Wall Performance by Design:

Role of Rainscreens in Moisture Management

~

Designing and Building Resilient Wall Systems with Engineered Rainscreens

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Building Enclosure Moisture Management Institute

Building Enclosure Moisture Management Institute (BEMMI)

- Founded in 2009
- Founding Members:
  - Advanced Building Products
  - Benjamin Obdyke
  - Cosella-Dörken
  - CavClear/Archovations

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BEMMI Mission

To promote growth of the

engineered rainscreen products industry

to improve moisture management in building enclosures through technical advocacy

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Learning Objectives

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

1. Explain conventional wall designs vs drained & ventilated wall designs
2. Define the function of a rainscreen
3. Identify the key design principles for resilient walls
4. Describe the difference between traditional & engineered rainscreen
5. Discuss moisture management for absorptive claddings

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CONTINUING EDUCATION AIA

Conventional Wall Design

Exterior wall assembly

- Exterior cladding
- Water-resistive barrier
- Insulating sheathing (continuous insulation)
- Sheathing, structural framing, cavity insulation
- Interior finish materials

Conventional Wall Design

Types of exterior cladding

- Non-absorptive
- Absorptive

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Non-Absorptive Claddings

- Metal
- Glass
- Vinyl Siding
- Composite Siding

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Absorptive Claddings

- Wood
- Fiber cement
- Stucco
- Manufactured stone
- Adhered veneer
- Brick






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Conventional Wall Designs
Residential

- Sheathing
- Water-resistive Barrier (WRB) / house wrap
- Siding / Cladding

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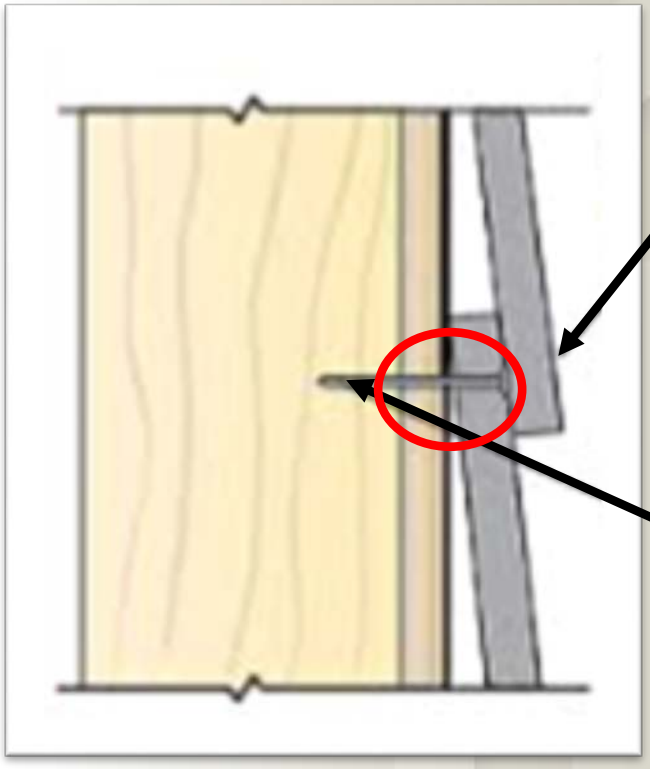
Concerns

- Cladding systems shed bulk water only
- Incidental water must be managed by WRD
- Puncturing of WRB
- Lack of continuous drainage plane
- Windows leak – water goes on WRB



Moisture Damage

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Moisture Damage

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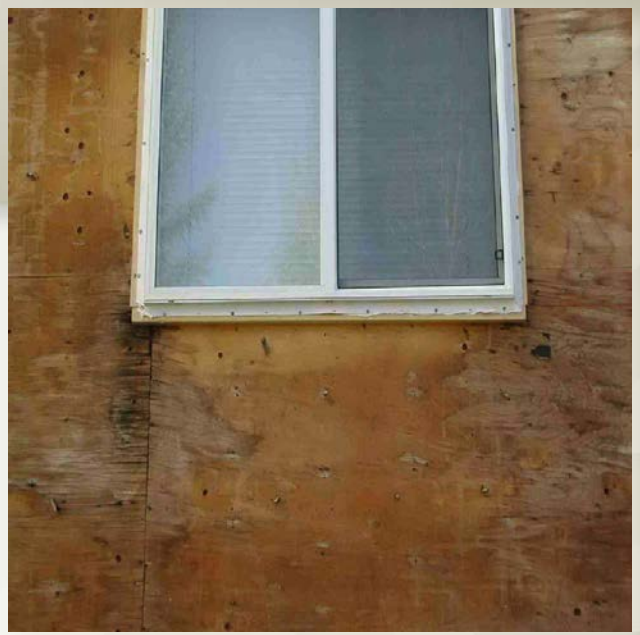
Moisture Damage



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Moisture Damage

Back of fiber cement board at nail penetration

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Moisture Damage

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Moisture Damage

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Restoration Costs

Potential repairs:

- Cladding
- WRB
- Window flashing
- Sheathing
- Framing
- Insulation

Restoration costs: $10,000 to $300,000+

Maximum coverage
under Homeowner Insurance: $5,000

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Bureau of Insurance
STATE OF MAINE

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LIMITED FUNGI, WET OR DRY ROT, OR BACTERIA COVERAGE

FOR USE WITH FORM HO 00 03

SCHEDULE*

These limits of liability apply to the total of all loss or costs payable under this endorsement, regardless of the number of "occurrences", the number of claims-made, or the number of locations insured under this endorsement and listed in this Schedule.		
1.	Section I – Property Coverage Limit Of Liability for the Additional Coverage "Fungi", Wet Or Dry Rot, Or Bacteria	$
2.	Section II – Coverage E Aggregate Sublimit Of Liability for "Fungi", Wet Or Dry Rot, Or Bacteria	$

*Entries may be left blank if shown elsewhere in this policy for this c

DEFINITIONS

The following definition is added:

"Fungi"

a. "Fungi" means any type or form of fungus, including mold or mildew, and any mycotoxins, spores, scents or by-products produced or released by fungi.

b. Under Section II, this does not include any fungi that are, are on, or are contained in, a good or product intended for consumption.

SECTION I – PROPERTY COVERAGES

ADDITIONAL COVERAGES

The following Additional Coverage is added:

12. "Fungi", Wet Or Dry Rot, Or Bacteria

a. The amount shown in the Schedule above is the most we will pay for:

(1) The total of all loss payable under Section I – Property Coverages caused by "fungi", wet or dry rot, or bacteria;

(2) The cost to remove "fungi", wet or dry rot, or bacteria from property covered under Section I – Property Coverages;

SECTION I – PROPERTY COVERAGES

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Conventional Wall Design

Sources of moisture

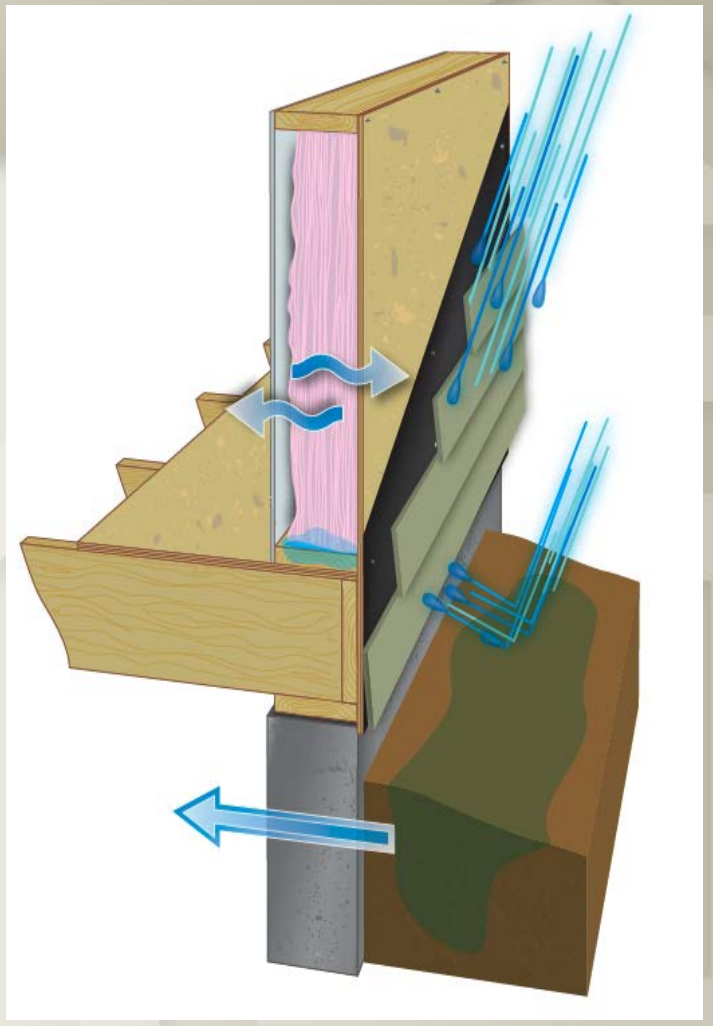
- Exterior natural sources (rain, snow, wind)
- Man-made sources (sprinklers)
- Interior sources
  (bathroom, washers, swimming pool, people)

Conventional Wall Design

Sources of moisture

- Climate zone effects, natural disasters
- Solar-driven moisture
- Capillary movement
- Condensation

Moisture Sources



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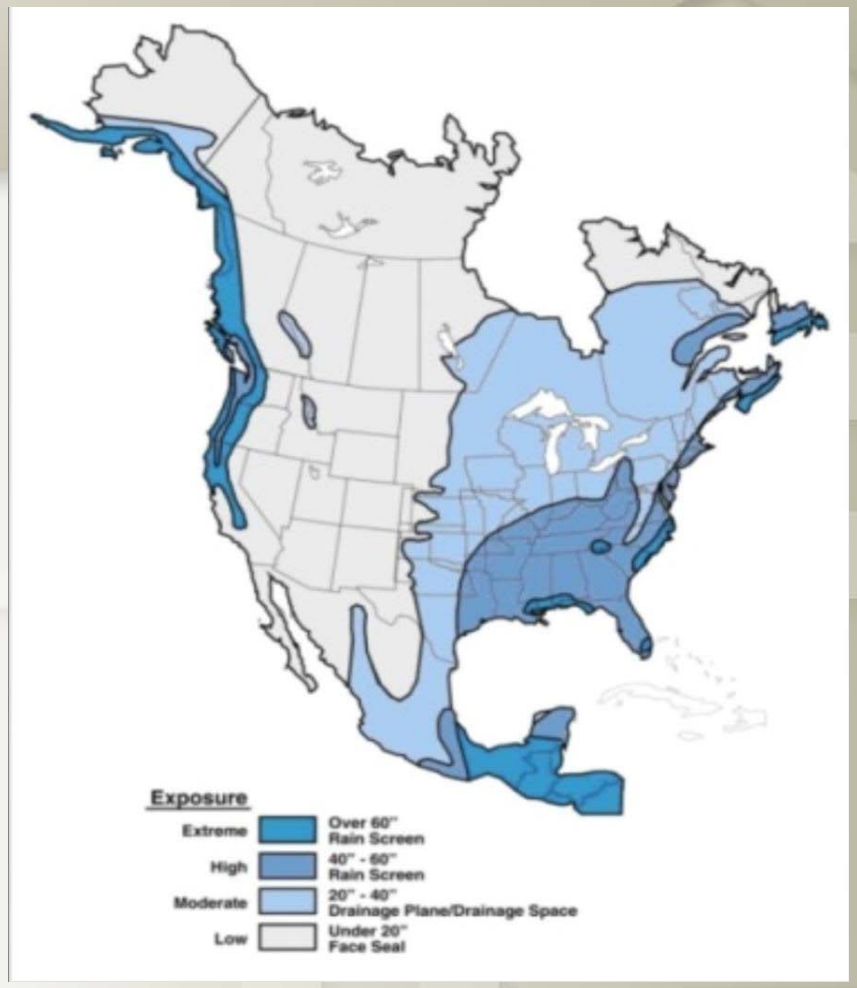
External Sources of Moisture

Rain

- Under 20”: face seal
- More than 20”: requires drainage & ventilation



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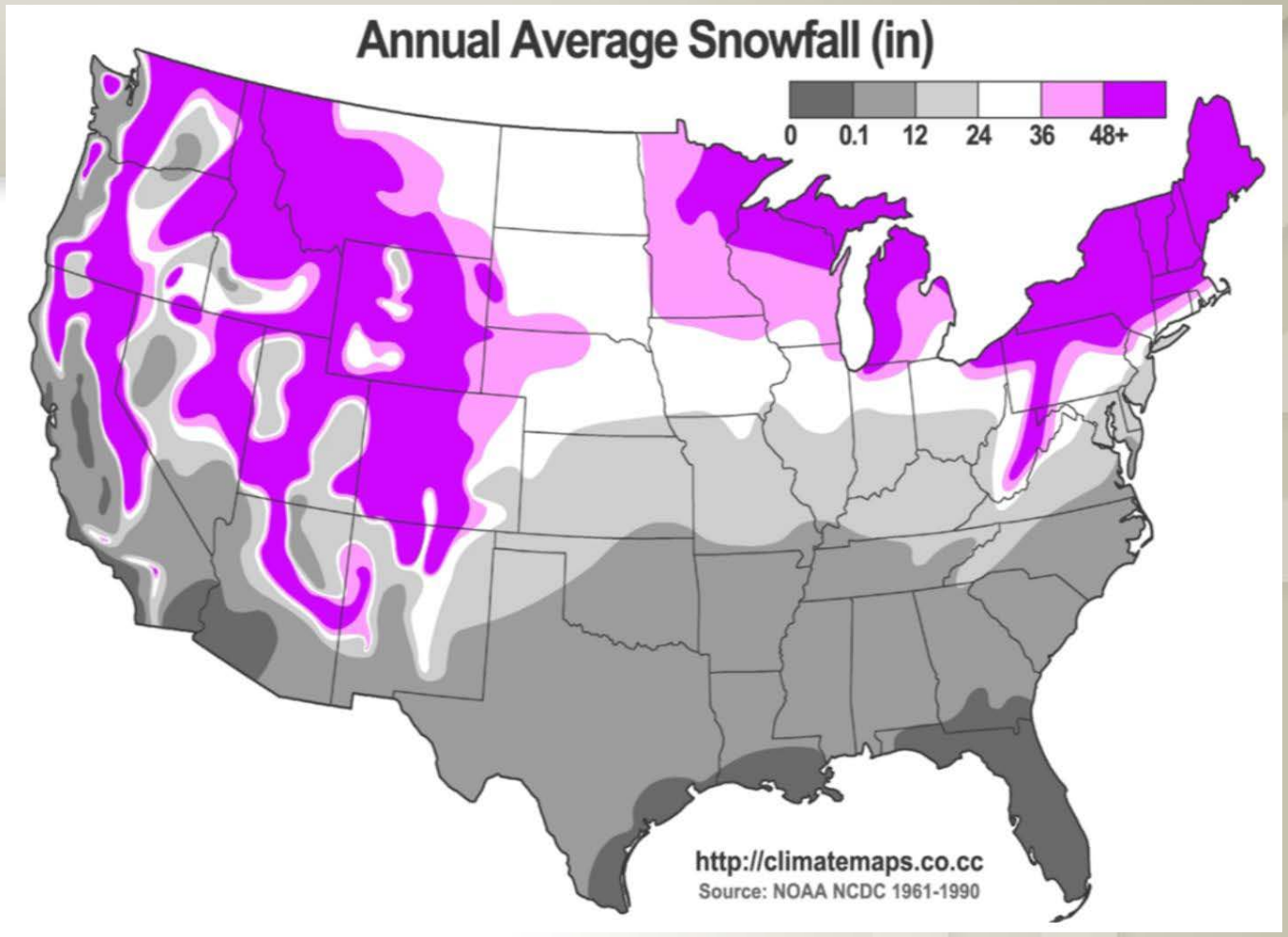
External Sources of Moisture



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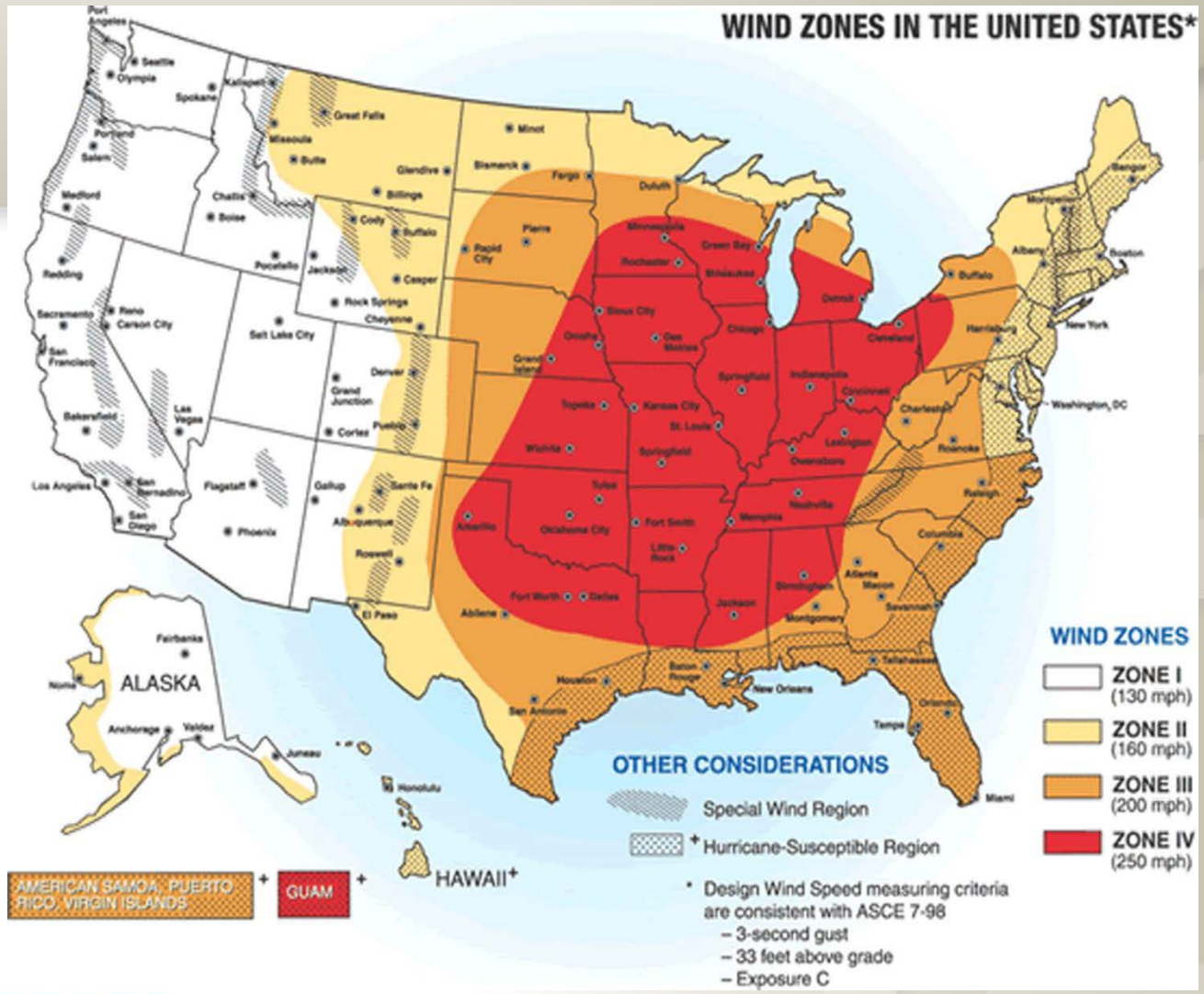
External Sources of Moisture

Wind



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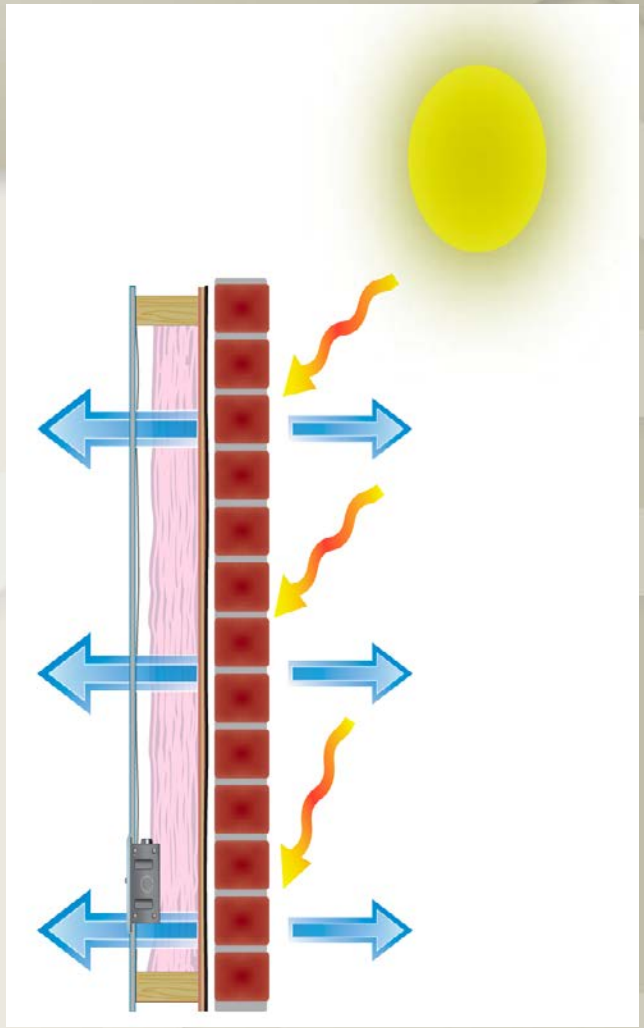
Solar Driven Moisture

After a rain-period absorptive cladding is soaked with water



Solar Energy can

- evaporate moisture
- push vapor **inwards!**

Vapor may condense inside the wall cavity!

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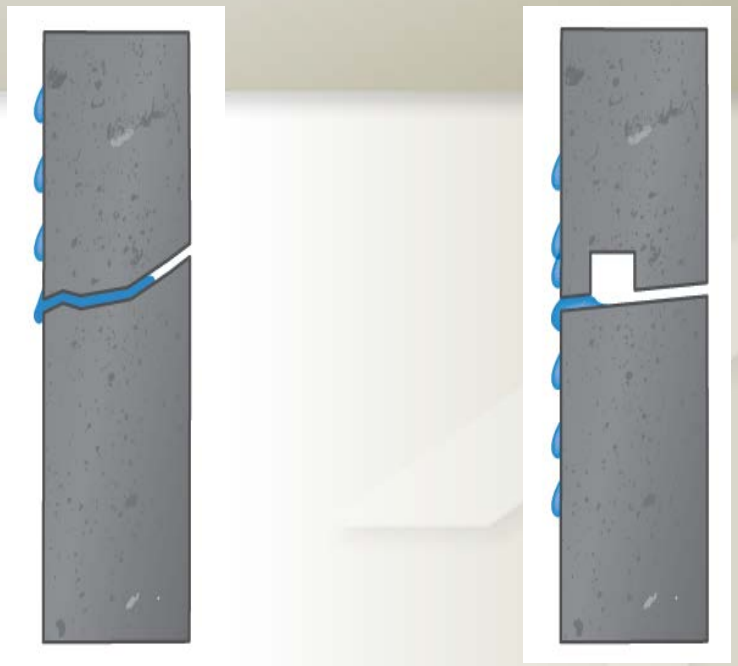
Capillary Movement



Cohesion and Adhesion

The smaller the fissure / crack,
the greater the suction and rise of water

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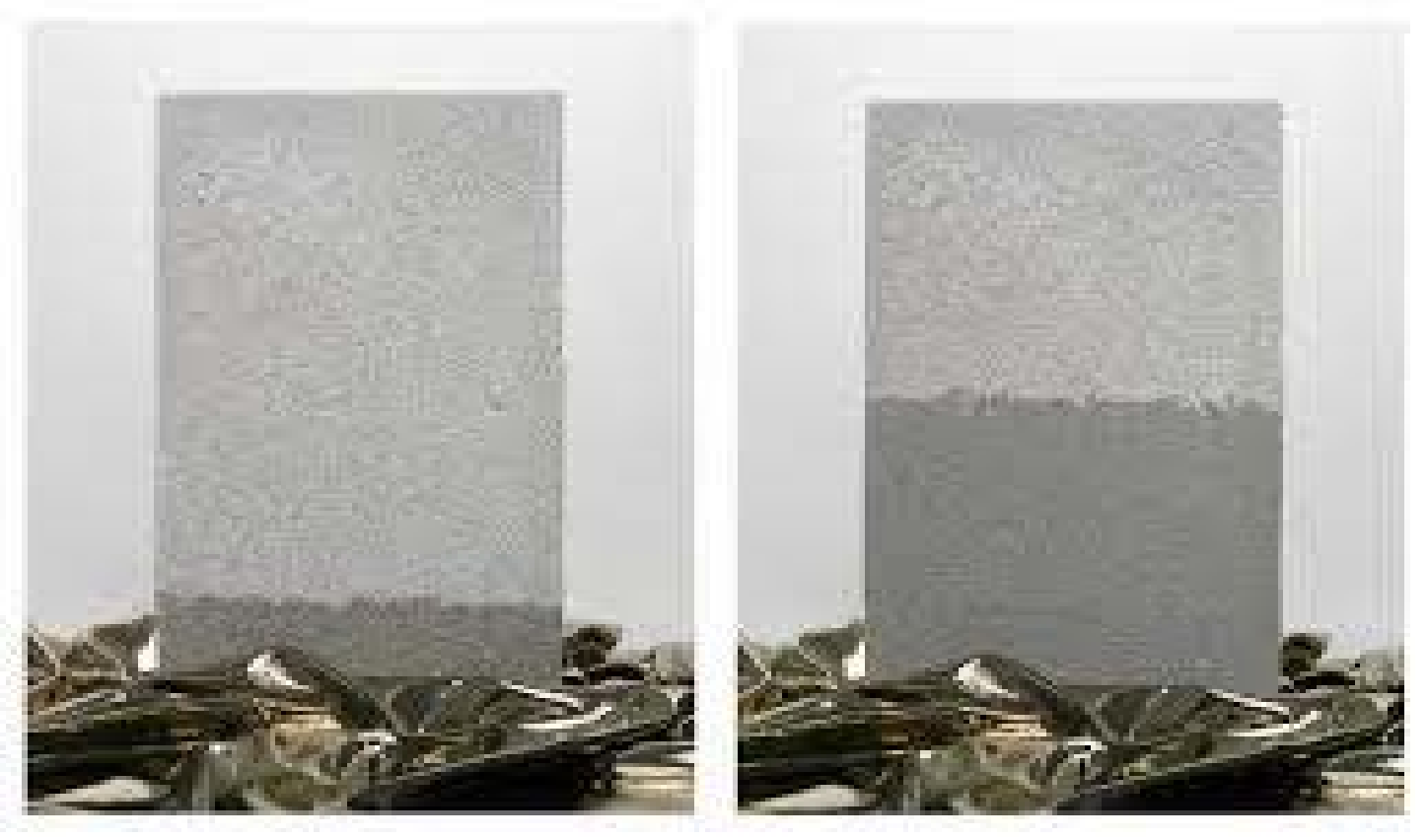
Capillary Movement



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Traditional Designs

Brick Industry Association

Tech Note #27

"It must be recognized that the exterior wythe cannot be made water tight. Provisions for ***internal drainage*** are necessary for these wall systems to function as intended."

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Traditional Designs

ASTM

“90% of all wall failures are the result of moisture related issues.”

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Traditional Designs

Risks of entrapped moisture

- Exterior wall saturation
- Rot, rust, and mold
- Structural integrity
- Health concerns

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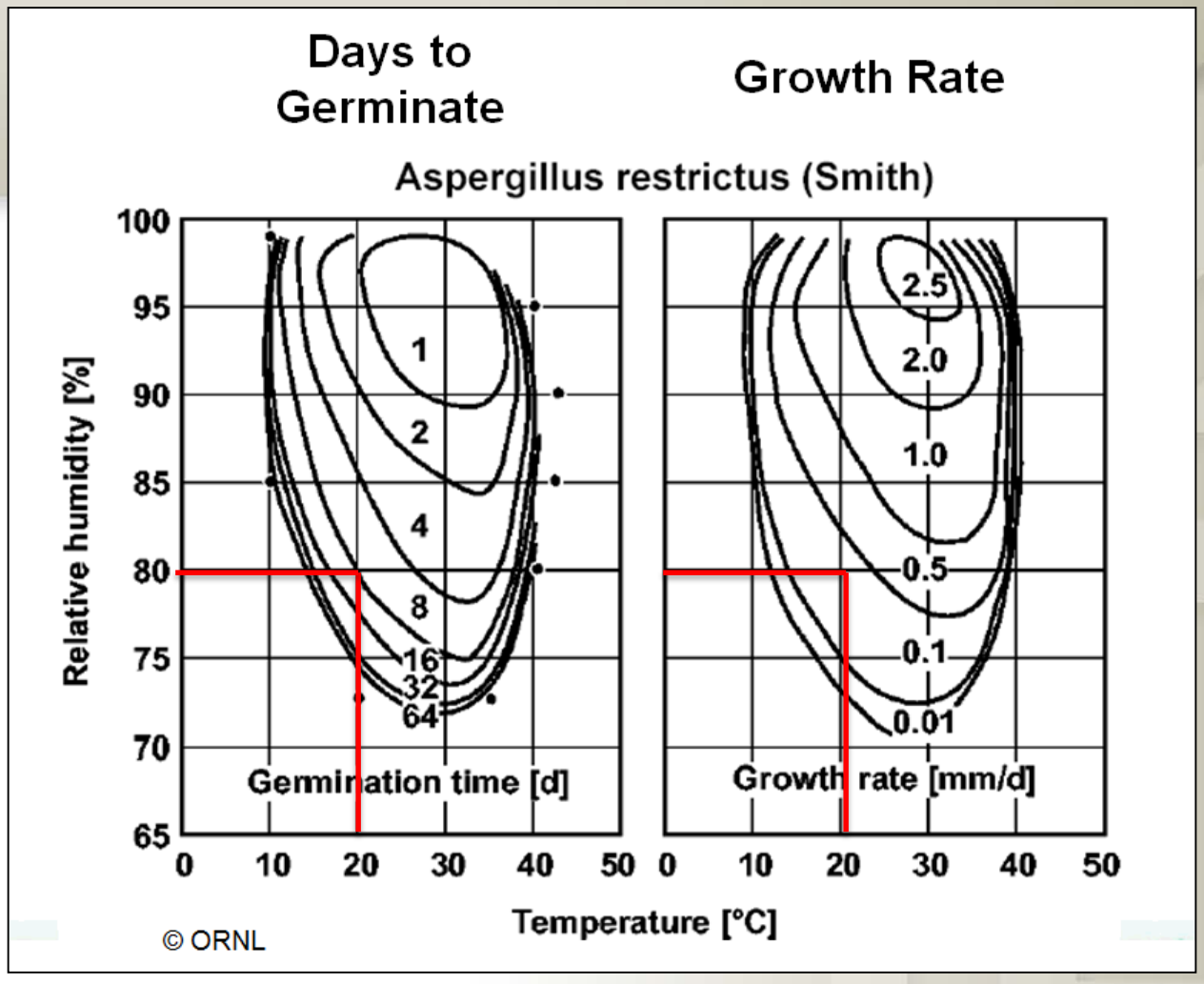
Traditional Designs



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Traditional Designs

Walls built more tightly to improve energy performance

- Lower drying potential

Potential costs

- $$$ spent on remediation / litigation
- High insurance premiums

Effective drainage and drying strategies mitigate risk.

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Moisture Management Strategies

Design strategies to improve drainage and drying:

- Capillary break
- Effective drainage
- Ventilation behind cladding system
- Drying energy to remove moisture from sheathing material

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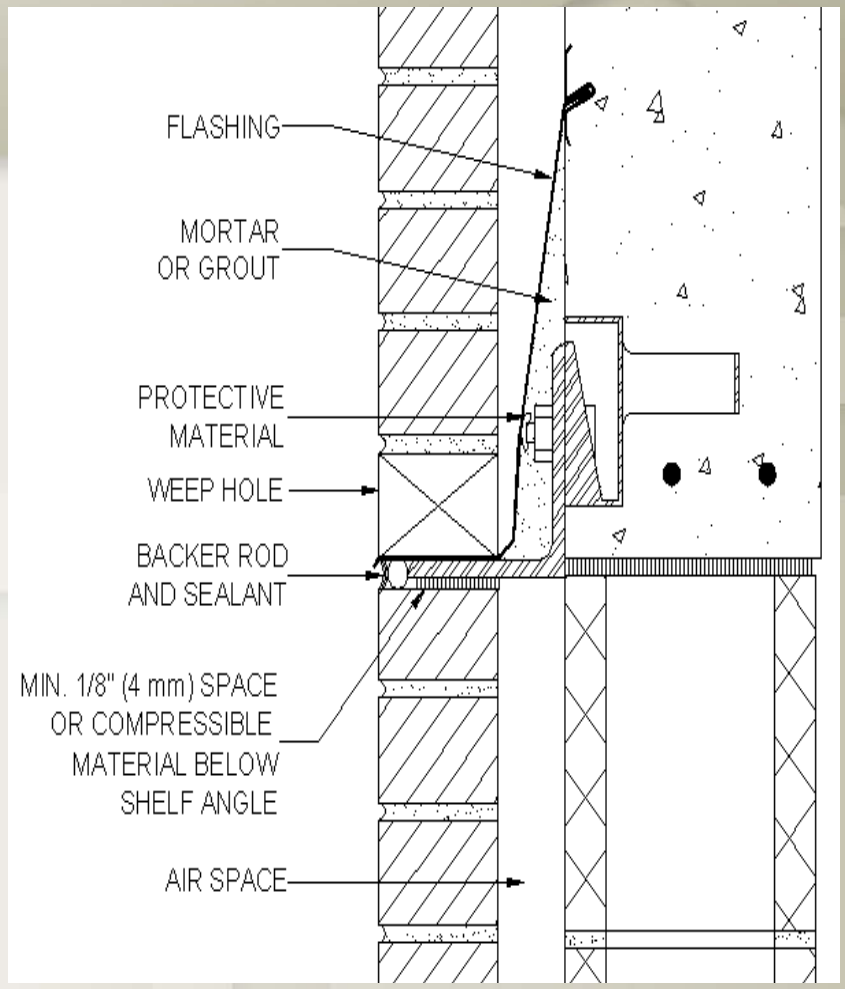
Drainage Space - Masonry Walls

- Code min. cavity airspace: 1”
- Industry standard: 2”
- International Masonry Institute: 2”
- Masonry Standard Joint Committee: 1.5” - 2.0”

Drainage and air flow are essential



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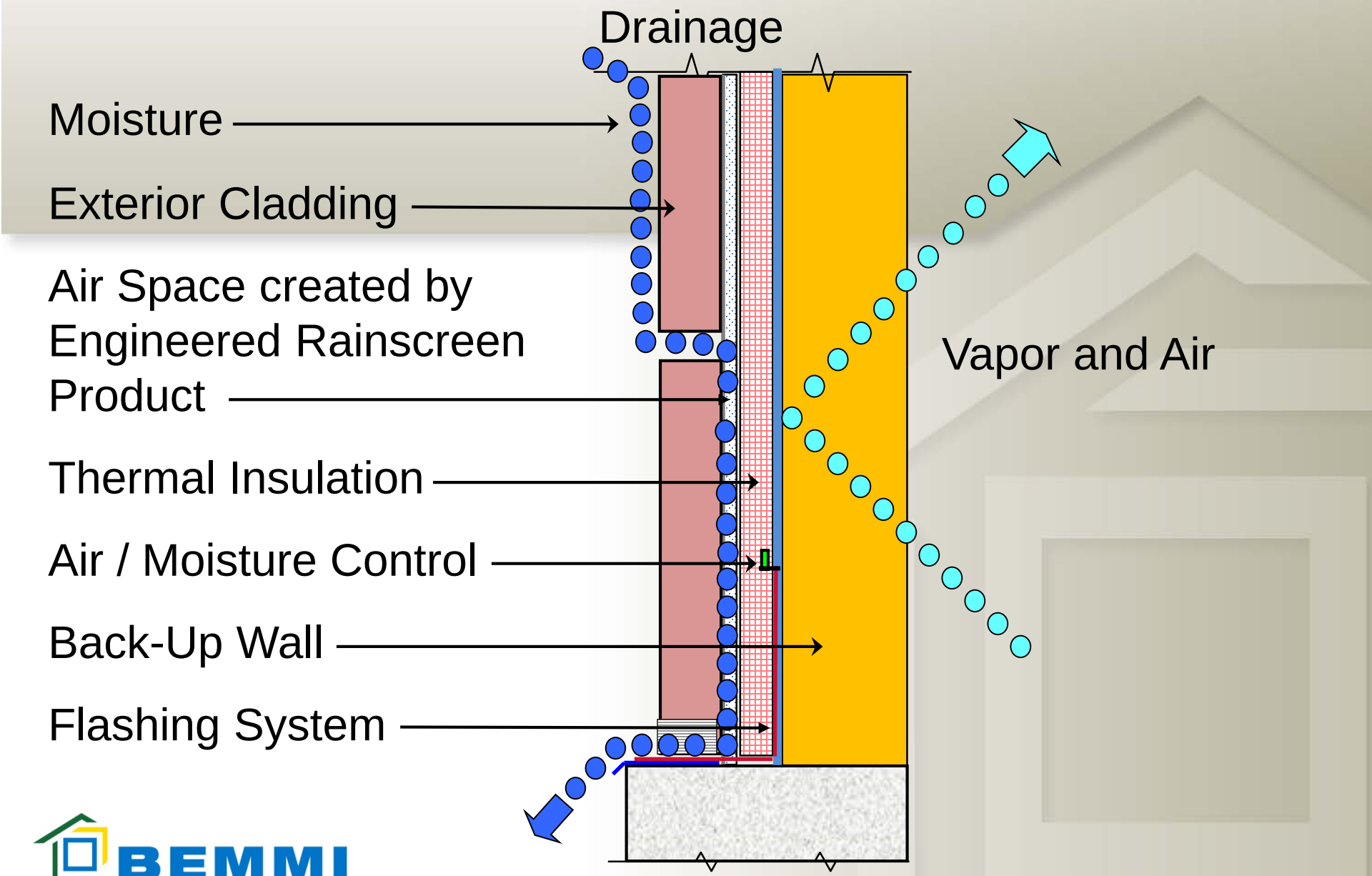
Function of a Rainscreen

Create space for drainage & ventilation

- Bulk water drainage
- Drying ventilation
  - Openings at top and bottom of wall
  - Drying of residual moisture
- Removal of vapor to prevent condensation
    - Outward vapor drive
    - Solar-driven moisture

Drainage Space - Masonry Walls



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Ventilation

Vented

- open only at bottom
- some air movement near bottom, but not over entire wall

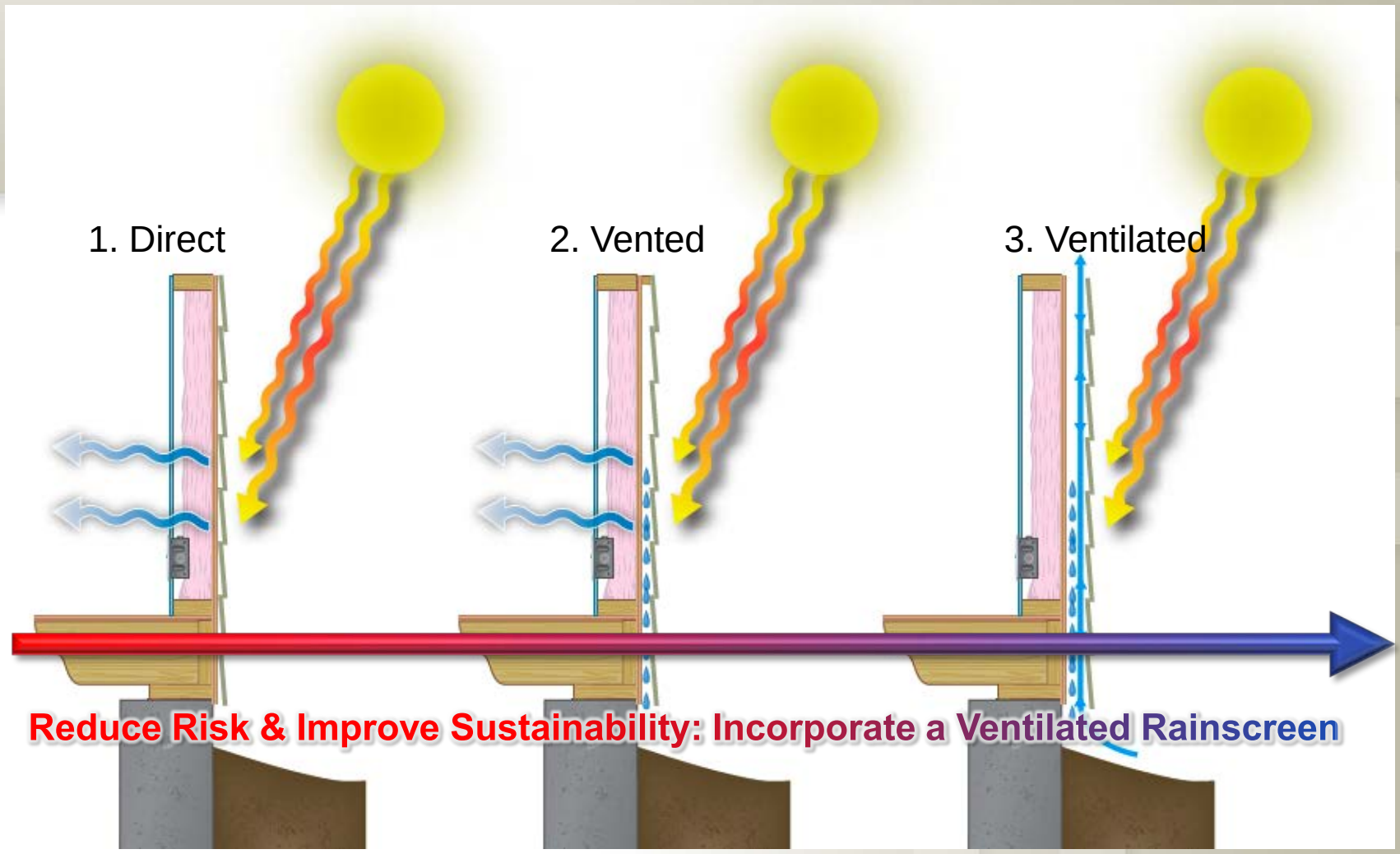
Ventilated

- open at top and bottom
- air movement over the entire surface of the wall

Benefits

- pressure moderation
- greatly enhanced drying potential

Cladding Application Methods



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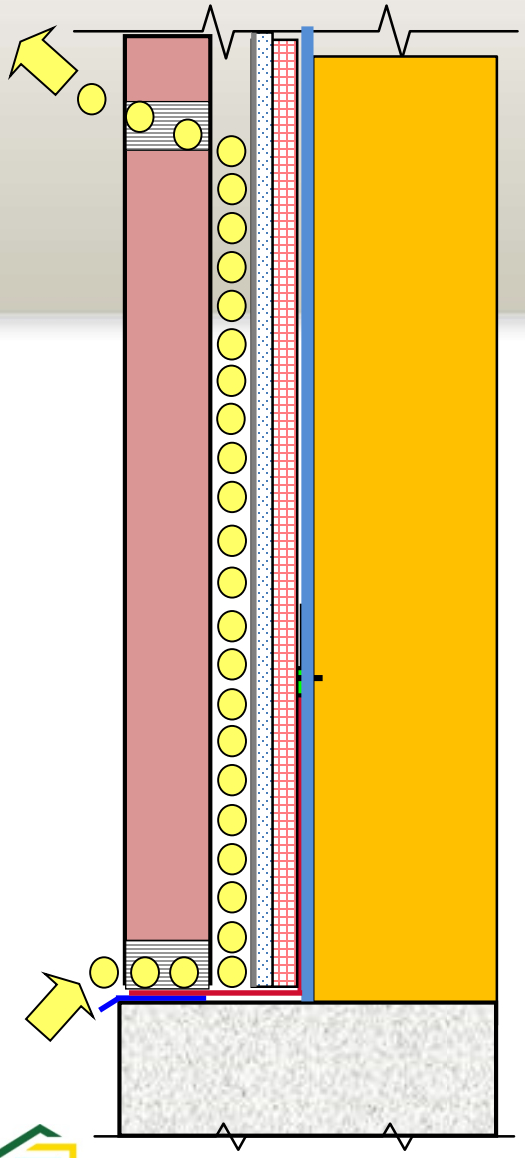
Ventilation



Top of wall was left open prior to roof completion. Moisture caused efflorescence.

Roof was installed. Wall was built with weep vents top and bottom. Efflorescence reduced with air movement.

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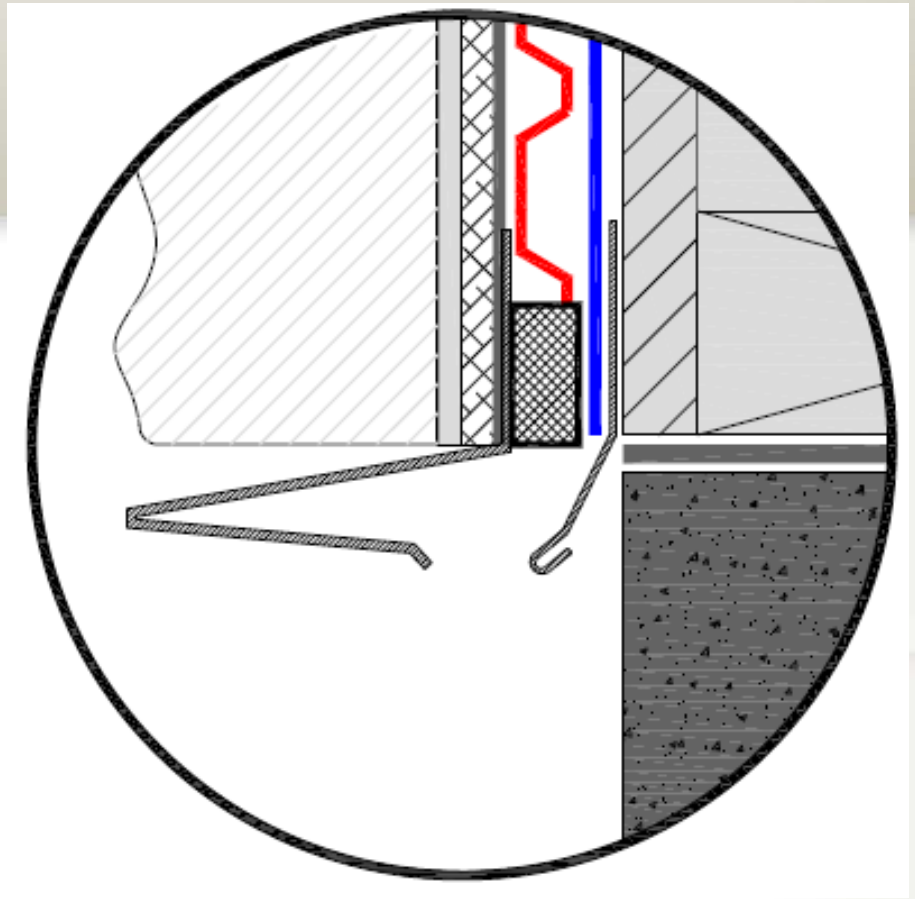
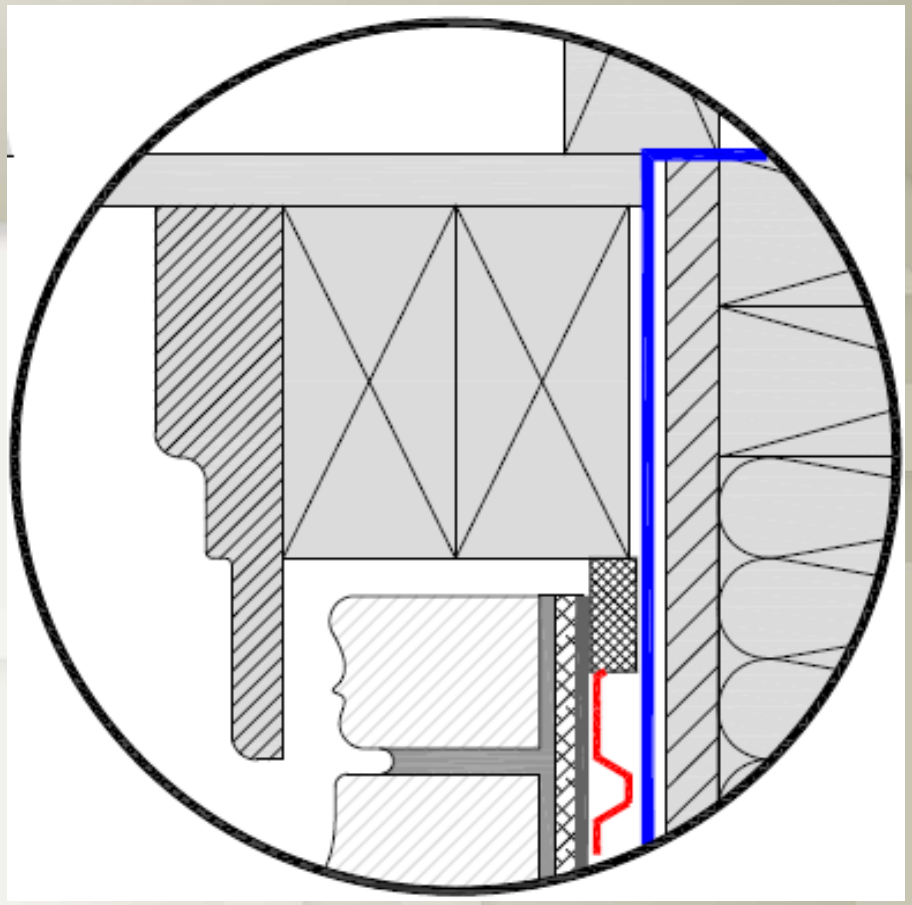
Ventilation



Bottom ventilation detail



Top ventilation detail

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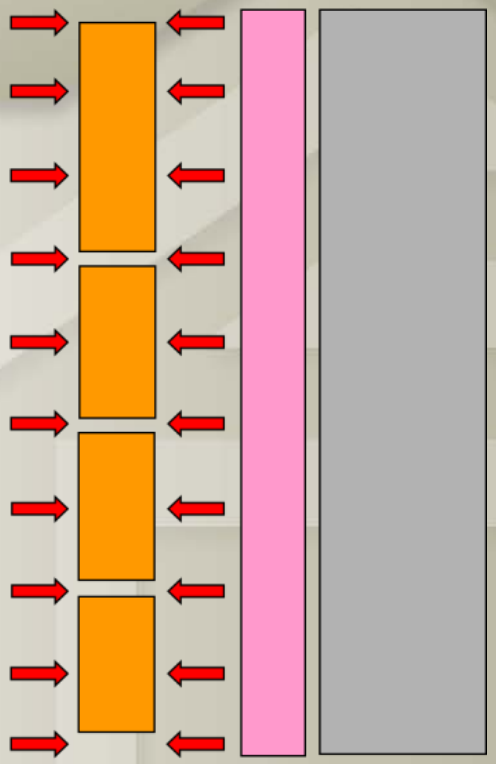
Rainscreen Functions

Pressure moderation

- Ventilated rainscreen can moderate pressures
- Wind pressure against wall can force moisture through cladding
- Moderating pressure reduces water penetration



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Rainscreen Functions

- Capillary break
  - Min. 3/16" (ASTM E2925-14)
- Reduce bulk water reaching water-resistive barrier
- Reduce surfactants (contained in some claddings) reaching water-resistive barrier

Designing Resilient Walls

Key features

- Risk management
  - Increasingly stringent energy codes require tighter enclosures making moisture management more critical
  - Nominal investment protects building
  - Protect reputation of designer and builder

With use of engineered rainscreen

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Designing Resilient Walls

Proper Materials

- Wall components must be resilient
  - alone
  - in combination with other materials

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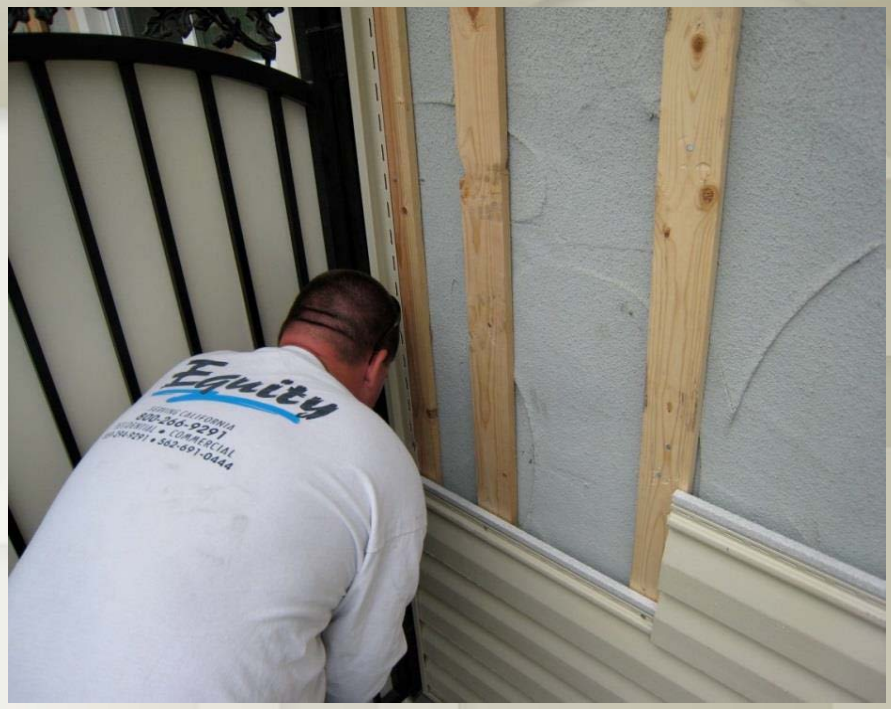
Traditional Rainscreen Products

Wood furring strips

- Retain water
- Possible decay
- Lack cross ventilation
- Wall area coverage (15%)
- Labor intensive



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Designing Resilient Walls

Engineered rainscreens vs wood furring strips

- Slimmer walls
- Labor efficiency
  - Furring strips: fabricate to size, install over studs
  - Engineered rainscreens: roll out similarly to WRB's, maximum open space created over entire wall

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Rainscreen Materials

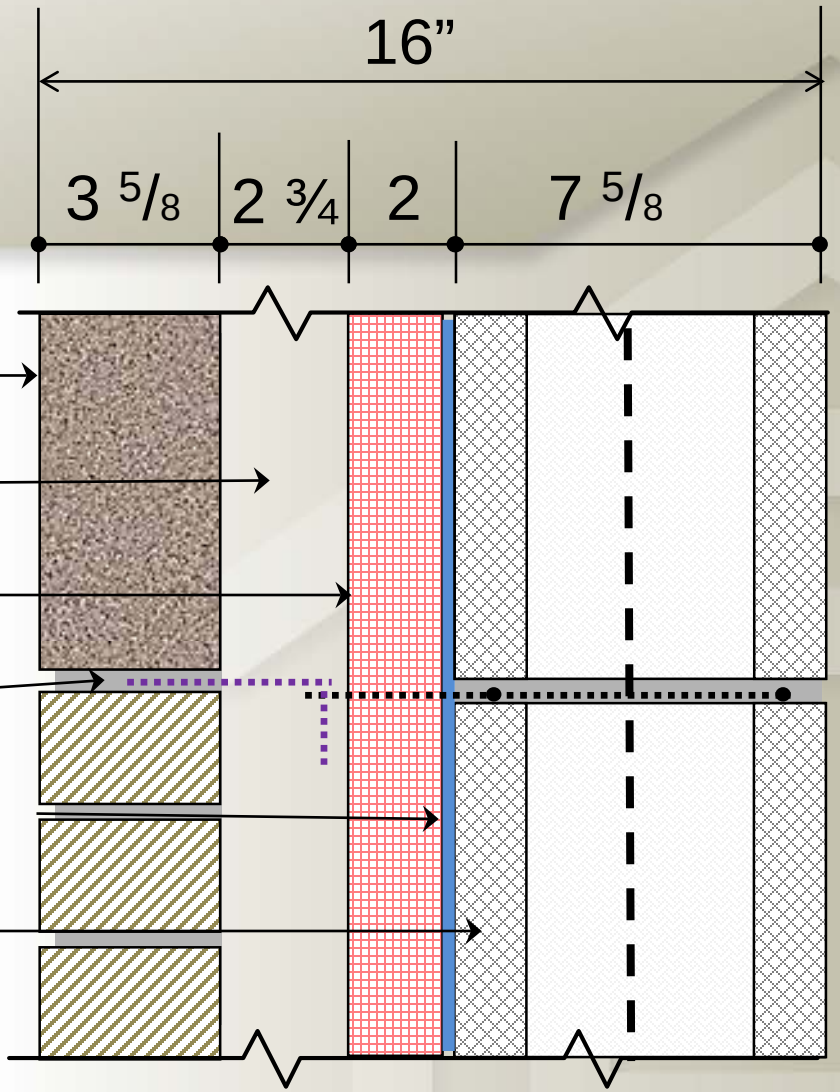
- No such thing as effective face-sealed cladding (e.g. early EIFS version)
- Building settlement, expansion/contraction of dissimilar materials, windows, seams, joints, connections, etc. contribute to water penetration

Create safety buffer

- Rainscreen materials:
  - Create space to remove bulk water and vapor
  - Protect WRB from surfactants
  - Add drying capacity

16” Insulated Cavity Walls

2” Insulation



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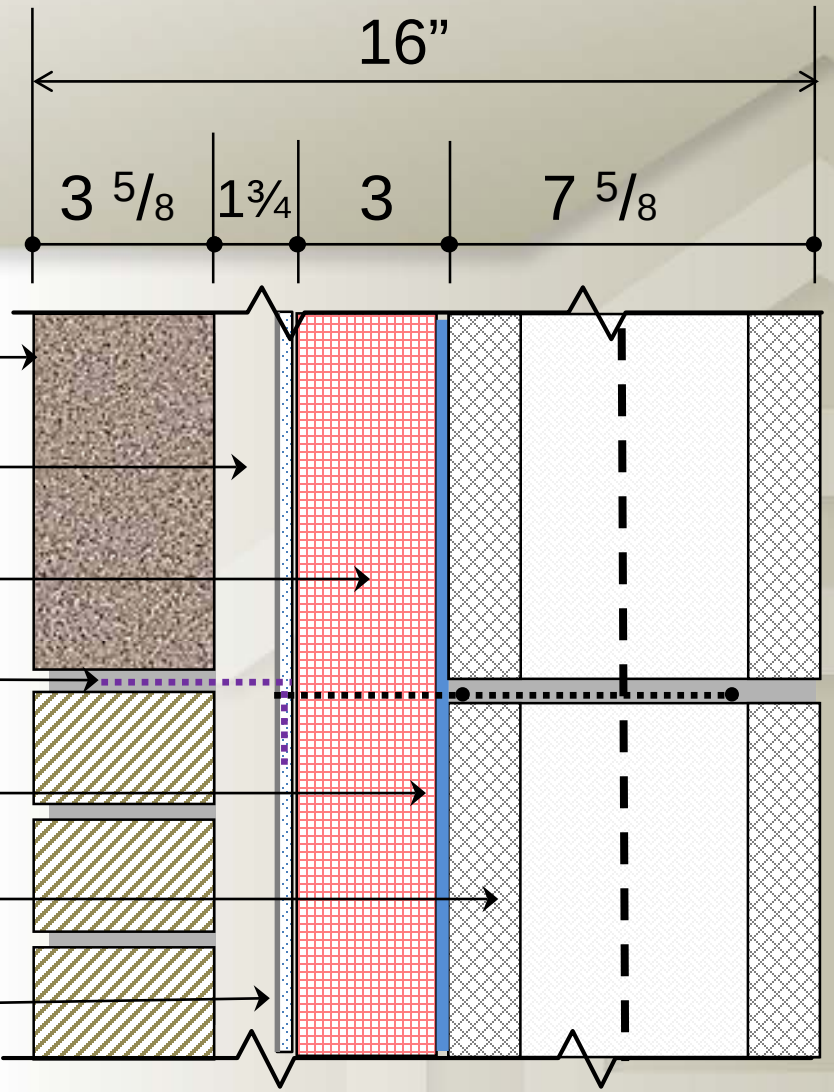
16” Insulated Cavity Walls

NEW Energy Codes
= 3” Insulation



Veneer unit

1 ¾” air space

3” rigid insulation

Veneer ties & J.R.

Water-resistive/Air barrier

CMU backup

Engineered rainscreen

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Drained Space in Masonry Walls

International Masonry Institute

ASK IMI December 2013

Chapter 14 – Exterior Walls / 1403.2 Weather Protection

"A 1 3/8"or 1 ½" air space with a 3/8" continuous drainage mat can be just as effective as a 2" air space where increased insulation and minimum wall thickness are design parameters."

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Engineered Rainscreen Materials

- Create fixed airspace
- Drain & ventilate wall
- Moderate air pressure
- Provides capillary break

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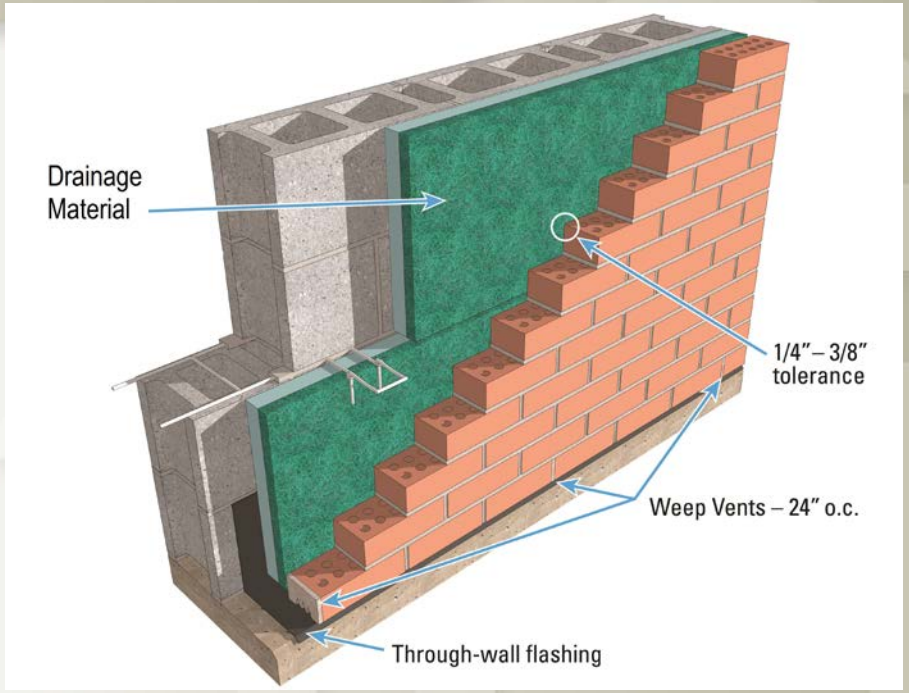
Engineered Rainscreen Materials

- Reduce efflorescence
- Protect against deterioration
- Help prevent mold
- Improve indoor air quality
- Decrease maintenance
- Increase lifespan of building



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Specification Considerations

Section 07460 – Rainscreen Components

- Cross-references other sections interfacing with engineered rainscreens
- Specifies materials and methods in one place
- Reduces risk of not being recognized by relevant sub-trade bidders

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Specification Considerations

Alternative:

Specify rainscreen in each relevant wall assembly

- Each bidder must include rainscreen in work
- Reduces risk of modifications to individual sections
- Could create differences in installation

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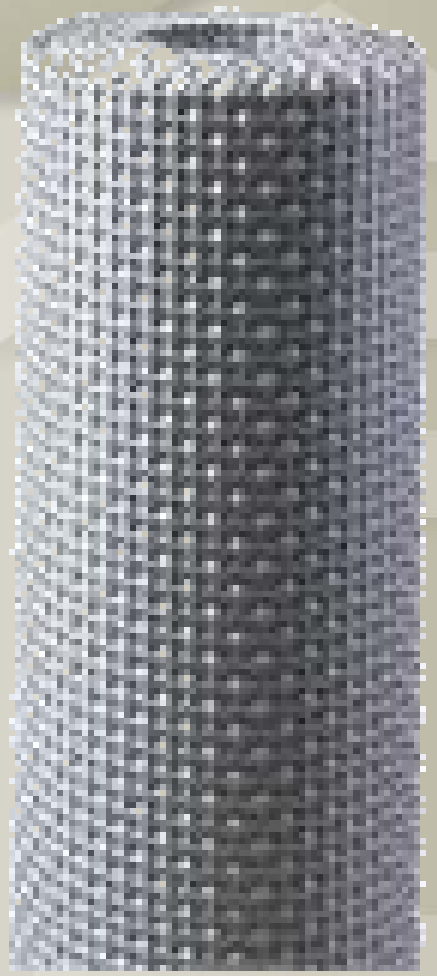
Engineered Rainscreen Examples

Dimpled sheet



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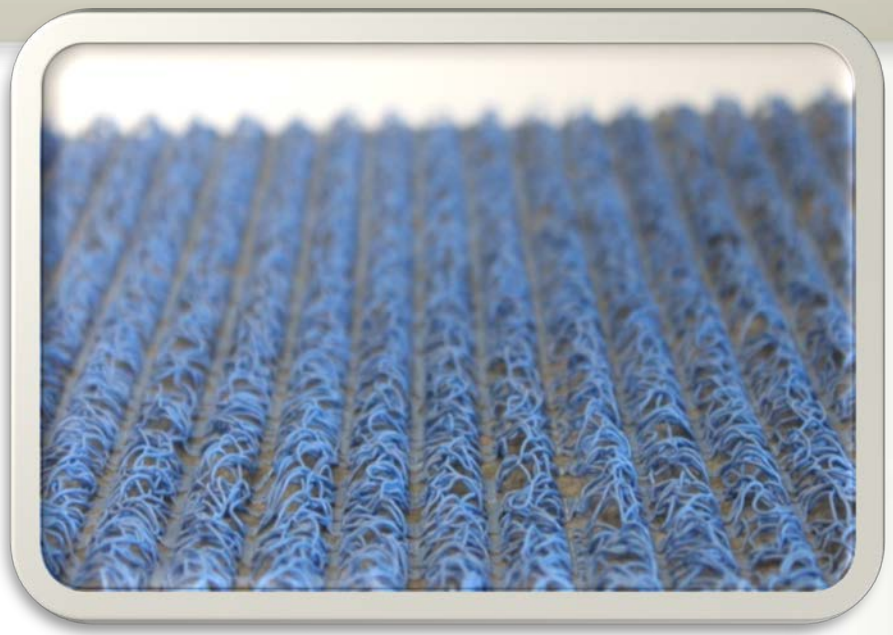
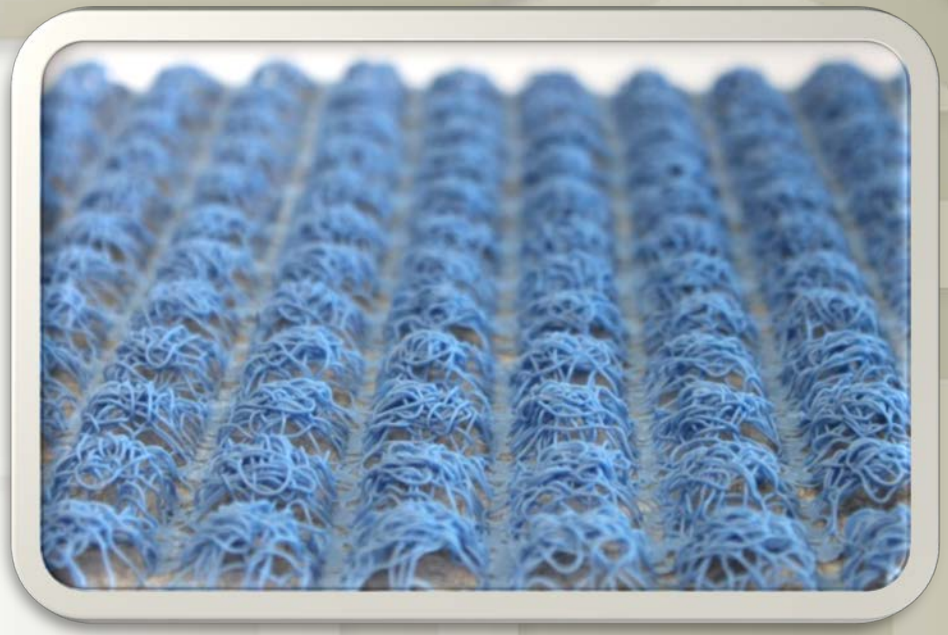
Engineered Rainscreen Examples





Entangled Matrix with Facing Fabric

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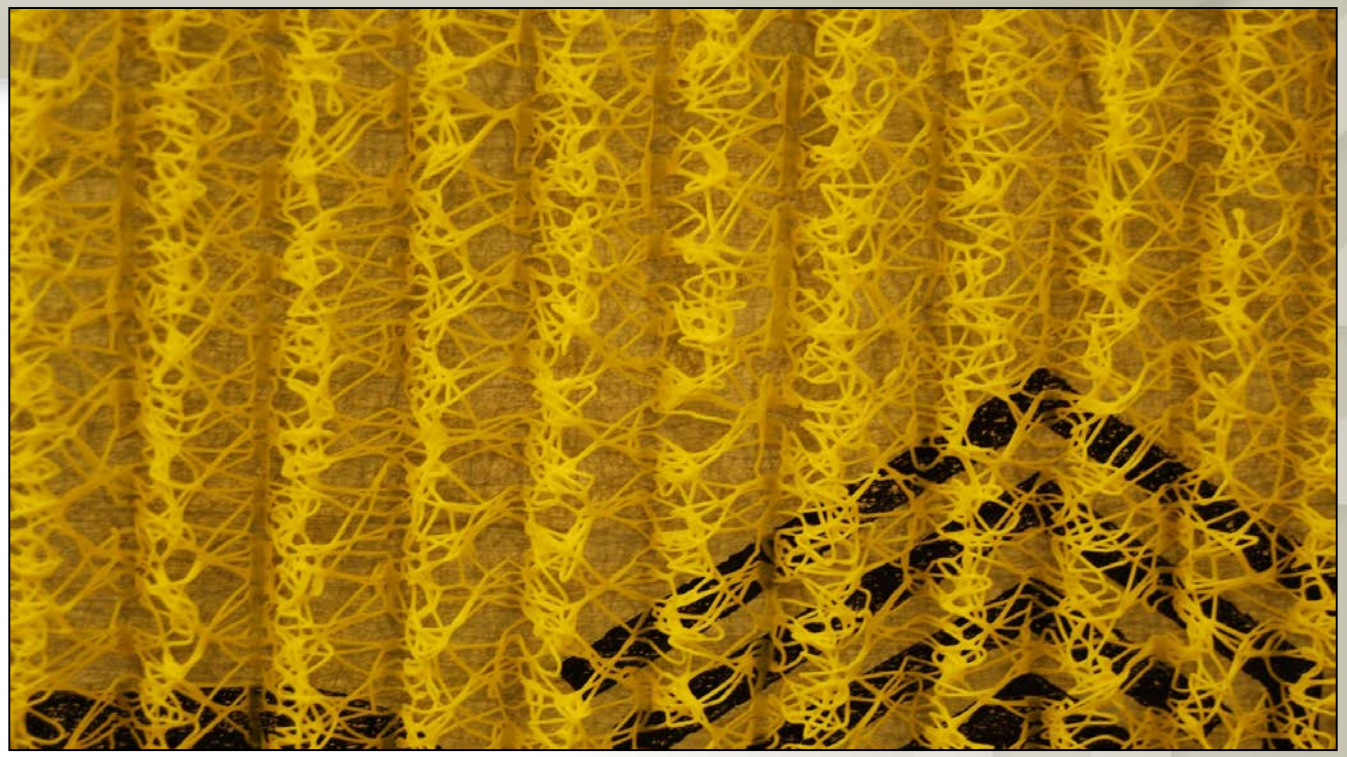
Engineered Rainscreen Examples



Entangled Matrix with WRB

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Engineered Rainscreen Examples

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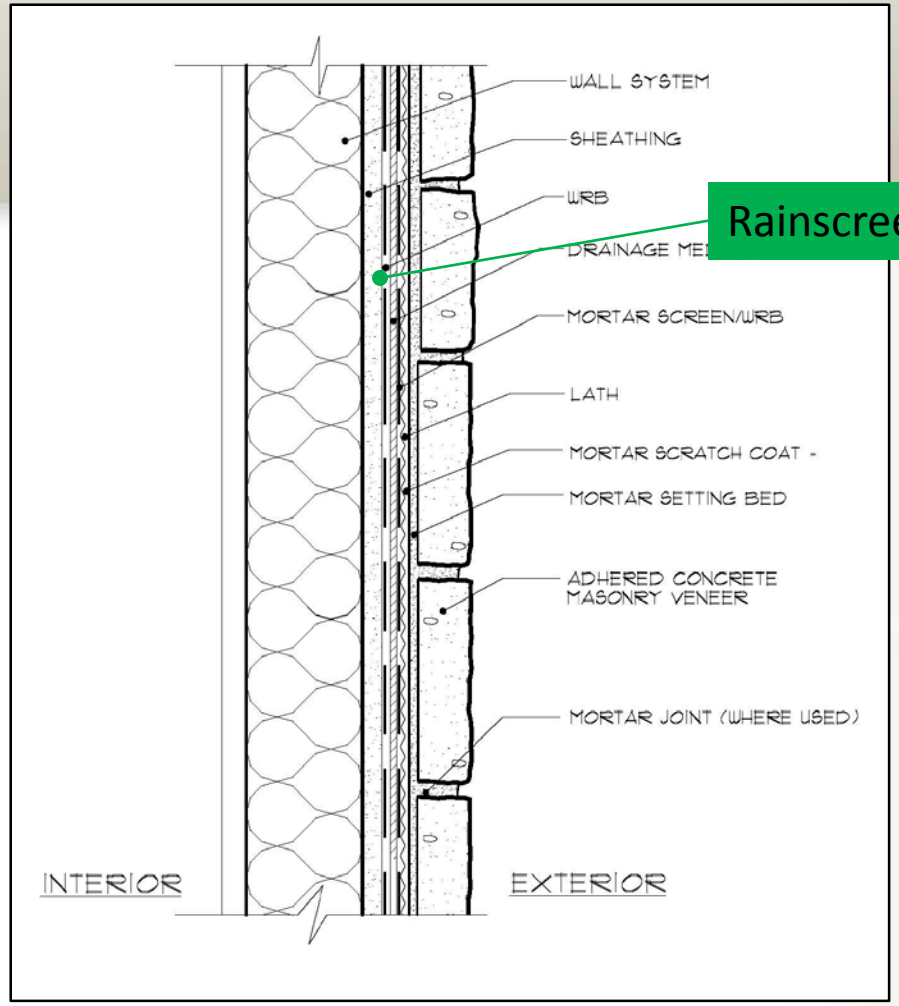
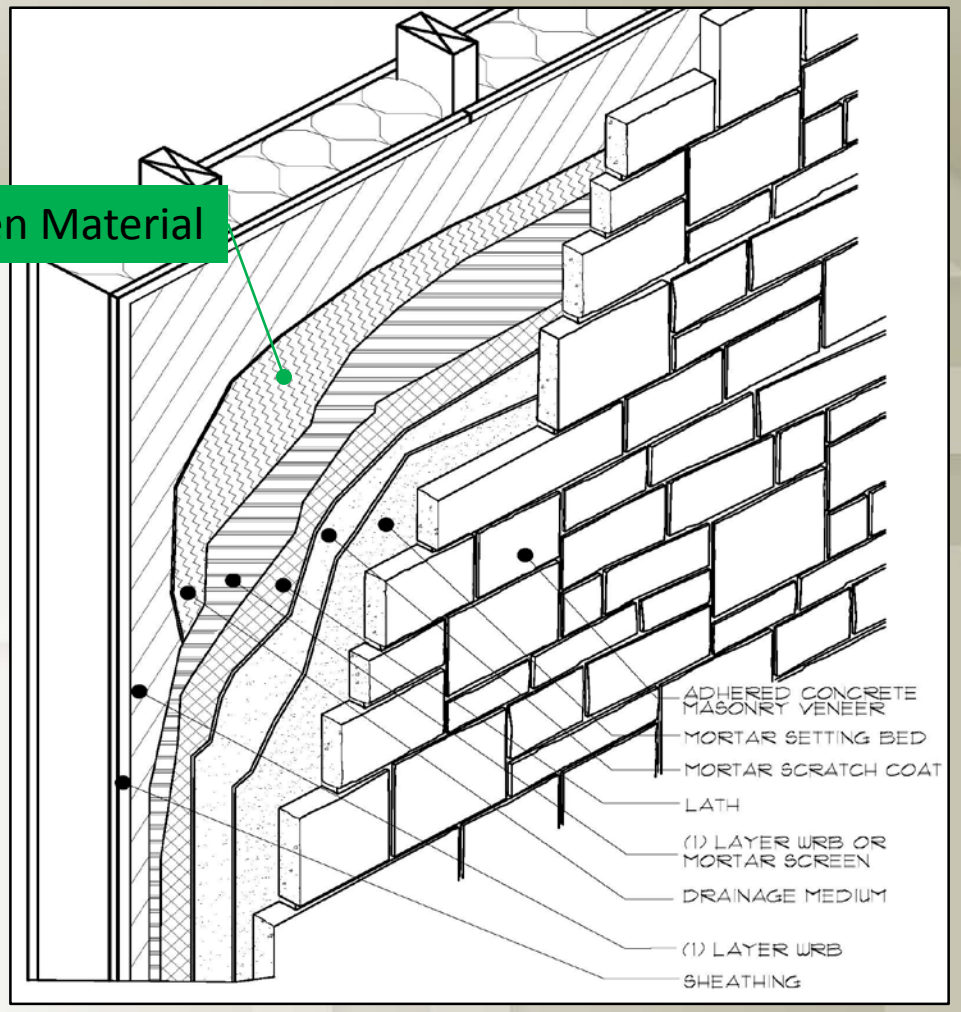
Designing with Engineered Rainscreen



Rainscreen Material



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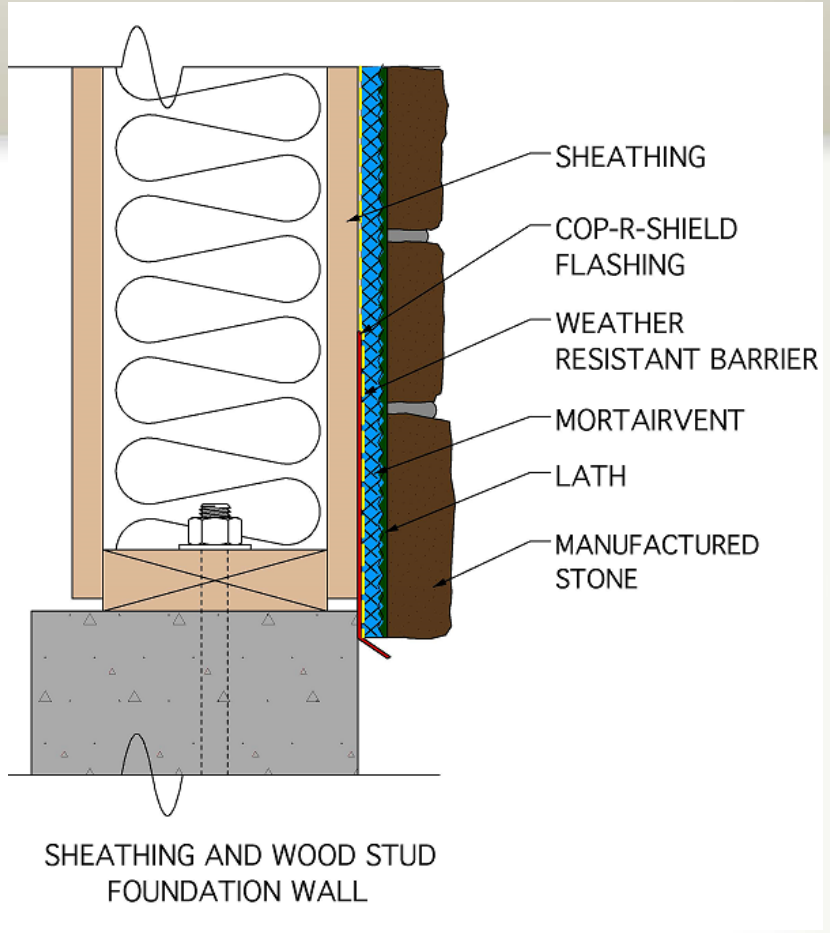
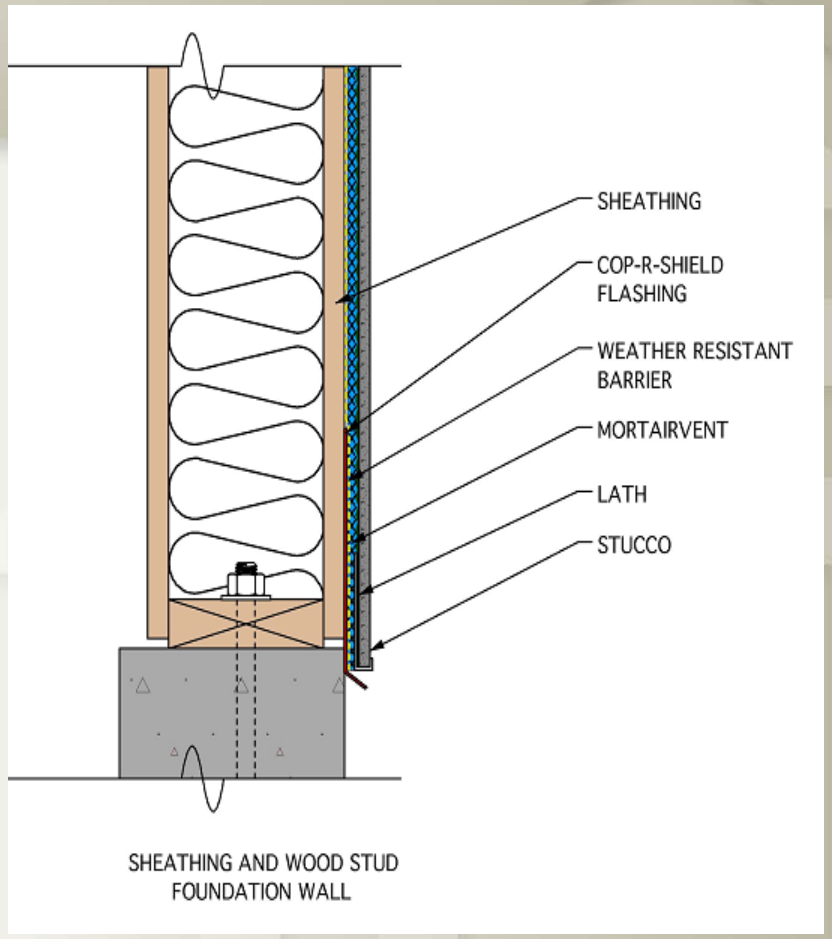
Designing with Engineered Rainscreen





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Installing Engineered Rainscreen

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Installing Engineered Rainscreen

Stucco or adhered masonry veneer

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Installing Engineered Rainscreen

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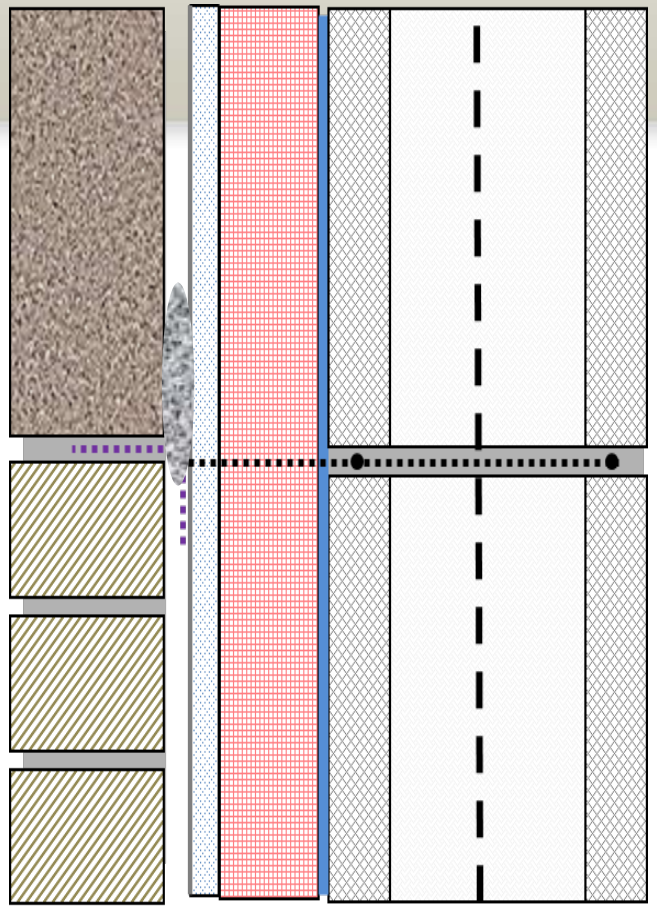
Installing Engineered Rainscreen



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Installing Engineered Rainscreen

Cedar shingles

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Installing Engineered Rainscreen

Siding

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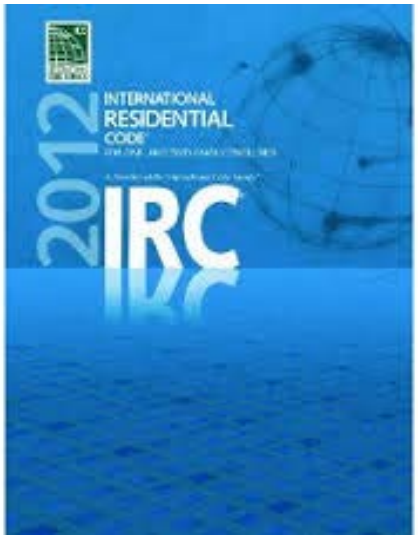
Building Codes and Industry Standards



ASTM INTERNATIONAL

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International Building Code (IBC) 2012

Chapter 14 – Exterior Walls / 1403.2 Weather protection

Exterior walls shall provide the building with a weather-resistant exterior wall envelope. The exterior wall envelope shall include flashing, as described in Section 1405.4. The exterior wall envelope shall be designed and constructed in such a manner as to prevent the accumulation of water within the wall assembly by providing a water-resistive barrier behind the exterior veneer, as described in Section 1404.2 **and a means for draining water that enters the assembly** to the exterior. Protection against condensation in the exterior wall assembly shall be provided in accordance with Section 1405.3.

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International Residential Code (IRC) 2012

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.

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Canada Building Code

2010 National Building Code (NBC) of Canada Section 9.27.2.2

"…exterior walls exposed to precipitation shall be protected against precipitation ingress by an exterior cladding assembly consisting of a first plane of protection and a second plane of protection incorporating a capillary break…"

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Canada Building Code

2010 NBC of Canada Section 9.27.2.2

"…a cladding assembly is deemed to have a capillary break between the cladding and the backing assembly where …there is a drained and vented air space not less than 10mm deep (.40)" 3/8" behind the cladding, over the full height and width of the wall…"

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Other Codes & Standards

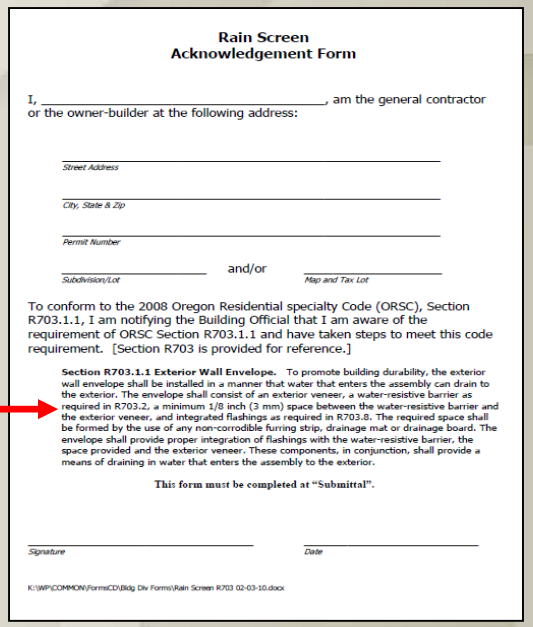
- State Building Codes – Oregon
  - Rainscreen Acknowledgement Forms
- Masonry Veneer Manufacturers Association (MVMA)
- Other references
  - Brick Industry Association
  - National Concrete Masonry Association
  - International Masonry Institute

Oregon Building Code

Section R703.1

"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. 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 water that enters the assembly to the exterior. Protection against condensation in the exterior wall assembly shall be provided in accordance with Chapter 11 of this code."

Rain Screen
Acknowledgement Form



Rain Screen
Acknowledgement Form

I, _____, am the general contractor or the owner-builder at the following address:

_____
Street Address

_____
City, State & Zip

_____
Permit Number

_____ and/or _____
Subdivision/Lot *Map and Tax Lot*

To conform to the 2008 Oregon Residential specialty Code (ORSC), Section R703.1.1, I am notifying the Building Official that I am aware of the requirement of ORSC Section R703.1.1 and have taken steps to meet this code requirement. [Section R703 is provided for reference.]

Section R703.1.1 Exterior Wall Envelope. To promote building durability, the exterior wall envelope shall be installed in a manner that water that enters the assembly can drain to the exterior. The envelope shall consist of an exterior veneer, a water-resistive barrier as required in R703.2, a minimum 1/8 inch (3 mm) space between the water-resistive barrier and the exterior veneer, and integrated flashings as required in R703.8. The required space shall be formed by the use of any non-corrodible furring strip, drainage mat or drainage board. The envelope shall provide proper integration of flashings with the water-resistive barrier, the space provided and the exterior veneer. These components, in conjunction, shall provide a means of draining in water that enters the assembly to the exterior.

This form must be completed at "Submittal".

_____ _____
Signature *Date*

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Installation Guide
For Adhered Concrete Masonry Veneer
3rd edition

"Rainscreen building techniques are typically used to improve the escape of incidental water and decrease drying time. Rainscreen products (such as drainage mats) that create a capillary break/air space between the cladding and the primary water resistive barrier can be effectively incorporated into ACMV applications."

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MVMA
Masonry Veneer Manufacturers Association

ASTM Standard

ASTM E2925-14 - Standard Specification for Manufactured Polymeric Drainage and Ventilation Materials Used to Provide a Rainscreen Function

- ASTM D3045 – Heat Aging
- ASTM D5199 – Nominal Thickness Test
- ASTM D5322 – Immersion Procedures
- ASTM D 6108 – Compression Testing
- ASTM D 6364 – Short-Term Compression Testing
- ASTM E84 – Surface Burning Test
- ASTM E2273 – Drainage Efficiency
- ASTM G 154 – UV Testing

ASTM INTERNATIONAL
Standards Worldwide

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Review

- Explain conventional wall designs versus drained & ventilated wall designs
- Define the function of a rainscreen
- Identify key design principles for resilient walls
- Describe the difference between traditional and engineered rainscreen
- Discuss moisture management designs when using absorptive claddings
- List rainscreen building code requirements and show how to be compliant

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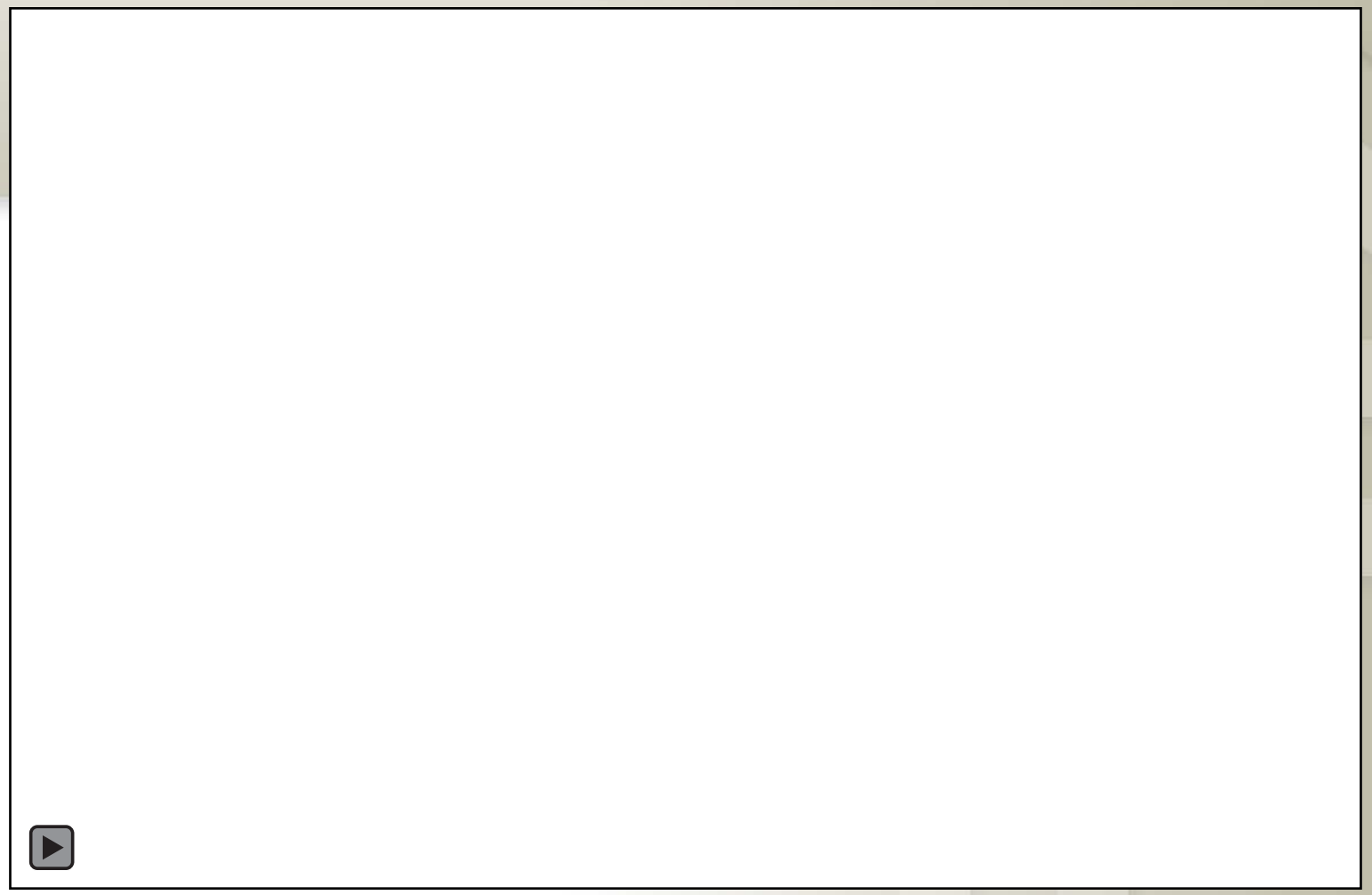
Ventilated Rainscreen



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Ventilated Rainscreens

Improve Enclosure Wall Design

- Incorporate **drainage spaces** to rid wall assembly of bulk water
- Incorporate air spaces to provide **ventilation** for enhanced drying potential
- Provide **Capillary break**
- Reduce **solar driven moisture** from **absorptive claddings**

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Thank you for your time!

ANY QUESTIONS?

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