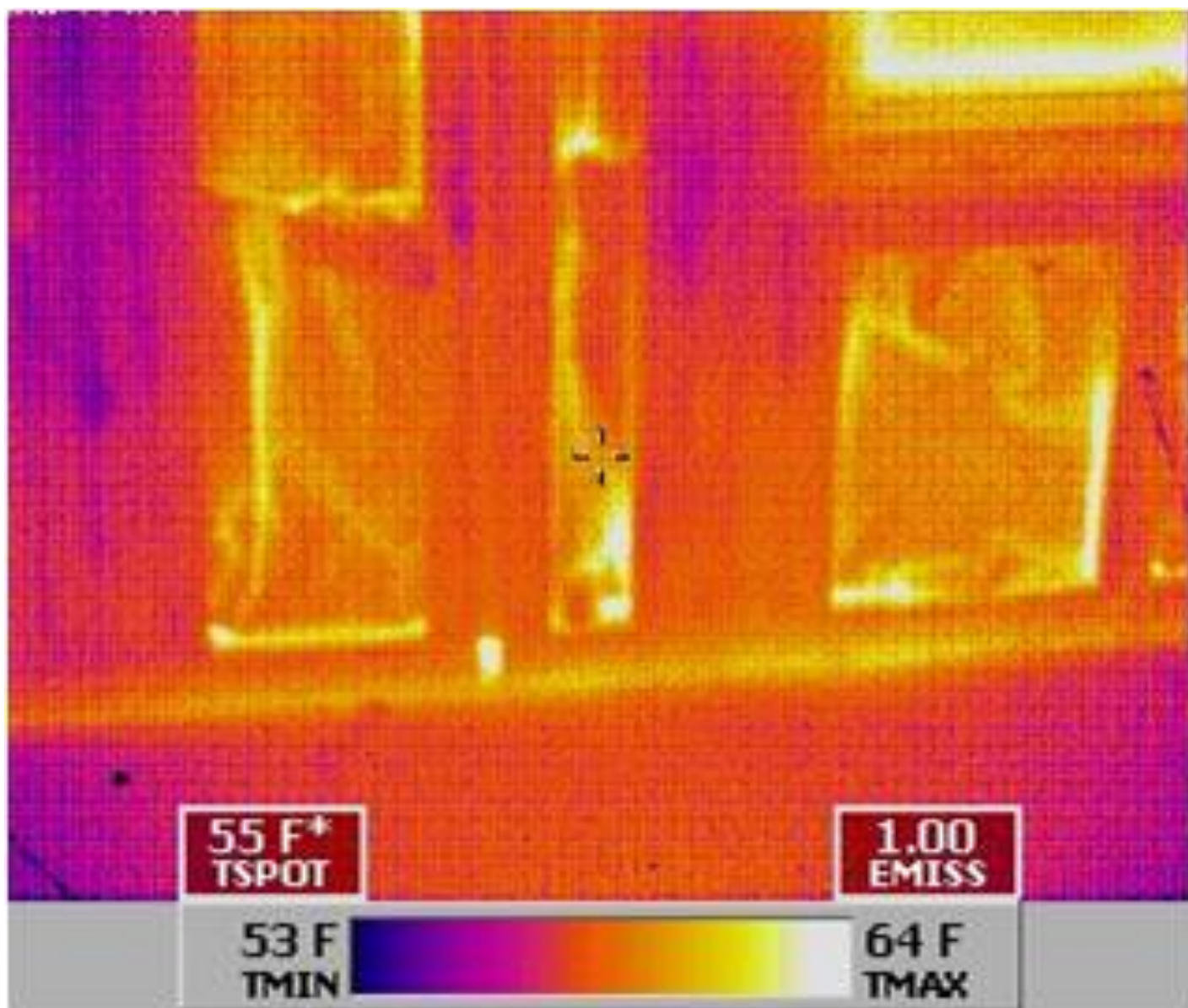


# Continuous Insulation





**Thermal Bridging**





# Insulations

Never met one that could not be made to work

- Fibrous
  - Fiberglass/Rockwool/Cavity
- Spray applied
  - Open/closed
- Foam panels
  - Polystyrene
  - Polyisocyanurate





How To Insulate Your Basement Wall

<https://www.youtube.com/watch?v=K6EKLH9L0ys>

- Basements leak

- Water

- 100% humidity 100% of the time

- Energy

- Soil Gas

- Radon



OAK RIDGE  
NATIONAL  
LABORATORY

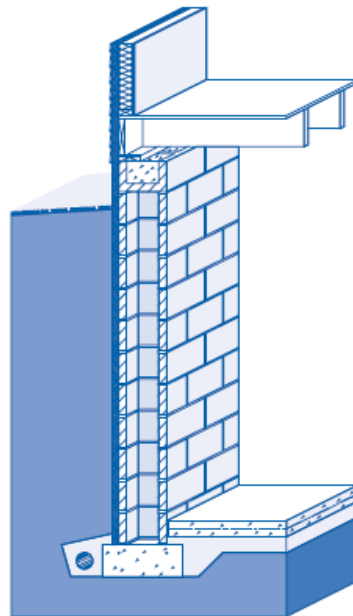
**MARTIN MARIETTA**

MANAGED BY  
MARTIN MARIETTA ENERGY SYSTEMS, INC.  
FOR THE UNITED STATES  
DEPARTMENT OF ENERGY

ORNL/CON-295

## Builder's Foundation Handbook

John Carmody  
Jeffrey Christian  
Kenneth Labs



Part of the National Program for  
Building Thermal Envelope Systems and Materials

Prepared for the  
U.S. Department of Energy  
Conservation and Renewable Energy  
Office of Buildings and Community Systems  
Building Systems Division







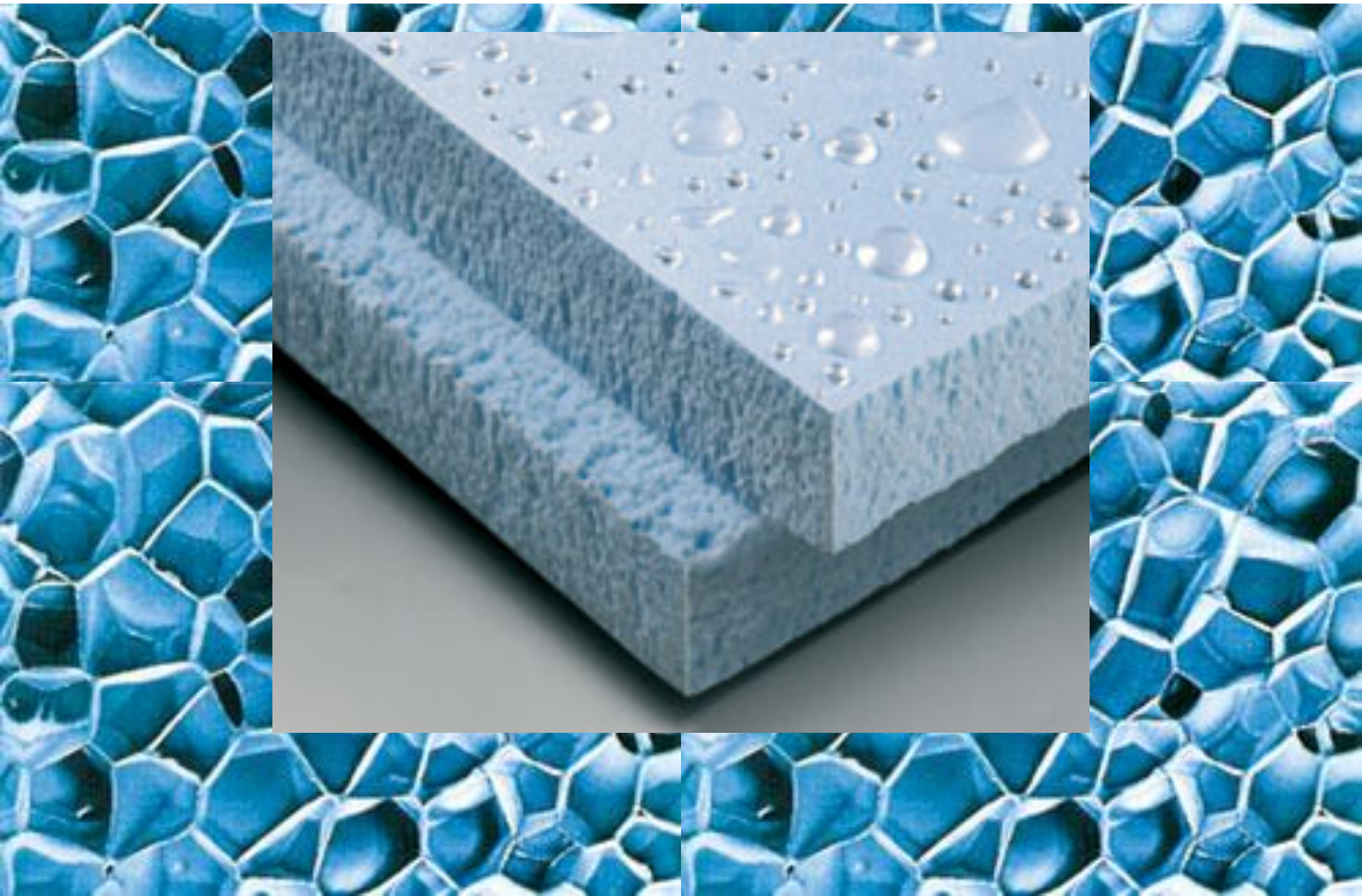


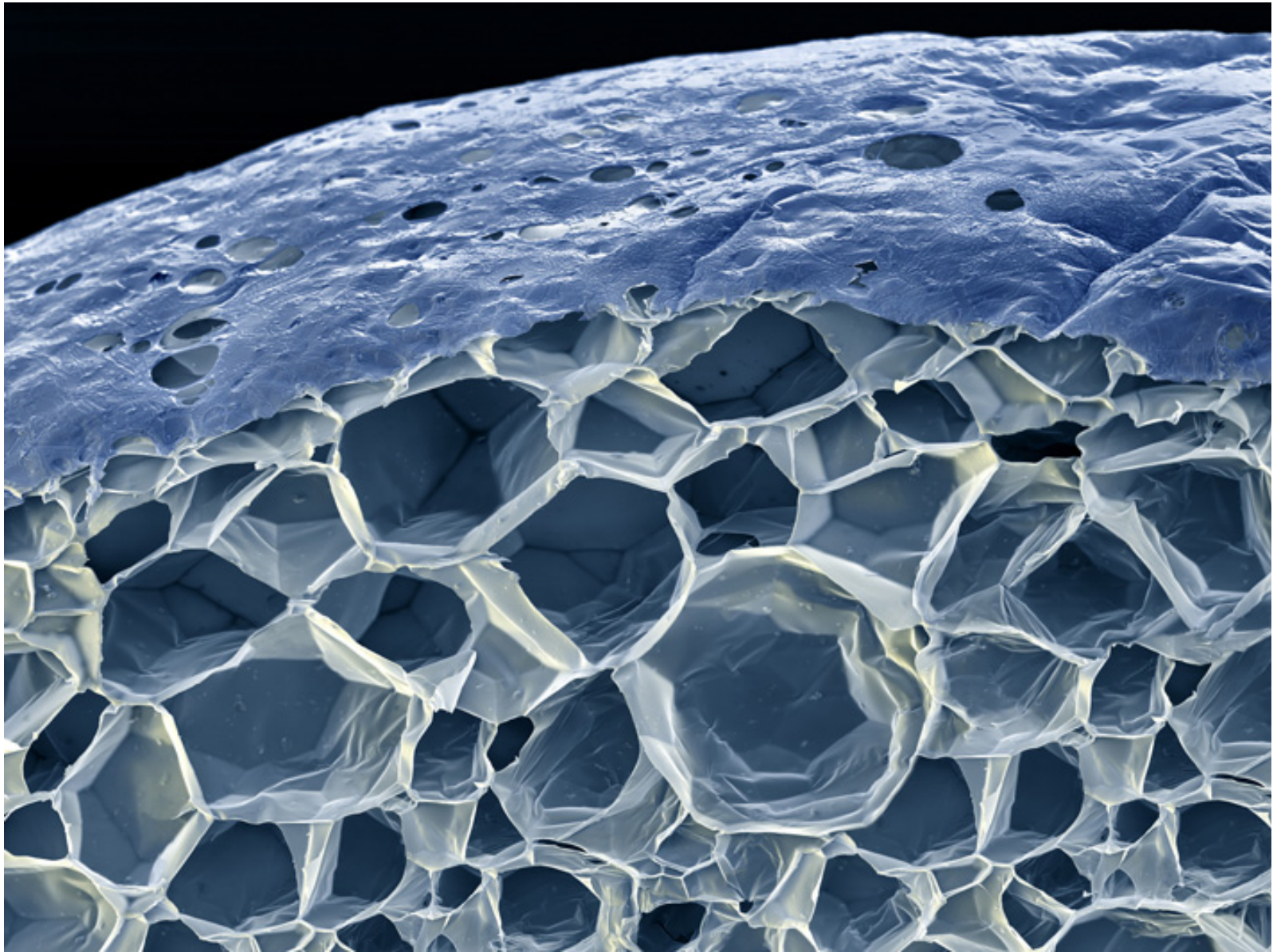




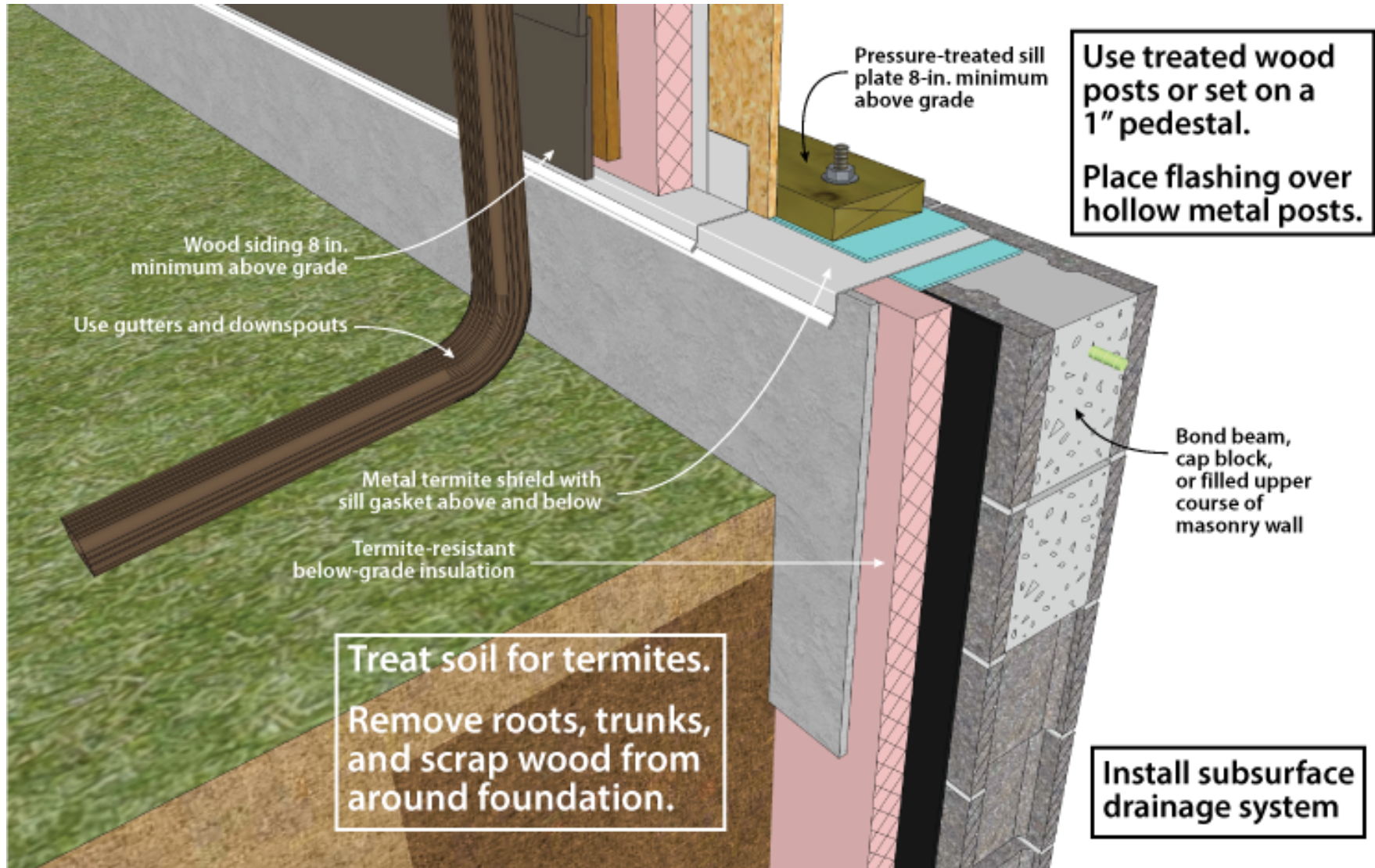




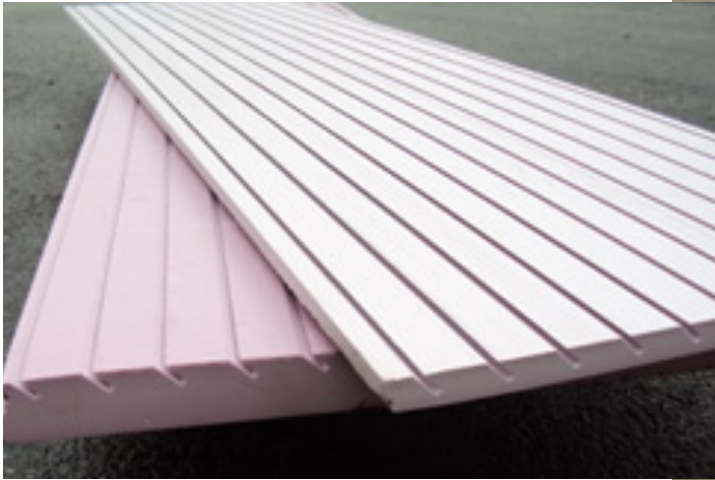




# DOE 2.1 Recommended Design and Construction Details

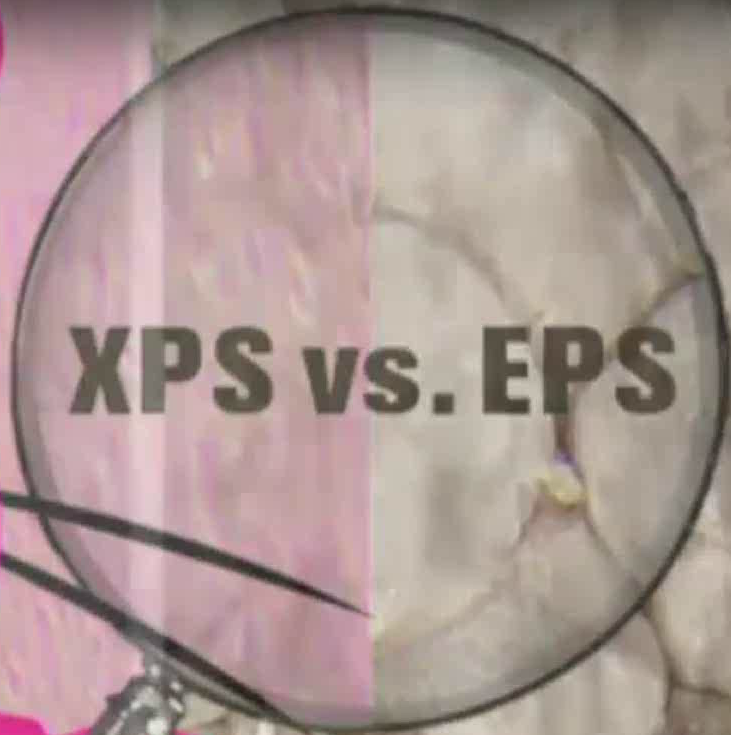


Probably not the best idea.





XPS vs. EPS: Science Doesn't Lie



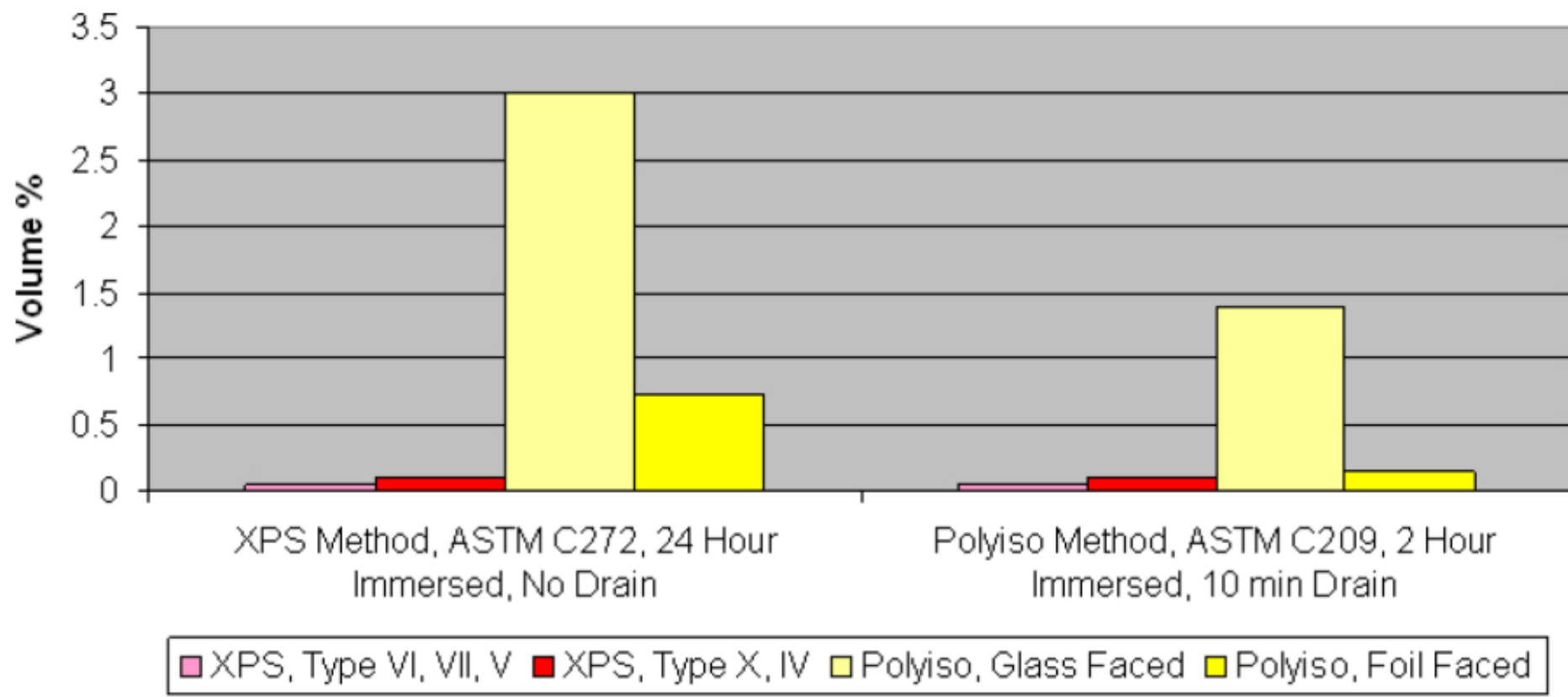
# XPS vs. EPS

## Science Doesn't Lie

Extruded (XPS) Polystyrene vs. Expanded (EPS) Polystyrene



<https://youtu.be/aiH4zXEE60g>





# Absorptive Insulation Board



EPS Below Grade Series 103  
November 2008

Technical  
*bulletin*

## 15-Year In-Situ Research Shows EPS Outperforms XPS in R-Value Retention

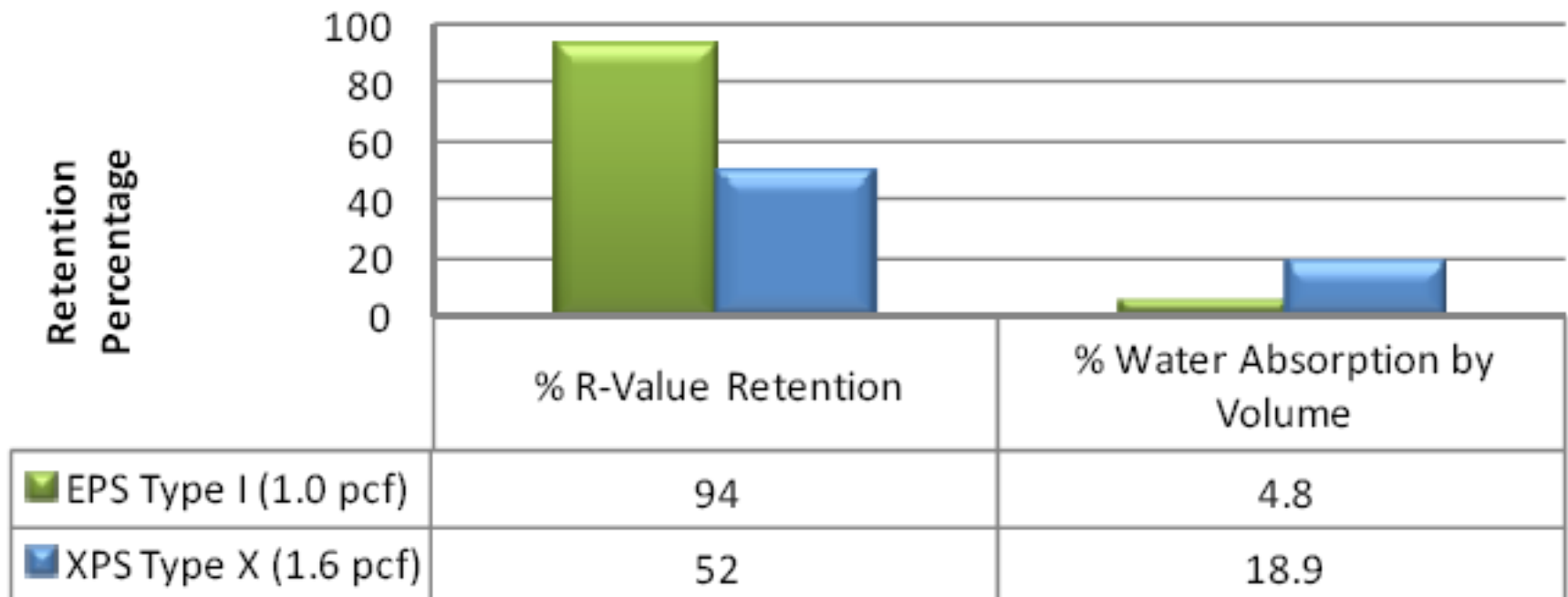


Excavation Site St. Paul, MN Climate Zone 1



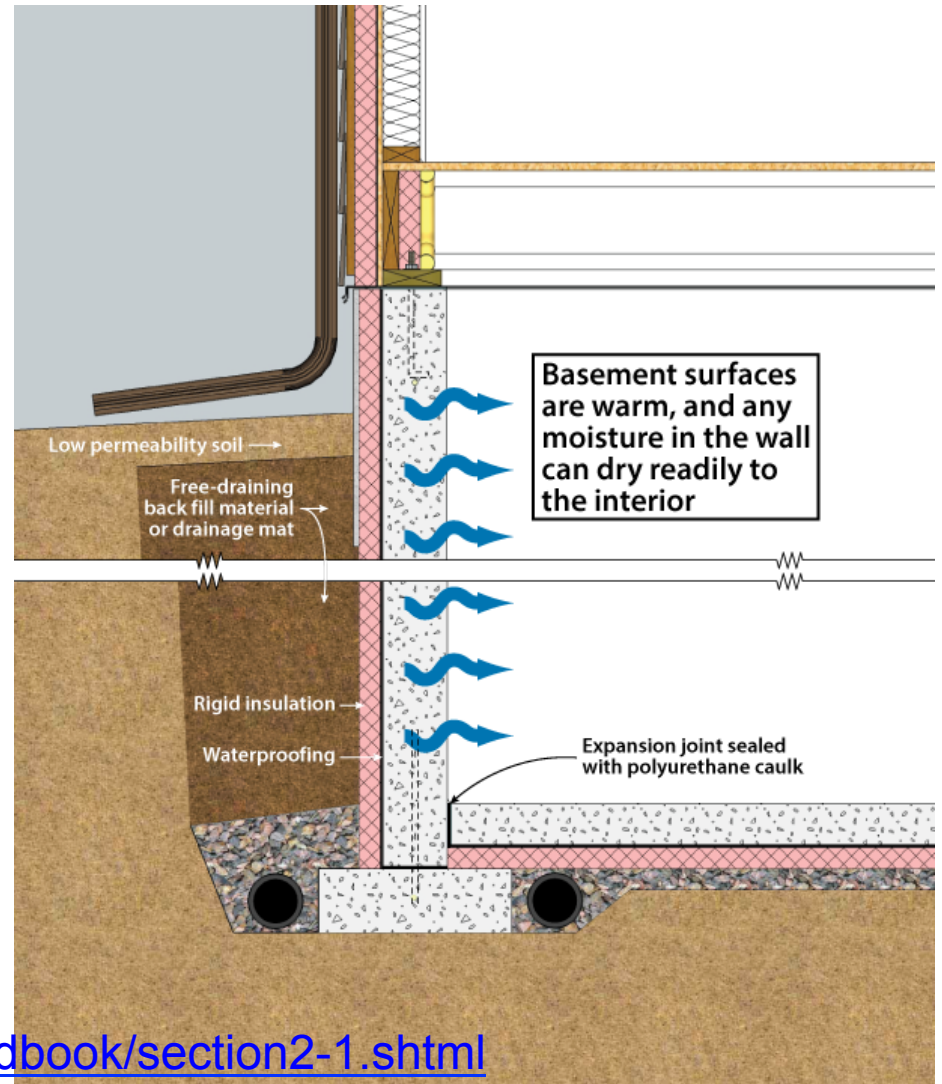
Side-by-Side Installation

## In-Situ R-Value Retention & Water Absorption



# Nature seeks balance

- Water flows more to less
- Air/water high pressure to low pressure
- Gravity is down
- Relative de-humidity



<http://foundationhandbook.ornl.gov/handbook/section2-1.shtml>

# Why Standardized Tests Don't Measure Educational Quality

*W. James Popham*

**Educators are experiencing almost relentless pressure to show their effectiveness. Unfortunately, the chief indicator by which most communities judge a school staff's success is student performance on standardized achievement tests.**







2012

INTERNATIONAL  
RESIDENTIAL  
CODE®

FOR ONE- AND TWO-FAMILY DWELLINGS

*A Member of the International Code Family®*

IRC®

INCLUDES THE RESIDENTIAL  
REQUIREMENTS FROM THE NFPA 70,  
NATIONAL ELECTRICAL CODE® 2011  
*The electrical code designated for use  
with the I-Codes®*



2012

INTERNATIONAL  
BUILDING  
CODE®

*A Member of the International Code Family®*

IBC®

# Why we tape insulation and other useless things

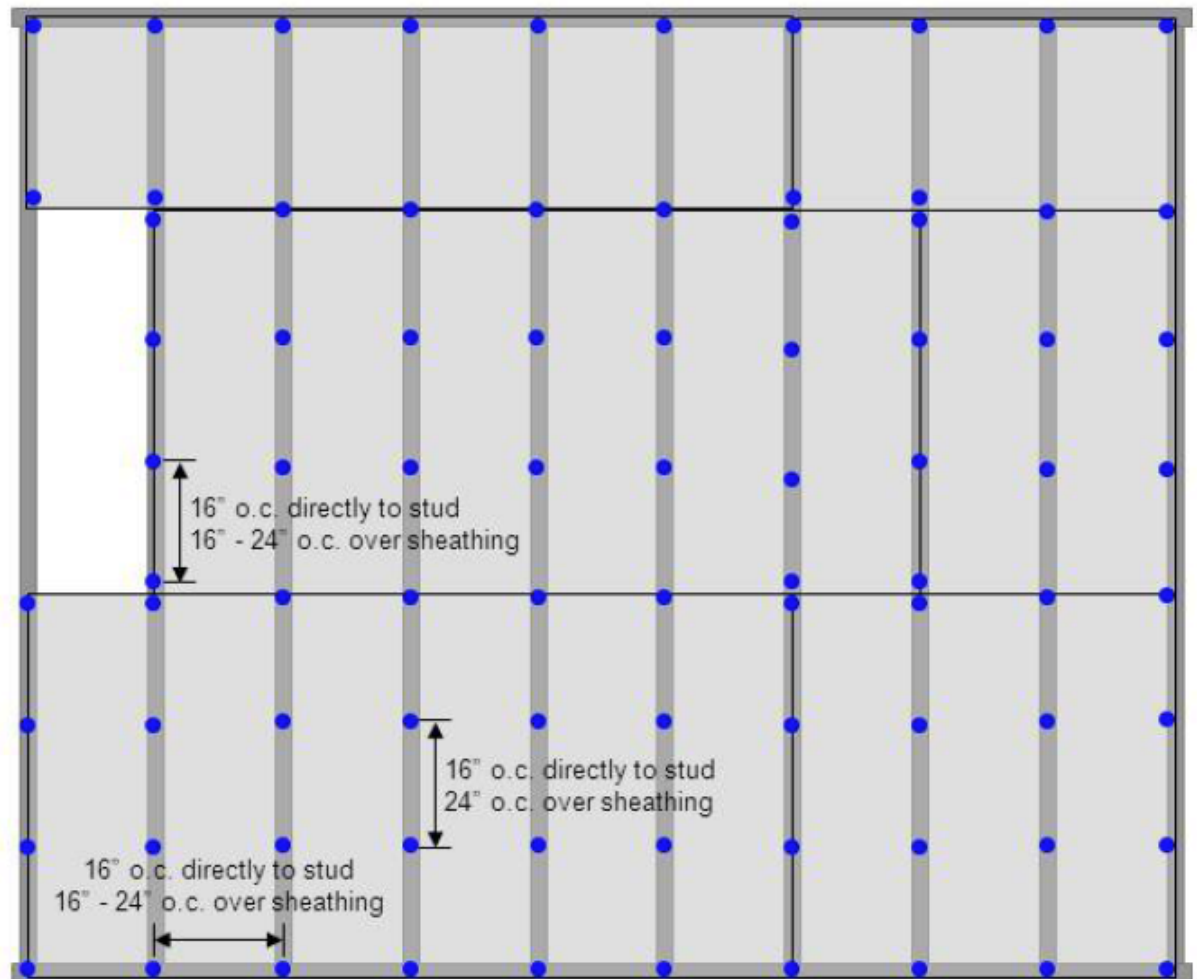






screws and fasteners  
21 – 28 holes

Figure 2. Recommended Fastener Spacing



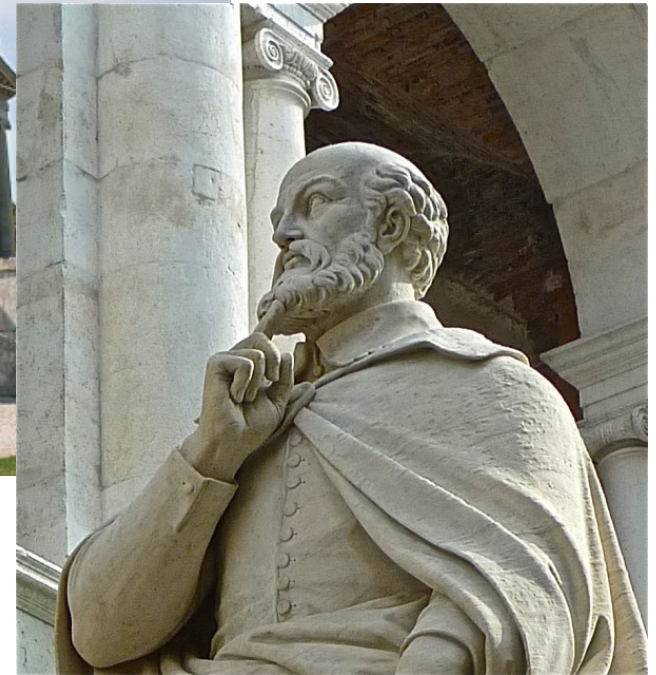
#### RECOMMENDED FASTENER SPACING

- Installed Over Exterior Sheathing: 16 - 24 inches o.c. perimeter, 24 inches o.c. field
- Installed Directly to Metal Studs: 16 inches o.c. perimeter, 16 inches o.c. field



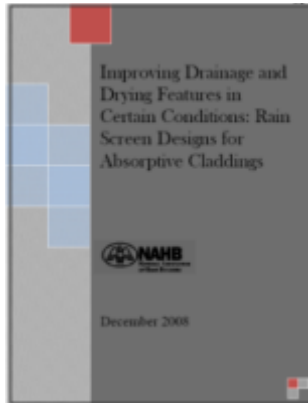
These picture shows how wood studs can transmit energy through a wall. The thermal stresses and exaggerated condensation points from through wall fasteners is also clearly demonstrated. Nails are mini heat sinks.

Long term dimensional stability of the insulation is also very apparent the durability of taping board joints are also in question.



Villa Rotunda by Andrea Palladino (1509-1580)

“It is very commendable in great fabricks, to make some cavities in the thickness of the wall from the foundation to the roof, because they give vent to the wind and vapours, and cause them to do less damage to the building.”



## Insight Stucco Woes: The Perfect Storm

An edited version of this insight first appeared in the ASHRAE Journal.

By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow ASHRAE



EXECUTIVE SUMMARY  
EXTERIOR WALL CLADDING  
PERFORMANCE STUDY

**The exterior cladding sheds most water at the outer surface; It anticipates that some water will penetrate behind the outer surface and directs the water out:**

- Assemblies should be designed and constructed to shed or drain water to the exterior.
- The key component in this approach is a drainage plane.
  - Window and door openings should be designed and constructed to shed or drain water to the exterior
  - Building materials should be treated that they drain rather than store water.

## Sited Reports

- [BSI-029: Stucco Woes—The Perfect Storm](#)
- [Improving Drainage and Drying Features in Certain Conditions: Rain Screen Designs for Absorptive Claddings.](#)
- [EIMA Executive ORNL Summary](#)



# Insight Stucco Woes: The Perfect Storm

An edited version of this Insight first appeared in the ASHRAE Journal.

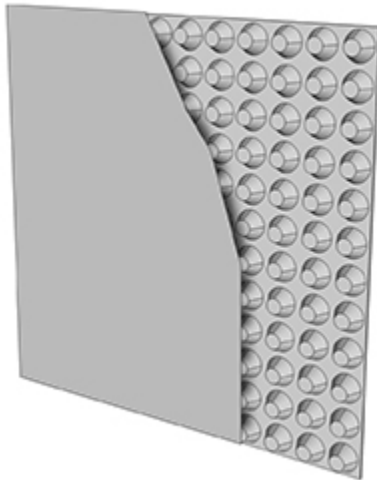
By Joseph W. Lstiburek, Ph.D., P.Eng., Fellow  
ASHRAE

**“Cultured stone is just lumpy stucco!”**

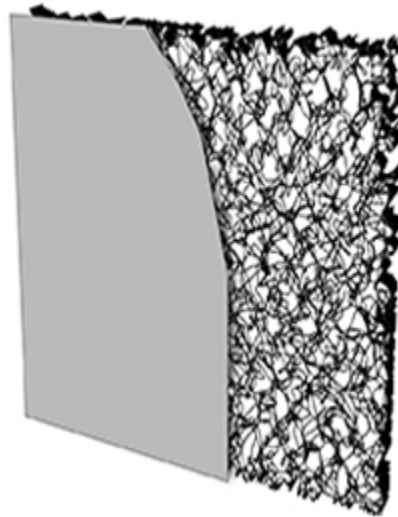


# Treat the symptom Drainage mats

**Example B**



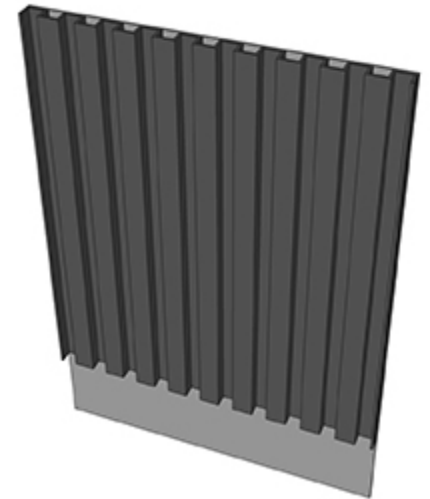
**Example C**



**Example D**



**Example E**



# Code Requirements:

Q: What is the minimum annual rainfall that would be a cutoff for advising for using a rainscreen?

A: Any area receiving more than 20" of annual rainfall should incorporate enhanced drainage techniques in the wall system, especially if using an absorptive cladding material. Areas receiving 40" or more of rainfall should utilize rainscreen design regardless of cladding material.

# Code Requirements: 2012 IRC

## SECTION R703

### EXTERIOR COVERING

**R703.1 General.** Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing as described in Section R703.8.

**R703.1.1 Water resistance.** The exterior wall envelope shall be designed and constructed in a manner that prevents the accumulation of water within the wall assembly by providing a water-resistant barrier behind the exterior veneer as required by Section R703.2 and **a means of draining to the exterior water that enters the assembly**. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section R702.7 of this code.

# Code Requirements: 2012 IRC

## Exceptions (cont.):

2. Compliance with the requirements for a **means of drainage**, and the requirements of Sections R703.2 and R703.8, **shall not be required for** an exterior wall envelope that has been demonstrated to resist wind-driven rain through testing of the exterior wall envelope, including joints, penetrations and intersections with dissimilar materials, **in accordance with ASTM E 331** under the following conditions:

2.1. Exterior wall envelope test assemblies shall include at least one opening, one control joint, one wall/eave interface and one wall sill. All tested openings and penetrations shall be representative of the intended end-use configuration.

2.2. Exterior wall envelope test assemblies shall be at least 4 feet by 8 feet (1219 mm by 2438 mm) in size.

2.3 Exterior wall assemblies shall be tested at a minimum differential pressure of 6.24 pounds per square foot (299 Pa).

2.4. Exterior wall envelope assemblies shall be subjected to the minimum test exposure for a minimum of 2 hours.

The exterior wall envelope **design shall be considered to resist wind-driven rain** where the results of testing indicate that **water did not penetrate** control joints in the exterior wall envelope, joints at the perimeter of openings penetration or intersections of terminations with dissimilar materials.

# Absorptive Cladding

Masonry and Stucco

Adhered Veneers

Wood Siding Materials

Engineered-wood Siding Materials

Cement-based Siding Materials











FIRE  
LANE  
NO  
STOPPING

# Windows Installation Devil in the details







Screws are very heat-conductive and can cause condensation where they miss the studs. We always check from the inside for missed fasteners, reinstall them, and use spray foam to seal the holes.





**Quote, Kohta Ueno Associate Member ASHRAE conclusion from the rr-1012 report,**

"A final set of simulations was run to determine the effect of exterior insulation material properties on rain leakage vulnerability. In addition to foil-faced polyisocyanurate, XPS and EPS were also compared, at the same thickness. Although XPS allows greater drying than foil-faced insulation, at the thickness used in this simulation (4 in., or 102 mm), the permeability is sufficiently low (0.25 perm, or 14 ng/Pa·s·m<sup>2</sup>) that the wall shows a similar increased vulnerability to moisture accumulations. However, the EPS wall appears to have stable moisture cycling behavior, and is even drier than the original wall during the wintertime peaks. Although these simulations might point to EPS as a promising option for exterior insulation retrofits, there are some drawbacks to this material, including lower R-value per inch, lower compressive strength, poorer workability (edge cutting), and difficulty in detailing the material as a water control layer/drainage plane."

**Thank-you for your  
interest!**

**For more information contact us at:**

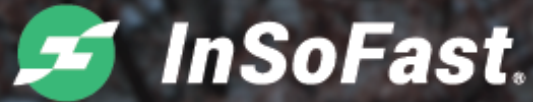
**888-501-7899**

**Or visit us on line @**

**[www.InSoFast.com](http://www.InSoFast.com)**



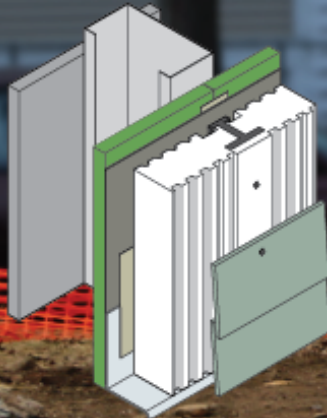
# Know your NOs



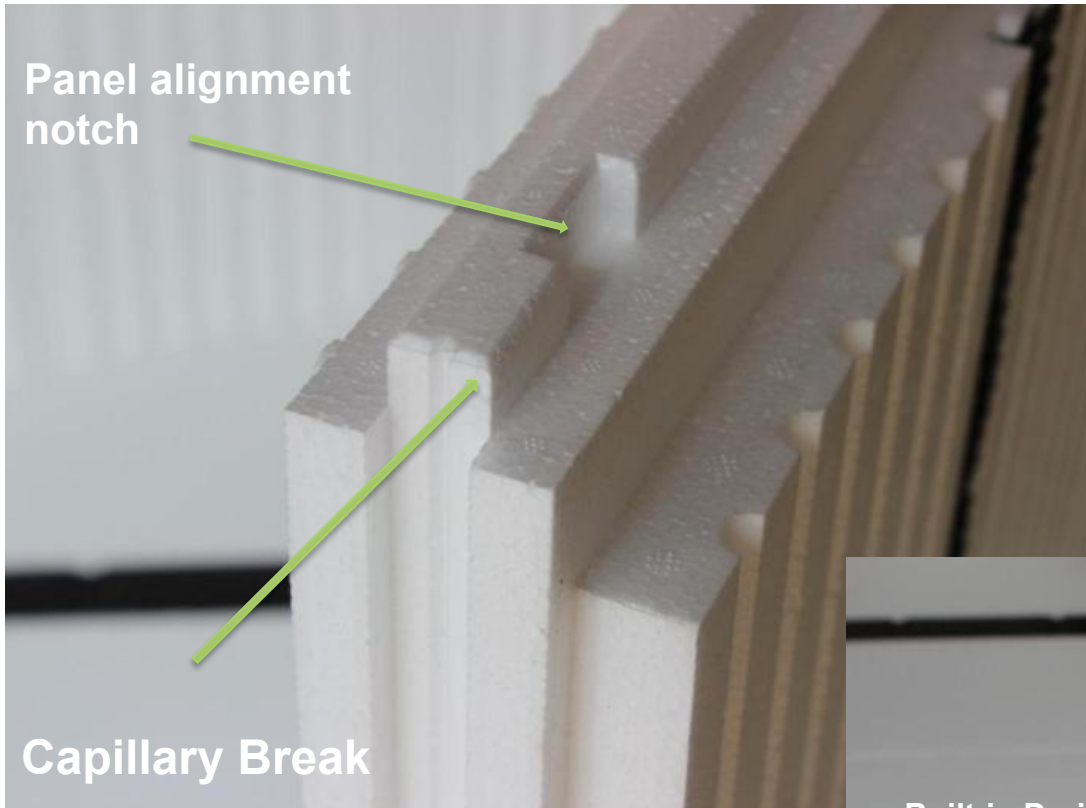
Continuous insulation panels  
with a built-in rainscreen  
and embedded framing

Requirements : simplified

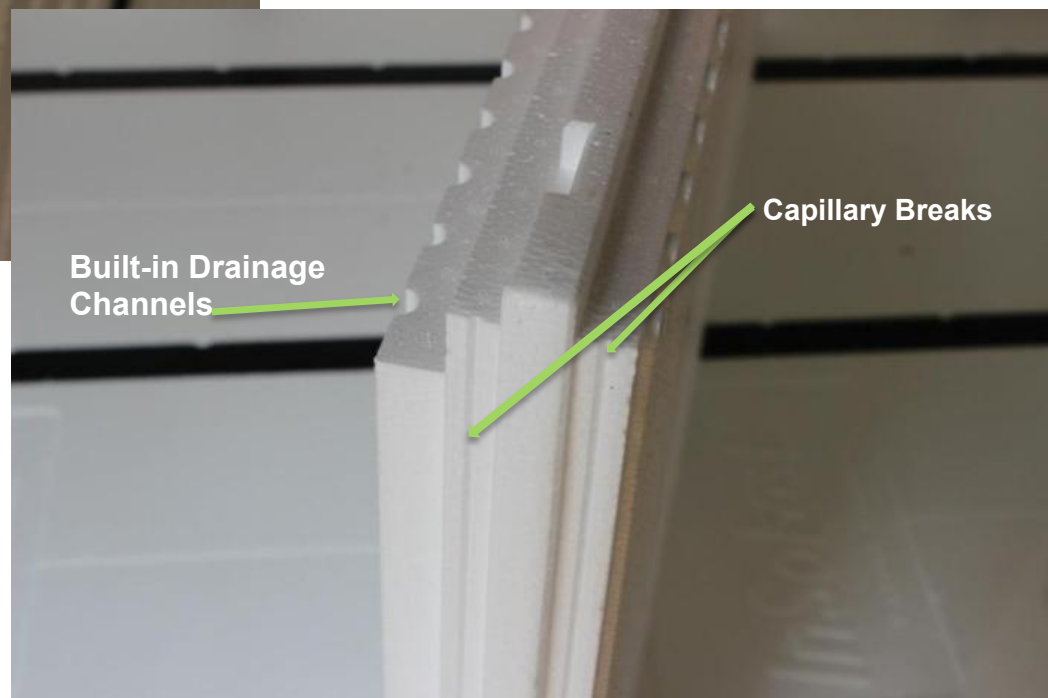
- × No tape
- × No washers
- × No drainage mat
- × No furring strips
- × No special tools
- × No extra steps
- ✓ No problem.







The interlocks on all 4 sides have engineered capillary breaks to prevent water migration through the insulation protecting the sensitive framing materials. InSoFast is not reliant on building tapes for a weather tight seal.



# Insulations Double Thermal By-pass



# *InSoFast* **EX** 2.5™

weather screen technology as an advanced solution for building designs.

