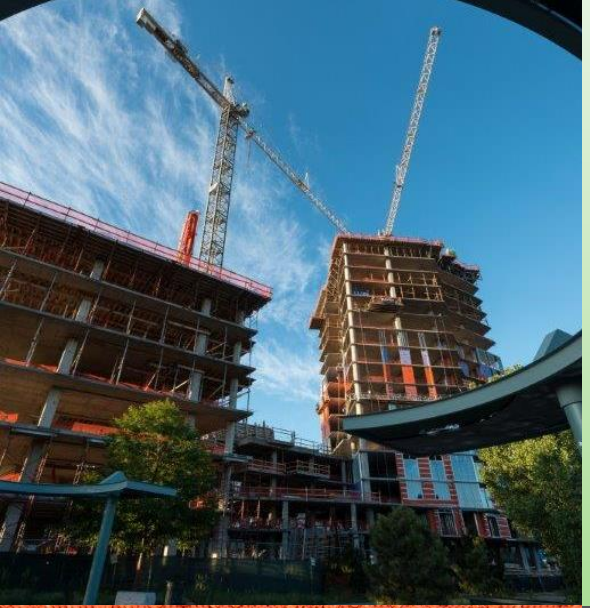
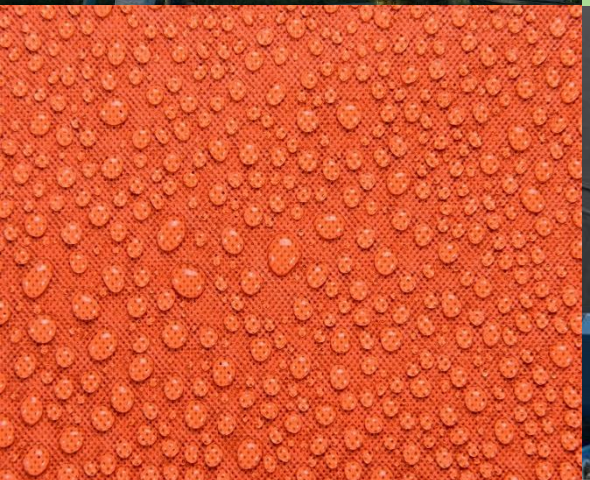


The Benefits of Rainscreen Design

Scott D. Wood, Senior Building Scientist



SCOTT D. WOOD
Senior Building Scientist

YOUR PRESENTER

Scott D. Wood is a Senior Building Scientist with the VaproShield team, and is responsible for product testing of manufactured materials and investigation/testing of properties for new product development.

He provides technical support for the company's representatives, client inquiries, and assists in development--updating product literature and creating VaproShield's AIA presentations.

Scott's extensive background has supported the excellent papers and presentations he has provided domestically and internationally.

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VAPROSHIELD®
Breathable Membrane Systems for Roofs & Walls

Course Description

Studies show that a ventilated rainscreen assembly has the ability to:

- Effectively drain water that has entered the behind the cladding
- Reduces the wet time of absorptive claddings
- Increased drying of the interstitial wall assembly
- Mitigate reverse vapor drive for highly permeable Water Resistant Barrier / Air Barrier (WRB/AB) systems

This course investigates current knowledge of vapor open (permeable) WRB/AB, ventilated rain screen cladding wall assemblies and their ability to mitigate water intrusion, reducing long-term exposure and enhancing the drying capacity of the building assembly providing a healthy and extended life of the building.

Learning Objectives

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

- Apply building science fundamentals to rainscreen design
- Define ventilated rainscreen design and its historical development
- Describe ventilated rainscreen drying mechanisms
- Identify the benefits of vented, vapor permeable WRB/AB wall assemblies
- Recognize the benefits of highly vapor permeable WRB membranes and compare the differences between vapor tight WRB membranes
- Identify rainscreen components to build an effective vented rainscreen cavity
- Understand the design details for a ventilated rainscreen system

Overview

- Building science of a wall assembly
- The building enclosure envelopes the building
- History of the Rainscreen
- What is a ventilated rainscreen design
- Evolution of the perfect wall
- Cladding and its function
- Functions provided by the Rainscreen
- Vapor tight and highly vapor permeable WRB membranes
- Benefits of a ventilated vapor open WRB/Air Barrier wall assemblies
- Testing drying capacities of WRB/Air Barrier systems in a simulated Rainscreen
- Rainscreen components to building a ventilated rainscreen cavity
- Rainscreen Cladding Systems

Demand for Sustainable Livable Buildings

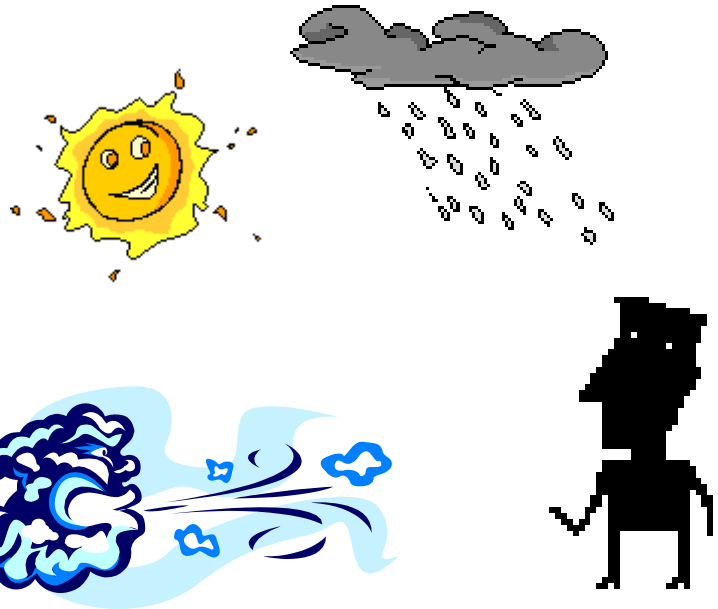
Occupant Demands
Code Demands
Climate Stresses

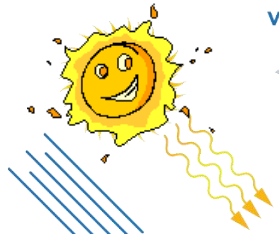
Building Science

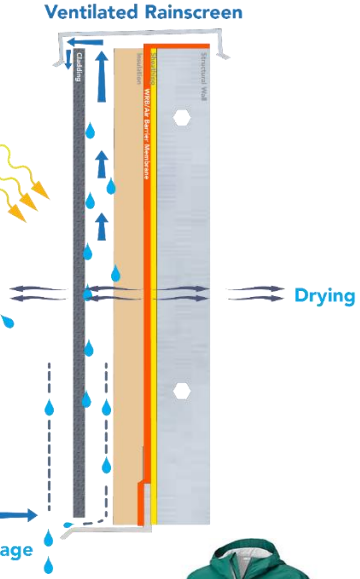
Study of:

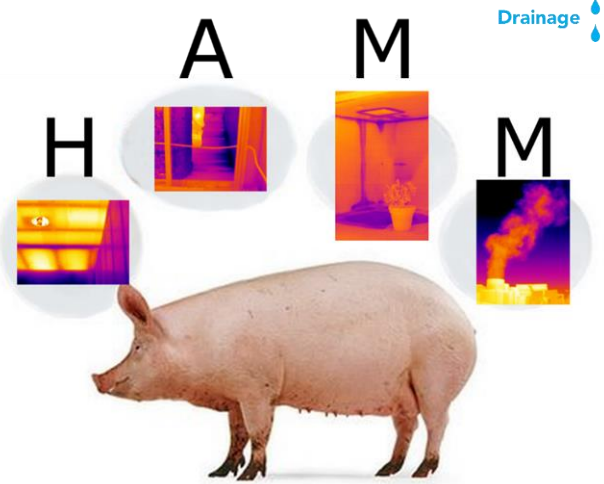
Heat flow, Air flow and Moisture flow through the building enclosure

HAMM









BUILDING ENCLOSURES

The enclosure has four "controlling" functions, elements or barriers.

That control the physical, chemical and biological reactions.

- Heat
- Air
- Moisture liquid
- Moisture vapor

Basic Requirements for a Wall Assembly

- The assembly provides separation between the conditioned space and the exterior

Dr. Neil Hutcheon 1963

They need to:

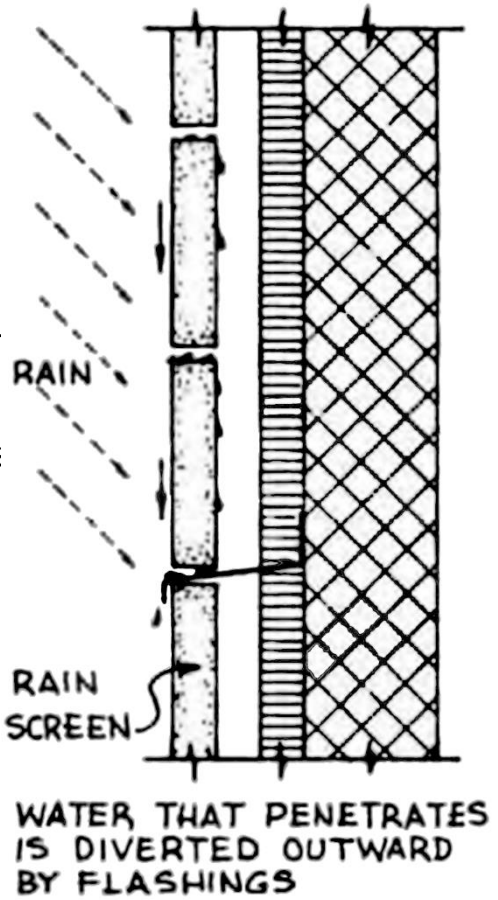
- Control Heat, Air, Moisture flow
- Control rain
- Control vapor
- Control rain penetration
- Control light, solar & other radiation
- Control noise & vibration
- Control fire
- Provide strength and rigidity
- Be durable
- Be of economic value
- Be of aesthetic value

Ventilated Rainscreen History

- Stave Church in Norway 1130 Oldest example of a ventilated rainscreen
- The Norwegian concept was advanced in the 1950s into Canada as an “open rain screen”

Rainscreen Cladding History

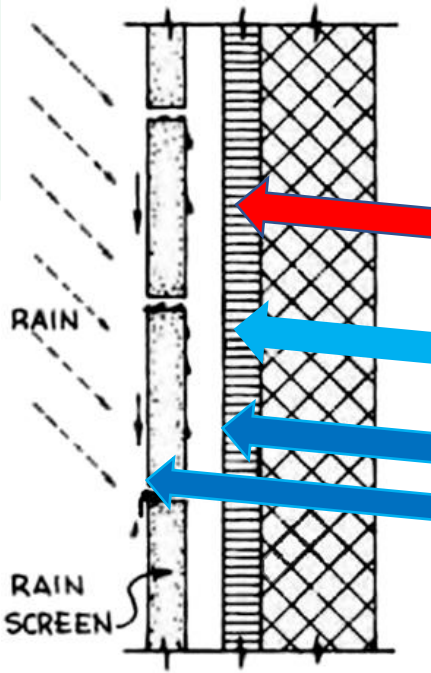
- *"This screen could be applied so that water vapour coming from within is automatically removed by ventilation of the space betweer wall and screen."*
  Johansson (1946), *The Influence of Moisture on the Hea for Bricks.*
- *"…cavities should be ventilated to outside, by air passages through the outer withe."*
  Hutcheons (1953), *Fundamental Considerations in the Design of Exterior Walls for Buildings*



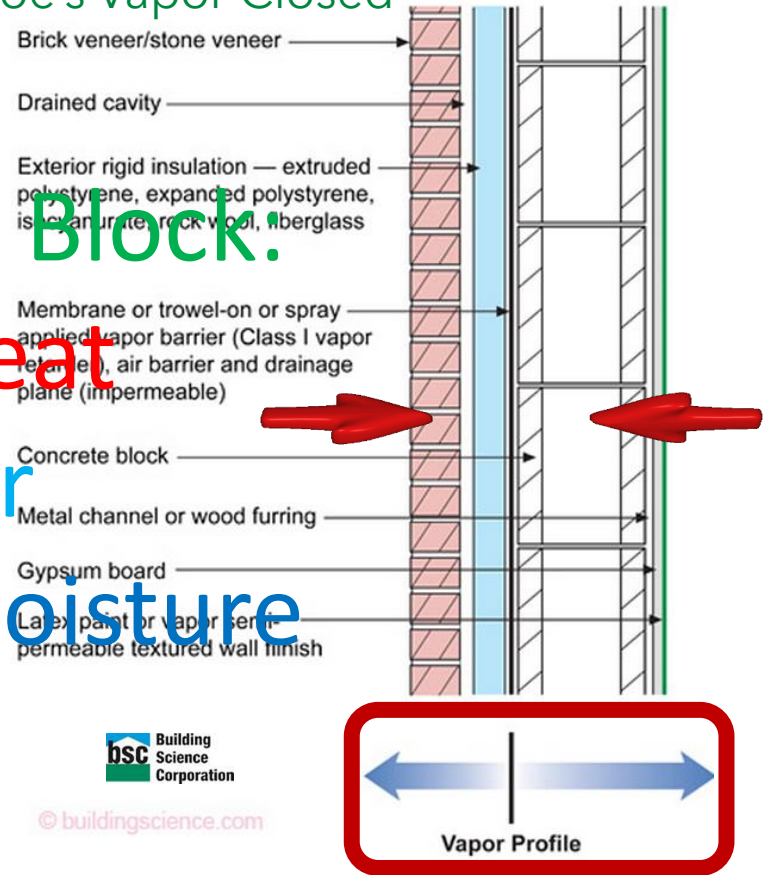
Hutcheons' 1964 The Perfect Wall

Wall Assembly Evolution – "The Perfect Wall"

1964 Hutcheons'



2010 Dr. Joe's Vapor Closed

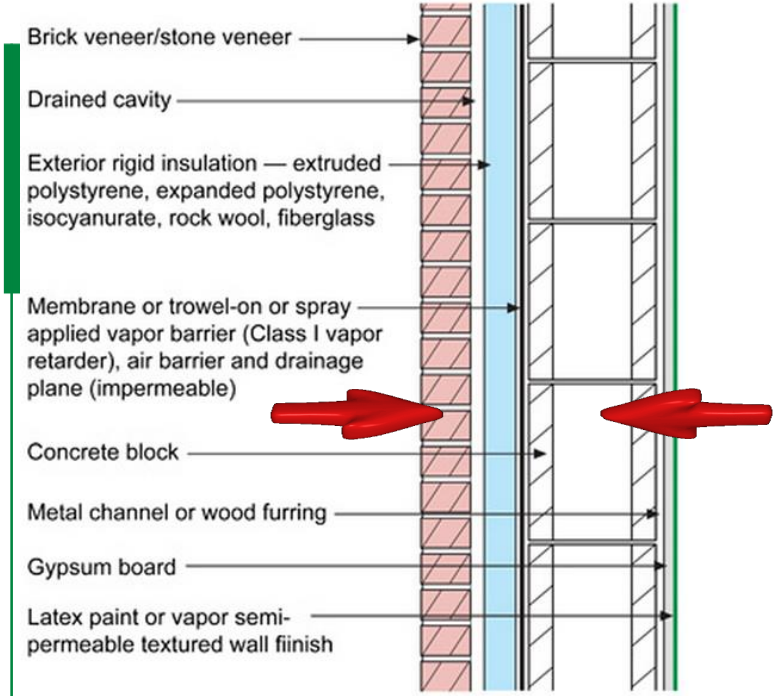


Must Block:

- Heat
- Air
- Moisture

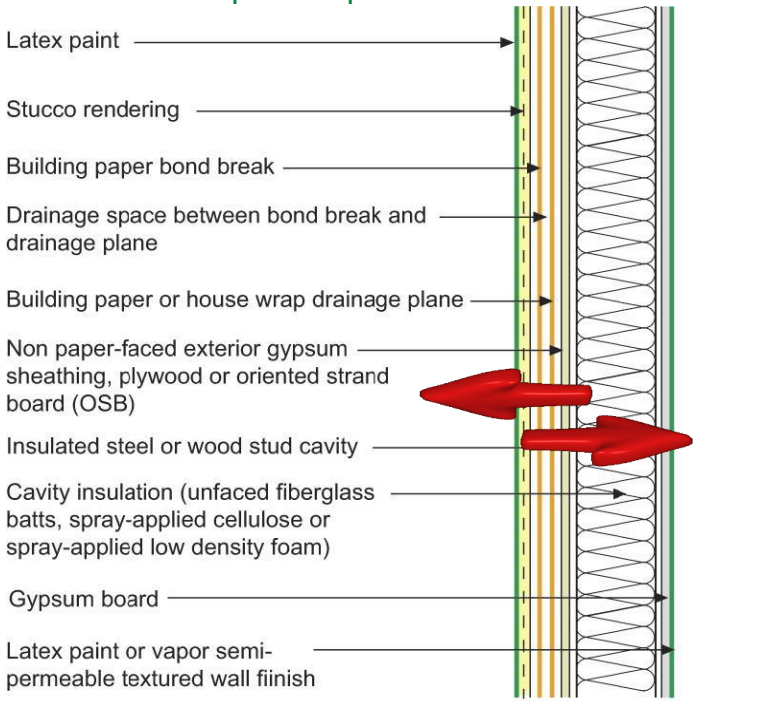
Wall Assembly Evolution – The New Perfect Wall

2010 Dr. Joe's Vapor Closed



2015.12 Joseph Haydn Does the Perfect Wall

Dr. Joe's Vapor Open



bsc Building Science Corporation

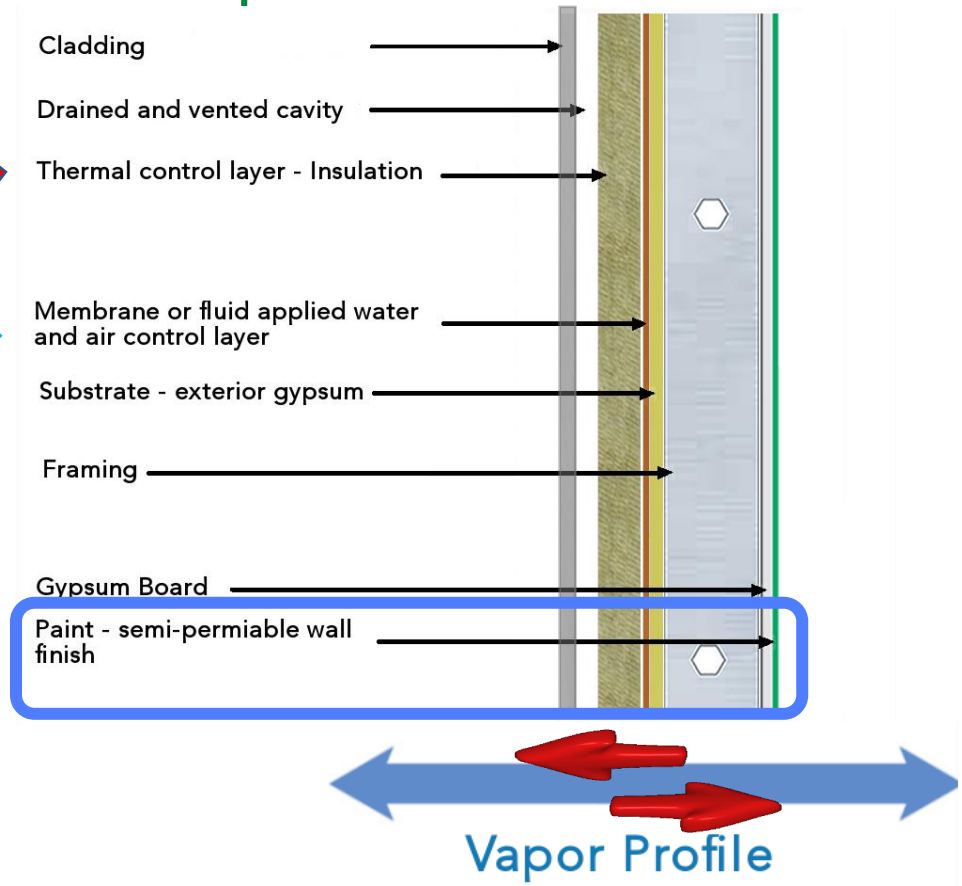
2011.04.15 BSD-106: Understanding Vapor Barriers

“The Perfect Wall” – Simplified

Controls:

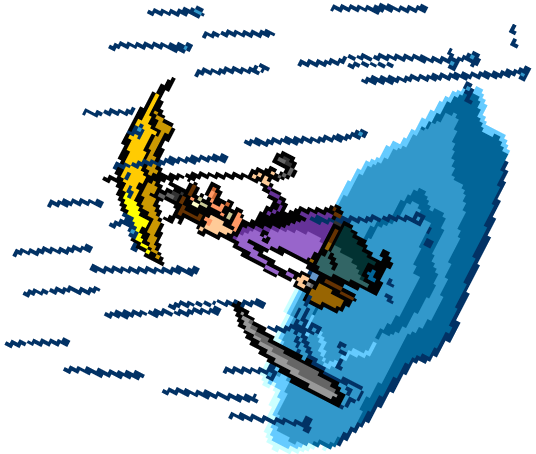
- Heat flow
- Air flow
- Moisture flow

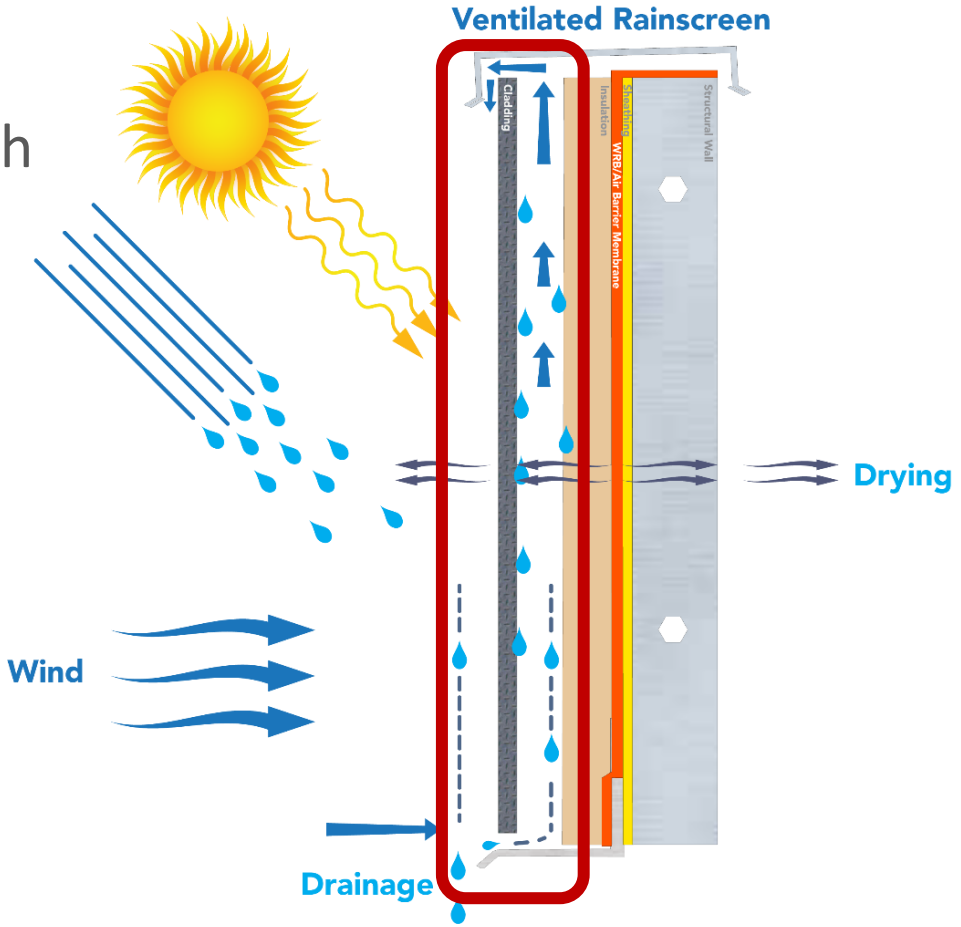
- Vapor **Open** Allowing vapor movement for vapor diffusive drying in both directions



What is a Ventilated Rainscreen?

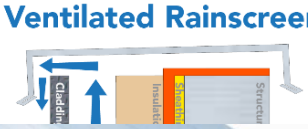
- Cladding “umbrella” with a Vented and Drained cavity





Rainscreen Cladding Provides

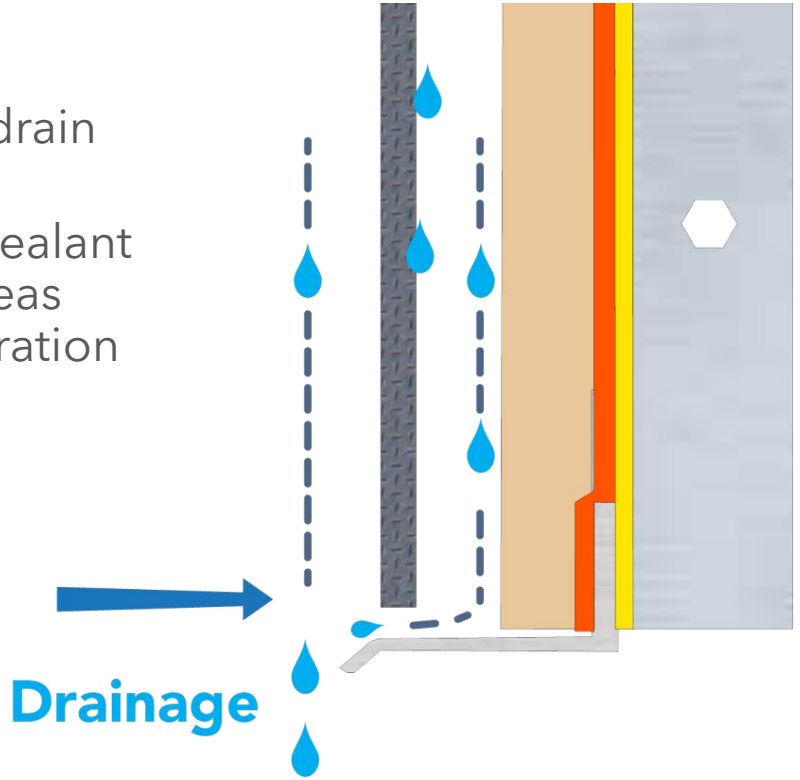
- Cladding Provides:
  - Aesthetics



Ventilated Rainscreen Advantages

Drainage Benefits:

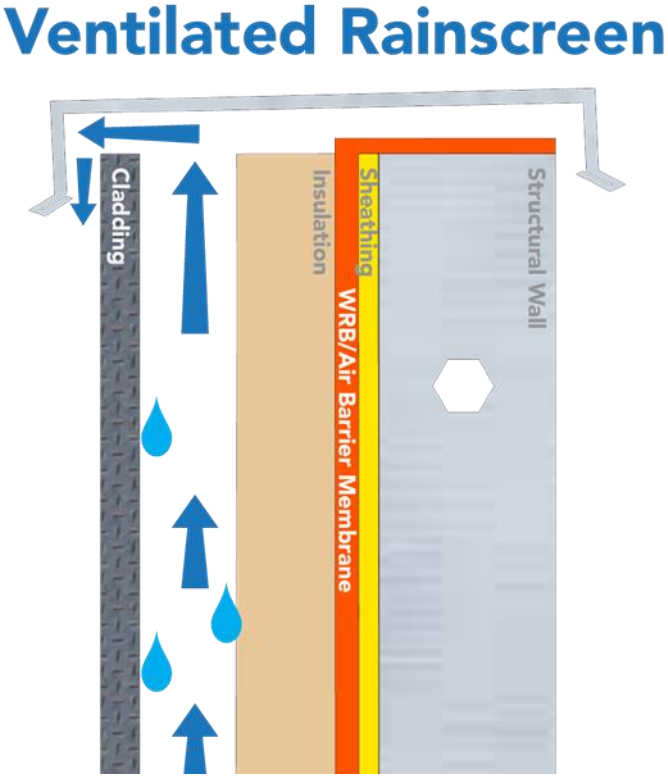
- Allows cavity moisture to drain away from the structure
- Water will not impede at sealant joints, cracks and other areas vulnerable to water penetration



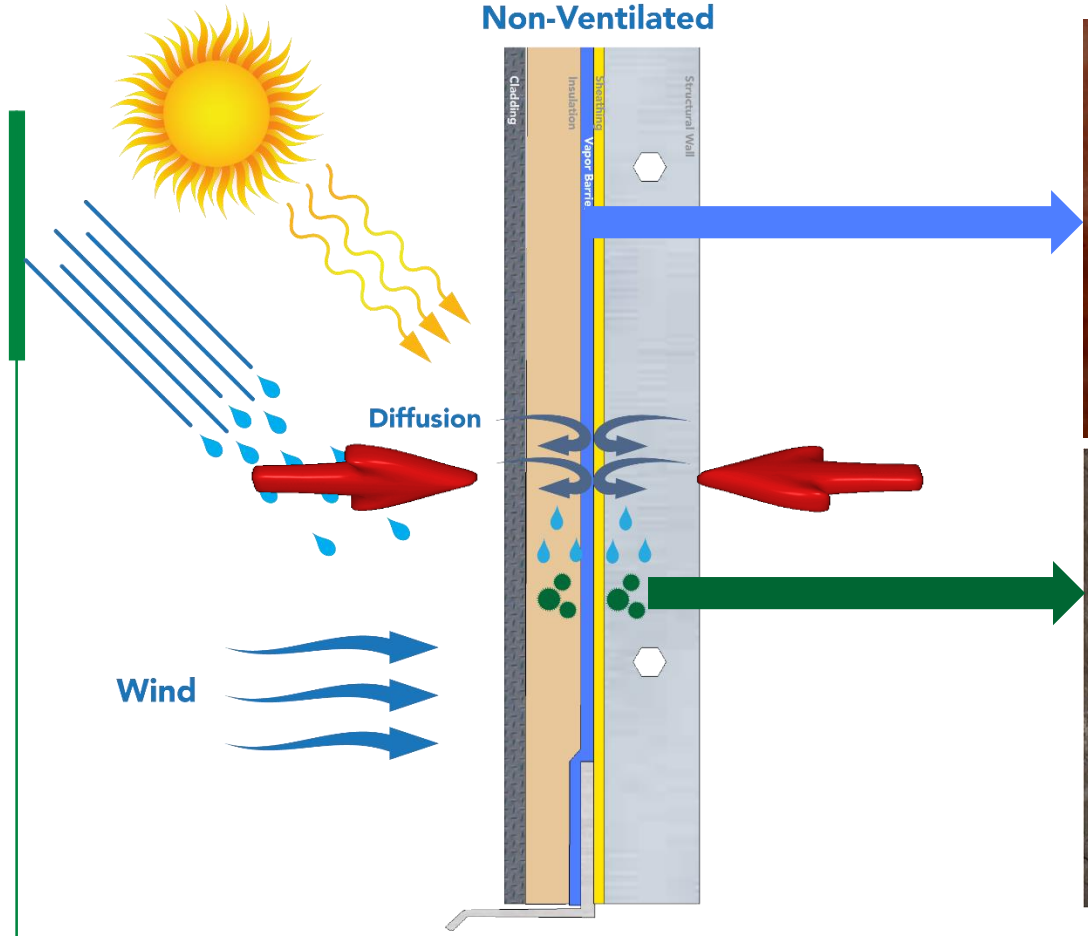
Ventilated Rainscreen Advantages

Venting Benefits:

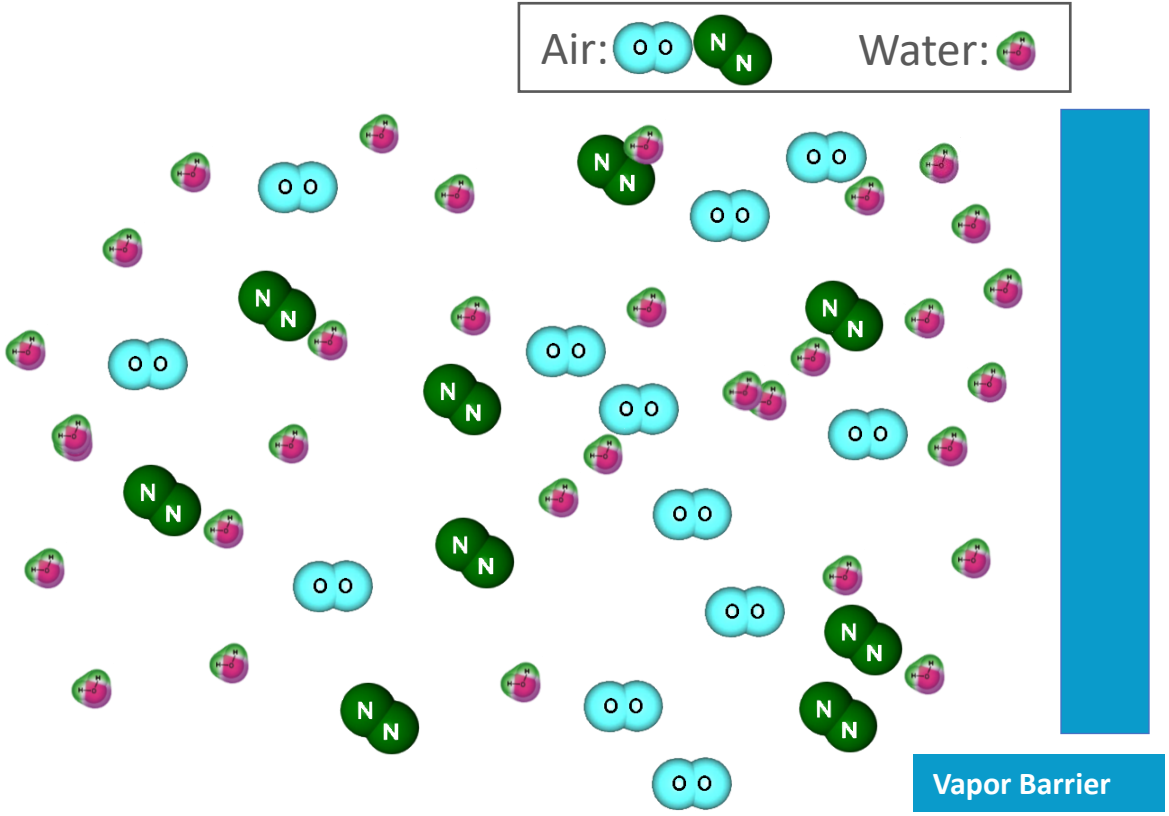
- Venting helps dry remaining moisture
- Enhances vapor diffusive drying
- Reduces reverse vapor drive

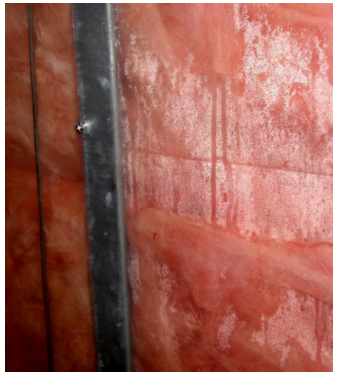


Non-Permeable Membrane DISADVANTAGES



Non-Vented, Non-Permeable Membrane

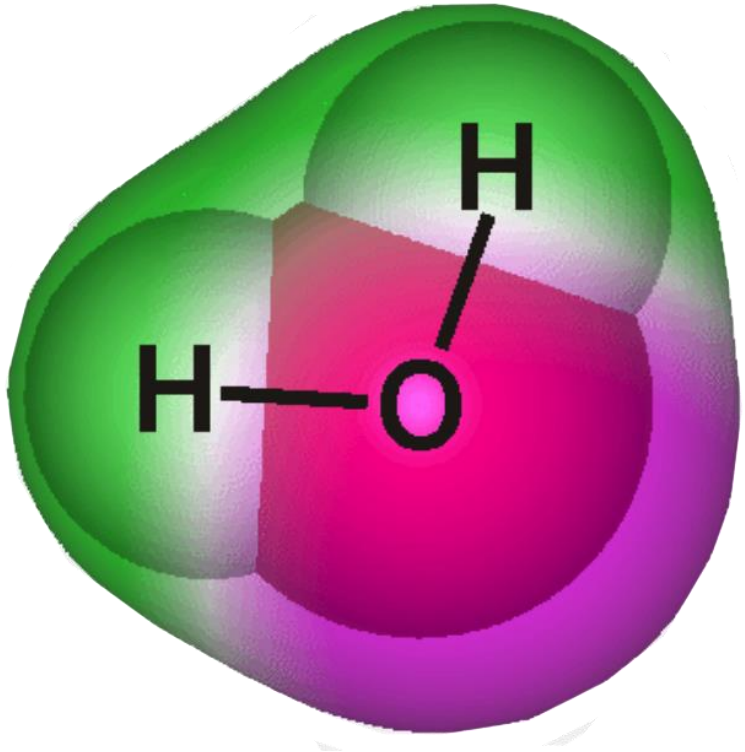




Water Tight, Air Tight, Water Vapor Open?

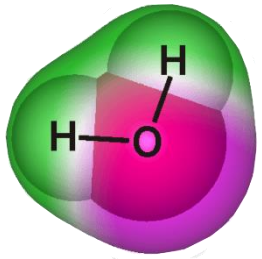
- but not leaking?
  - Water vapor in the air is a gas, **invisible to the eye**
  - Water Vapor Transmission is only measured through solids

    US PERM= grains/ft^2•hour•inchHg

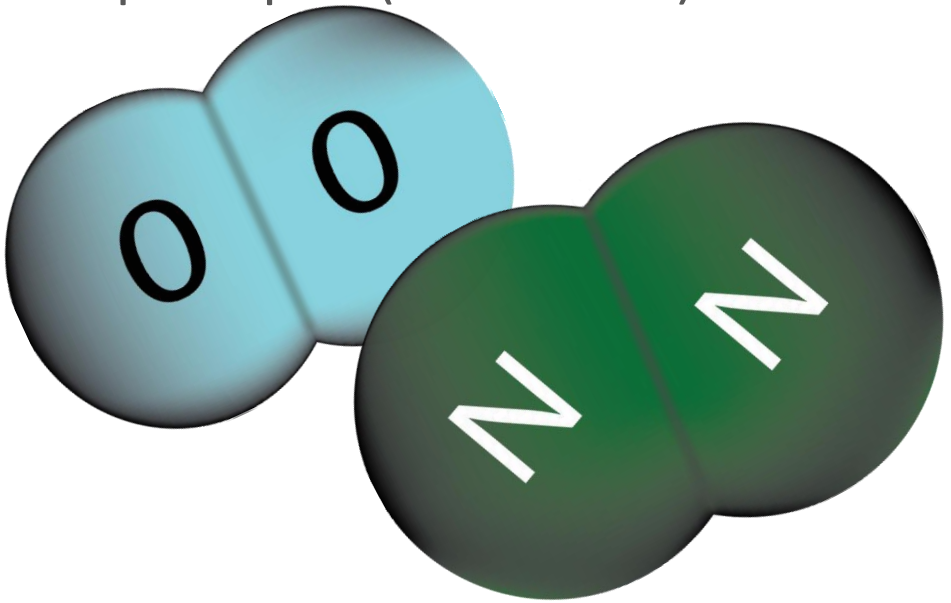


Vapor Open vs. Non-Permeable Membranes

- How can a WRB/AB be Vapor Open (Permeable) and Air Tight?
- Water molecules are 25% smaller than Air Molecules



Water molecule = 275 picometers (pm)

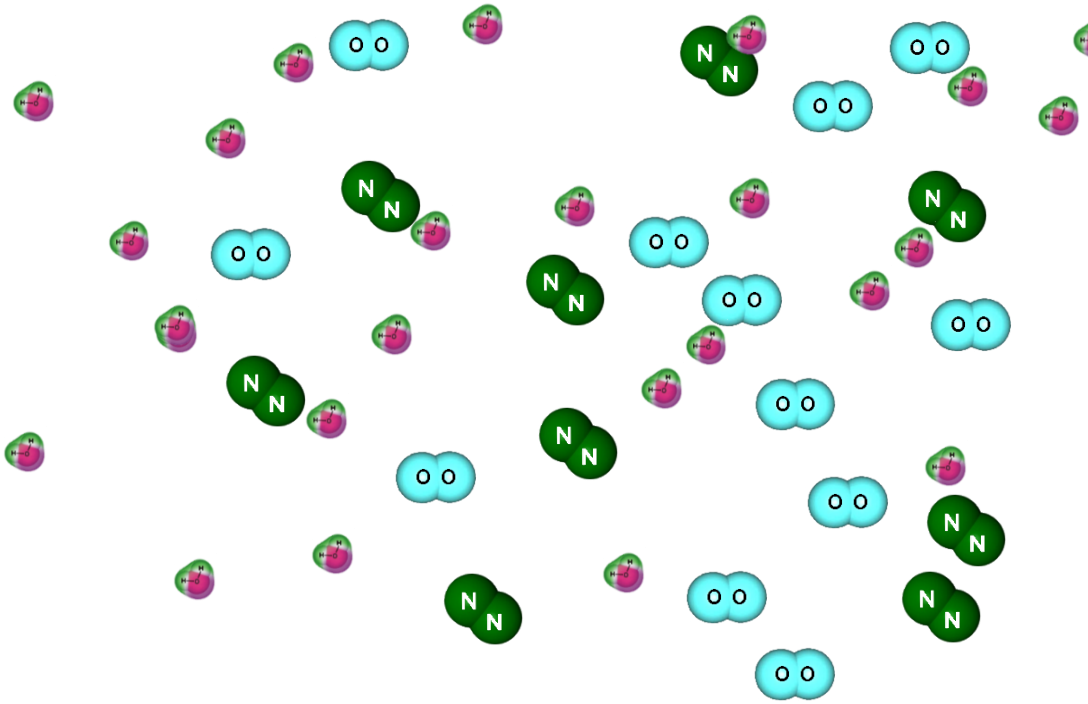


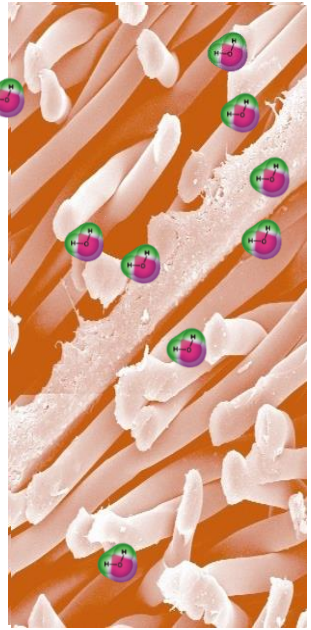
Air molecule = 320-370 pm

Vapor Open Membrane and Air Barrier

Water escapes because it is smaller than air

Air: O O N N Water:



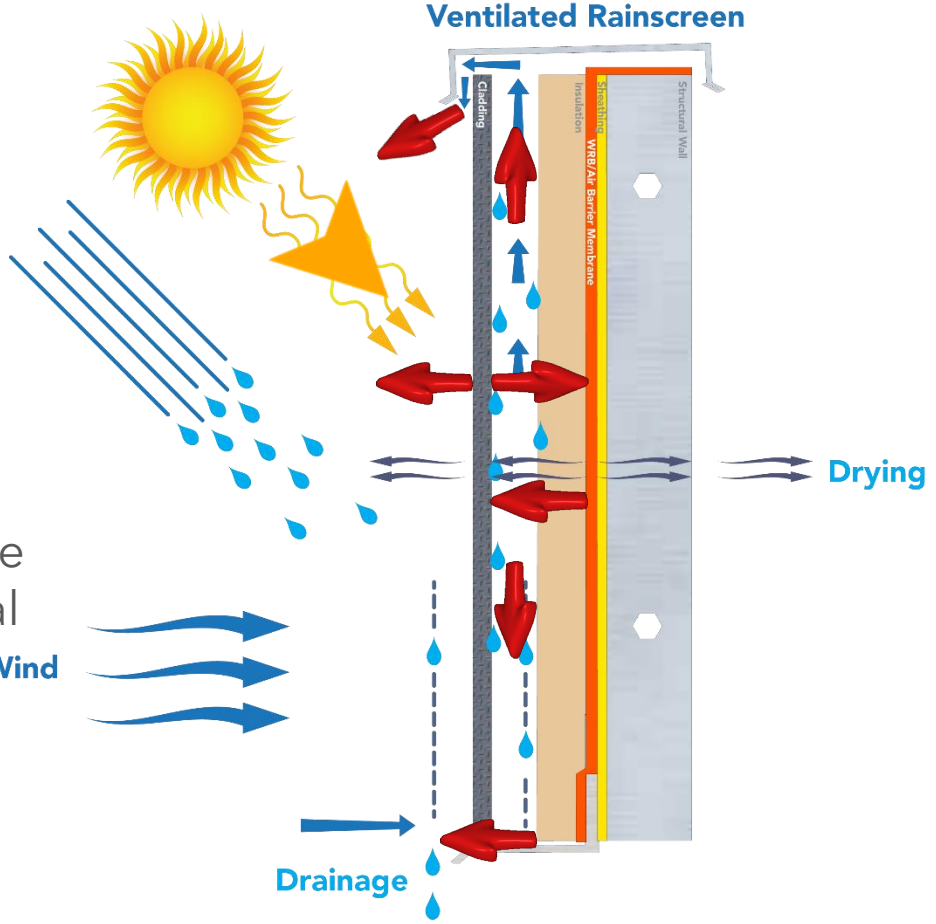


Breathable or "Vapor Open" WRB/Air Barrier membrane

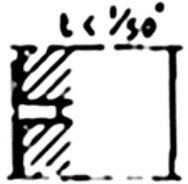
Vapor Escapes

Ventilated Rainscreen ADVANTAGES

- Promotes Drainage and Drying
- Boosts drying of Cladding
- Enhances vapor diffusion with a permeable WRB/AB membrane
- Mitigates reverse vapor drive Enhances: Buoyancy, Natural Convection or Stack Effect
- Reduces heat transfer from the cladding



Rainscreen Cavity Size

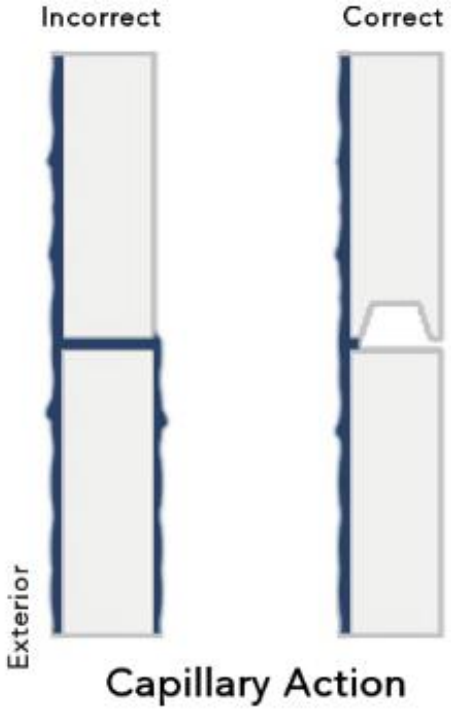


Capillary Break that allows free drainage

- Minimum 0.5 – 1.0 mm (1/16″)
- Typical in construction at 3 - 7 mm (⅛″ - ¼″)

WBDG
WHOLE BUILDING DESIGN GUIDE
a program of the
National Institute of Building Sciences

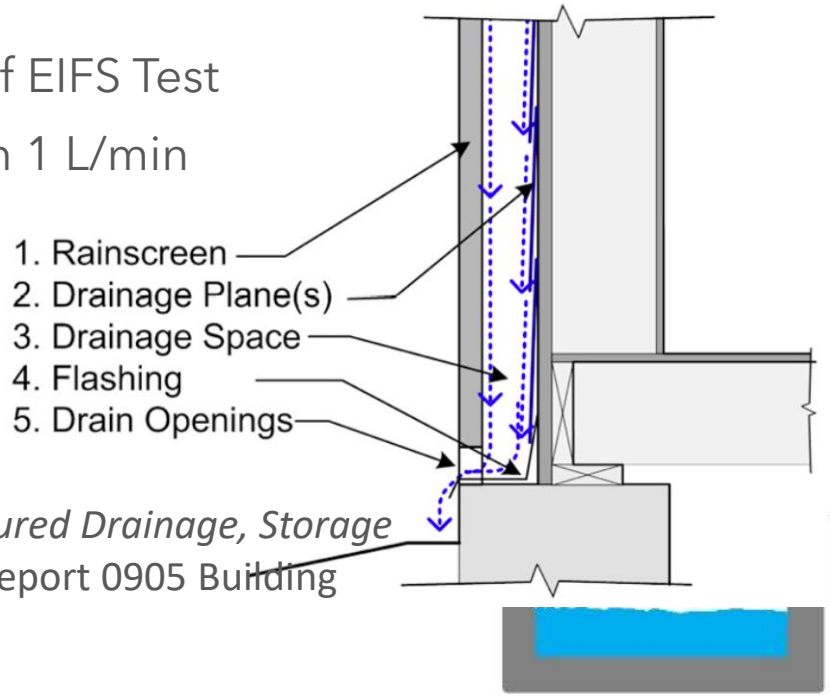
- 6.4-12.7 mm (¼” - ½”)



Rain Screen Cavity Size

Drainage

- ASTM E2273 Drainage efficiency of EIFS Test
- A 0.5 – 1.0 mm gap can easily drain 1 L/min
  - Hydrogap: 1.0 mm
  - DrainWrap: 0.1 mm
  - RainDrop 3D: 0.5 mm
  - TamlynWrap Drainable Housewrap: 1.5 mm
  - Valeron Vortec: 0.08 mm



J.F. Straube, J. Smegal, 2009. *Modeled and Measured Drainage, Storage and Drying Behind Cladding Systems*. Research Report 0905 Building Science Corporation

Smegal, 2006, Thesis (Ph. D.) University of Waterloo

2021 IBC Rain Screen Cavity Size

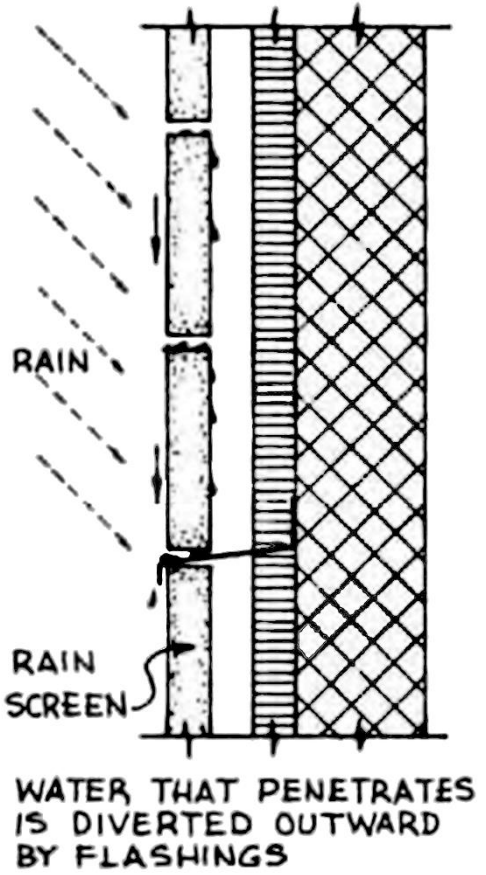
Drainage Cavity Required

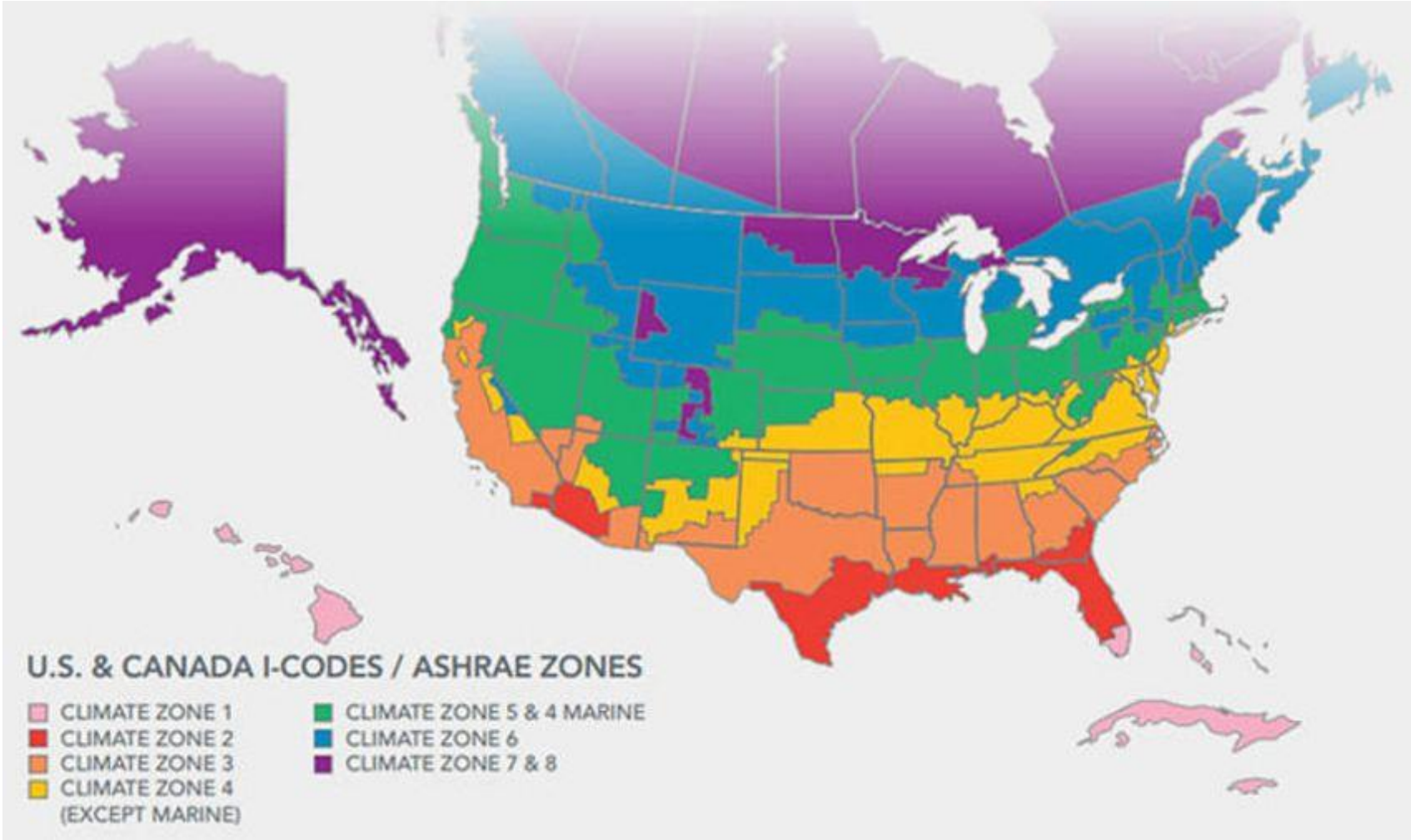
- ASTM E2273 Drainage efficiency of EIFS Test

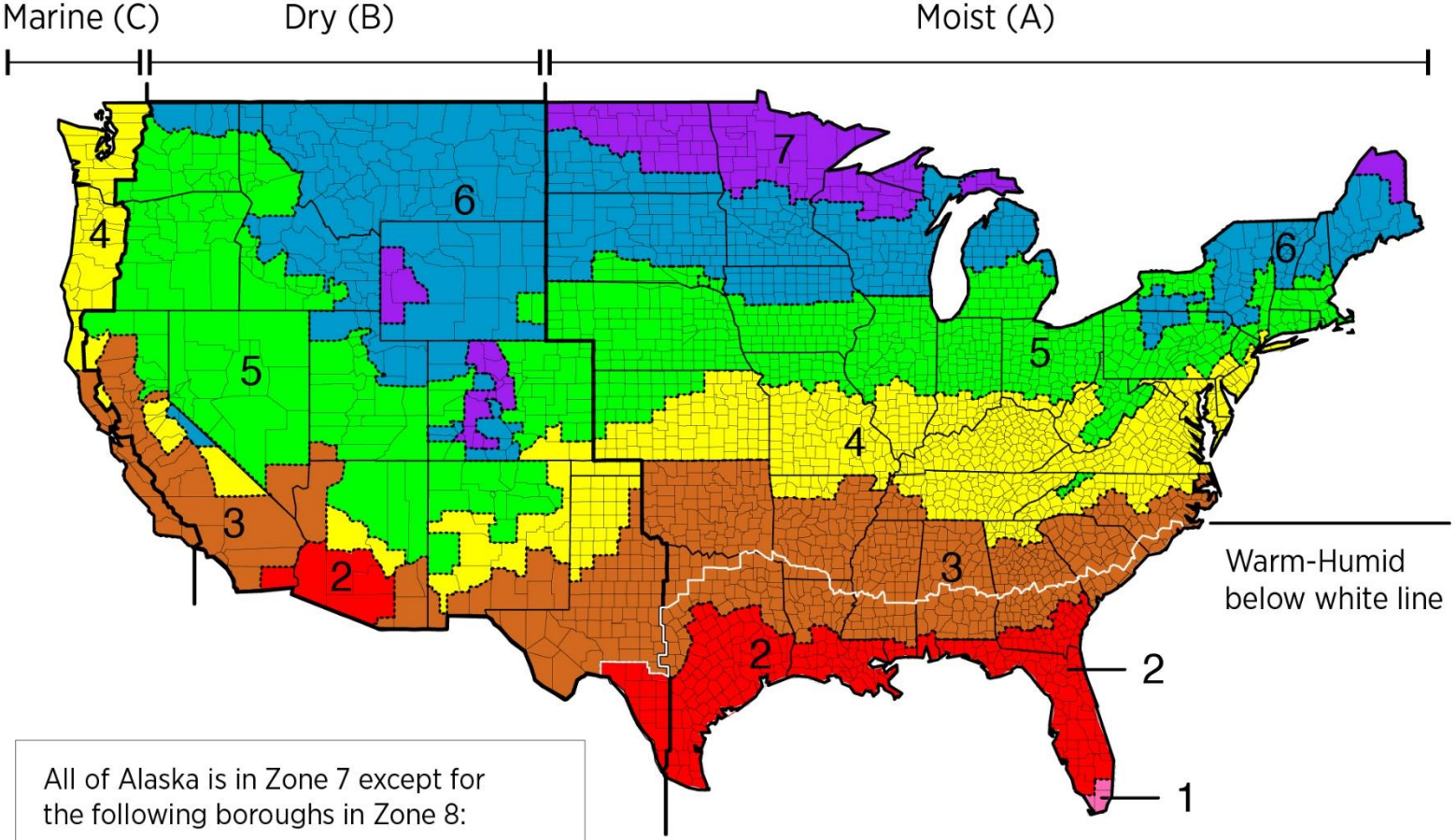
  Drainage must be 90% or greater

- A 4.8 mm ($^{3}/_{16}^{th}$) gap required

2021 IBC Chapter 25, “Gypsum Board, Gypsum Panel Products and Plaster,” section 2510.6.2, for moist or marine climate zones, a WRB shall comply as noted above.




U.S. & CANADA I-CODES / ASHRAE ZONES
CLIMATE ZONE 1
CLIMATE ZONE 2
CLIMATE ZONE 3
CLIMATE ZONE 4
(EXCEPT MARINE)
CLIMATE ZONE 5 & 4 MARINE
CLIMATE ZONE 6
CLIMATE ZONE 7 & 8



All of Alaska is in Zone 7 except for the following boroughs in Zone 8:

Bethel, Northwest Arctic, Dellingham, Southeast Fairbanks, Fairbanks N. Star, Wade Hampton, Nome, Yukon-Koyukuk, North Slope

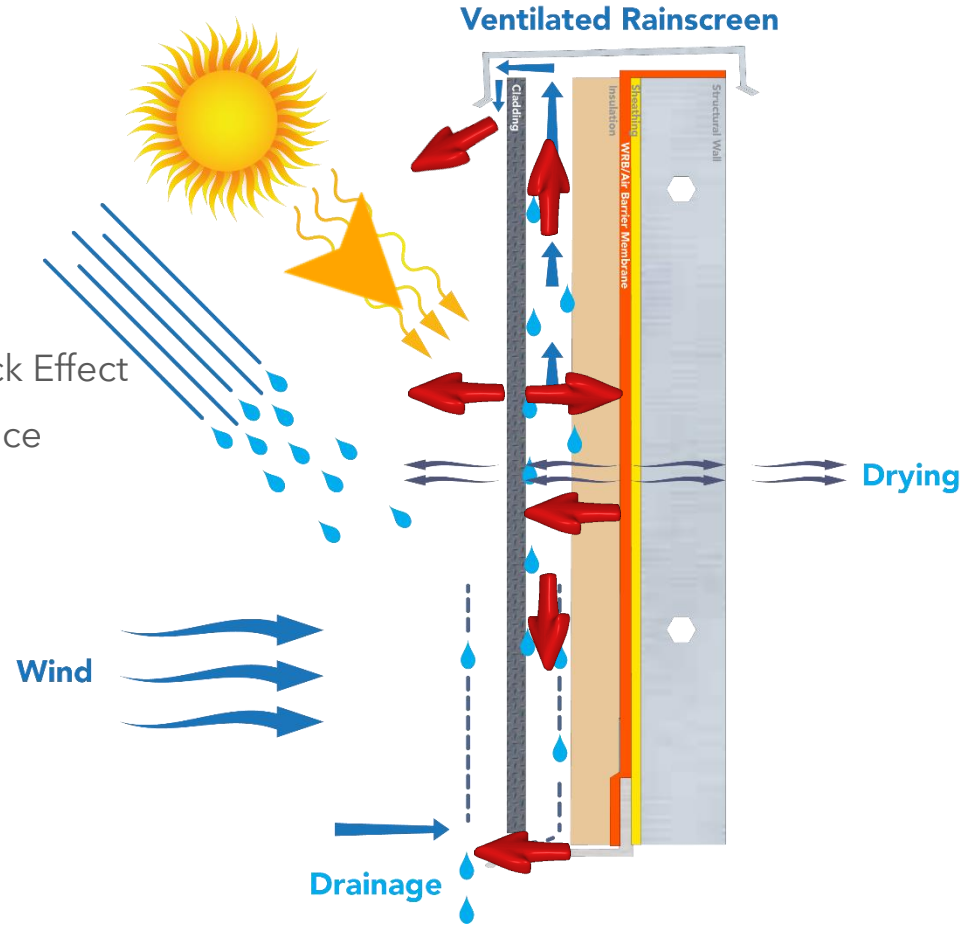
Zone 1 includes Hawaii, Guam, Puerto Rico, and the Virgin Islands

Rain Screen Cavity Size

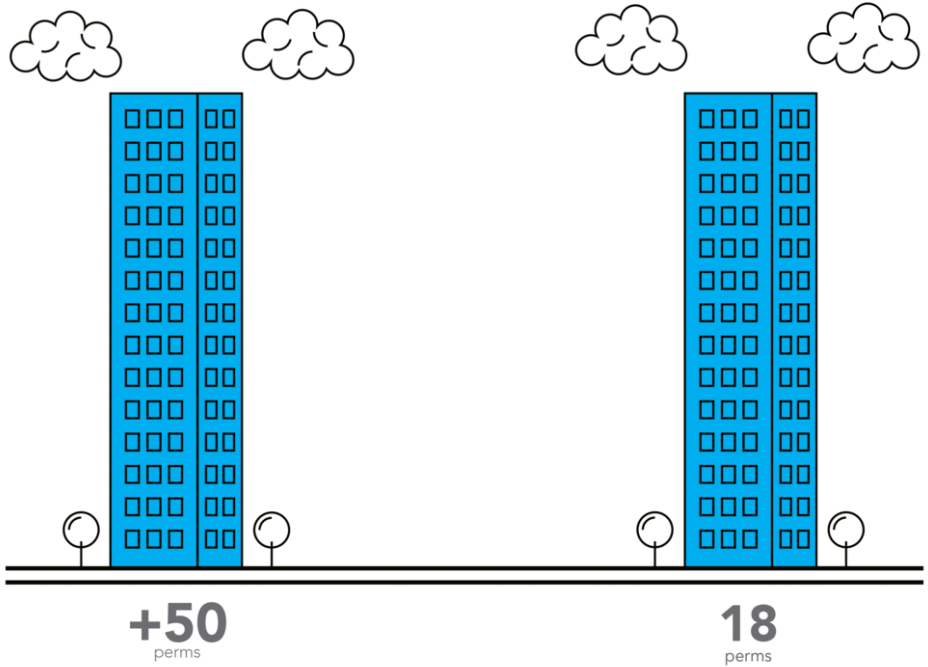
Venting

- Code references 25 mm (1″) for Brick
  Good drainage
- >7 – 10 mm ($^1/_4$″-$^3/_8$″) allows venting:
  Buoyancy, Natural Convection or Stack Effect

  Driven by temperature difference
- Enhances Cladding drying
- Enhances vapor diffusive drying
  Higher the PERMS, faster the drying



Vapor Open WRB/AB High Drying Capacity: Proven by Science



Vapor Open WRB/AB High Drying Capacity

- 14 WRB materials were evaluated for diffusive drying
  - 3 fluid applied WRB
  - 11 membranes some with primer as per manufacture

Vapor Open WRB/AB High Drying Capacity

- 1’x1’ plywood samples were saturated with water
- WRB/AB installed on ½ of the plywood
- Samples placed in drying chamber

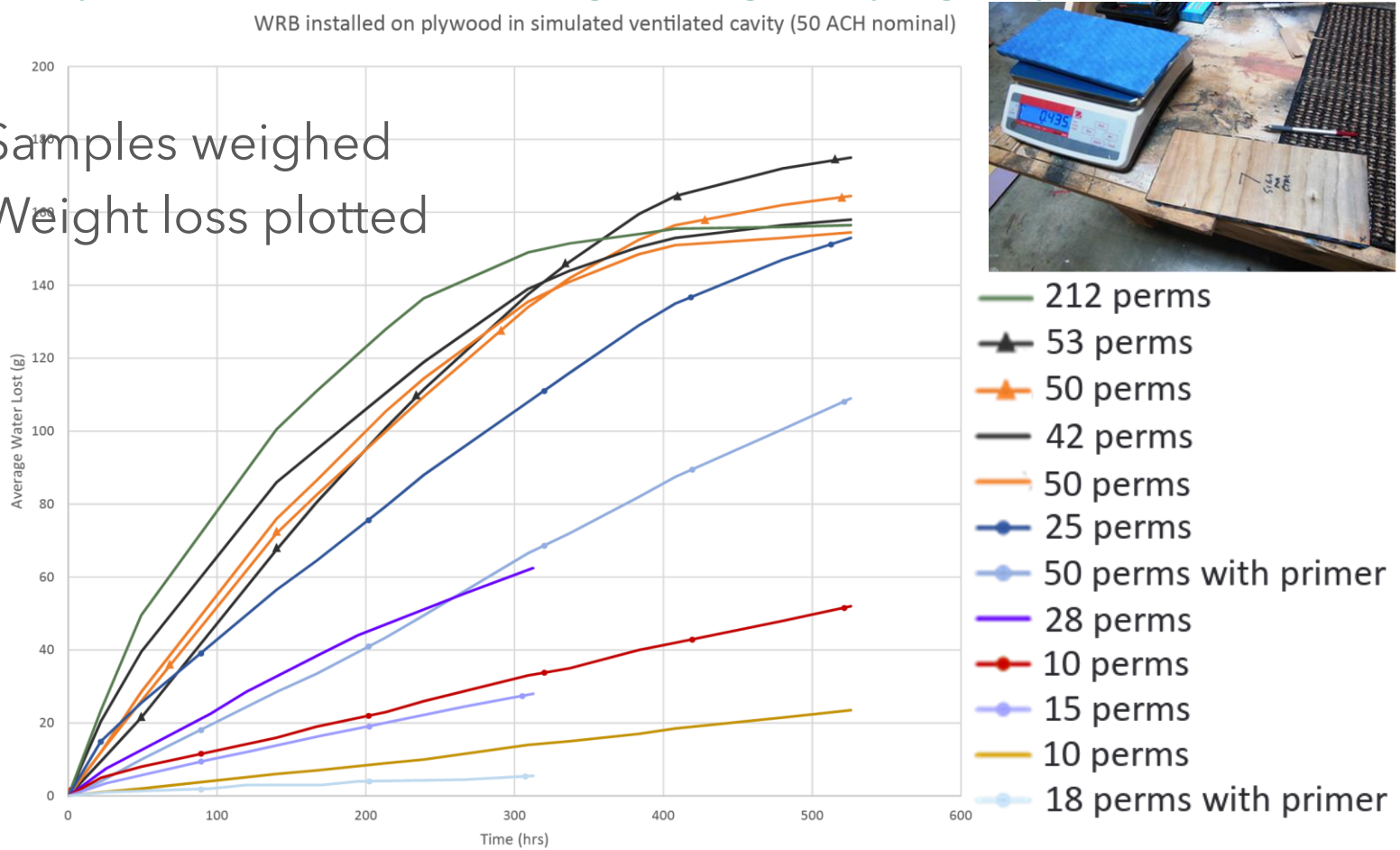
50 Air Change Hour (ACH)

21.7 °C (71 °F) ± 5%

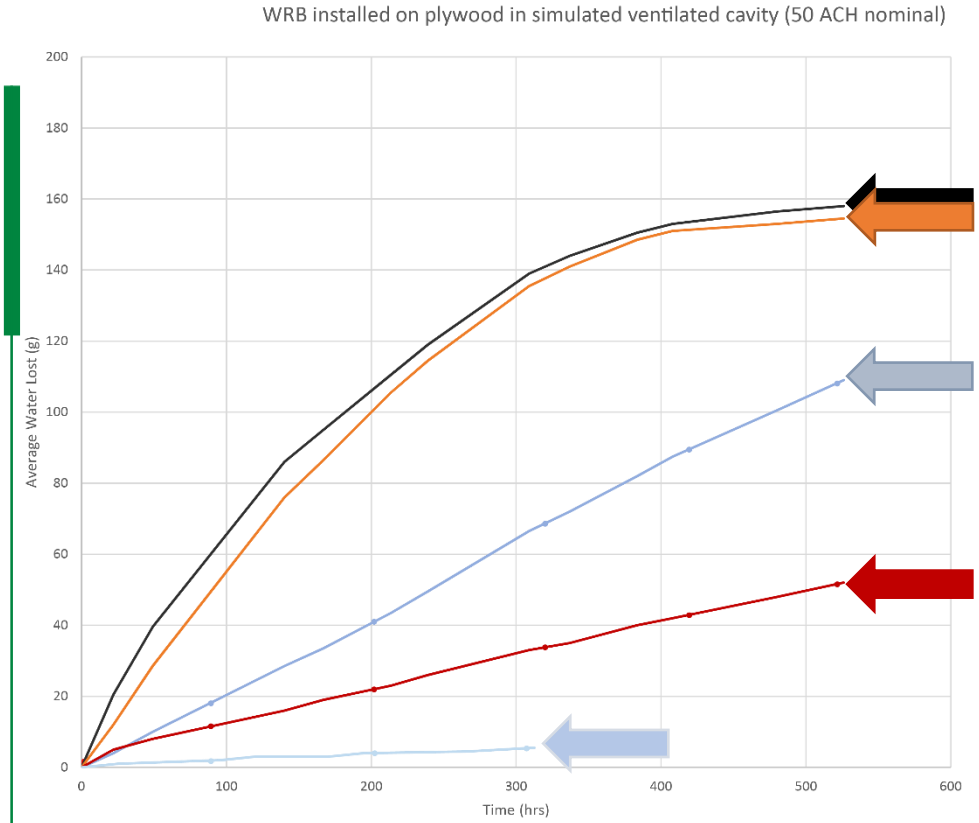
54% RH ± 8%

Vapor Open WRB/AB Advantages: High Drying Capacity

- Samples weighed
- Weight loss plotted



Vapor Open WRB/AB High Drying Capacity



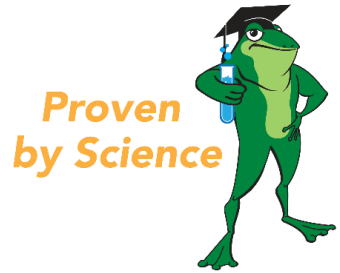
57 perms

50 perms

50 perm product with primer

10 perm product

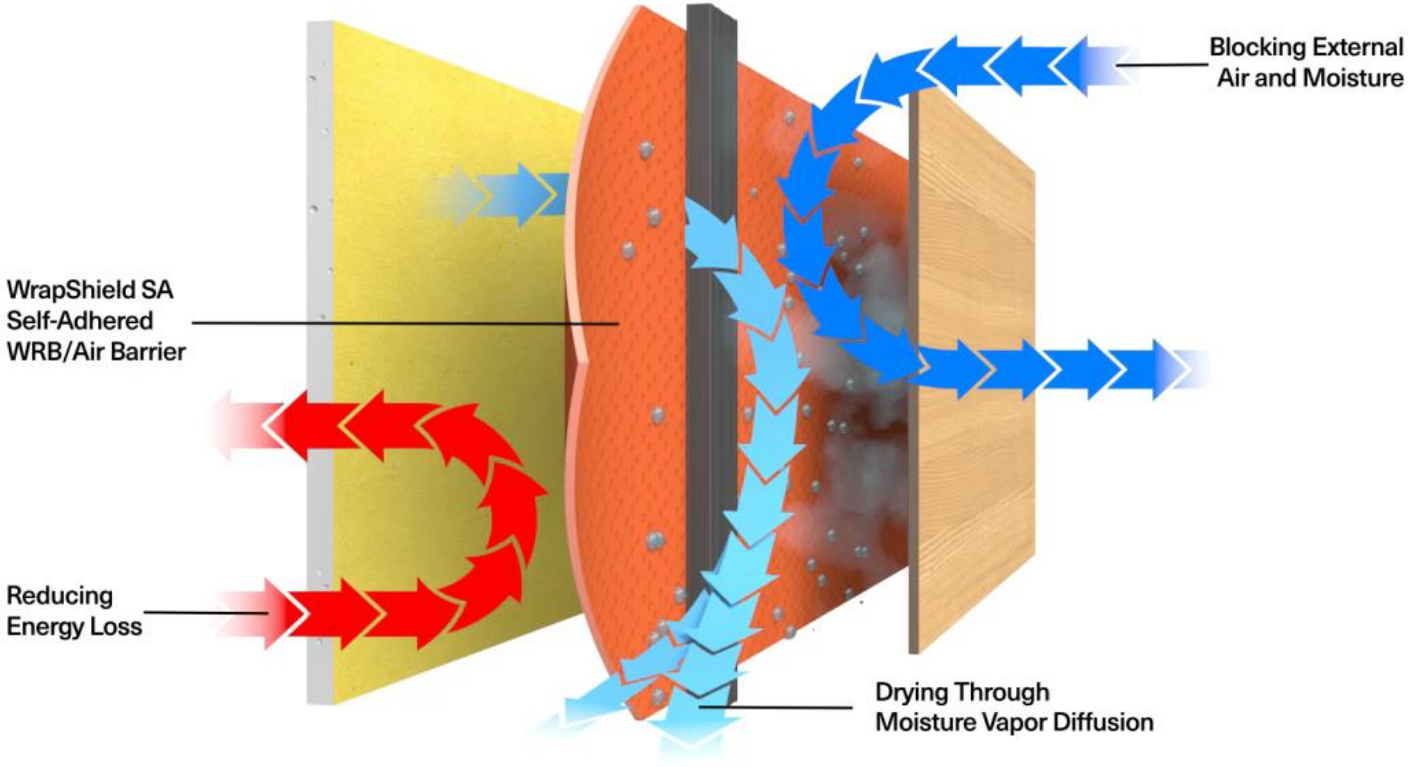
18 perm product with primer



Weather Resistive Barrier Comparative Drying Study

Project: #1402-1012, Author: BEE Building Envelope Engineering, Seattle, WA

Permeable Membrane + Ventilated Rainscreen



Rain Screen Details: Self-Adhered Shims

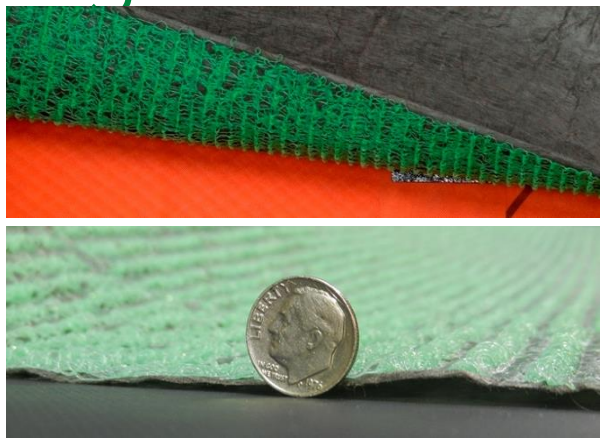
- Simple
- Easy
- Effective
- Seals (gaskets) Fasteners
- Adds Thermal Break
- Minimal Cost
- ⅛″ (3 mm) or ¼″ (6 mm)

Rain Screen Details: Self-Adhered Shims

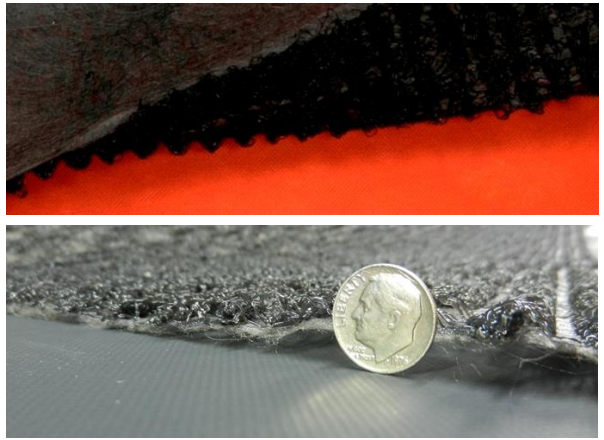
Rain Screen Details: Drainage Mat

- Installed over WRB/AB
- Positive drainage cavity
- Multiple depths: 3 mm or 7 mm
- Increases building envelope

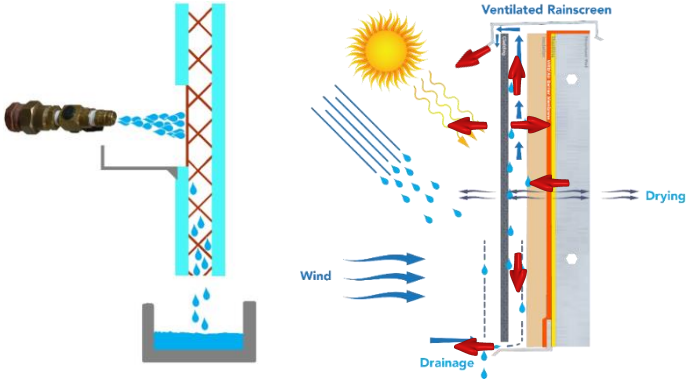
3 mm (⅛”)



7 mm (¼”)

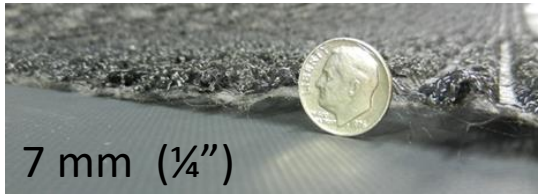


Drainage and Drying



Rain Screen Details: Multiple Claddings

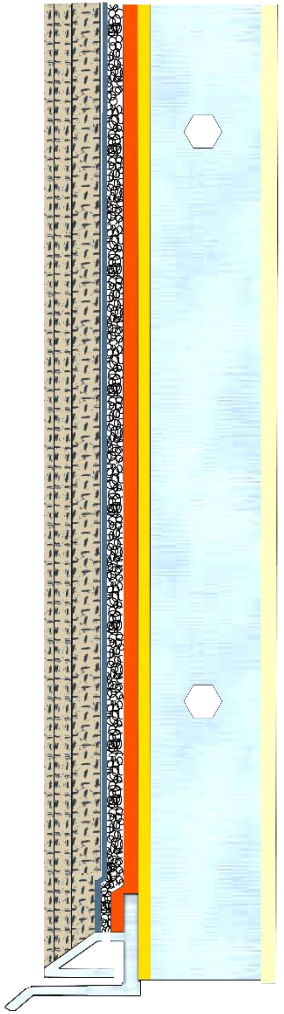
Rain Screen Details: Stucco



- Drainage matrix is installed over the vapor open WRB/Air Barrier, behind stucco

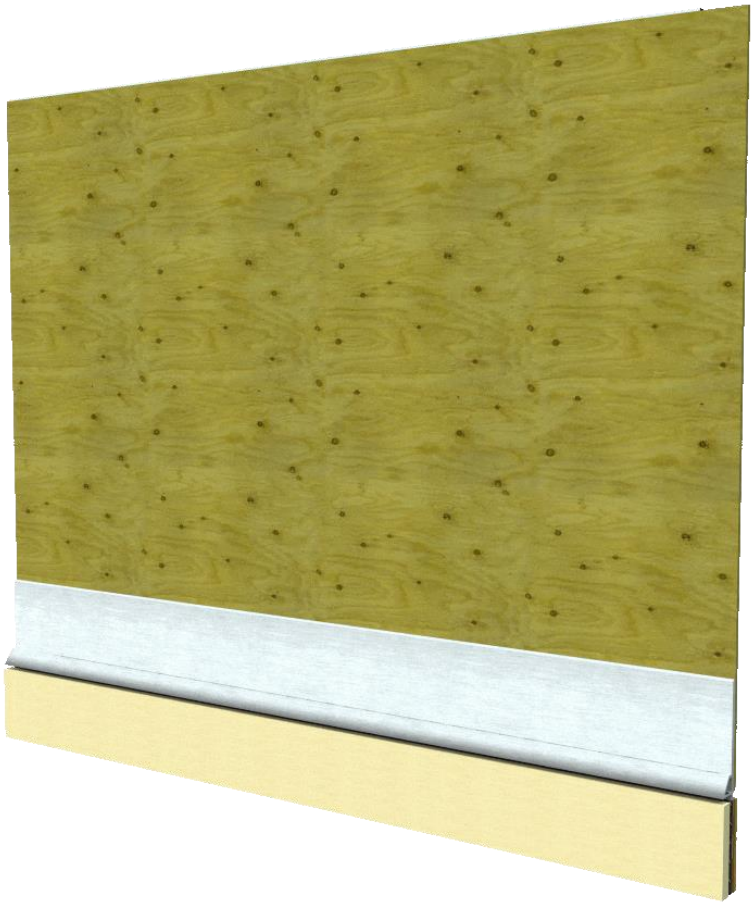
Concealed WRB

- Moist Climates
  It rains in all climates!
- Required 4.8 mm ($^{3}/_{16}^{th}$)
- For proper drainage and drying



Rain Screen Details: Stucco

Rain Screen Details: Stucco



Rain Screen Details: Brick

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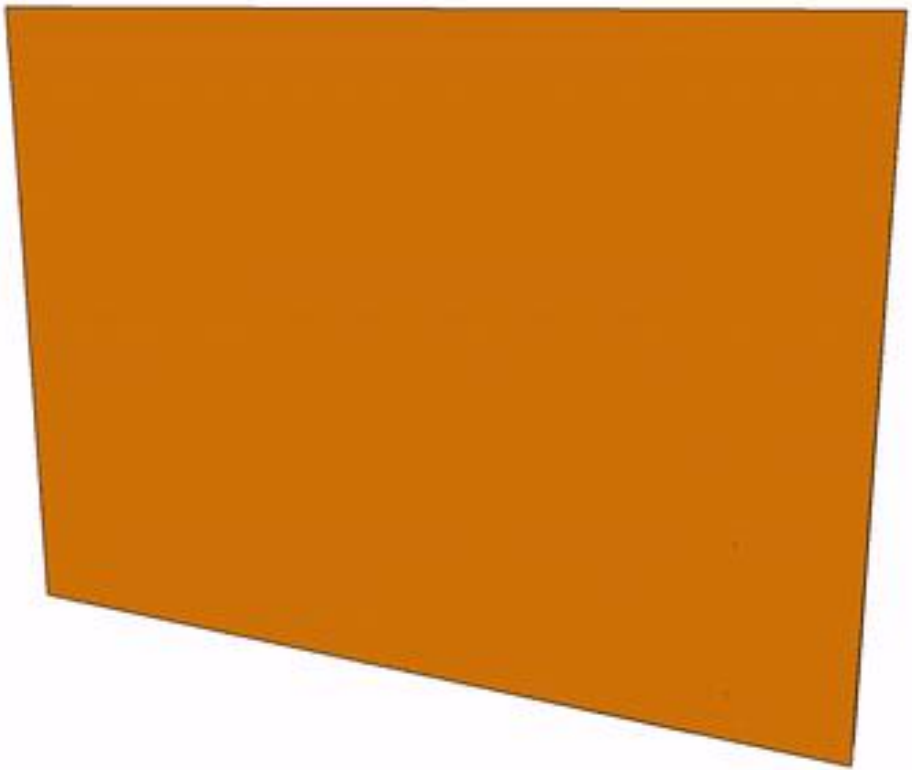
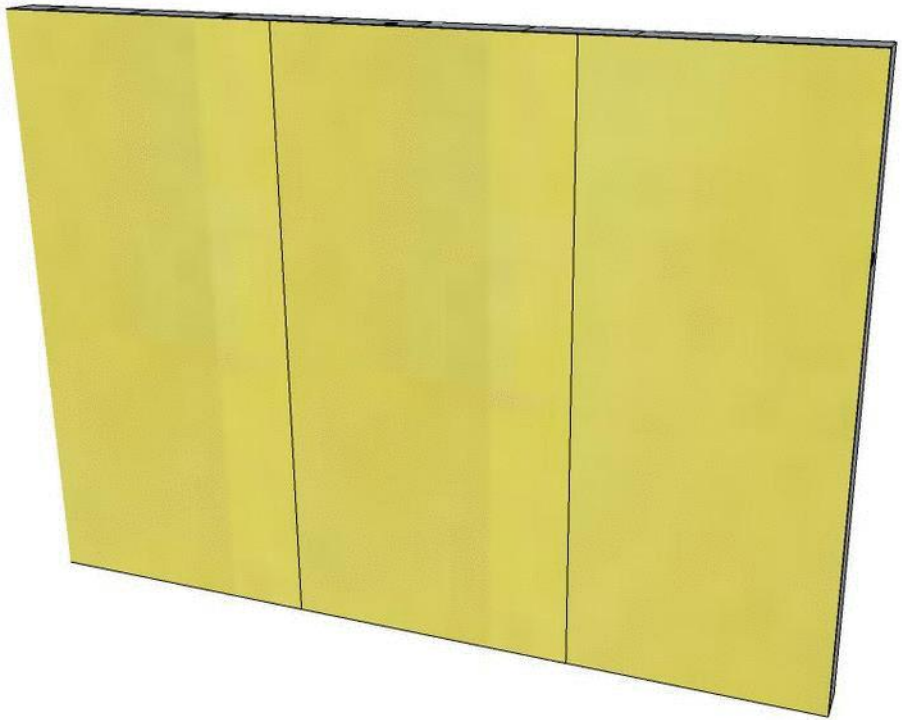


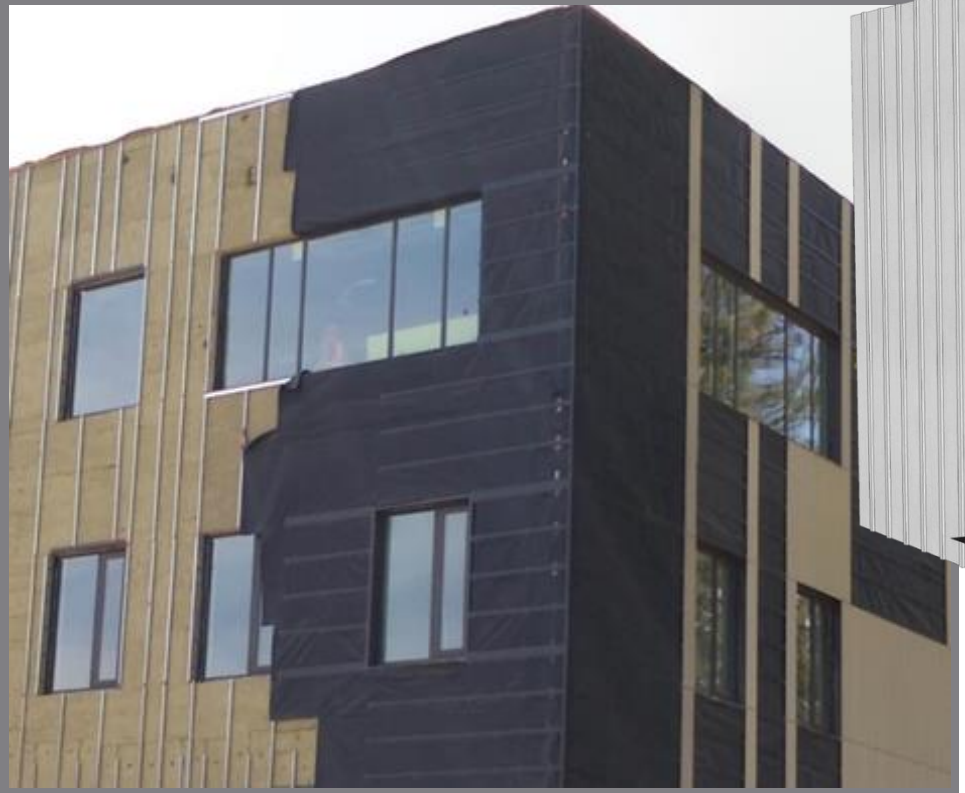
Rain Screen Details: Open Joint

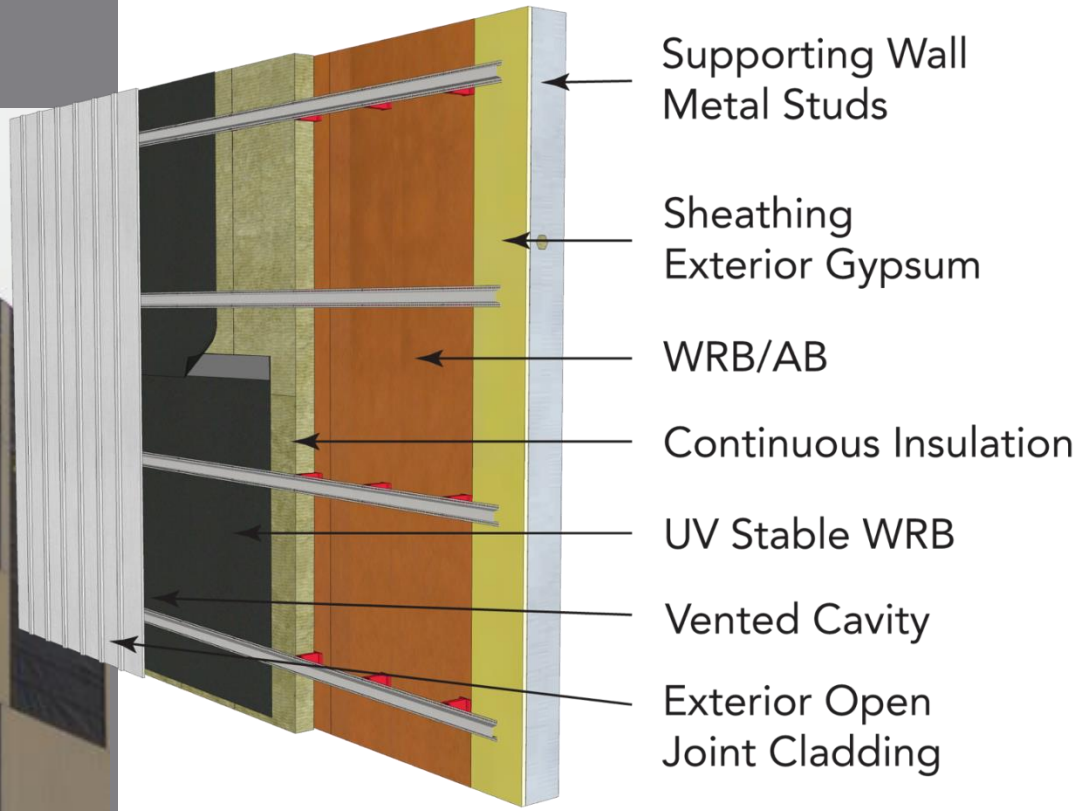
- Vapor open WRB/Air Barrier (black) for open joint cladding
- Girts create rain screen

Rain Screen Details: Open Joint



UV Stable Vapor Open WRB/AB





Summary

- Building science of a wall assembly
- The building enclosure envelopes the building
- History of the Rainscreen
- What is a ventilated rainscreen design
- Evolution of the perfect wall
- Cladding and its function
- Functions provided by the Rainscreen
- Vapor tight and highly vapor permeable WRB membranes
- Benefits of a ventilated vapor open WRB/Air Barrier wall assemblies
- Testing drying capacities of WRB/Air Barrier systems in a simulated Rainscreen
- Rainscreen components to building a ventilated rainscreen cavity
- Rainscreen Cladding Systems

THE BENEFITS OF RAINSCREEN DESIGN

- For additional AIA presentations please go to:
https://vaproshield.com/technical-resources/educational/aia

THANK YOU FOR YOUR TIME

VAPROSHIELD®
Breathable Membrane Systems for Roofs & Walls