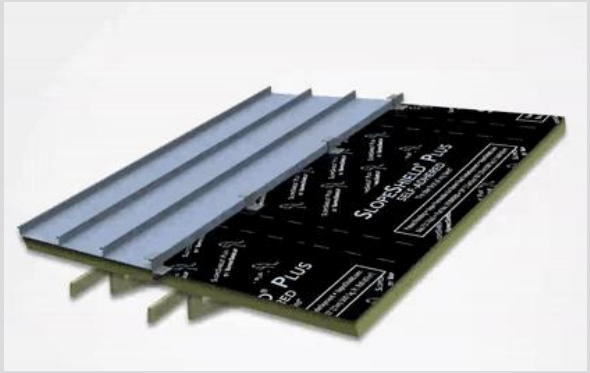
In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

"This educational offering is recognized by the Minnesota Department of Labor and Industry as satisfying **1.5 code/energy hours** of credit toward **Building Officials and Residential Contractors** continuing education requirements."

For additional continuing education approvals, please see the continuing education credit section in the conference agenda booklet.

Extending the Life of the Roofing Assembly



WELCOME!

Our Presentation Will Start Momentarily

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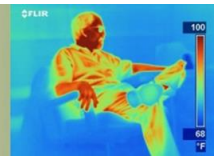


VAPROSHIELD®
Breathable Membrane Systems for Roofs & Walls

Your Presenter:
Scott D. Wood

SCOTT D. WOOD
Senior Building Scientist

YOUR PRESENTER

Scott D. Wood is a member of the VaproShield team, providing lab evaluations on competitor and VaproShield's products.

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

As president of Scott Wood Associates he provides a level I and II Building Science Thermography course. His extensive background in building science and infrared thermography has supported the excellent presentations and papers he has provided domestically and internationally.

DISCLAIMER

This Presentation reflects the opinion of the author based on professional experience. The author reserves the right to modify opinions should additional (factual) information be made available that is contrary to the opinions expressed herein.

COURSE DESCRIPTION

- Studies show that a breathable self-adhering roofing underlayment has the ability to:
  - Provide drying
  - Ease installation
  - Extend the life of the roof assembly
- This course investigates current knowledge of breathable, vapor-open (permeable) roofing underlayments and their ability to mitigate water intrusion, reduce long-term exposure to wetted substrates, and enhance the drying capacity of the roof assembly — extending the life of the roofing assembly.

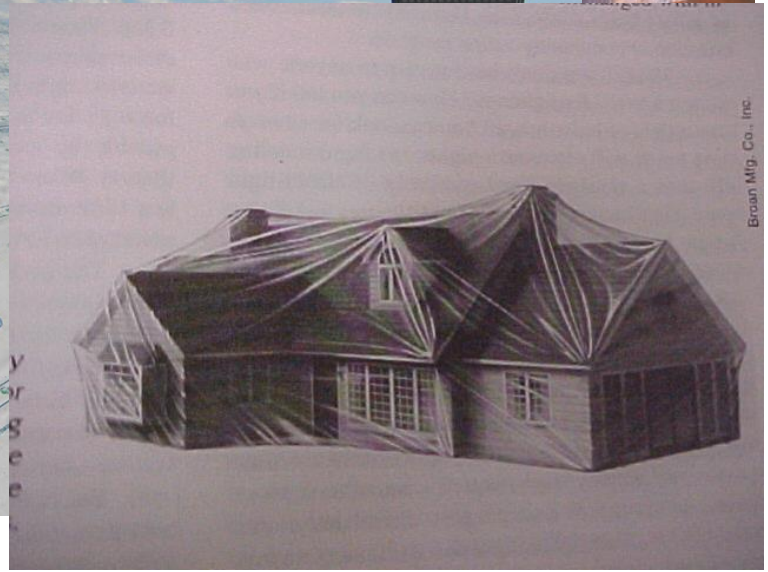
LEARNING OBJECTIVES

At the end of the presentation, participants will be able to:

- Describe the history of roofing underlayments
- Understand the difference between asphalt felt and synthetic underlayment’
- Define the roof assembly barriers; heat, air, moisture
- Show the mechanisms of vapor-permeable roof underlayment extending the life of the roof assembly
- Articulate why a breathable roofing underlayment provides superior drying capacity over conventional roofing underlayments
- Understand key details when installing a roofing underlayment

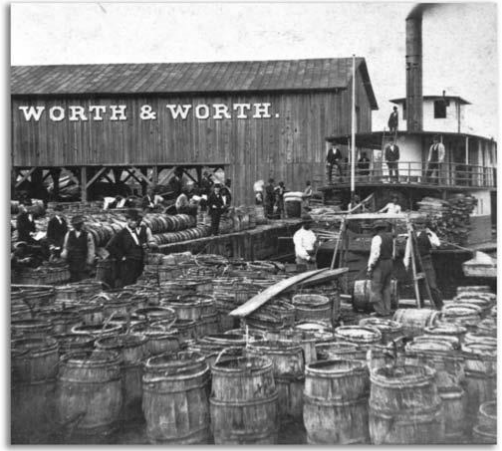
Overview

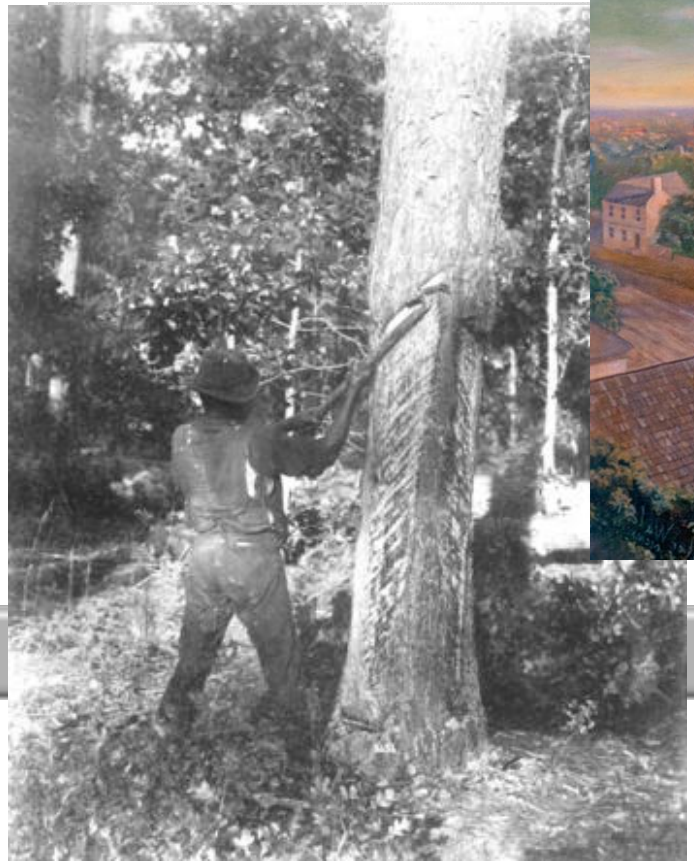
- A history of roofing underlayments
- The development of asphalt felt thro



In the Beginning

History of Roofing Underlayment





- Asphalt felt manufacturing

1840s 1870s 1980s 2000 2010

- Pine tar saturated fabric
- Coal tar used to make tar paper

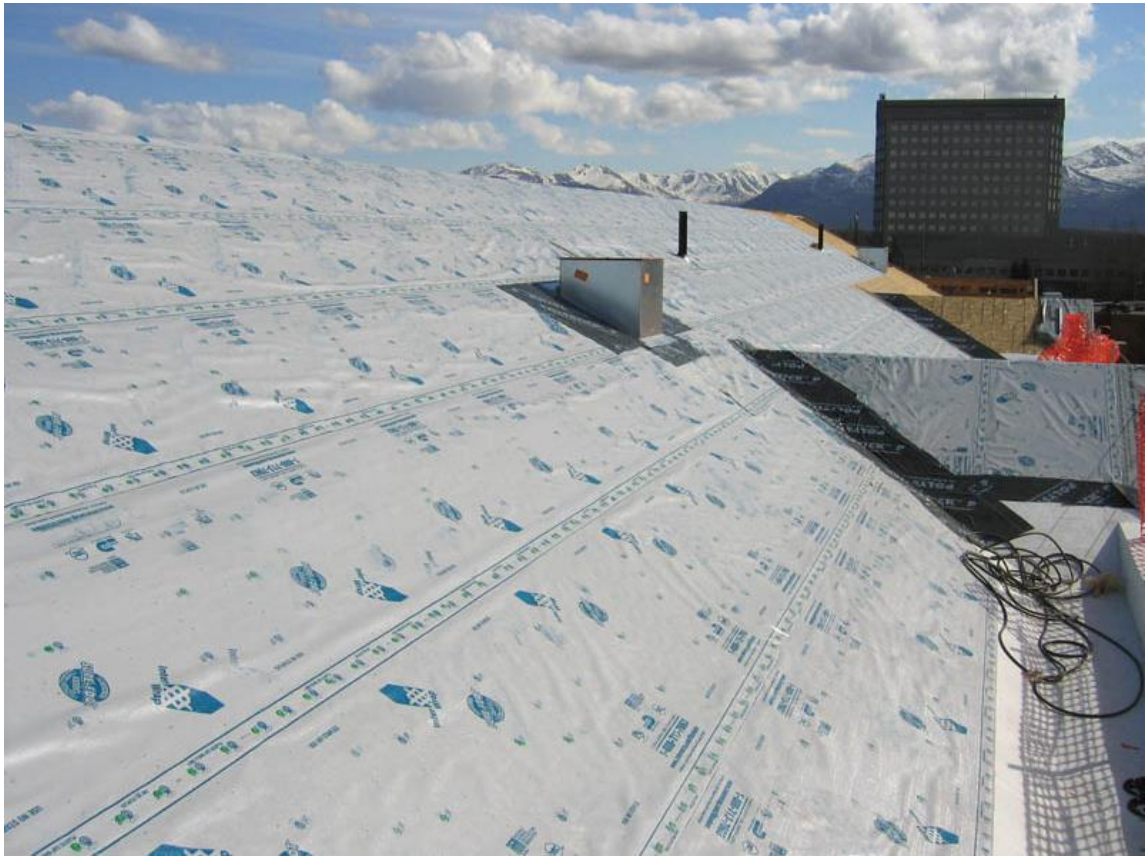
- Synthetic, waterproof underlayments in North America

Asphalt Felt

- Not waterproof
- Easily tears
- Prone to degradation from UV exposure
- Labor installation rates are high

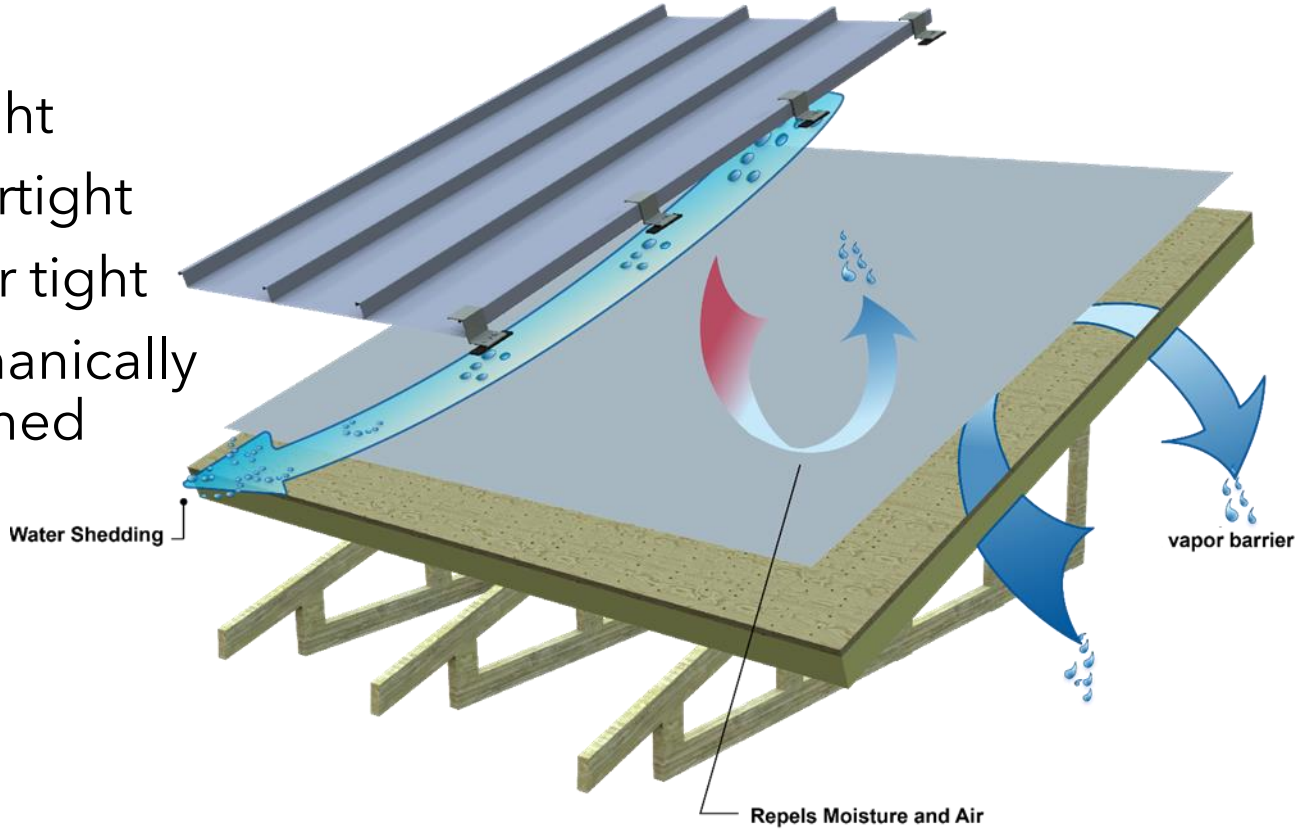
Synthetic Underlayment

- Durable
- Improved UV stability
- Tougher in winds
- Secondary water barrier
- Improved dry-in



First Synthetic Underlayment

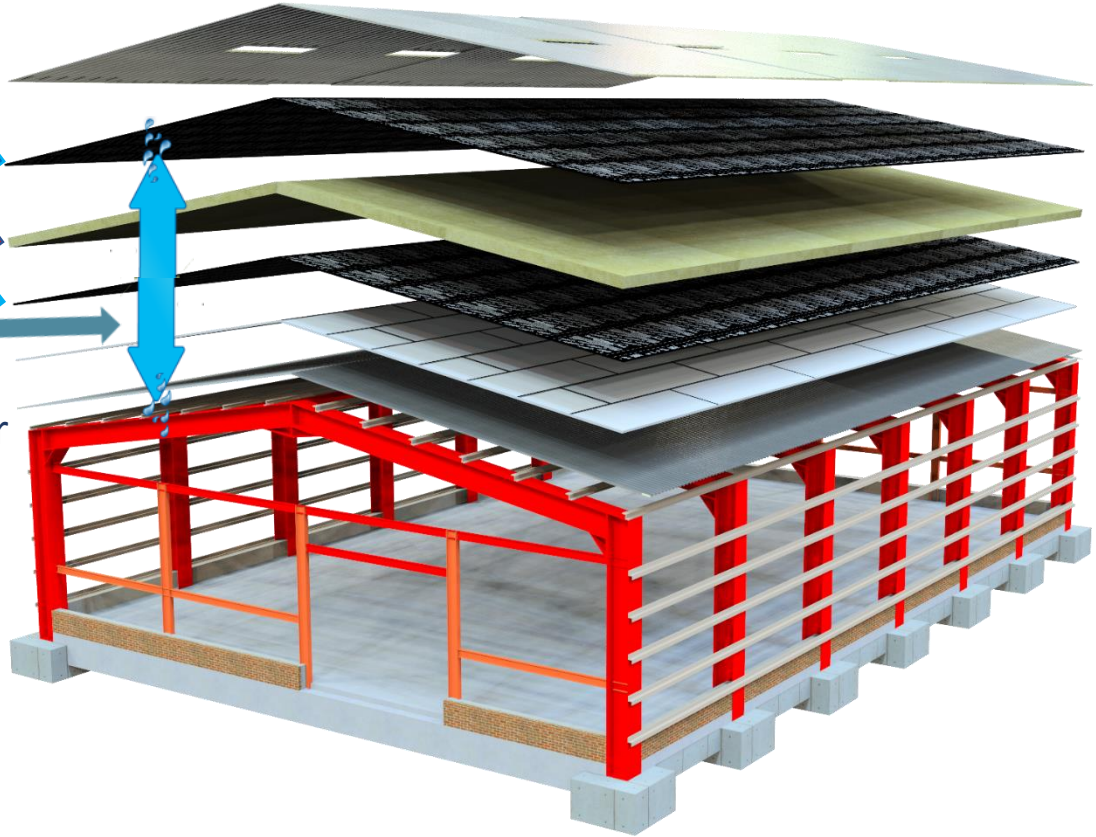
- Airtight
- Watertight
- Vapor tight
- Mechanically attached



Basic Requirements for an Assembly

Controls:

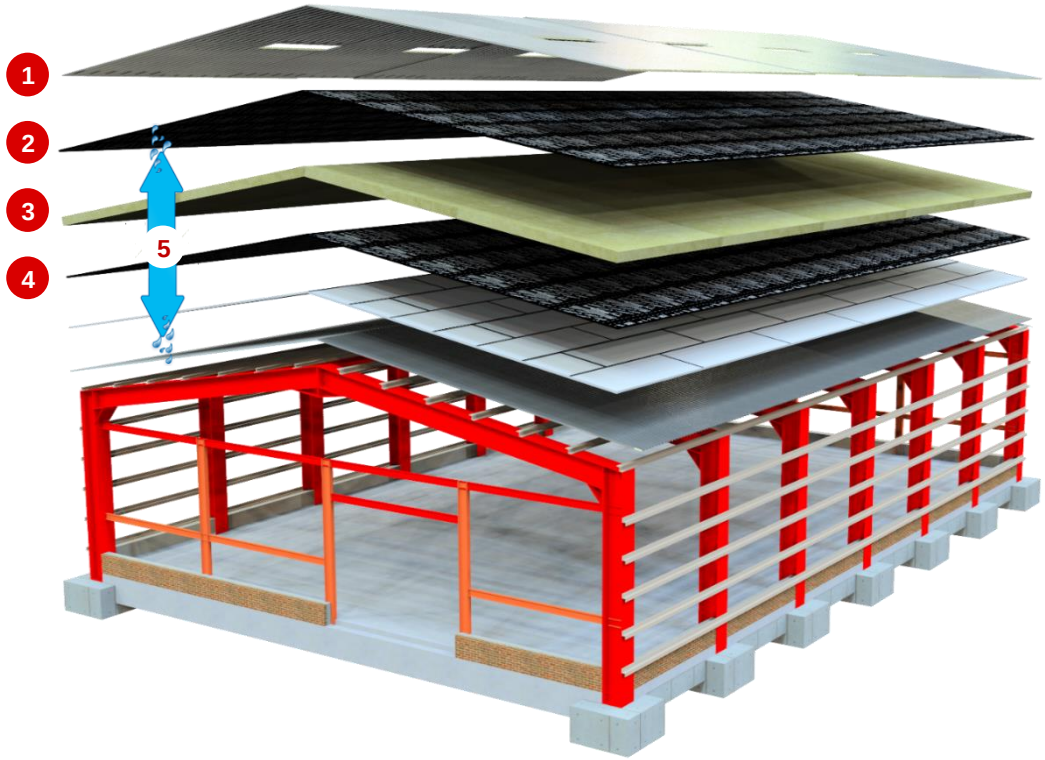
- Moisture flow
- Heat flow
- Air flow
- Vapor Open



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

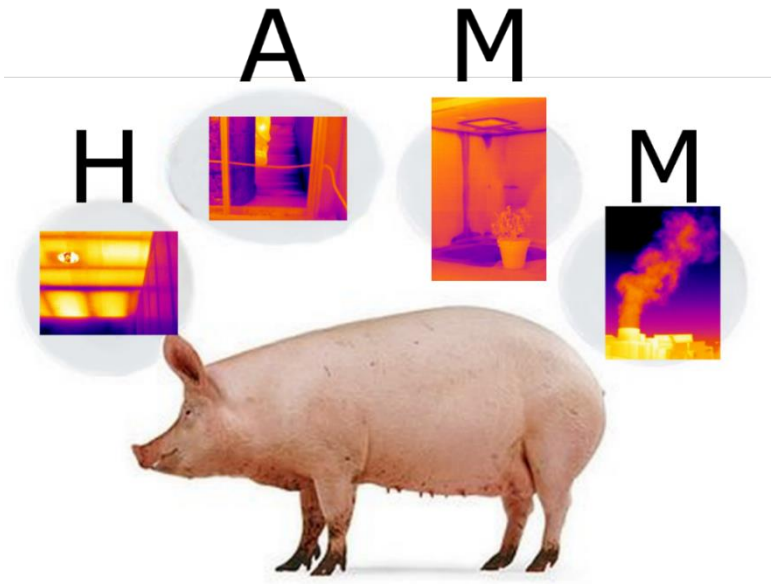
Basic Requirements for an Assembly

1. **Rain control:** The primary waterproofing layer is the major barrier to water, snow, and ice penetration
2. **Moisture flow:** The underlayment controls moisture flow and allows any moisture that gets past the primary layer to drain out without further penetration.
3. **Heat flow:** Insulation stops heat flow, loss, and gain.
4. **Airflow:** The assembly must control airflow, which also carries heat and moisture.
5. **Vapor open:** The assembly should be vapor open to allow vapor diffusive drying in both directions.



The Four Controlling Elements

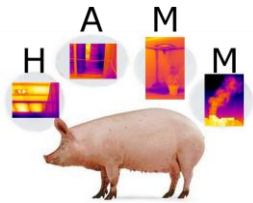
- H: Thermal control
- A: Air control
- M_{liquid}: Rain control
- M_{vapor}: Vapor control

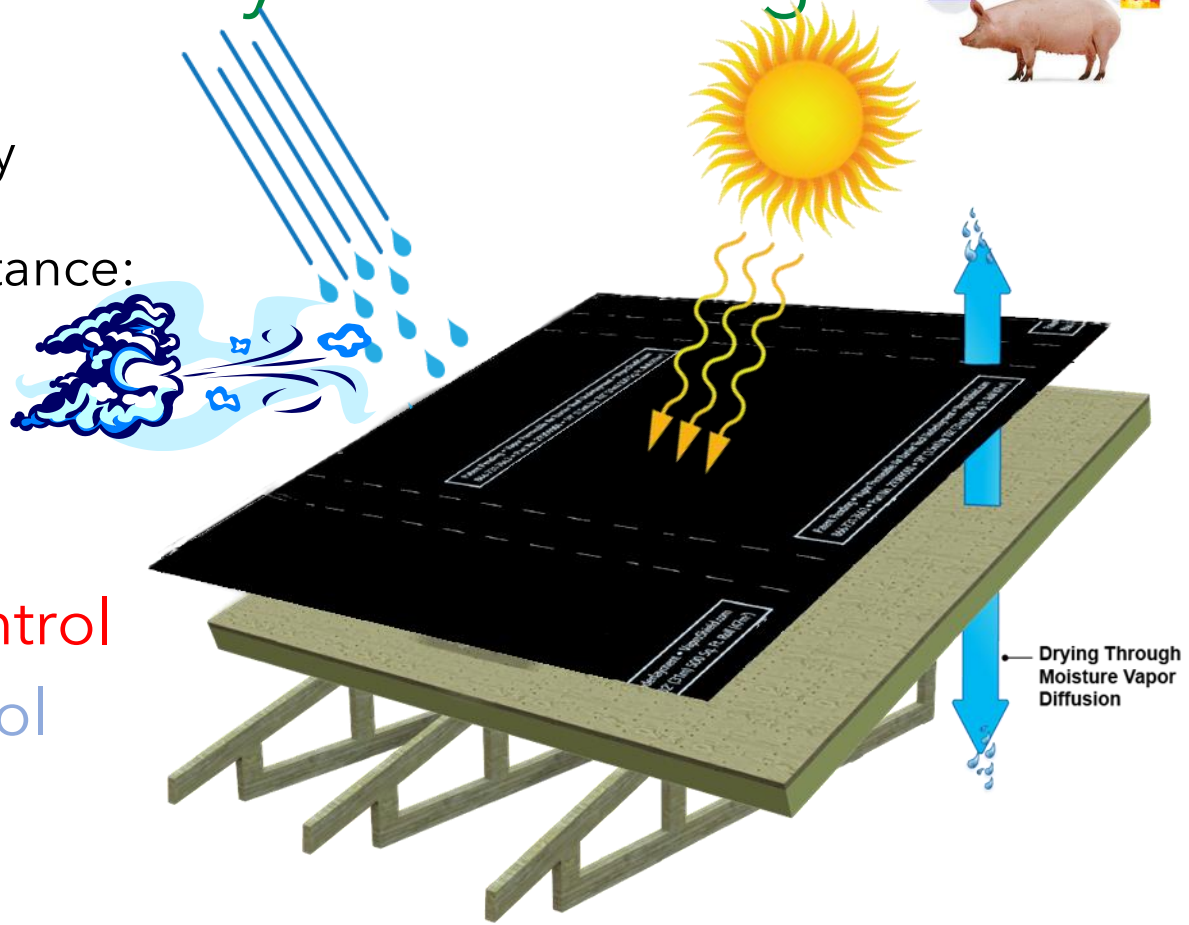


The Roof Assembly's Controlling Elements

The roof assembly must control, in order of importance:

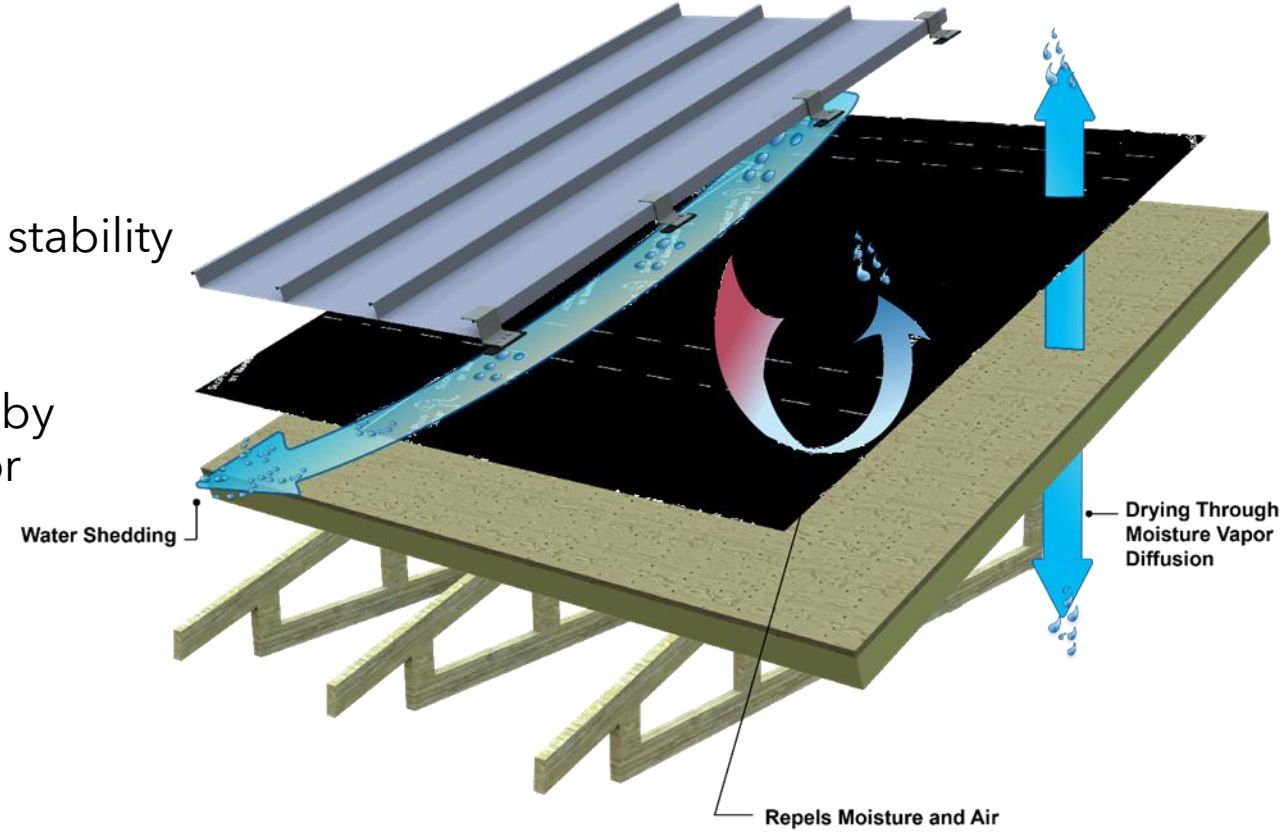
1. Rain Control
2. Air Control
3. Thermal Control
4. Vapor Control





Breathable Roofing Underlayment

- Airtight
- Watertight
- Long-term UV stability
- HIGH DRYING CAPACITY
  Allows drying by moisture vapor diffusion



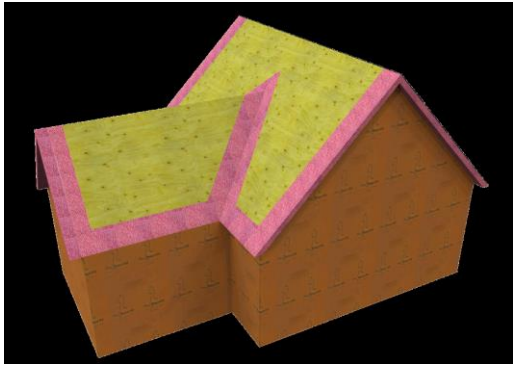
Roofing Underlayment Requirements

- Introduced 2007 Codes (IBC, IRC, The State of Florida) called for Self Adhered (SA) underlayment
- 2008 the “Self Adhesion” was made optional

Traditional Self-Adhering Underlayments

- Robust, thick “pool liner”
- Claims to “self heal” around punctures
- Vapor impermeable
- Self-adhesion started as asphalt
- Progressed to butyl-based adhesive
- Moved to pressure sensitive adhesive (PSA)

Ice Barriers: Pool Liners

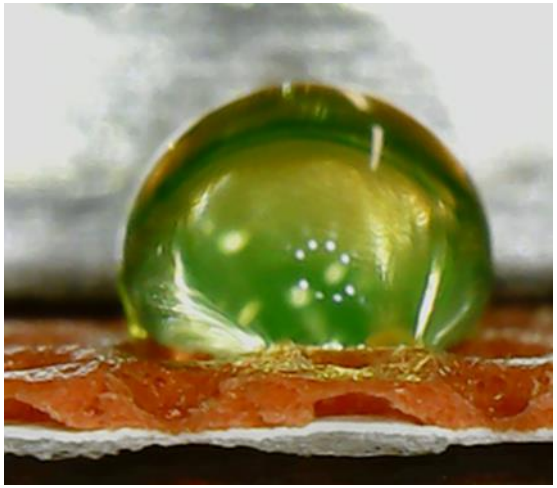


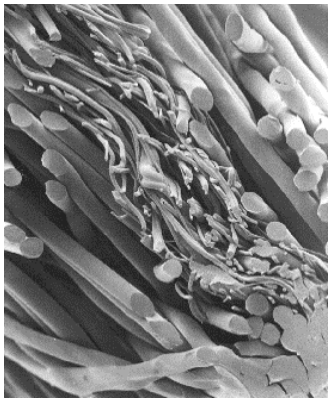
IBC2021:
1507.1.2 Ice barriers
In areas where there has been a history of ice forming along the eaves causing a backup of water, an ice barrier shall be installed for asphalt shingles, metal rood shingles, mineral-surface roll roofing, slate and slate-type shingles, wood shingles, and wood shakes. The ice barrier shall consist of not less than **two layers of underlayment cemented together**, or a **self-adhering polymer modified bitumen sheet** shall be used in place of normal underlayment and extend from the lowest edges of all roof surfaces to a point not less than 24” (610 mm) inside the exterior wall line of the building.

Water Holdout

- Evaluations for water hold out testing

Vapor Open Water & Air Tight?

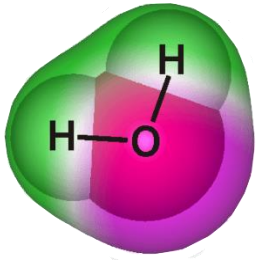




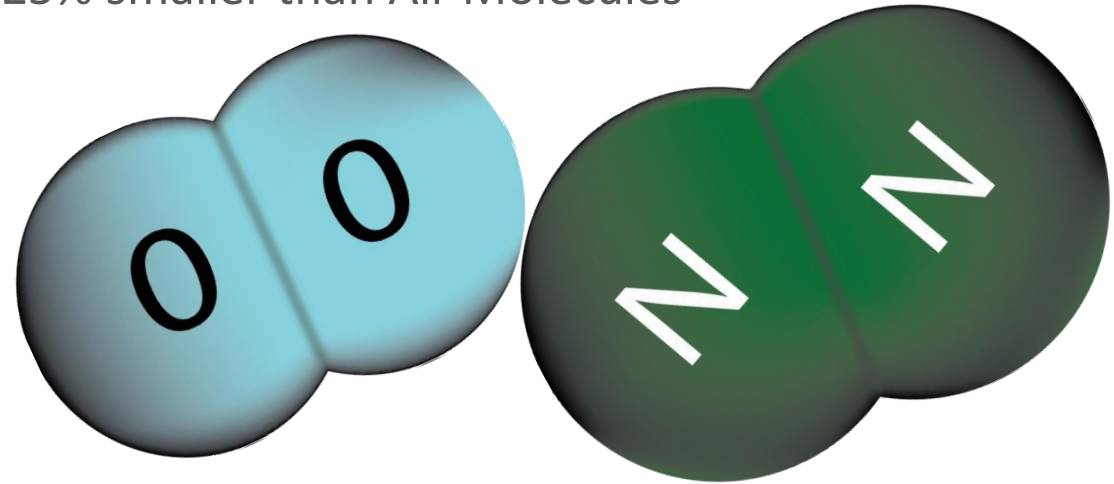
Vapor Open Water Tight?

How can a WRB/AB be Vapor Open (Permeable) and Air Tight?

- Water molecules are 25% smaller than Air Molecules



Water molecule = 275 picometers (pm)

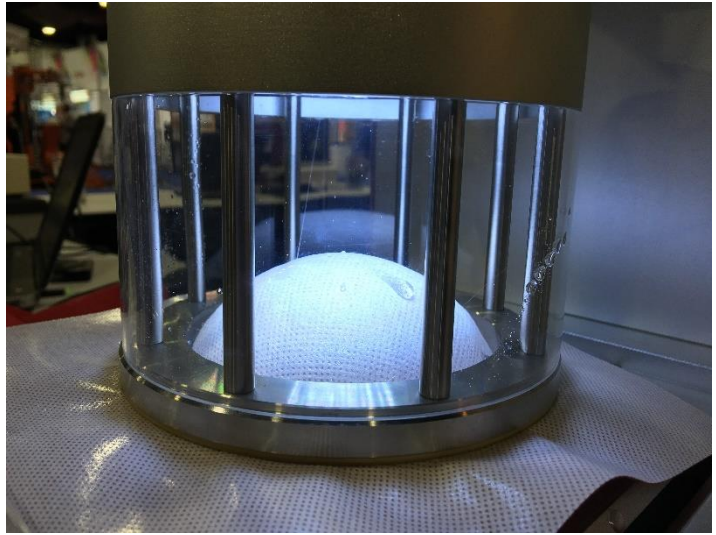


Air molecule = 320-370 pm

Water Holdout Tests

- 'Boat test' (ASTM D779)
- 'Ponding test'-Canadian Construction Materials Center (CCMC 07102)
- Hydrostatic Pressure Test (AATCC Test method 127 Modified
- Hydrostatic Pressure Test EN 20811

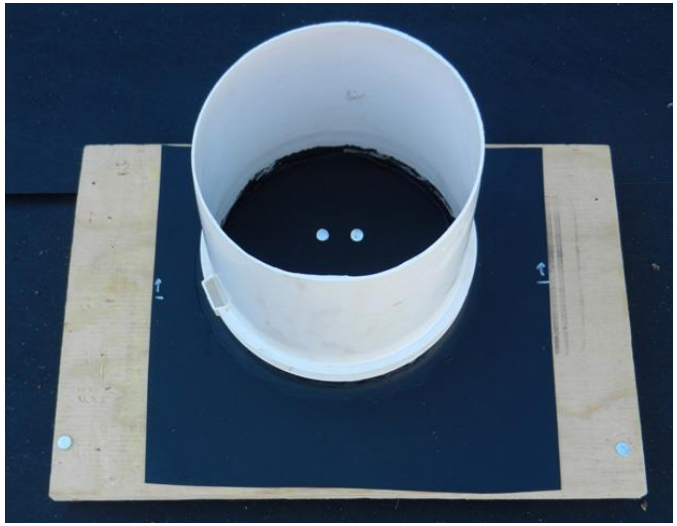
- Indicator material in a "boat" 60 min
- 2.5 cm (1") water column 2 hours
- 61 cm (24") column 72 hours

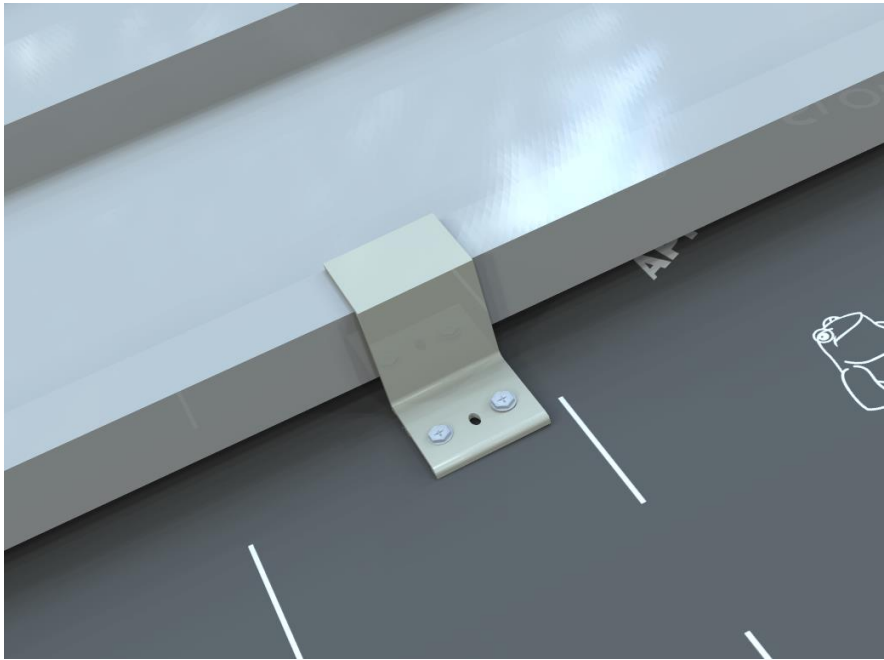


Nail Sealability Test

ASTM D7349-*Standard Test Method for Determining the Capability of Roofing and Waterproofing Materials to Seal Around Fasteners.*

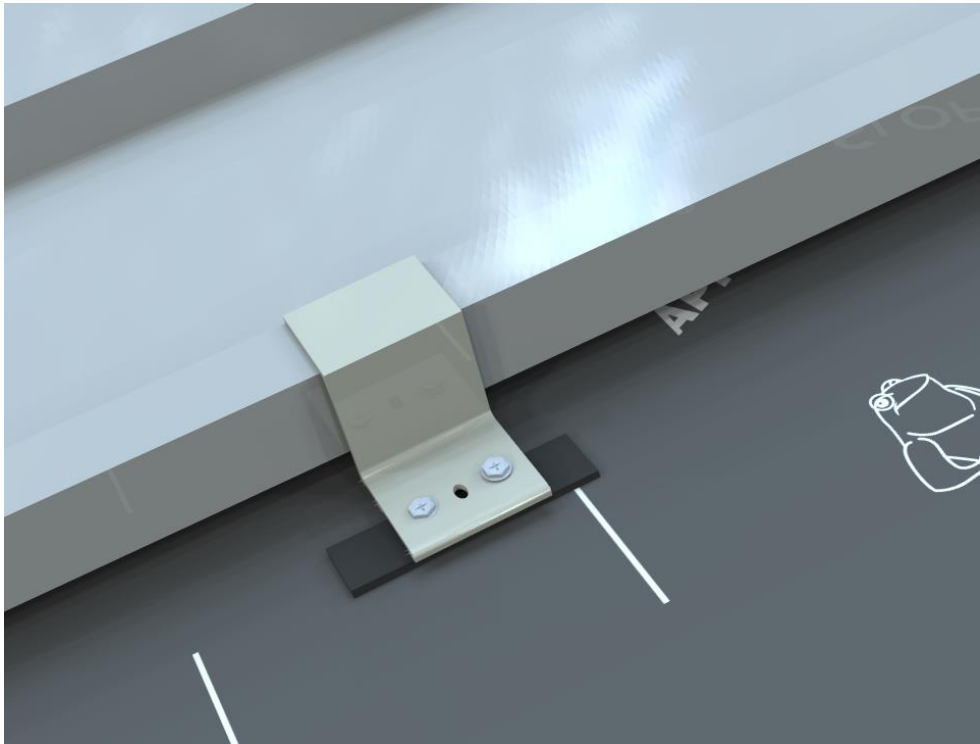
- Fastener water hold-out test





Nail Sealability Test

- To ensure water holdout use a shim to “gasket” large fasteners.



Common Causes of Roof Failures

- Ice damming
- Changes in roof drainage
- Build up of roof debris
- Deterioration due to condensation. Lack of air tightness and breathable membrane

How Much Moisture does Roofing Assembly Hold?

- Hygric Buffer: hygroscopic materials that can store moisture.

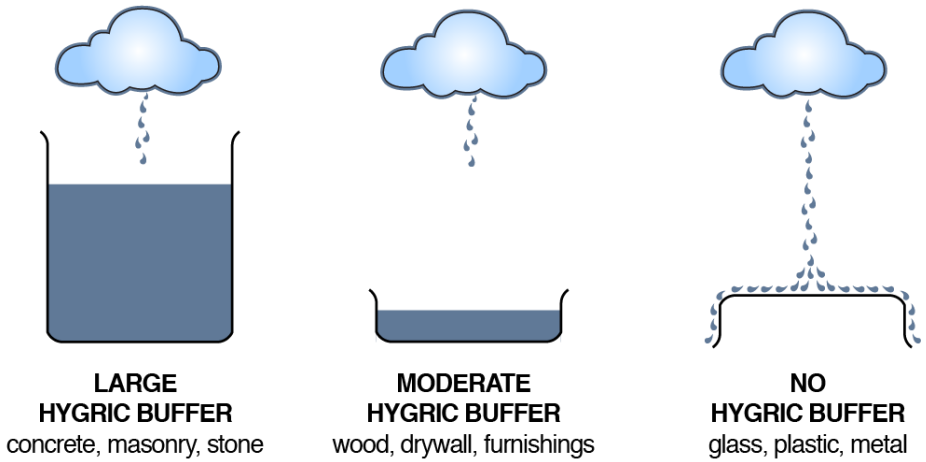


Image Source Whole Building Design Guide, a program of the National Institute of Building Sciences

Adsorption (hygroscopic material)

- ASHRAE Handbook of Fundamentals
- Adsorption provides a Hygric Buffer Though >80% RH causes damage

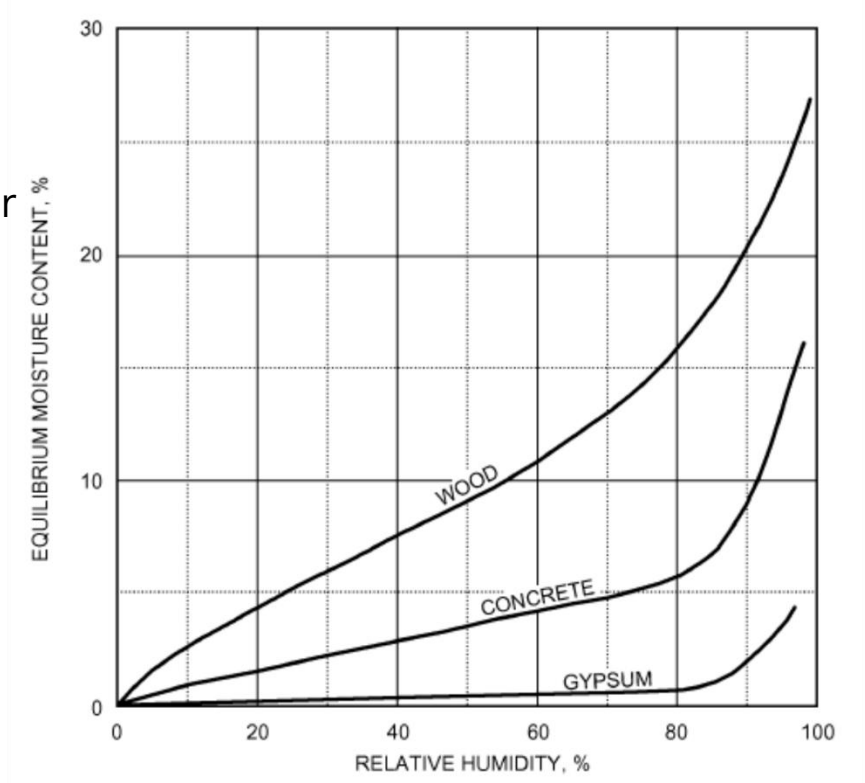
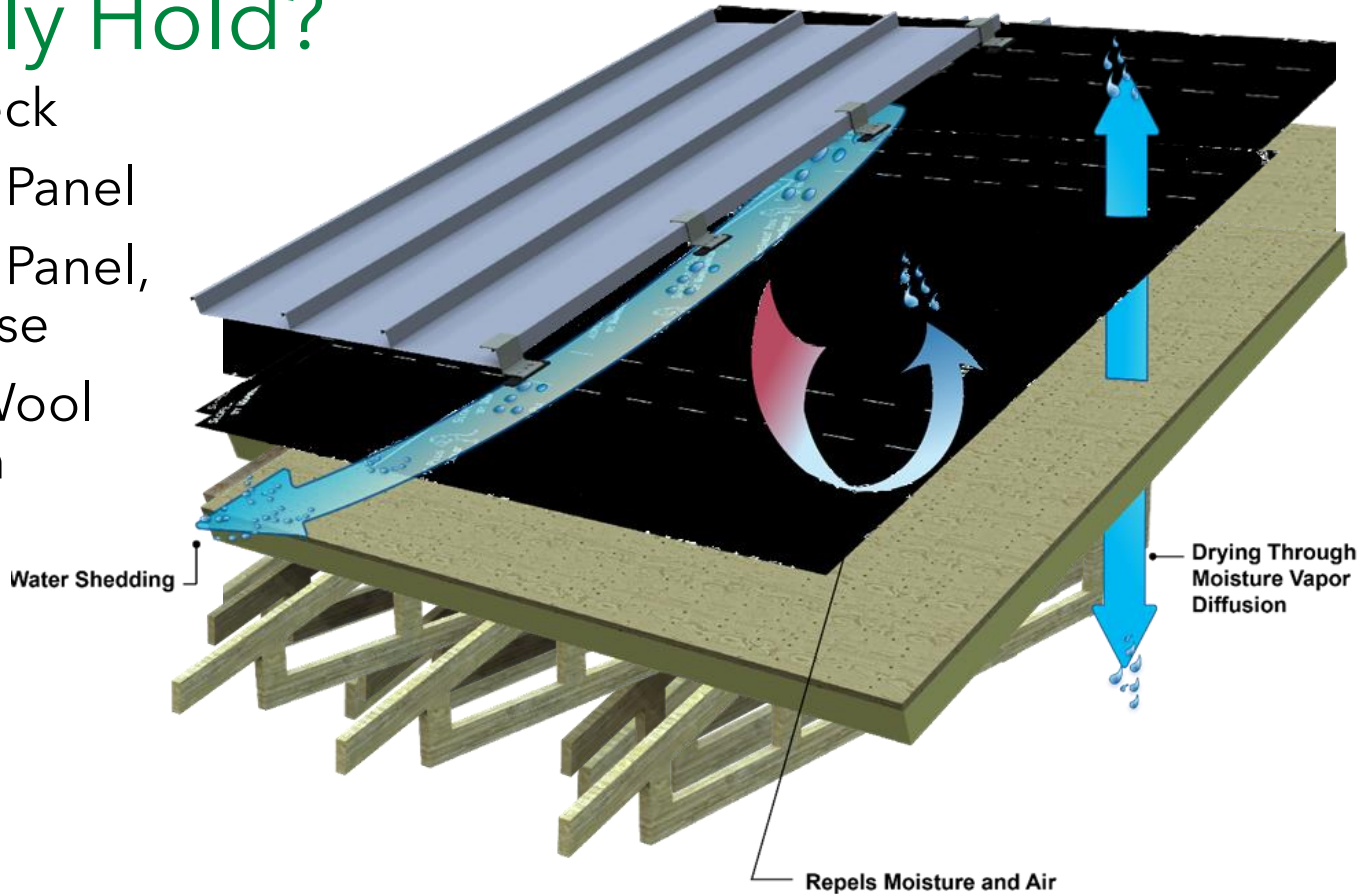


Fig. 1 Adsorption Isotherms for Wood, Concrete and Gypsum

How Much Moisture does Roofing Assembly Hold?

- Wood Deck
- Insulated Panel
- Insulated Panel, Wood base
- Mineral Wool Insulation
- CLT



Color Matters

- Black color intentional
- Absorbs heat from the sun
- Accelerates drying process of wet sheathing and insulation

Dries existing insulation for Roofing replacements

Durability, Water Holdout & High Drying

Should be:

- Durable to foot traffic
- Excellent traction for installers
- Long exposure times: 180 days
- Suitable for all climates and geographic locations, including extreme temperature areas
- High drying capacity
- Exceptional water holdout

Construction Protection

MASS TIMBER PROTECTION

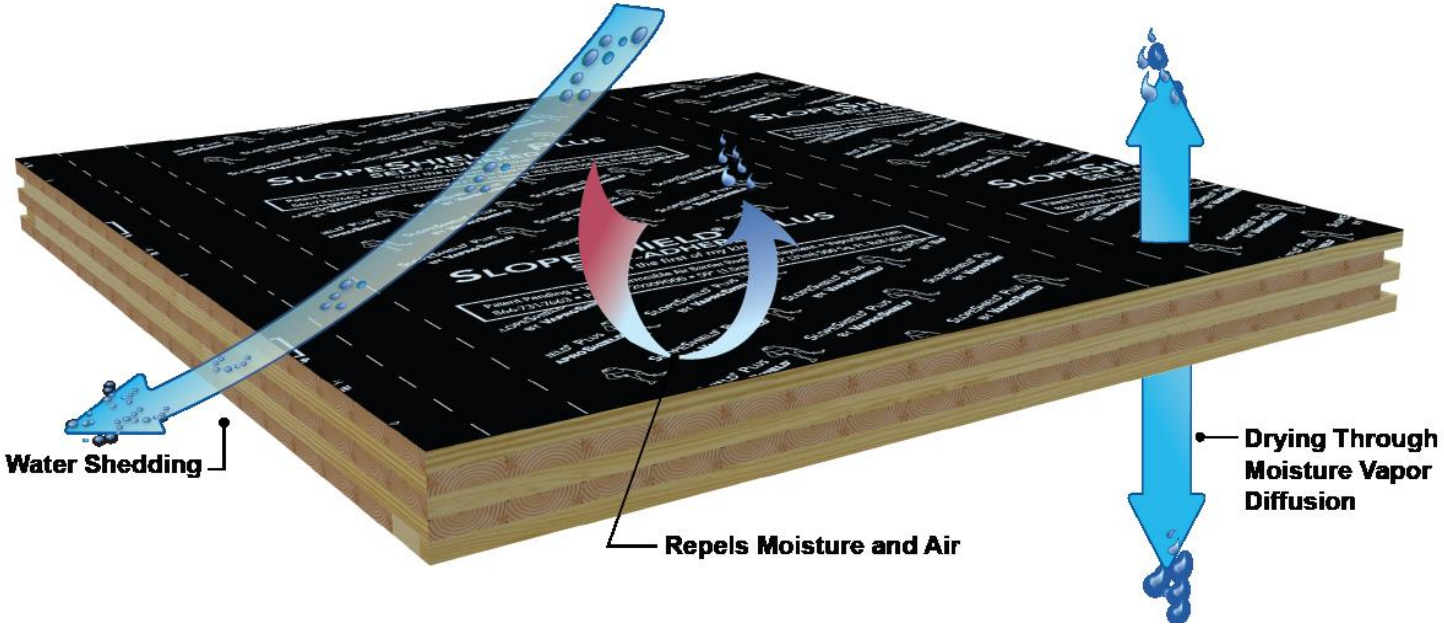
Mass Timber protection

- Taller wood buildings experience greater water loads

- A water-resistive barrier (WRB) and roof membrane/ underlayment is needed to protect the enclosure from water ingress during construction

Permeable Moisture Membrane Protection

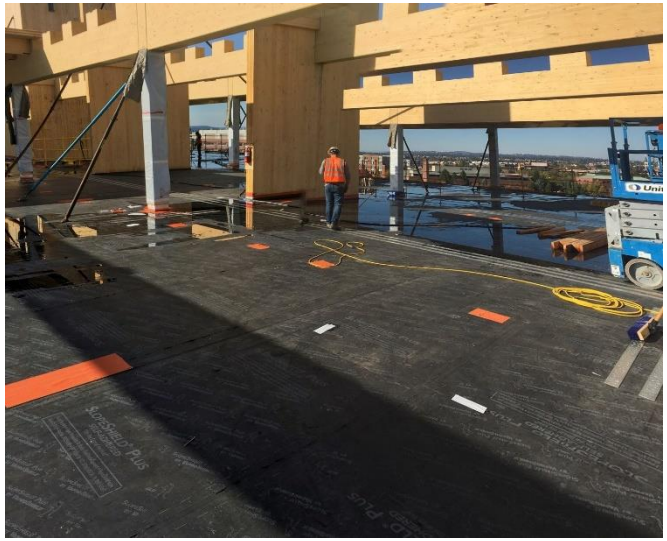
- A permeable roof membrane underlayment is used for protection of roof and floors to protect and allow drying.

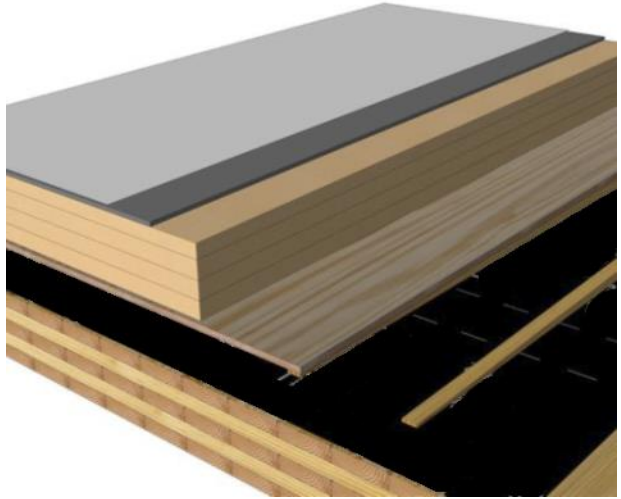


Floor and Roof Protection

- Provides water protection during construction.

- Provides an Air Barrier

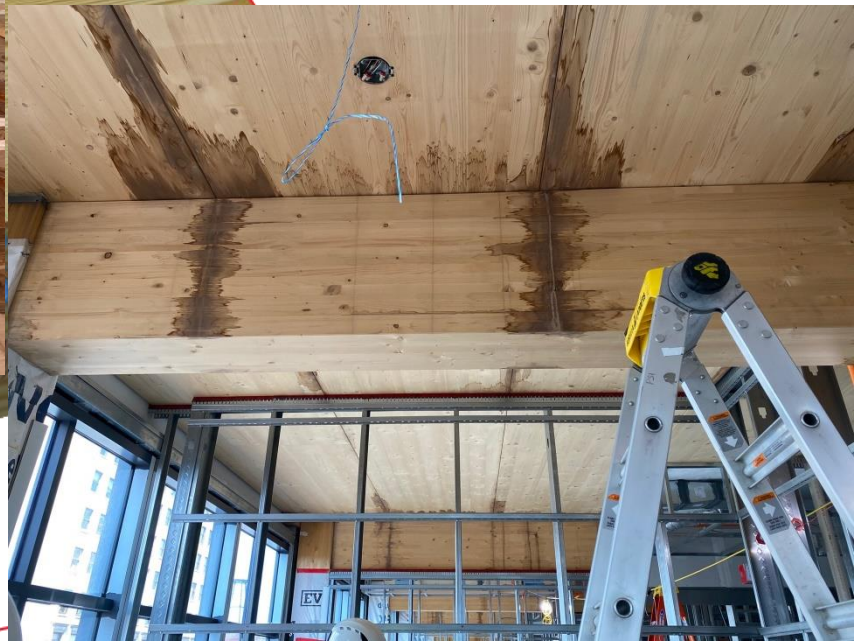




Deck and Roof Protection for Mass

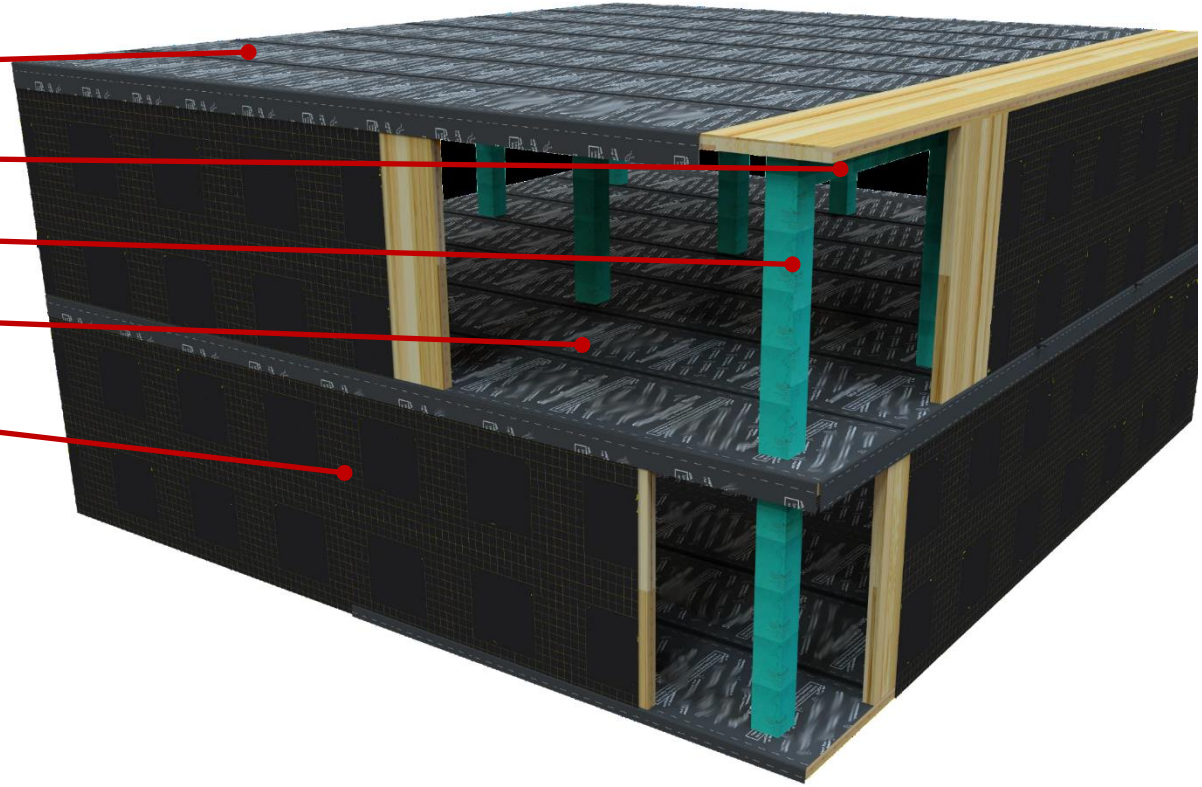
- Water protection during construction is critical

Taped Joint Moisture Protection Failure



Moisture Protection for the Building

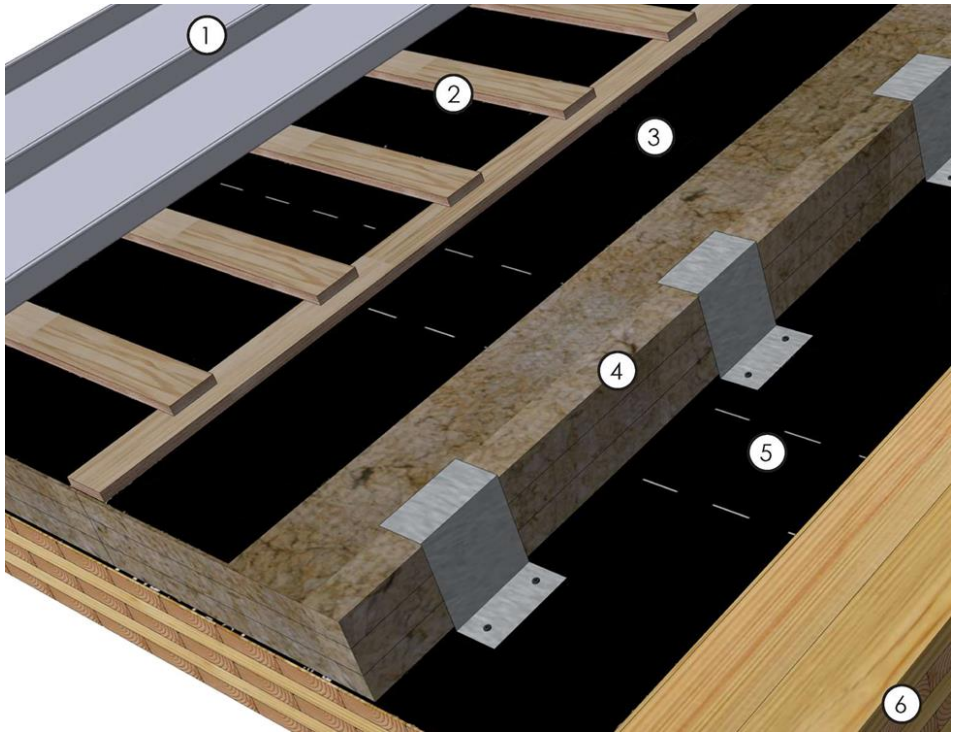
- Roof
- Column
- Beam
- Floor
- Wall



Details – Metal Roofing Insulated Mass Timber

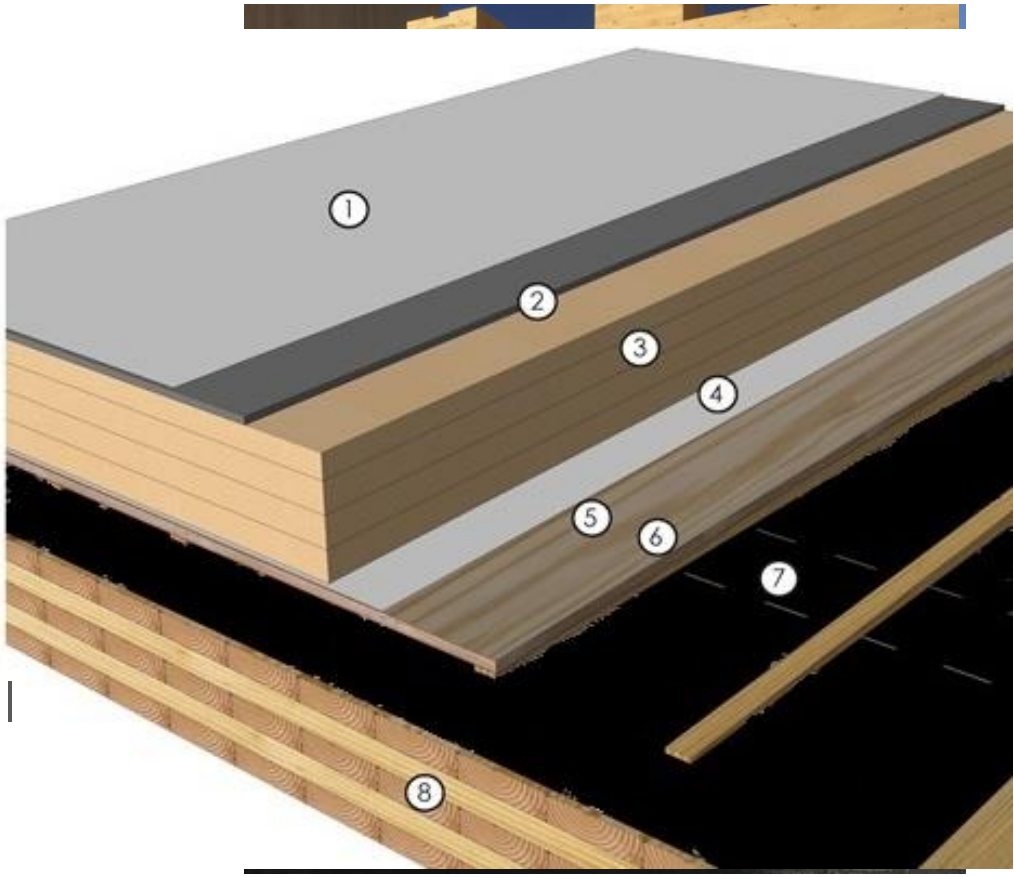
- Roof construction and insulation approaches will vary, but some general examples follow:

1. Standing seam metal roof panel
2. Batten/counter batten
3. Breathable roof underlayment allows underlying materials (4, 6) to dry out
4. Mineral wool insulation between intermittent metal clips
5. CLT roof deck protection during installation before final assembly is installed

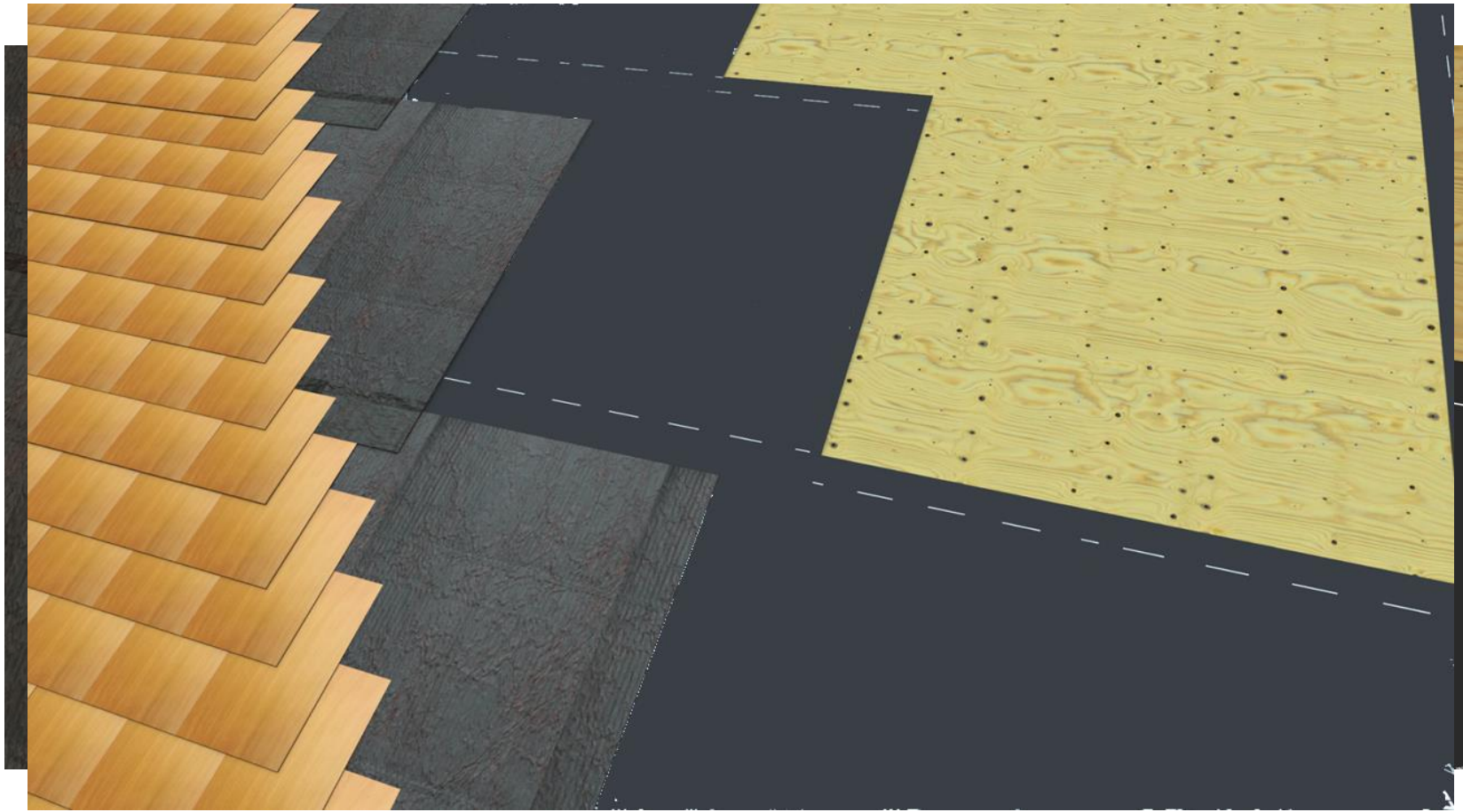


Construction Phase Considerations

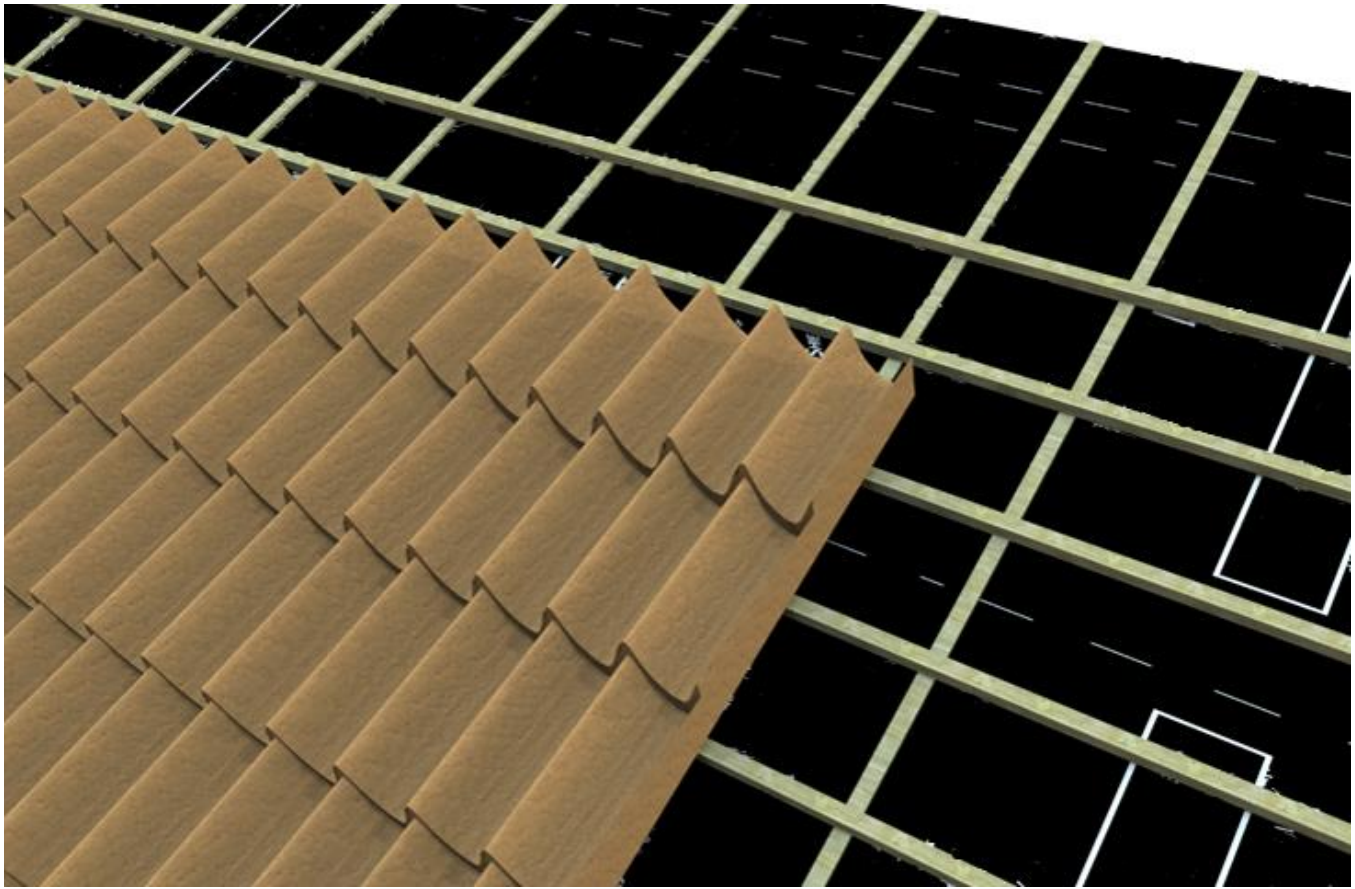
- A roof underlayment may be used for temporary protection in some cases
- A moisture management plan should include shipping coordination and protection, site protection, and general water management



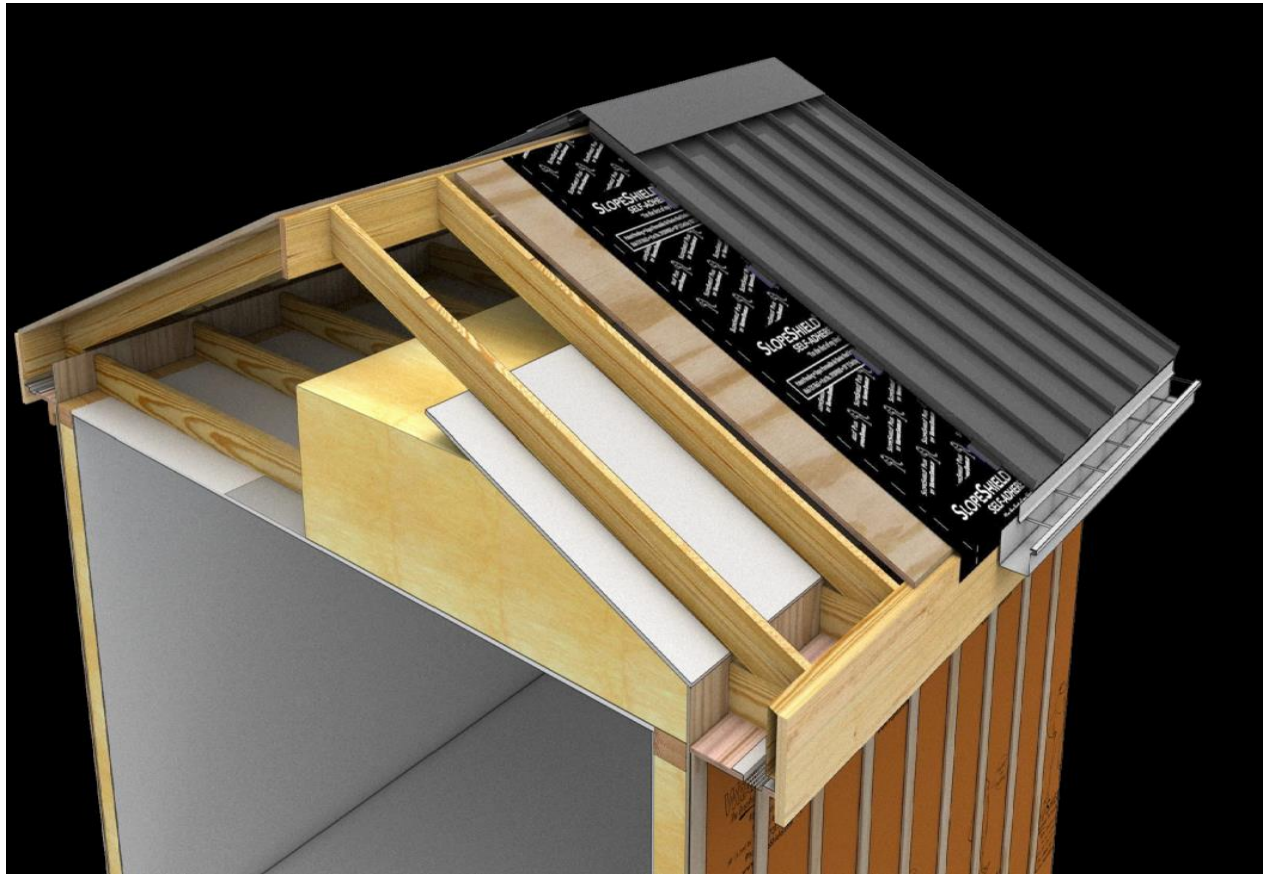
Details – Cedar Shakes



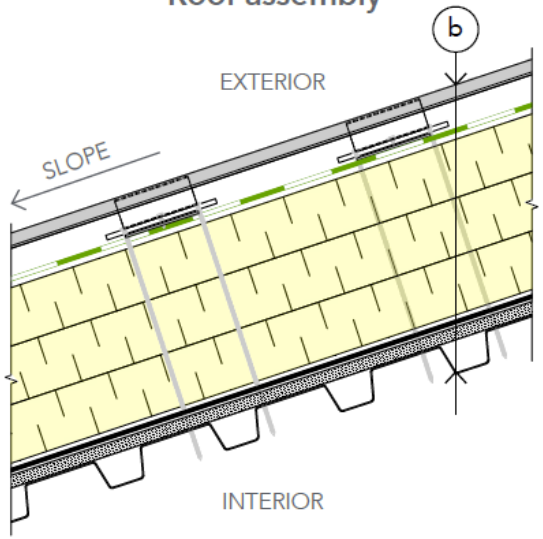
Details - Slate/Clay Tile



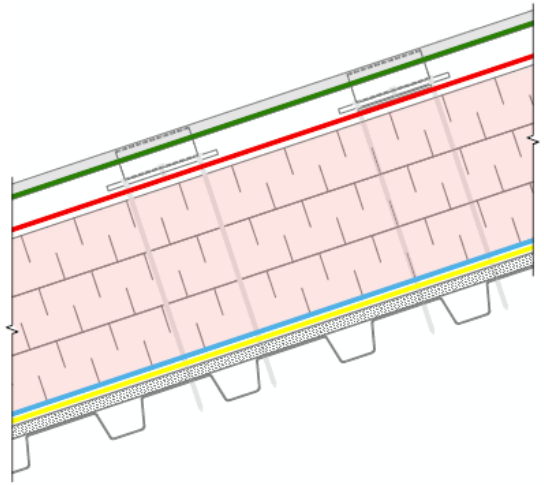
Residential



Roof assembly



Control layers



Assembly b:

Exterior

- Roof covering
- Ventilated air space
- Underlayment
- Thermal insulation
- Air barrier and vapor retarder membrane*
- Substrate board
- Structure

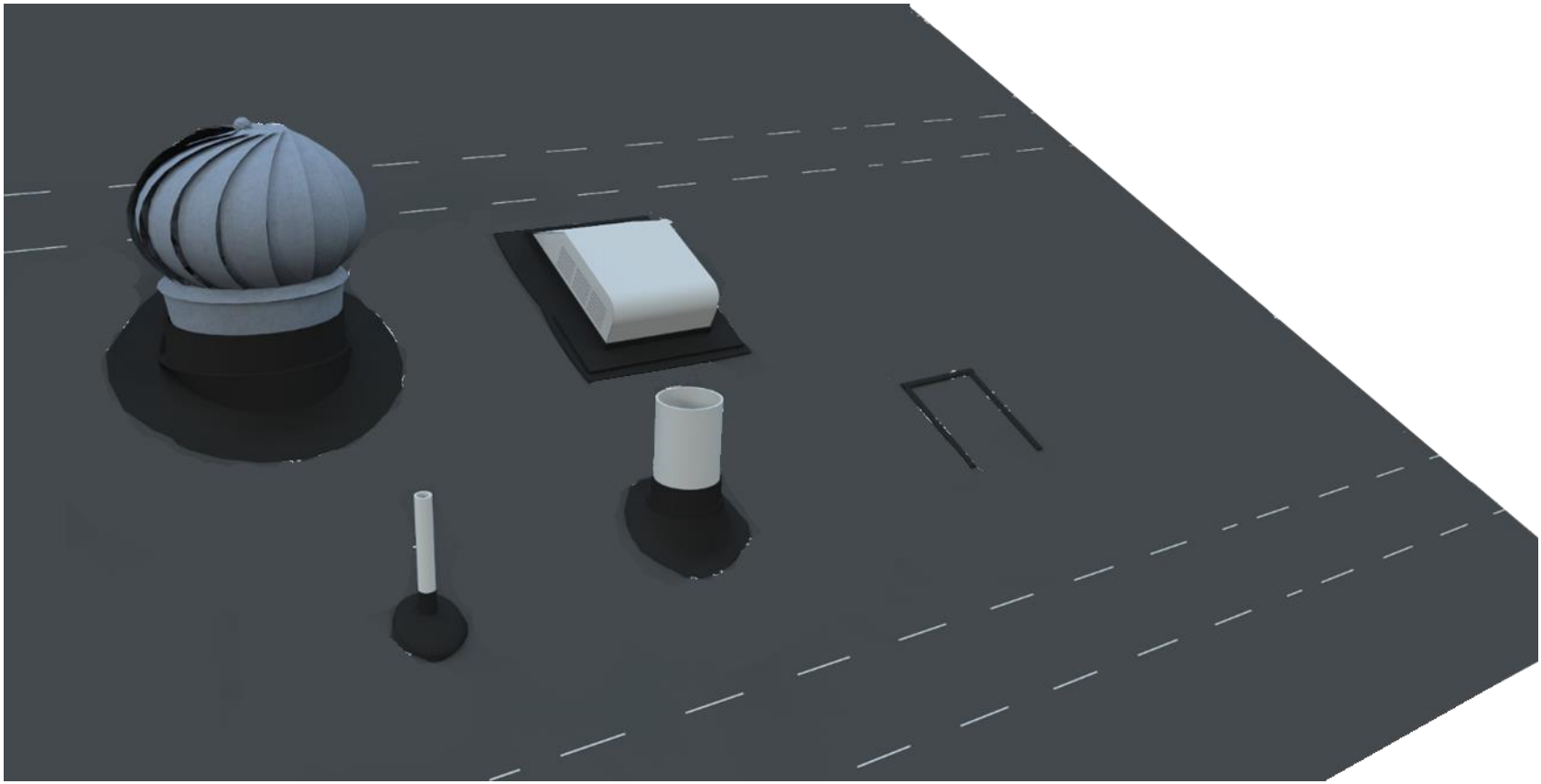
Interior

Control Layer Legend

- Water-shedding surface
- Water control layer
- Thermal control layer
- Air control layer
- Vapor control layer

**The need for vapor control at this plane may vary with climate.*

Details - Penetrations



The Enclosure Envelopes the Building

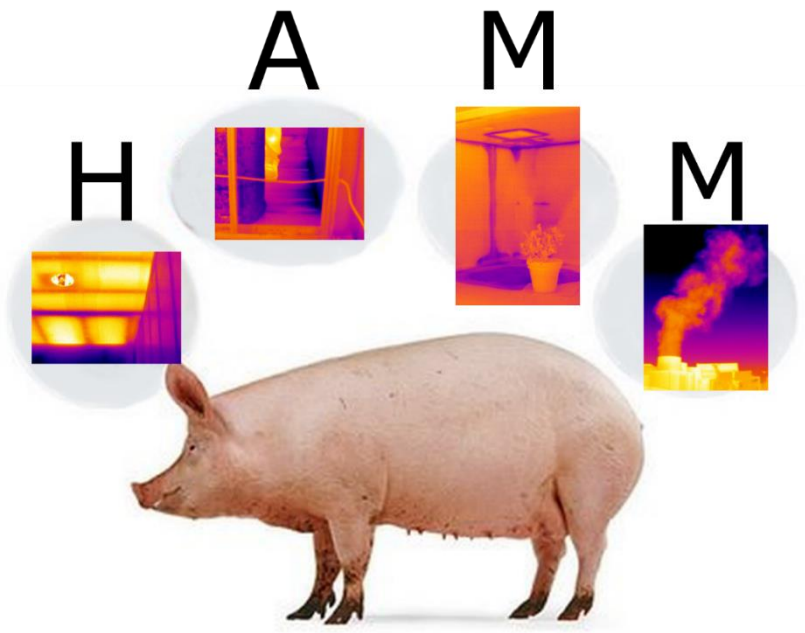
- The building enclosure has four major functions.

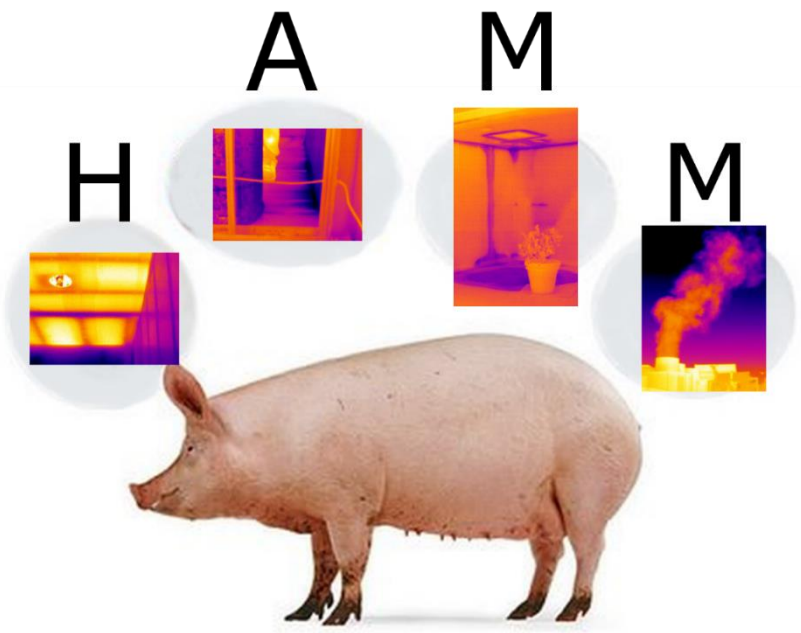
H: Thermal control

A: Air control

M_{liquid}: Rain control

M_{vapor}: Vapor control



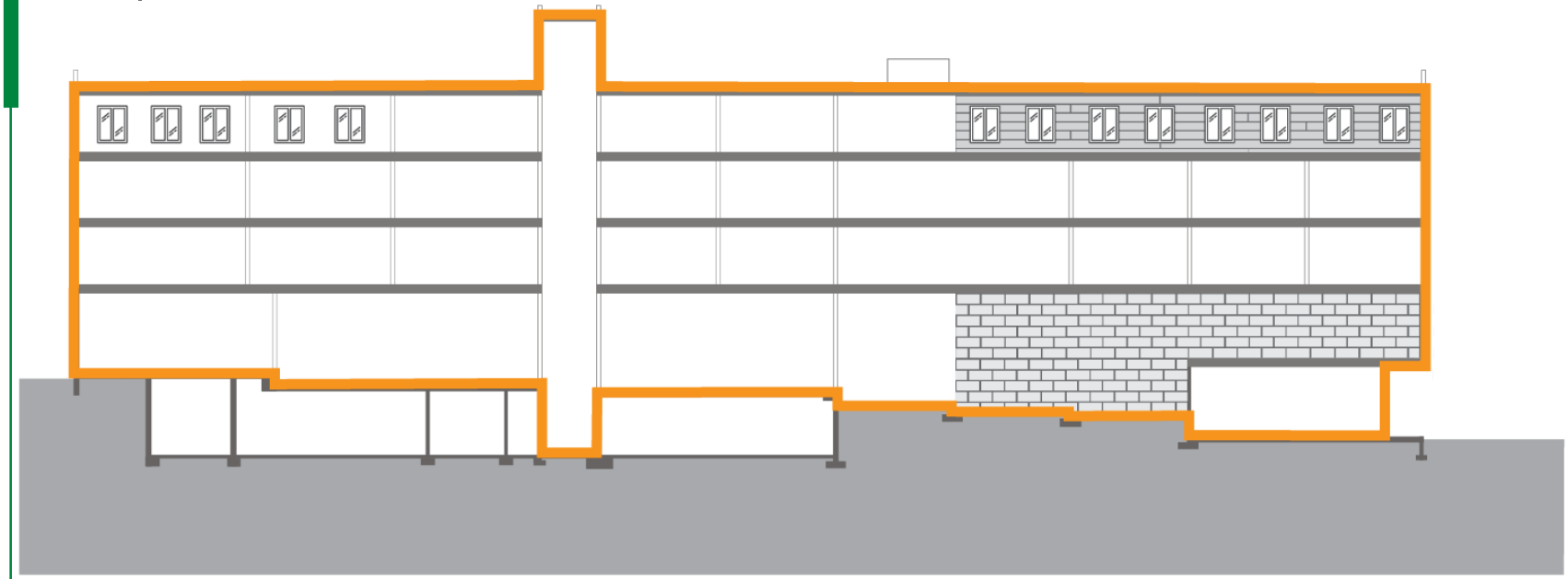


Of the four controlling elements which must be continuous?

- H: Thermal control
- A: Air control
- M_{liquid}: Rain control
- M_{vapor}: Vapor control

Continuous Air Barrier/High Drying Capacity WRB

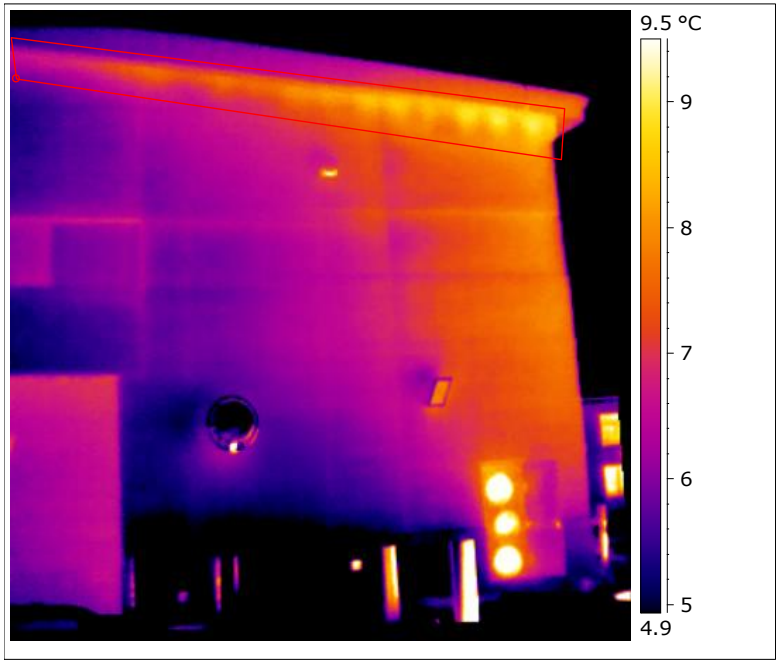
- Vapor Open Air Barrier must surround the conditioned space



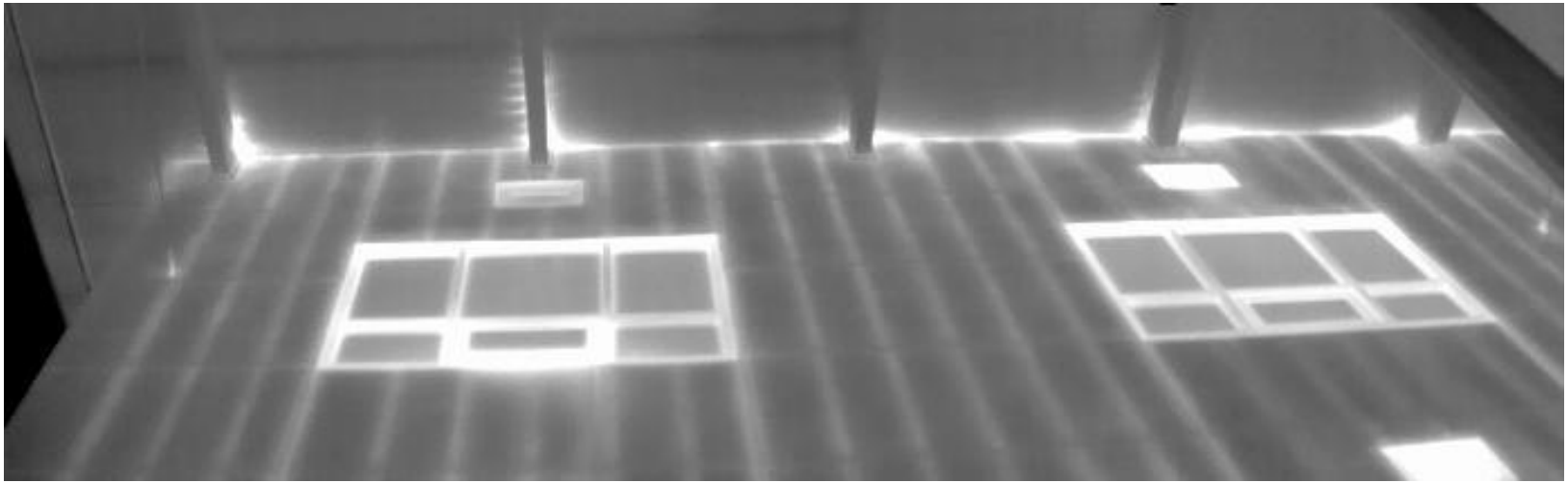
Air Leakage Testing

US Army Corps of Engineers®

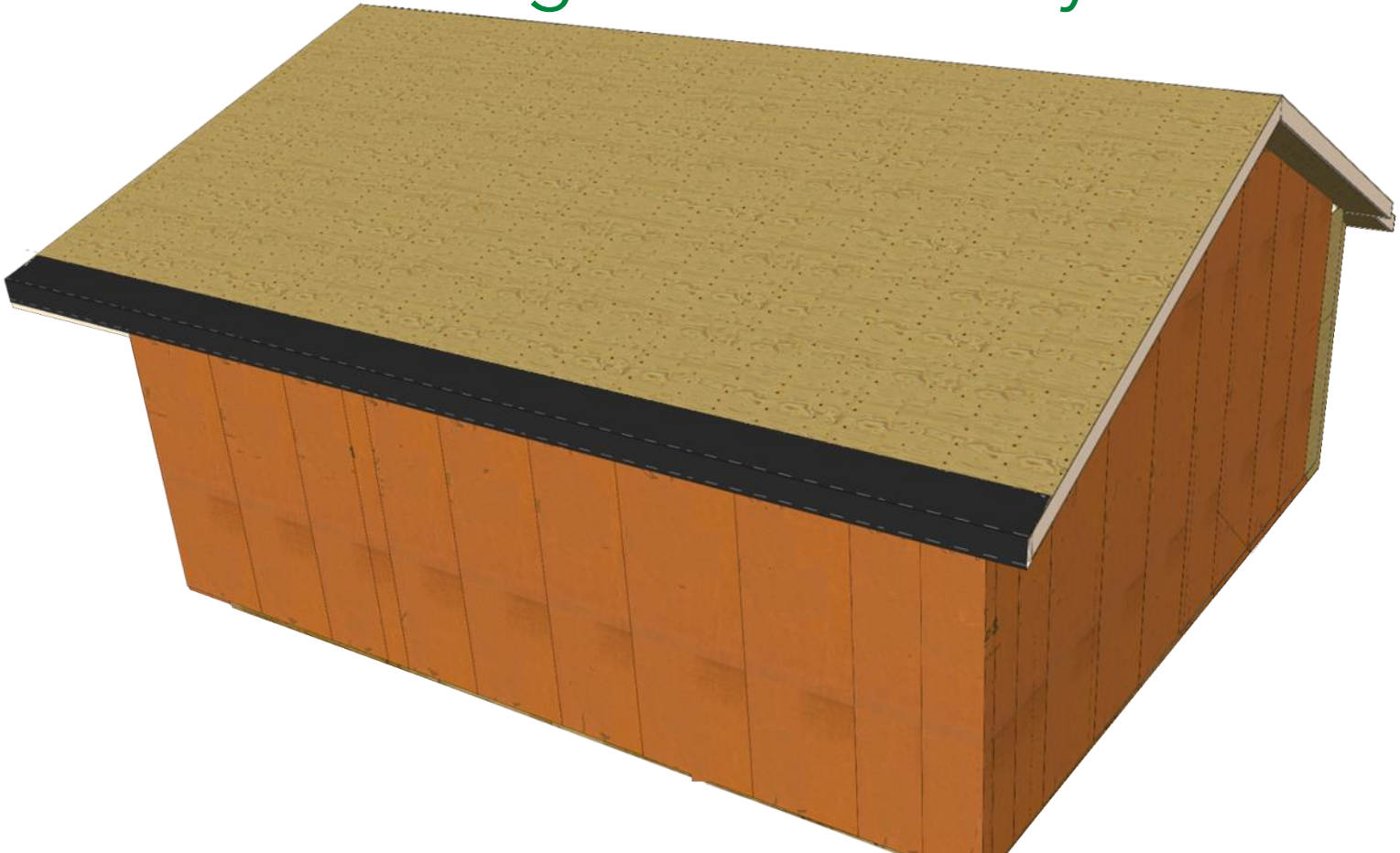
USACE Air Leakage Protocol



Air Leakage Testing

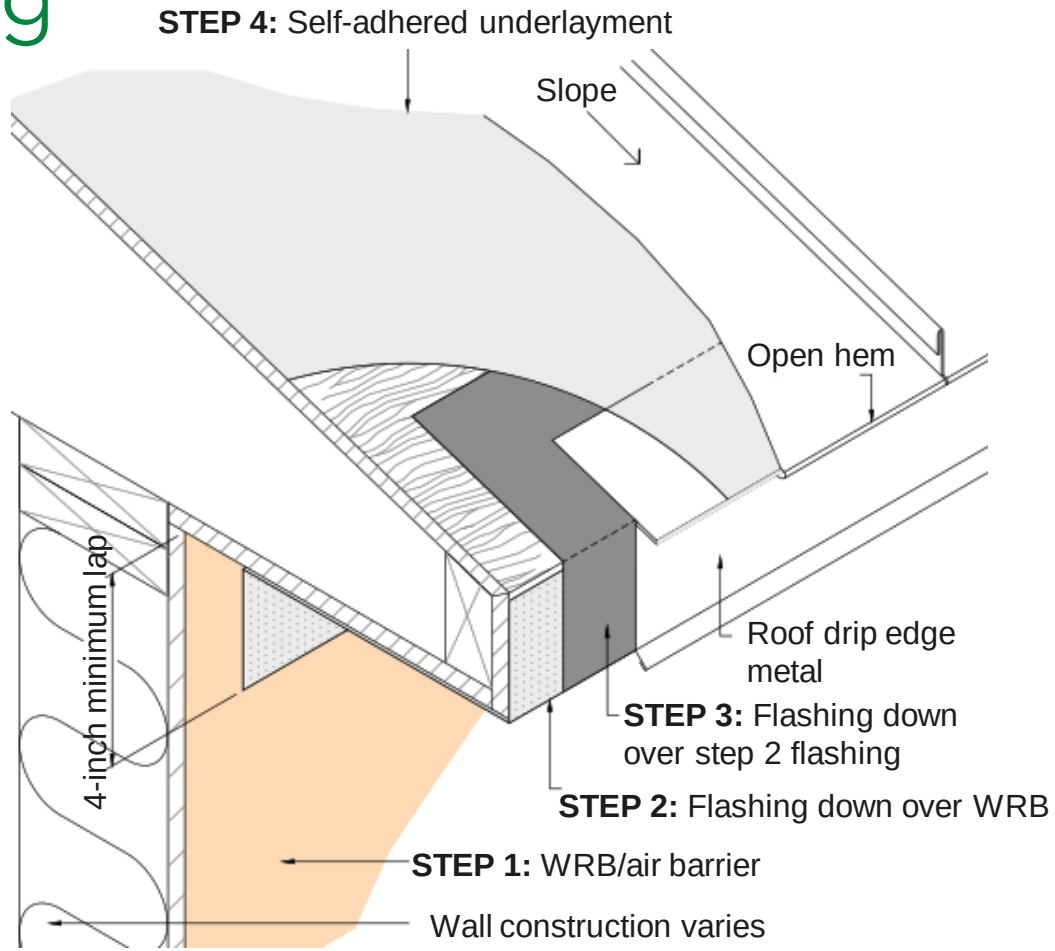


Details – Flashing for Continuity



Details - Flashing

Ensure air barrier continuity by extending the roof membrane flashing shingled over the wall WRB/Air Barrier membrane



Summary

History

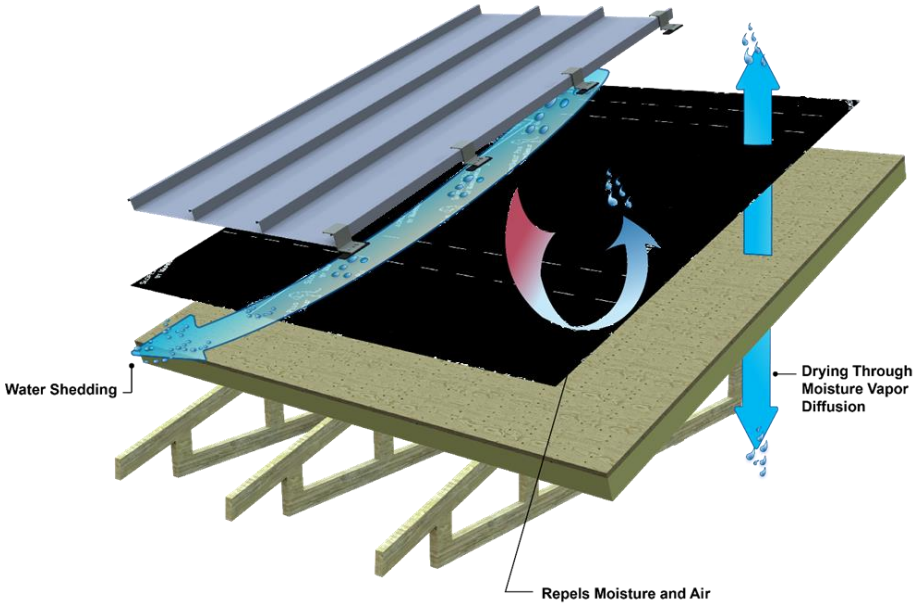
- Asphalt Felt – 1859
- Synthetic - 2010

Roof Assembly Barriers HAMM

Vapor-Open SA Underlayment

- Ease of Install
- Water/Air Barrier
- UV stable
- Increased Drying
- Provides Sustainability

EXTENDING THE LIFE OF THE ROOF ASSEMBLY



THANK YOU FOR YOUR TIME

VAPROSHIELD®
Breathable Membrane Systems for Roofs & Walls