RAiNA
RAINSCREEN ASSOCIATION IN NORTH AMERICA

How and Why Rainscreen Walls Work, or When They Don't:

A Deep Dive into the Building Science

Graham Finch, MASc, P.Eng
Principal, Senior Building Science Specialist
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AIA Learning Credits: 1.0 LU/HSW
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Course #: RAiNA-CONF24-2

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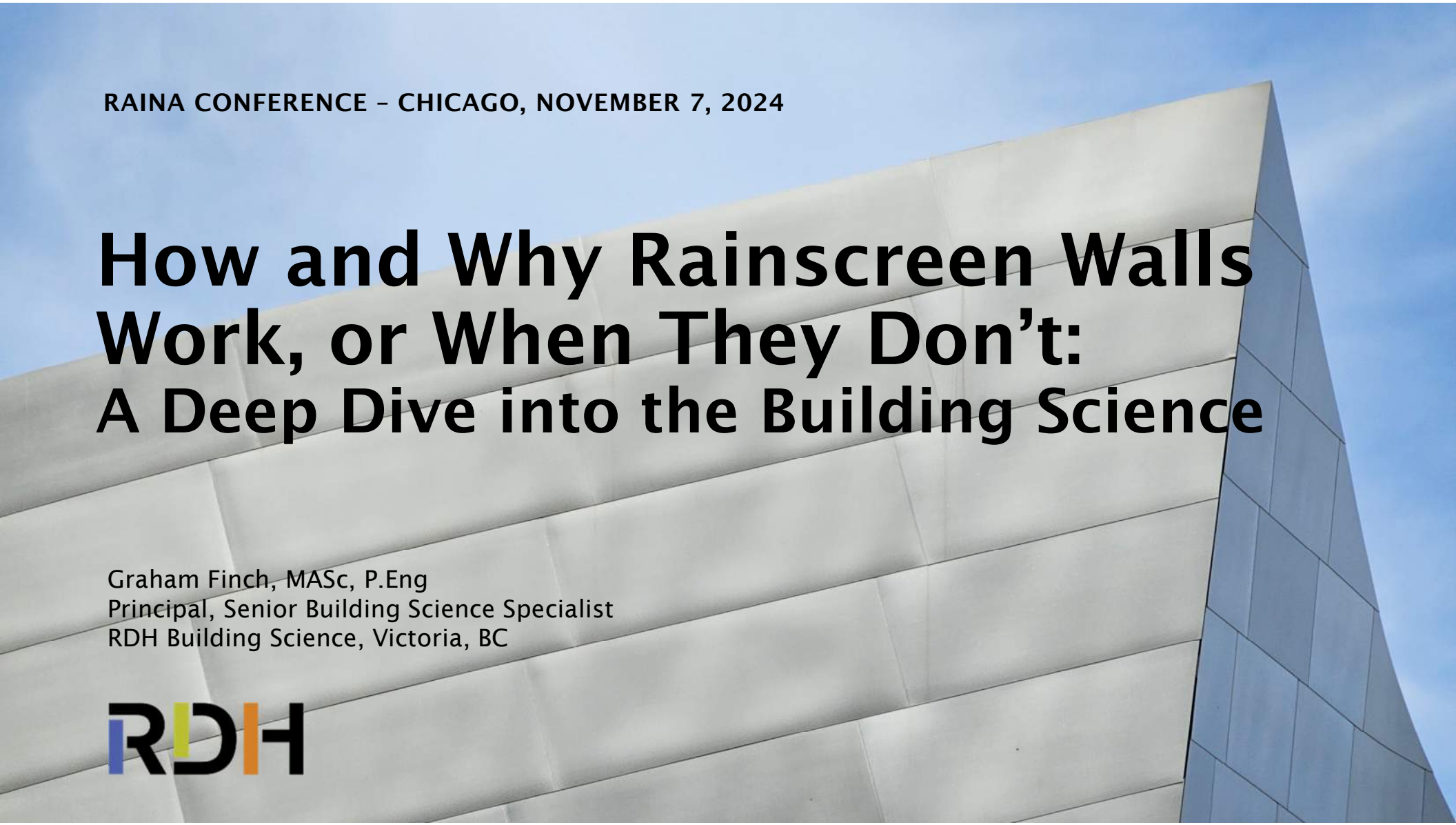
Presenter Bio

Graham is a Principal and Senior Building Science Specialist with RDH Building Science who specializes in enclosure design, research, and investigation work for new and existing buildings. His work experience includes a wide range of projects including building enclosure and facade design and analysis, forensic investigations, research studies, building monitoring, enclosure testing, and various product development and testing services for projects across Canada and the US.

Graham is regarded as an industry leader in evaluating thermal energy and hygrothermal (heat, air, and moisture) performance of building enclosures. Specific to rainscreen walls, much of his practice and graduate research has focused on hygrothermal performance of rainscreens and innovation in higher performance exterior insulated cladding attachments. His work has resulted in several publications and practical recommendations for the construction industry for rainscreen wall designs. Graham is also a co-chair of the Rainscreen Performance Committee for RAiNA.



RAINA CONFERENCE – CHICAGO, NOVEMBER 7, 2024

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Outline

Rainscreen walls are systems made up of several materials that come together as a minimum building enclosure function to protect buildings from rain. Rainscreens must also manage environmental loads, including structural loads, fire and smoke, UV radiation, sound, heat flow, airflow, and vapor movement. Each of the system components, including the airspace between the outer and inner layers (aka the cavity or gap), are important to performance – and they need to work together to be effective.

The outer finish/cladding is the most visible rainscreen layer. This layer sheds water and provides the first line of protection of the underlying materials from the environment. If cladding gaps are added to an open rainscreen, extra water and UV gets past the outer layer and then managed with carefully selected materials and details. The structural attachment of the cladding through sub-framing and cladding attachments, and often exterior insulation, requires a thoughtful design that is balanced for thermal performance and structural efficiencies. Hidden behind the cladding is the critical airspace – the one “free” rainscreen component. This gap provides a clear path for water drainage and airflow through openings to the exterior. Most of the time, this system keeps the wall dry. If the air gap is oversized or attention isn’t taken with the selection of cladding or other materials, then this hidden cavity can become a fire concern. If the gap is too small, water can get trapped or airflow restricted, hindering performance. An inner water-resistive layer completes the rainscreen and acts as the last line of defense from water, and may also control airflow and vapor. Insulation placed within the rainscreen cavity for thermal benefit may widen the gap and impact water control decisions and the insulation materials may also have fire code ramifications. Some designers talk about pressure equalization as a solution for additional water management but find it difficult to achieve in practice. Pest management must also be considered in the openings and details and these screen openings can even tie into wildfire resistant construction details for rainscreen walls too.

Needless to say, a lot is going on within a rainscreen wall. This presentation uncovers how rainscreen walls work at a fundamental level and gets into the key design and construction considerations that make them perform as intended.

Learning Objectives

1. Identify the essential parts of a rainscreen wall including what is absolutely necessary or just “nice to have”.
2. Examine the importance of the size of the rainscreen air gap on air, water, thermal and fire performance.
3. Construct better rainscreen details to allow for proper drainage and ventilation while balancing other performance needs such thermal performance, pest entry, and fire resilience.
4. Recognize challenging rainscreen wall designs where extra attention may be required for material selection and detailing.

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Local Curiosities in My Formative School Years

Page A2 · The Review

News

Saturday, October 25, 1997

A billion-dollar nightmare

Fixing failed condos could cost $1 billion

CONDO CRISIS

Martin van den Hemel
staff reporter

It's an estimated billion-dollar problem that scientists wa of more than a decade ago.

Canada Mortgage Housing Corporatio Jim White says researchers knew th of wall designs com inside most failing dominiums on the

indicated that walls without rainscreens (a drainage cavity inside a wall that allows for penetrating water to exit a wall) will not hold up to Mainland's

Costs range from $58,000 to more than $100,000 per unit

Leaky highrise owners go from 'disbelief' to forking out

Matthew Claxton
touring writer

SCHOOL TEACHER
Turess bought a con-
Pacific Point high-
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shortly after construction finished in 1991.

"At first we thought that leaky condos were strictly confined to the lowrise buildings," Rumball said. "We noticed a huge repairs and maintenance expenditure on a yearly basis. Virtually everything was leaking."

The rebuilding will cost $10.5 million and will include both towers and a connecting building, said Rumball. The cost ranges from $58,000 to more than $100,000 per unit.

Many residents have been unable to pay for the repairs, and have received zero-interest loans from the B.C. Homeowner Protection Office. According to the Crown corporation's statistics, 65,000 condo units in the province and half have been re-

The Homeowner tion Office helps condo through grants to deprovincial sales tax on interest-free loans

Experts say plastic shrouds like the one encompassing the 16-storey Pacific Point building (right) will become a common sight as more highrises need leaks fixed. (Above) Residents enter the building through a construction zone.

photos Dan Toulgoet

an investment, but has had difficulty finding tenants because of the leak. Now he is facing a $62,000 repair bill and can't get a Homeowner Protection loan because he doesn't live in the building.

Several other high-

dos around

The number affected is unknown.

"I don't think anybody knows, but the number will be staggeringly high," said James Bald

Owners of leaky condos plead for compensation

As the Barrett commission begins its probe into condo building practices, homeowners told of a heavy financial and emotional toll.

IAN MULGREW
VANCOUVER SUN

One after another — some brandishing corroded pipes, others placards — irate homeowners pleaded Tuesday for compensation for their leaky condominiums and townhouses.

As the provincial Barrett commission into shoddy building practices began its first day of hearings in a Vancouver hotel ballroom, angry protesters picketed outside looking for relief from an estimated $1 billion in bills, a staggering toll in emotional turmoil and as-yet-uncalculated health costs.

"The banks must love the rise in personal loans," read one sign.

The commission was appointed earlier this month after growing complaints from consumers, industry organizations and trade unions about problems plaguing the provincial housing market that have affected tens of thousands of people.

Inside, people pounded the presenter's podium and poured out their hearts to commissioner Dave Barrett, former New Democratic Party premier, and his two advisers, Vancouver economist Robert Allen and Victoria lawyer Peter Leask.

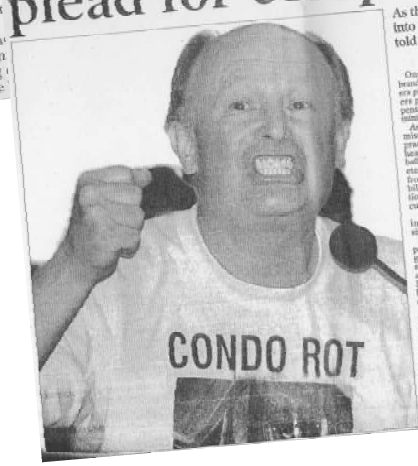
"I was humiliated having to go on welfare," said a teary-eyed Georgia Doerksen, an infant crippled in her arms.

Her Burnaby condo turned out to be so leaky built the same

family on to welfare and precipitated illnesses in her children, she said.

"We felt we were taken for a ride," she lamented. A placard leaning beside her stated: "Leaky condo owners are cash cows."

— SEE COMMISSION, A2
VANCOUVER SUN



Tourism is B.C.'s top job creator

The booming industry now employs 235,000 people, up about 11,000 over last year.

ALAN DANIELS
SUN TOURISM REPORTER

The burgeoning tourism industry created about 11,000 jobs in British Columbia last year, adding new jobs three times faster than any other sector of the provincial economy, according to figures expected to be released today by Tourism Minister Ian Waddell.

Officials say there are more opportunities than ever in tourism-related industries such as transportation, accommodation, food and beverage service and interpretive attractions.

A complete schedule of tourism

Potential killer may be growing inside homes

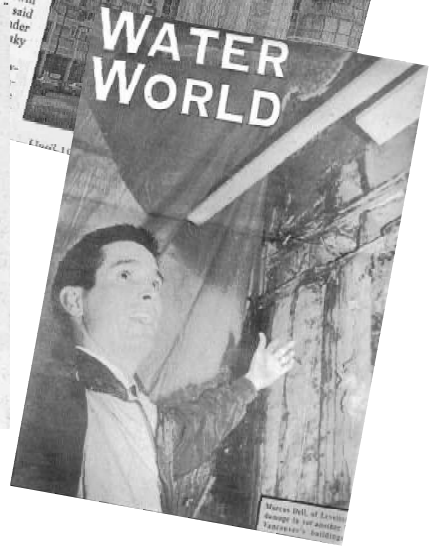
Martin van den Hemel
staff reporter

While the plight of condo homeowners facing mounting repair costs has been closely followed in the media, a potentially seri-

> Very few people know about it and very few people want to know about it.
>
> *Jim White, researcher for the Canada Mortgage and Housing Corporation*

fungi, known as

homes where there had



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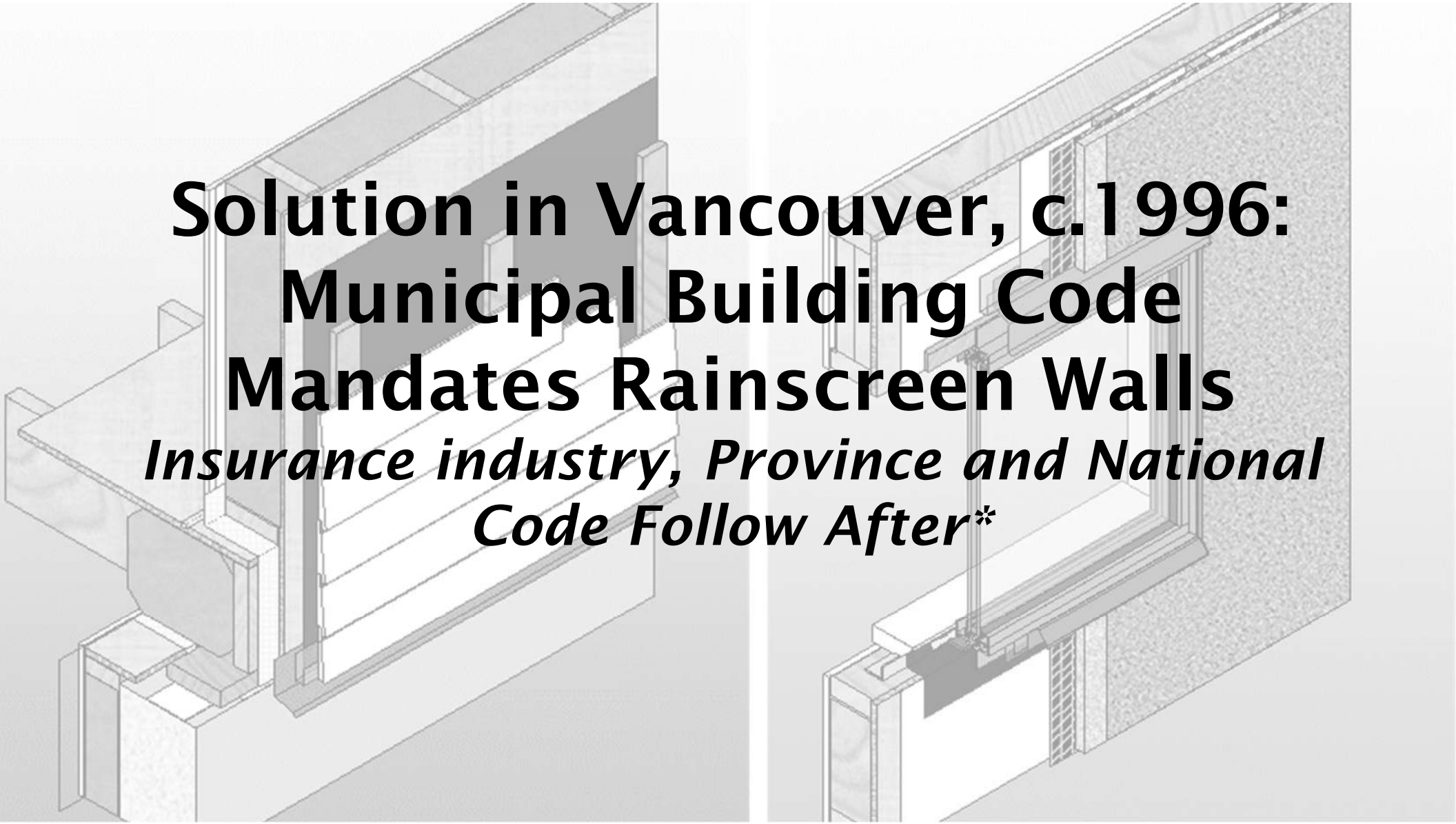

Solution in Vancouver, c.1996: Municipal Building Code Mandates Rainscreen Walls

Insurance industry, Province and National Code Follow After*

“Rainscreen” in the News in the Late 1990s

- **From a Condominium Development Sales Flyer:**
  - The condo residences will have **the rainscreen construction warranty** as well as the 2-5-10 Home Guarantee. In addition, there is extra sound proofing in addition to double glazed broken windows with screens and low maintenance vinyl siding with shake and exterior rock features. The residents at the presales luxury real estate properties will also have asphalt shingle roof, wall insulation R14 and R20, hard wired smoke detectors, secure underground parking for all residents, professional landscaping and exterior lighting and pedestrian pathways in this master planned community”.
- **Article in a Vancouver-Asian Newspaper:**
  - 리키 콘도 문제와 관련하여 기술적으로 변화된 것 중의 하나가 외부 마감재 뒤에 드레인 공간을 주는 외벽 시스템을 의무화한 것이다. 개선된 디테일과 드레인 공간은 우수의 외벽 내부 침투를 차단하고 침투하더라도 배수가 될 수 있도록 하며 외벽 건조를 촉진하는 기능을 하고 있다. 이런 외벽 시스템을 **(Rain screen Wall)** 시스템이라 부른다.
- **From a Prominent Local Developer**
  - **Rain Screen Technology:** **A rain screen is a protective barrier** of drainage channels installed between the interior and exterior wall surfaces, allowing the building to shed water. The rain screen acts both as a moisture break and an air space, preventing water from becoming trapped inside the walls, and making sure the frame dries completely after the water drains off.
- **From a Rental Property Listing**
  - About This Property: A very bright east facing unit with a large balcony. A 2 Bdrm / 2 Bath unit with a spacious open concept including hardwood floors, 6 appliances, built-in safe, secured underground parking space, plus a storage locker. The building was built in 2000 with **the new Rain Screen Wall System technology**.

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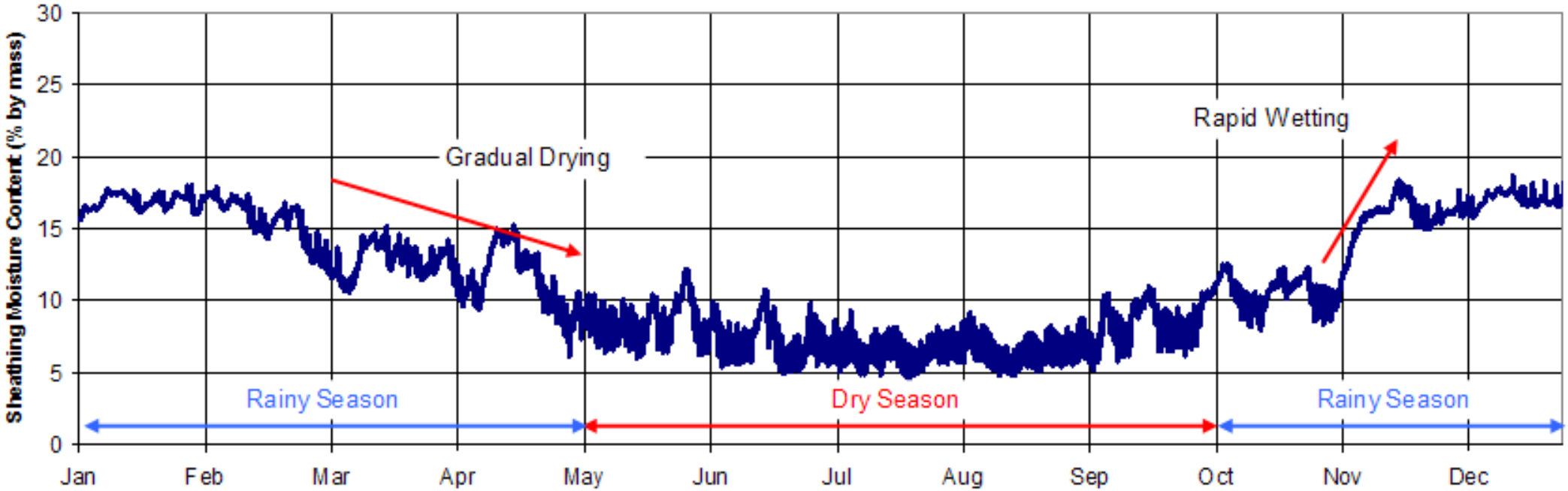
Early Work Experiences & Influences

Monitored Field Performance of Rainscreen Walls in BC

Wood-Frame Rainscreen Walls: Normal Trends



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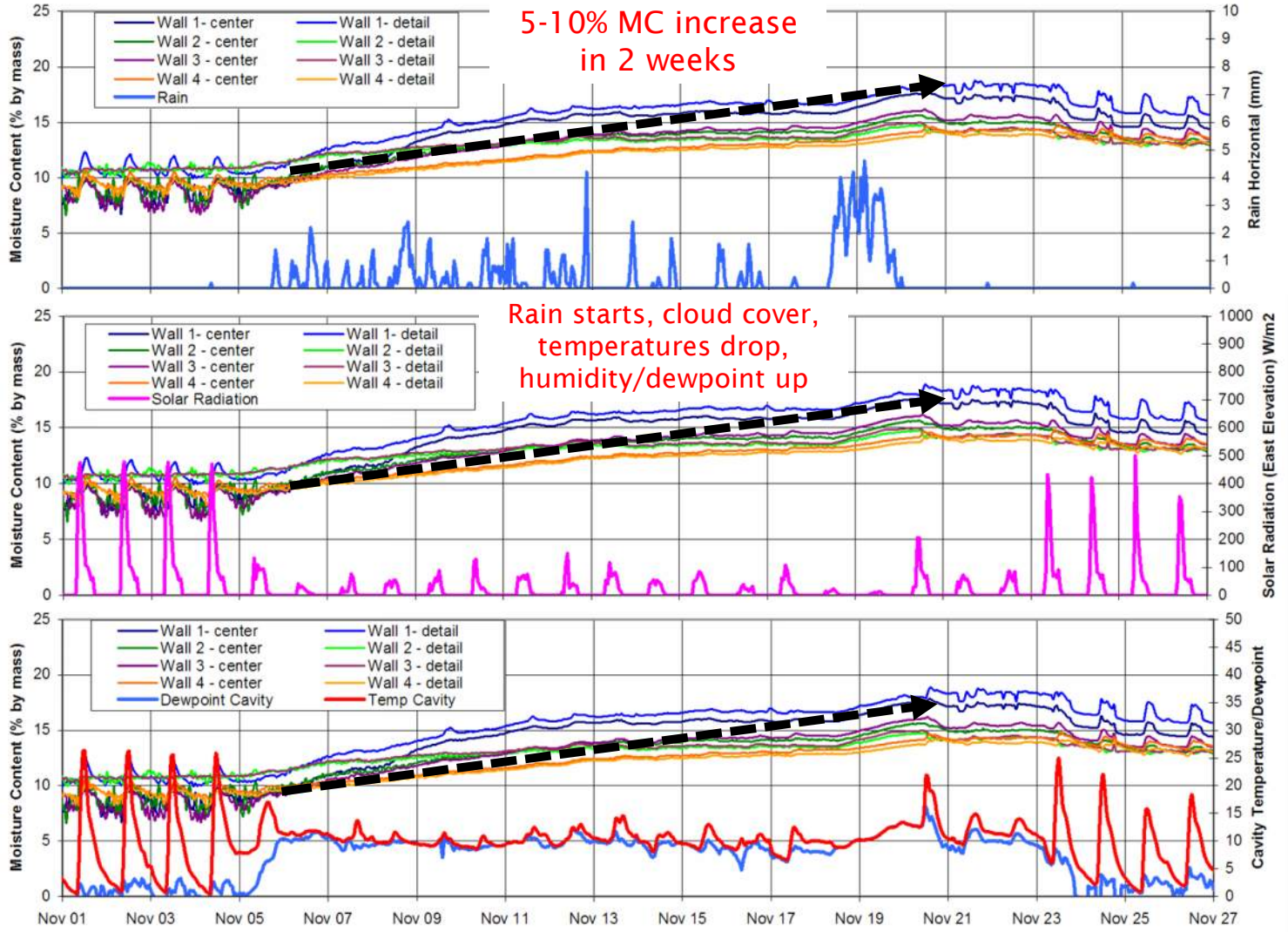
Rainy West Coast Winters : Walls Get Damp

RAIN

SOLAR

TEMPERATURE



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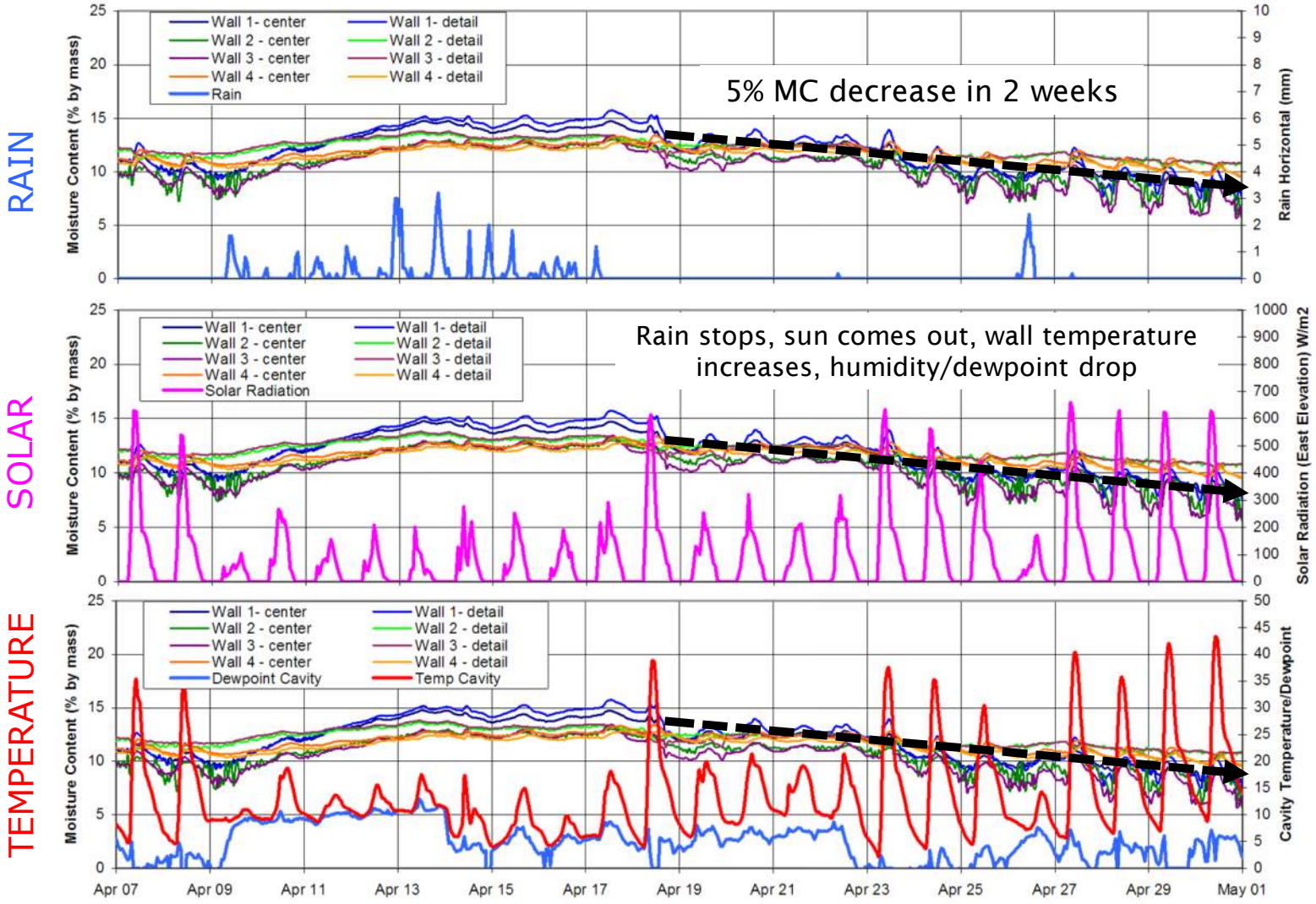
The Sun Comes Out in Spring: Walls Dry Out



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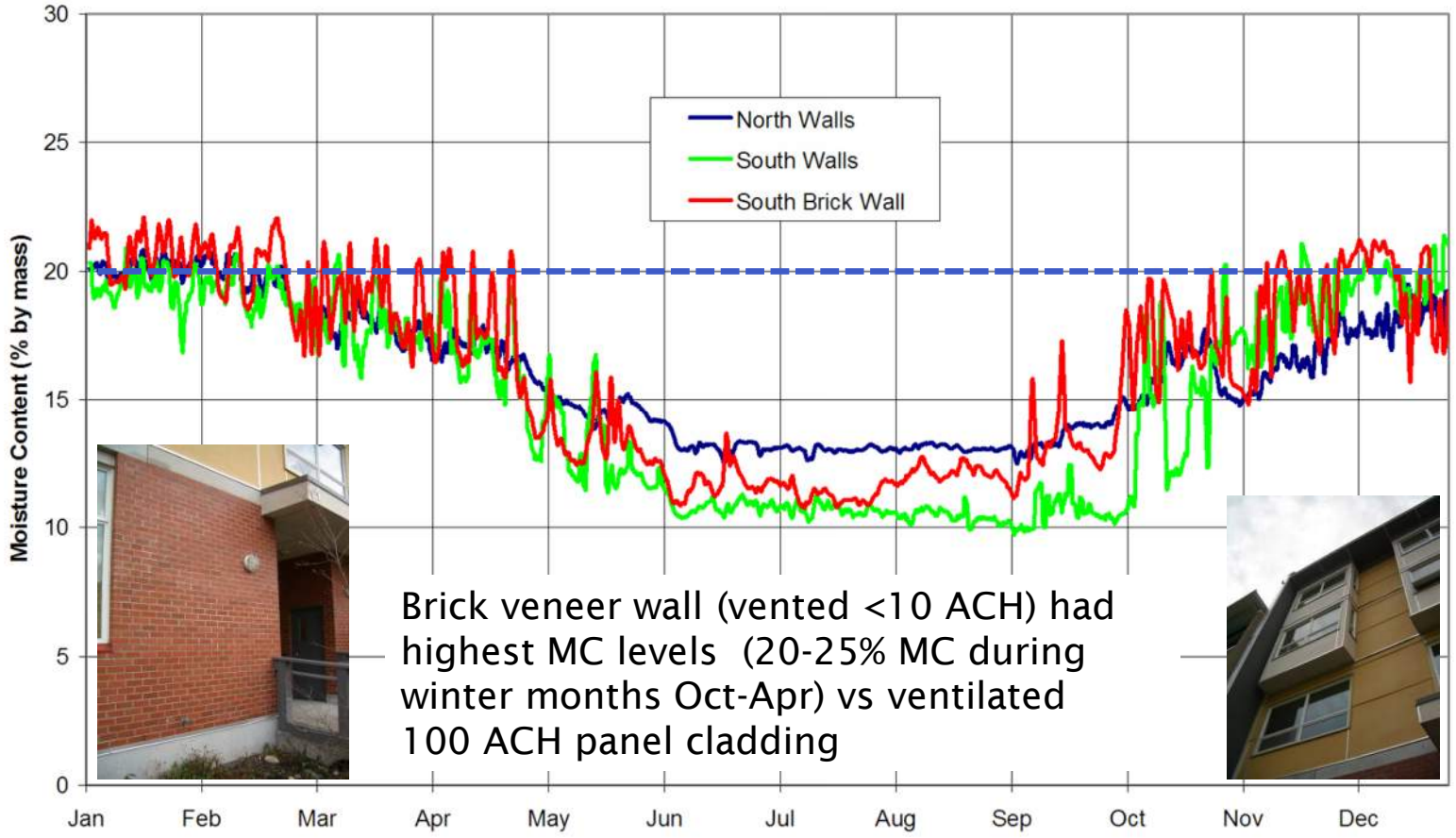
Less Rainscreen Cavity Ventilation with Absorptive Claddings = Damper Walls



Brick veneer wall (vented <10 ACH) had highest MC levels (20-25% MC during winter months Oct-Apr) vs ventilated 100 ACH panel cladding

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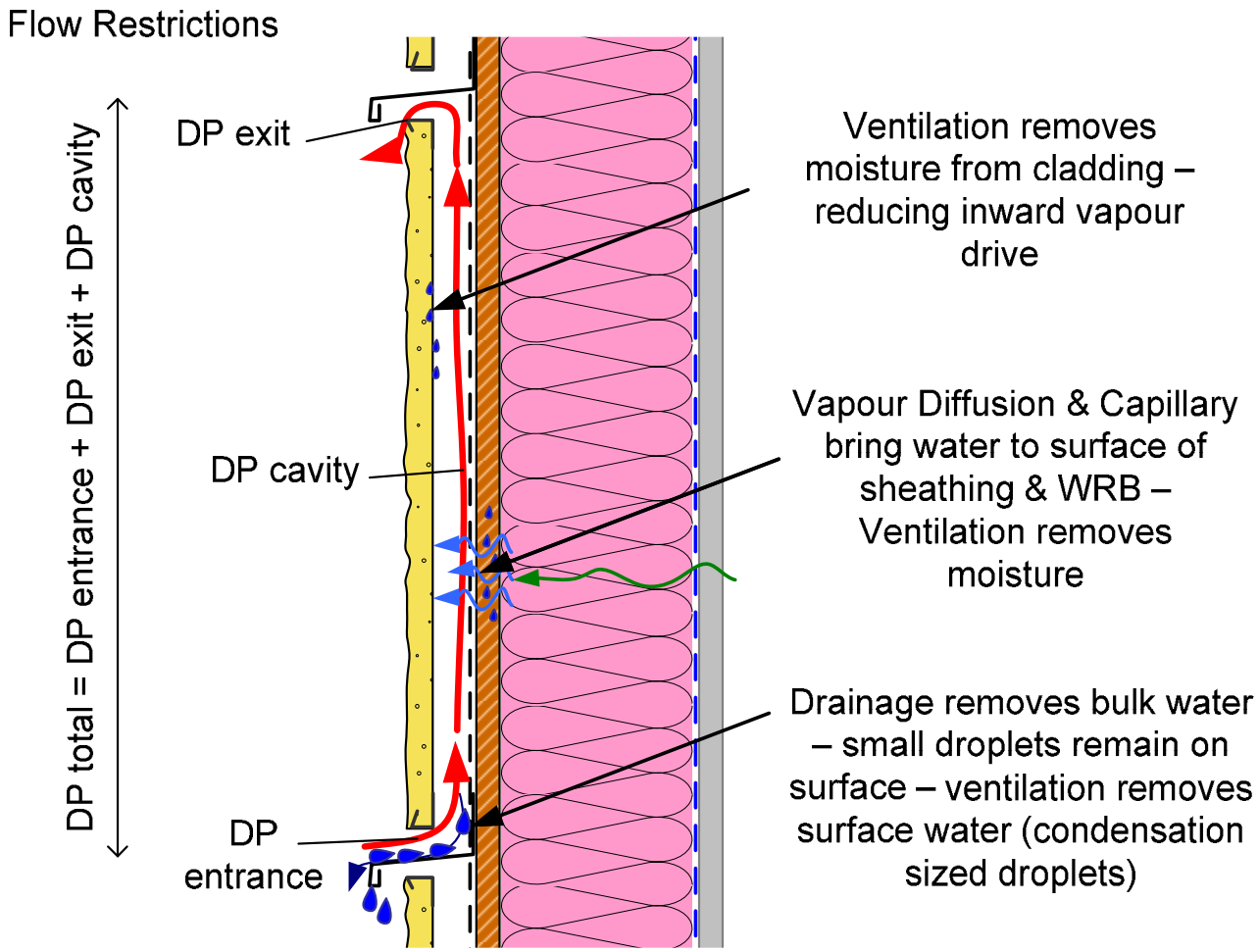
Furthering Rainscreen Wetting and Drying Science



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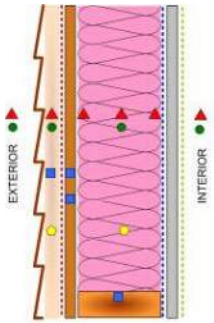
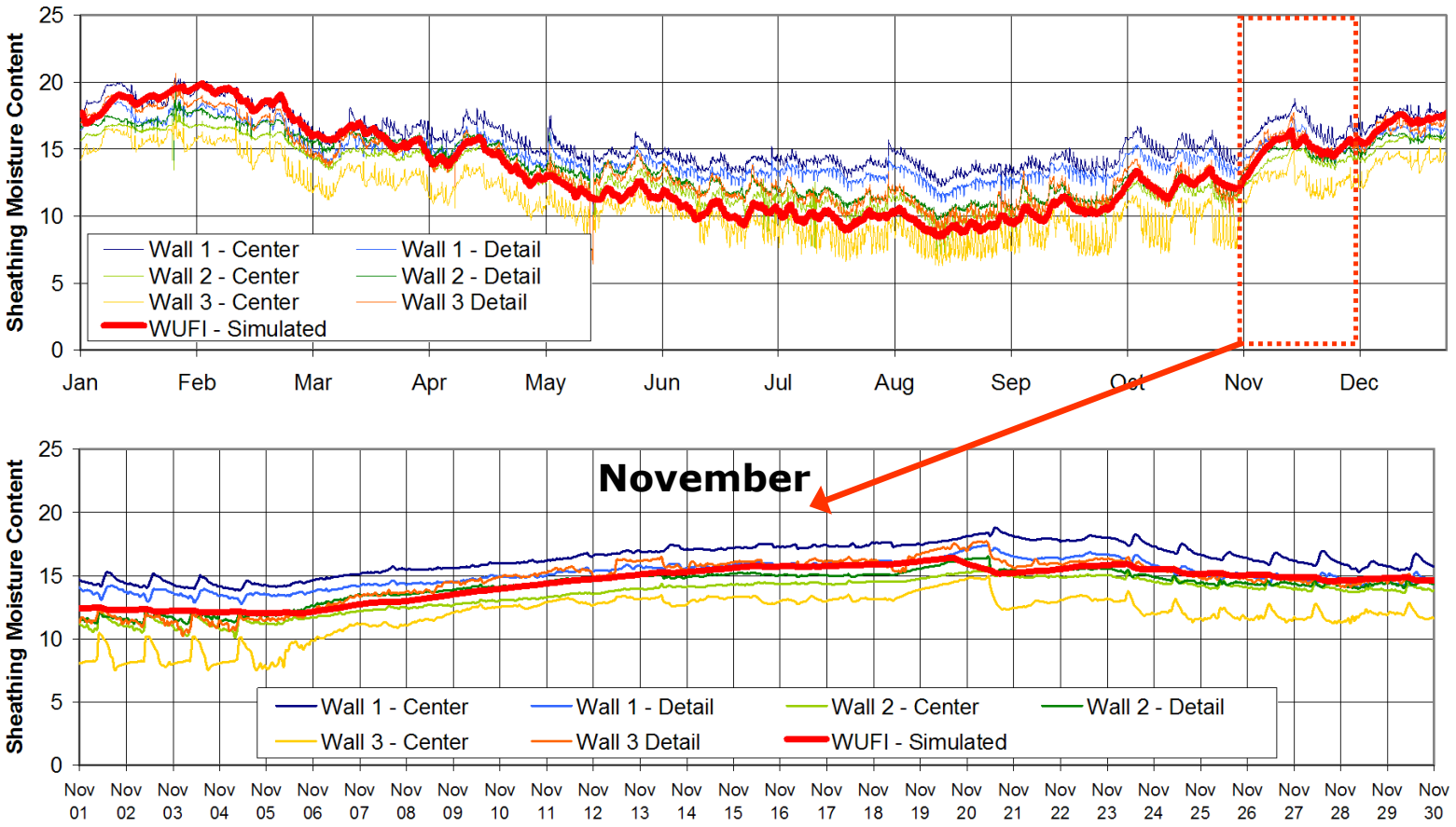
Calibrated Computer Models (WUFI) Developed from Measured Data & Ventilation Rates





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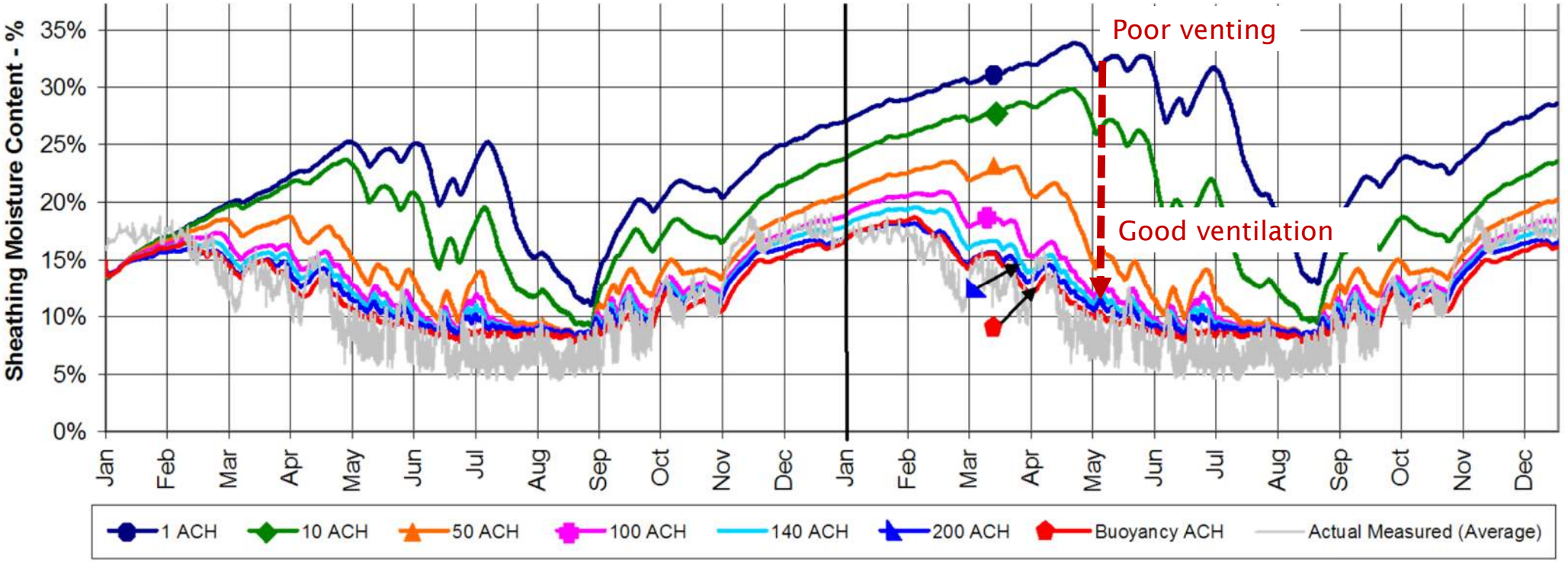
Ventilation Rates Can be Calculated & Modeled
More Ventilation = Drier Wood-frame Walls in BC



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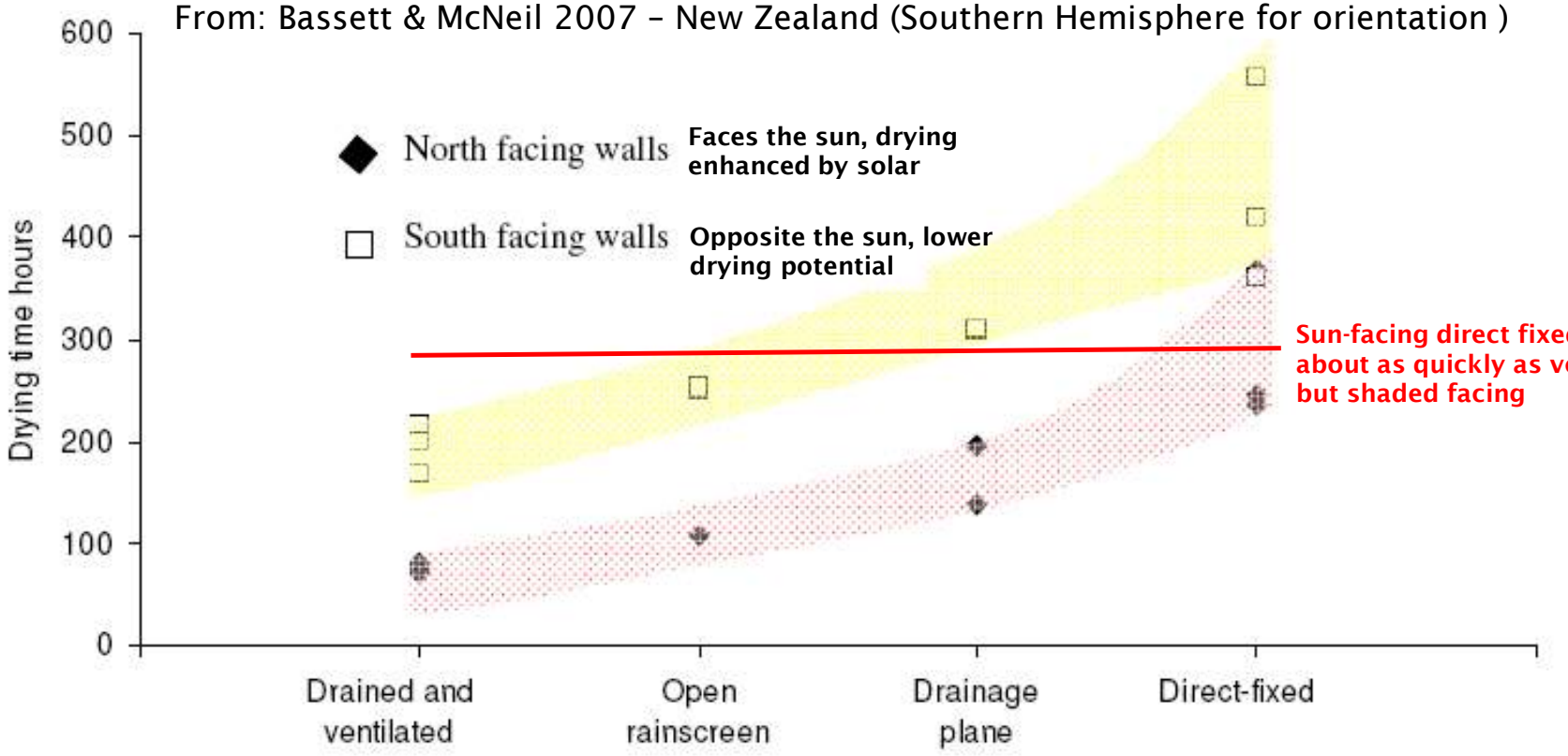
Impact of Rainscreen Cavity Ventilation on Wall Drying Rates

From: Bassett & McNeil 2007 – New Zealand (Southern Hemisphere for orientation)



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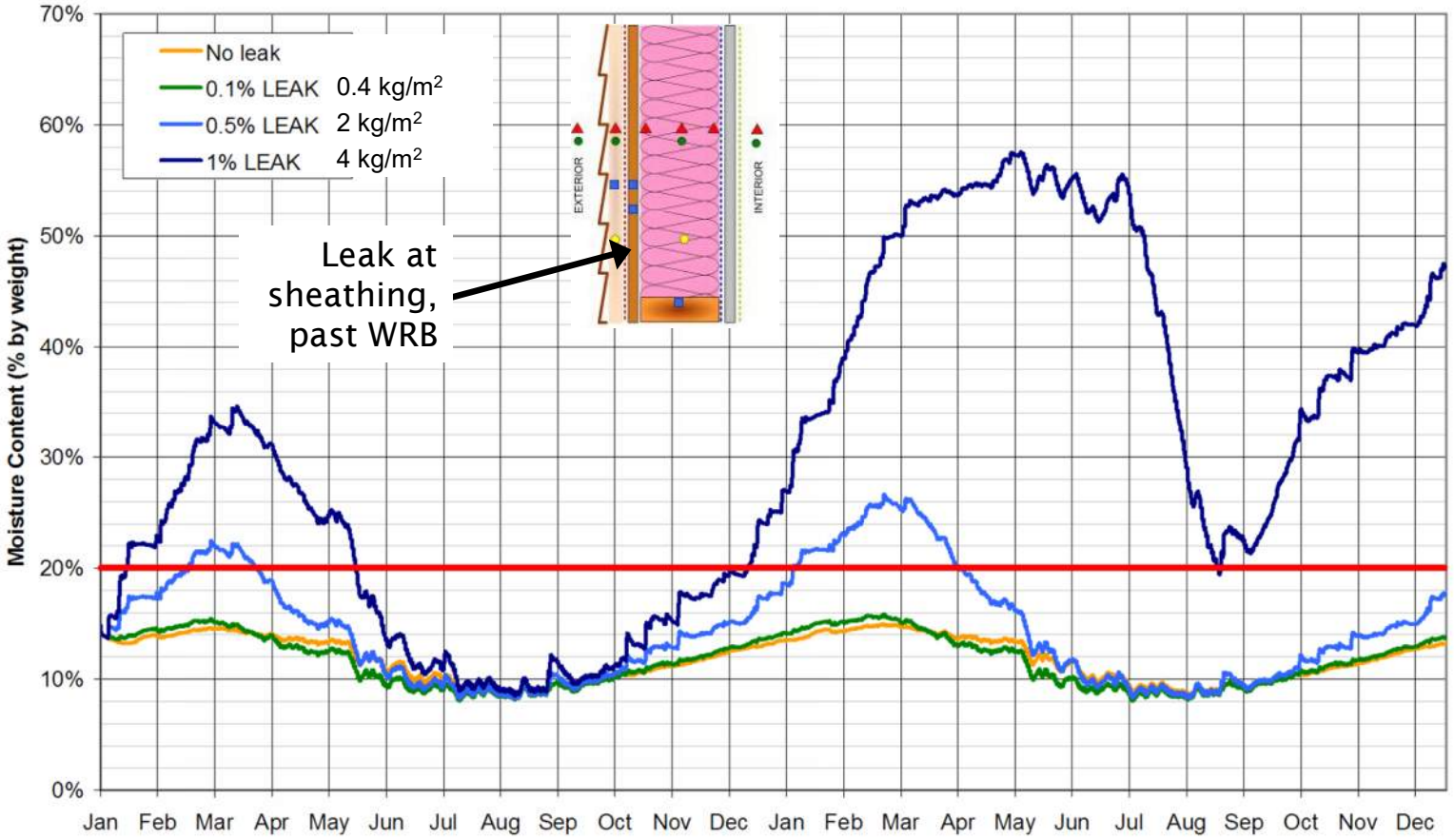
Rainwater Leaks Still Matter
But "Smallish" Leaks Can be Dried Out



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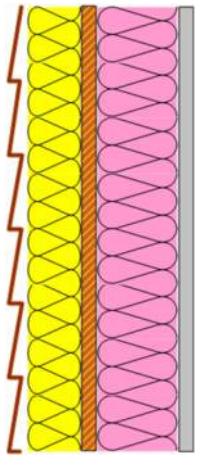
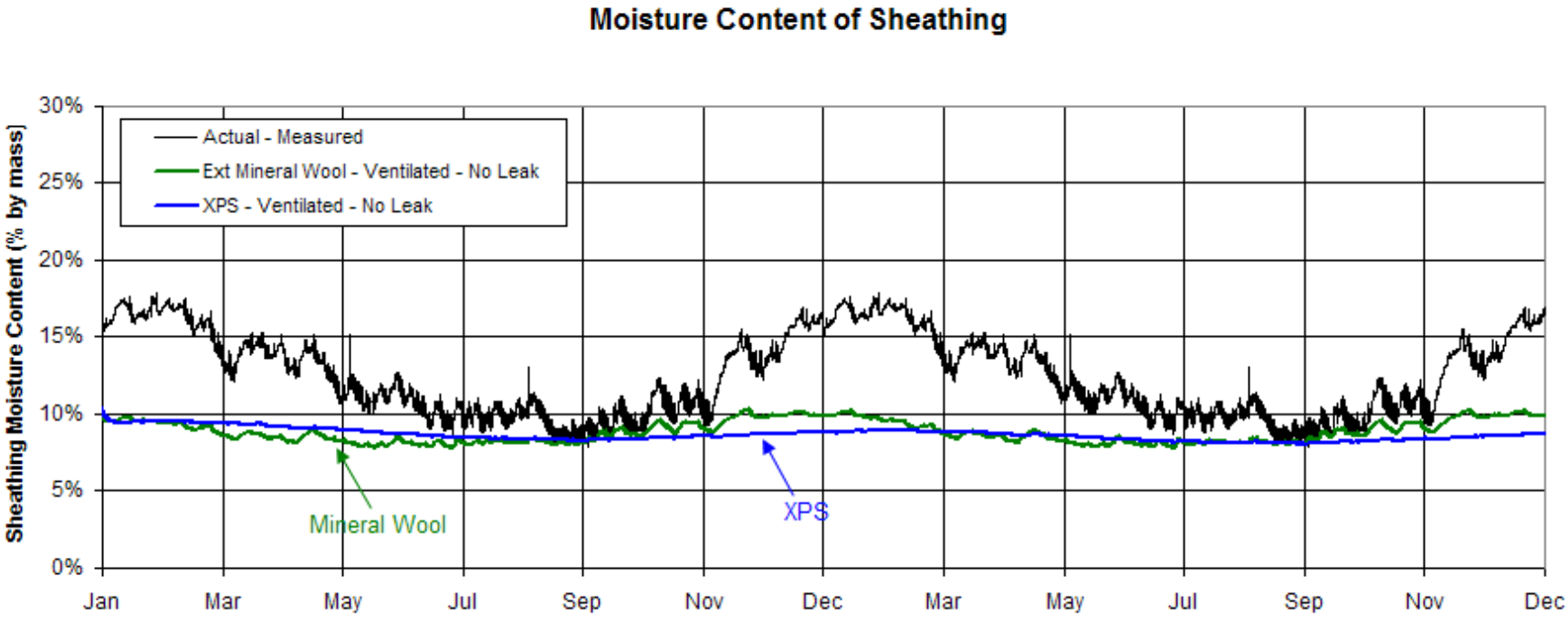
Adding Exterior Insulation to Wood-frame Rainscreen Wall = Drier Backup Walls





→ 3 ½" (R-12) Batt Insulation with 2x4 studs + 2" Exterior Insulation – (R8 Mineral Wool or R10 XPS)

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Laying the Groundwork for Later When Code Starts to Require Exterior Insulation for Homes

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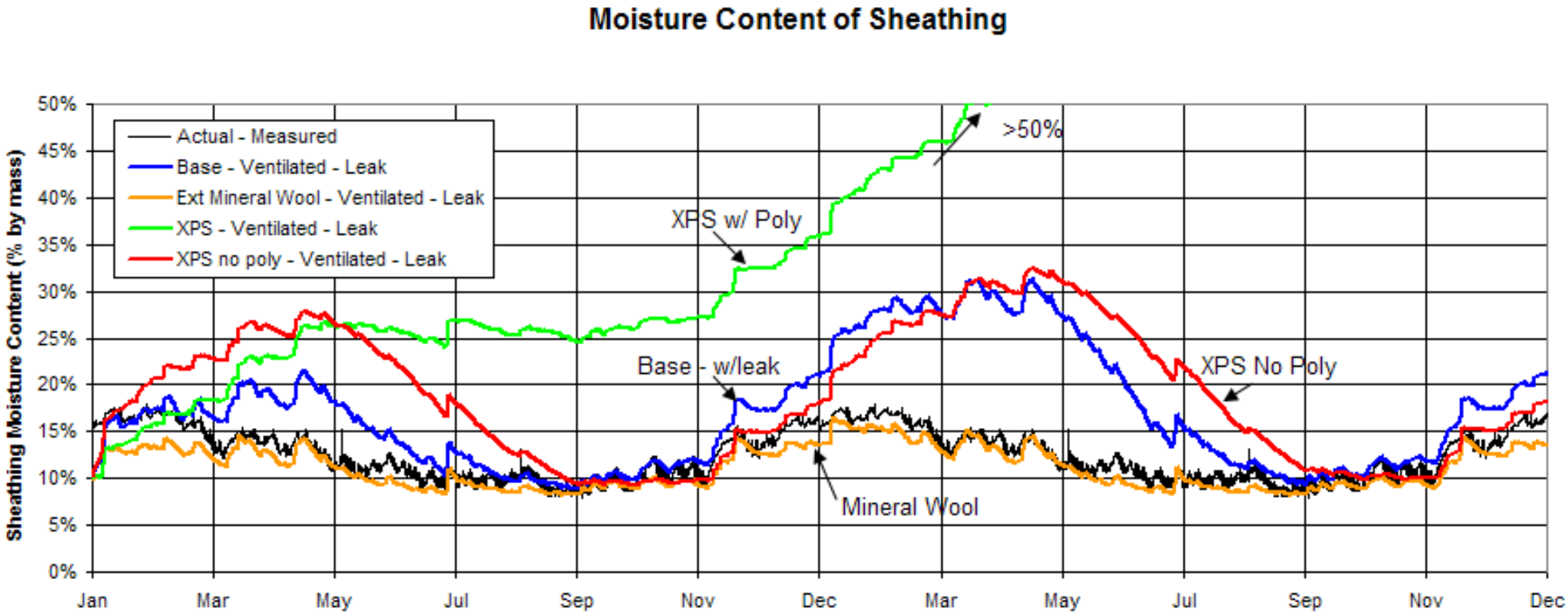
Proper Design of Exterior Insulation Type/Thickness and Vapor Control is Critical to Performance



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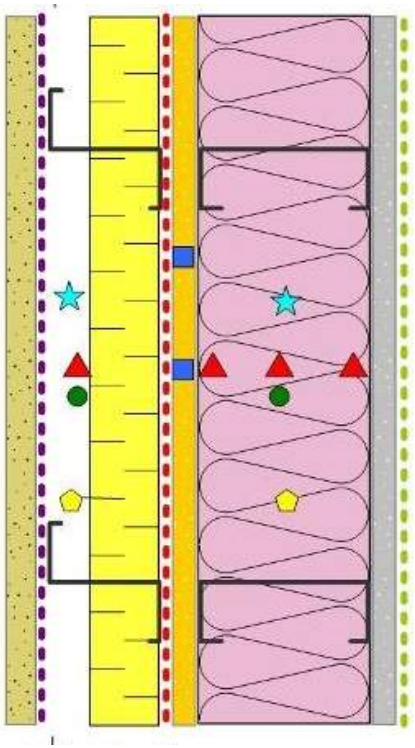
Low Exterior to Cavity Insulation Ratios with Incorrect Vapor Control Strategy can Fail

Leaky-condo prior to rehab



Bad thermally too – continuous Z-girts

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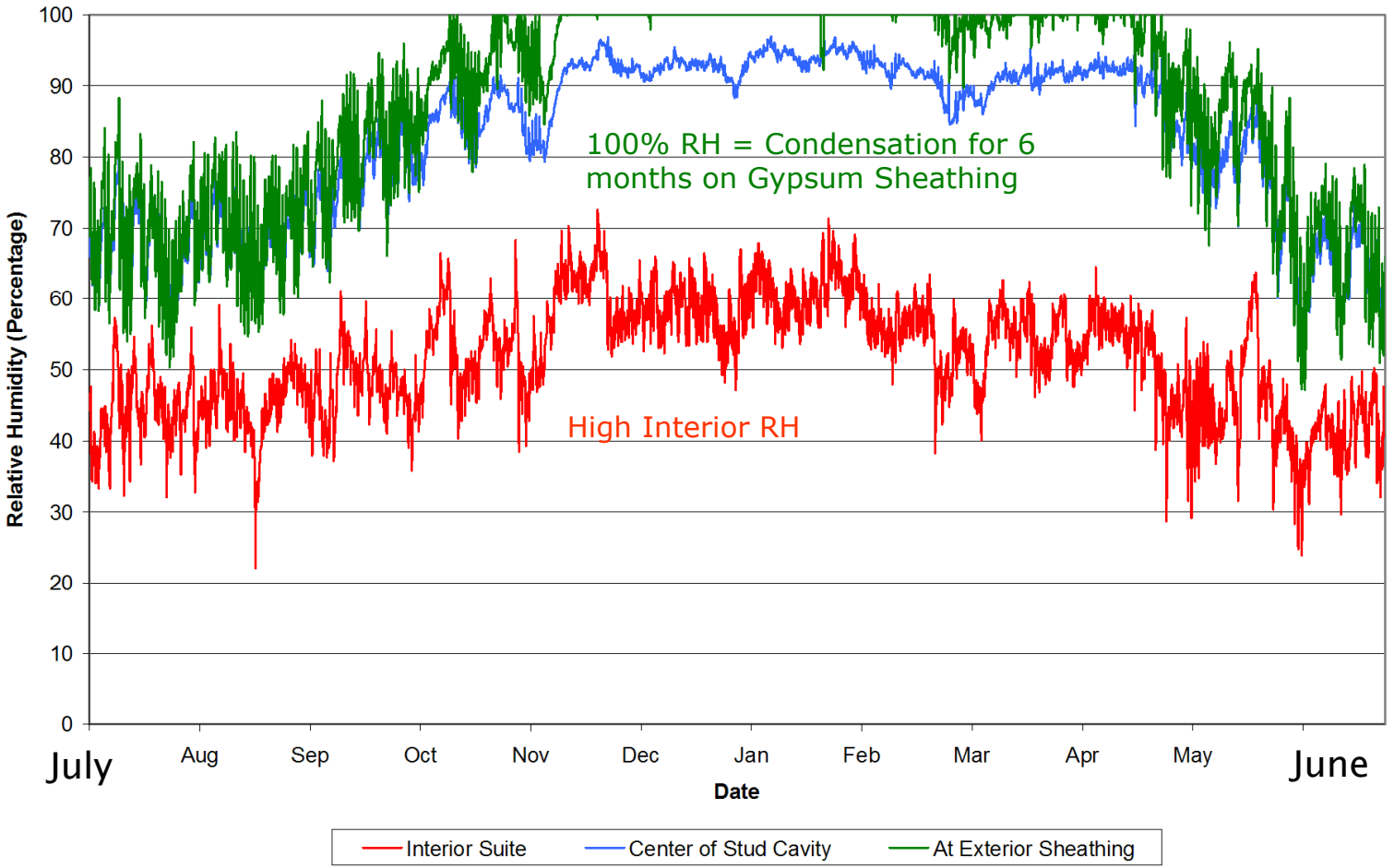
A Rainscreen Can't Dry Out Vapor Control Mess-ups



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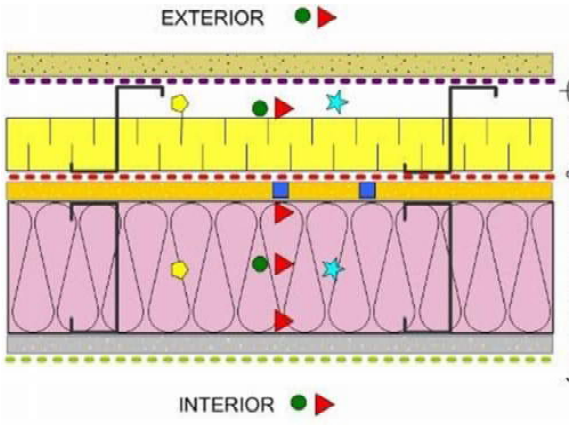
A Rainscreen Can't Fix This…



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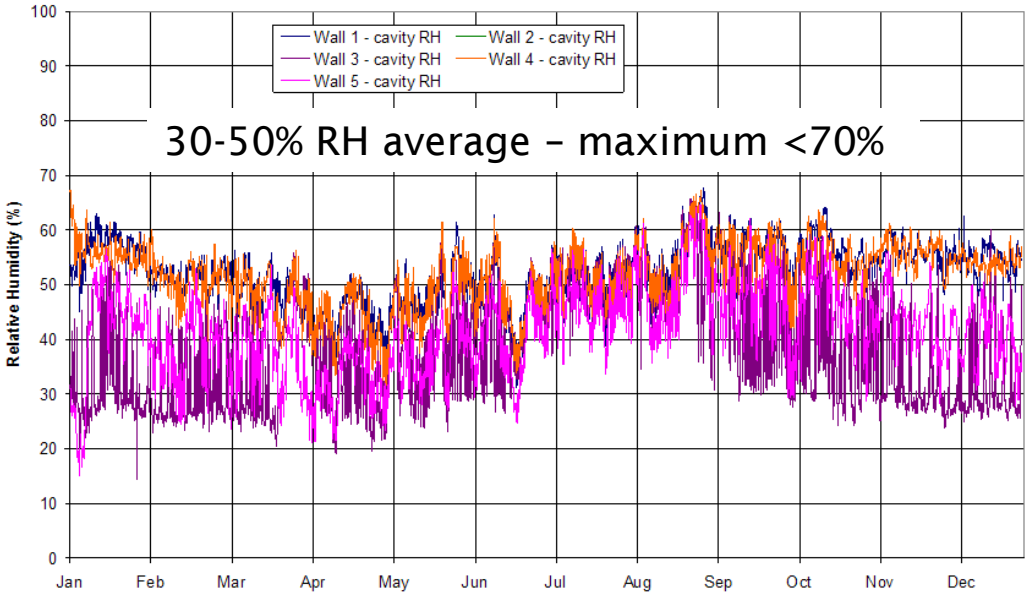
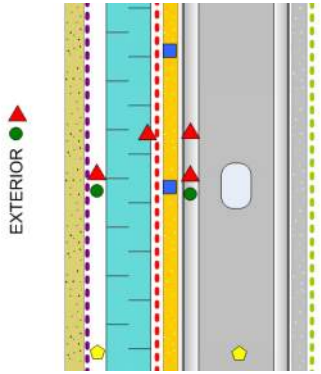
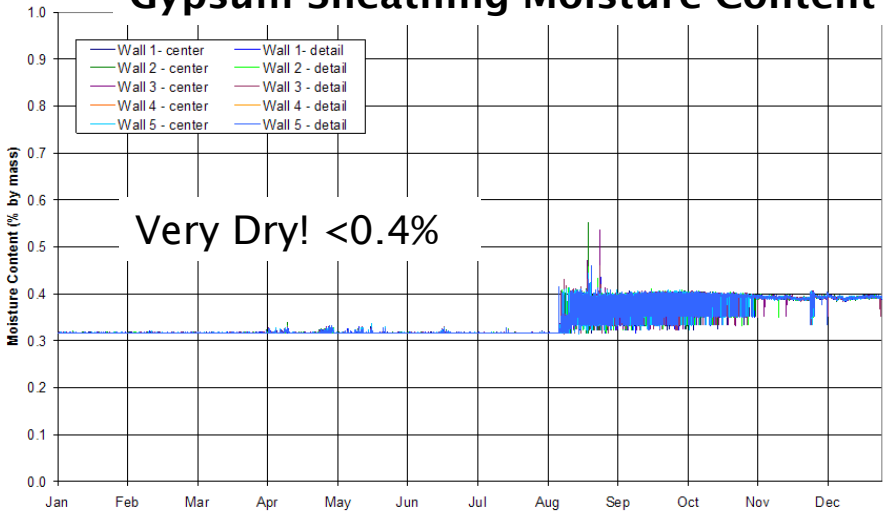
All Exterior Insulation = Warm/Dry/Durable Walls

RH at Exterior Sheathing





Gypsum Sheathing Moisture Content



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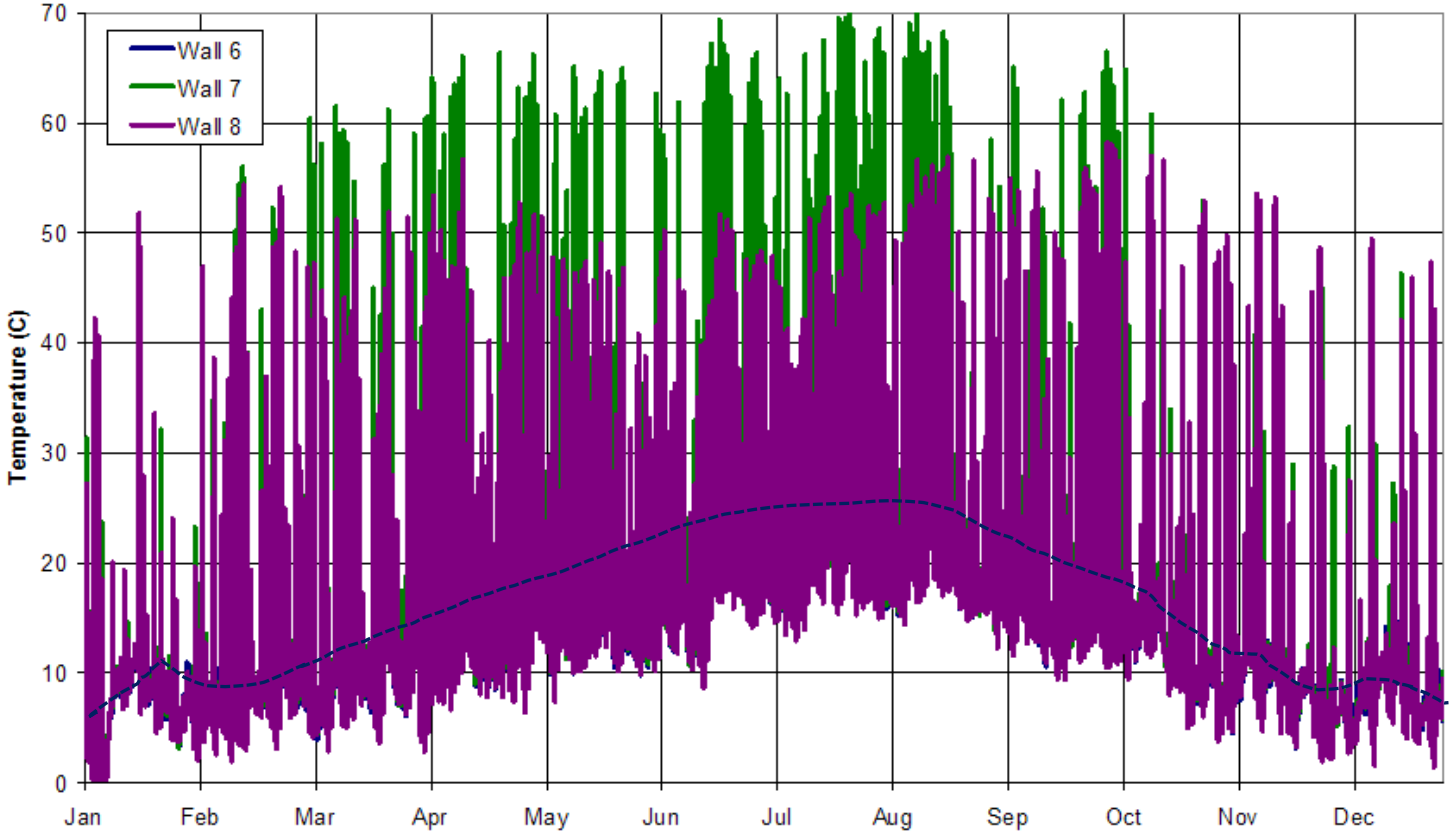
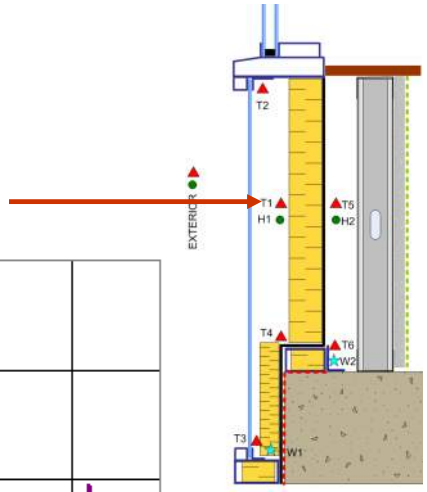
Rainscreen Spandrel Panels Get Hot!

158˚F/ 70˚C





Early 2000s Drivers for Exterior Insulation Innovation

Pre-Enclosure Rehabilitation – Stud Insulated, Lots of Thermal Bridging (Studs/Slabs/Structure)



Post-Enclosure Rehabilitation – Exterior Membrane & Fully Exterior Insulated (BUT! Still Bridging Exterior Insulation)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Typical Practice in Early 2000s - Continuous Metal Z-Girts

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Innovation: First Generation Clip Cladding Attachments

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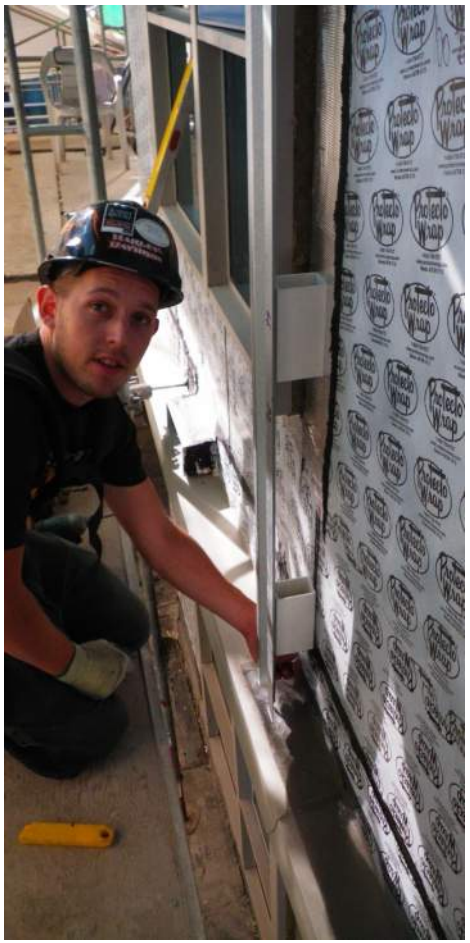
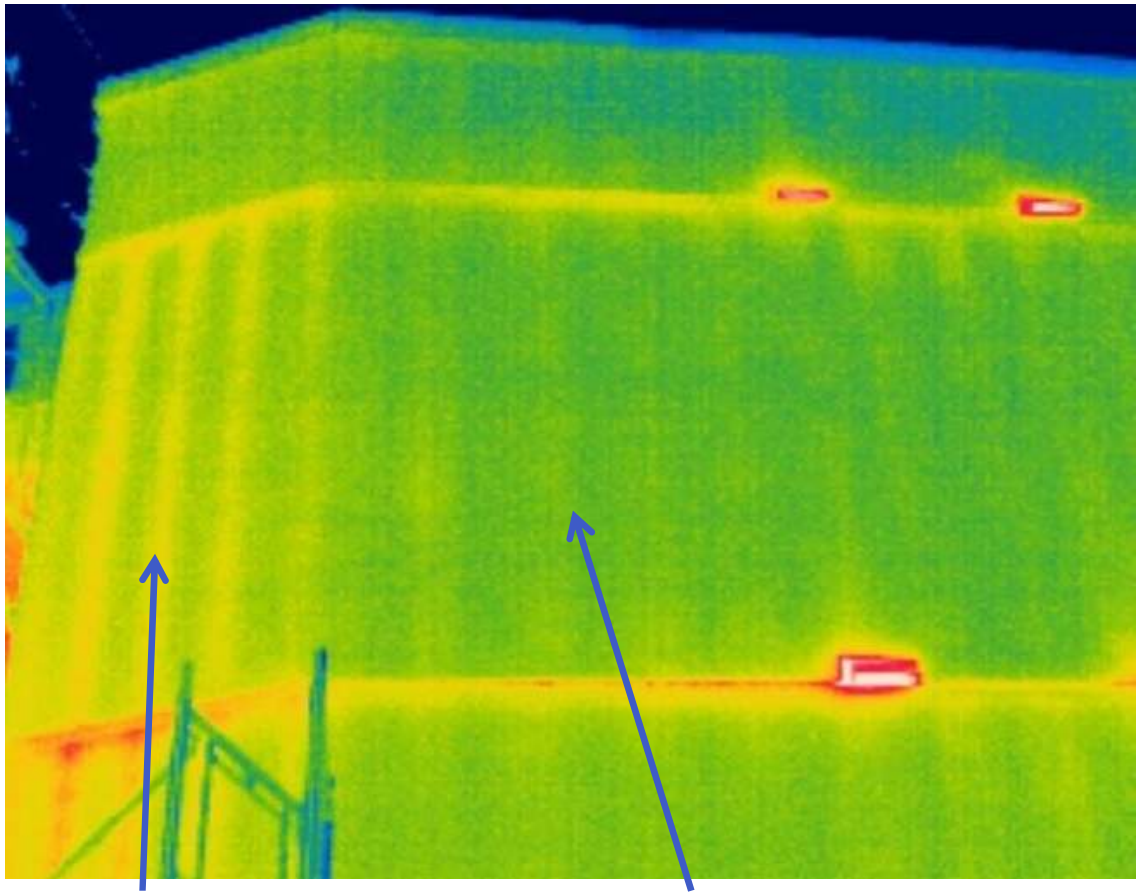
The First Fiberglass Spacer Cladding Attachment



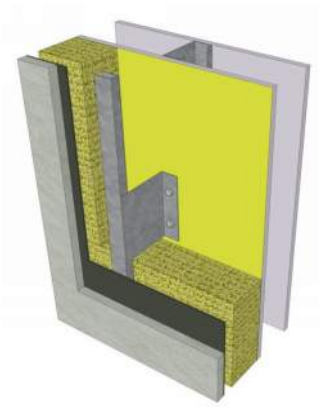
Proof in Visual & Measured Data

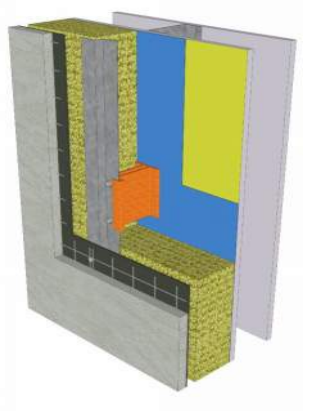


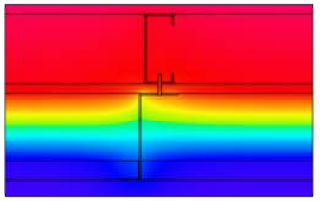
Continuous 16 ga Steel Z-girts
Through insulation

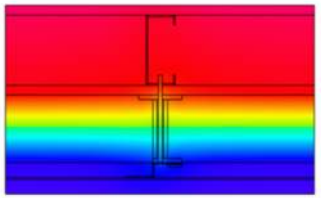
Intermittent Fiberglass Clips/Spacers w/
Steel Hat Tracks (outboard insulation)

The First in the Start of a New Industry









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Further Reducing Thermal Bridging for Cladding Attachment – Long Screws through Insulation

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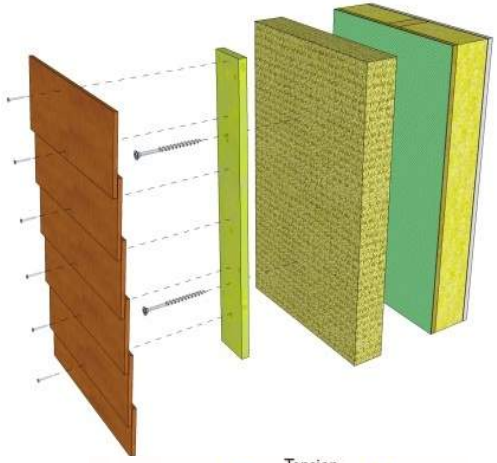
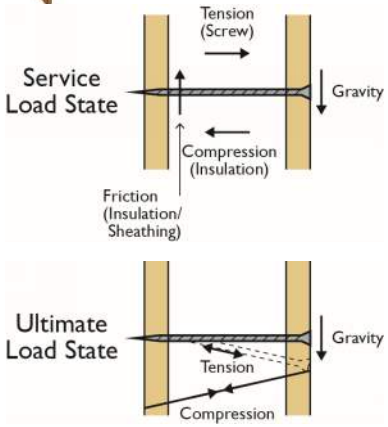
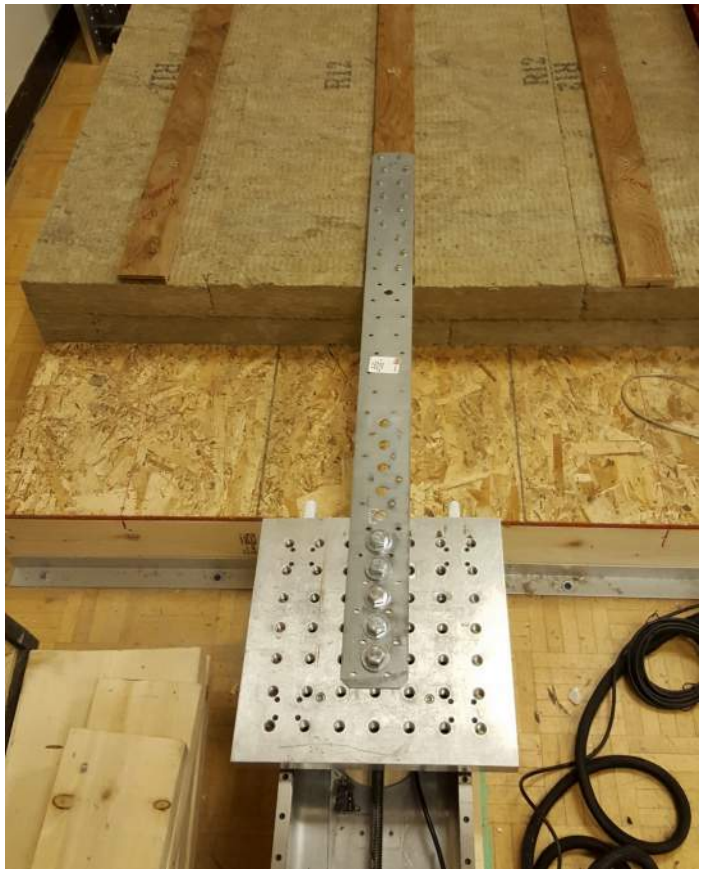
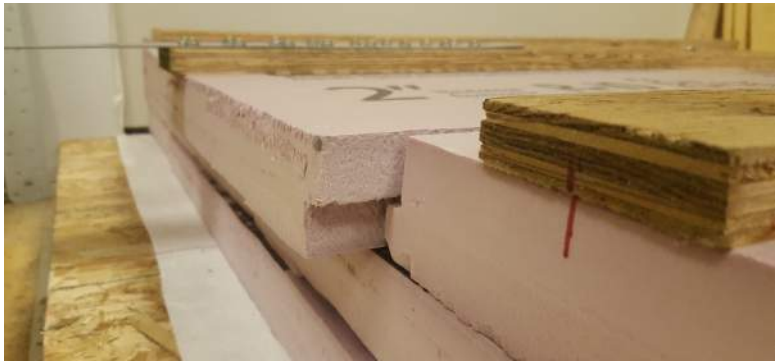
Long Screws through Insulation as Cladding Support and a Rainscreen





Lots of Long Screws through Exterior Insulation & Rainscreen Testing & Industry Guidance





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Today:
Current State of the Industry?

Is a Rainscreen a Material?

SLICKER®
RAINSCREEN
SAMPLES

GET YOUR
FREE
SLICKER®
RAINSCREEN
SAMPLES
TODAY

ZIP System™ Rainscreen

ZIP System rainscreen is the latest ZIP System solution to help builders achieve a high-performance wall assembly. It streamlines drainage and ventilation between sheathing and reservoir cladding systems. With easy installation, it provides an air gap and drainage plane to promote drying behind cladding systems. Now, teams can meet the new code-required 3/16" air gap and secondary water-resistive layer for stucco and adhered stone assemblies with a single rainscreen product[1].

Description

DuPont™ Tyvek® DrainVent™ Rainscreen is a three-dimensional, honeycomb-textured drainage mat with attached heavy-duty filter fabric that provides advanced protection against moisture damage in exterior wall systems. **Tyvek® DrainVent™** provides a flat surface for cladding application, optimal compression resistance and multi-directional channels for optimal drainage and airflow.

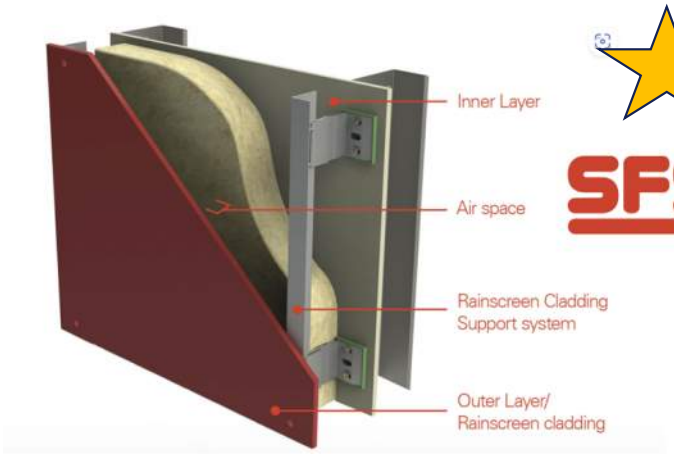
Is a Rainscreen a Cladding Material or System?

RAINSCREEN PRINCIPLES

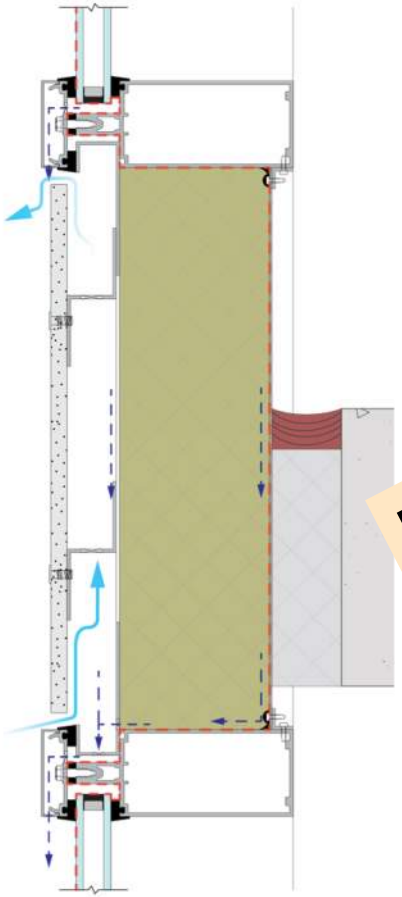
ECO CLADDING

OUTSIDE-IN APPROACH

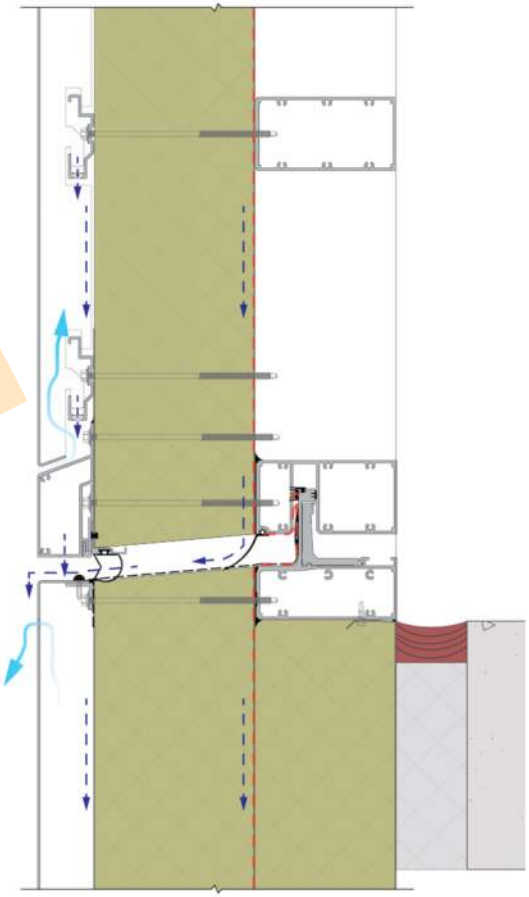
A successful drained and back-ventilated (DBV) rainscreen is not limit
materials and sub-framing system alone, it requires an integration of e
upon a holistic approach to the exterior envelope. ECO Cladding is an
"outside-in" approach, starting with the selection of the cladding mater
inner waterproofing of the wall.



Can a Rainscreen be Applied to a Curtainwall System?



RAiNA TECH BULLETIN COMING SOON ON TOPIC



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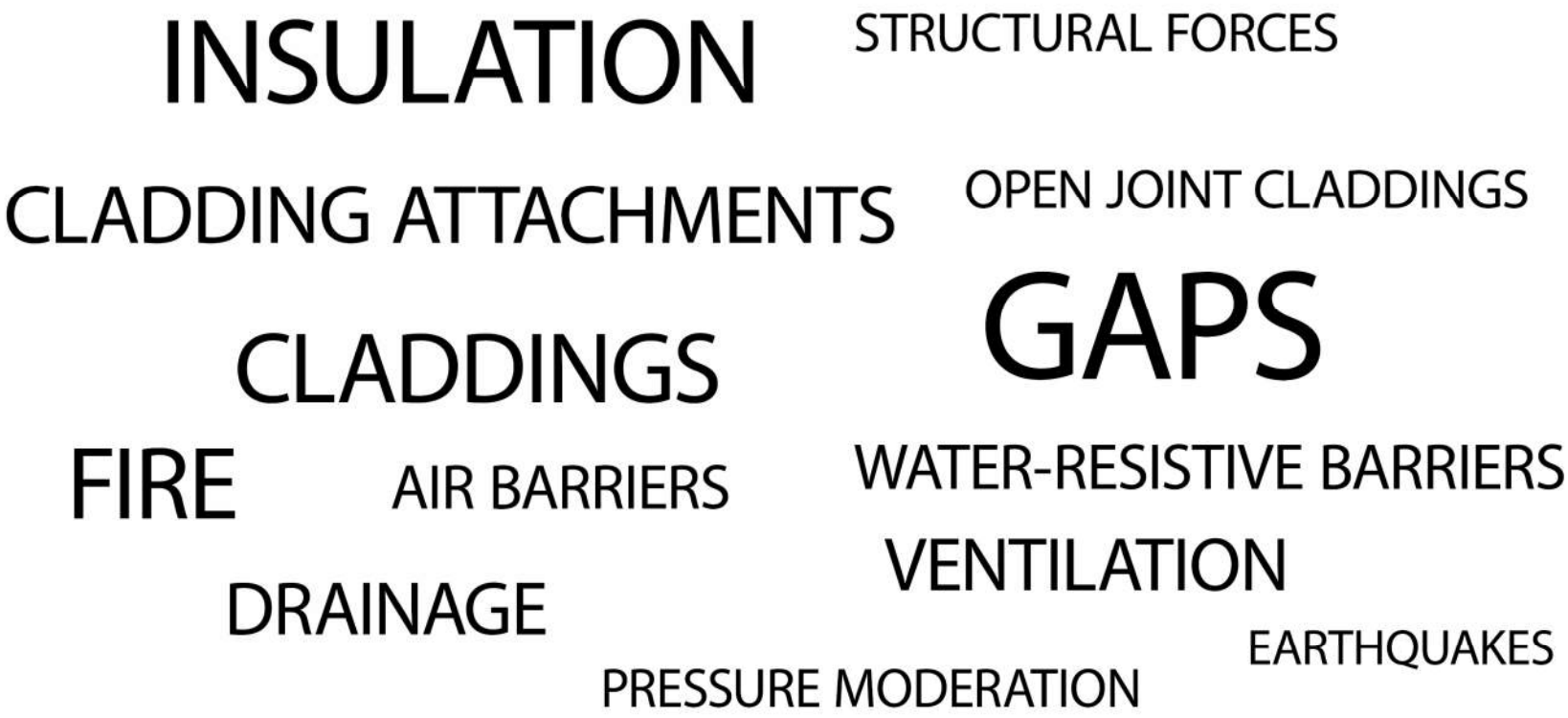
Rainscreen Considerations?



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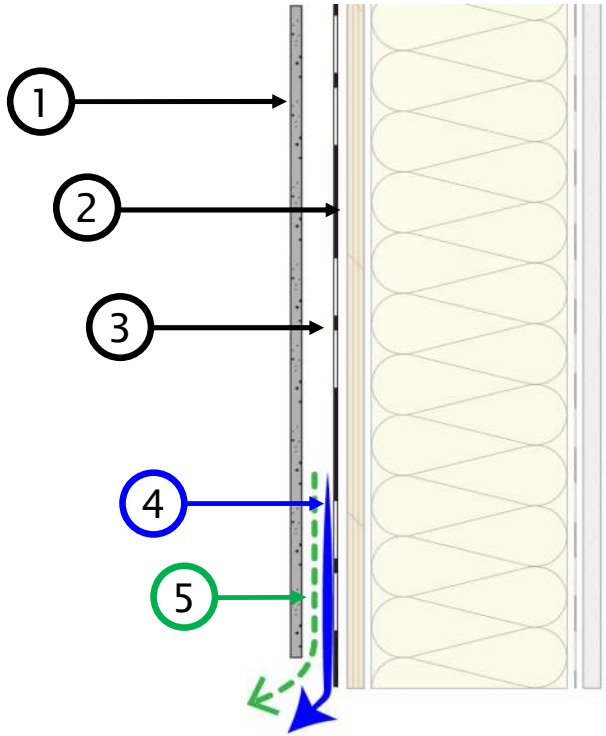
What is a Rainscreen?:

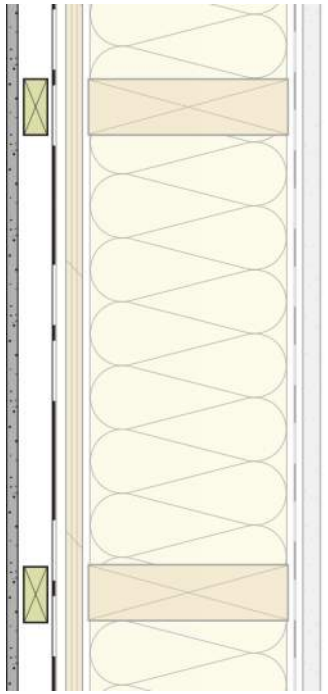
"An assembly applied to an exterior wall which consists of, at minimum, an outer layer, an inner layer, and a cavity between them sufficient for the passive removal of liquid water and water vapor"

An assembly applied to an exterior wall which consists of, at minimum:

1) Outer layer
2) Inner layer
3) Cavity between the layers sufficient for the passive removal:
   4) Liquid water
   5) Water vapor

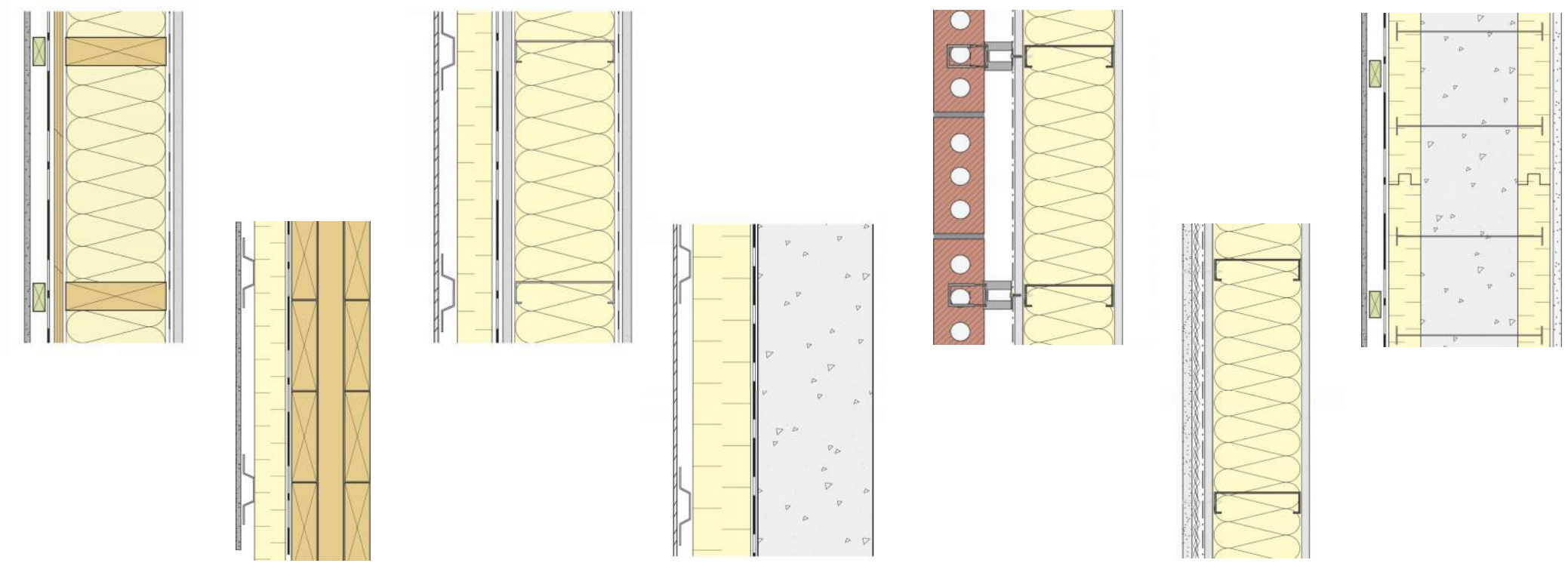


Vertical section



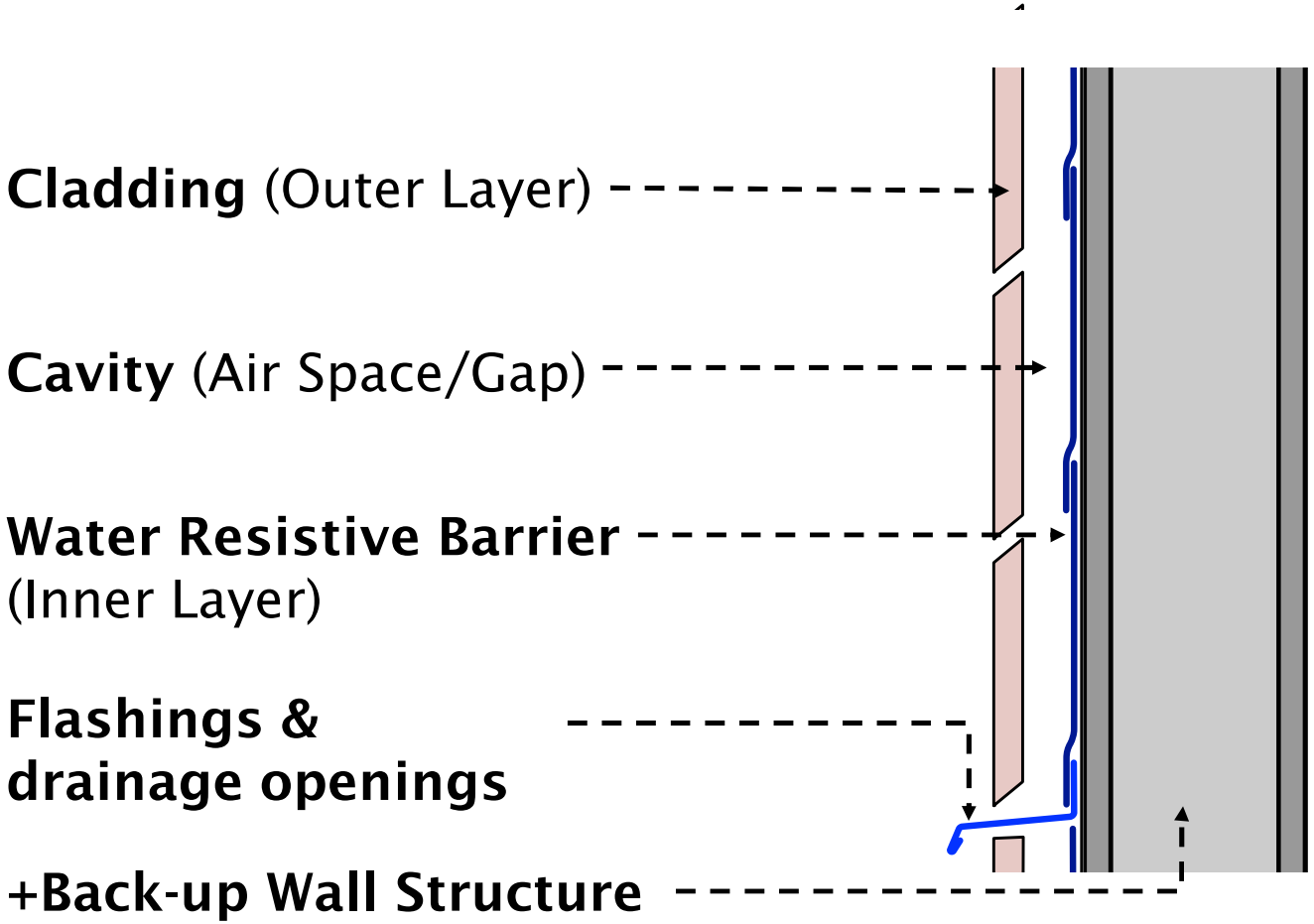
Horizontal section

A Rainscreen Is Not:
Product, Material or Building Type Specific



Almost any cladding & any backup wall
separated by a cavity…
…that is drained and vented/ventilated

A Rainscreen Wall Includes (at a minimum):



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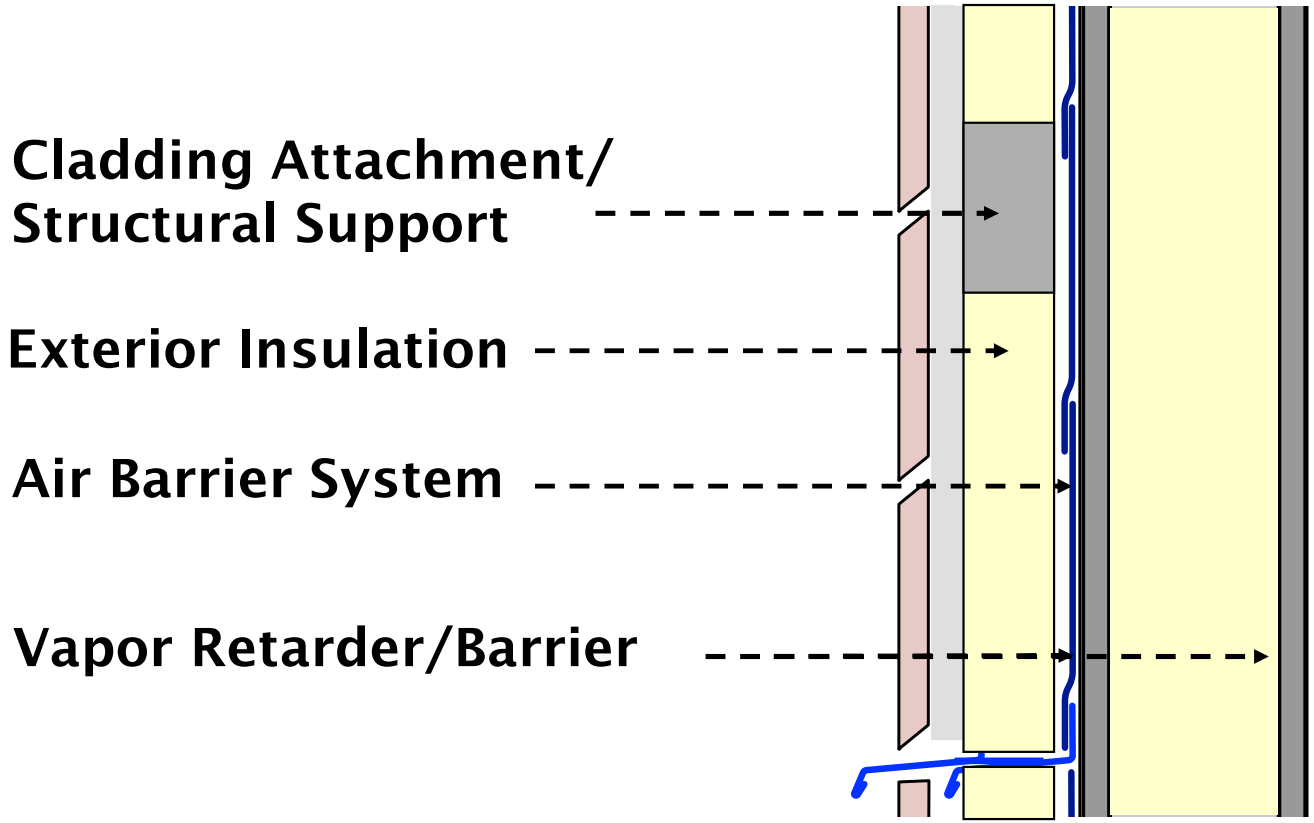
Any Modern Wall (Including a Rainscreen) May Also Include:



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What Can Fail a Rainscreen = What to Design For

- Water (Rain, Elevated RH, Condensation, Ice/Snow)
  - Leak into backup assembly/building
  - Corrosion (e.g. cladding attachment, fasteners)
  - Fungal growth & decay
  - Wetting & moisture deterioration (e.g. moisture sensitive/bio-based, gypsum, MGO claddings and back-up components etc)
  - Freeze-Thaw damage
- Fire
  - Combustion of components – burn through / contribute to larger fire
  - By-pass within concealed cavity / spread up building
- Structural Loads
  - Wind, Earthquake, Impact, Missile, Gravity/creep
  - Chemical deterioration of components (e.g. Hydrogen embrittlement, corrosion etc)
- Pests

…and

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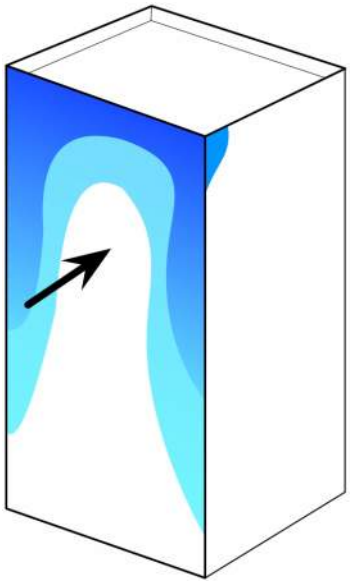
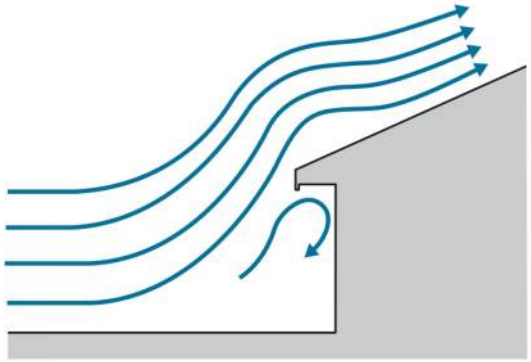
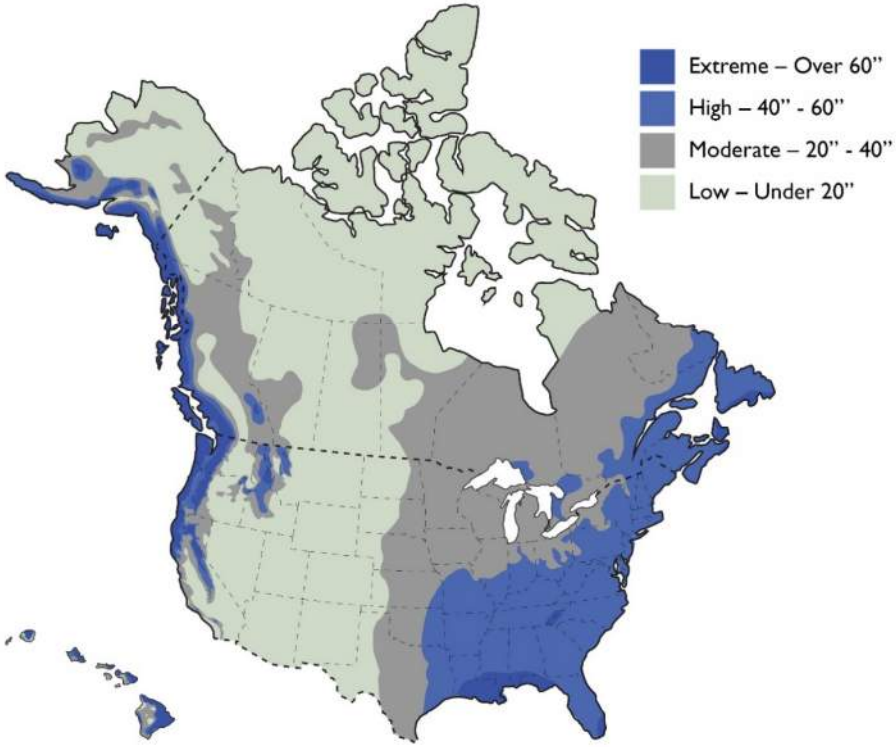
Rainscreens Used For High Rain Loads

→"Load" is climate and building exposure







→BUT… Benefits beyond Rain Control

- →Cladding & backup wall drying (if ventilated)
- →Bypass vapor barrier claddings
- →Also a useful cladding adjustment & tolerance gap

Claddings – The "Outer Layer"

- Almost any material can be used as a cladding for a rainscreen wall
- Is the exterior finish, water-shedding and exposed to the environment
- Includes interface and joint treatments, openings, flashings, trims and other accessories
- Degree of "openness" at joints & interfaces impacts water, UV, insect/pest entry into cavity
- Profile/shape may be used for drainage & ventilation

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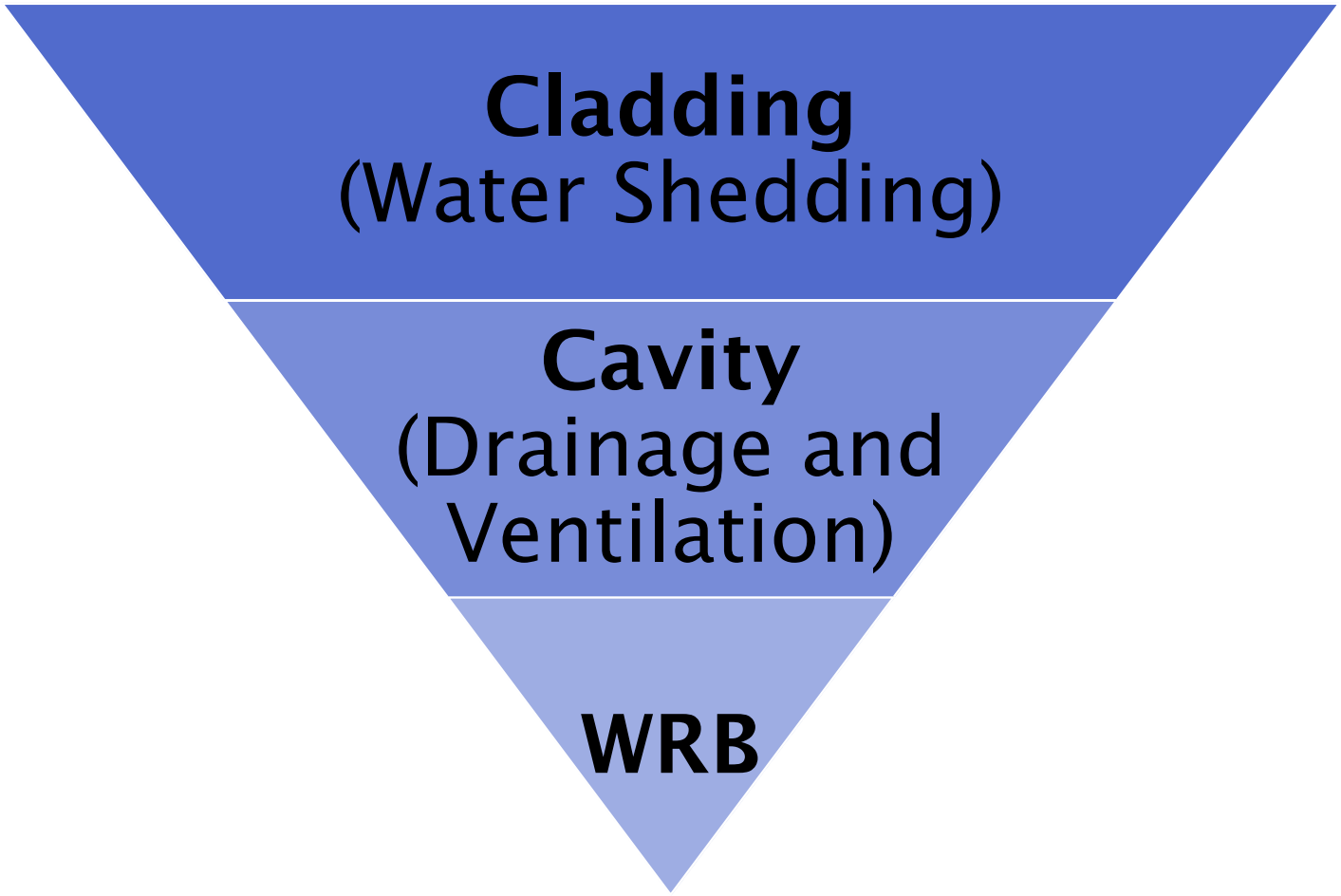
Will it Really Work with Any Cladding Material?


.. And Will it Really
Work with Any Green
Cladding Material?

Hierarchy of Rainscreen Water Control



"Outer Layer"

"Inner Layer"

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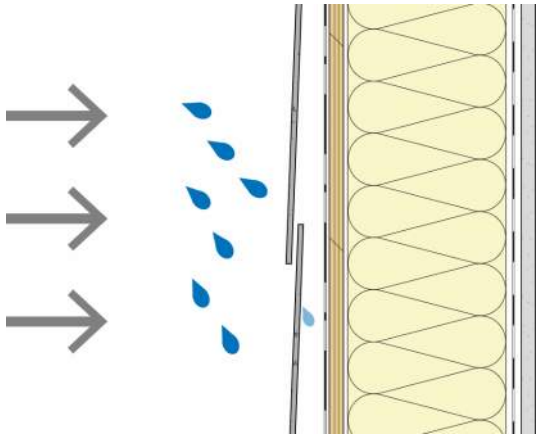
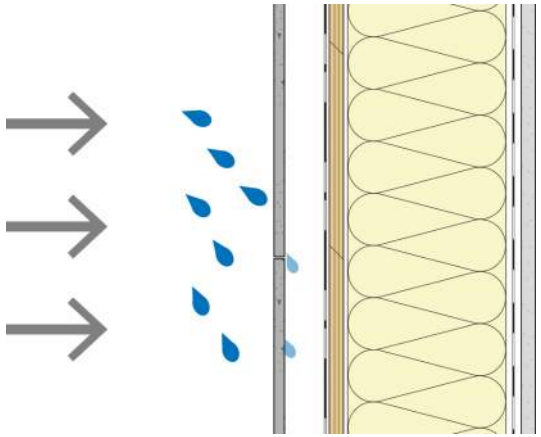
Cladding
Cavity
WRB (Behind
Exterior Insulation)

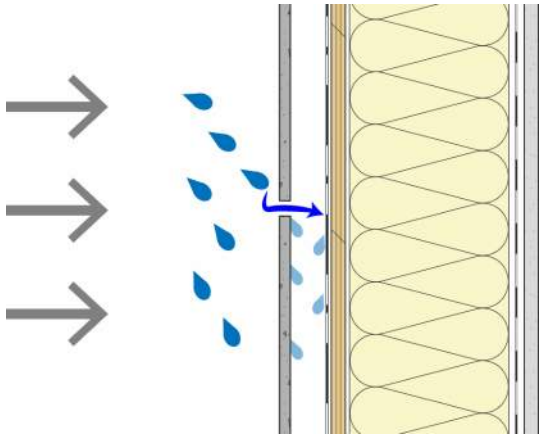
Cladding Choices & Water Control



Lapped and well jointed claddings. Shed ~100% water at outer surface. Minimal water entry into the cavity except at unsealed penetrations. Airflow will help remove vapor from wetted cladding.

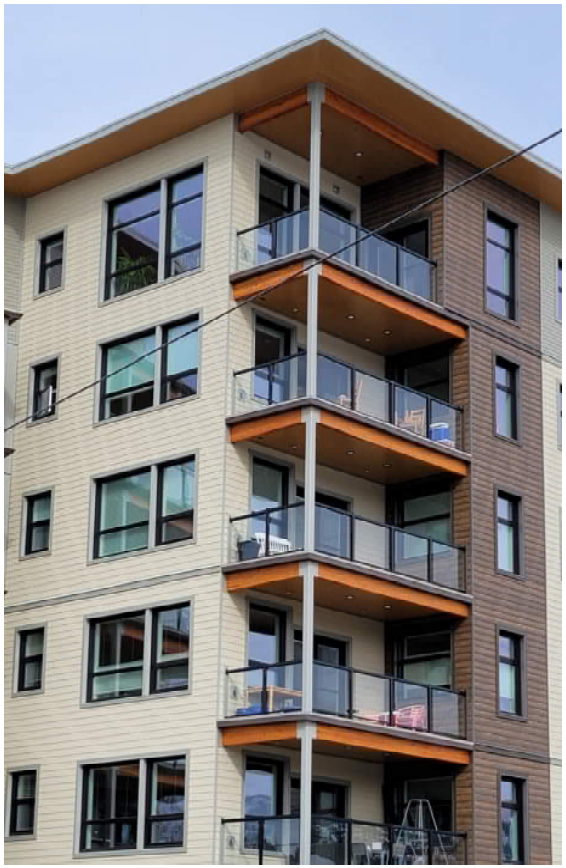


Panel claddings with sealed joints. Cladding holes/cracks, unsealed or failed joints allow small amounts of water into the cavity which mostly drains down the back of the cladding. Airflow is helps remove vapor from cavity and cladding.



Open jointed & perforated claddings. Allow for direct water ingress into the cavity increasing the requirements for drainage, airflow and WRB detailing

Most Rainscreen Claddings Shed Most of the Water



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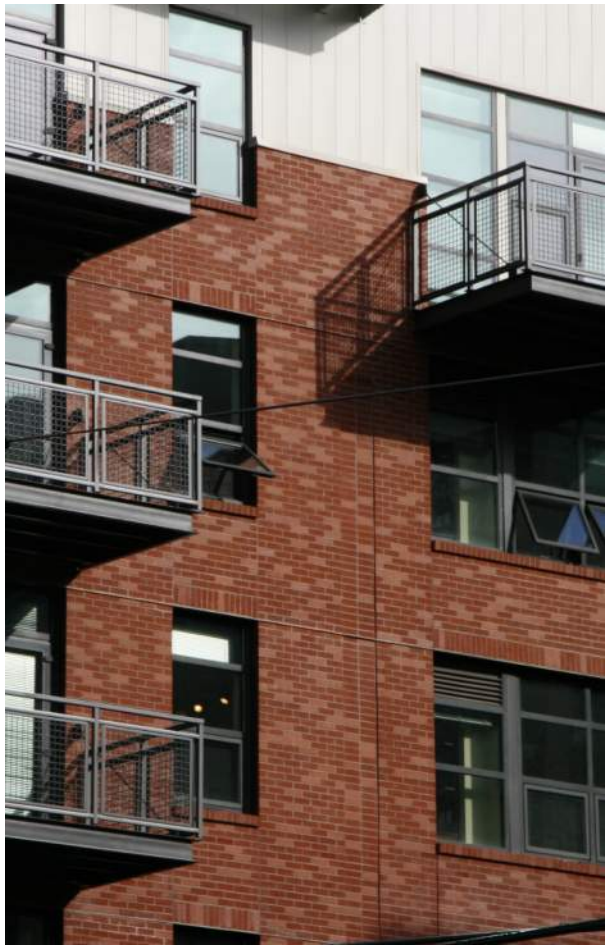
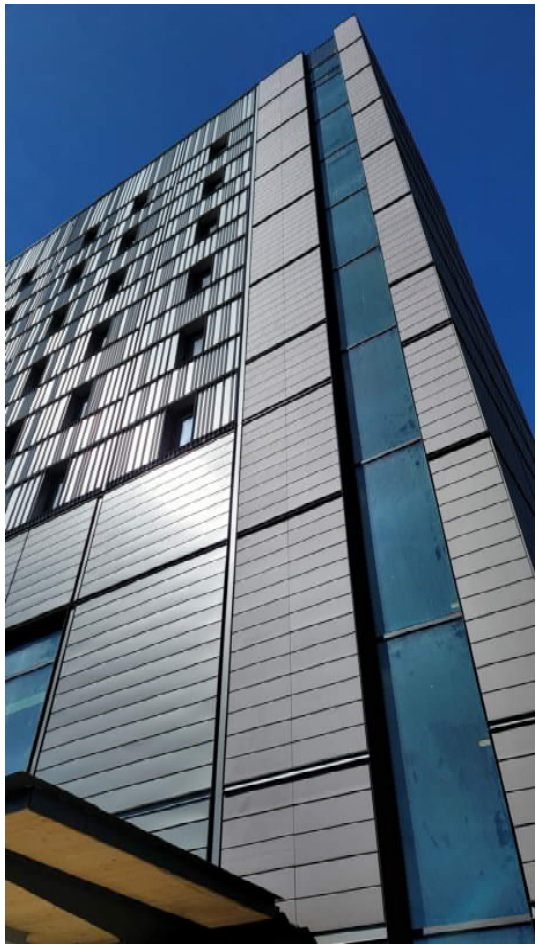
Most Rainscreen Claddings Shed Most of the Water





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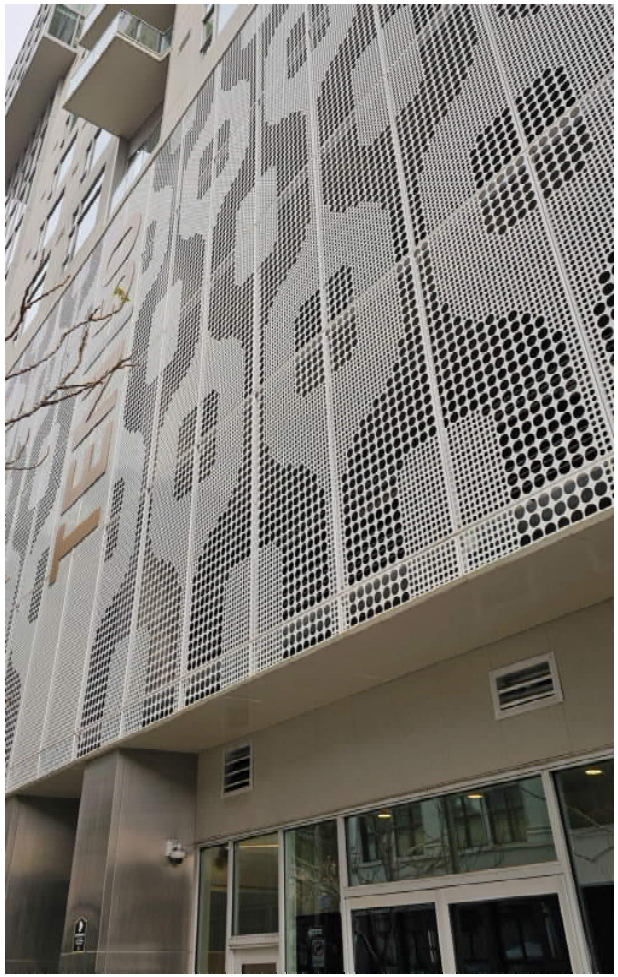
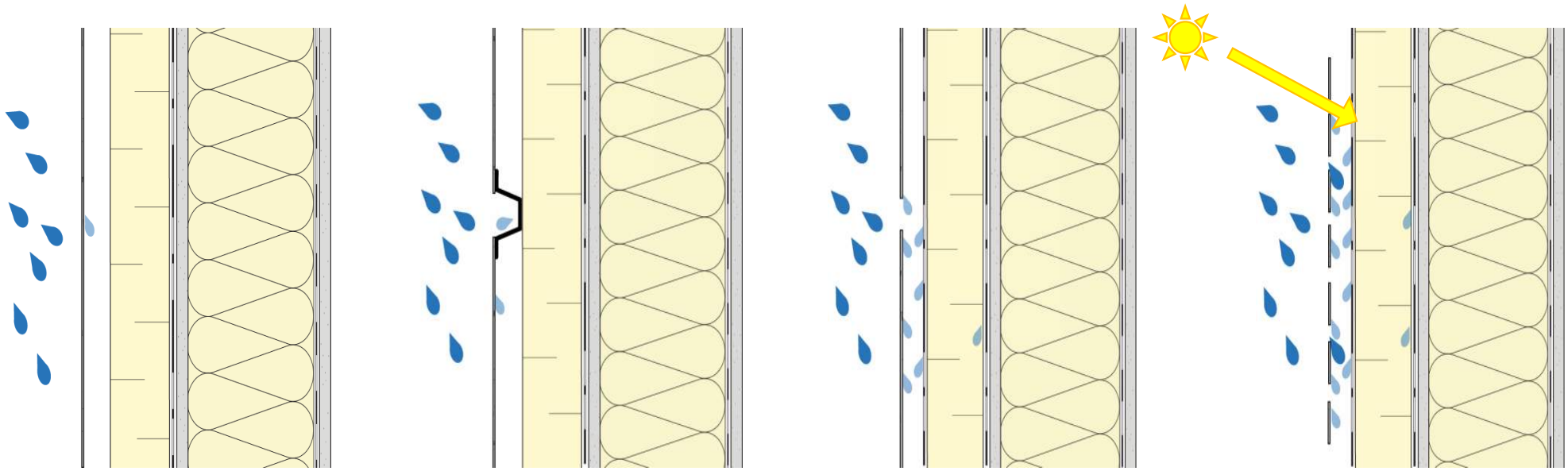
But… What if This is My Cladding?



Open joints/ holes in cladding = more water +UV for WRB to manage



A Little to a Lot of Water Reaching the WRB

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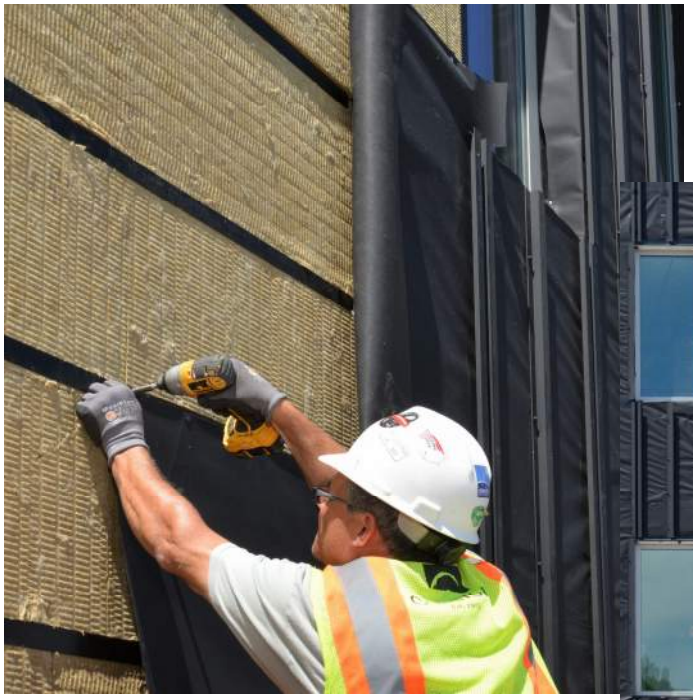
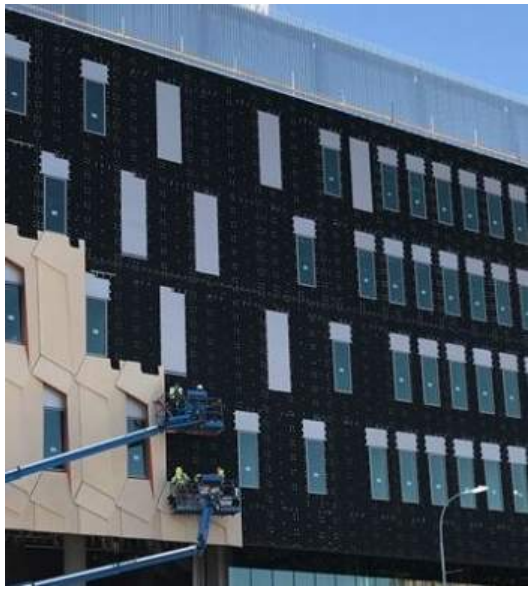
Baffled “Open Joint” Rainscreen – Looks Open but Performs Closed

UV Stable WRB For Open Jointed or Perforated Claddings





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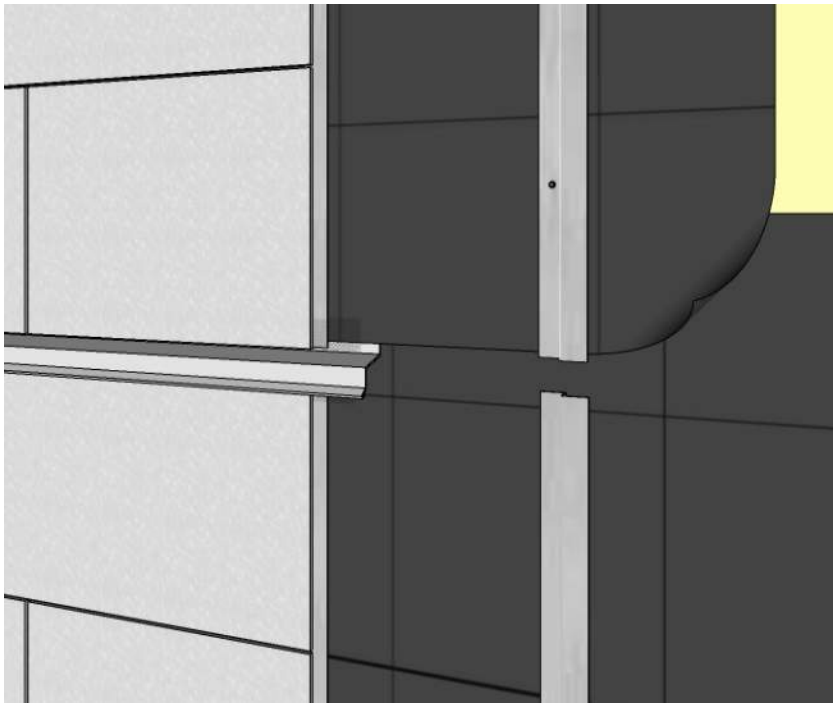
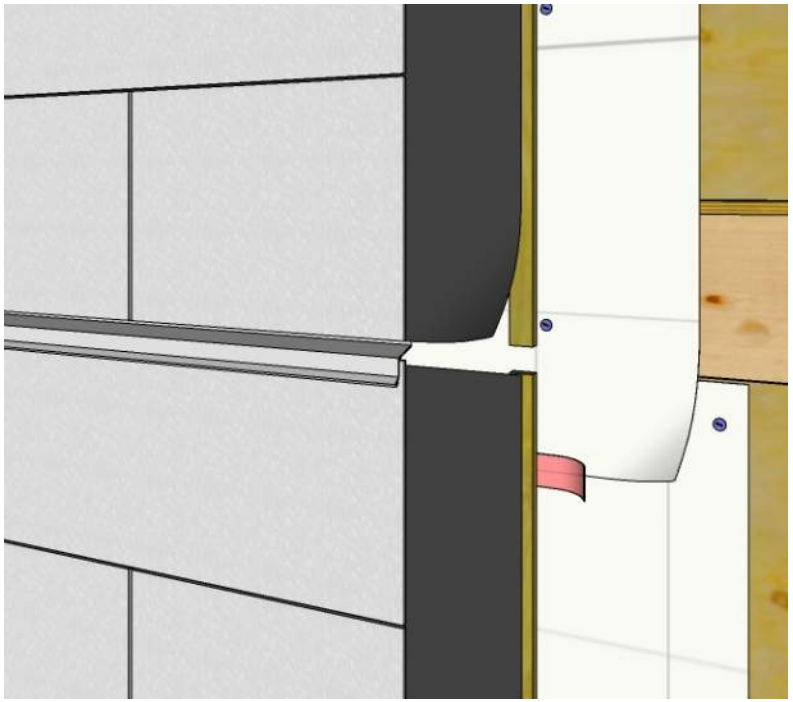
Where to Place the UV Resistant WRB membrane?

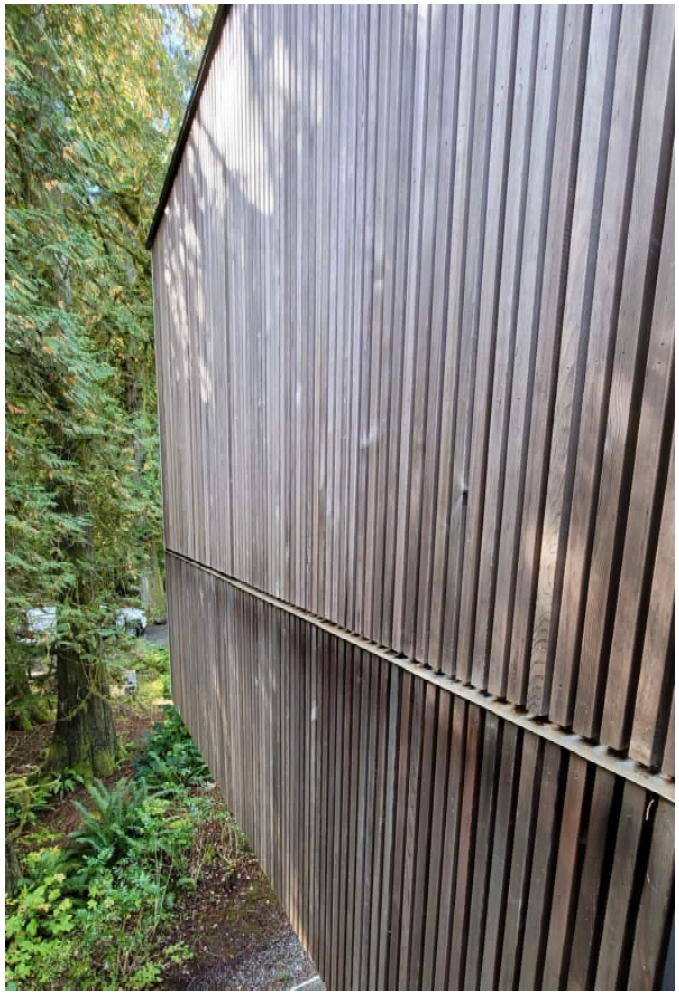


At back of cavity - at face of insulation or sheathing
UV stable WRB at inside of rainscreen cavity, cladding support framing exposed to moisture. Expect more water in cavity to manage



Directly behind cladding over cladding support and rainscreen cavity.
Additional UV stable “screening” membrane in addition to primary WRB at inside of rainscreen cavity

Why UV Stable Exposed Drainage Membranes?



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Open Joint Rainscreen w/ Exterior Insulation Without UV Protection

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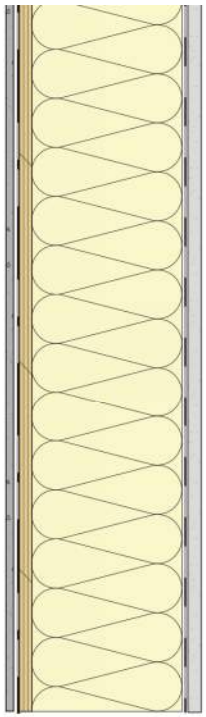
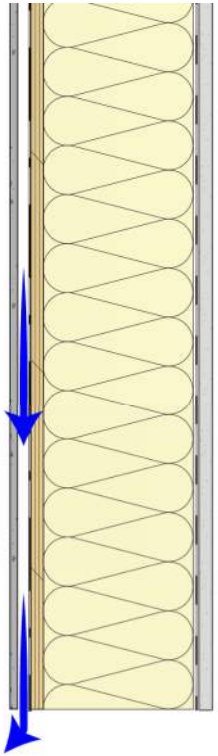
Cavity – Air space / Gap

- Gaps stop capillary action **(>1/16”)** and water transfer/bridging **(1/8”)** from outer to inner surface of rainscreen,
- Allows drainage of water (**<1/16”)** and ventilation removal of vapor, (**>1/8”)**
- Width and details impact fire and smoke propagation, **(especially >1”)**
- In Canada, Building Code minimum rainscreen gap is 3/8”, though often ¾” to 1” is typically used.
- In some parts of certain newer US Code sections min 3/16” gap but only specific applications

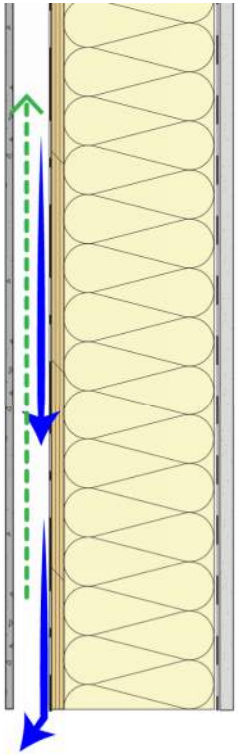
Impact of Cavity Width on Drainage & Airflow



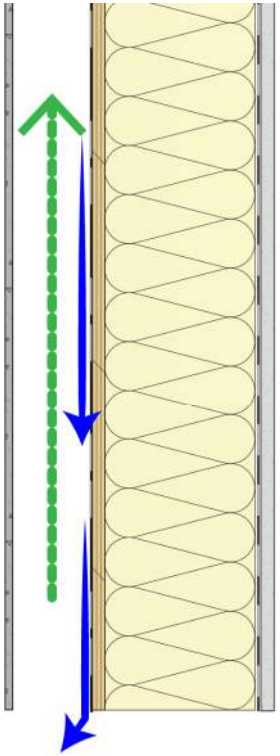
No gap, no drainage or airflow possible



Small gap (1/16” - 1/8”), some drainage but minimal airflow potential



Moderate gap (~1/2”), full drainage and decent airflow potential

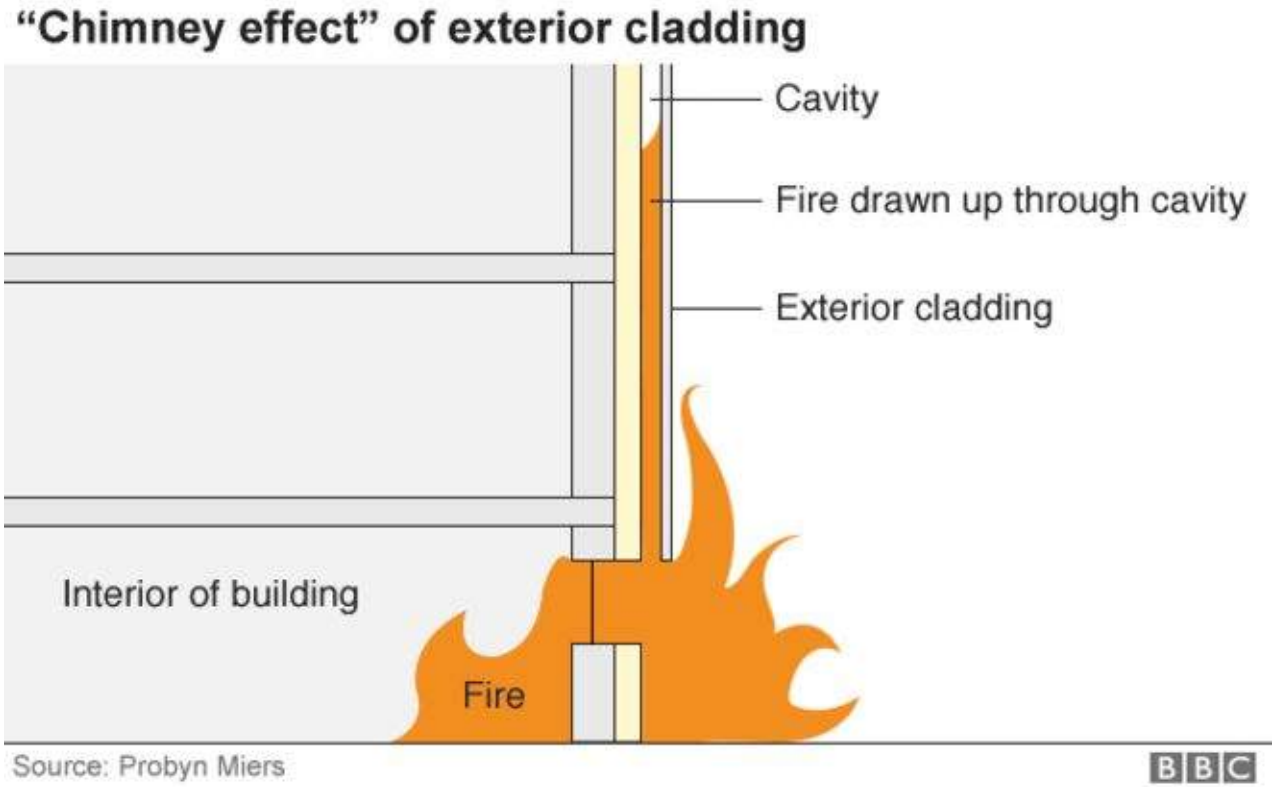


Large gap (>3/4”), full drainage and increased airflow potential

Very Big Gaps

Why Not Bigger is Better?

→Fire, rodents, birds. To avoid… gaps of under 2” are preferred



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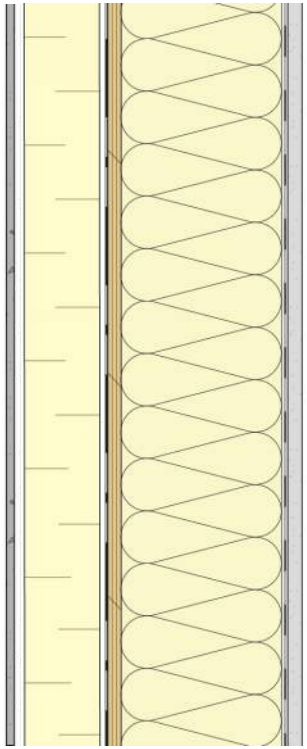
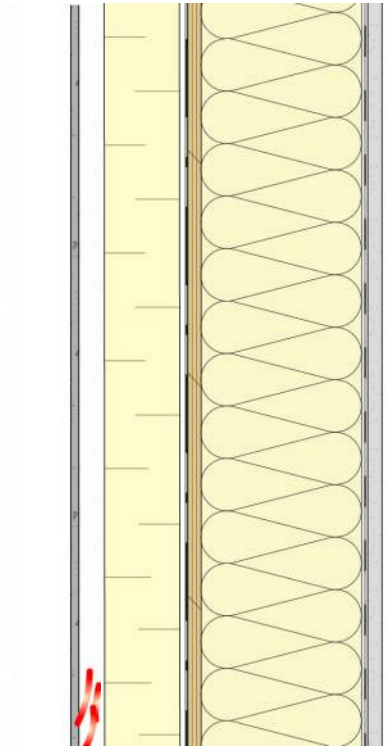
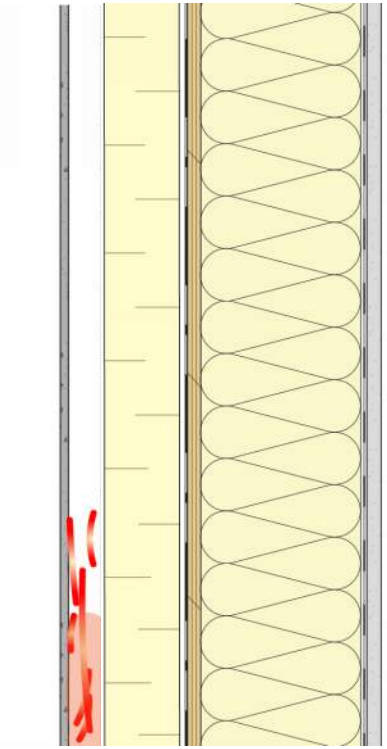
Impact of Cavity Depth on Fire Propagation



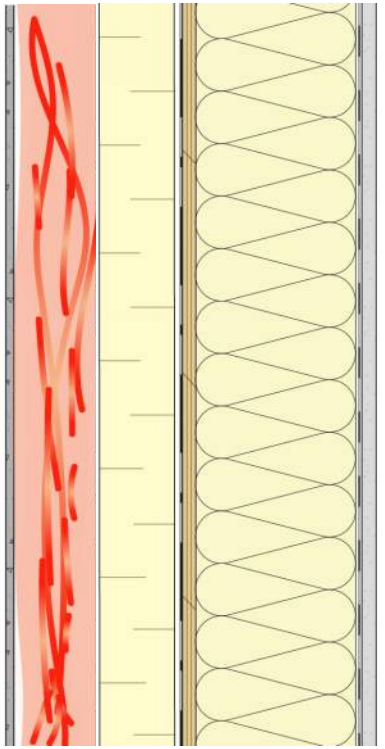
No gap, no entry for fire behind cladding



Small gaps <1/2", hard for fire to propagate in cavity as will rapidly deplete oxygen and starve fire out



Gap ~1" fire may start but will deplete oxygen within minutes and starve fire out limiting propagation



Gap ~2"+ fire burns combustible materials and oxygen is replenished fast enough for combustion to continue and spread

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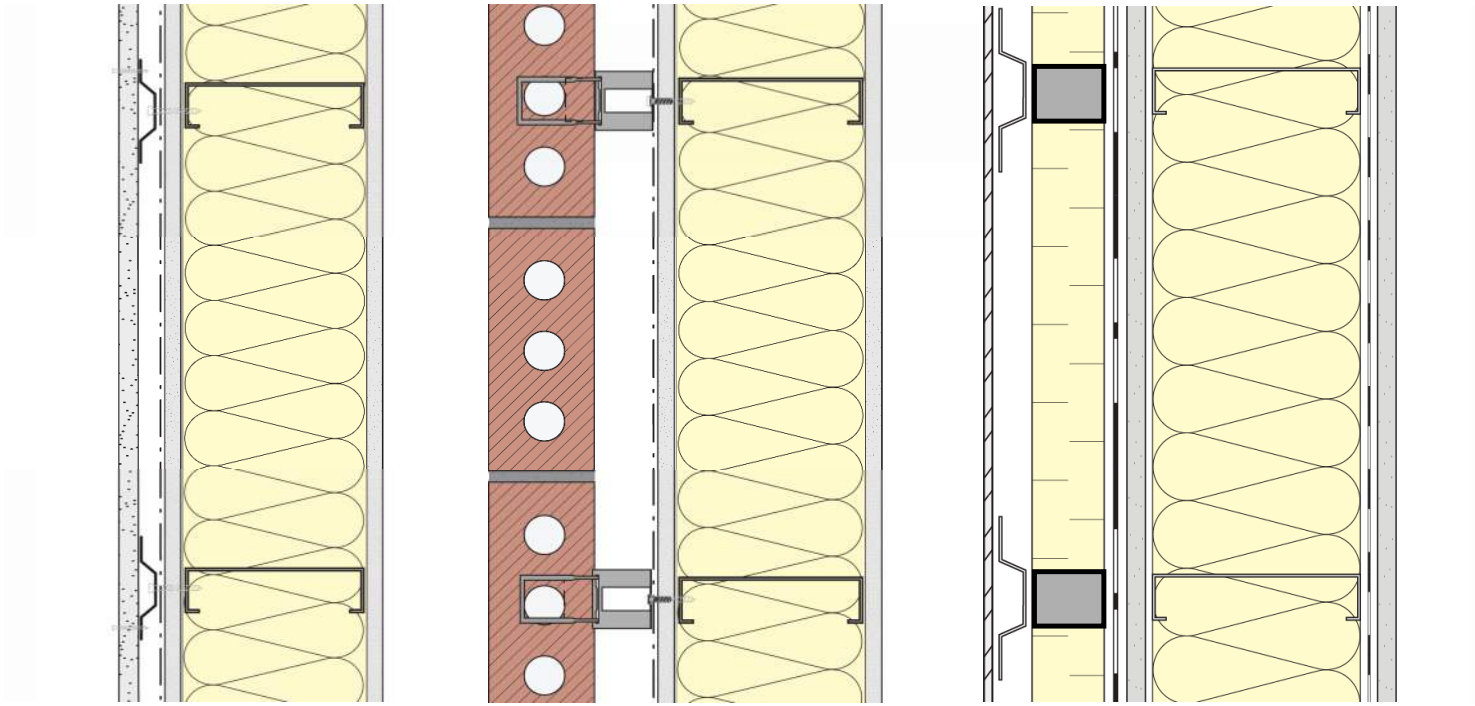
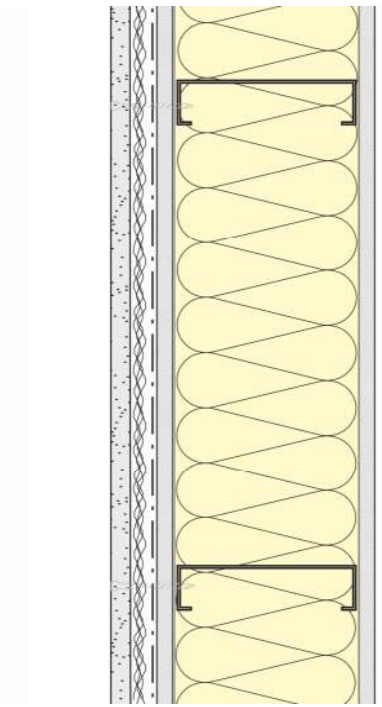
Creating the Rainscreen Cavity

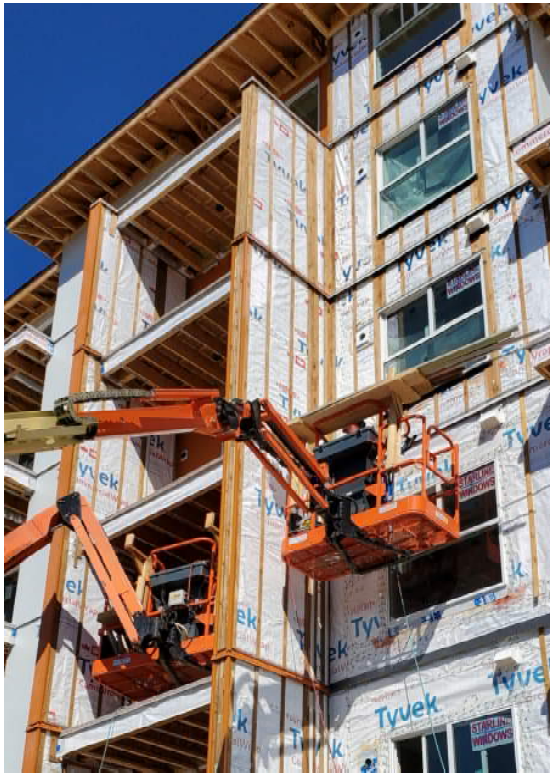


Continuous or intermittent girts/furring/strapping/shims/spacers/ties etc. made of wood, metal or fiberglass/plastic etc. oriented vertically, horizontally or diagonally



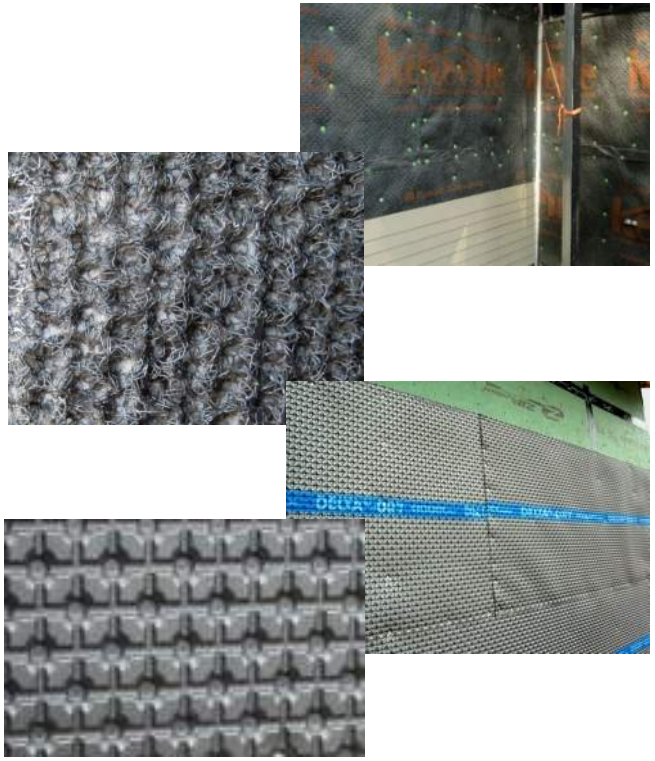
Engineered drainage/vent composites

Examples



Wood strapping over mechanically attached housewrap WRB

Steel hat framing – on thermal cladding attachment clips through exterior insulation over self adhered membrane WRB



Engineered drainage/vent composites over a WRB

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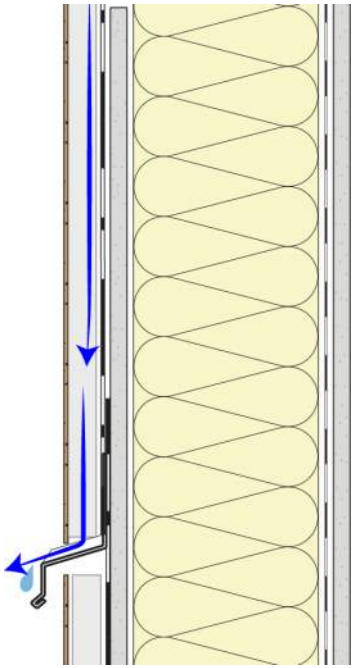
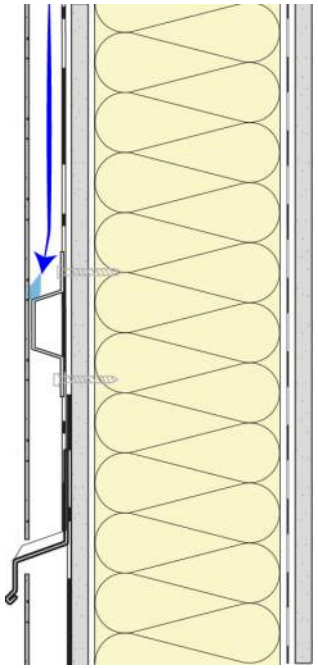
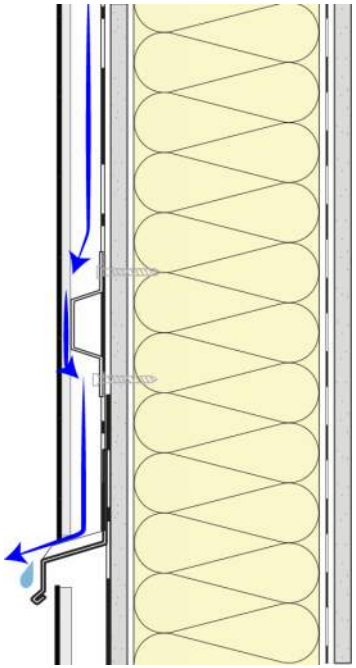
Cavity Drainage & Airflow Considerations



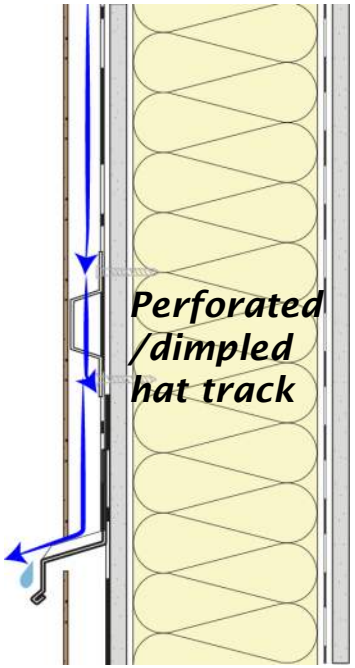
Vertically oriented cladding support, allows for gravity drainage and open air space



Horizontally oriented cladding support tight to solid cladding – blocking drainage/airflow



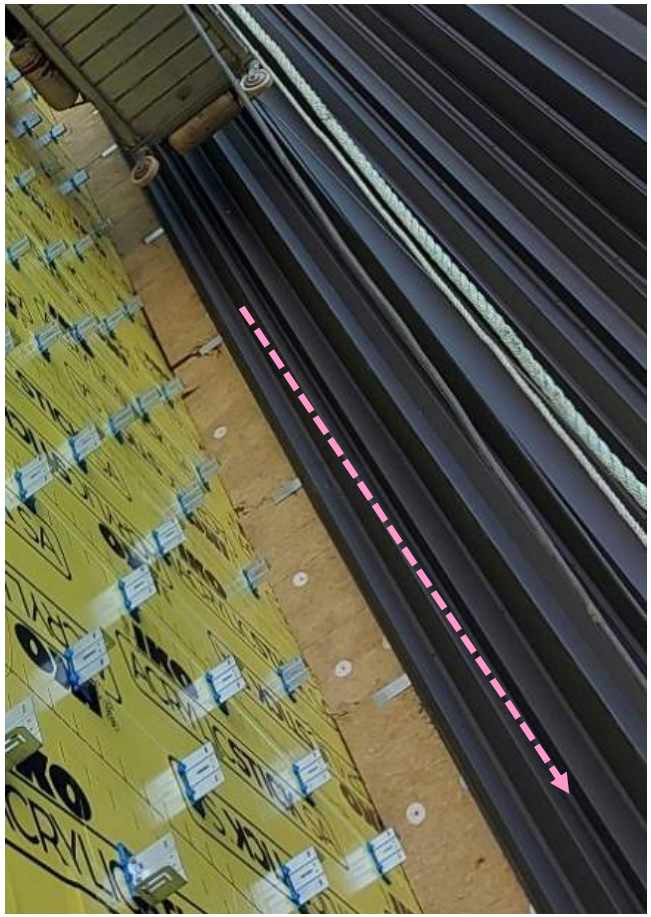
Horizontally oriented cladding support with open profile cladding– allows drainage/airflow



Horizontally oriented perforated or dimpled cladding support and solid cladding allows drainage/airflow

Spot the Airflow and Drainage Paths?

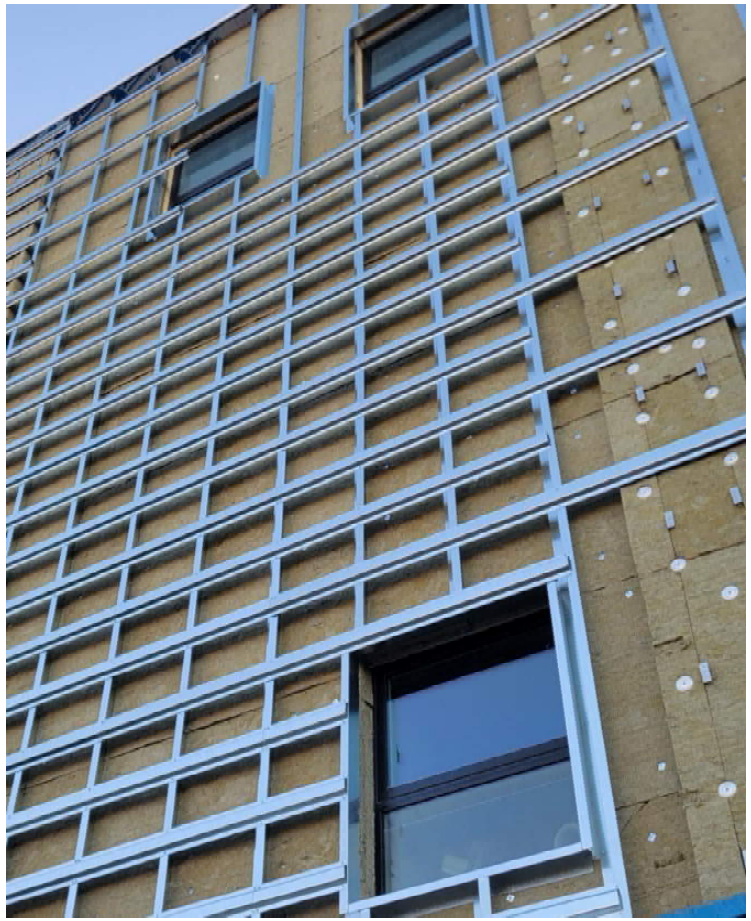
Airflow and drainage exterior of insulation in vertical hat track cavity



Airflow and drainage exterior of insulation in corrugated cladding

Airflow and drainage exterior of insulation in cladding profile, +shims at horizontals

Lots of Different Preferences – But Always Watch Drainage Paths & Vent Openings



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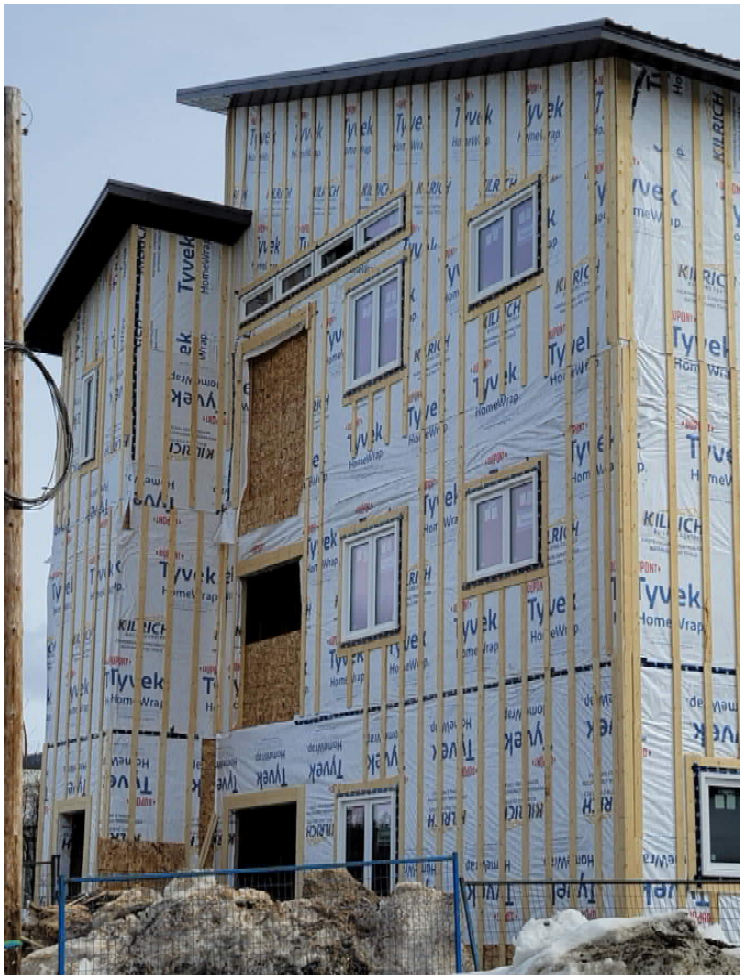
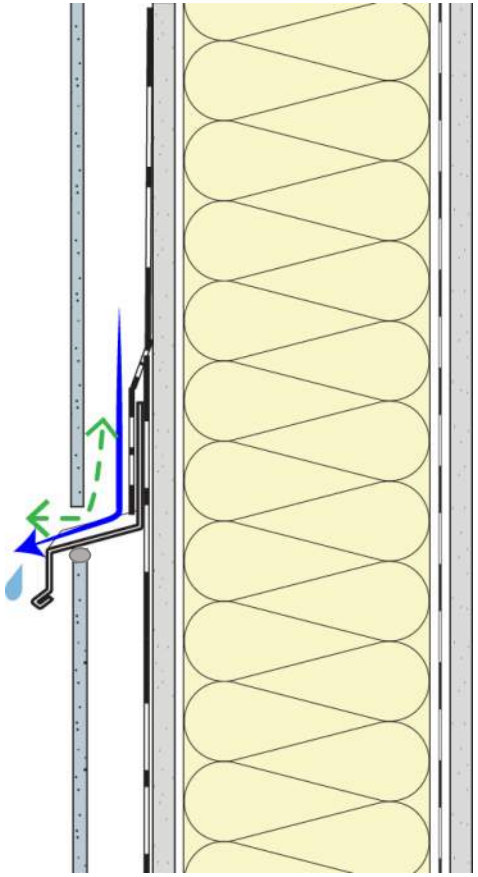
Rainscreen?

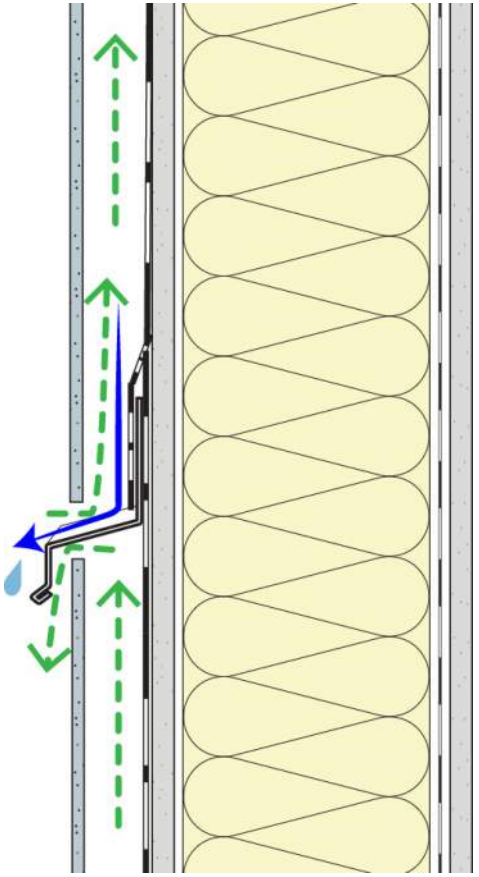


Metal and Plastic Perforated/Drained Furring

Vent Opening: Venting vs Ventilation



Opening only at bottom of wall
drained and vented
(low air flow rates)

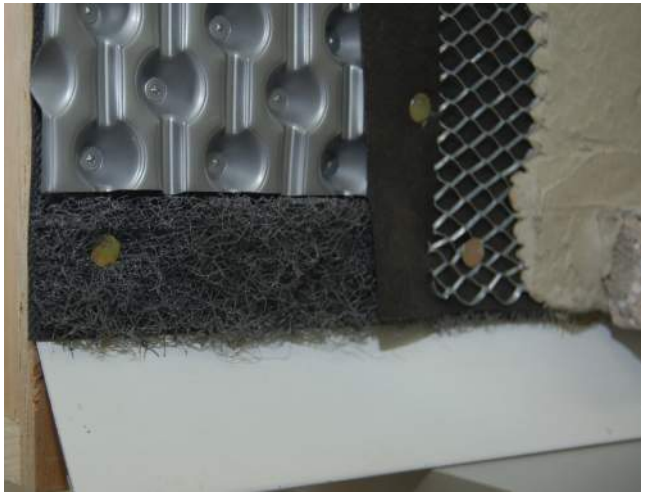


Opening at bottom **and** top
ventilated
(higher air flow rates)

Amount of venting or ventilation (i.e. air-exchange) needed depends on several design and climatic factors – mostly beneficial though not always necessary

RDH

Whatever You Use to Keep Out the Insects – Make Sure it Doesn't Block Too Much Airflow



Wildfire Considerations – Base of Rainscreen Wall

The “Inner Layer”: WRB

→~~Weather~~ Resistive Barrier?

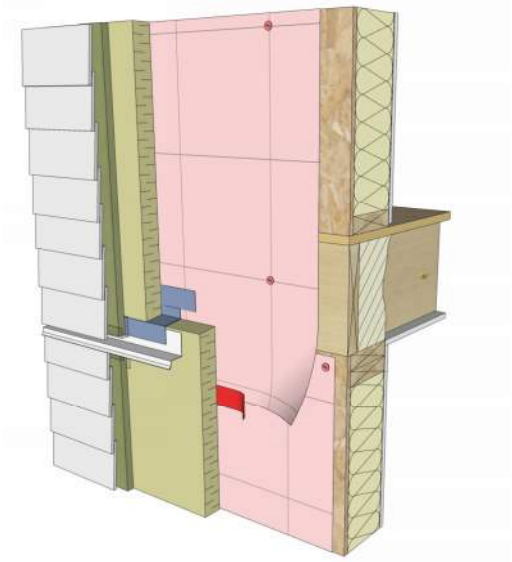
NO!!! It isn’t managing the weather, just the water (and maybe air)

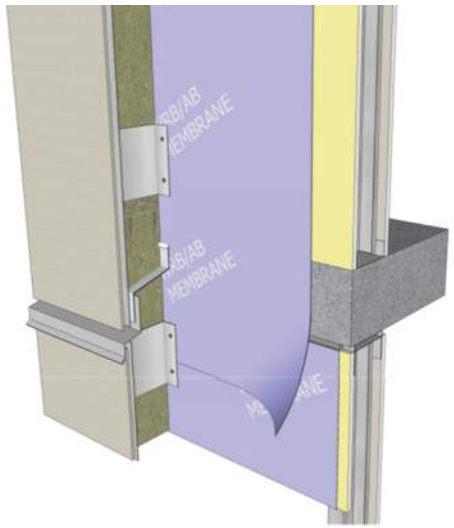
→Whether Resistive Barrier?

As in:
“I wonder whether this will work?”

→**Water Resistive Barrier?**

YES!

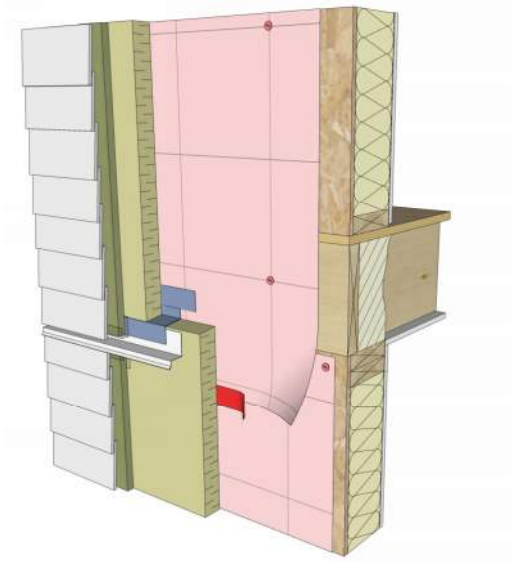


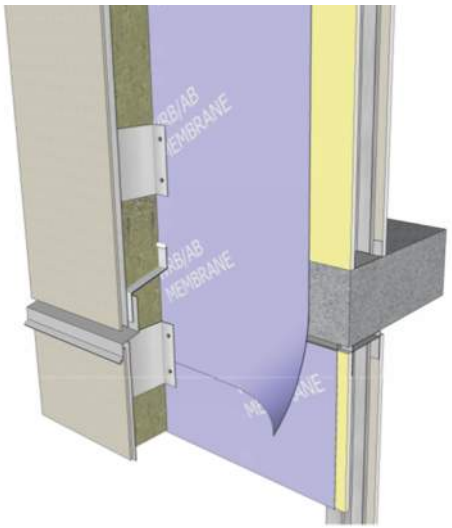


RDH

Water Resistive Barrier (WRB)

- The “inner layer” of the rainscreen, located inboard of the “cavity”
- Secondary plane of water control in walls
  - *System* of membranes, tapes, sealants, waterproof sheathings, rigid insulation, etc.
  - *Detailed* to be water resistive, lapped, drained and flashed to exterior
- May also be detailed as part of the air barrier system, and/or provide vapor control





Building paper w/ lapped joints

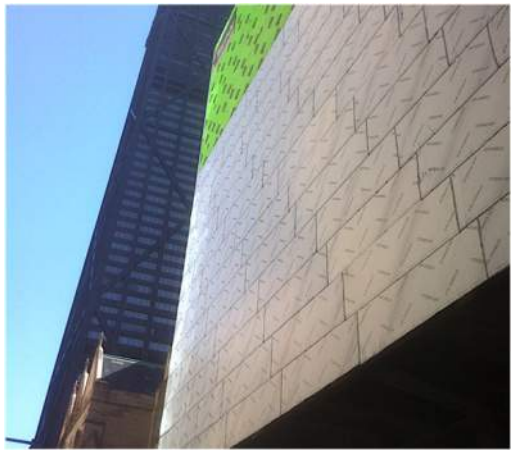
Mechanically attached house-wraps w/ taped joints

Sealed gypsum sheathings – sealant or tape at joints

Sealed wood sheathings – sealant or tape at joints

Liquid applied membranes w/ sealed joints

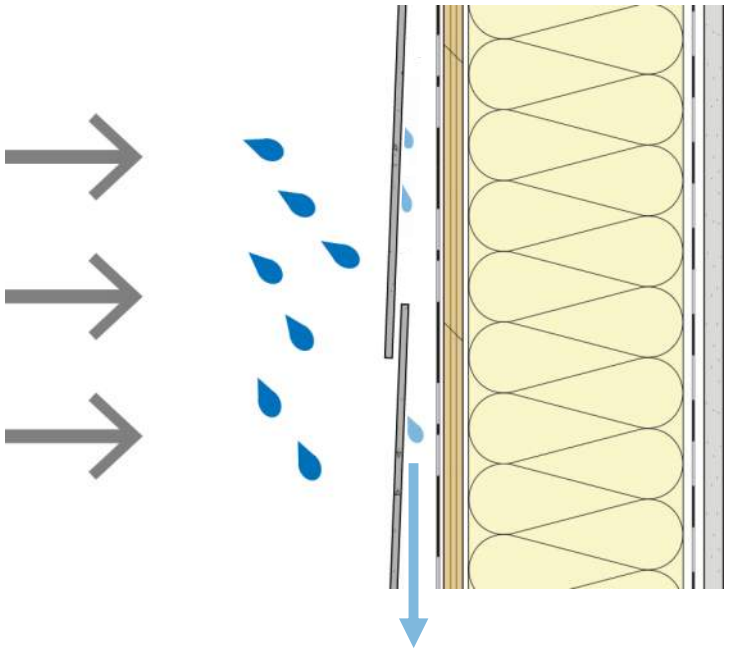
Self-adhered vapor permeable membranes



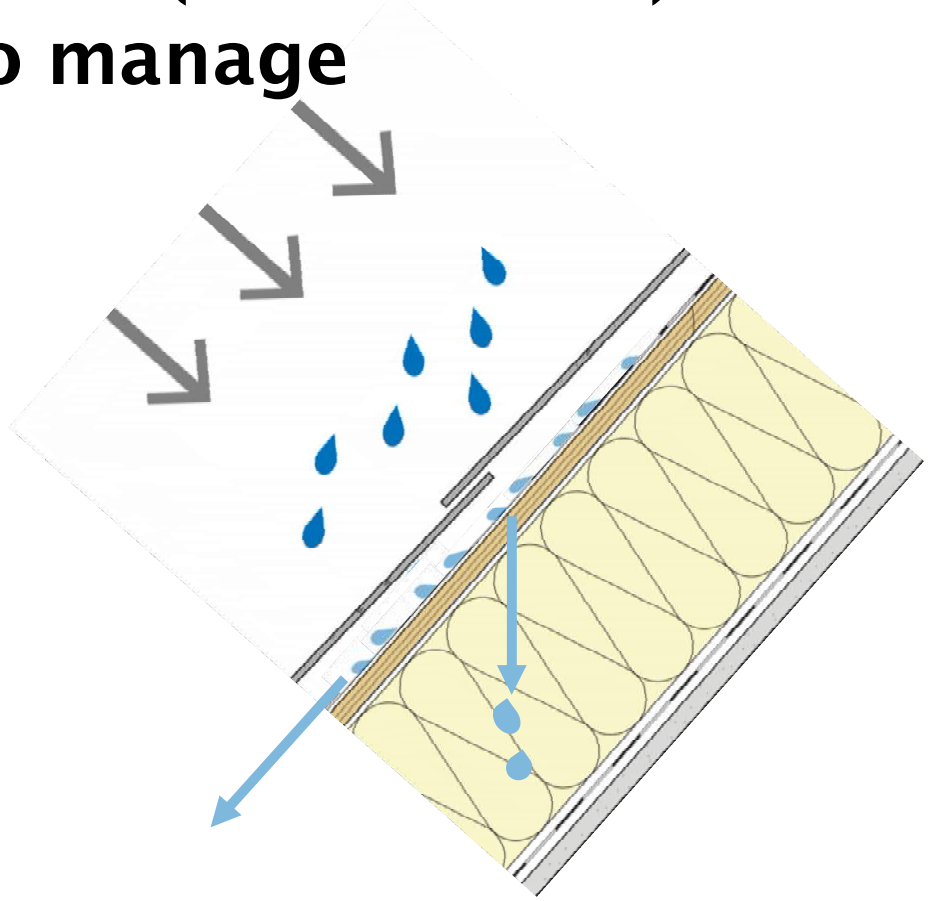
Self-adhered vapor impermeable membranes

Sprayfoam

Careful with Sloped Walls (aka “woofs”) = More water for WRB to manage



Gravity is your friend



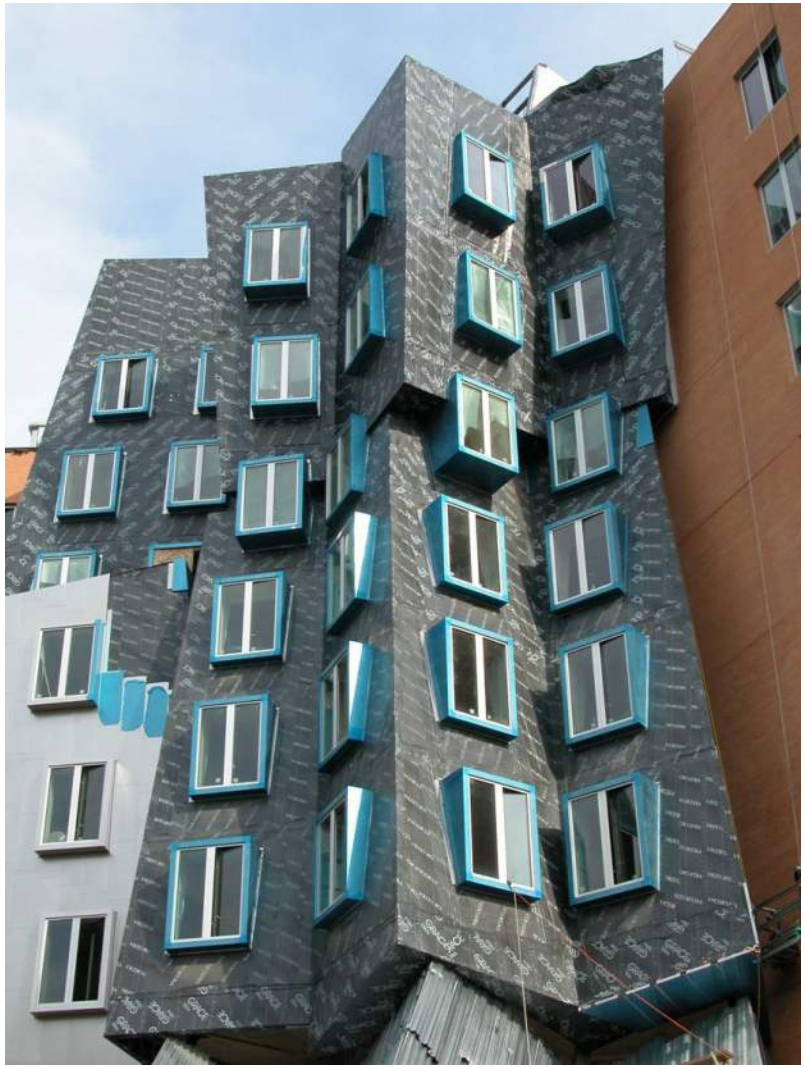
Gravity is not your friend

RDH

Design as a Rainscreen Roof, Not a Wall

Sloped Wall-Roof “Woofs”

- Walls that are back sloped have significantly higher exposure and require very high performance water control layers.
- Lapping for these types of walls is very important.
- Behaves more like a roof than wall in terms of water control.
- Also consider secondary impacts of water control layer, is it an exterior vapour retarder?? Most very high performance water control products are vapour impermeable.



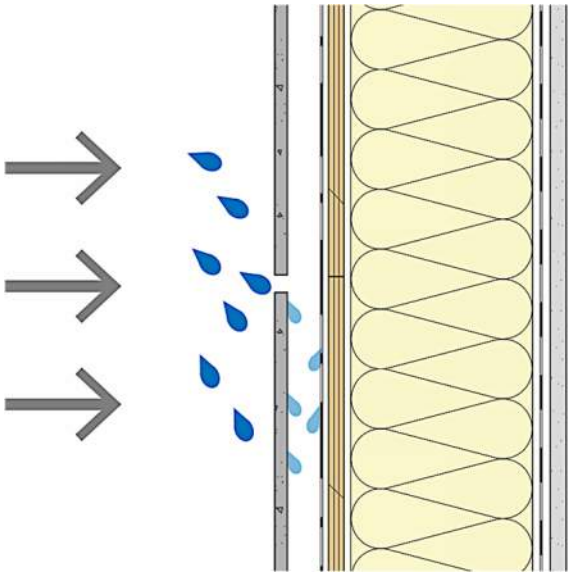
RDH

The Opposite – Wall Sloped to Face Ground (Gravity Keeps Water Away from WRB

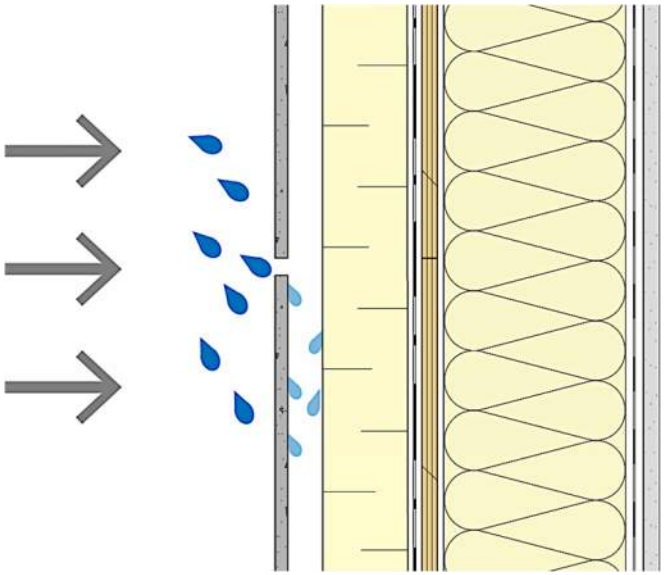
Exterior Insulation Considerations

- Must be moisture tolerant and self supporting for exterior cavity
- Air and vapor permeability of exterior insulation will impact air and moisture control strategies for whole wall
- Material properties also important for combustion and smoke development
- Mineral wool, XPS, EPS, foil faced polyiso, CCSPF… most common

Exterior Insulation Aids Water Control



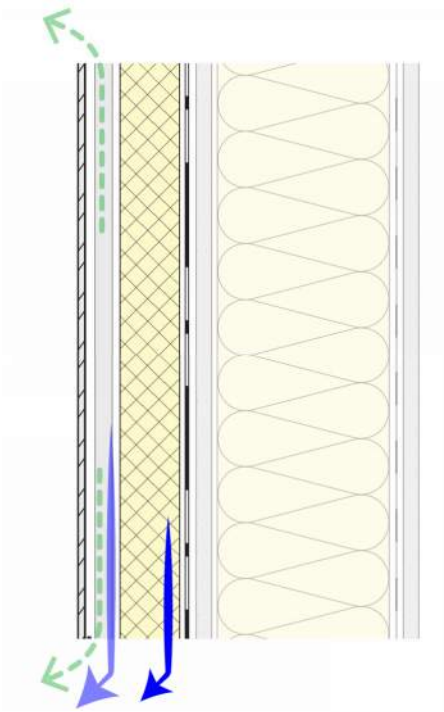
In a wall without exterior insulation, water is more likely to reach the WRB in event of a water bypassing the cladding



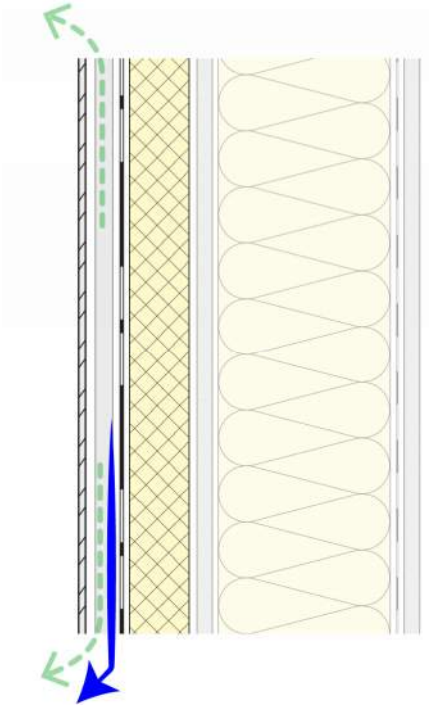
In a wall with exterior insulation, the **surface and thickness** of insulation layer(s) protects WRB inboard from contact with water in event of water bypassing the cladding

RDH

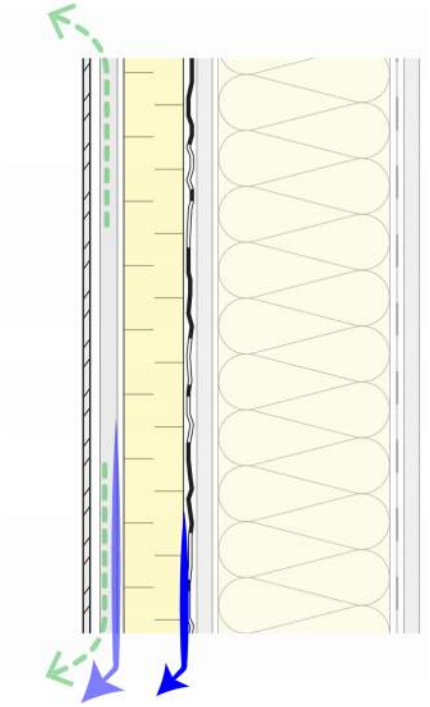
Exterior Insulation & Location of WRB



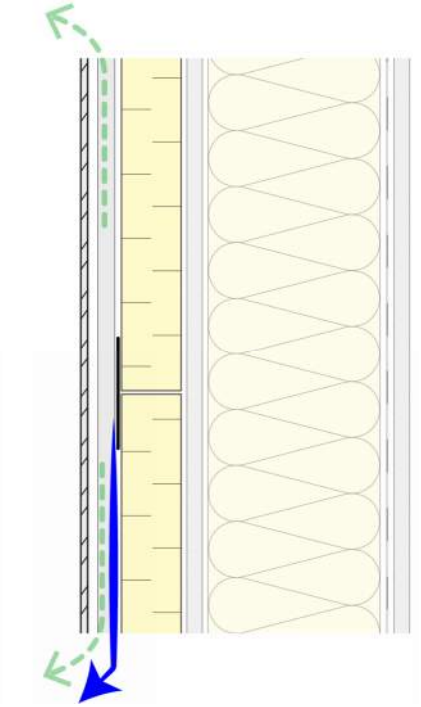
Fibrous draining and moisture resistant exterior insulation - **WRB at backup wall**



Fibrous, possibly moisture sensitive exterior insulation or open jointed/perforated cladding – **WRB* added on face of insulation**

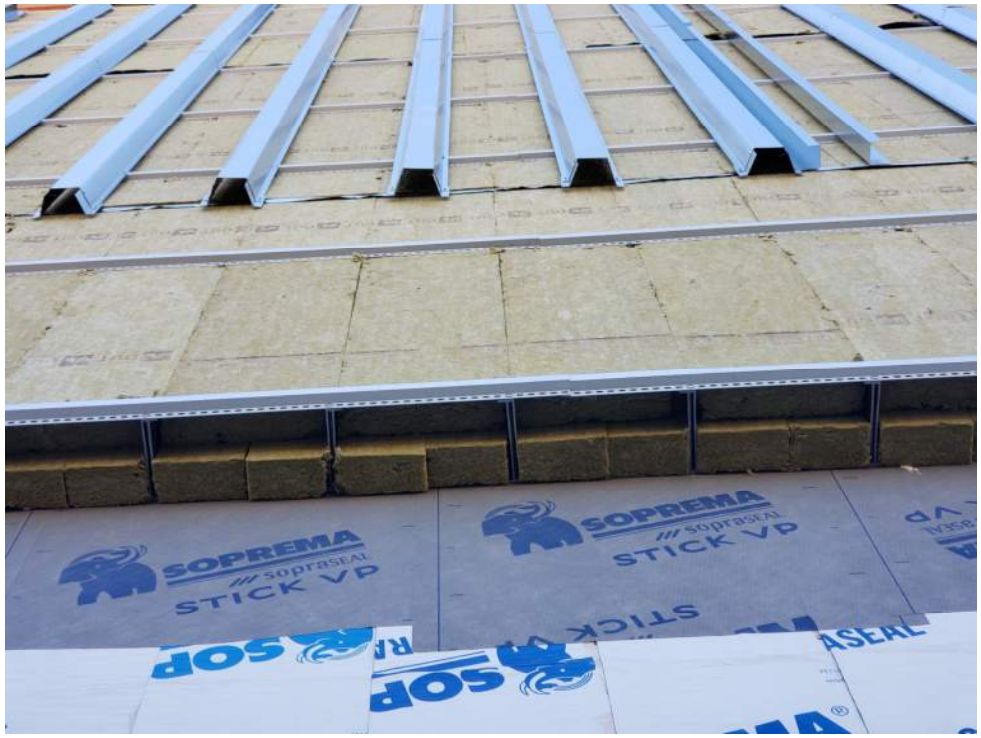


Foam plastic exterior insulation with intentional or accidental drainage behind – **WRB at backup wall**



Foam plastic exterior insulation with taped/sealed joints or possibly additional membrane – **WRB at face of insulation**

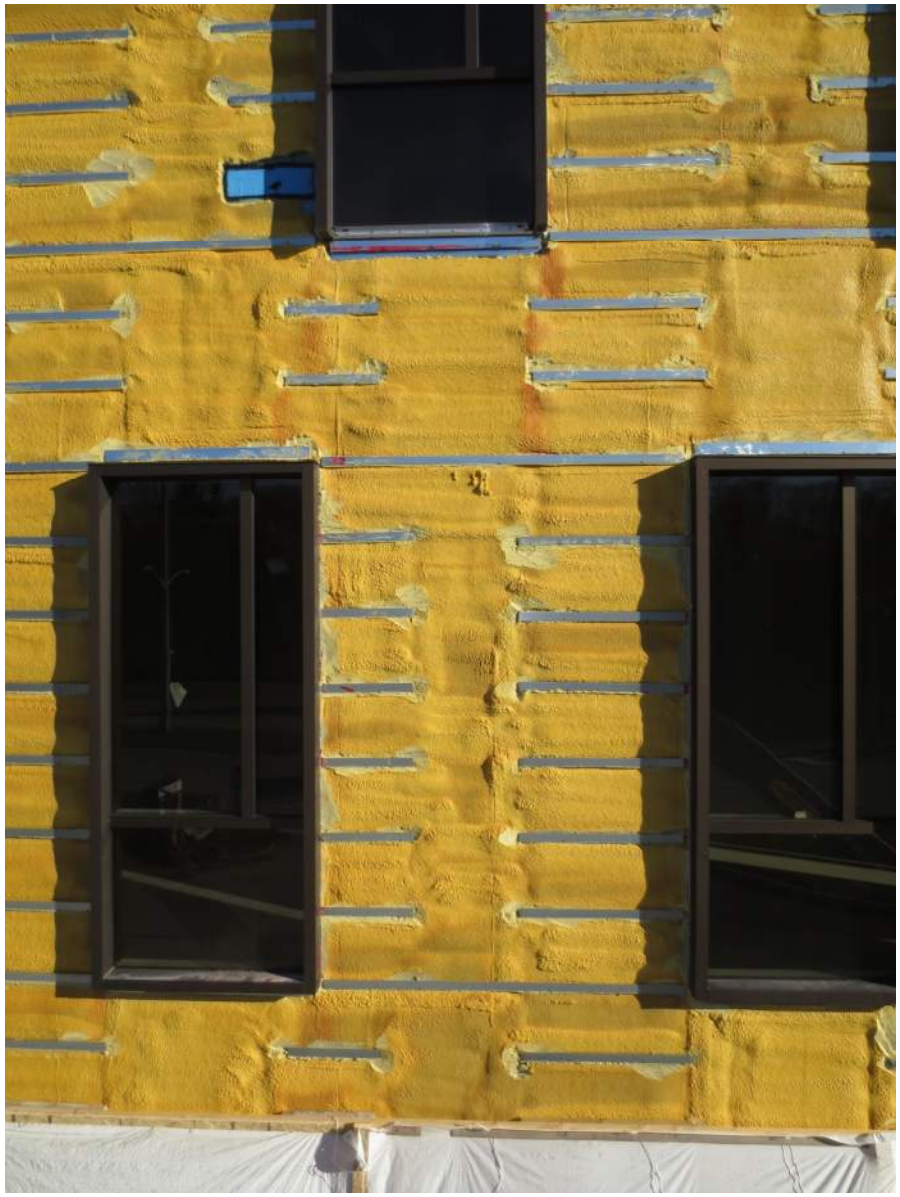
Exterior Insulation Aids Water Control



RDH

…Or Can be a Funnel

Don’t face Z-girts with
the exterior leg upwards



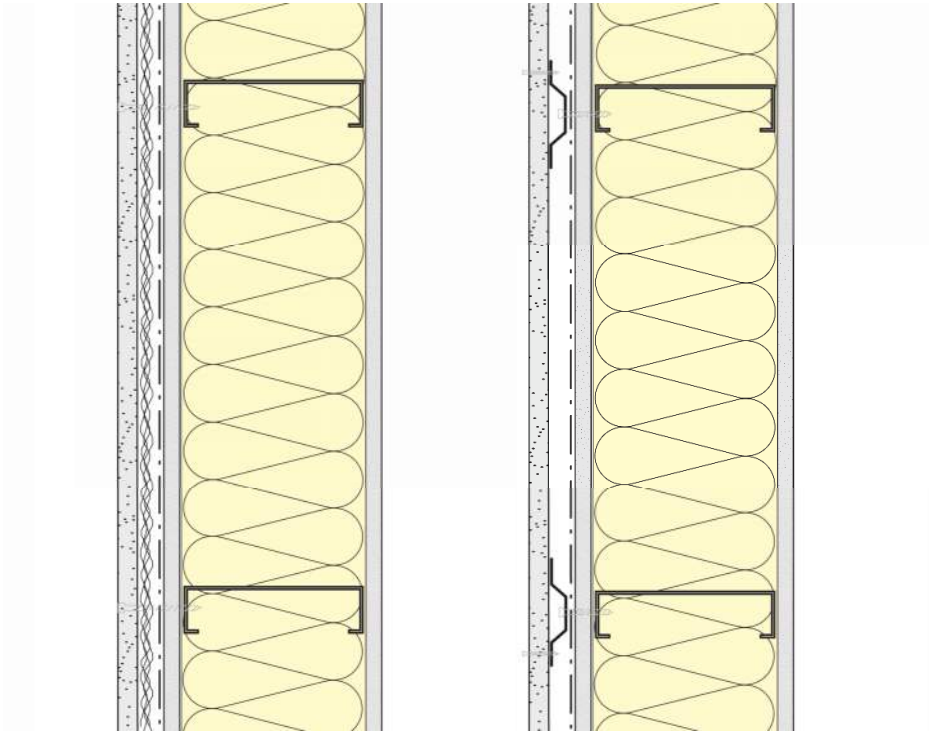
RDH

Is the WRB the Taped Exterior Insulation or the SAM? …or is the taped foam a supplemental drainage layer protecting the WRB?

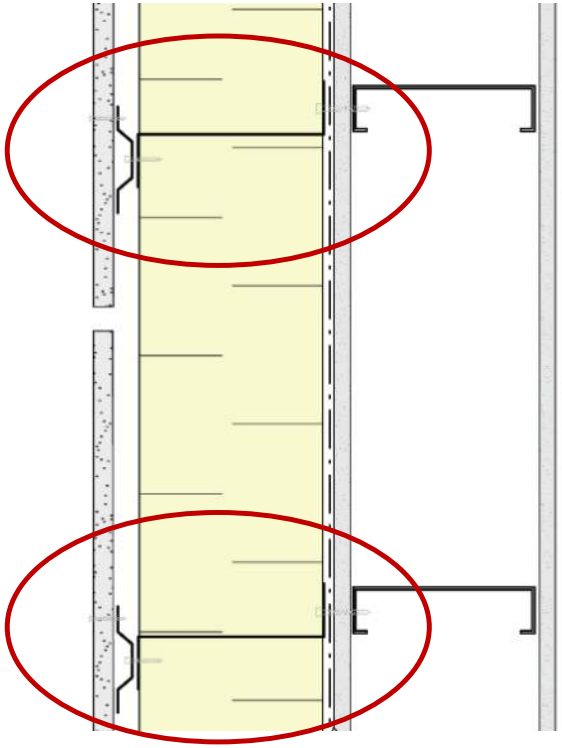
RDH

Spot the WRB and + Supplemental Drainage Layers

Cladding Attachment & Exterior Insulation

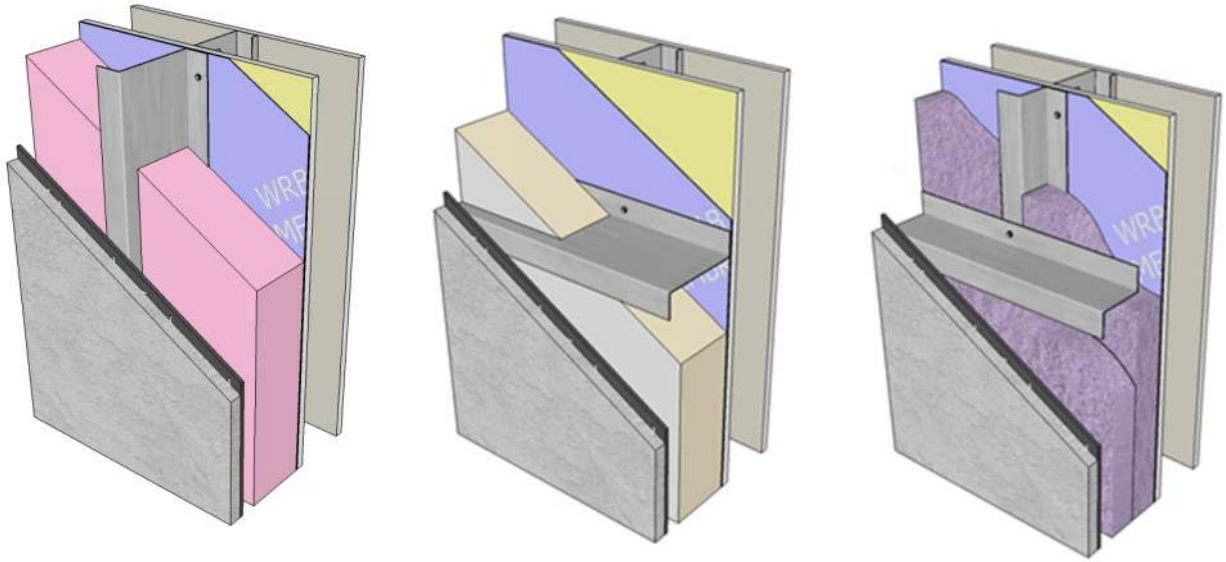


Cladding attached directly through the cladding and cavity, or into furring pre-attached to the structural framing

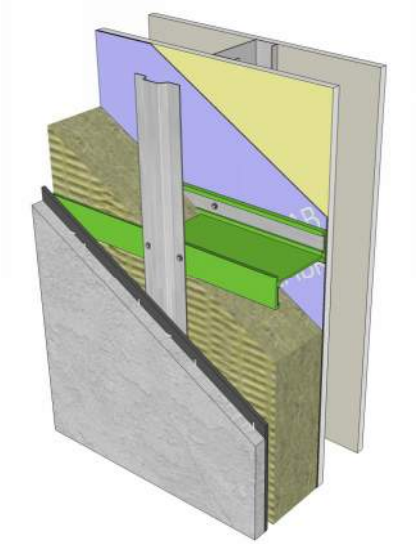


Cladding attached to cladding support structure attached separate through exterior insulation to back-up

Cladding Attachment Through Exterior Insulation - Continuous Framing

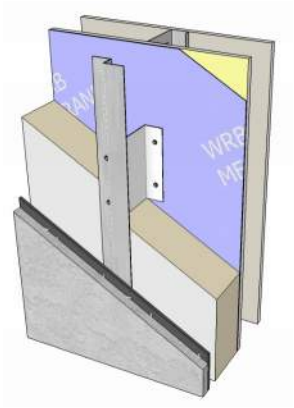
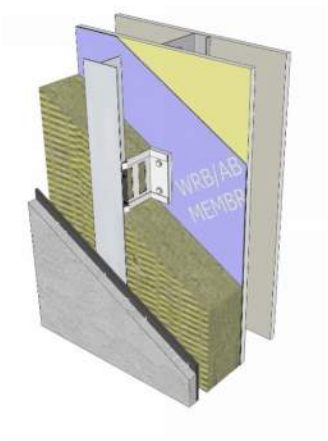
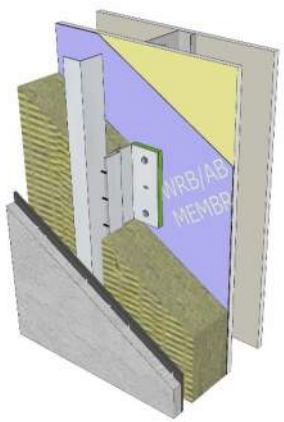
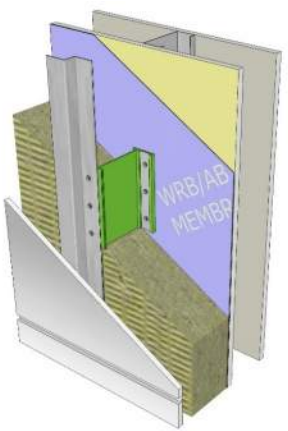
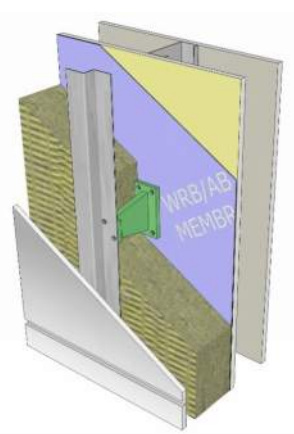
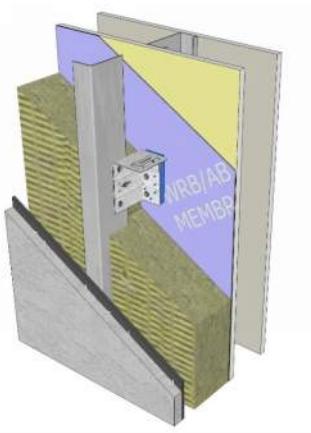
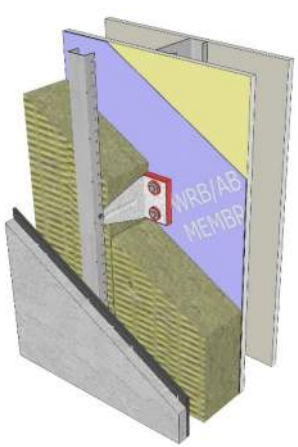
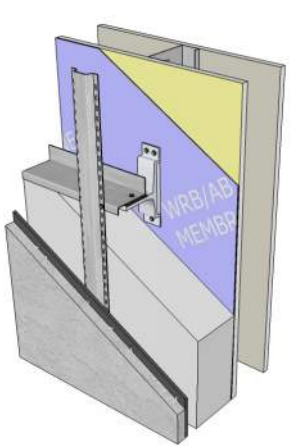
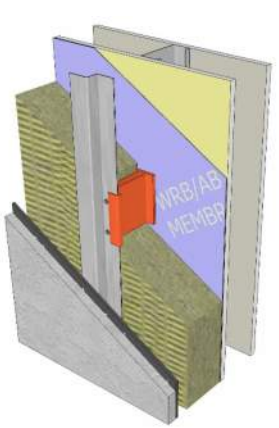
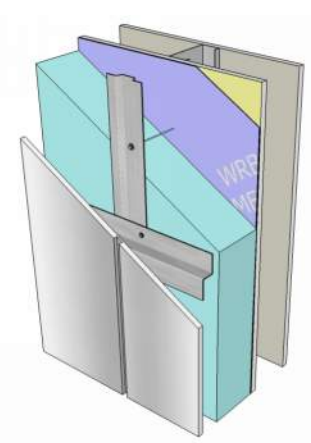


Continuous metal girts – results in very poor effective thermal performance

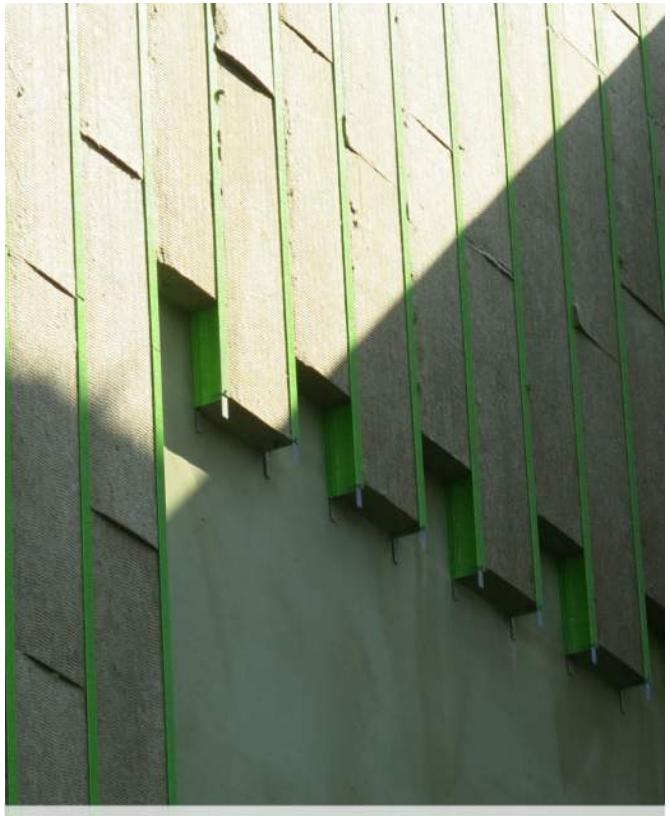


Continuous low-conductivity (fiberglass) girts – results in improved thermal performance

Cladding Attachment Through Exterior Insulation – Various Clip & Rail Systems

Cladding Attachment through Exterior Insulation

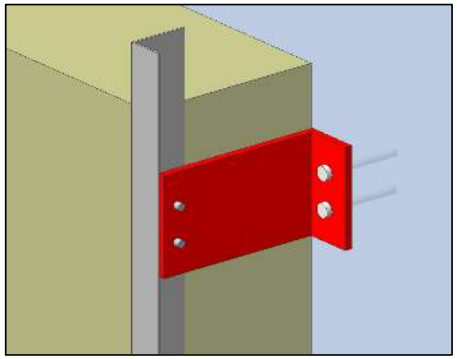


Low Conductivity Materials

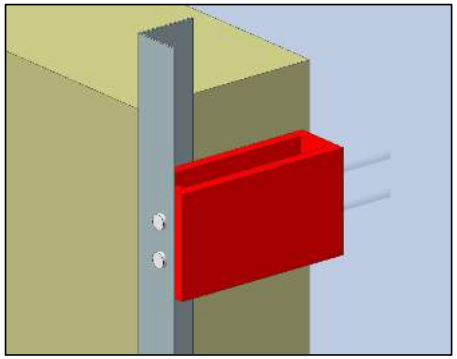
Less Material (e.g., Clips)

Combination

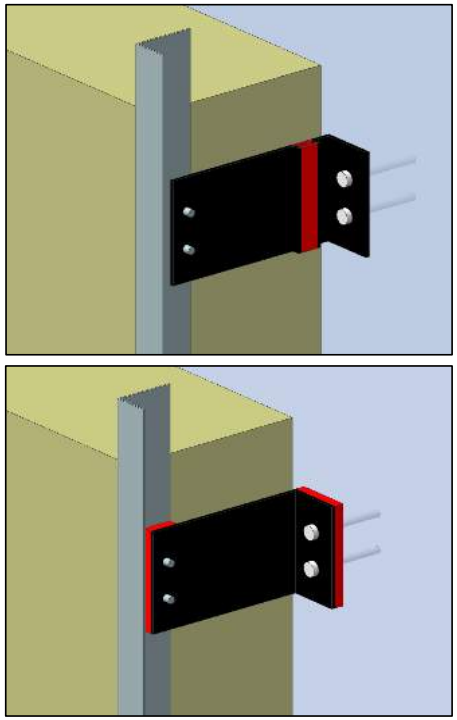
Cladding Attachment Typologies



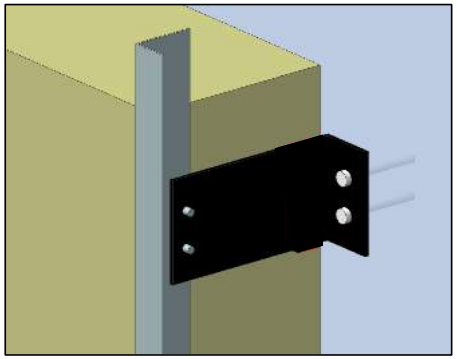
Non-Metal



Non-metal Spacer with Through Fasteners



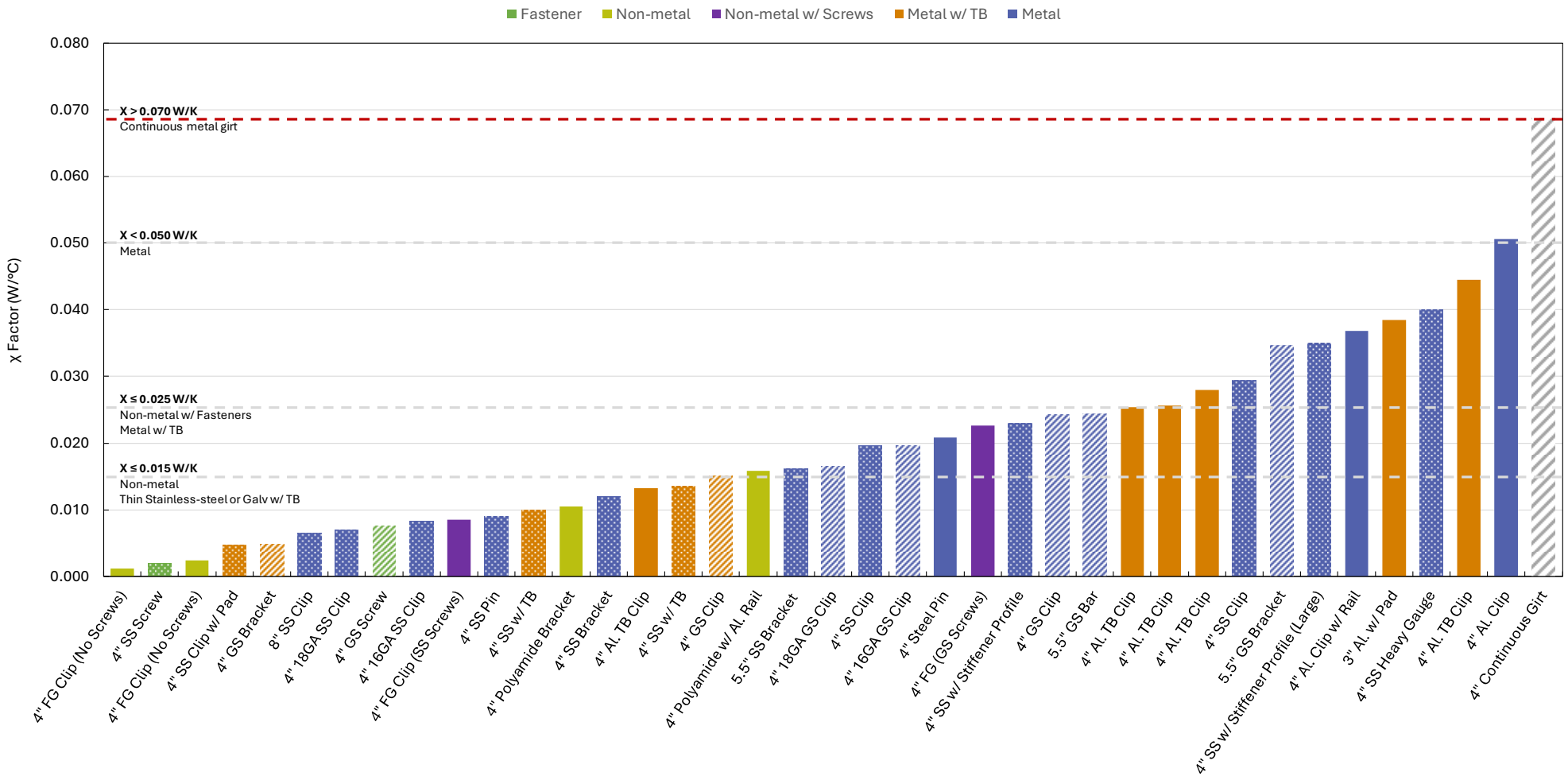
Metal Brackets with Thermal Break



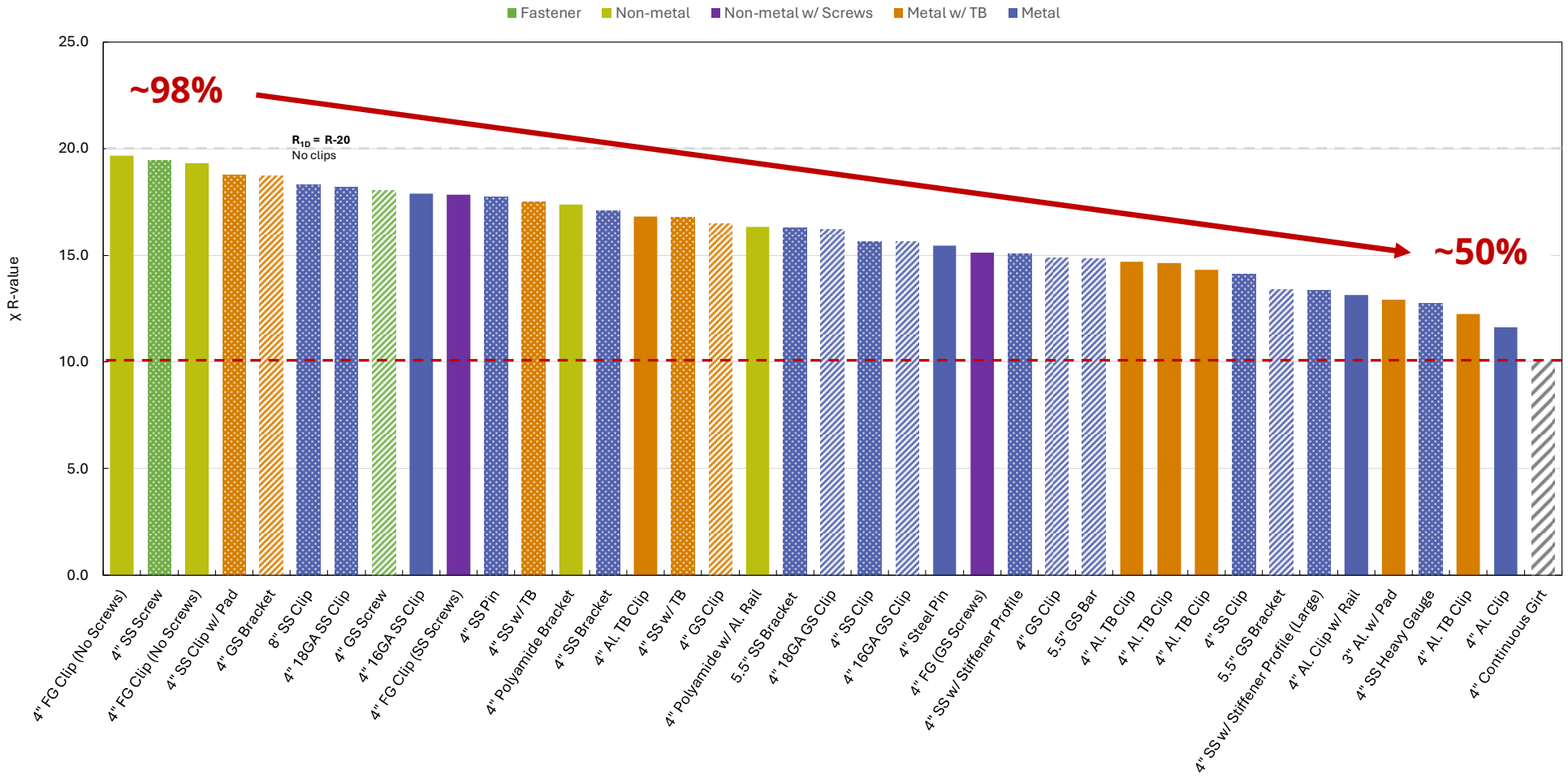
Metal

RDH

Thermal Performance Comparison – Heat Flow per Clip

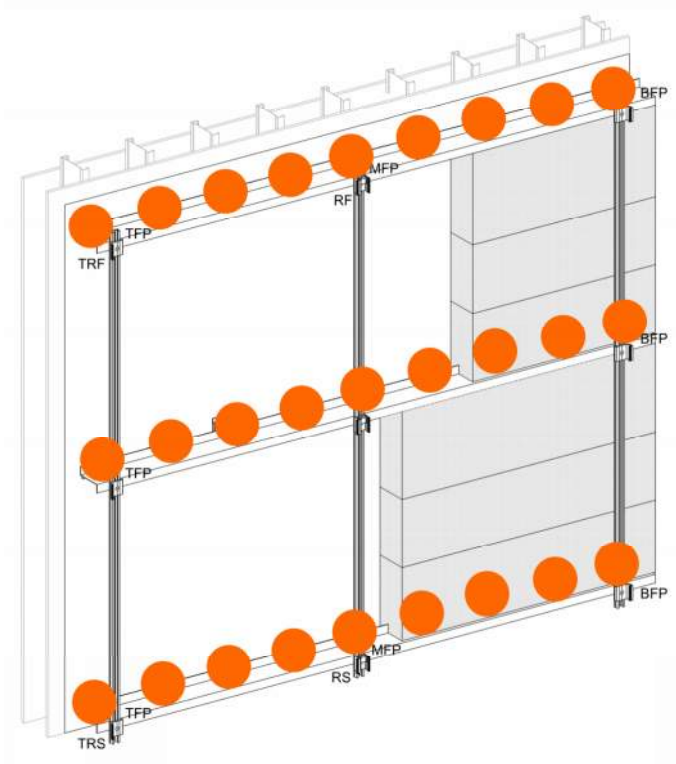


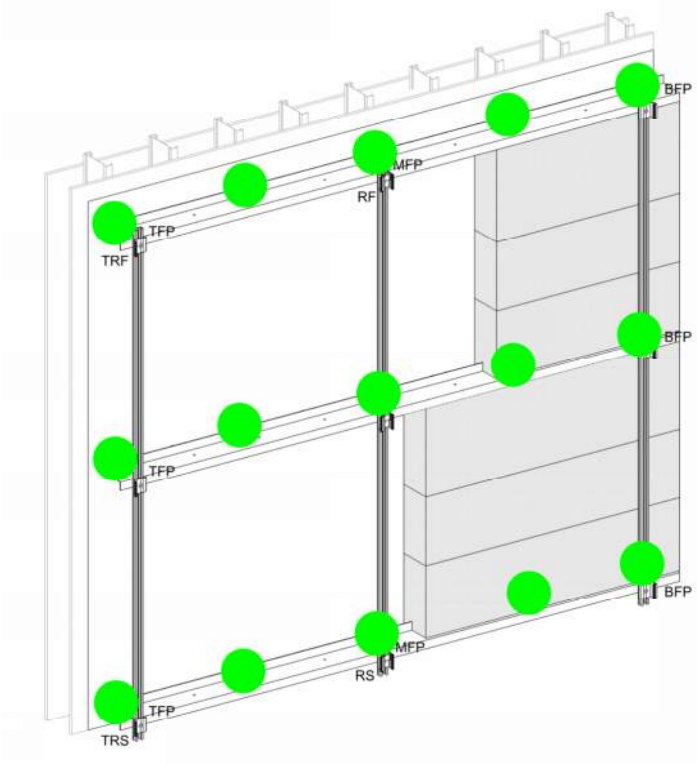
Thermal Performance Comparison – Effective R-value with Clips at 16”x24” Spacing (R-20 unbridged)



Structural & Thermal Performance Optimization

More Strength per clip = Fewer Clips





Less Structural Capacity

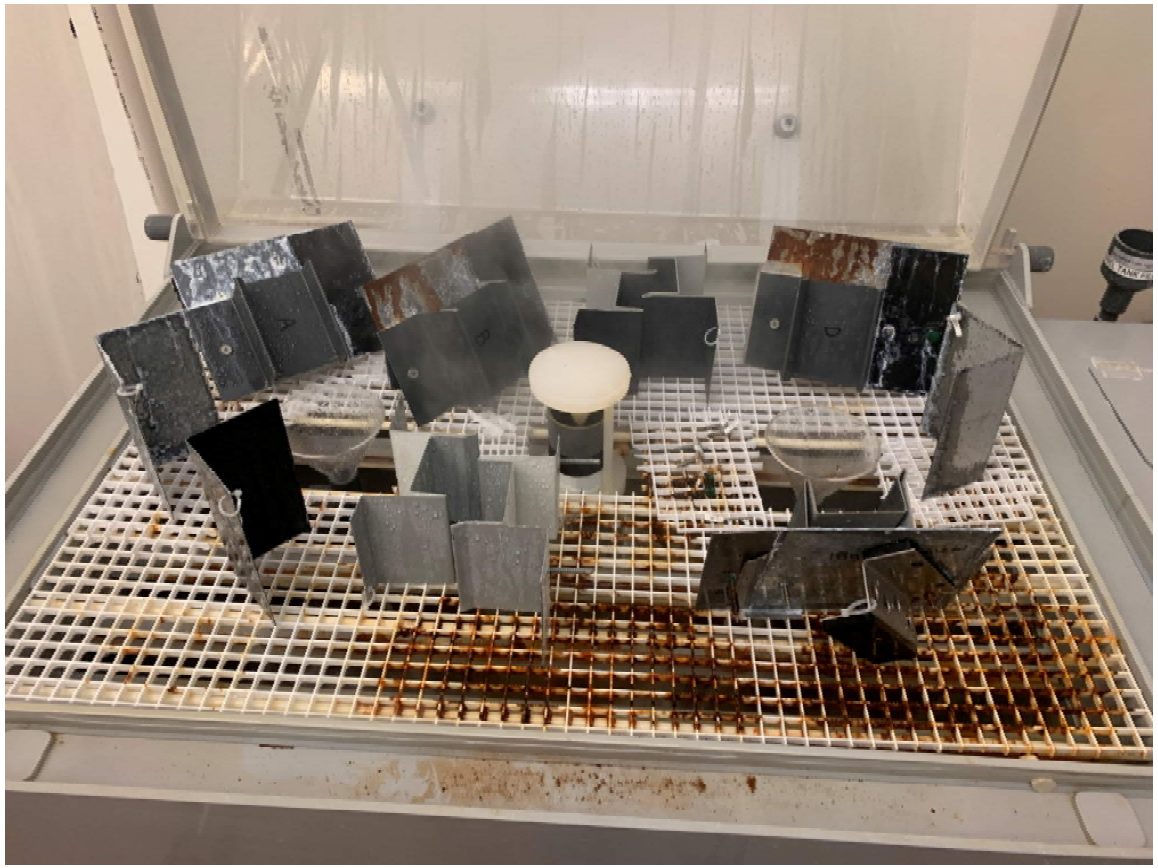
More Connections Per Area

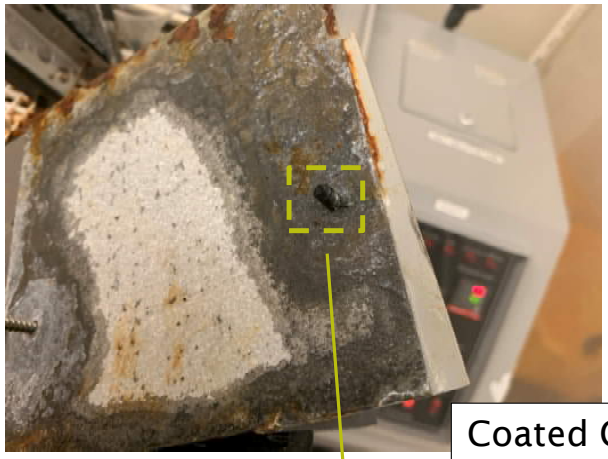
More Thermal Bridging

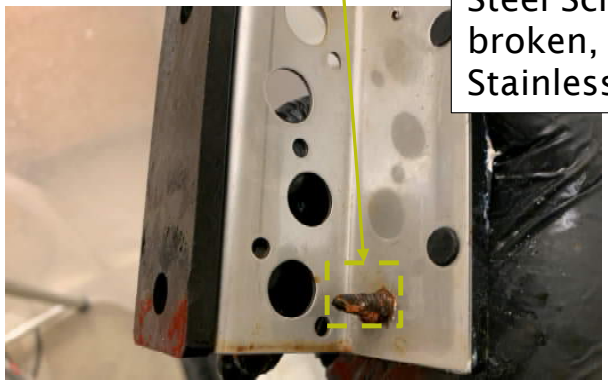
RDH

Watch Dissimilar Metals & Galvanic Corrosion (Clips, Rails, Fasteners, Claddings, Flashings etc.)

Evaluating Galvanic Corrosion Risk for Cladding Attachment Systems

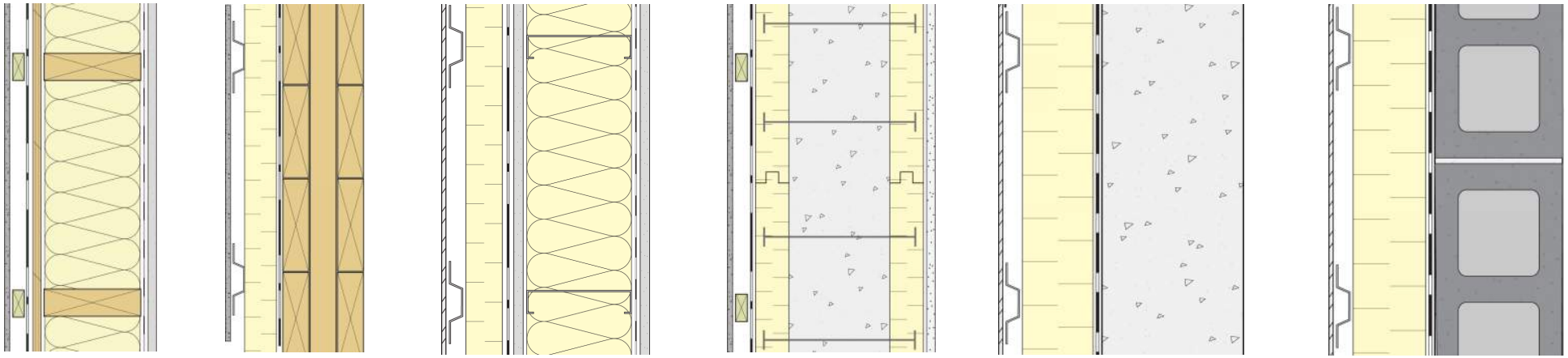






Coated Galvanized Steel Screw broken, detaching Stainless Steel Clip

Backup Wall Structure For a Rainscreen

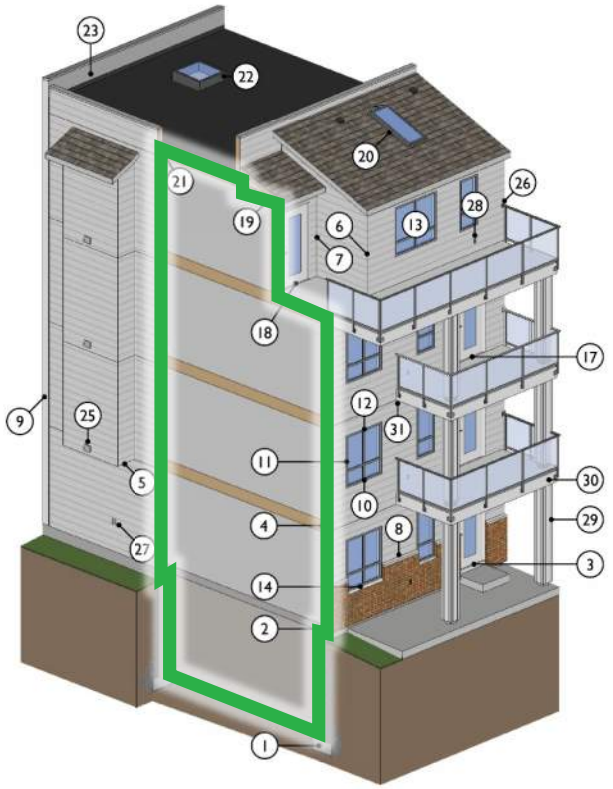


Primary structural system provides the ultimate support for the cladding/cladding attachment system, likely substrate for the WRB and possibly the air barrier and/or vapor retarder.

May also include insulation in lieu of or in addition to exterior insulation within the rainscreen assembly.

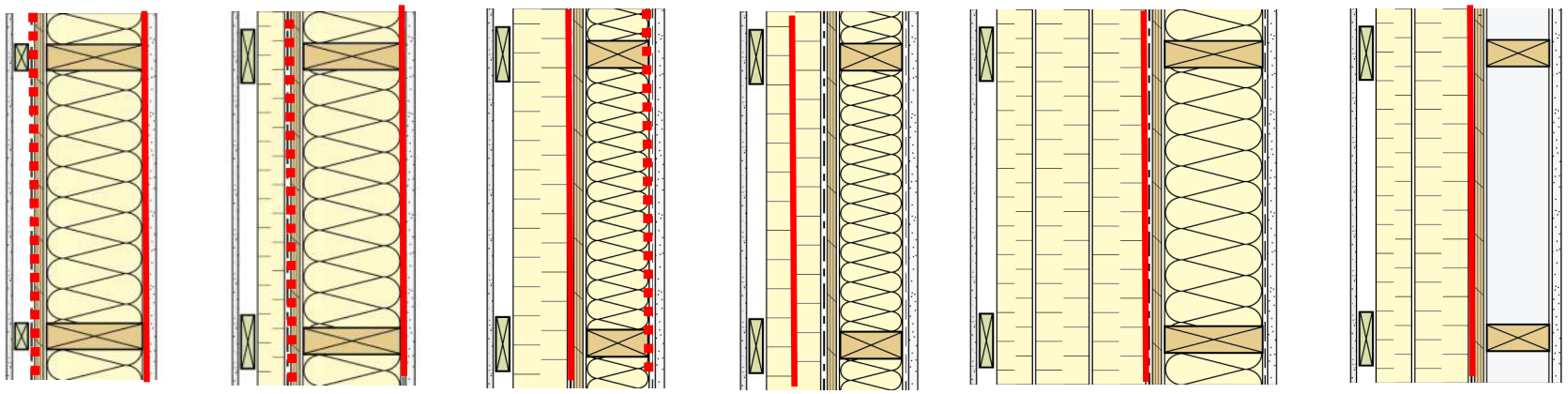
Air Barrier Systems

- Air Barrier (AB) system – controls air flow through the building enclosure
  - System includes membranes, tapes, sealants, gaskets sheathings, insulation boards, sprayfoam etc. detailed and sealed
- Air Barrier is always recommended, and often required by code where separating interior & exterior space
  - In context of walls, many assemblies where a rainscreen is desirable outside of the conditioned building enclosure and may not be air-tight (wing walls, parapets etc.)



Placement of Air Barrier Systems in a Rainscreen

(Hint is Always At or Behind the "Inner Layer")



Primary Air Barrier System

Secondary Airtight element

RDH

A Rainscreen Cannot Fix Air Barrier Problems

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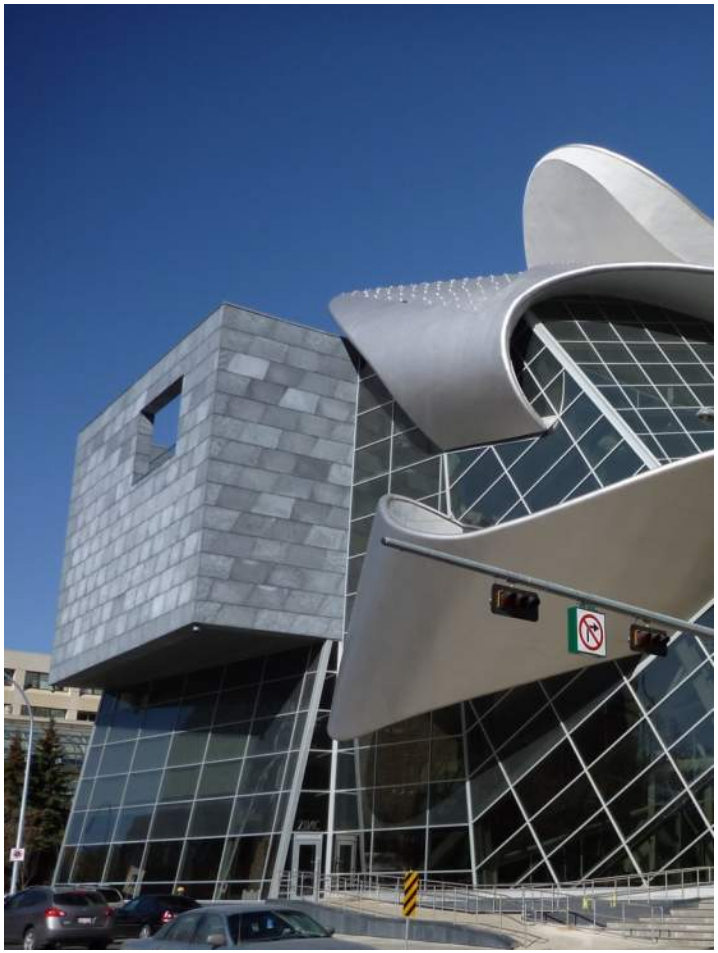
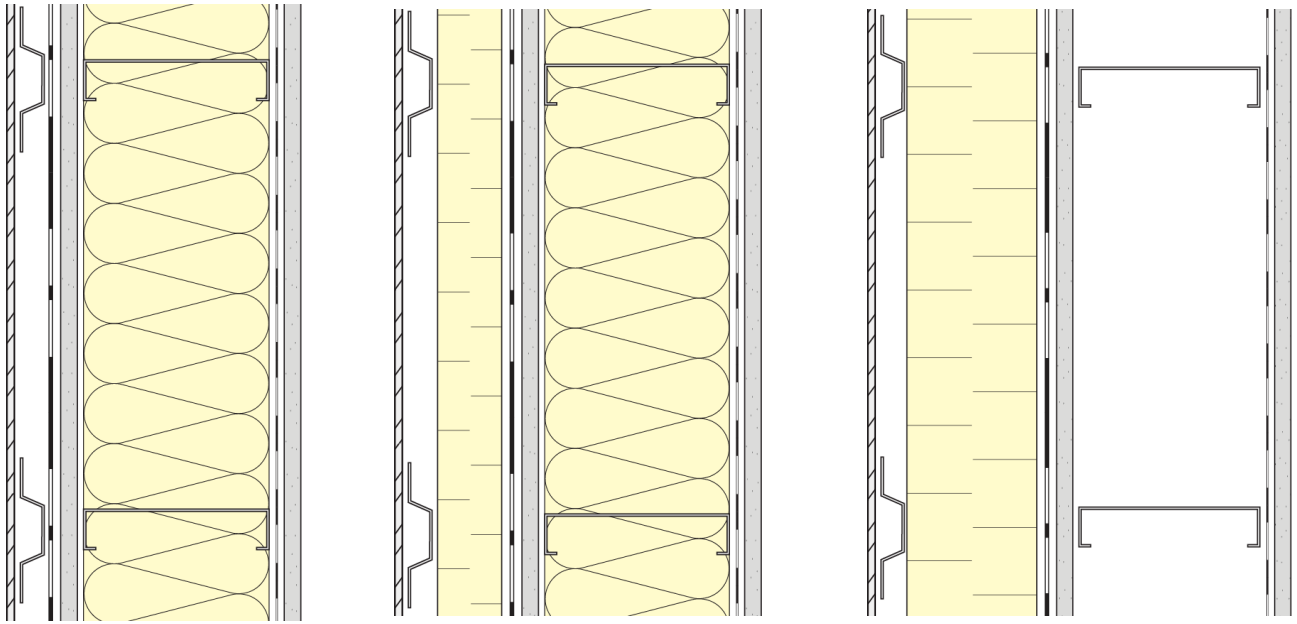
A Rainscreen Cannot Fix Air Barrier Problems

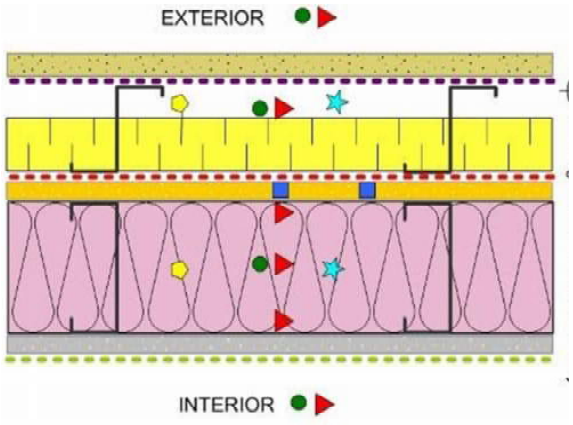


Vapor Diffusion Control – Vapor Barriers/Retarders

- Many materials within a wall will control water vapor transported by diffusion
- The need for vapor control and position in an assembly is dictated by wall design, insulation placement, exterior climate, and indoor conditions
- Note that rainscreen cavity airflow negates vapor diffusion impact of impermeable claddings on exterior of wall
- A rainscreen can't fix a vapor diffusion problem



Recall: A Rainscreen Can't Fix This…



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Key Lessons

- Rainscreen is a system – always has an outer layer/cladding, cavity (drained & passively vented/ventilated) and inner layer/WRB
- Thermal performance with exterior insulation – dependent on cladding attachment system components (many available systems of varying performance) and structural optimization
- Minimize water entry (most claddings), but if must use open rainscreen, then design for significant water entry into cavity
- Cannot expect rainscreen to dry out “too much” water diverted into the cavity
- Need air barrier – rainscreen with air leakage will have issues – rainscreen cant fix this
- Need to watch vapor control – materials in cavity. Rainscreen can’t dry out backup mess-ups

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Discussion + Questions

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