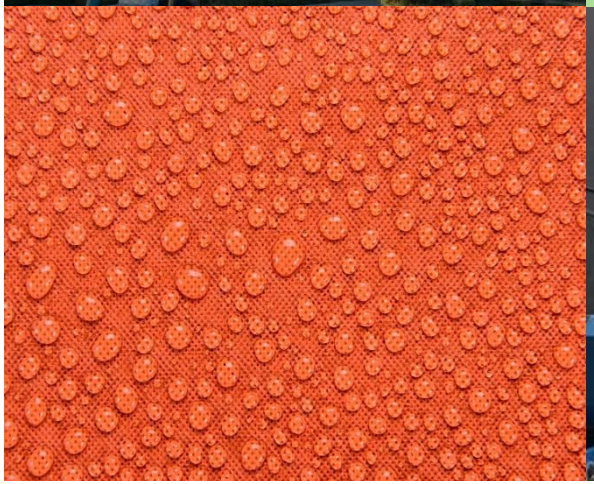
The Benefits of Rainscreen Design

Scott D. Wood, Senior Building Scientist



SCOTT D. WOOD

YOUR PRESENTER

Scott D. Wood is a Senior Building Scientist at VaproShield, and is responsible for product QA/QC on 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 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

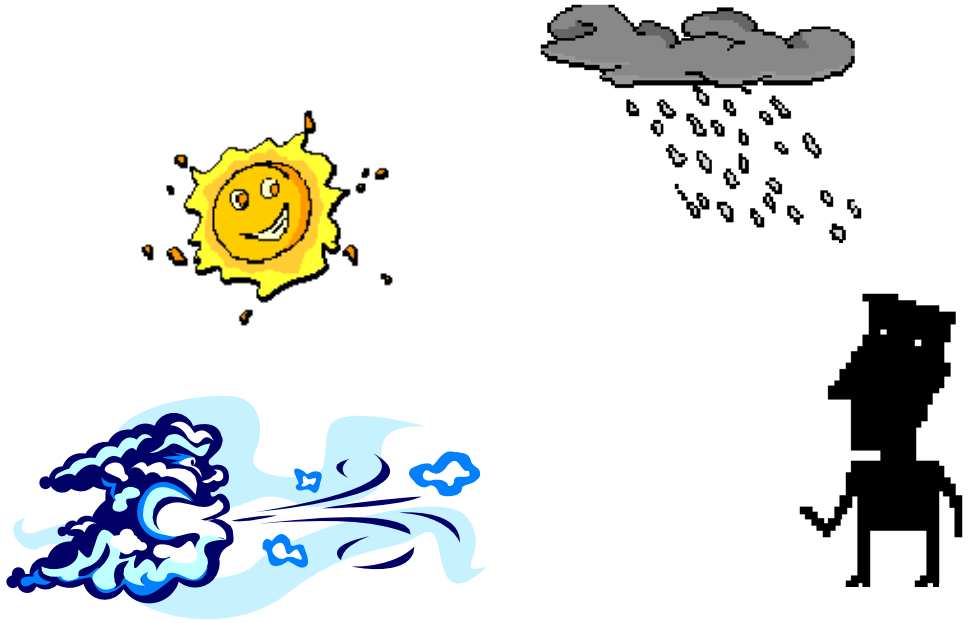
Demand for Sustainable Livable Buildings

Occupant Demands
Code Demands
Climate Stresses

Building Science

Study of:

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



Basic Requirements for a Wall Assembly

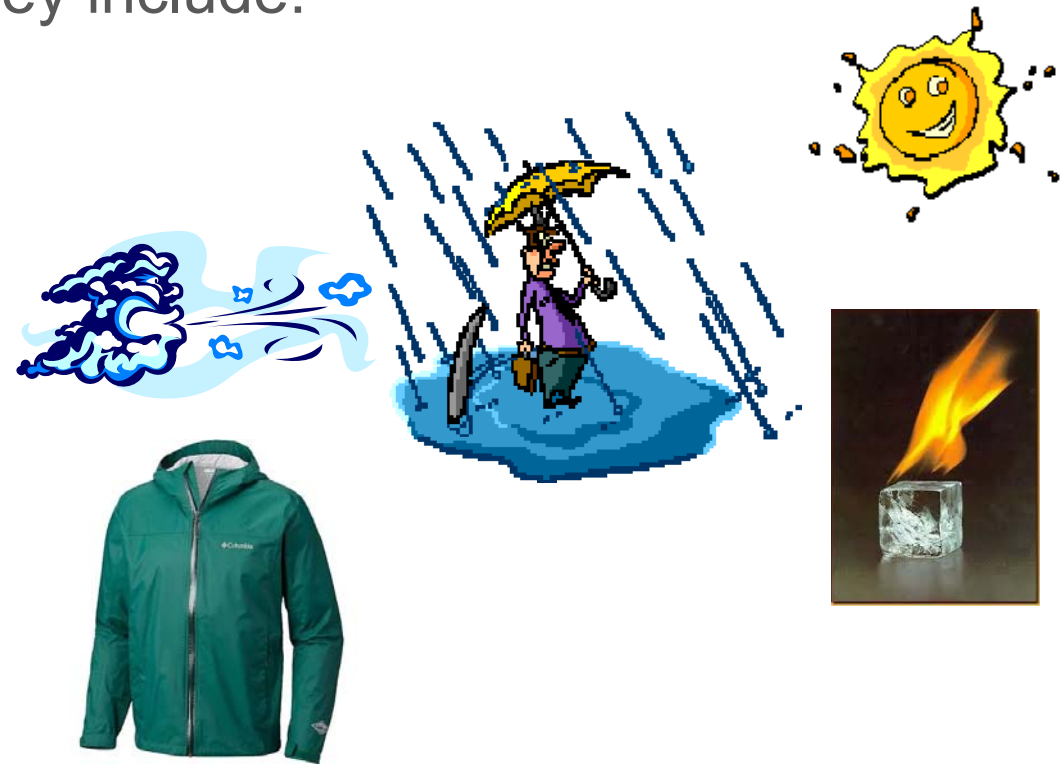
- The assembly provides separation between the conditioned space and the exterior

- **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

The Wall Assembly's Controlling Elements

The building enclosure's four "controlling" elements.
In order of importance, they include:

1. Rain control
2. Air control
3. Vapor control
4. Thermal control

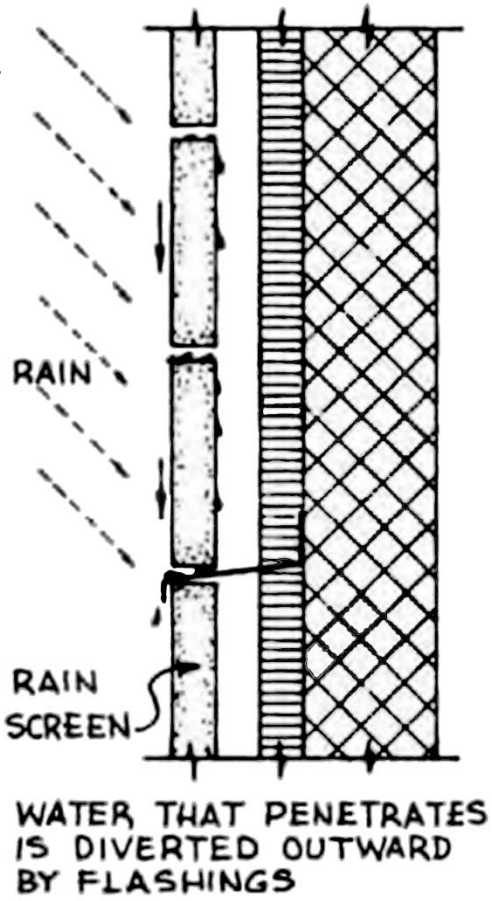


Ventilated Rainscreen History

- 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

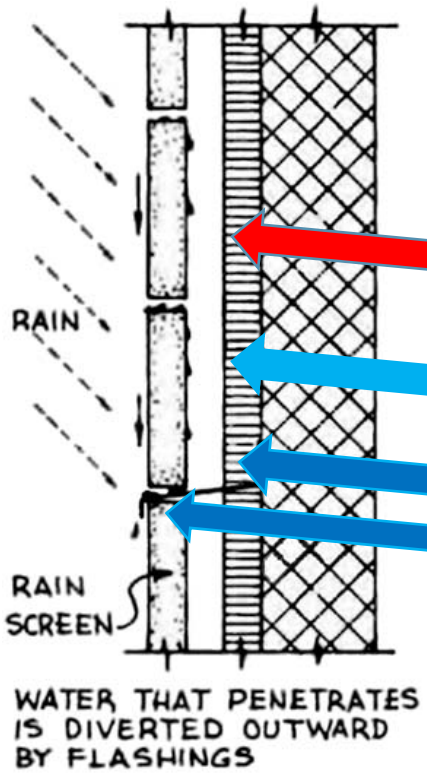
- *"This screen could be applied so that water vapour coming from within is automatically removed by ventilation of the space between wall and screen."*
  Johansson (1946), *The Influence of Moisture on the Heat Conductance for Bricks.*
- *"…cavities should be ventilated to outside, by air passages through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



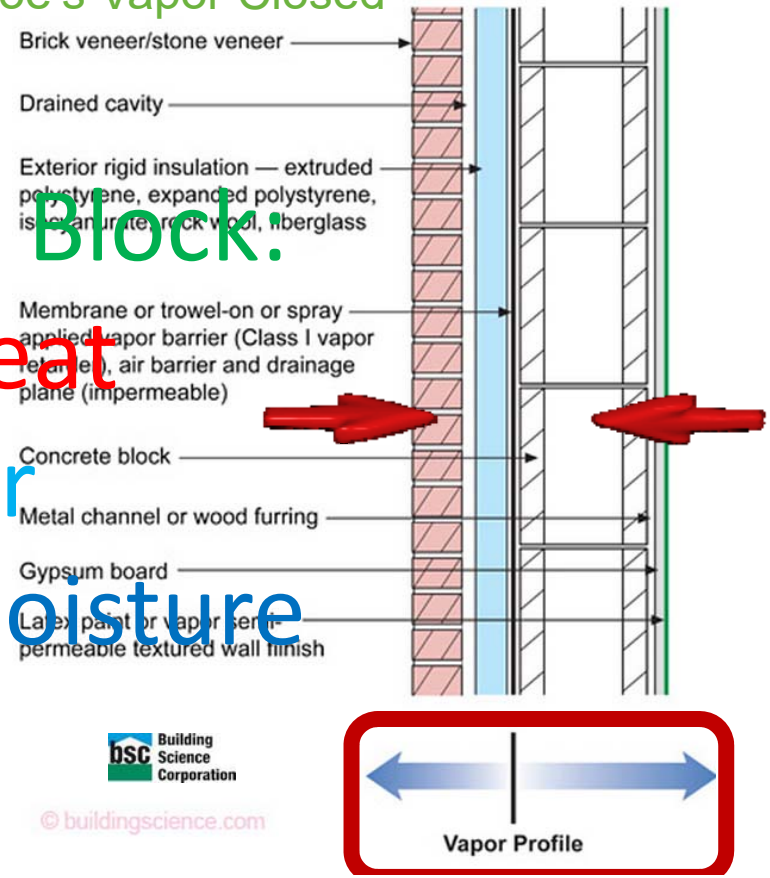
Hutcheons' 1964 The Perfect Wall

Evolution of the Wall Assembly – “The Perfect Wall”

1964 Hutcheons’



2010 Dr. Joe’s Vapor Closed

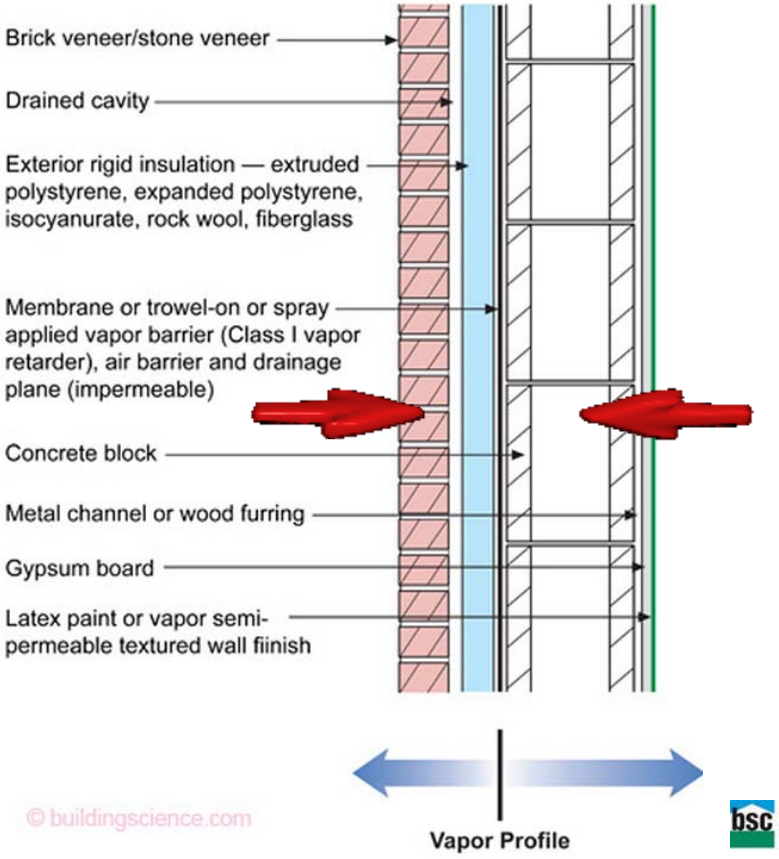


Must Block:

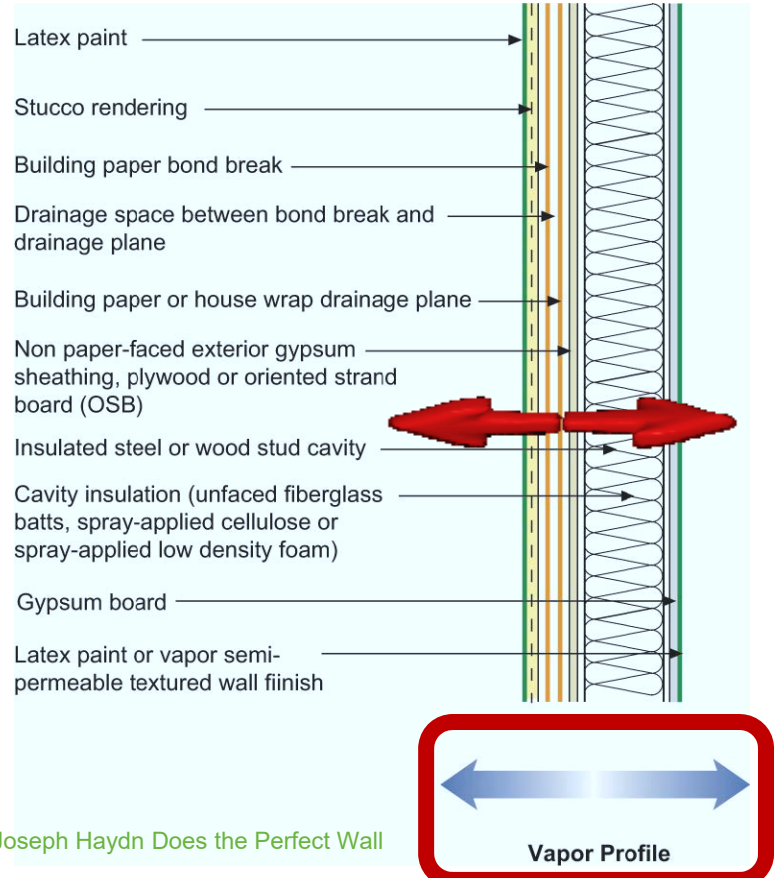
- Heat
- Air
- Moisture

Evolution of the Wall Assembly – “The New Perfect Wall”

2010 Dr. Joe’s Vapor Closed



2015 Dr. Joe’s Vapor Open

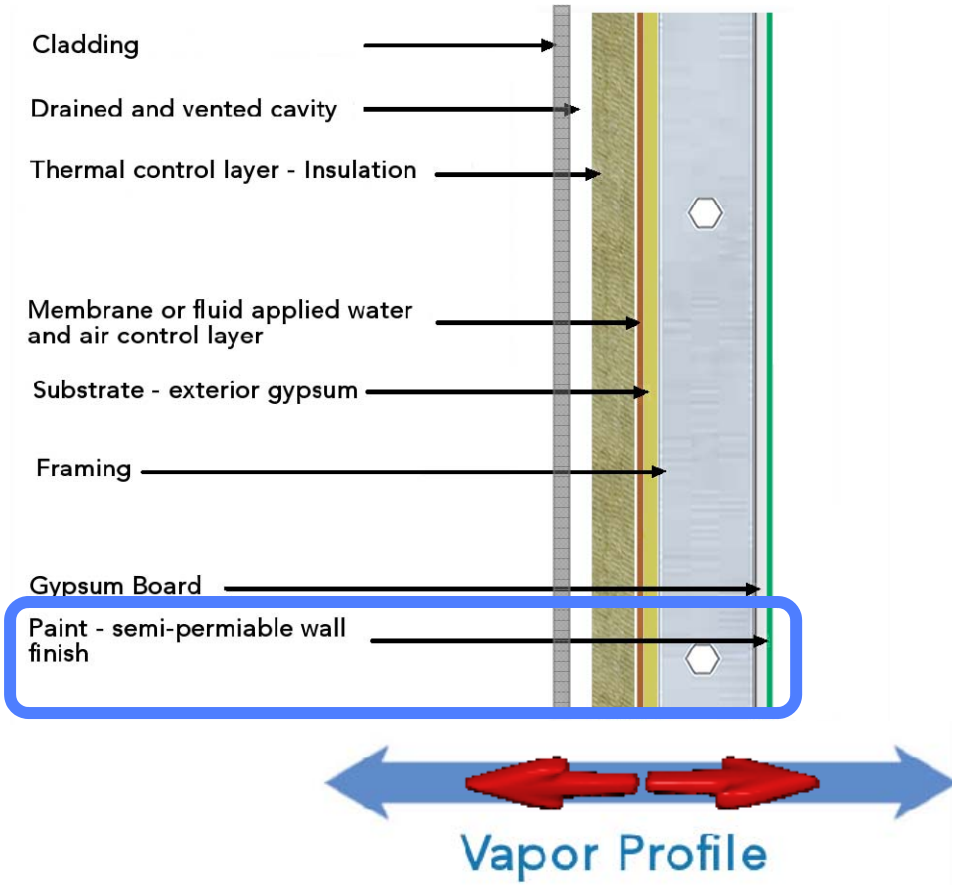


“The Perfect Wall” – Simplified

Controls:

- Heat flow
- Air flow
- Moisture flow

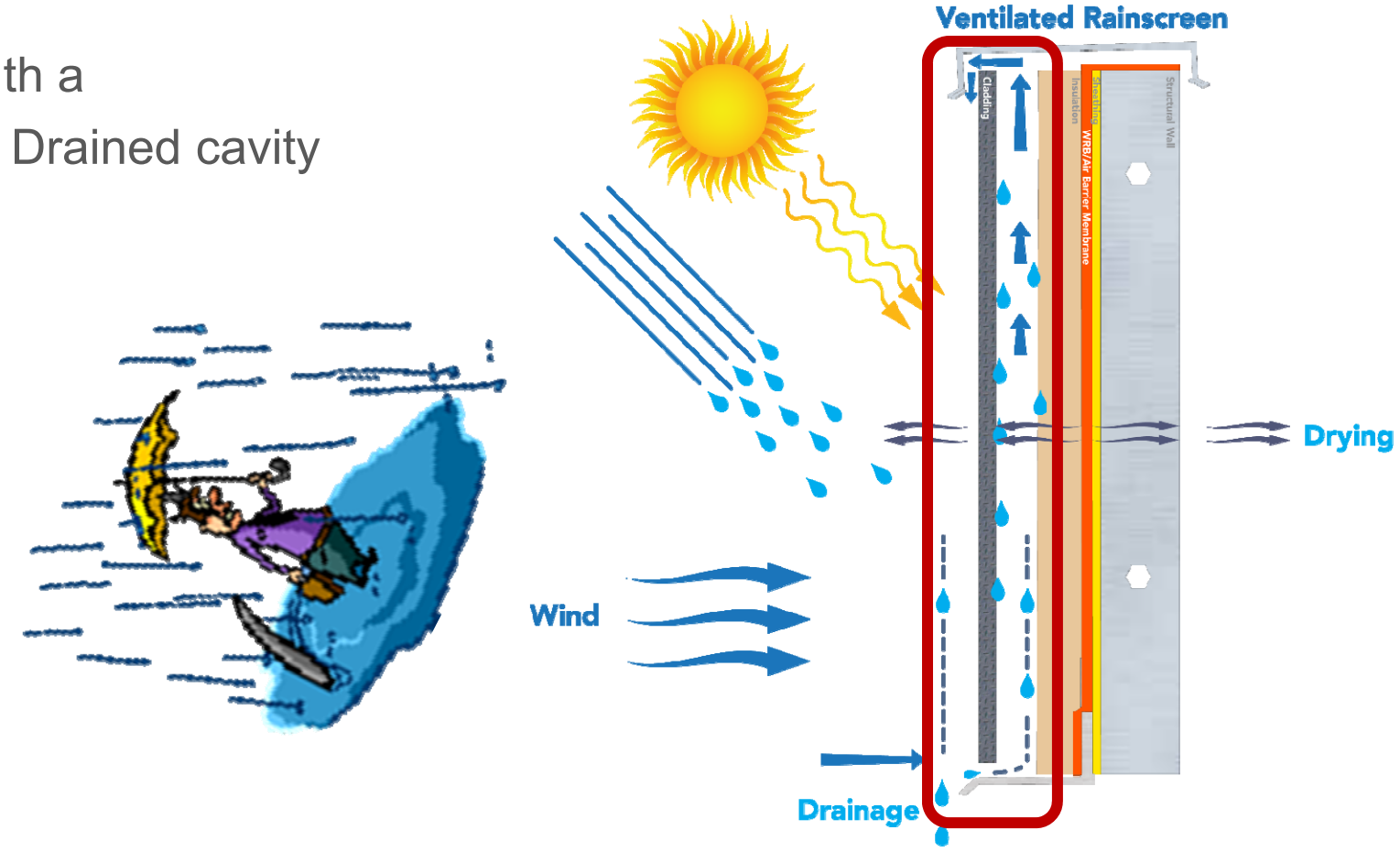
- Vapor **Open** Allowing vapor movement for vapor diffusive drying in both directions



What is a Ventilated Rainscreen?

Cladding with a

Vented and Drained cavity

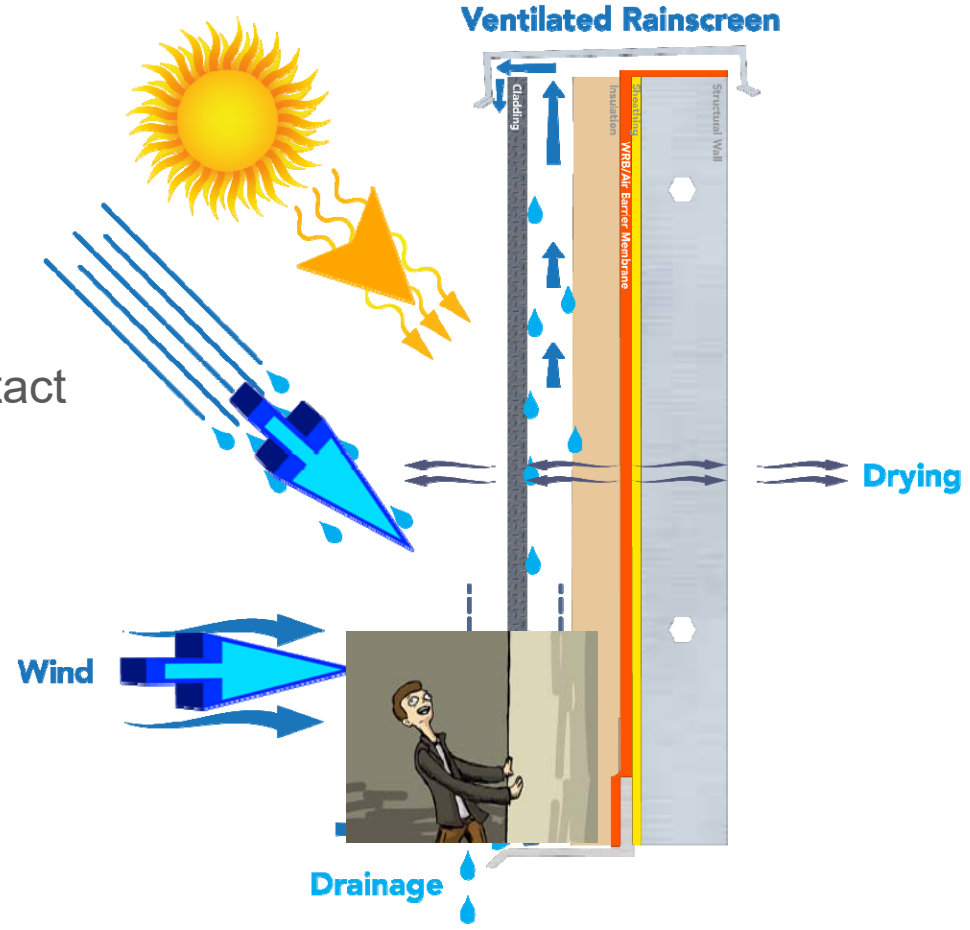


Rainscreen Cladding Provides

Cladding Provides:

- Aesthetics
- Reduced UV and Rain exposure
- Distributes wind pressures

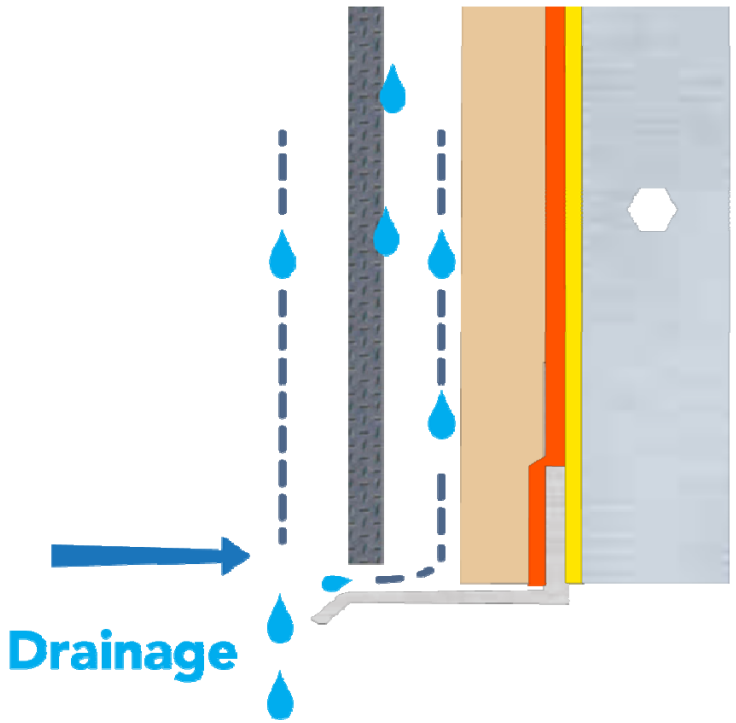
tact



Ventilated Rainscreen Advantages

Drainage Benefits:

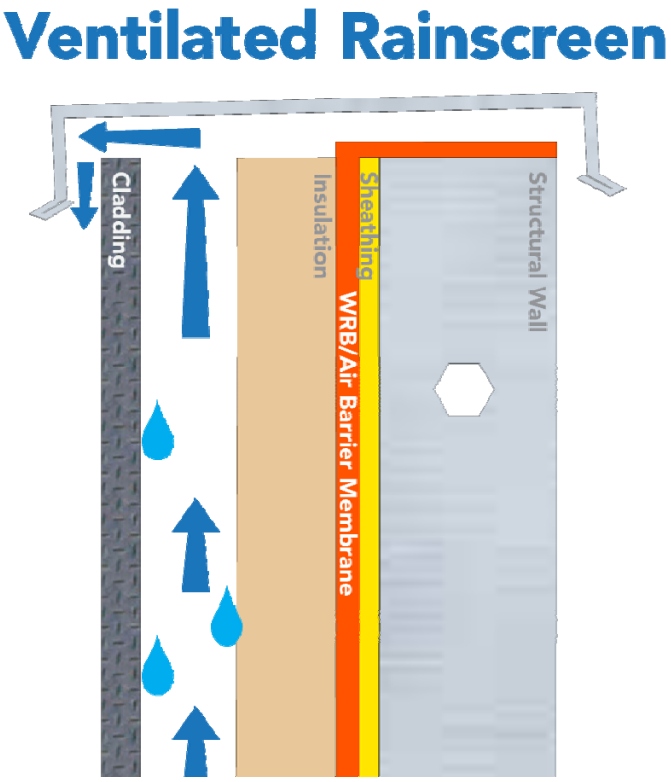
- Allows cavity moisture to drain away from the structure
- Water will not impede at sealant joints, cracks and other areas vulnerable to water penetration



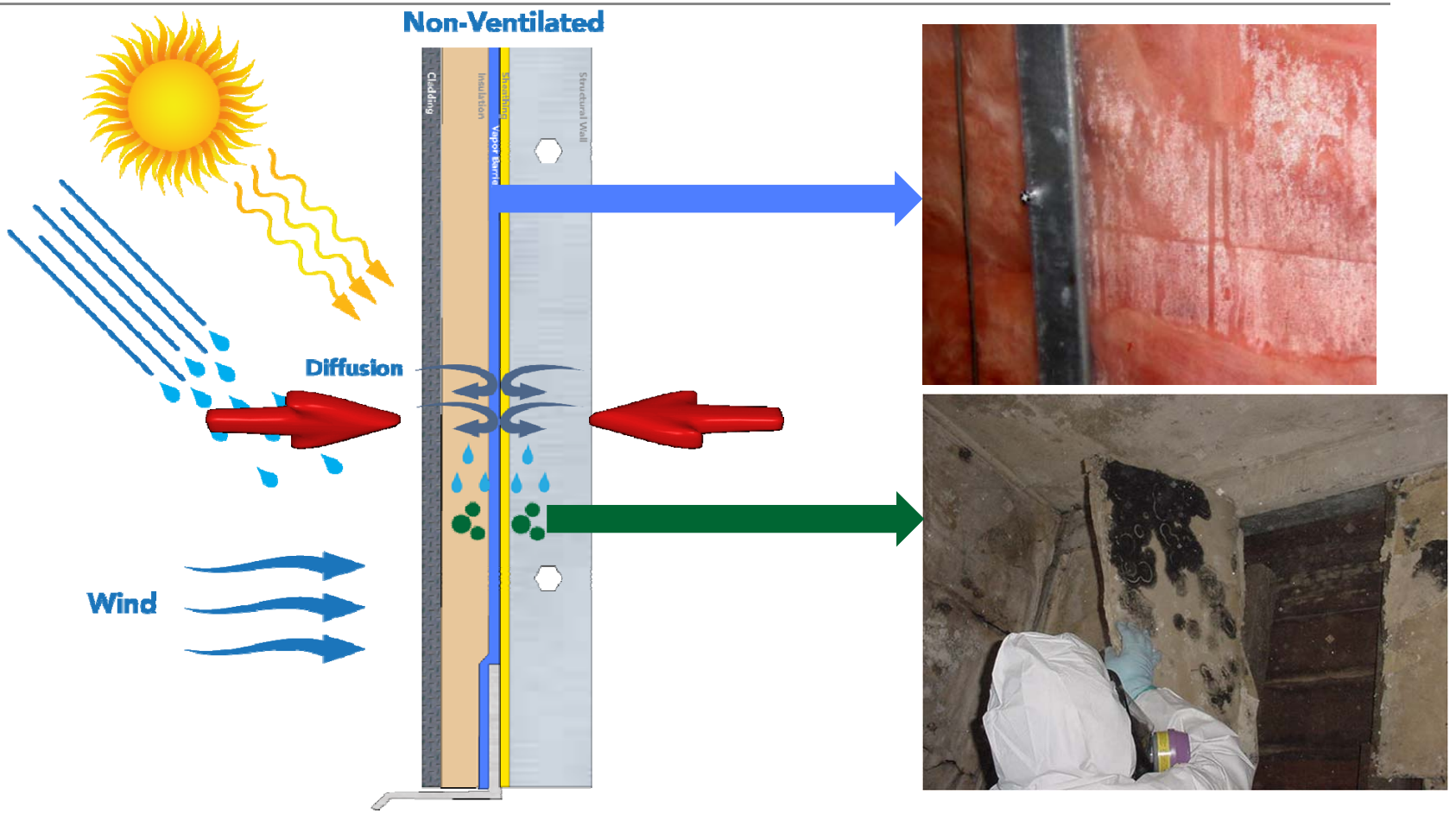
Ventilated Rainscreen Advantages

Venting Benefits:

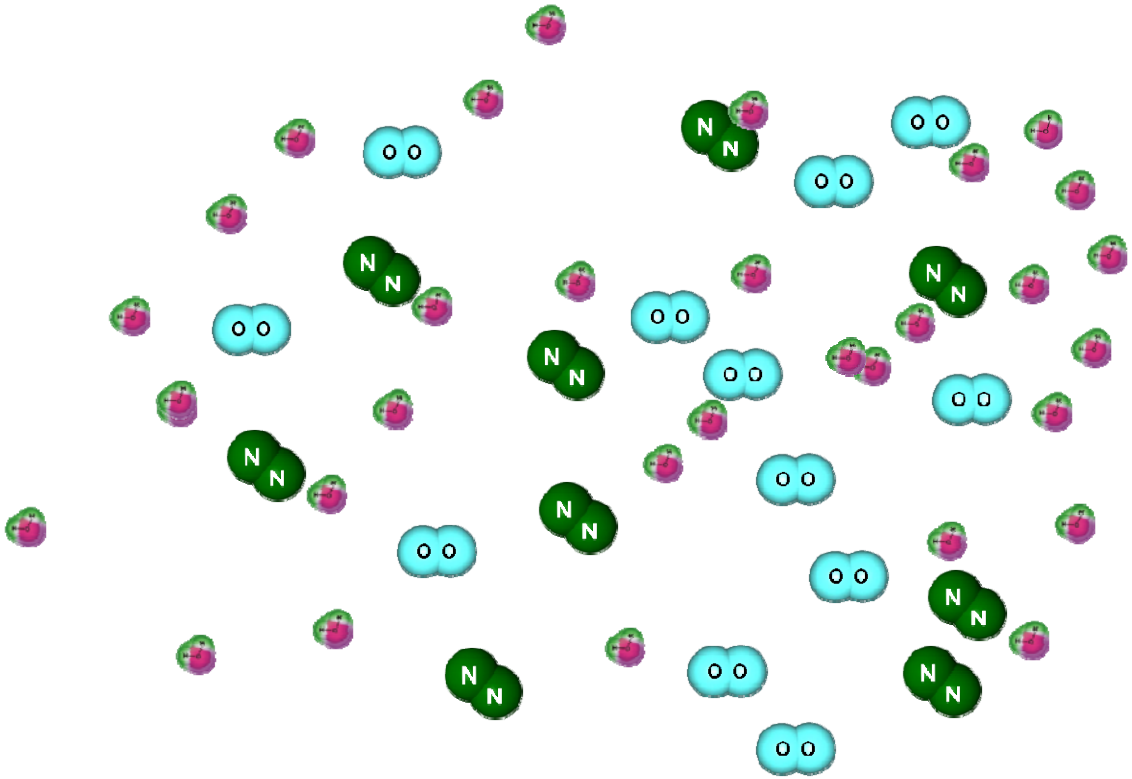
- Venting helps dry remaining moisture
- Enhances vapor diffusive drying
- Reduces reverse vapor drive



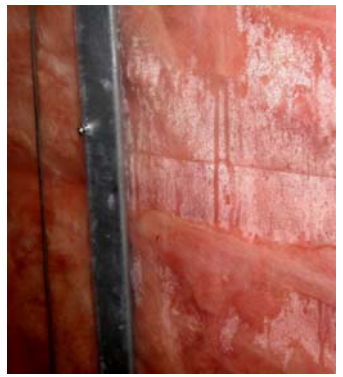
Non-Vented, Non-Permeable Membrane DISADVANTAGES



Non-Vented, Non-Permeable Membrane



Vapor Barrier



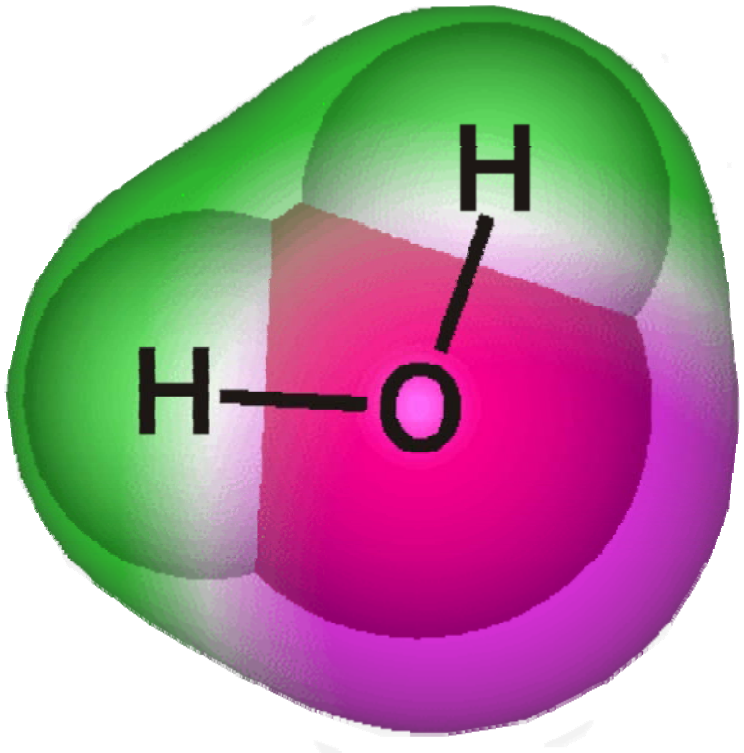
Liquid Water Tight, Air Tight, Water Vapor Open?

Liquid Water Tight, Air Tight, 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

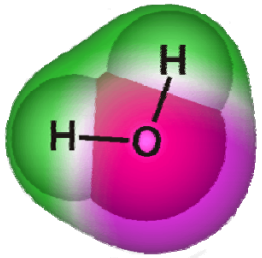
  US PERM= grains/ft^2•hour•inchHg



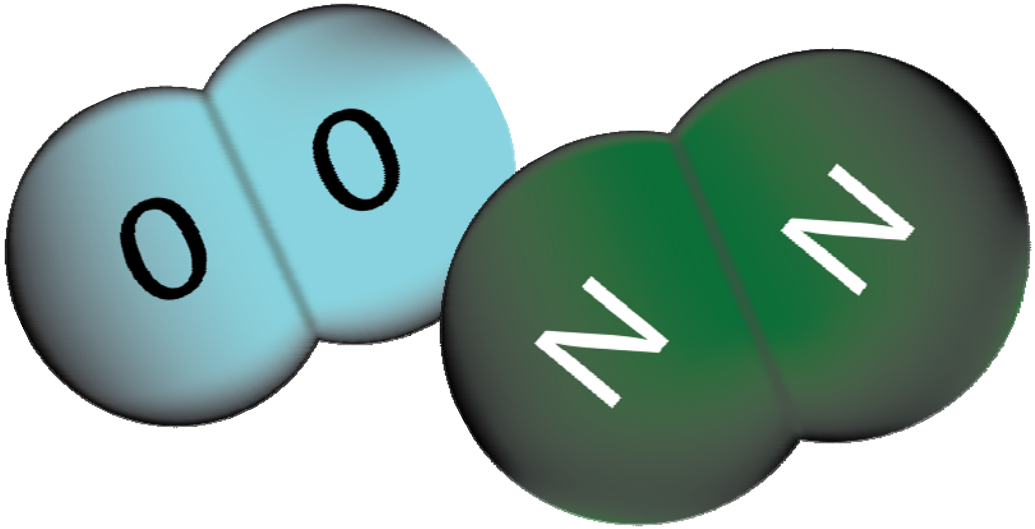
Vapor Open vs. Non-Permeable Membranes

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)

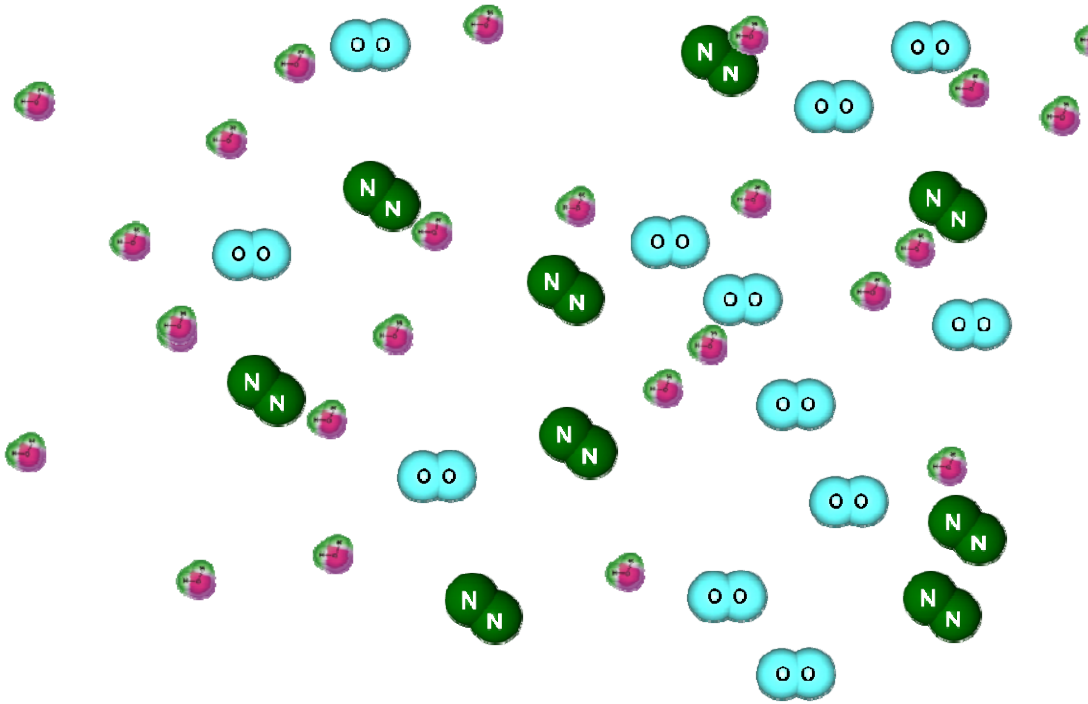


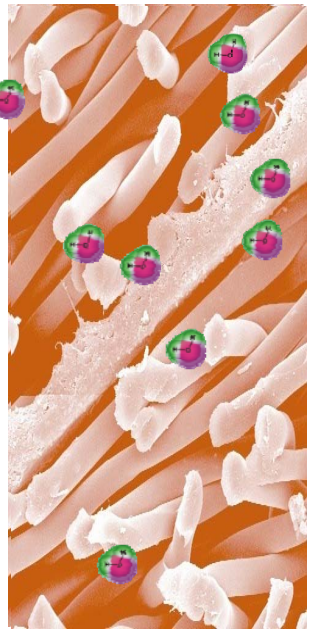
Air molecule = 320-370 pm

Vapor Open Membrane and Air Barrier

Air: Water:

Water escapes because it is smaller than air



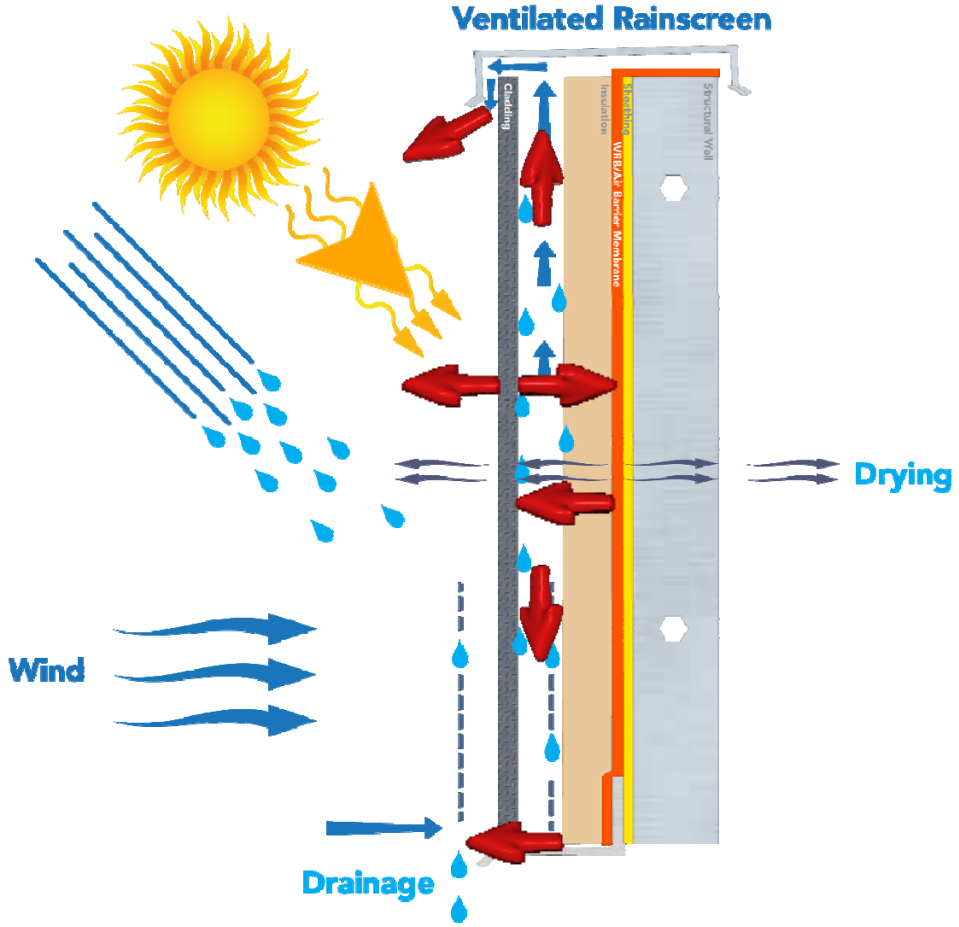


Breathable or "Vapor Open" WRB/Air Barrier

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

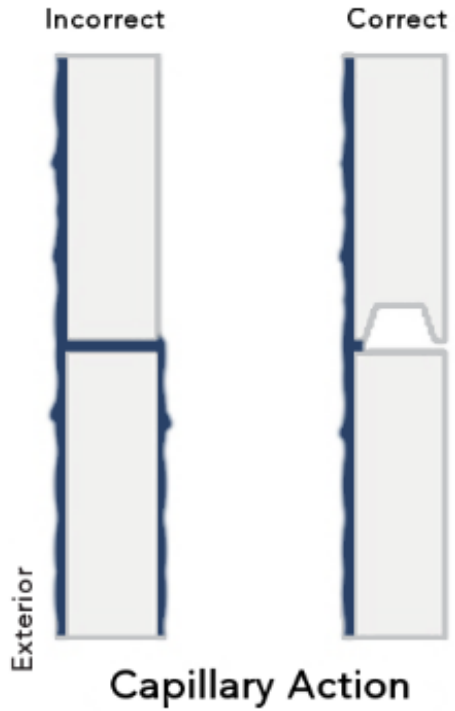
Capillary Break to allow free drainage

- Minimum 0.5 – 1.0 mm (1/16”)
- Typically referenced in construction at 3 - 7 mm (⅛” - ¼”)

(b) CAPILLARITY

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

- 6.4-12.7 mm (¼” - ½”)



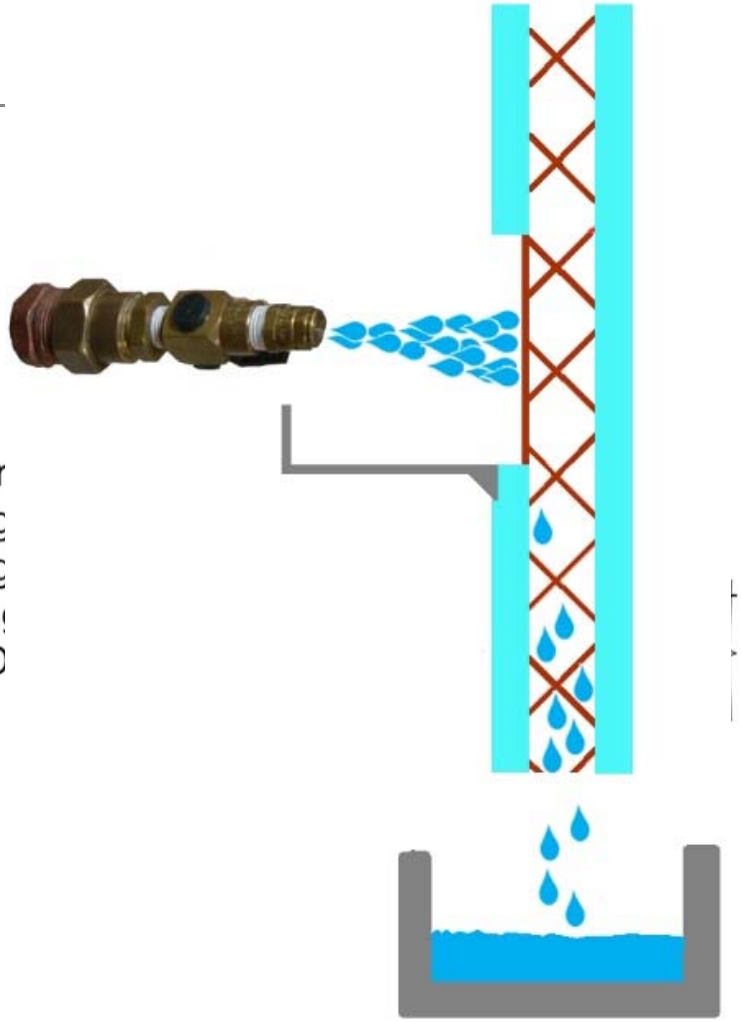
Capillary Action

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 mm
- DrainWrap: 0.1 mm
- RainDrop 3D: 0.5 mm
- TamlynWrap Drainable Housewrap: 1.5 mm
- Valeron Vortec: 0.08 mm

1. Rainscr
2. Drainag
3. Drainag
4. Flashin
5. Drain C



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

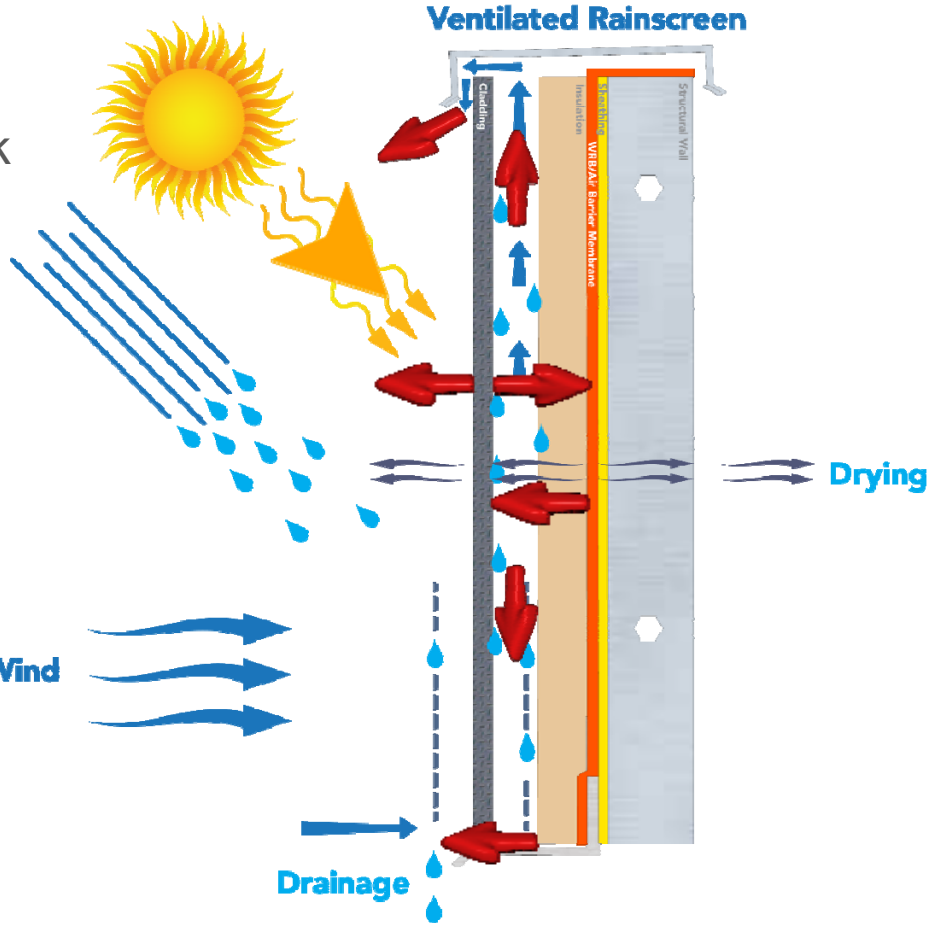
Smegal, 2006, Thesis (Ph. D.) University of Waterloo

Rain Screen Cavity Size

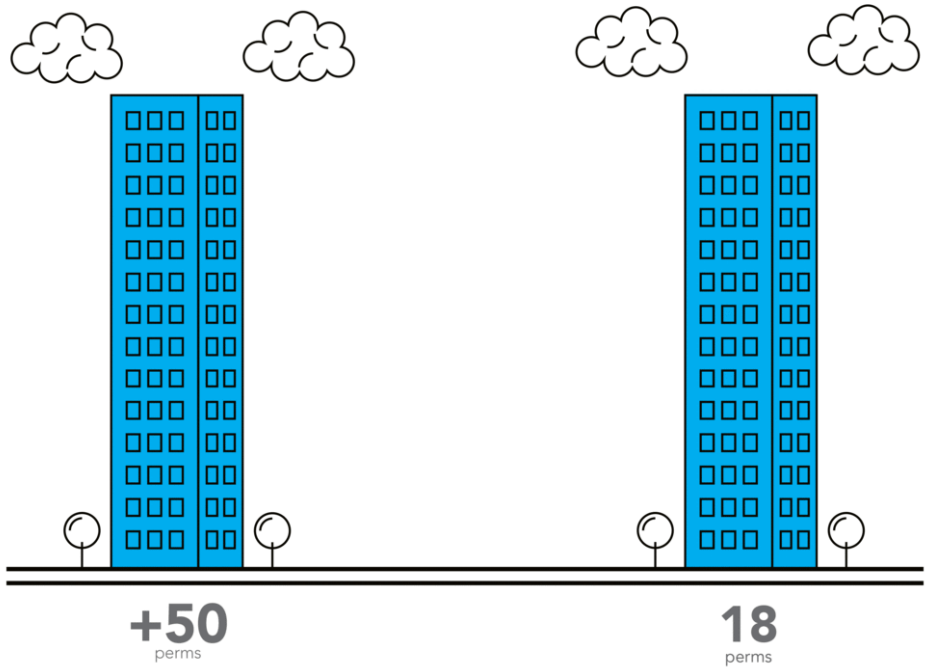
Venting

- 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

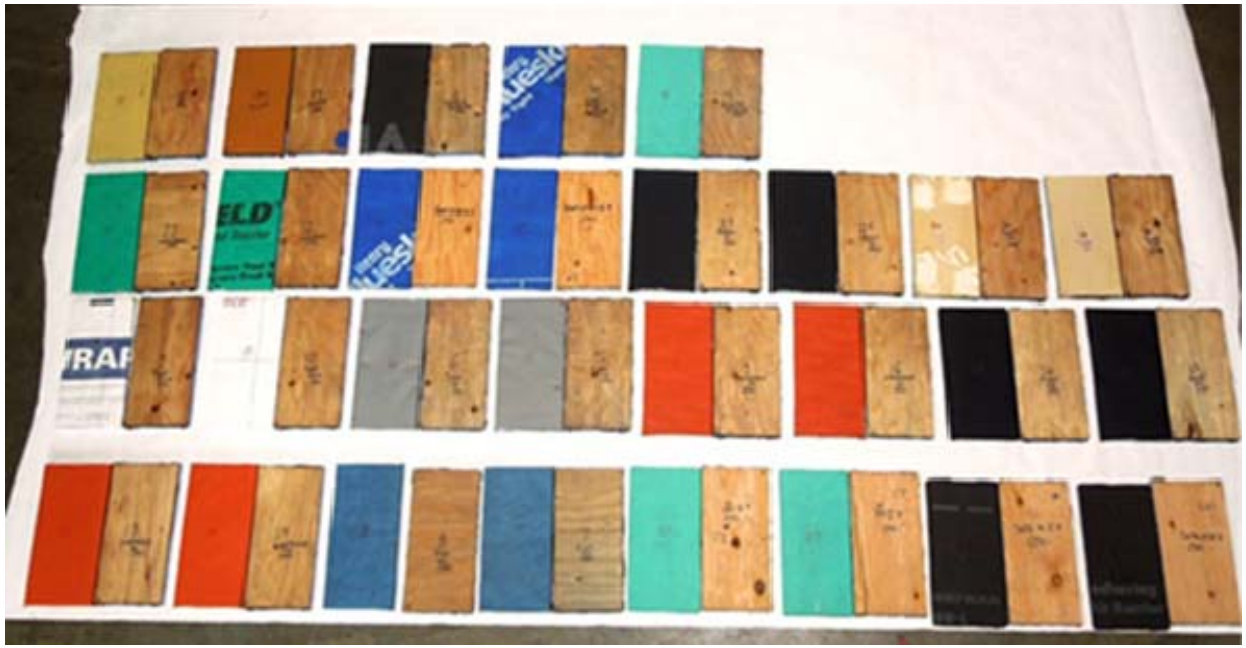


Vapor Open WRB/AB High Drying Capacity: Proven by Science



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

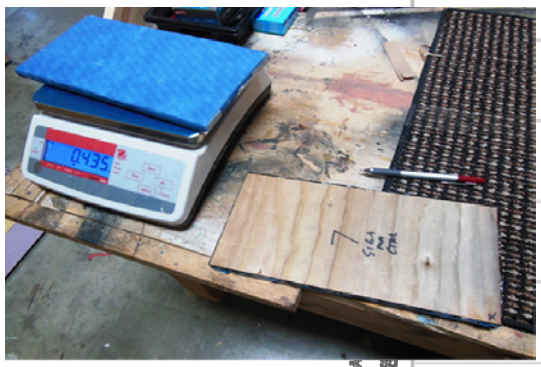
50 Air Change Hour (ACH)

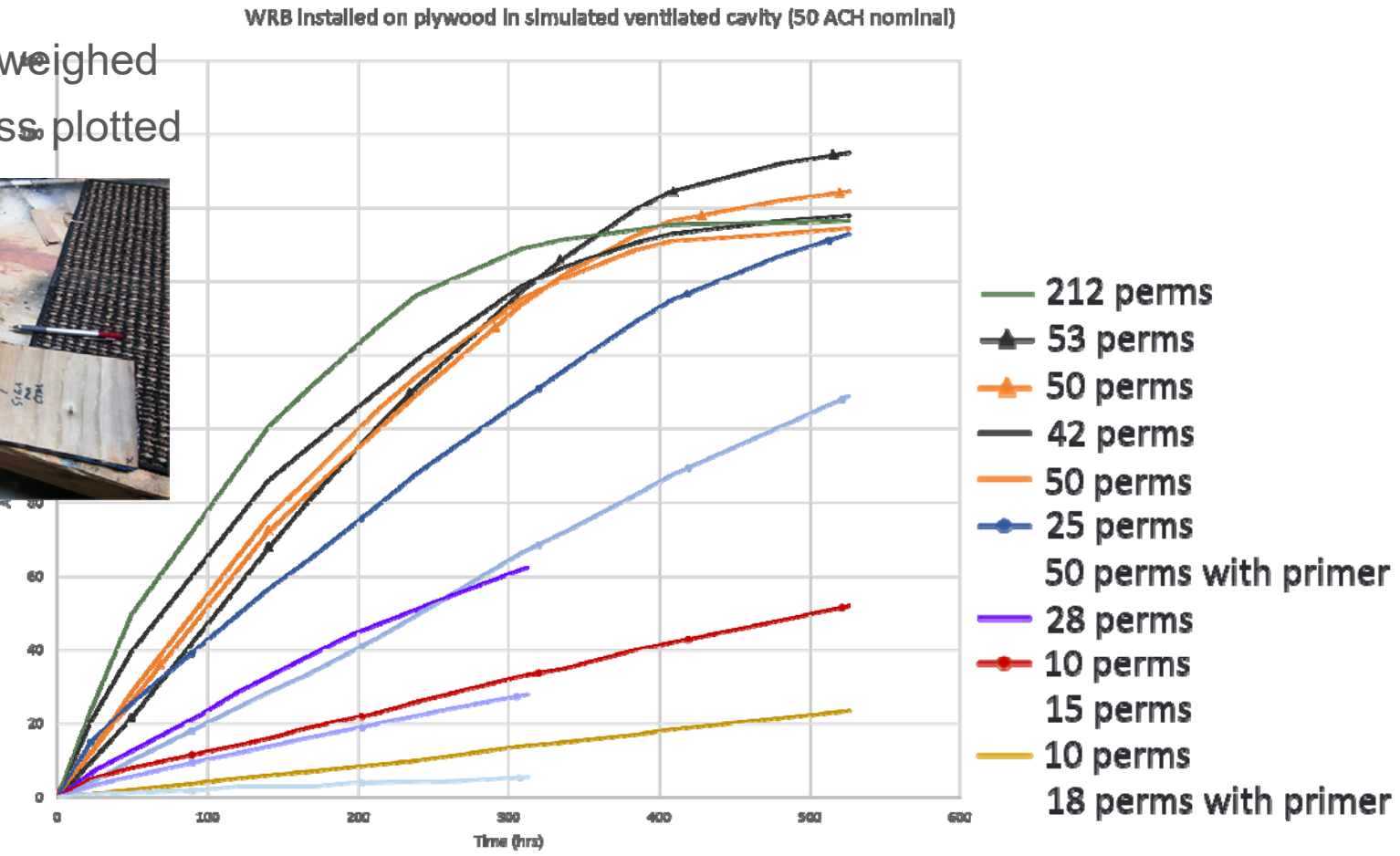
21.7 °C (71 °F) ± 5%

54% RH ± 8%

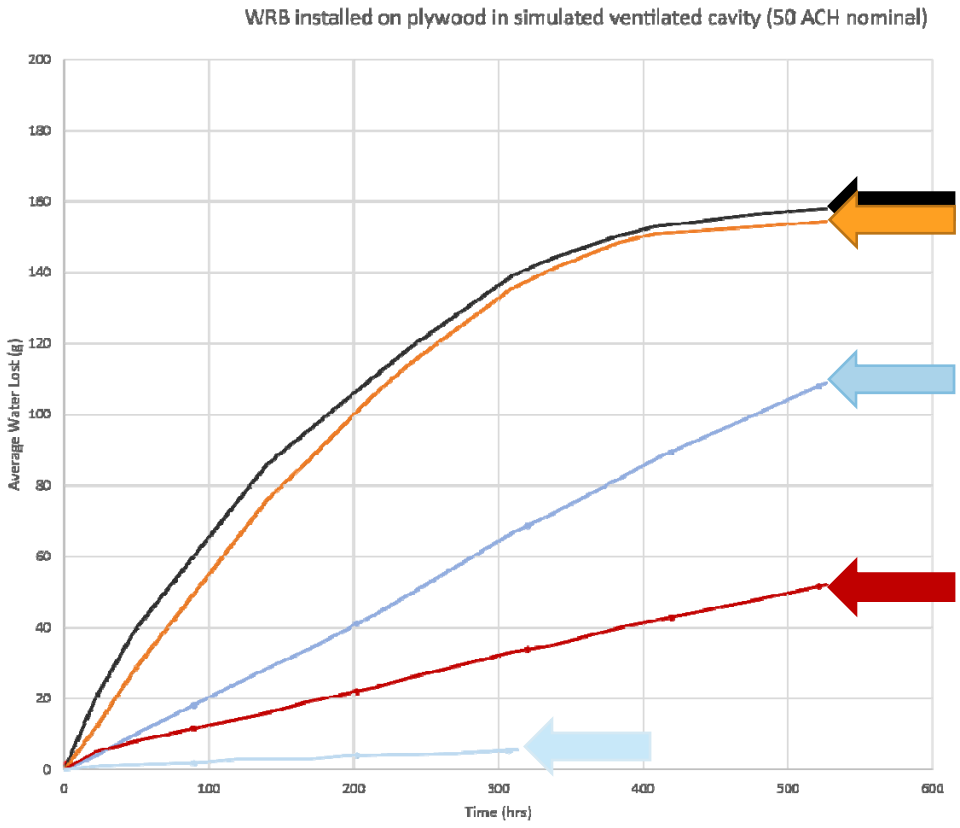
Vapor Open WRB/AB Advantages: High Drying Capacity

- Samples weighed
- Weight loss plotted





Vapor Open WRB/AB High Drying Capacity



57 perms

50 perms

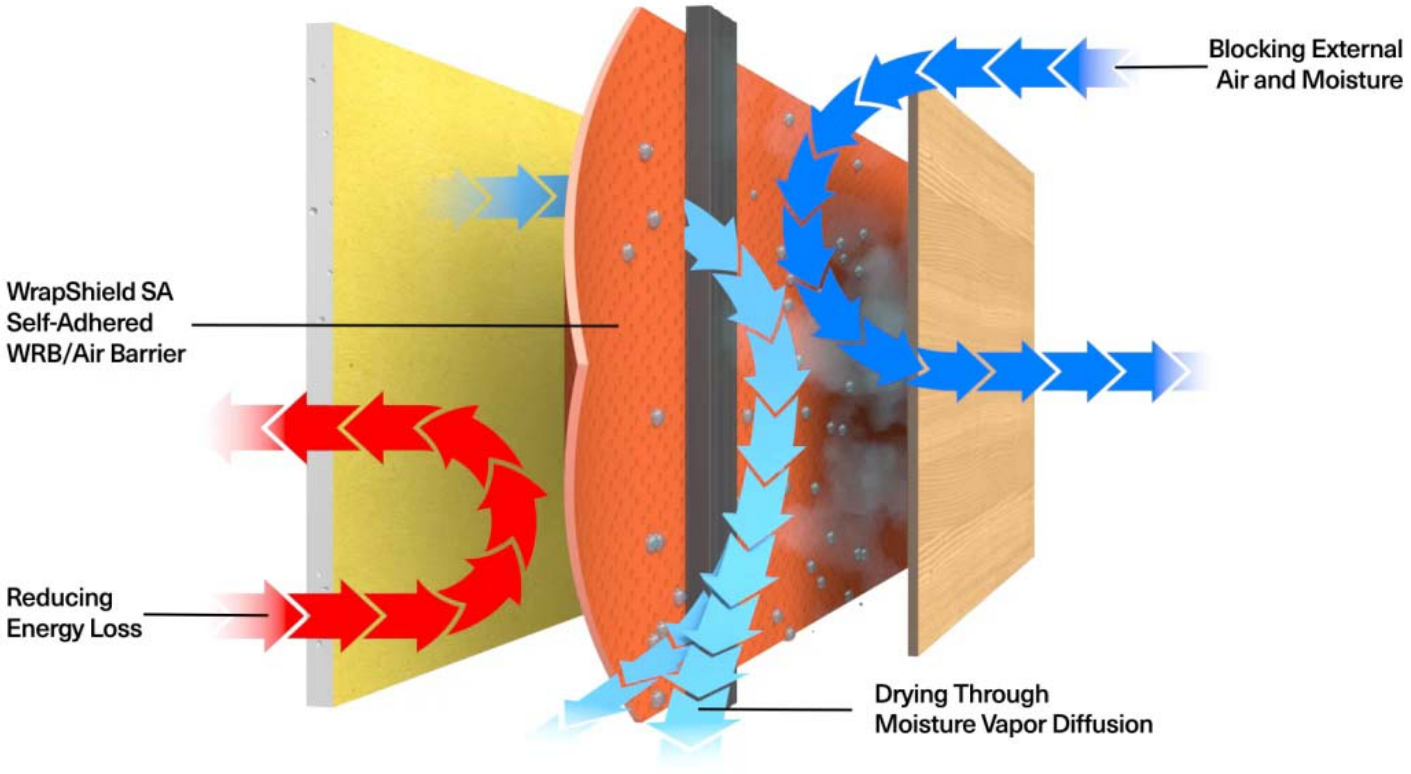
50 perm product with primer

10 perm product

18 perm product with primer

Weather Resistive Barrier Comparative Drying Study
Project: #1402-1012, Author: BEE Building Envelope Engineering, Seattle, WA

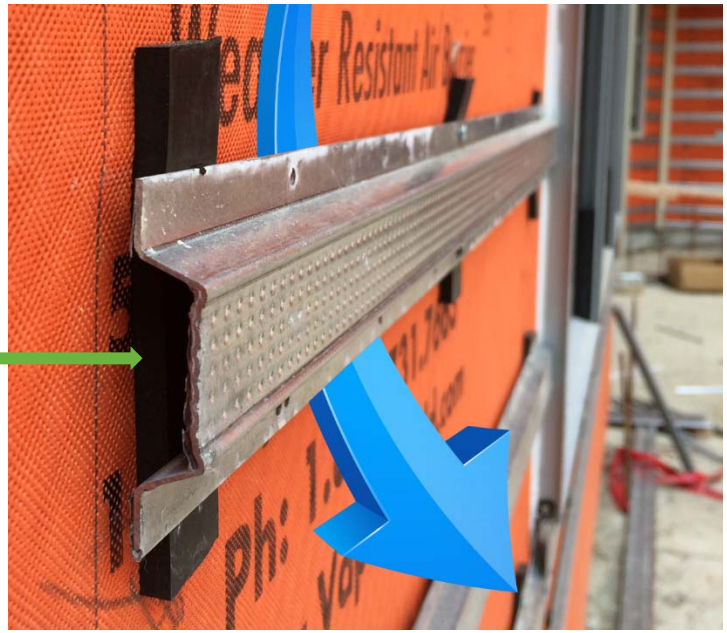
Permeable Membrane + Ventilated Rainscreen



Rain Screen Details: Self-Adhered Shims

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

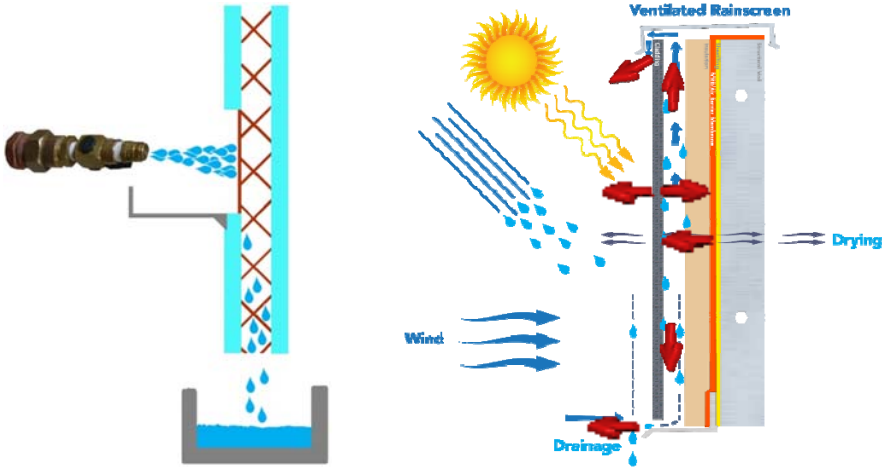
Rain Screen Details: Self-Adhered Shims



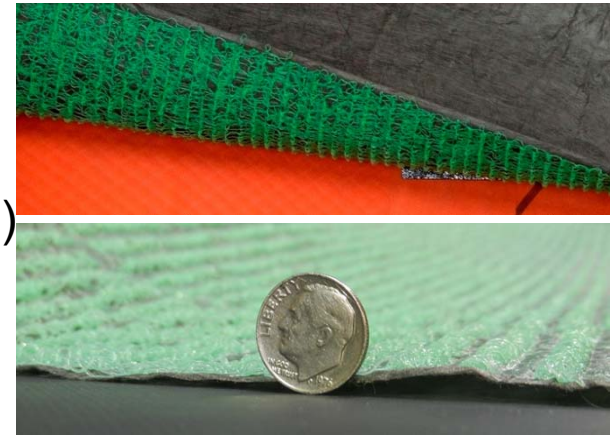
Rain Screen Details: Drainage Mat

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

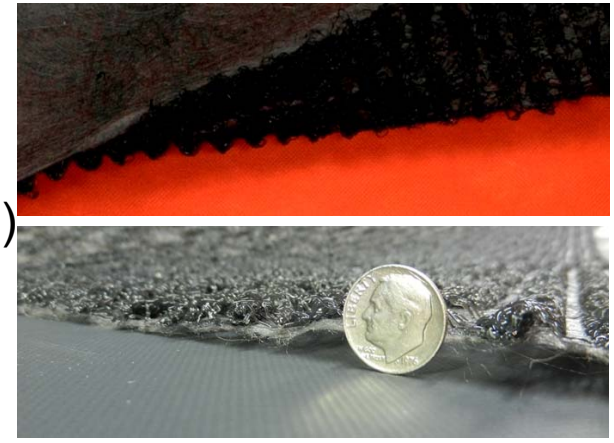
Drainage and Drying



3 mm (⅛”)

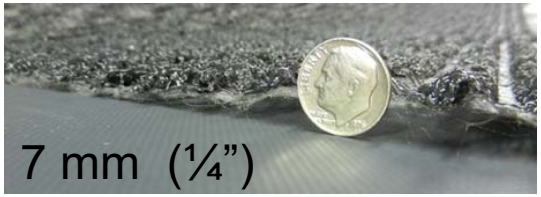


7 mm (¼”)



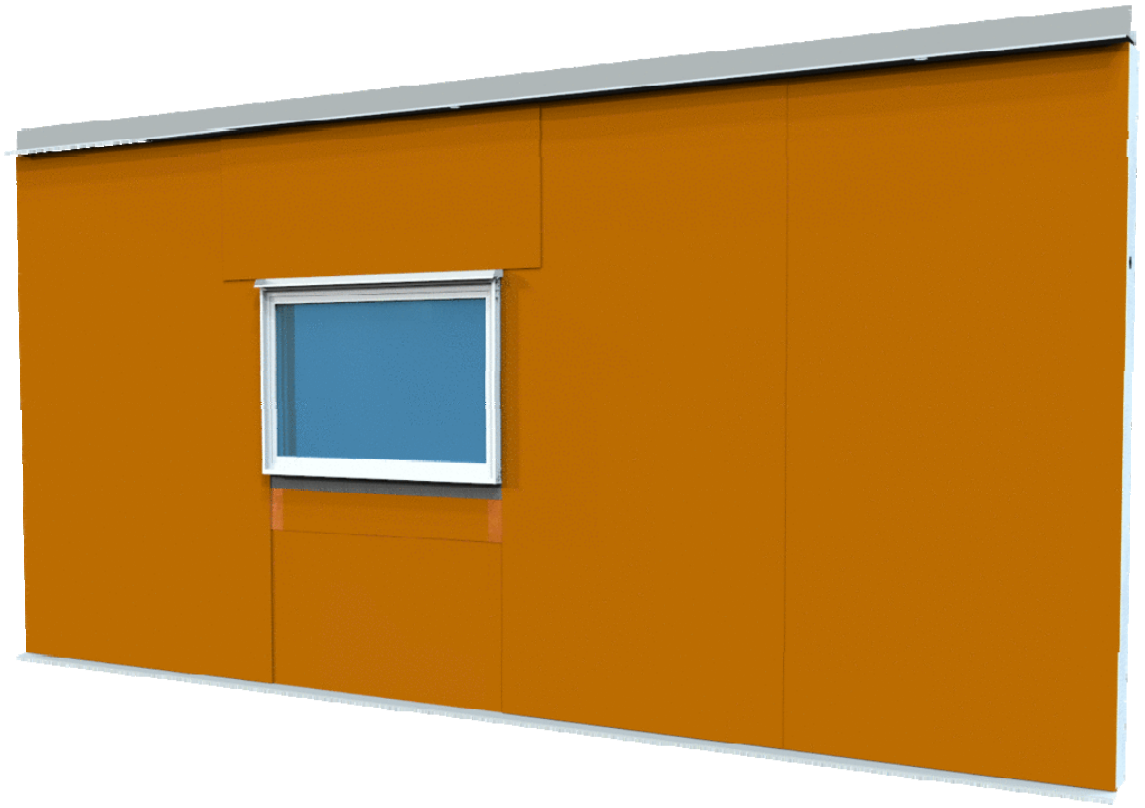
Rain Screen Details: Multiple Claddings

Rain Screen Details: Stucco



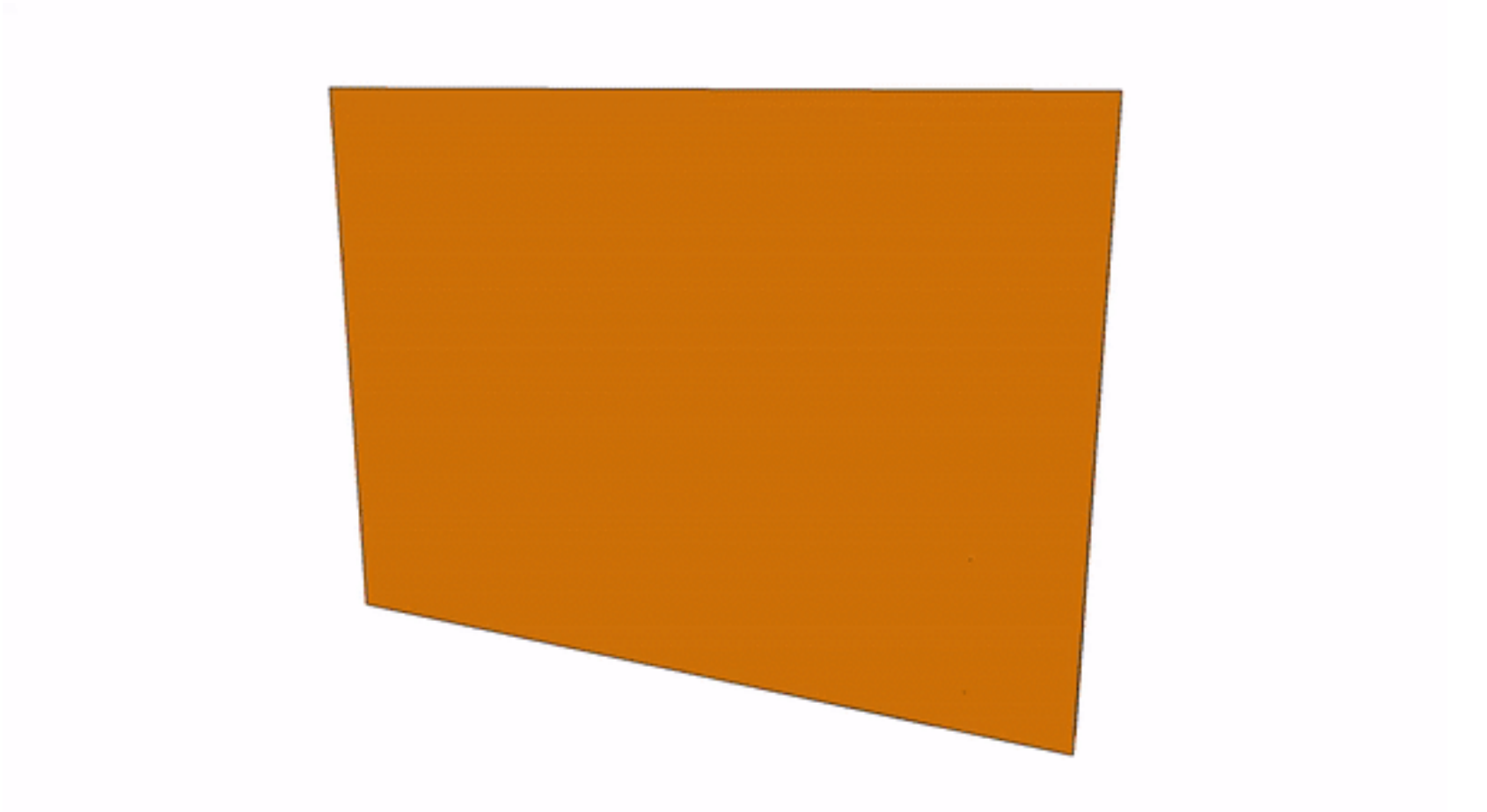
- Drainage matrix is installed over the vapor open WRB/Air Barrier, behind stucco

Rain Screen Details: Stucco

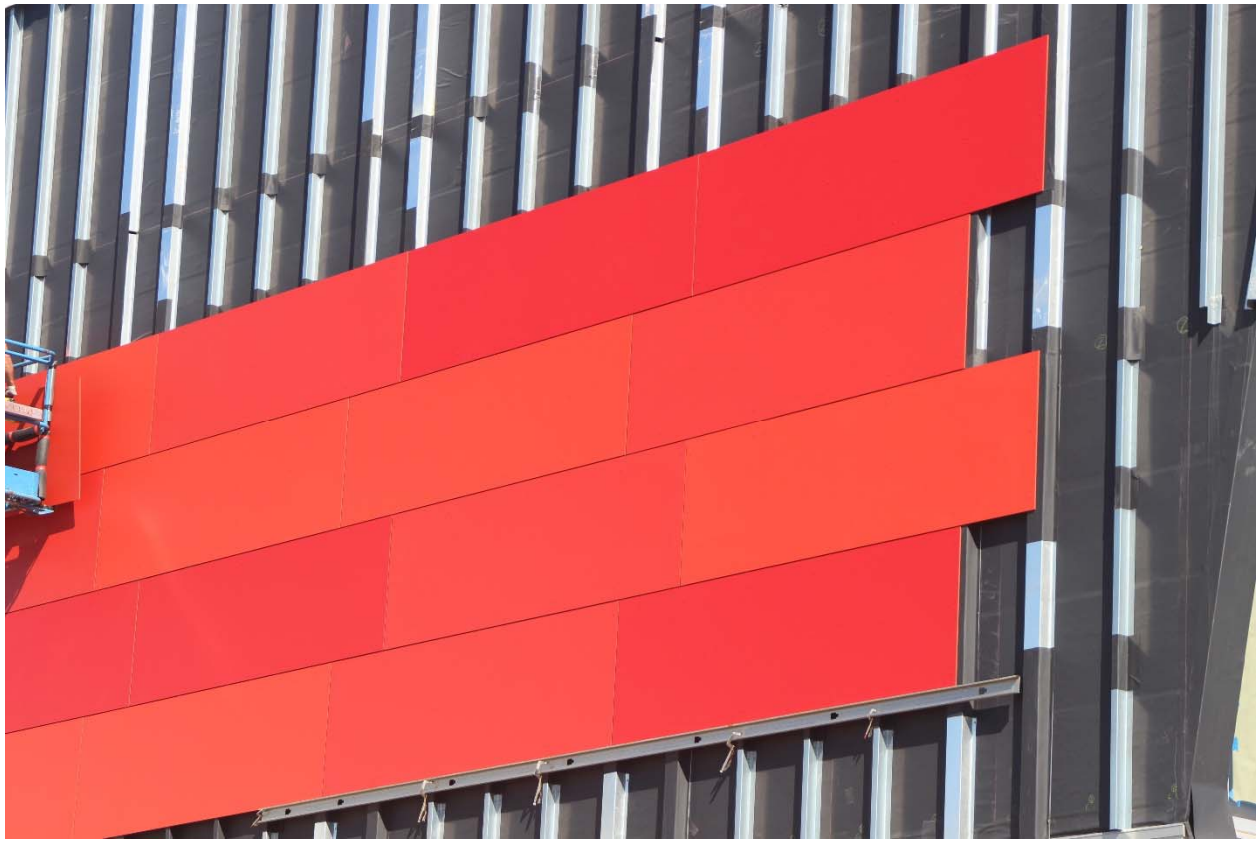


Rain Screen Details: Brick

Rain Screen Details: Brick

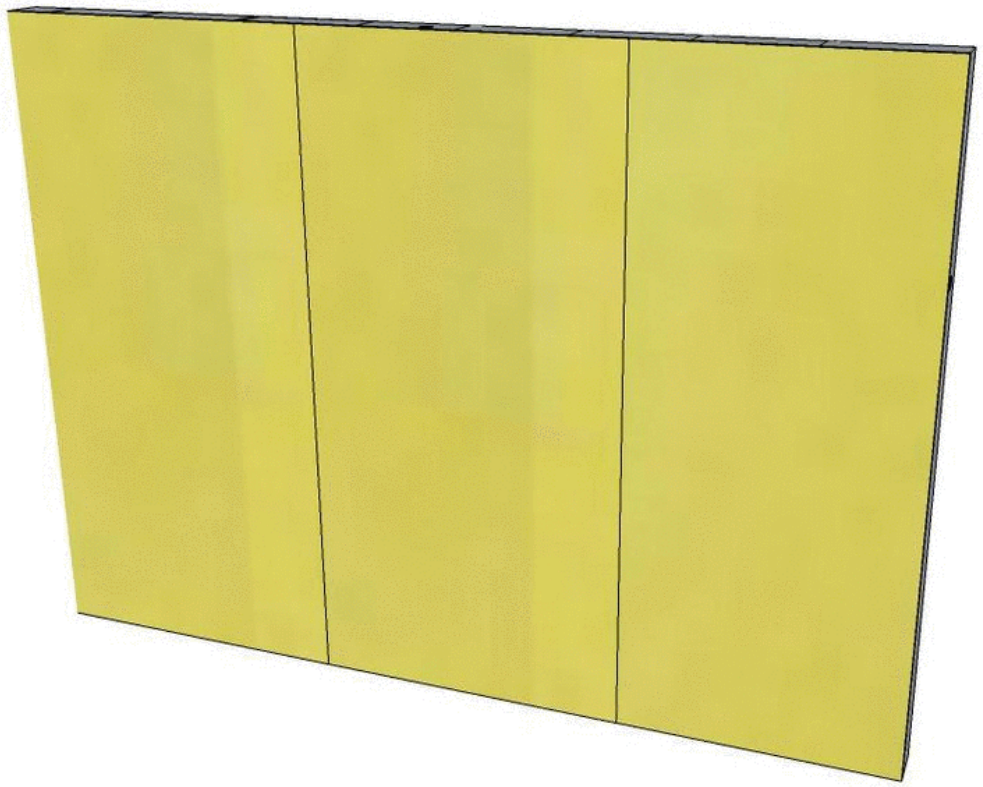


Rain Screen Details: Open Joint

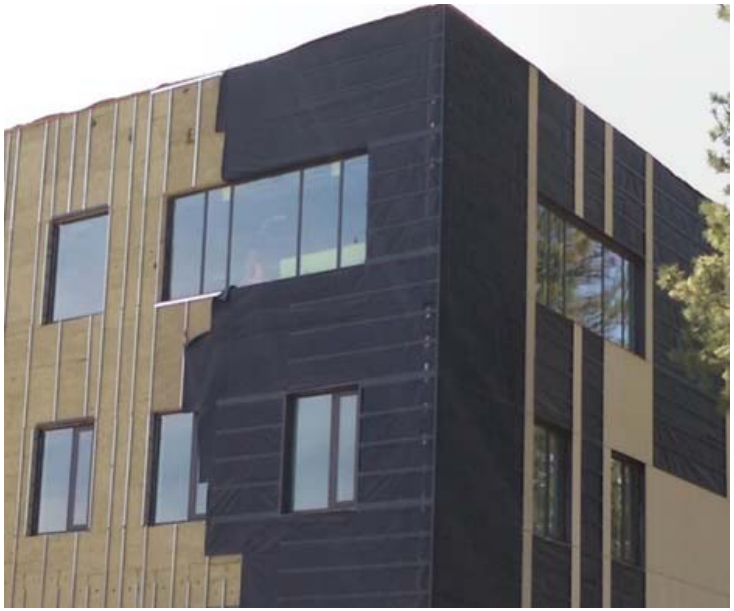


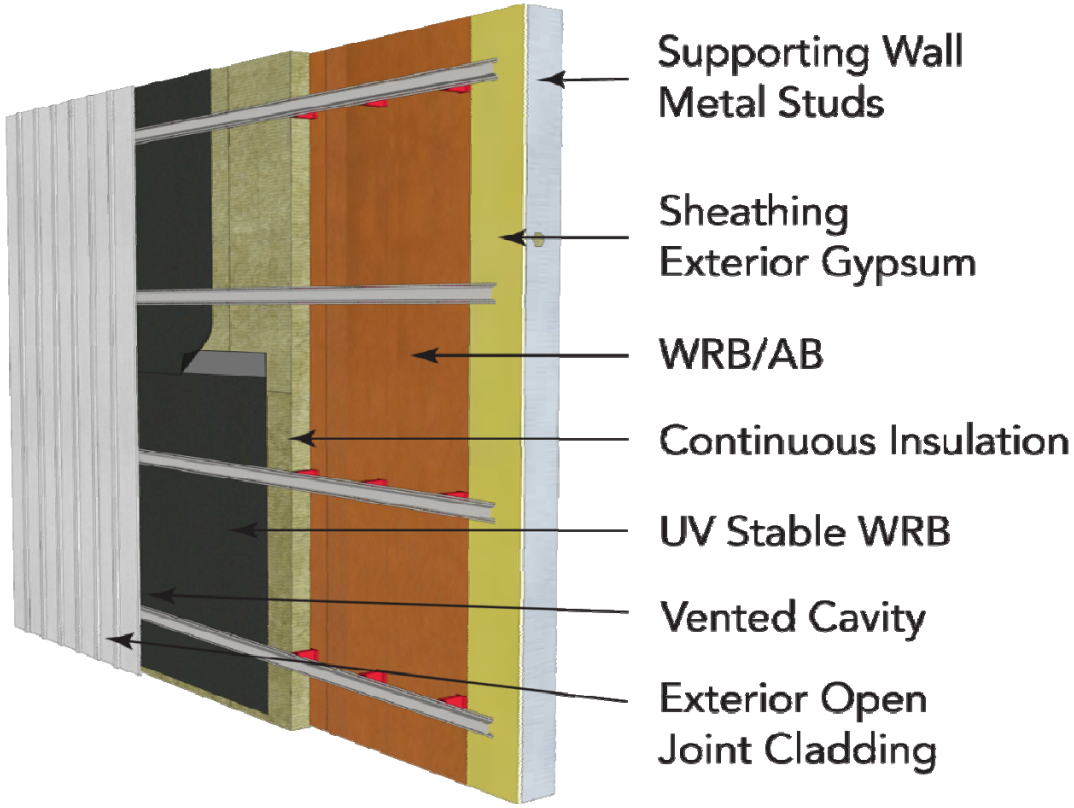
- Vapor open WRB/Air Barrier (black) for open joint cladding
- Girts create rain screen cavity

Rain Screen Details: Open Joint



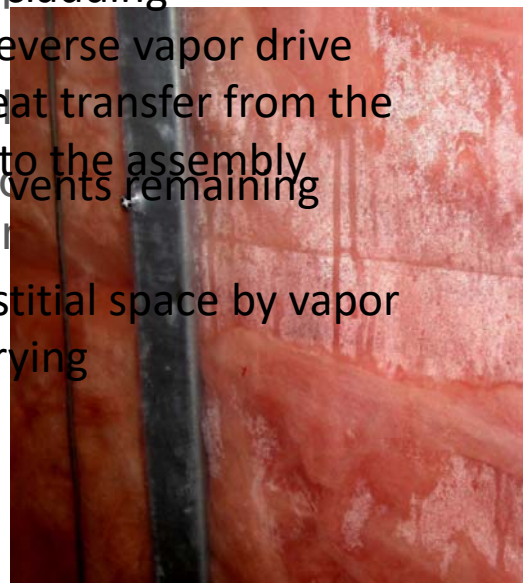
UV Stable Vapor Open WRB/AB

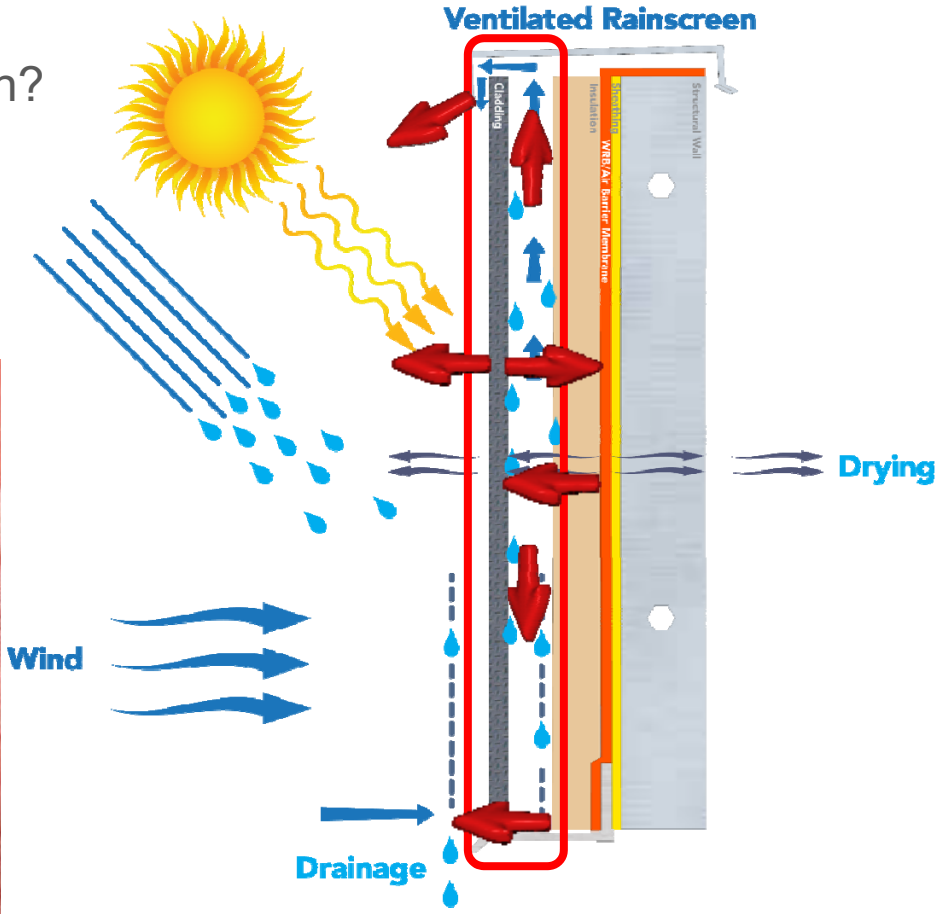




Summary

- What is a ventilated rainscreen design?
- Benefits of ventilated, vapor open WRB/Air Barrier wall assemblies
  - Lumped Ia > 2.7 and Gap to Drain and Vent
  - Allows drying of the internal side of the cladding
  - Decrease reverse vapor drive
  - Reduces heat transfer from the cladding into the assembly
  - Drains and vents remaining moisture
  - Dries interstitial space by vapor diffusive drying
- Differences between vapor tight and highly vapor permeable WRB membranes
- Wall assembly
- Rainscreen
- ventilated rain





The Benefits of Rainscreen Design

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Thank you for your time

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