Control Layers: Vapor Barriers, Vapor Retarders & Air Barriers

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Program Description

There are a few control layers within an assembly and in this webinar we will look at 3 of them. Vapor retarders, vapor barriers and air barriers are distinctly different but are often interchanged. In this webinar we will review the property differences along with applications of use for each.

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Program Objectives

- Understand the reason for control layers and how they can reduce the flow of moisture & air through and assembly
- Review the difference between Vapor Barriers, Vapor Retarders & Air Barriers and how installing the wrong product for the application can reduce the structural integrity of the assembly.
- Review why a vapor barrier should be installed in specific applications to increase indoor air quality for the occupant.
- Understand the definitions of vapor barriers and vapor retarders and review the correct item to use as your control layer.

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Today's Goal

- Understand that moisture can move through an assembly by means of both diffusion and convection
- Understand how to reduce both by choosing the correct material
- Understand the importance of using the correct terminology

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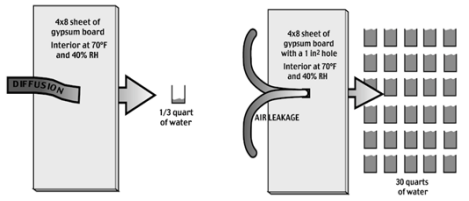
Diffusion vs. Convection



Source: Building Science Corporation.

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Typical Assembly Behavior

- Enclosure assemblies typically get wet through:
  - Convection
  - Bulk moisture penetration
- Enclosure assemblies typically dry though:
  - Diffusion
  - Evaporation

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Drying

- Drying is the result of properly designing enclosure assemblies to allow for intruding moisture to dry to the interior, exterior, or both by diffusion and evaporation

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Control of Water Vapor in Diffusion

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What is a Throttle?

- The material in a building enclosure assembly with the lowest vapor permeability
  - This material will limit the overall amount of water vapor that can travel through the enclosure via diffusion
  - Example: vapor retarders are throttles by design

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Water Vapor Flow

- Water vapor = water in gaseous state
- Key concepts related to water vapor:
  - Relative humidity
  - Dew point
  - Condensation

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What is a Vapor Retarder?

- The element that is designed and installed in an assembly to retard the movement of water by vapor diffusion. (Building Science Corporation, *Understanding Vapor Barriers*)

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Vapor Retarders

- Keep it out and let it out if it gets in. (Building Science Corporation, *Understanding Vapor Barriers*)
- Air Control and Vapor Control can be the same material within the assembly, but often are not.

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Vapor Barriers & Retarders

- Material that limits the flow of vapor through diffusion
- Vapor retarders are NOT vapor barriers

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Vapor Retarder Classifications - IRC

- Class I Vapor Retarder:
  < 0.1 perm
- Class II Vapor Retarder:
  0.1 perm – 1.0 perm
- Class III Vapor Retarder:
  1.0 perm – 10.0 perm

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Vapor Permeability

- Vapor impermeable: < 0.1 perm
  - Foil facing
- Vapor semi-impermeable: 0.1 perm – 1.0 perm
  - Extruded polystyrene (XPS)
- Vapor semi-permeable: 1.0 perm – 10.0 perm
  - OSB
- Vapor permeable: > 10 perms
  - Brick veneer

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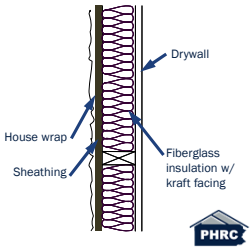
Categorize That Control Layer

- What are the potential control layer properties that house wrap is providing to this wall assembly?
  - Vapor barrier & Air barrier
  - Water-resistive barrier & Vapor barrier
  - Water-resistive barrier & Air barrier
  - All of the above



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Bulk Water Control (WRB)

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Water-Resistive Barrier

- *A material behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly.* *(2015 IRC Definition)*
- Drain the water out if it gets in. (Building Science Corporation, *Understanding Vapor Barriers*)

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Flow of Bulk Water

- Bulk water will mainly flow down due to the force of gravity.
- Different installation instructions for different applications.

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Source: https://www.canalfrontbuilders.com/blog/2018/10/17/housewraps-whats-the-difference-and-why-does-it-matter-90j0j

Source: https://www.canalfrontbuilders.com/blog/2018/10/17/housewraps-whats-the-difference-and-why-does-it-matter-90j0j

Source: https://www.huberwood.com/zip-system/long-length-sheathing

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Just a few examples of product vapor permeability

- Typar – 11.7 perms
- Tyvek – 54 perms
- Hydrogap – 16 perms
- Zip System – 12-16 perms

All Vapor Permeable or Vapor Open

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Vapor Retarder Classification Examples

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What Class is it?

- Kraft faced fiberglass batt insulation

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What Class is it?

- "Tyvek" house wrap

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What Class is it?

Source: Menards.com

- 1" of Johns Manville AP Foil-Faced polyisocyanurate continuous insulation

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What Class is it?

- 1" DuPont Styrofoam XPS Foam Insulation

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Product Specifications Matter

- Not all rigid foam is the same
- Specify the type of foam and any or no facing

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Vapor Barrier

- **Vapor Barrier < 0.1 perm**
  - *Class I* vapor retarder
  - Vapor *Impermeable*
- **When are vapor barriers necessary?**
  - When are they NOT?

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Vapor Transmission and the 2015 IRC

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2015 IRC R702.7 – Vapor Retarders

- **Class I or II vapor retarders are required on the interior side of frame walls in Climate Zones 5, 6, 7, 8 and Marine 4.**
  - Exception:
    1. Basement walls
    2. Below-grade portions of any wall
    3. Construction where moisture or its freezing will not damage the materials

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Source: International Code Council (ICC). (2014). 2015 International Residential Code, Country Club Hill, Ill.

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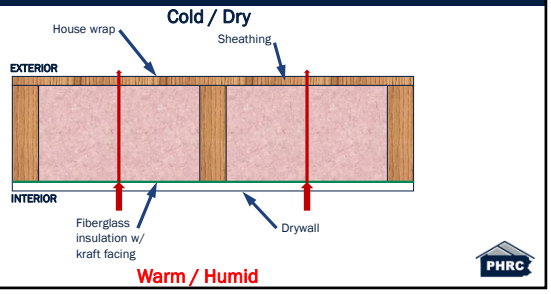
Vapor Drive in Winter



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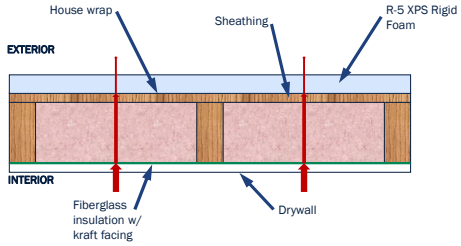
2x4 Wall with 1" R-5 XPS Exterior Foam



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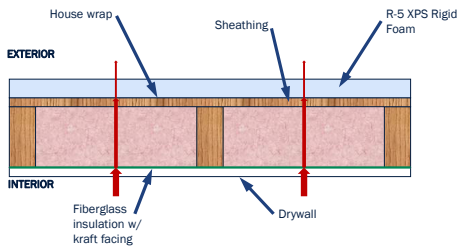
What type of scenario do we have here?



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Potential for Double Class II Vapor Retarder

- 1" Rigid XPS = 1.5 perm max./inch; Class III
- Kraft faced batt insulation = 1 perm; Class II
- House wrap = 11-54 perm; Vapor Open

Is this good?
Remember "Throttle"
Dry at least one direction

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Use of Class III Vapor Retarders

- R702.7.1 Class III vapor retarders shall be permitted where any one of the conditions in Table R702.7.1 is met.

TABLE R702.7.1 CLASS III VAPOR RETARDERS

CLIMATE ZONE	CLASS III VAPOR RETARDERS PERMITTED FOR:[a]
Marine 4	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R-value ≥ 2.5 over 2 × 4 wall. Continuous insulation with R-value ≥ 3.75 over 2 × 6 wall.
5	Vented cladding over wood structural panels. Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R-value ≥ 5 over 2 × 4 wall. Continuous insulation with R-value ≥ 7.5 over 2 × 6 wall.
6	Vented cladding over fiberboard. Vented cladding over gypsum. Continuous insulation with R-value ≥ 7.5 over 2 × 4 wall. Continuous insulation with R-value ≥ 11.25 over 2 × 6 wall.
7 and 8	Continuous insulation with R-value ≥ 10 over 2 × 4 wall. Continuous insulation with R-value ≥ 15 over 2 × 6 wall.

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2015 IECC Table R402.1.2

2015 IRC Table N1102.1.2

Table N1102.1.2 (R402.1.2)
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT [a]

Climate Zone	Fenestration *U*-Factor	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE[i]	MASS WALL *R*-VALUE	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13 + 5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13 + 5[h]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13 + 5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20 + 5 or 13 + 10[h] or 18 + 6.5[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20 + 5 or 13 + 10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

Source: International Code Council (ICC). (2014). 2015 International Residential Code, Country Club Hill, Ill.

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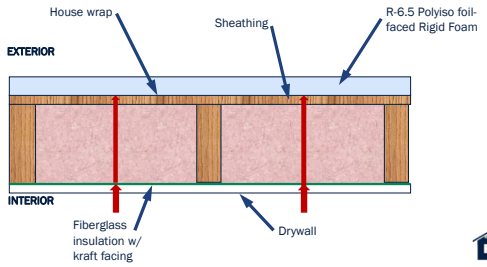
2x6 Wall with 1" R-6.5 Polyiso Exterior Foam



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Potential for Double Class II Vapor Retarder

- 1" Rigid Polyiso Foil Faced = 0.05 perm max./inch; Class I
- Kraft faced batt insulation = 1 perm; Class II
- House wrap = 11-54 perm; Vapor Open

Is this good?
Remember "Throttle"
Dry at least one direction

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Control of Water Vapor in Convection

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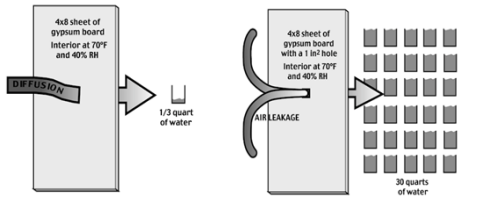
Diffusion vs. Convection



Source: Building Science Corporation.

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Air Leakage

- Significant contributor of heat loss (convection)
- Often considered most cost-effective way to save energy in a house
- The old rule was: "Let the House Breathe"
- The new rule is: "Build Tight, Ventilate Right"
  - Create a controlled air exchange

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Air Barrier

- Air barrier defined by ABAA as maximum permeance of 0.004 cfm/ft^2 @ 1.57 psf (0.02L/sm^2 @ 75 Pa)
- No quantifiable definition in ICC codes
  - Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope.
- Must be a continuous barrier
  - More important to be continuous than the vapor retarder
  - Must tape housewrap for air barrier
  - Lapped seams is enough for vapor retarder

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Air Barrier Materials

- 1/2" Drywall
- Mechanically Fastened Housewrap
- Plywood / OSB
- XPS rigid foam sheathing
- Spray foam insulation
- Spray-applied air barriers
- Self-Adhered Sheet air barriers
- Concrete
- Polyethylene

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Air Sealing

- Creating an Air Barrier System
  - Properly limiting air infiltration requires a continuous air barrier at the building enclosure
  - Achieved with tape, caulk, adhesive, gasket, foam
    - Assembly perimeter (wall/attic, wall/floor, wall/foundation)
    - Penetrations, seams, etc

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Benefits of Air Sealing

- Lower initial cost of HVAC unit
- Lower energy use for heating and cooling
- Fewer drafts = more comfort
- Reduce potential moisture issues
- Greater control of interior environment

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2015 IRC Definitions

- Air Barrier.
  - Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material, or a combination of materials.

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General Air Barrier *Methods*

- Drywall Method
- Spray Foam Method
- Sheathing Method
- Housewrap Method

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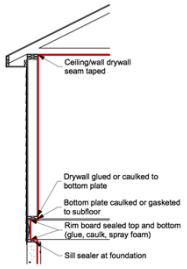
Drywall Method



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Drywall Method: Critical Details

- Seal or caulk at rough openings (windows/doors)
- Electrical outlets, switches, etc sealed
- Recessed lighting, attic accesses, cantilevered floors
- Tubs, showers, fireplaces
- Caulk first stud of intersecting walls

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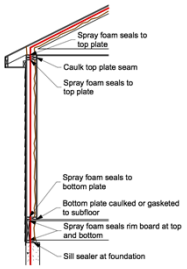
Spray Foam Method



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Spray Foam Method: Critical Details

- Spray Foam Insulation seals most penetrations inherently
- Caulk framing joints (jack/king studs, columns, headers, etc)
- Seal or caulk at rough openings (windows/doors)

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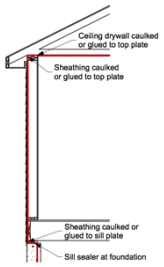
Sheathing Method



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Sheathing Method: Critical Details

- All sheathing joints taped or sealed
- Seal or caulk at rough openings (windows/doors)
- Recessed lighting, attic accesses, cantilevered floors

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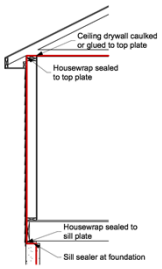
Housewrap Method



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Housewrap Method: Critical Details

- Housewrap installed with cap nails / cap staples
- All housewrap seams/joints taped or sealed
- Seal or caulk at rough openings (windows/doors)
- Continue housewrap over rim board / floor system
- Tape or seal housewrap to top plate and sill plate

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Summary

- Terminology is important
- Design and detail the assembly using the product with the correct specification for the application
- Know which layer in your assembly is your “throttle” or control layer

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Resources

- Typar - http://www.typar.com/assets/downloads/pdf/TYPAR-BuildingWrap_SellSheet.pdf
- Tyvek - https://www.dupont.com/products/tyvek-homewrap.html?src=gg-kg_tyvek-be-us_tyvek-house-wrap&gclid=CjwKCAiAl4WABhAJEiwATUnEF-34plAvXjGoKlGayo-6wQKVg41-DjcmZhhlb3h0Xx5l7ASF-777sRoCBrYQAvD_BwE
- HydroGap - https://benjaminobdyke.com/product/hydrogap-drainable-housewrap/
- Zip System - https://www.huberwood.com/uploads/documents/technical/literature/ZIP-System-Brand-Brochure.pdf
- Dow Styrofoam Brand - https://www.dupont.com/content/dam/dupont/amer/us/en/performance-building-solutions/public/documents/en/SC00133-STYROFOAM%20Brand%20SM%20Insulation-PIS-Digital2.pdf
- Owens Corning Ecotouch - https://dcpd6wotaa0mb.cloudfront.net/mdms/dms/Residential%20Insulation/10013811/10013811-EcoTouch-PINK-FIBERGLAS-Insulation-Product-Data-Sheet.pdf?v=1592540232000
- Johns Manville AP Foil-Faced - https://www.jm.com/content/dam/jm/global/en/building-insulation/Files/BI%20Data%20Sheets/Resi%20and%20Commercial/BID-0151-AP-FoilFaced-DS.pdf

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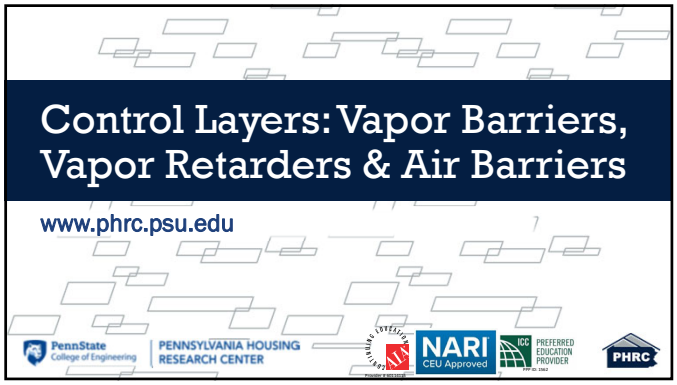
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