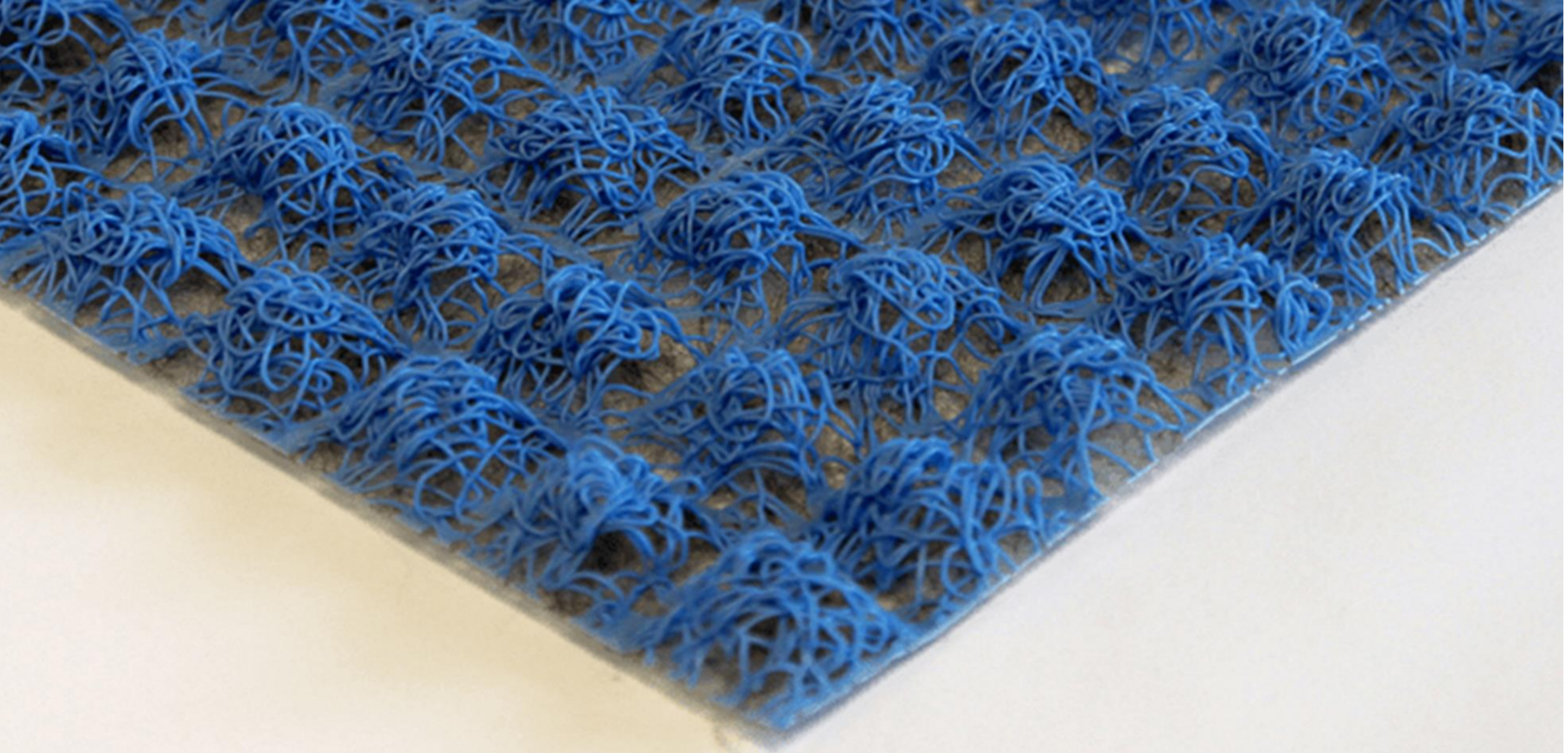

The Importance of Space: Rainscreen Technology in Residential Building Design

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The Importance of Space: Rainscreen Technology in Residential Building Design

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Purpose and Learning Objectives

Purpose:

Building science experts have acknowledged the need for both drainage and ventilation in exterior wall systems in order to eliminate moisture issues and extend the life of buildings. This presentation reviews the concepts of rainscreen technology and the solutions for compliance with a focus on engineered drainage and ventilation mats used in direct-applied and ventilated wall designs.

Learning Objectives:

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

- identify the causes and effects of water damage and discuss the current building codes as they pertain to moisture protection in wall construction
- state the science behind rainscreen technology and how it can extend the life of the structure and improve indoor air quality
- define the components and functions of direct-applied and ventilated wall designs, and
- list product solutions for rainscreen compliance and how they facilitate the drainage of moisture from, as well as the ventilation of, the wall system.

Contents

Moisture Damage

Creating Space

Spacing. It’s learned at an early age.

When teaching youth sports teams, coaches encourage players to work as a team, each having a role to play. However, the only way to truly succeed is if everyone works together, plays their positions, and spreads out. Good things can happen when players spread out and create space, whereas games may be compromised when players bunch or cluster together.

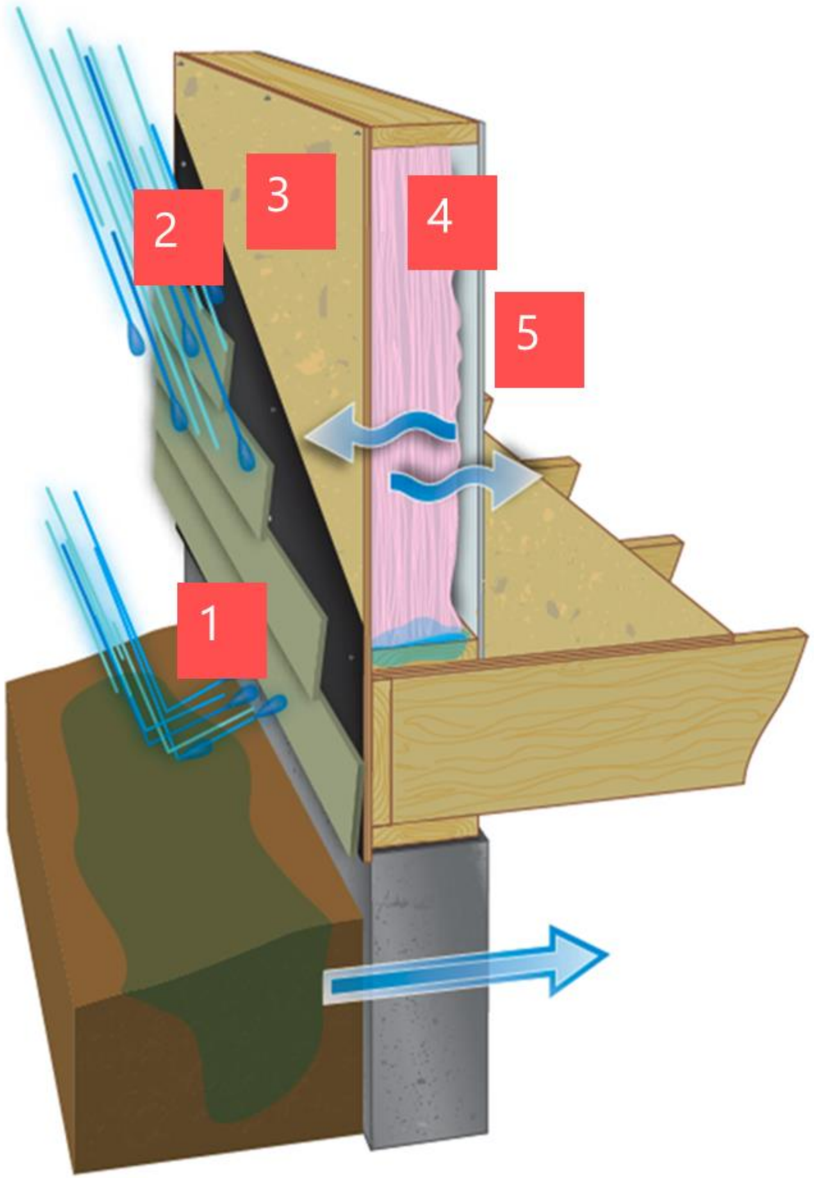
The same concept applies to wall construction. No one miracle product will make a healthy, functioning wall system. There need to be several products that will work together to create a properly constructed wall. One of the first steps to creating a healthy wall is to design space within the wall. Most building scientists agree that a 6 mm gap is the minimum requirement to build a compliant exterior wall system.

This presentation begins with a discussion of the causes and effects of moisture migration in wall construction.

Typical Residential Walls

On the right is a typical residential wall—exterior cladding, then a weather-resistant barrier (WRB), and finally the sheathing against the structural framing with insulation. Known as a direct-applied or face-sealed wall system, it is susceptible to moisture damage.

1. exterior cladding
2. weather-resistant barrier
3. sheathing (continuous insulation)
4. structural framing, cavity insulation
5. interior finish materials



Moisture Damage

Building experts agree that no matter how tightly a building is constructed and insulated, no matter what type of exterior cladding is selected and how expertly installed, moisture will always find a way into the building enclosure. Water (both liquid and vapor) gets into the wall and becomes trapped, and over time, this moisture will damage the building materials within the wall system.

Moisture infiltration can compromise the building’s structural integrity, cause exterior surfaces to deteriorate, and shorten the life of paints and stains. Additionally, it can lead to rot and mold growth that causes structural damage and creates serious health hazards to the building occupants.

Removing moisture and water vapor from the wall assembly as rapidly as possible (before it can damage structural components) is the goal of moisture management.

Here, you see the damage moisture can cause when trapped between the cladding and weather-resistant barrier in a cottage in Cape Cod, MA.

Moisture Damage

The first visual sign of moisture damage is the corrosion of building materials, which will compromise the structural integrity of the wall system and could decrease the life span of the building. Another damaging effect of moisture is efflorescence, where an off-white, salty-like substance is evident on the wall's exterior. Cracking, spalling, and interior mold are other visual examples of moisture-related issues.

The photos show some examples of what happens when space is absent within a wall system and moisture becomes trapped. Moisture issues include:

- blistering exterior paint (top left image)
- rotting cladding (top right image), and
- efflorescence on the surface of the brick (lower image).

Moisture Damage: Cape Cod, MA

Below is an example of a coastal cottage. Notice the number of nail penetrations through the sheathing. These penetrations are a widespread building practice that creates opportunities for moisture infiltration. On average, a 2,500-square-foot home can have up to 6,000 nail penetrations, generating multiple areas for moisture intrusion. You can see sill plate and joist damage, which leads to costly restoration and repairs.



Remediation Cost: Cape Cod, MA

The restoration costs for this Cape Cod cottage were almost $100,000 and very difficult on the contractor, since the occupants would not leave their home during restoration.

What do you think the insurance covers?

	$/SF	$/2,000 SF
Demo & Disposal	$2.00	$4,000
Framing & Facia	$30.00	$60,000
Installation	$1.75	$3,500
Shingle, Trim, & Paper	$10.00	$20,000
Sheetrock	$2.20	$4,400
Paint (interior walls & ceiling)	$3.50	$7,000
Total Remediation/SF	**$49.45**	
Total Remediation/2,000 SF		**$98,900**

Remediation Insurance: Cape Cod, MA

With the extent of damage closing in on six figures, the homeowners relied on their insurance policy, which only covered roughly 5% of the restoration costs.

Unfortunately, the 5% the insurance policy covered was only $5,000.00.

SECTION 1: Property Coverages: Additional Coverages

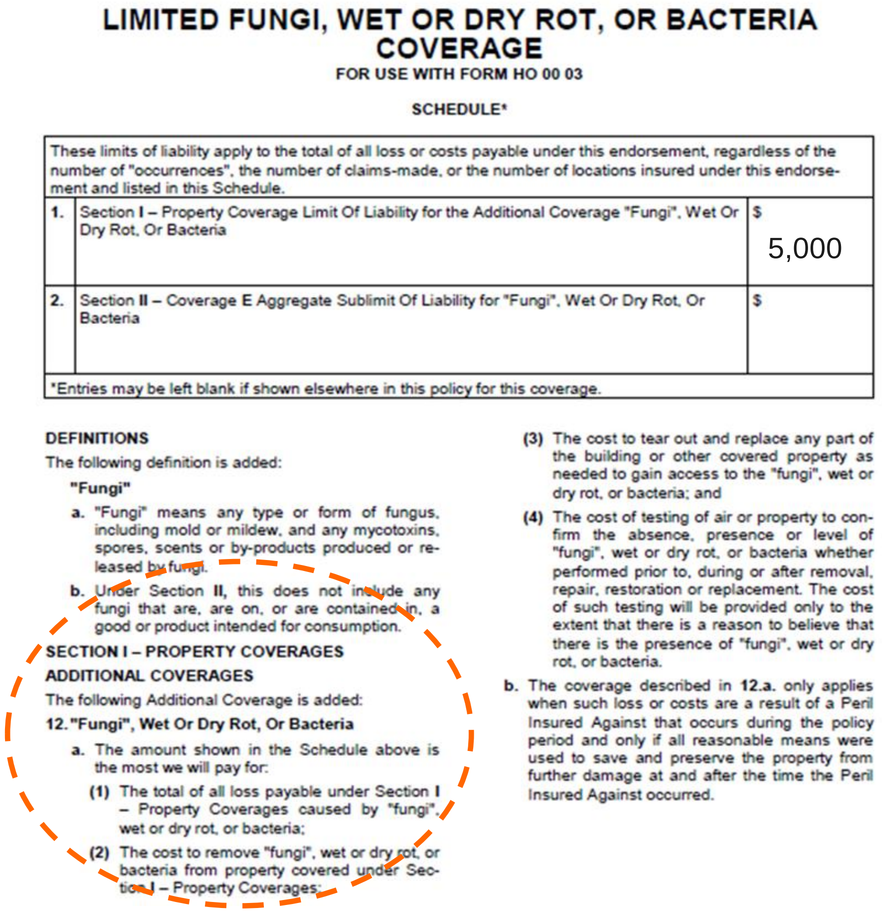
The following additional coverage is added:

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 1—Property Coverages cause 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 1—Property Coverages.



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	$ 5,000
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 coverage.		

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;

(3) The cost to tear out and replace any part of the building or other covered property as needed to gain access to the "fungi", wet or dry rot, or bacteria; and

(4) The cost of testing of air or property to confirm the absence, presence or level of "fungi", wet or dry rot, or bacteria whether performed prior to, during or after removal, repair, restoration or replacement. The cost of such testing will be provided only to the extent that there is a reason to believe that there is the presence of "fungi", wet or dry rot, or bacteria.

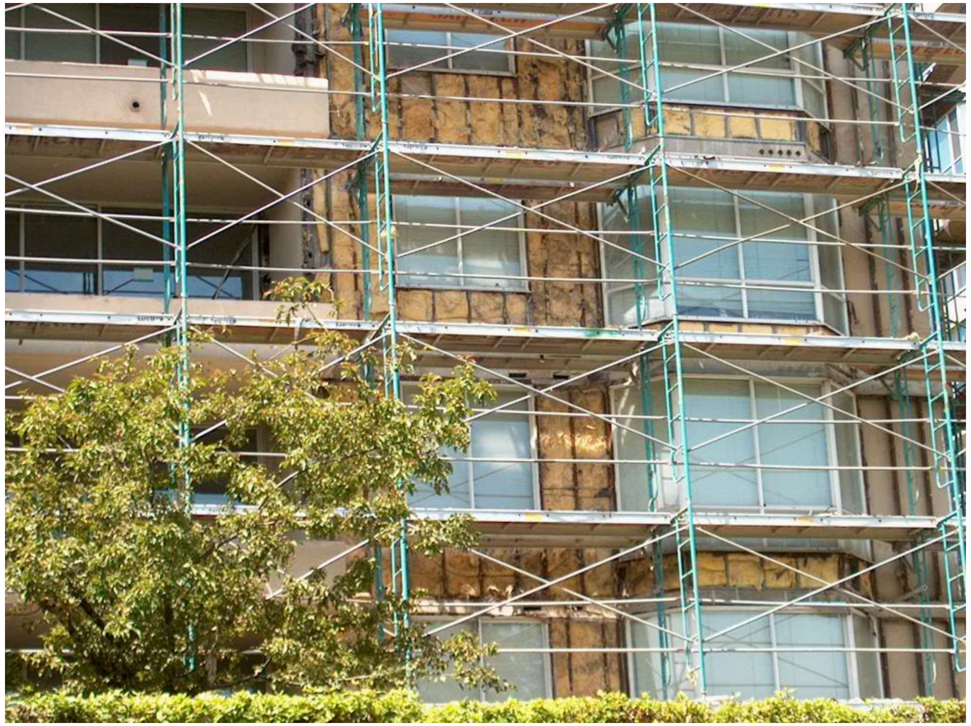
b. The coverage described in 12.a. only applies when such loss or costs are a result of a Peril Insured Against that occurs during the policy period and only if all reasonable means were used to save and preserve the property from further damage at and after the time the Peril Insured Against occurred.

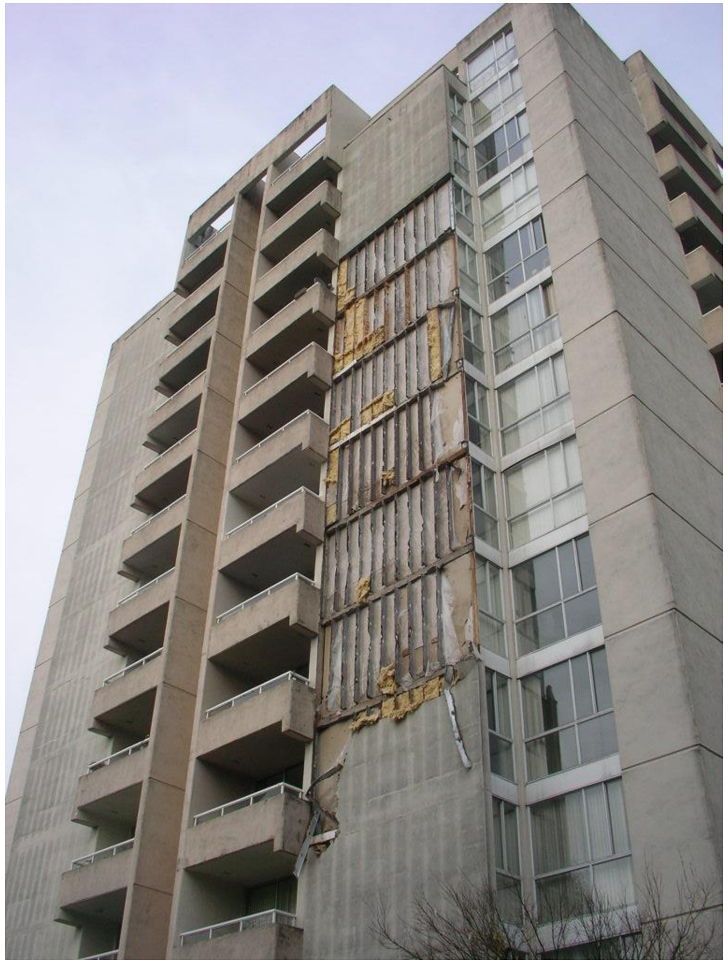
Pacific Northwest Restoration

Here is another example in the Pacific Northwest. This building was over ten years old; however, the restoration costs per square foot doubled compared to the previous Cape Cod project. If homeowners need to relocate during construction, the restoration costs can increase to over $200 per square foot!

Moisture Damage

When it comes to moisture issues, you can't just slap a coat of paint over it and move on. Moisture issues need to be dealt with and usually at a significant expense.





Relatively New Construction

A misconception in the marketplace is that mold is an old home issue. The images you see here are from a relatively new home. Mold can colonize in 3 to 12 days. It can become visible in 18 to 21 days. When building materials become saturated, there is a 48- to 72-hour window for drying before the mold cycle begins.

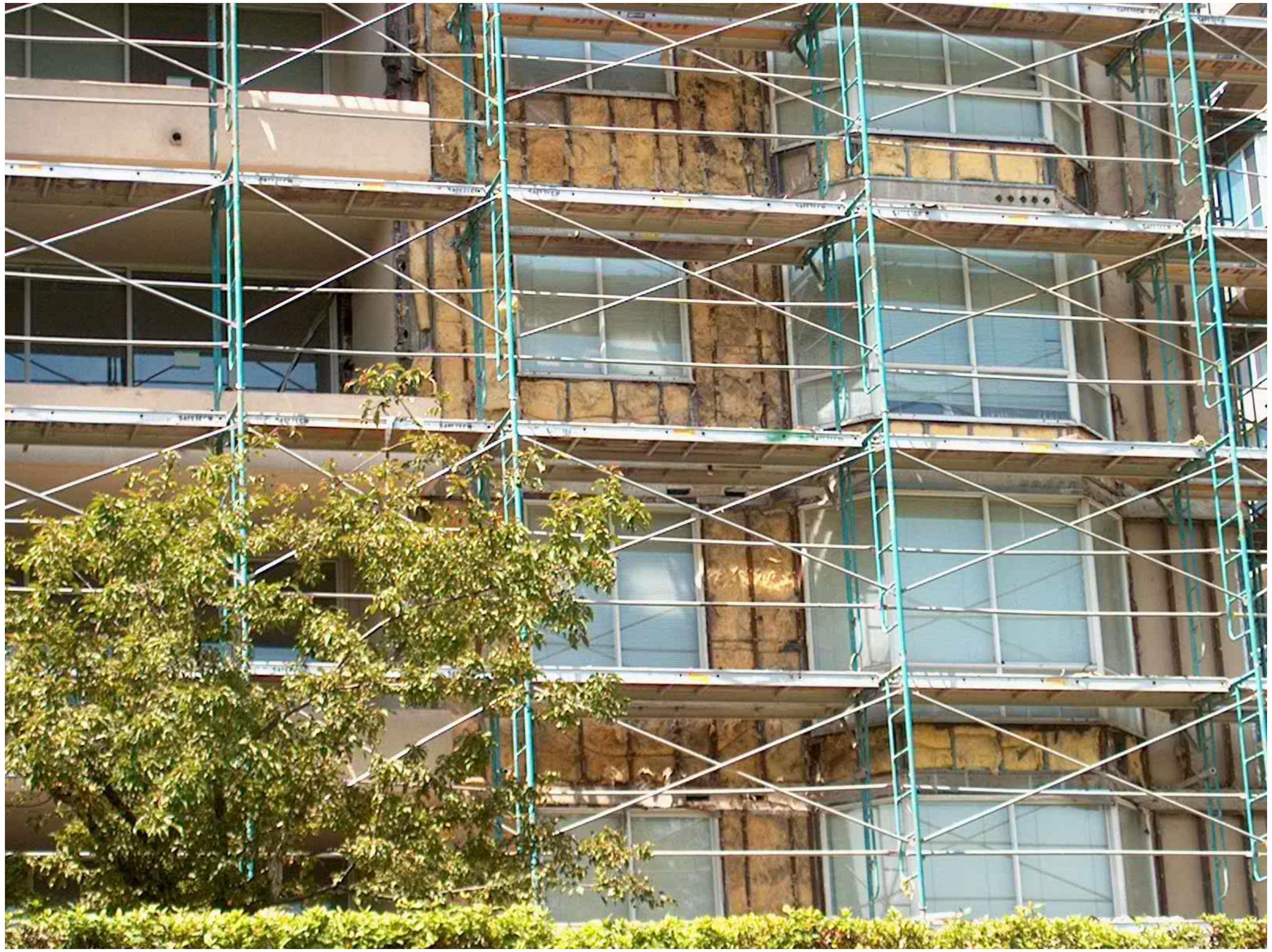
Builder Liability

Not only do the homeowners have concerns with significant restoration fees, but the builder might also be liable.

Typically, builder liability can include any time from six months to ten years but varies from state to state. For example, in California, a builder's liability is up to four years for construction defects and ten years for latent defects.

Therefore, it is critical to design the walls and building envelope correctly.

So how does this happen? To begin, let's look at today's cladding options and wall design.



Claddings and Wall Design

Absorptive Claddings

Innovative technologies have increased cladding options over the past 15 years to include:

- wood
- stucco
- manufactured stone
- brick
- fiber cement, and
- adhered veneers.

These cladding options are made from absorptive materials and have a natural tendency to allow excess moisture in. Sidings expand and contract, creating gaps in the exterior surface of the building. Consequently, intersections, joints, and wall penetrations are all susceptible to moisture infiltration.

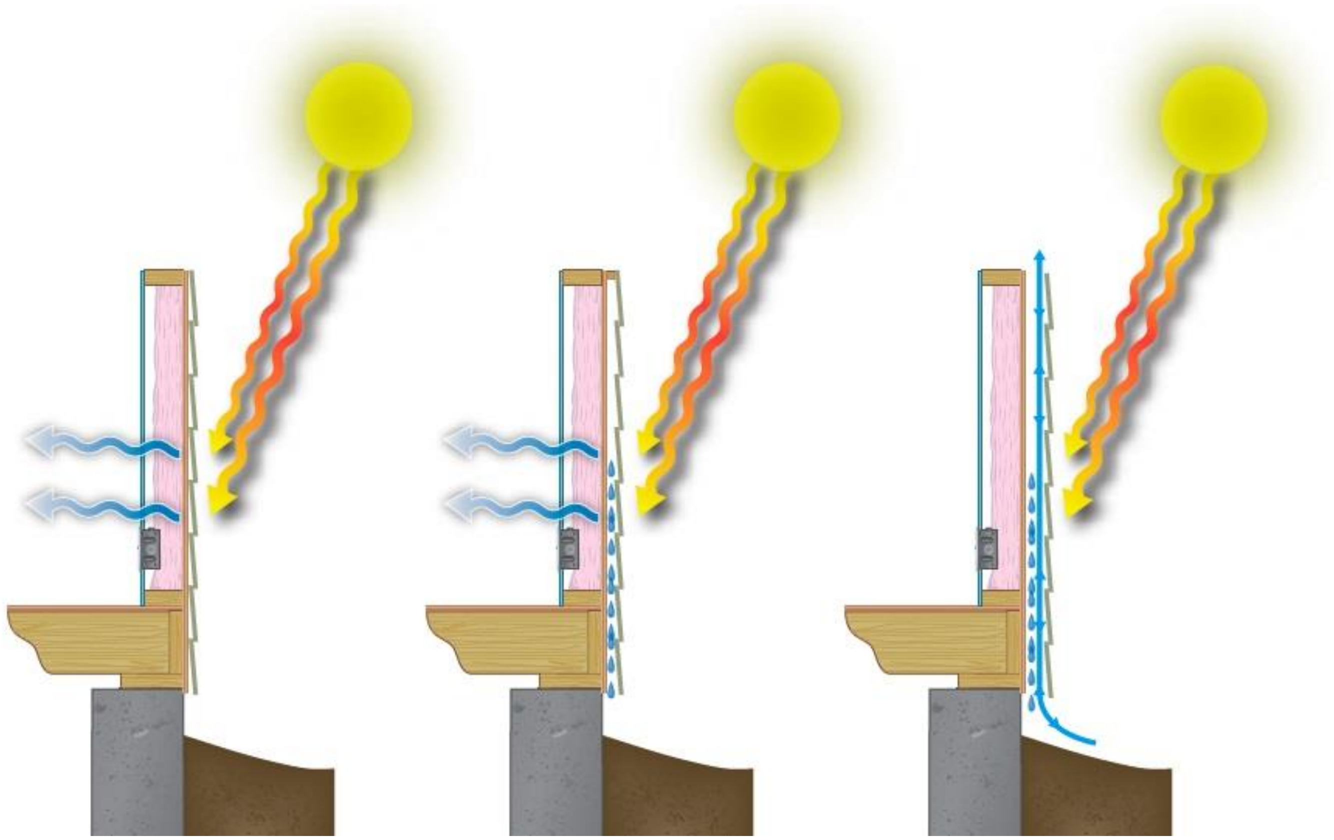
Moisture and Wall Failure

Today, roughly 81% of all cladding materials used in construction absorb moisture, and according to the International Masonry Institute (IMI), 80% of all wall failures are traced back to moisture-related issues. Furthermore, here is a daunting statistic: roughly 50% of all residential (direct-applied) wall systems have moisture damage, and most homeowners are not even aware the issue exists.

Facts like these have industry experts, such as the Brick Industry Association (BIA), making statements that support proper drainage. For example, BIA Tech Note #27 states, “It must be recognized that the exterior wythe cannot be made watertight. Provisions for internal drainage are necessary for these wall systems to function as intended.”

As previously mentioned, there is no such thing as a waterproof wall. Instead, walls need to be designed to handle moisture intrusion.

Wall Design

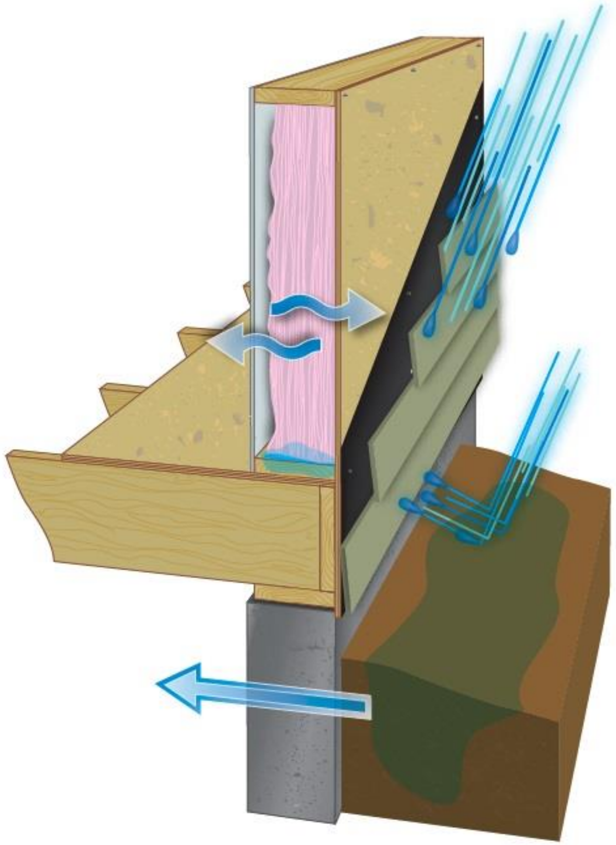


Direct Applied · Vented · Ventilated

The three most common wall designs are direct applied, vented, and ventilated.

The two most popular wall systems used today are the direct-applied approach, often used in residential and light mixed-use commercial buildings, and the ventilated wall design that has gained popularity on the commercial side for many decades.

Direct-Applied and Ventilated Wall Design



Direct-Applied Wall (arrows indicate pathways for moisture migration)

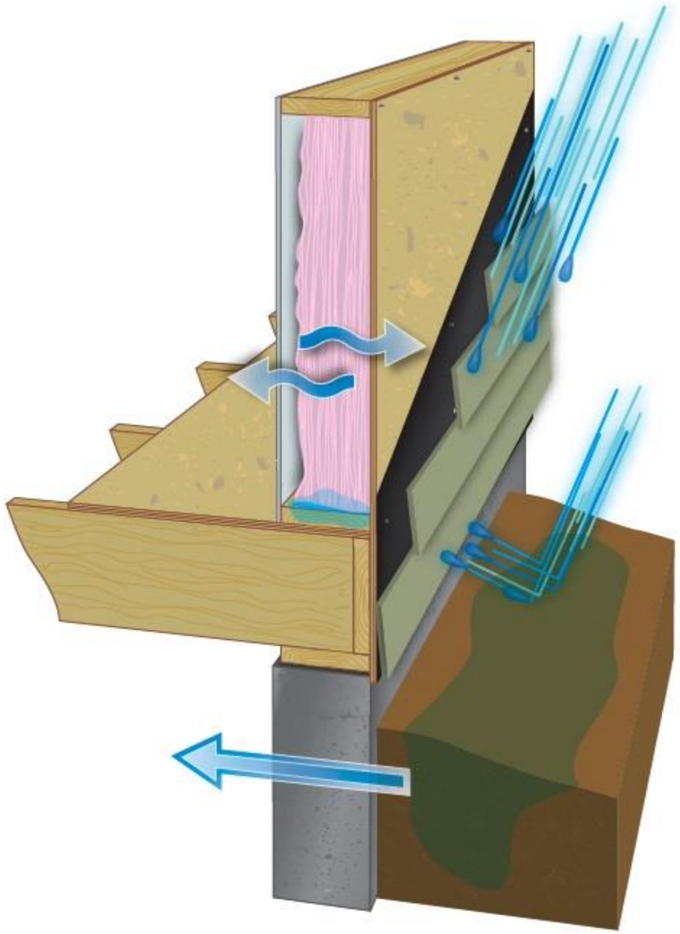
Ventilated Wall

Direct-Applied Wall Systems

A direct-applied wall system constructed with no means of internal drainage often results in moisture migrating in the following ways:

1. Moisture enters through gaps in cracks in the cladding and can move inward.
2. Excess moisture from within the building can force its way outward via vapor diffusion.
3. Groundwater has a natural tendency to push itself inward.

The probability that moisture will remain trapped is high since there is no means of drainage.



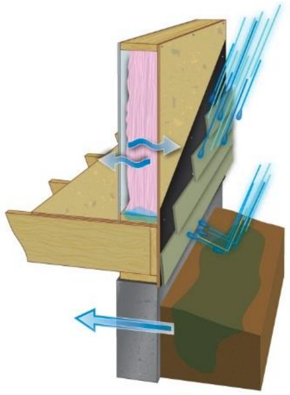
Components

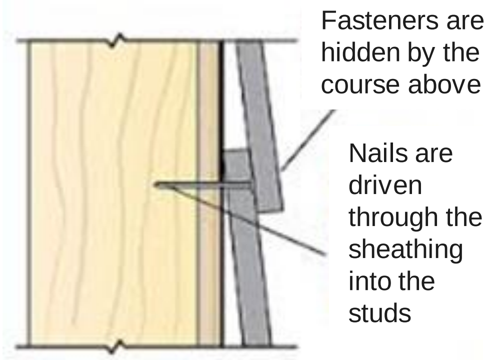
- Exterior cladding
- Weather-resistant barrier
- Sheathing (continuous insulation)
- Structural framing (cavity insulation)
- Interior finish materials

Arrows indicate pathways for moisture movement

Direct-Applied Wall Systems

If we factor in house wraps not being installed correctly, the probability of moisture issues in a direct-applied wall increases significantly.





The picture second from the right shows what happens to the back side of fiber cement when nails are overdriven due to excessive nail gun pressure. Moisture cannot drain, leaving it to take the path of least resistance—in this case, back into the fiber cement siding. Once this siding becomes saturated, the moisture buildup tries to work its way to the outer surface, which is noticeable by the peeling paint and overall breakdown of the cladding (far right image). Could this have been avoided? Yes. In the next section, we review the factors that require consideration, beginning with a discussion of the sources of moisture.

Review Question

What is the goal of moisture management?

Answer

The goal of moisture management is to remove moisture and water vapor from the wall assembly as rapidly as possible before it can damage structural components.

Sources of Moisture

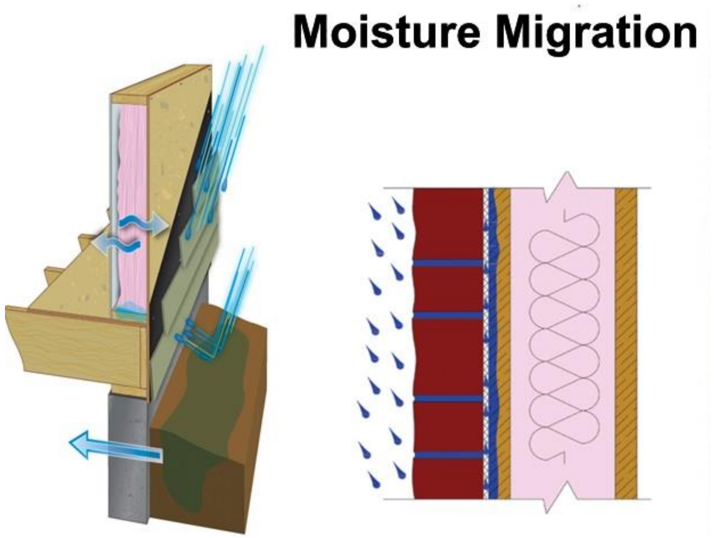
Moisture Sources and Movement

Sources of moisture include the following:

- manufactured sources (sprinklers)
- external sources
- condensation

Moisture movement occurs in these ways:

- capillary movement
- vapor drive (solar vapor drive)
- pressure differentials



External sources include rain, wind, and snow. Wind-driven rain can be forced into small openings in the exterior cladding at joints, laps, utility cutouts, electrical outlets, nail holes, and more. Trapped moisture can expand through freeze/thaw cycles and damage certain absorptive claddings, such as brick, stone, and stucco.

High humidity and extreme temperatures can cause vapor diffusion, where moisture will flow from warm to cold environments (transported by air movement through leaks in the assembly) and condense on the colder surface.

Capillary Movement

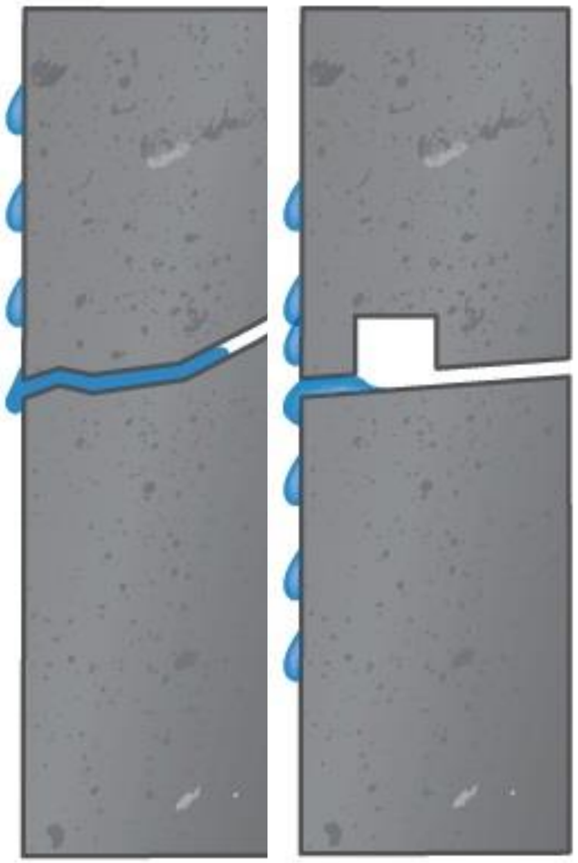
Over time, absorptive claddings (wood, fiber cement, concrete, stucco, mortar, and brick) will crack, or the sealants will crack due to differential movement or simple wear and tear.

Capillary action refers to the movement of water within the spaces of a porous material due to the forces of adhesion, cohesion, and surface tension.

When moisture makes contact with absorptive claddings, the moisture is drawn into the wall via capillary action—for example, an exterior concrete wall in contact with precipitation.

Interestingly, the smaller the fissure, the greater the drawing power for moisture to penetrate (illustrated at right).

To mitigate capillary movement within a wall system, designers should implement a capillary break. A capillary break can be a nonporous material (such as glass, plastic, or metal) or a gap between parallel layers of material.



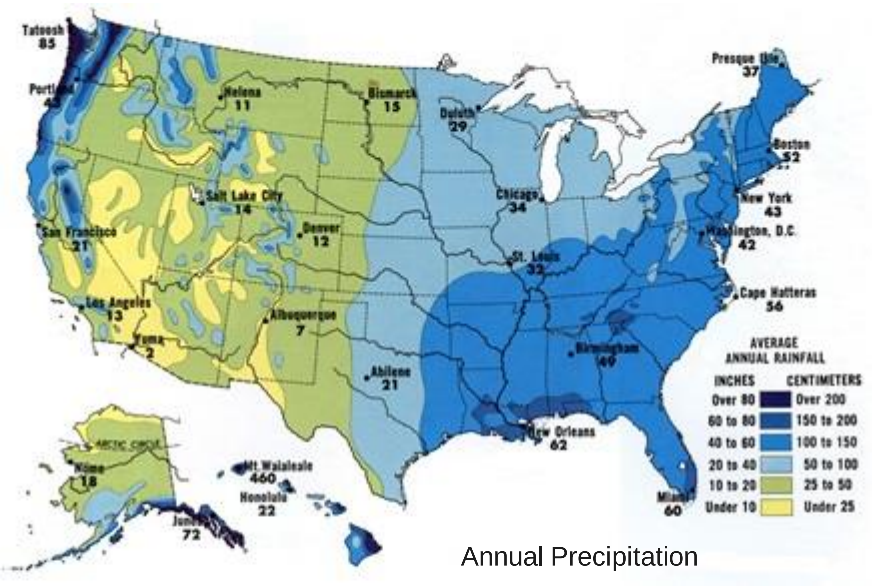
Cohesion and Adhesion
The smaller the fissure/crack, the greater the suction and rise of water.

Geographical Considerations

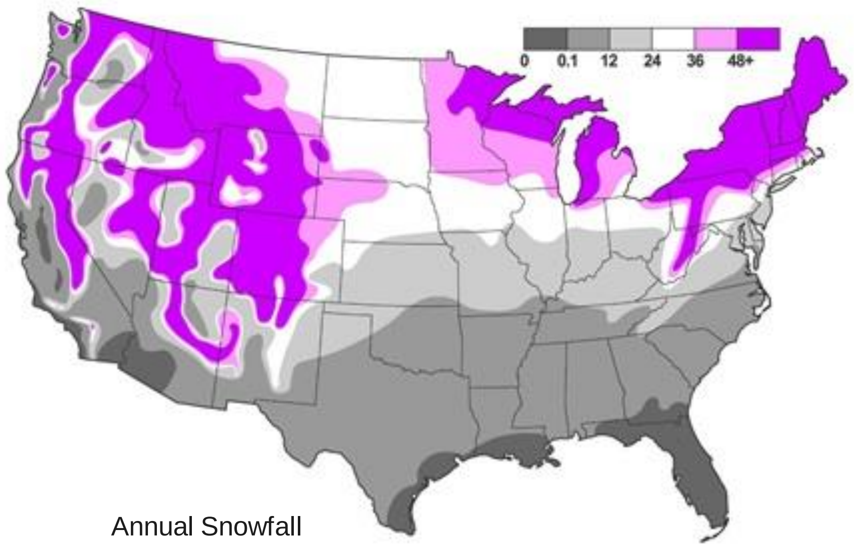
Project location and the climatic patterns are vital factors for wall design. The amount of annual rainfall can be used as a guide for determining the level of moisture management needed in a wall. Building science professionals state that any area receiving over 20 inches of annual rainfall should have a gap designed within the wall system for proper drainage and drying.

The upper US map shows precipitation levels—all regions in various shades of blue experience 20+ inches of rain annually. Compound that with average annual snowfall (lower image), and it becomes evident that a significant portion of the US should include a capillary break within wall designs.

Interestingly, Arizona and other similar areas of the country have 110°F days and 40°F nights. This sharp temperature change causes condensation to form within walls. Architects should incorporate a capillary break within these walls to allow trapped moisture to drain.



Annual Precipitation



Annual Snowfall

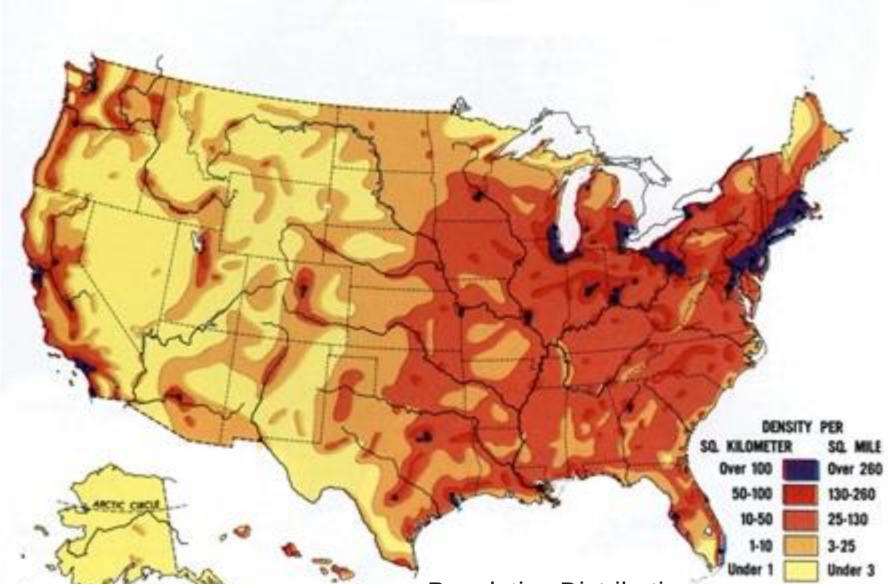
Population and Wind

The upper map indicates population spread. The areas with the most rainfall are also the most heavily populated geographies, which means more buildings and potentially more issues.

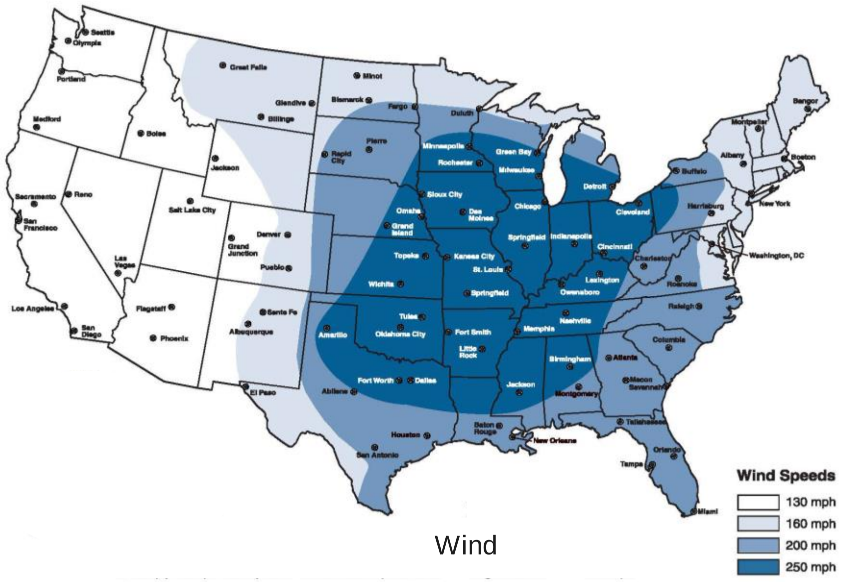
The lower map identifies wind speeds. Since moisture travels through the air, wind levels play a significant factor in moisture intrusion. Wind blowing around the building can create a negative pressure within the wall assembly, which siphons water into the wall.

A 50 mph wind can exert 6 pounds of pressure on the surface area of a wall. This pressure is enough to allow moisture into the smallest of cracks.

As a result, building professionals need to be as mindful of wind pressures as they are of rainfall and snowfall.



Population Distribution

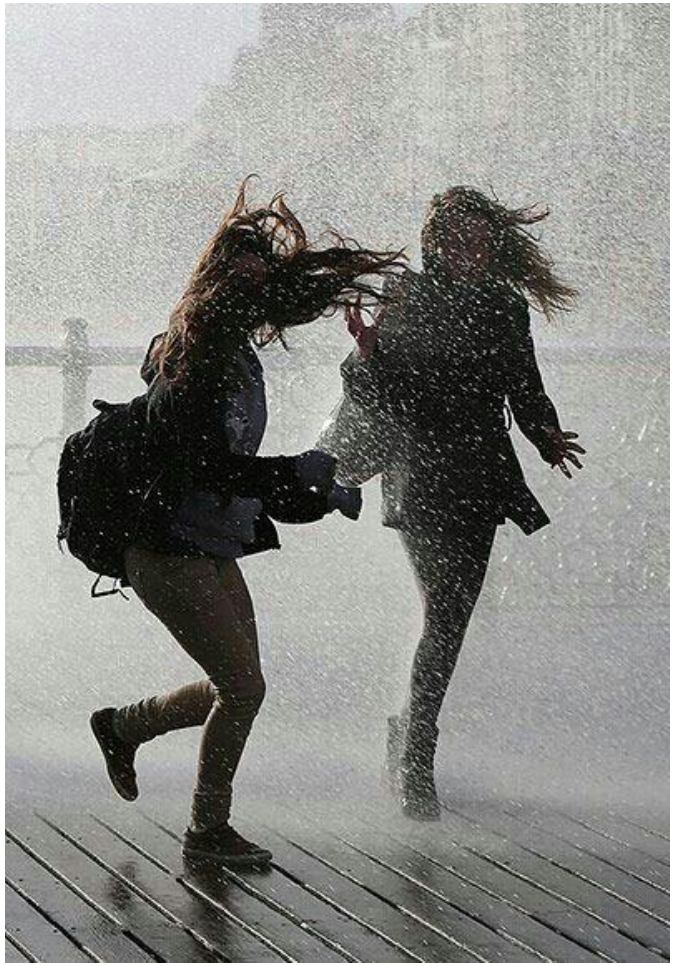


Wind

Kinetic Energy

Wind pressure is caused by kinetic energy (energy created by being in motion). The momentum of rain driven by wind causes increased penetration of water into walls.

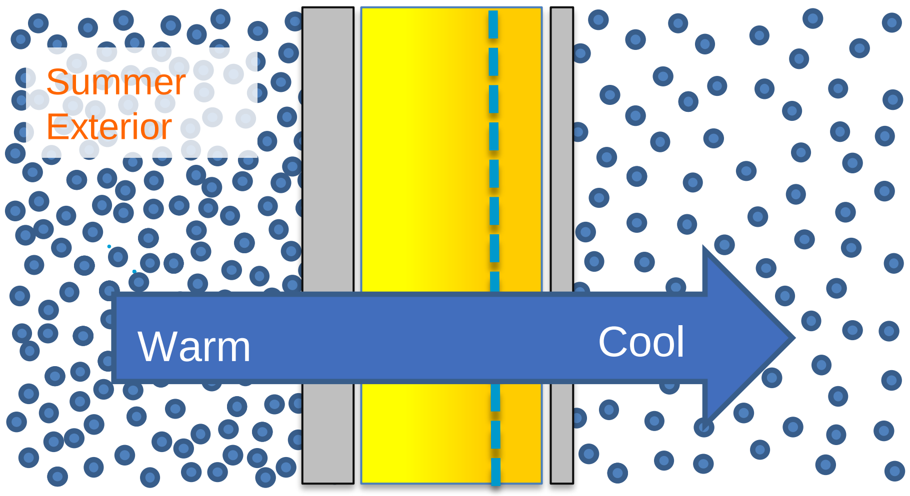
Unfortunately, not all insurance policies cover damage from wind-driven rain. Most insurance policies only cover minimal damage from dry rot and other moisture-related issues.

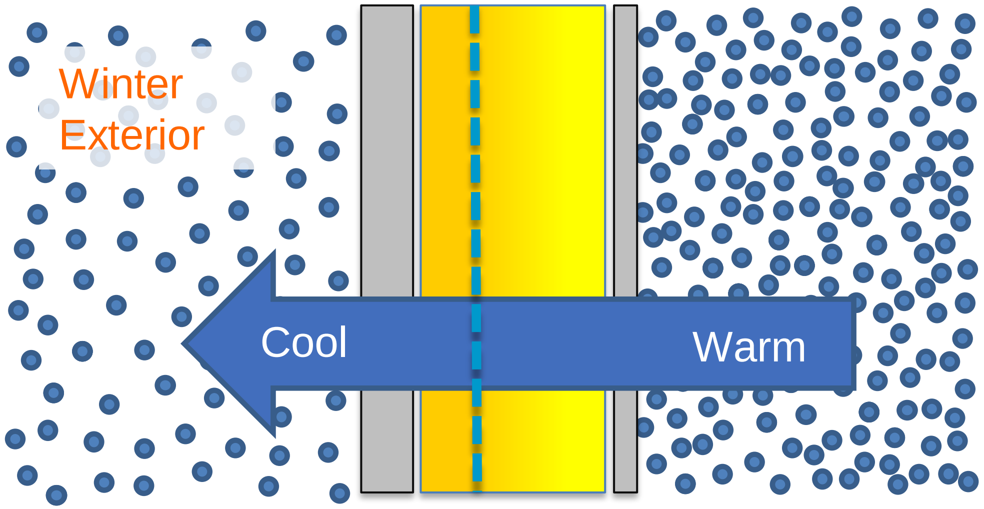


Vapor Drive

Vapor drive describes the movement of vapor molecules through a vapor-permeable material. When air travels through a wall system, warm air, which is dense with water molecules, searches for cool air, which is less dense with water molecules. The warm air is trying to reach an equilibrium with the cool air.

How intensely water vapor molecules try to move through the wall is vapor drive or solar vapor drive.



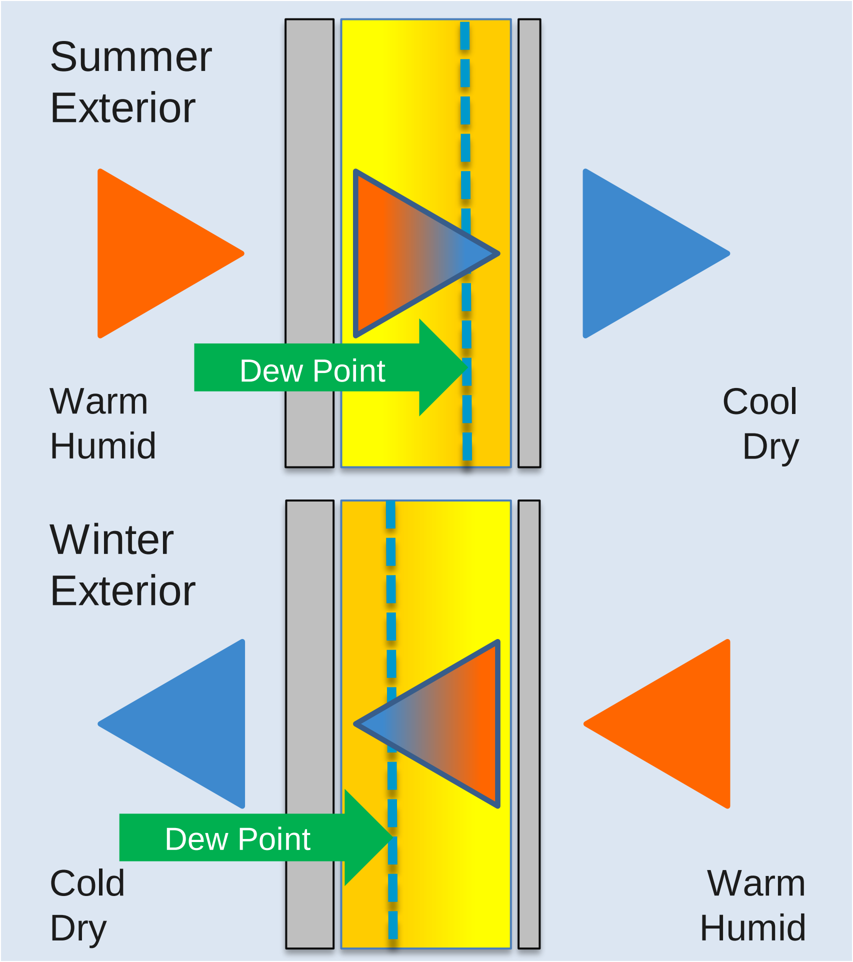


Vapor Drive

Kinetic energy drives rain into the cladding through cracks.

When the warm air meets the cool air, we find the dew point; this is where condensation can occur.

Wall space must be designed to allow for adequate draining and drying.

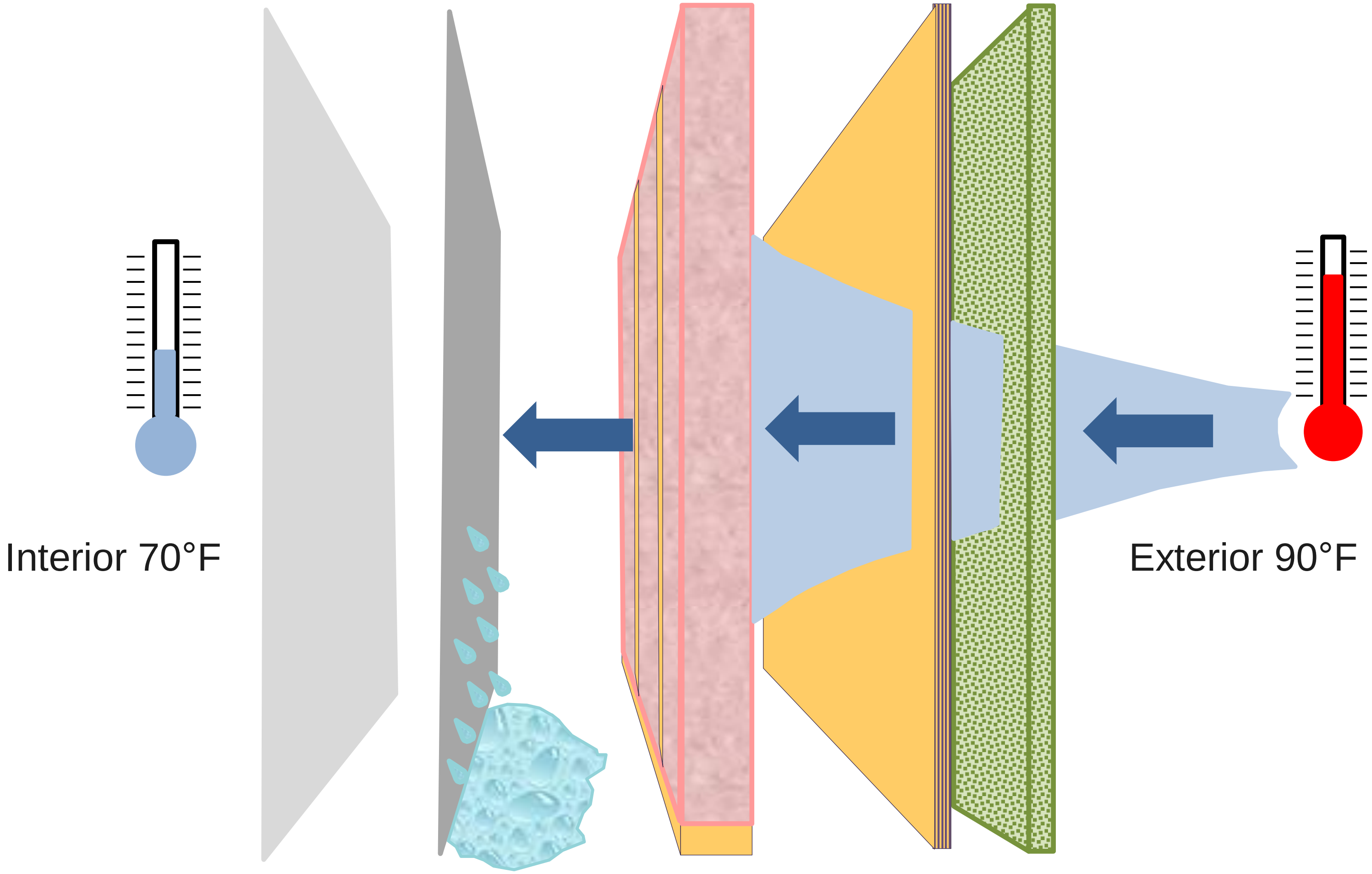


Condensation

As you can see here, moisture will collect within the wall.

At the point of accumulation, everything in its path is now saturated, including the cladding, WRB, sheathing, insulation, and studs.

The structural integrity and energy efficiency of the wall system are now compromised.

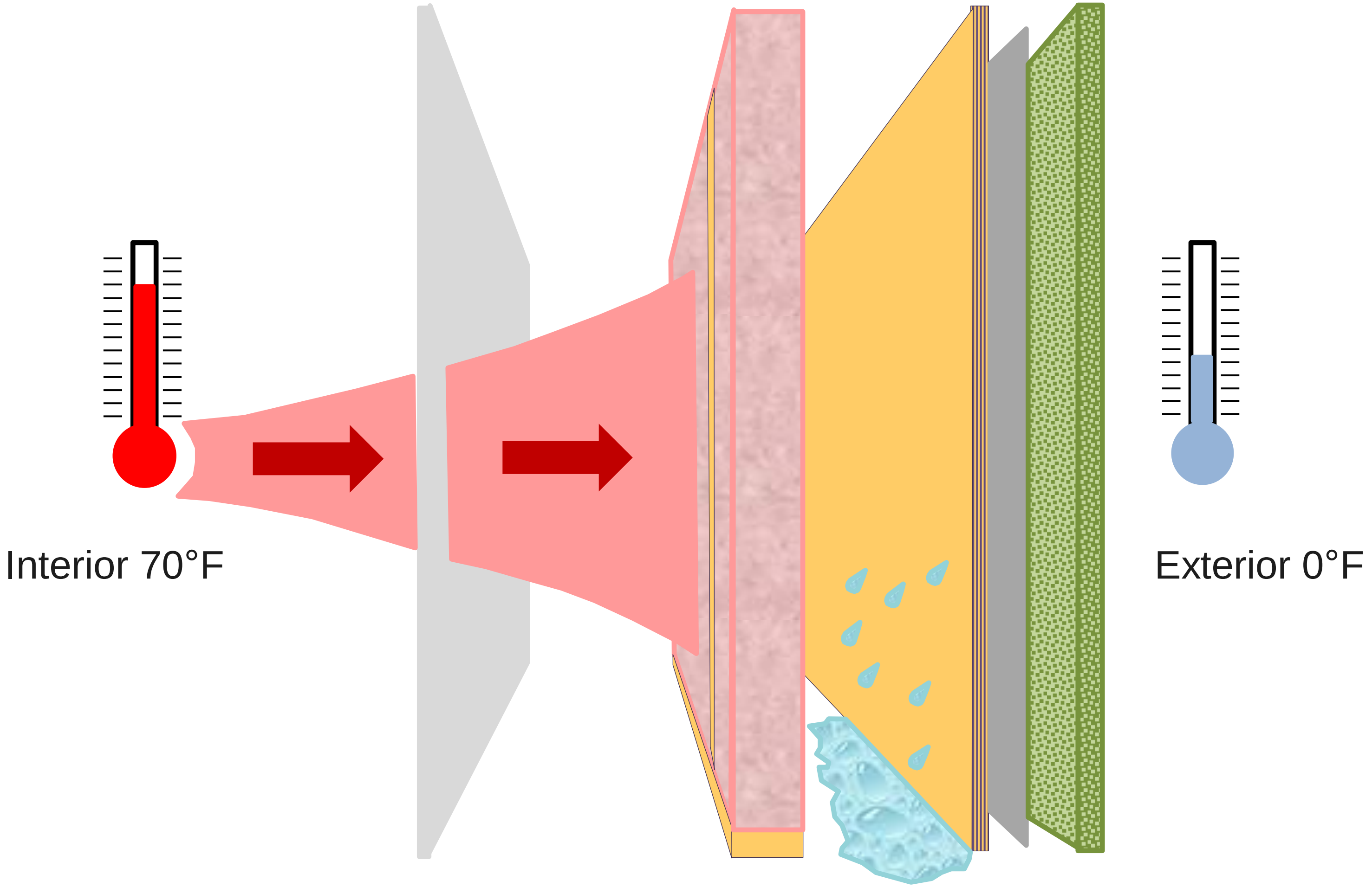


Condensation

The same also occurs during the winter months.

Heat travels from the warm interior to the cold exterior. When warm air meets cold air, condensation occurs on the back side of the sheathing.

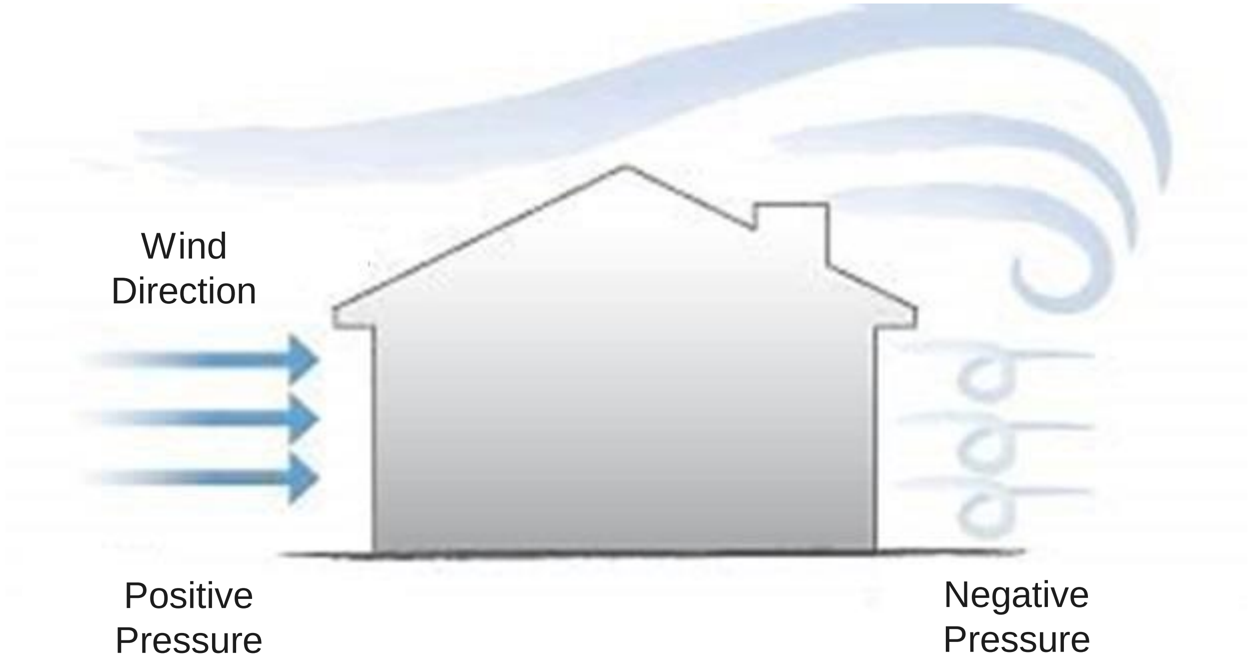
Either way, the insulation and studs are compromised.



Pressure Differences

The positive and negative pressures surrounding a building and inside a building are referred to as pressure differentials. Condensation, vapor drive, and capillary action are all impacted by pressure differentials. The greater the pressure difference between the outside of the cladding and the interior determines the drawing power of the wall system.

For example, have you ever entered a building and been met with resistance when opening the front door? That's positive and negative pressure working against each other. The same can be said when driving in a car. If someone cracks open a window in the back, you get a thumping noise. The only way to adjust that sound is to either close the window or open another to neutralize the pressure inside the car.



Gravity

Gravity can be friend or foe in keeping buildings dry. To reduce the chances of moisture infiltration, builders and designers often use shingle lapping of WRB/house wrap and roofing to keep buildings dry. Constructing slopes (overhangs and shingle-style cladding) to shed moisture and grading the ground away from structures help mitigate water damage. However, gravity can also draw water down through openings or cracks in cladding materials away from roofing and nonabsorptive cladding, causing moisture-related problems.

Review Question

List the sources of moisture and the ways that moisture moves.

Answer

Sources of moisture include the following:

- *manufactured sources (sprinklers)*
- *external sources*
- *condensation*

Moisture moves via these mechanisms:

- *capillary movement*
- *vapor drive (solar vapor drive)*
- *pressure differentials*

Wall Design and Moisture Management

Best Practices

Now that we understand the sources and effects of moisture intrusion as well as the ways that moisture moves, let's review some of the considerations in best-practice wall design.

Questions to ask:

- Where is the project located?
- What are the weather patterns in the area?
- What is the cladding choice?
- What do the construction plans and local building codes call for?
- What version of the building code needs to be followed?
- What is the budget?
- Who is making the decisions on this project (building owner, architect, contractor)?

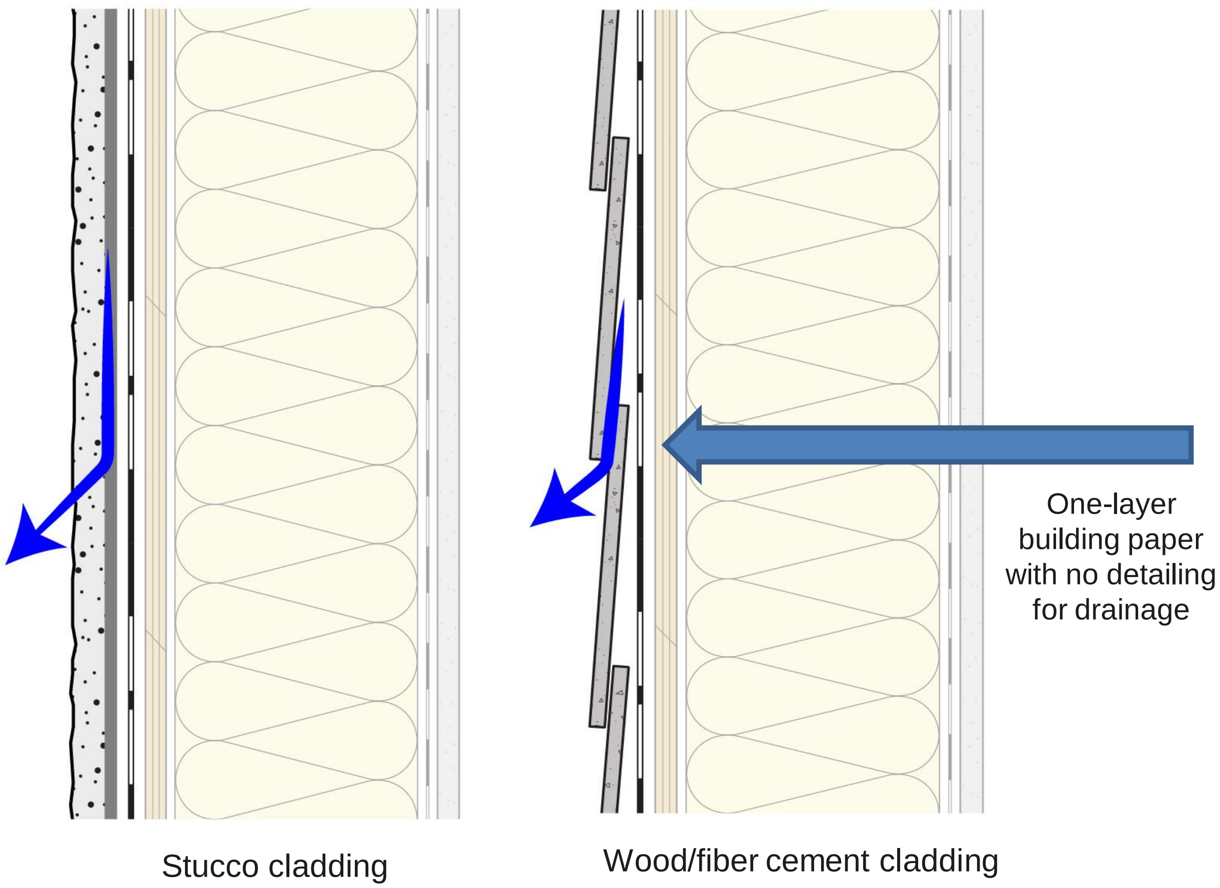
Wall Design: Direct Applied

Here is an example of a direct-applied barrier wall, the most common type of wall in residential construction.

This wall design features the cladding placed directly against the weather-resistant barrier with no space for proper drainage.

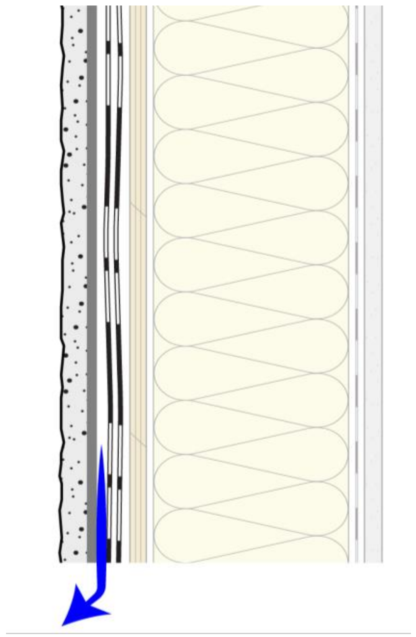
The mechanical fasteners used to adhere the cladding to the WRB often pierce the barrier, allowing moisture infiltration as mentioned in the Cape Cod example.

One-Layer Building Paper

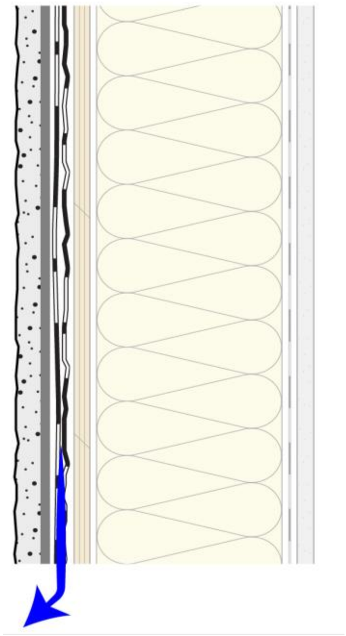


Wall Design: Drained

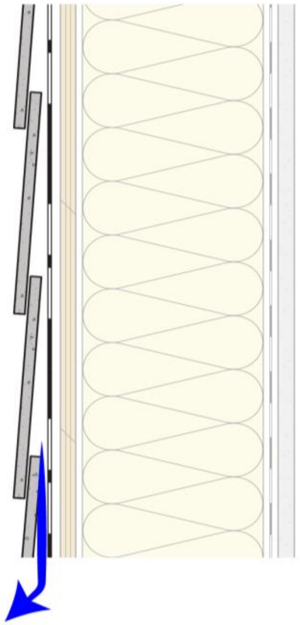
The second option is a drained wall. This wall system has the cladding right up against the WRB; however, two layers of building paper are used this time. Sometimes a layer of building paper on a textured wrap or a drainable house wrap is used. The drainage efficiency is measured per ASTM E2925, “Standard Specification for Manufactured Polymeric Drainage and Ventilation Materials Used to Provide a Rainscreen Function.”



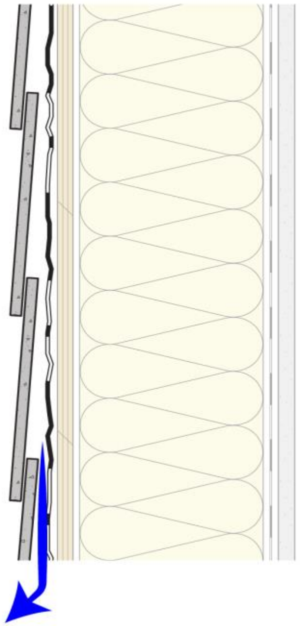
Two layers of building paper under stucco cladding



Building paper on textured wrap under stucco cladding



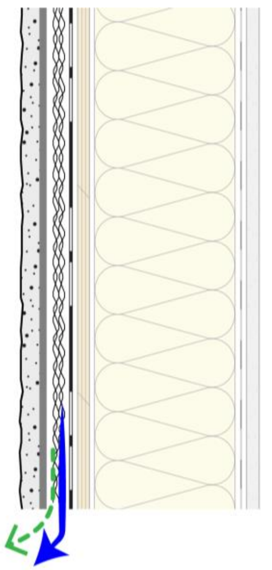
One layer of building paper with detailing for drainage under wood/fiber cement cladding



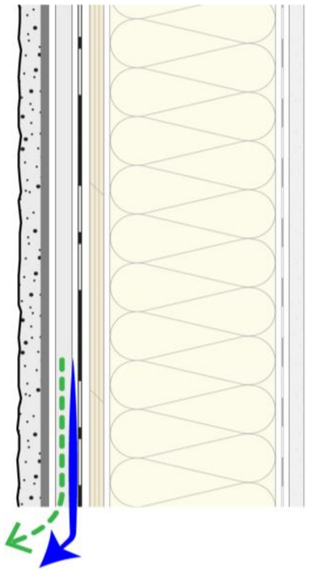
Textured wrap under wood/fiber cement cladding

Wall Design: Drained and Vented

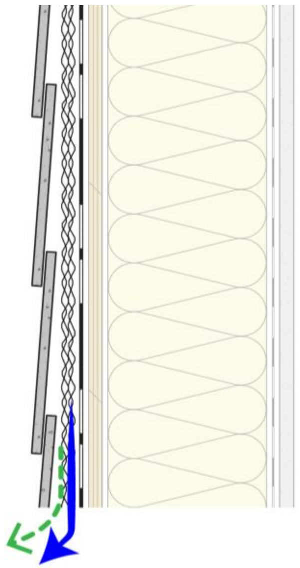
A drained and vented wall is also an option. In commercial construction, these are known as cavity walls. Specific detailing of the cavity allows for drainage and ventilation behind the cladding. Cavity walls often have larger capillary breaks and intentional airflow behind the cladding, with the venting at the bottom of the wall. The degree of ventilation can be defined by an air exchange rate. These wall systems are designed to handle moisture once it gets past the cladding and into the airspace. They do not control the amount of moisture that enters the wall; they simply do their best to handle the moisture once it does enter the wall.



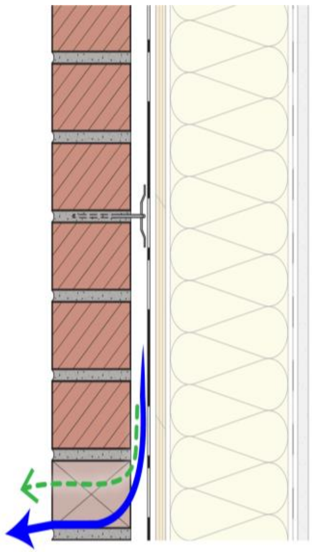
Stucco cladding



Stucco cladding



Wood/fiber cement cladding



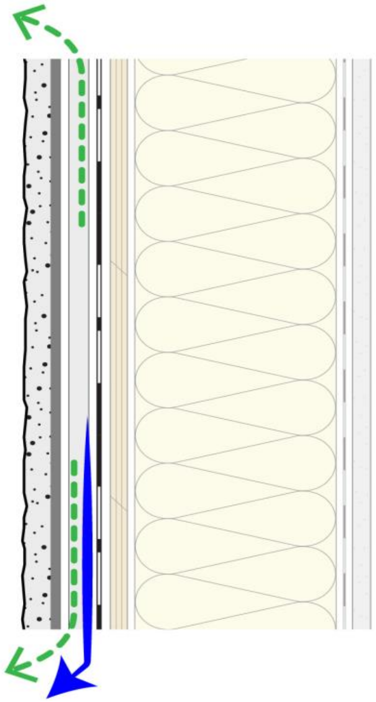
Brick cladding

Wall Design: Rainscreen, Drained and Ventilated

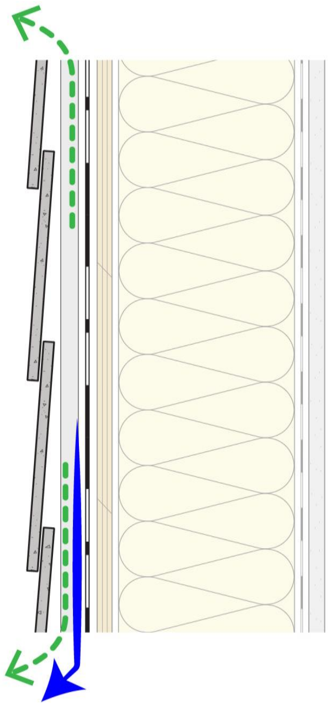
Here is an example of a drained and ventilated wall or, as it is more commonly known, a rainscreen wall.

These walls are designed to drain moisture at the bottom and allow air to escape at the top.

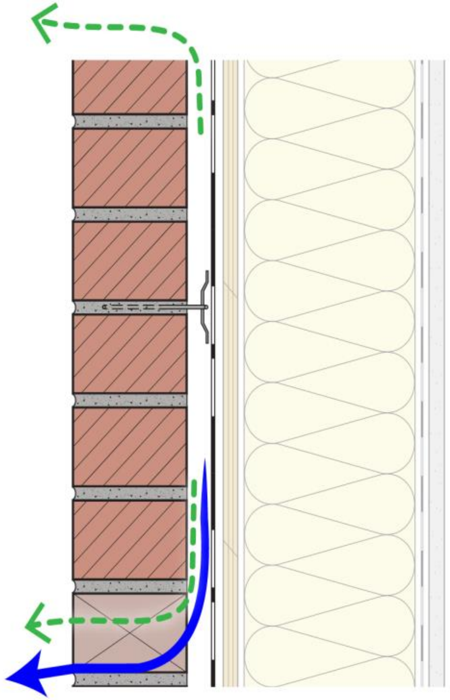
These openings create an intake and an exhaust that allow air to flow through the wall in a convective fashion, which drains and helps dry the interior of the wall and all components within.



Stucco cladding



Wood/fiber cement cladding

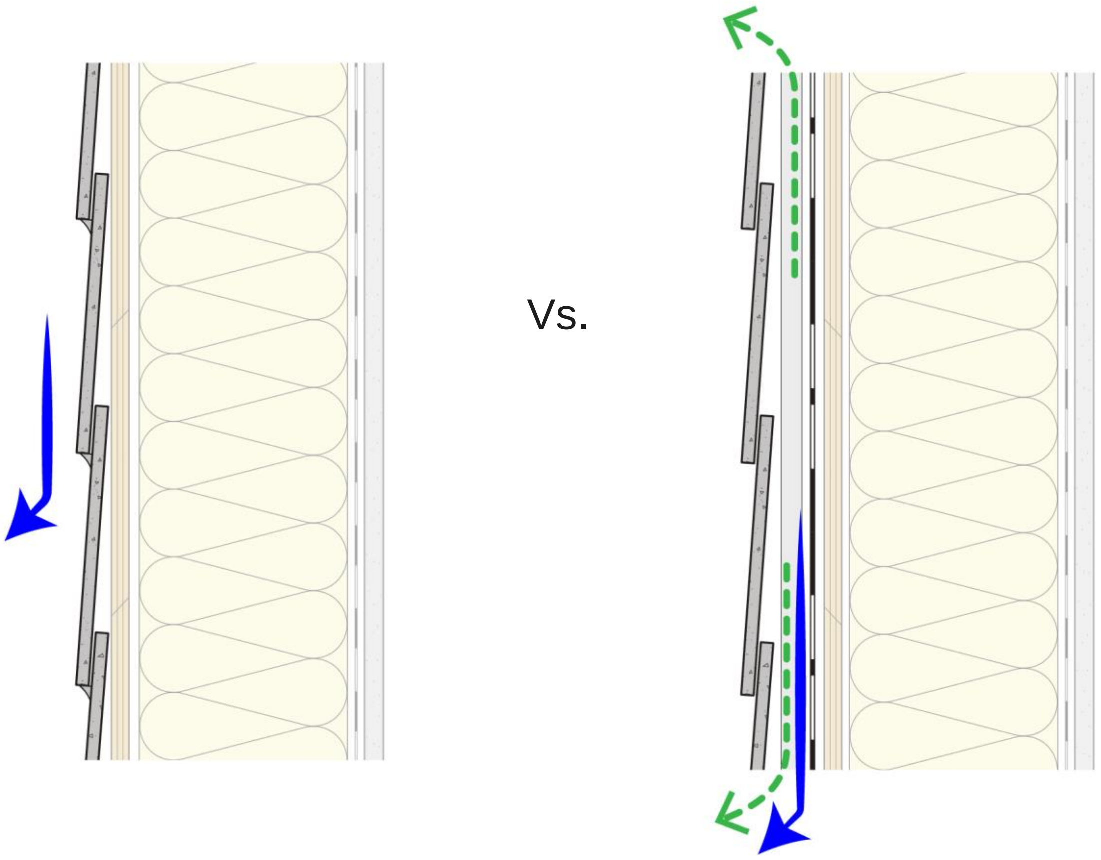


Brick cladding

Rainscreen Systems

What Is a Rainscreen?

A rainscreen is not a product. A rainscreen is an assembly applied to an exterior wall that 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.



The Rainscreen Concept

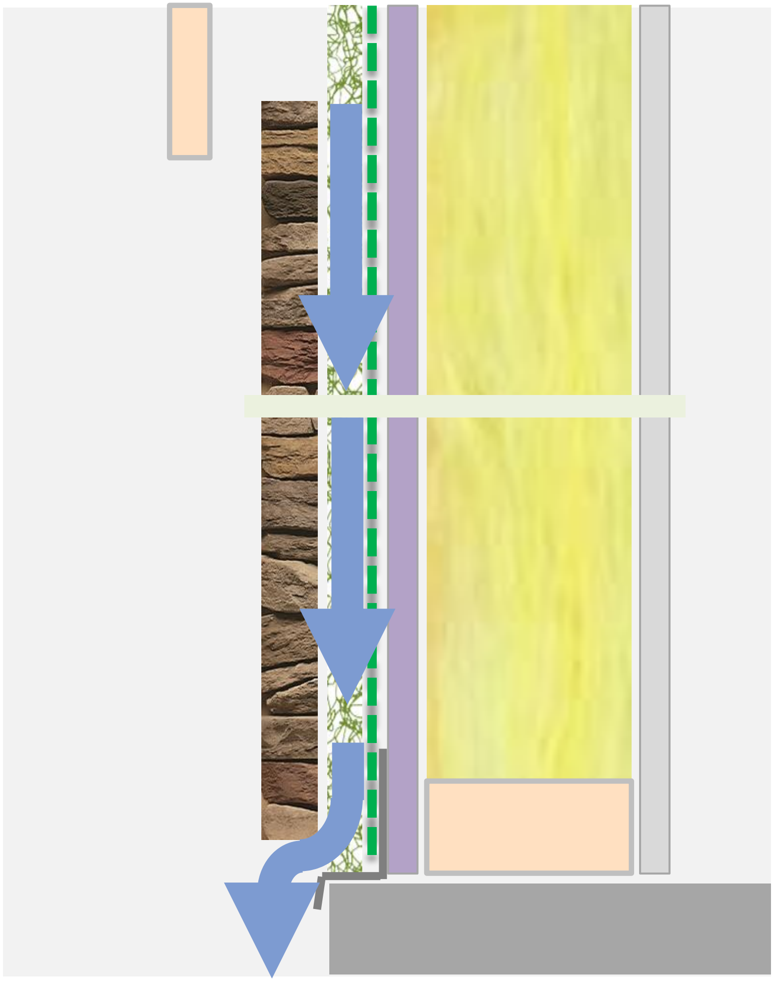
A ventilated wall works to moderate the pressure differences between the outside environment and inside environment by allowing air into the wall system. Unlike a drainage wall that handles moisture once moisture enters, a ventilated wall controls the amount of water that enters by neutralizing the airspace, which reduces the drawing power often created between the inner and outer walls.

1. Rainscreen walls create a space for drainage and ventilation within the wall.
2. A required capillary break of 3/16″ or greater per ASTM E2925 will reduce the amount of bulk moisture that reaches the weather-resistant barrier.
3. Rainscreen walls reduce the transmission of surfactants contained in some claddings.
4. These wall systems drain and ventilate.

The Rainscreen Concept

Moisture that enters the wall can drain via the capillary break created within the wall system.

This same space allows for convective drying when vents or openings are at the base and top of the wall.



Designing for Moisture Intrusion

For a rainscreen wall system to truly work, proper material selection, detailing, and installation practices must be adhered to when installing the weather-resistant barrier. Correct WRB installation is critical to ensure that the entire rainscreen wall system is not compromised.

Rainscreen components:

1. Sheathing
2. WRB
    - must be detailed correctly
    - must be installed correctly
    - the proper function of a rainscreen wall depends on the performance of the weather-resistant barrier
3. Capillary break
4. Cladding

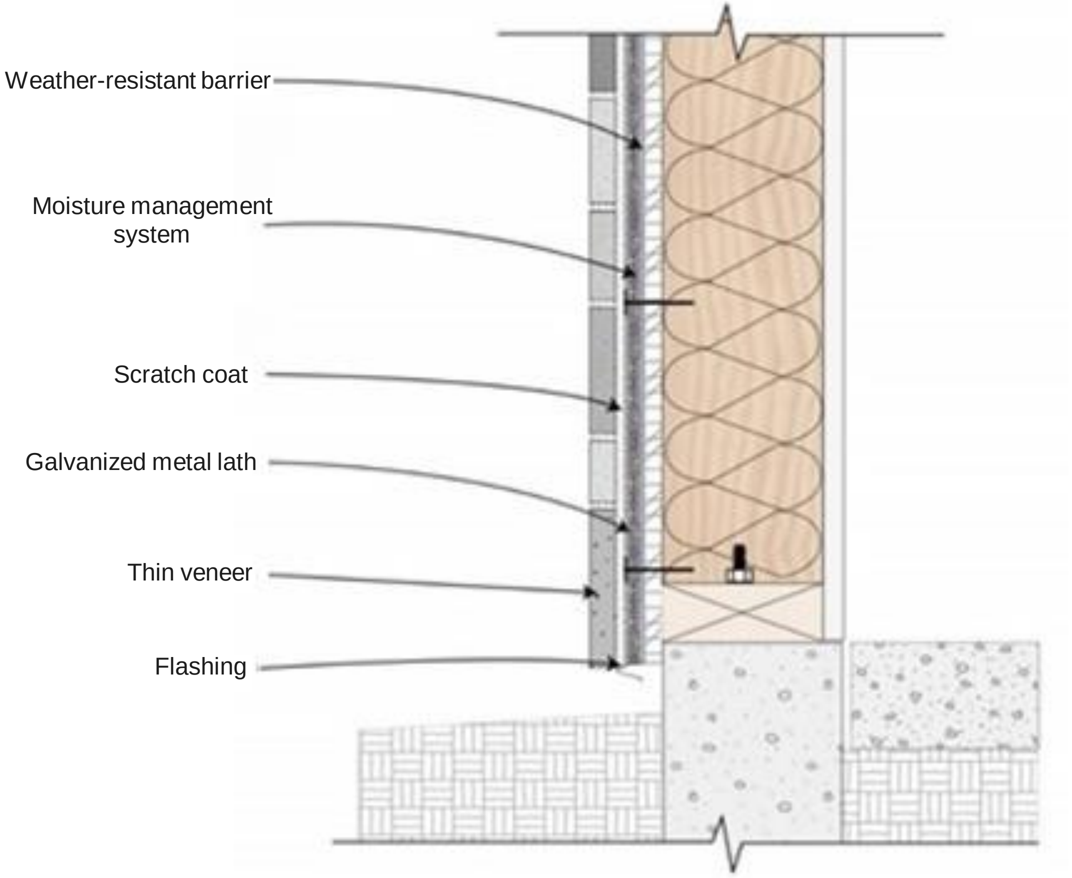
Creating a Capillary Break

The best defense against moisture intrusion is a cavity wall design or any wall design with a capillary break no less than 6 mm.

It is industry standard to specify a 6 mm thickness in the US and a 10 mm thickness in Canada. Creating a capillary break of 6 mm or 10 mm doesn't just drain but also ventilates behind the cladding.

Drainage is essential, but the real benefit of rainscreen technology is the convective drying aspects. Circulating air removes moisture found in the inner wall, keeping materials dry and prolonging the life of the entire wall system. Most drainable house wraps do not ventilate as they provide a gap that is only 1 mm thick.

The following slides discuss some examples of improperly installed WRBs.



Felt

Here, you see one layer of No. 15 felt used; however, something went wrong during installation.

The image shows what happens when moisture works its way behind the felt and the wall becomes damaged.

Not all felt is the same. Some lower-quality felts absorb moisture and contain volatile compounds that harm the wall.

WRB: Rips and Tears

Per *International Residential Code* Section R703.2, a WRB must be free from holes and breaks. Unfortunately, house wraps can tear or be punctured by mechanical fasteners during installation.

Once a tear happens, it is crucial to have it fixed by the contractor before cladding installation. Often the fix never happens, and leaks occur, leading to mold and rot.

Sheathing

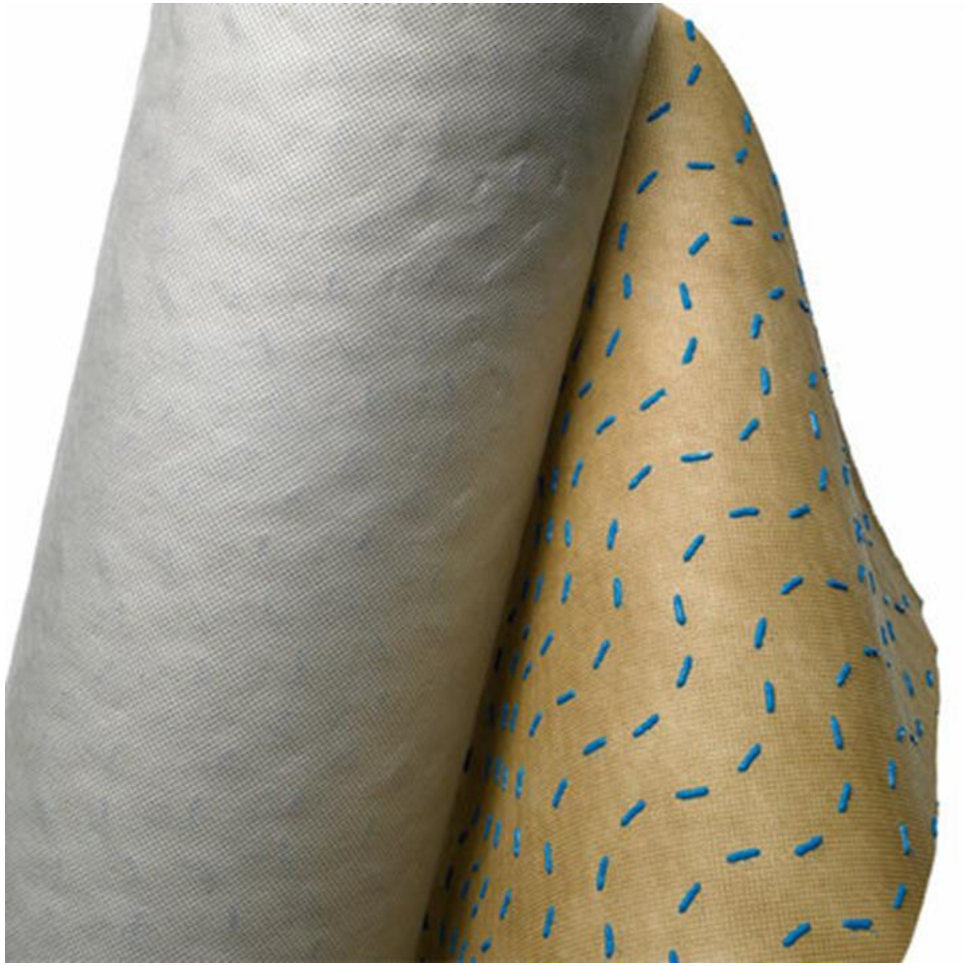
A popular option is sheathing with an integrated layer of moisture protection. However, the integrated moisture protection is not on the ends of the sheathing, nor is there moisture protection on the ends if the sheathing needs to be cut.

If this wall is designed without a capillary break, moisture can work its way into the building at these locations.

Drainable Weather-Resistant Barrier

One of the biggest misconceptions out there right now relates to drainable house wraps. A drainable house wrap is a very good house wrap; however, it lacks the ventilation requirement of a rainscreen.

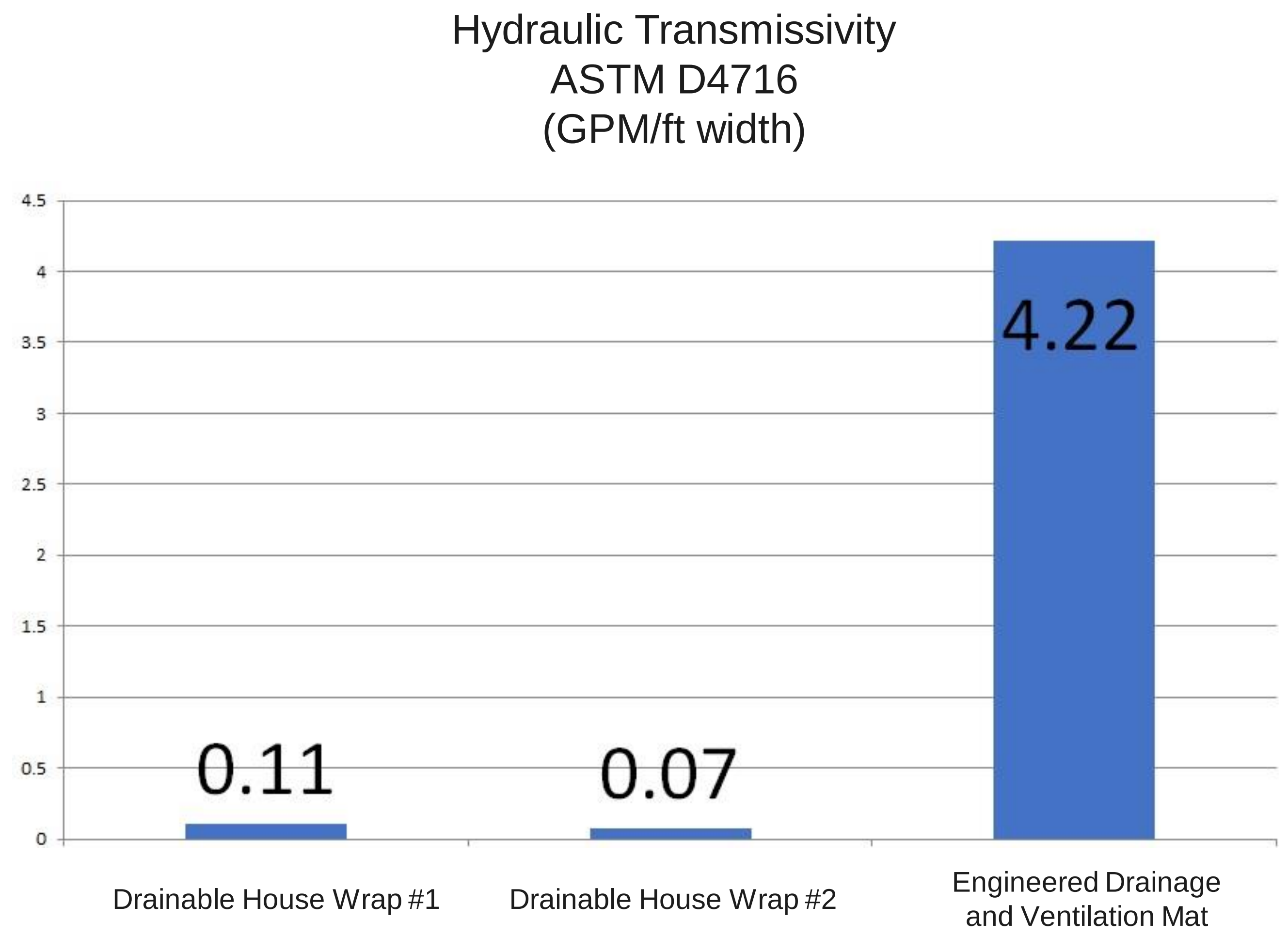
The surface tension of moisture can span 1–2 mm. Drainable house wraps are 1 to 1.5 mm thick. For proper ventilation, there needs to be at least 4.5 mm of airspace.



Engineered Drainage and Ventilation Mats vs. Drainable WRBs

Let's compare the drainage and ventilation test results of drainable house wraps and engineered drainage and ventilation mats, beginning with hydraulic transmissivity.

This graph shows that an engineered drainage and ventilation mat generates 4.22 gallons of moisture per minute per square foot, compared to 0.11 and 0.07 gallons per minute from two leading drainable house wraps.

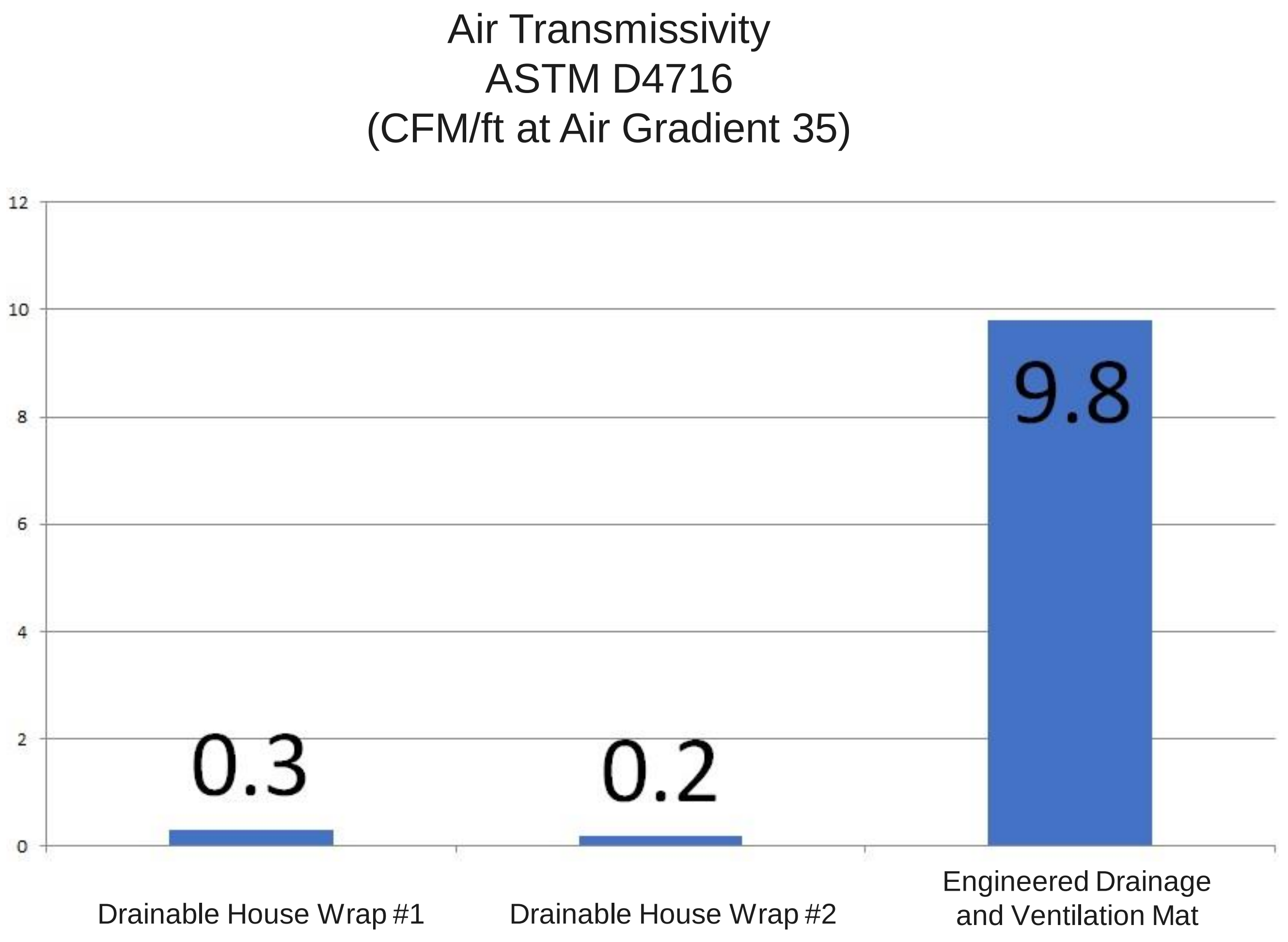


Engineered Drainage and Ventilation Mats vs. Drainable WRBs

Next, we compare air transmissivity.

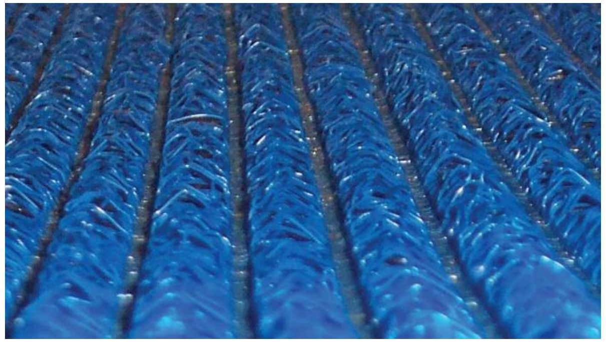
As you can see on the graph, an engineered drainage and ventilation mat passes 9.8 cubic feet per minute of air, compared to 0.2 and 0.3 cubic feet from two widely used drainable house wraps.

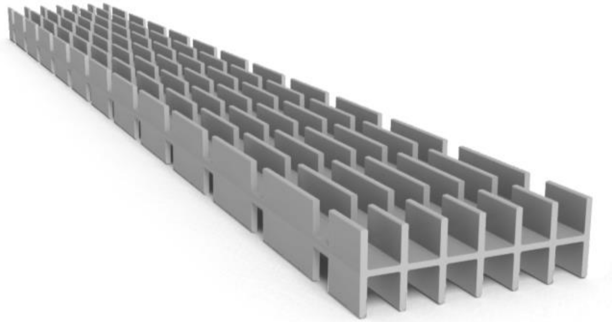
As you can see, the engineered drainage and ventilation mat far outperforms the drainable house wrap.

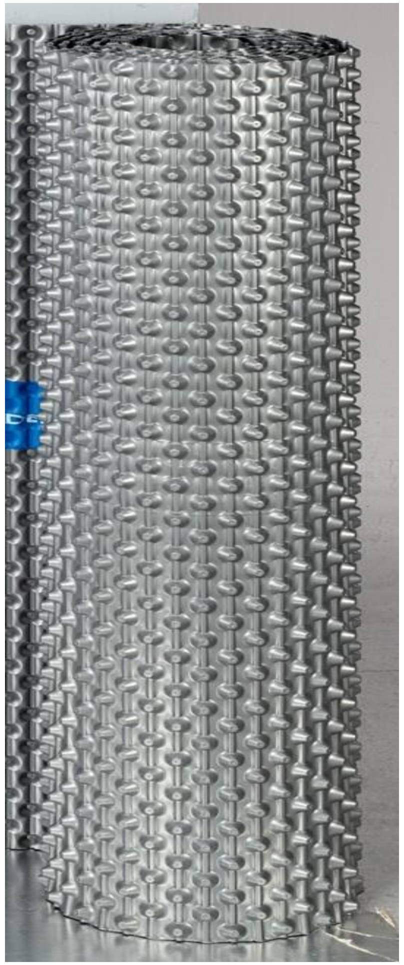


EDVM: Engineered Drainage and Ventilation Mat

The best way to create and maintain the proper space within a wall system is by incorporating engineered drainage and ventilation mats (EDVM) or furring strips.





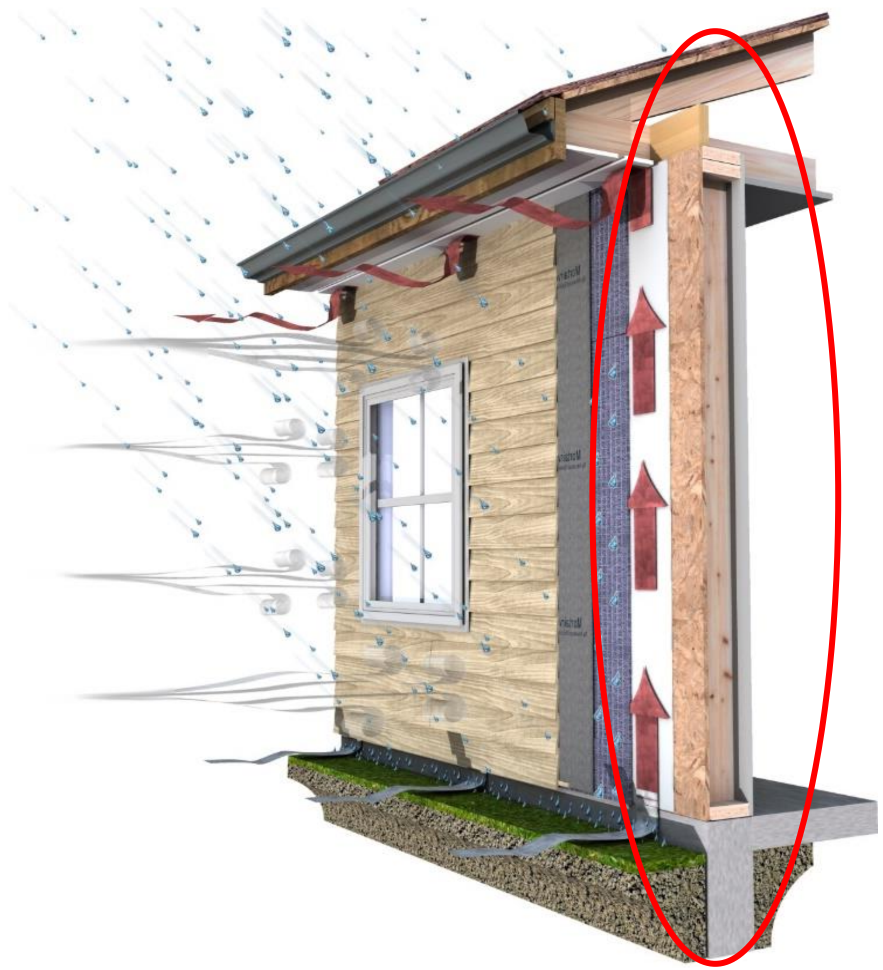


What Does an EDVM Do?

A layer of house wrap along with a layer of engineered drainage and ventilation mat creates the proper space needed within the wall for drainage, ventilation, and separation to avoid moisture spanning the airspace. The addition of a ventilation mat takes the place of one layer of building paper found in current building codes, according to the National Concrete Masonry Association in their *Installation Guide and Detailing Options for Compliance with ASTM C1780*.

The EDVM creates space within the wall to promote drainage and ventilate the wall.

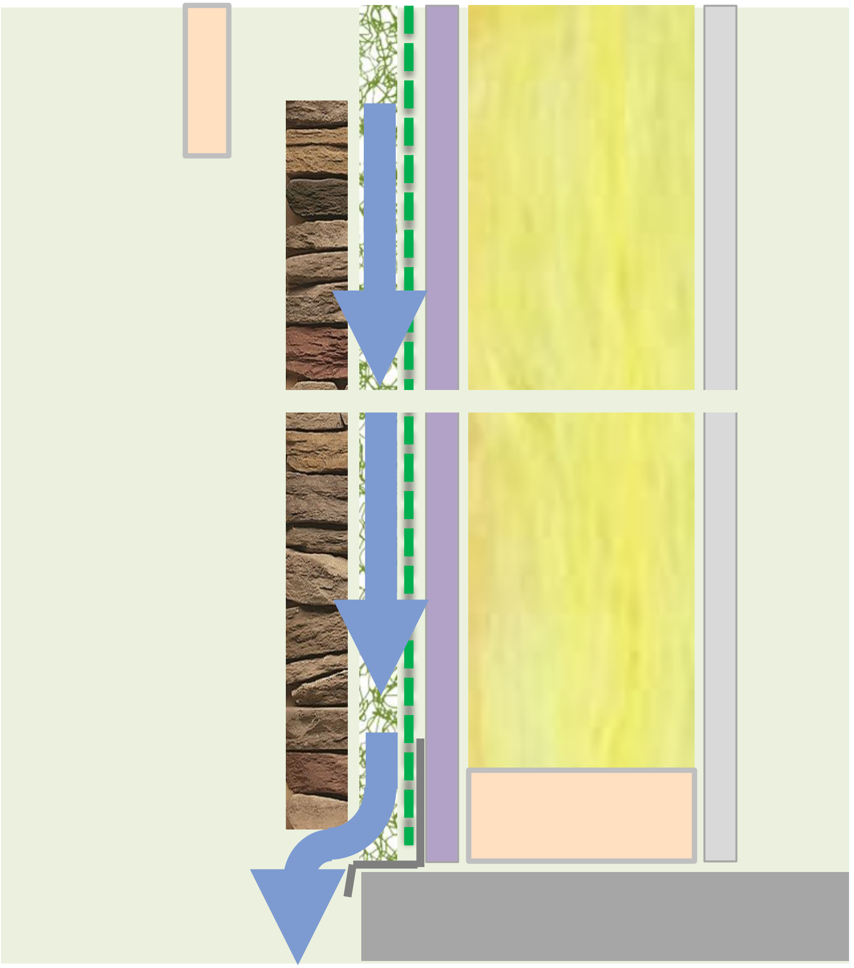
The mat will stop any capillary water movement via a capillary break and provide a thermal break, enhancing the insulation value of the wall by decreasing energy lost through thermal bridging.



Rainscreen Wall

Here, you can see a wall with one layer of WRB and one layer of EDVM. So, in effect, the EDVM has turned a direct-applied wall system into a drained and ventilated wall system. The capillary break creates a clear space for moisture to drain down and not through to the wall's interior.

The ventilated wall redistributes moisture by draining liquid water and allows evaporating and drying of any residual moisture.



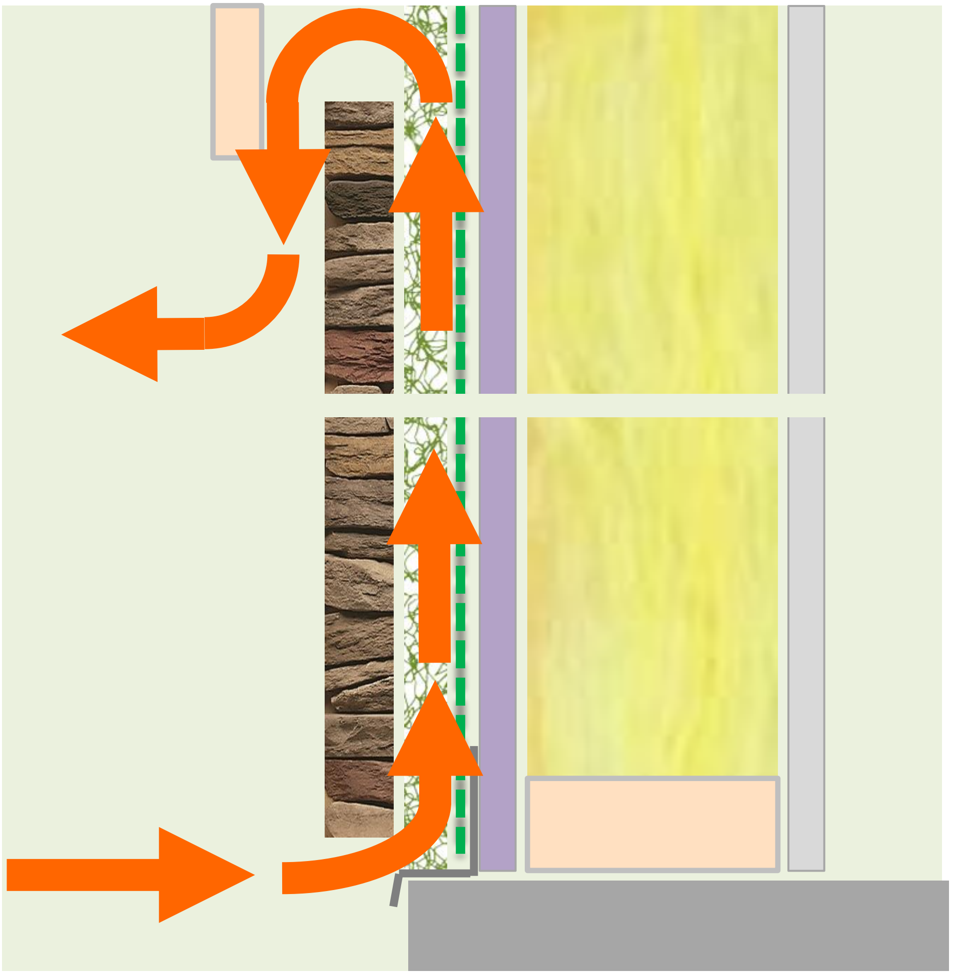
Rainscreen Wall

The capillary break, or void, also allows convective airflow that dries the wall and all the internal components.

There are openings at the top and bottom of the wall, creating a stack effect. The stack effect will:

- allow air movement over the entire surface of the wall, and
- enhance drying potential, especially when the sun heats the cladding.

A rainscreen wall only vented at the bottom has a limited drying effect as there is only air movement at the base.



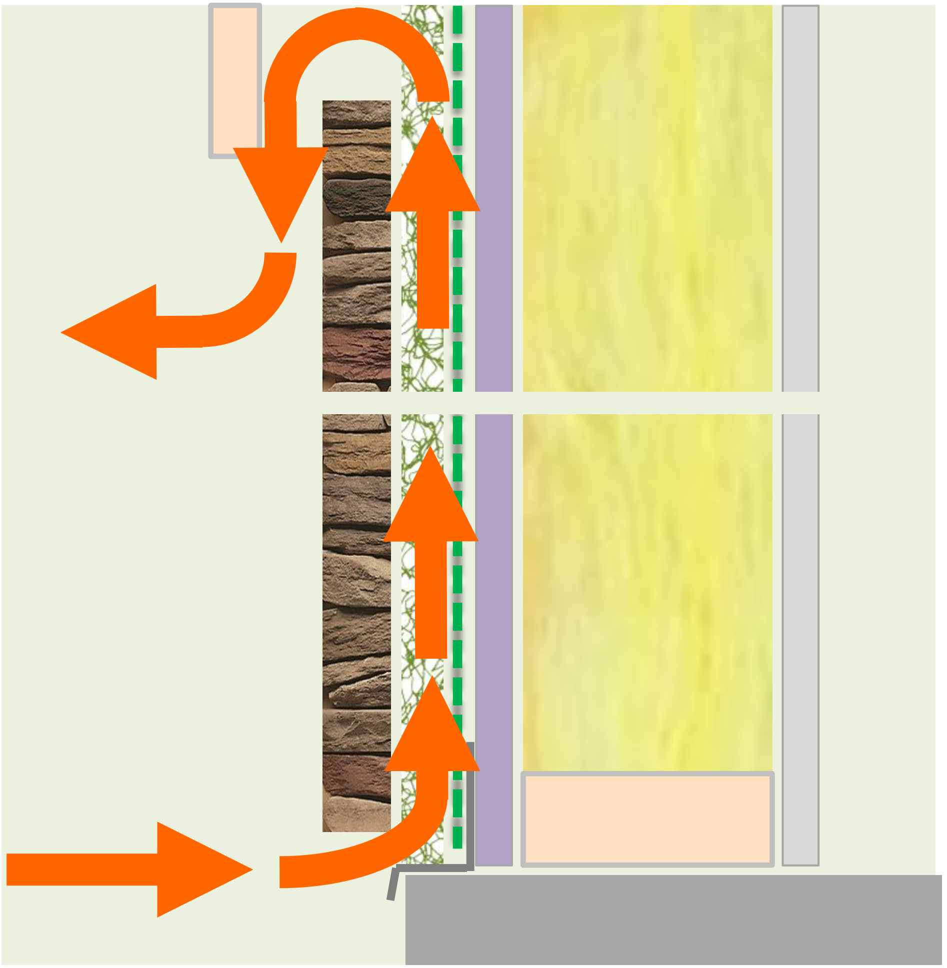
Rainscreen Drying Effects

There must be an air intake and an exhaust to have a correctly vented wall. If the top is closed off, you have a vented wall. If the top and bottom are closed off, you have a problematic wall.

Openings at the top and bottom of the wall help dry residual moisture left after drainage of bulk moisture. Sometimes, small but significant amounts of water that porous materials can absorb are attached to internal wall surfaces by surface tension.

Proper ventilation also helps remove two types of moisture vapor before it can condense:

- vapor inside the house, moving out
- moisture stored in cladding after rainfall that is entering the wall cavity by solar vapor drive

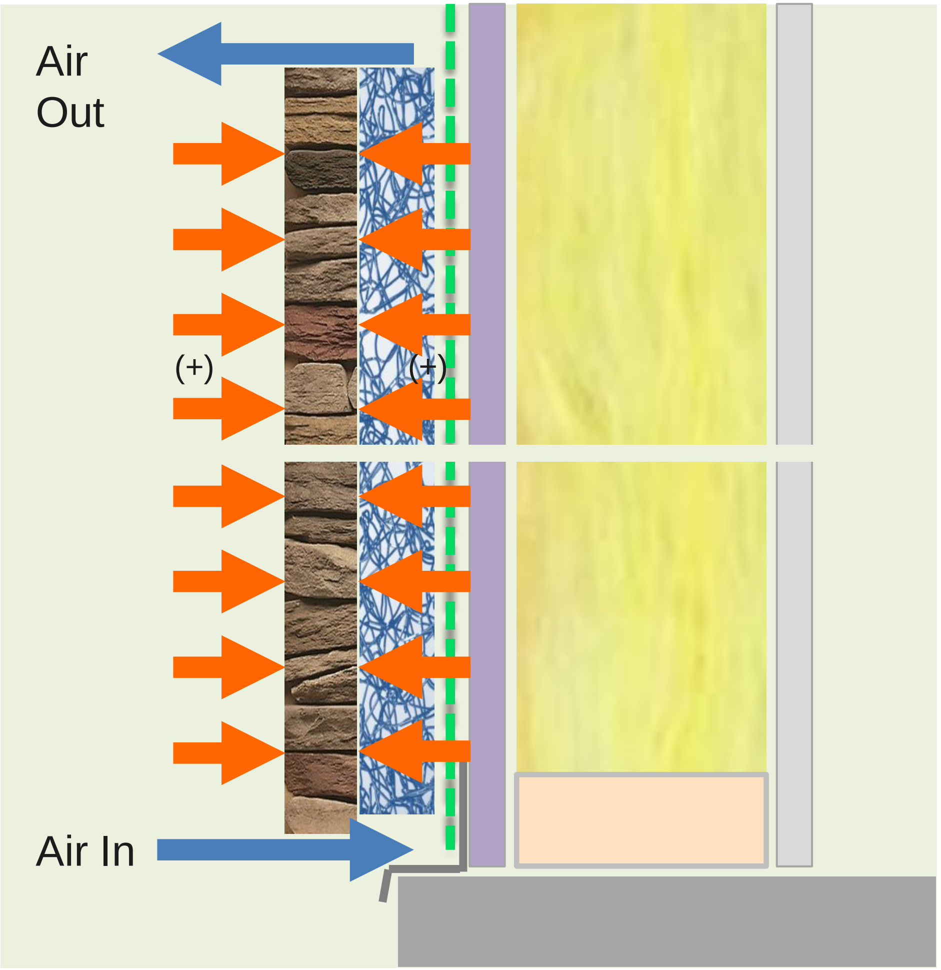


Pressure Differences

Remember, air must enter the airspace and work in a convective fashion to neutralize the airspace. The larger the void, the longer it will take for neutralization. The smaller the airspace, the quicker the air pressure is neutralized within the wall system.

Air pressure differences or wind loads draw liquid water and water vapor inward, pushing or drawing water through cracks, gaps, or openings in exterior wall materials.

A rainscreen gap moderates this pressure as external air pressure is transferred to the air gap behind the cladding, reducing water penetration force.



ASTM E2925

When choosing the right product to create the capillary break, refer to ASTM E2925, “Standard Specification for Manufactured Polymeric Drainage and Ventilation Materials Used to Provide a Rainscreen Function.” Below are the recommended testing standards to accompany the performance criteria of this standard.

ASTM D3045, “Standard Practice for Heat Aging of Plastics Without Load”

ASTM D5199, “Standard Test Method for Measuring the Nominal Thickness of Geosynthetics”

ASTM D5322, “Standard Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids”

ASTM D6108, “Standard Test Method for Compressive Properties of Plastic Lumber and Shapes”

ASTM D6364, “Standard Test Method for Determining Short-Term Compression Behavior of Geosynthetics”

ASTM E84, “Standard Test Method for Surface Burning Characteristics of Building Materials”

ASTM E2273, “Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies”

ASTM G154, “Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials”

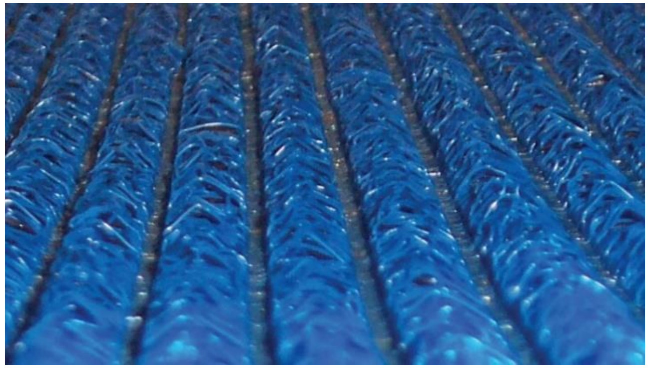
Rainscreen Options

There are three types of drainage and ventilation components recommended in ASTM E2925: engineered drainage and ventilation mats made from an entangled net material (type A) or a formed polymeric sheet or dimple board-type product (type B); and an engineered furring or formed batten strip (type C). Each of these used with a drainable house wrap will form a rainscreen system.

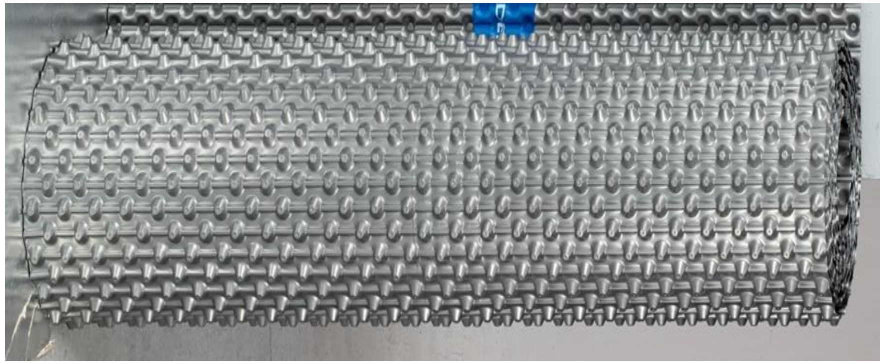
Type A: Entangled mesh (EDVM)

Type B: Formed polymeric sheet (EDVM)

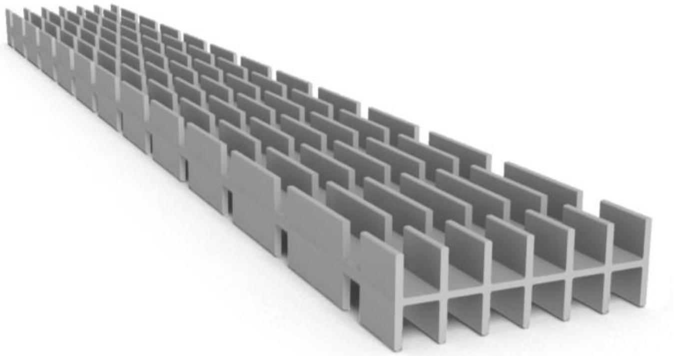
Type C: Engineered furring/formed batten strip



Type A



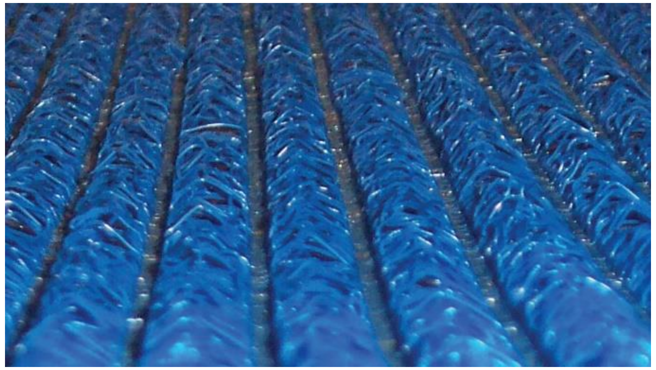
Type B



Type C

Type A: Entangled Mesh (EDVM)

- Typically, a three-dimensional entangled net extruded from polypropylene or nylon 6
- Most have a heat-bonded filter fabric
- Fabric acts as a mortar deflection
- Keeps uniformity throughout the surface area of the product
- Mold and mildew resistant
- Excellent compressive strength
- Will not crack to failure when manipulated
- Resistant to most chemicals
- Class A fire rating per ASTM E84
- Compatible with all siding materials (manufactured stone, stucco, fiber cement, wood)
- Tested to ASTM E2925

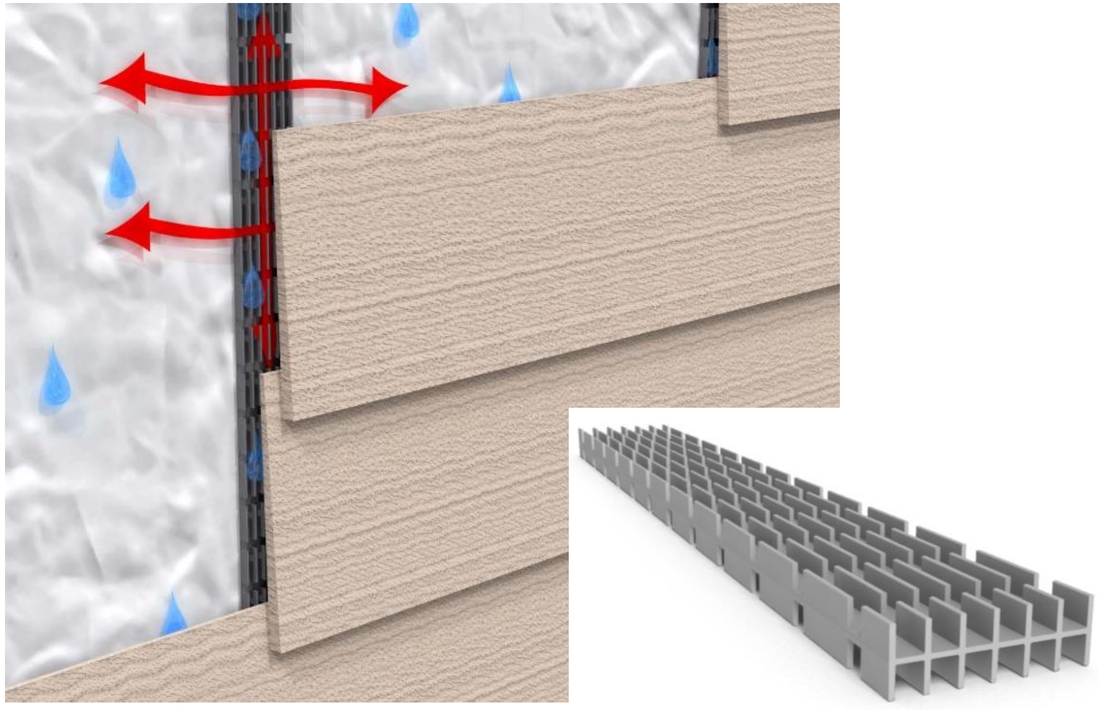


Type B: Formed Polymeric Sheet (EDVM)

- Commonly, a three-dimensional dimple mat
- Most have a heat-bonded filter fabric
- Fabric acts as a mortar deflection
- Keeps uniformity throughout the surface area of the product
- Mold and mildew resistant
- Excellent compressive strength
- Will not crack to failure when manipulated
- Resistant to most known chemicals
- Class A fire rating per ASTM E84
- Compatible with all siding materials (manufactured stone, stucco, fiber cement, wood)
- Tested to ASTM E2925

Type C: Engineered Furring or Formed Batten Strips

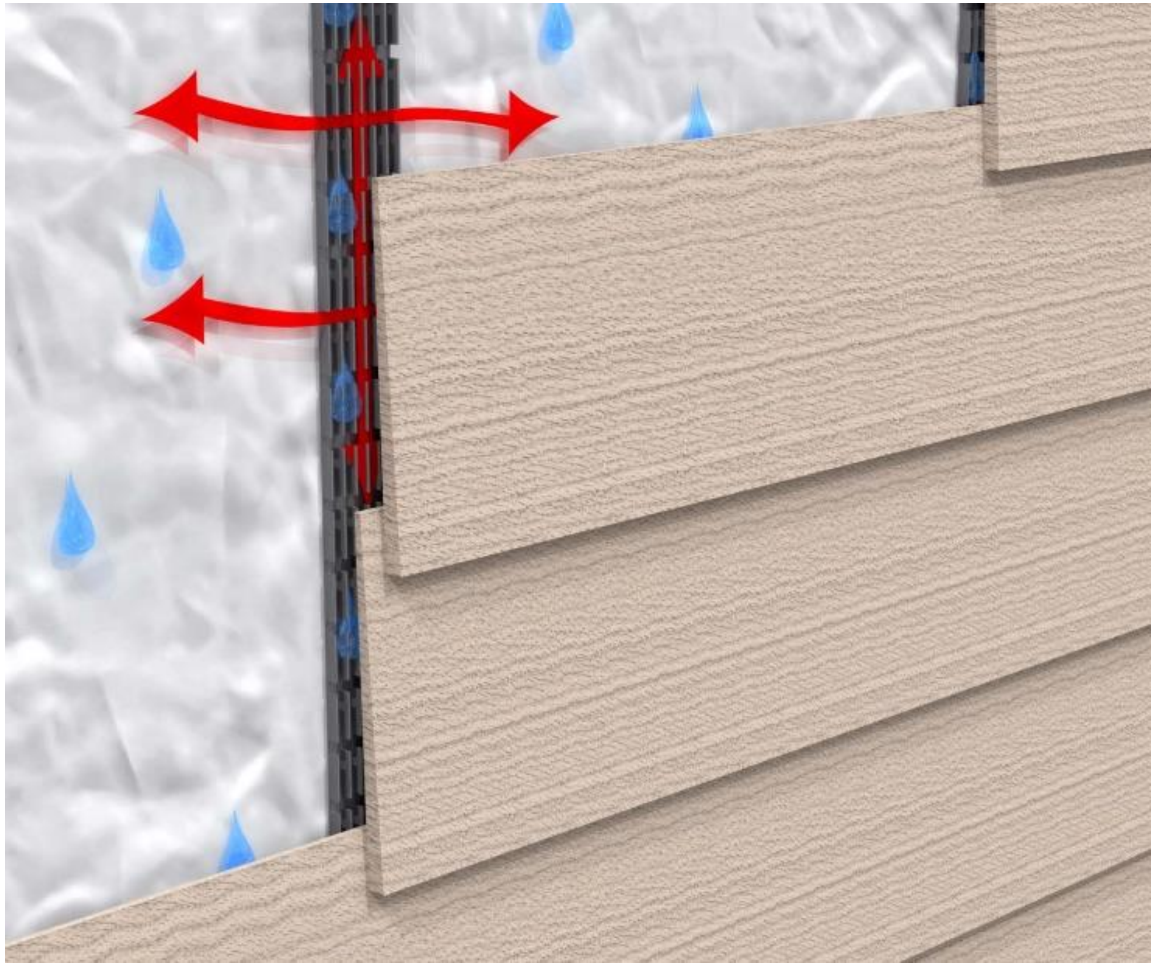
Engineered furring or formed batten strips used in conjunction with a drainable house wrap create a rainscreen assembly. Innovations in batten technology allow additional benefits not found in traditional wooden furring strips.



Considerations

Wooden batten strips, for example, are inexpensive, readily available, and sometimes structural. However, they can hold moisture. There is significant surface-to-surface contact and no cross ventilation.

Engineered furring strips create dual drainage and ventilation and can be used in vertical and horizontal applications. They are always the same dimensions, which saves labor, and they do not absorb moisture.



Review Question

Which of the following is NOT considered a rainscreen system?

A. Drainable house wrap
B. House wrap with furring strips
C. House wrap with an engineered drainage and ventilation mat

Answer

A. **Drainable house wrap**
B. House wrap with furring strips
C. House wrap with an engineered drainage and ventilation mat

A rainscreen system must drain and ventilate. Most drainable house wraps do not ventilate as they provide a gap that is only 1 mm thick. A gap of 6 mm thick is required to effectively ventilate behind the cladding.

Rainscreen Specifications and Summary

Industry Support

Over the years, more and more industry support is being given to rainscreen wall designs. The Rainscreen Association in North America (RAiNA) comprises over eighty organizations from all facets of the construction industry to promote the right way to build according to rainscreen wall science. RAiNA has subcommittees that work with the building codes, education and training, wall performance, definitions, and outreach to the industry in various forms.

Other sources of information include:

- Brick Industry Association
- *International Building Code*
- *International Residential Code*
- *National Building Code of Canada*
- International Masonry Institute
- National Association of Home Builders
- Building Science Corporation
- National Concrete Masonry Association

Specification Considerations

Products tested to ASTM E2925 and that fall under Type A, B, or C of ASTM E2925 can be specified in the following sections:

Section 072800 – Rainscreens
Section 074600 – Rainscreen Components
Section 074646 – Mineral Fiber Cement
Section 042000 – Unit Masonry
Section 042001 – Masonry Veneer
Section 042723 – Cavity Wall Unit Masonry
Section 092400 – Portland Cement Plastering

Please remember the **test password DRAINAGE**. You will be required to enter it in order to proceed with the online test.

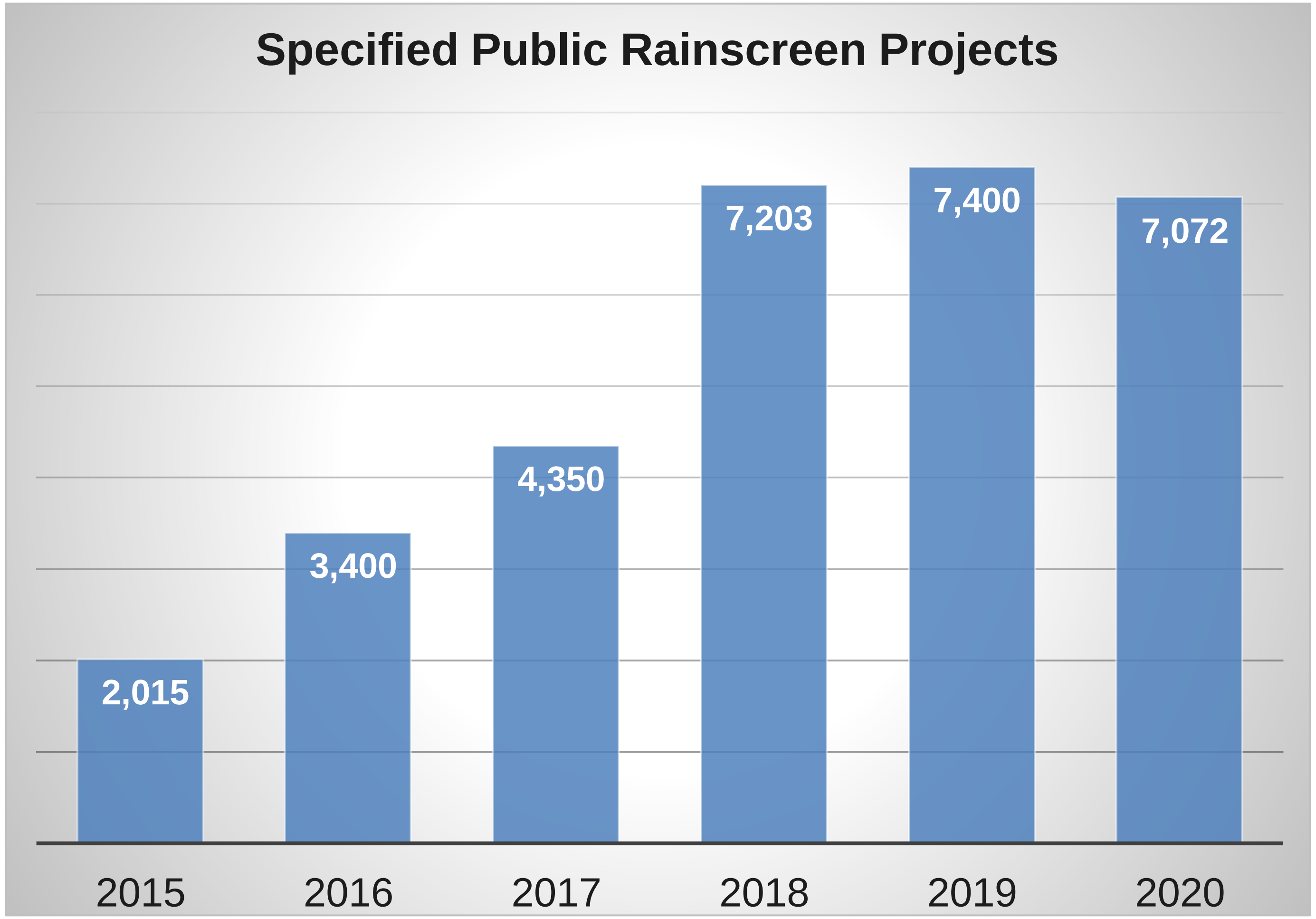
International Residential Code (IRC) 2018

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.

Section R703.2 – Water-resistive barrier. One layer of No. 15 asphalt felt, free from holes and breaks, complying with ASTM D226, “Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing,” for Type 1 felt or other approved water-resistive barrier shall be applied over studs or sheathing of all exterior walls.

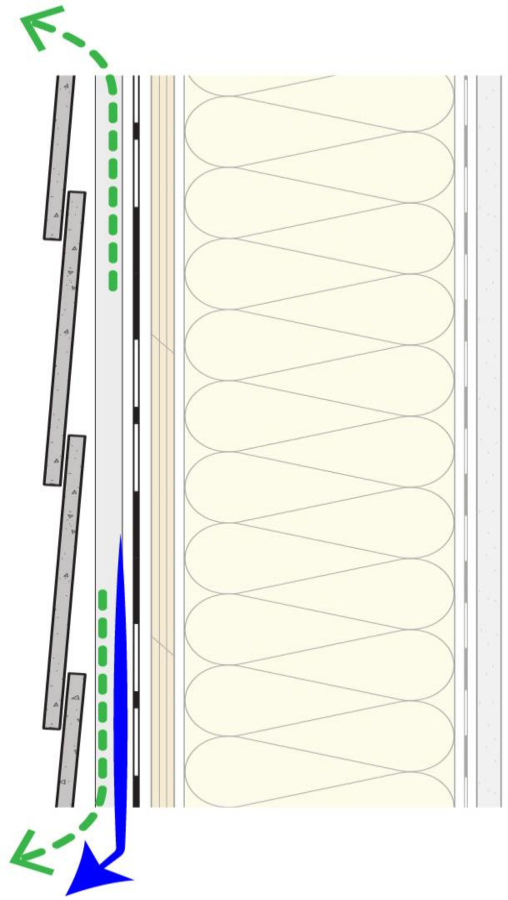
Rainscreen Specifications: 2015–2020

Between 2015 and 2020, there has been a significant increase in specifications calling for rainscreen design, proof that the industry acknowledges its importance in best practice wall design.



Summary

- Moisture infiltration can lead to mold growth, compromise the structural integrity of a structure, cause exterior surfaces to deteriorate, and shorten the life of paints and stains.
- The best way to defend against moisture migration is by installing a product that drains and ventilates. A rainscreen system is created by installing a house wrap covered by an engineered drainage and ventilation mat or by installing a house wrap with furring strips.
- The innovative rainscreen technology neutralizes the air pressure within the wall system by creating a drainage and ventilation cavity between the weather-resistant barrier and the exterior wall. This design allows excess moisture to drain from the wall system and permits ventilated air to circulate and dry the interior wall components.



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