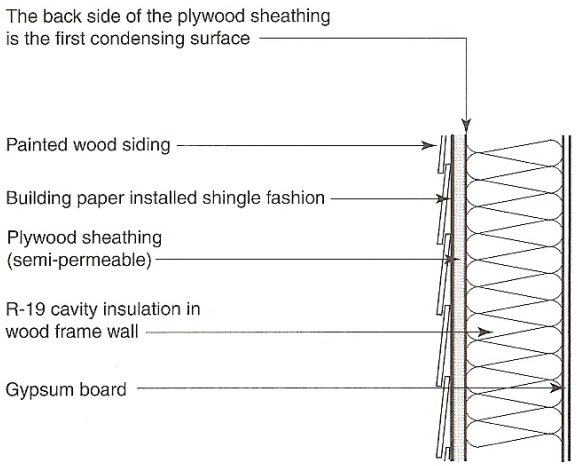
# Advanced Building Science

## Moisture Control in Insulated Assemblies

- Evaluating various wall assemblies
- Preserving drying potential
- Enhancing storage

- Readings
  - HPE: Chapter 4



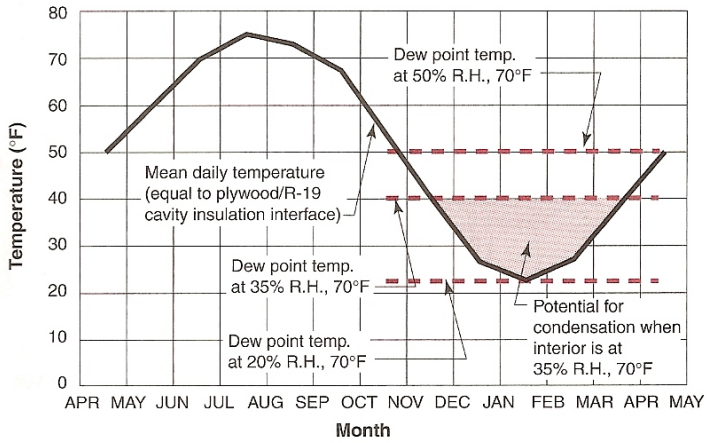
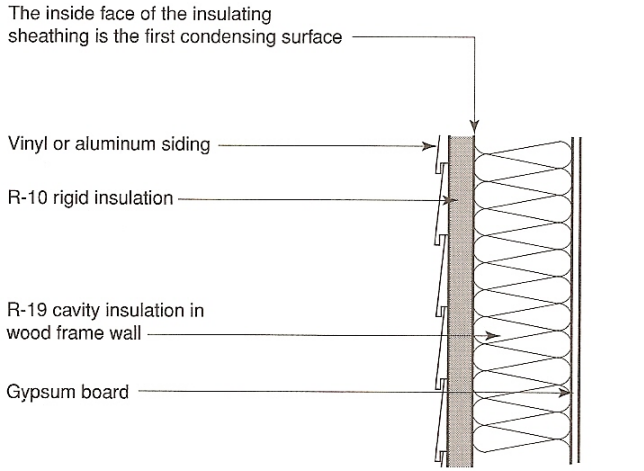




**Figure III.9**
**Potential for Condensation in a Wood Frame Wall Cavity in Chicago, Illinois (Cold Climate)**

- By reducing interior moisture levels, the potential condensation is reduced or eliminated
- No condensation occurs if interior moisture levels are maintained below 20% RH at 70°F

Source: Lstiburek, Builder's Guide for Cold Climates, 2001



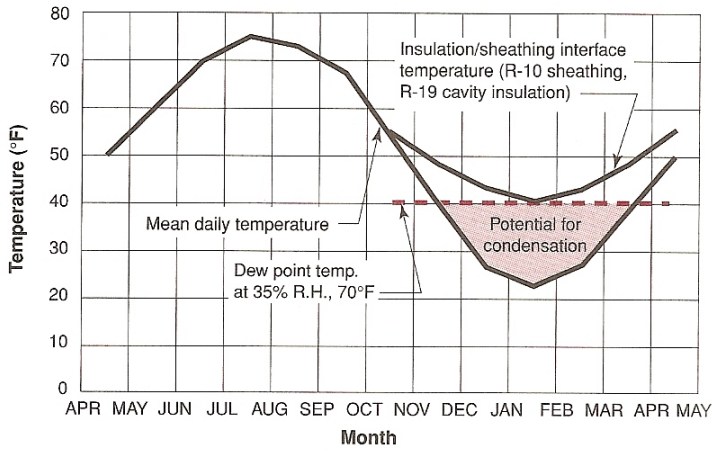
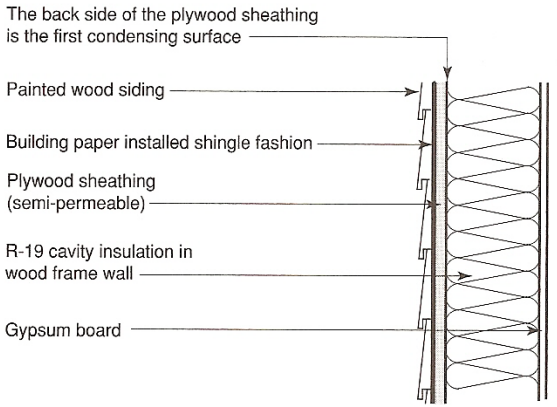




**Figure III.10**
**Potential for Condensation in a Wood Frame Wall Cavity Without an Interior Vapor Diffusion Retarder in Chicago, Illinois**

- The R-10 insulating sheathing raises the dew point temperature at the first condensing surface (cavity side of the foam sheathing) so that no condensation will occur when interior moisture levels are less than 35% relative humidity at 70°F

Source: Lstiburek, Builder's Guide for Cold Climates, 2001



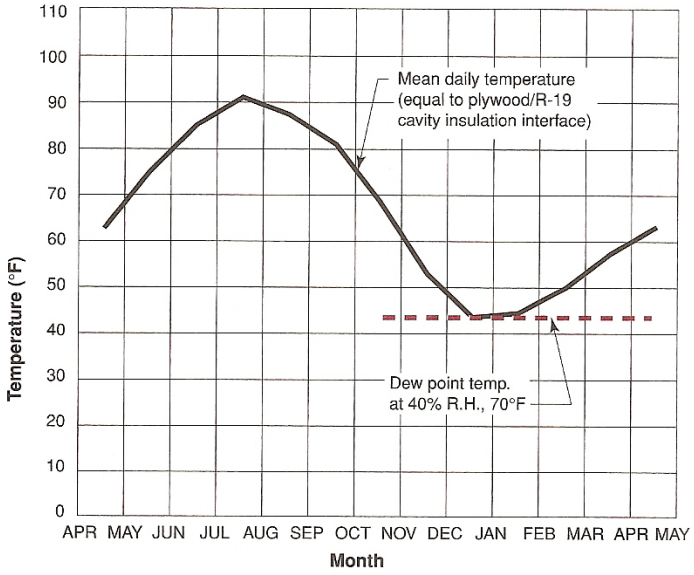




**Figure III.12**
**Potential for Condensation in Las Vegas, Nevada**

- There is no potential for condensation until interior moisture levels exceed 40% RH at 70°F during the coldest months of the year
- An interior vapor diffusion retarder is not necessary in building assemblies in Las Vegas where interior moisture levels are maintained below 40% RH at 70°F during the heating period

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

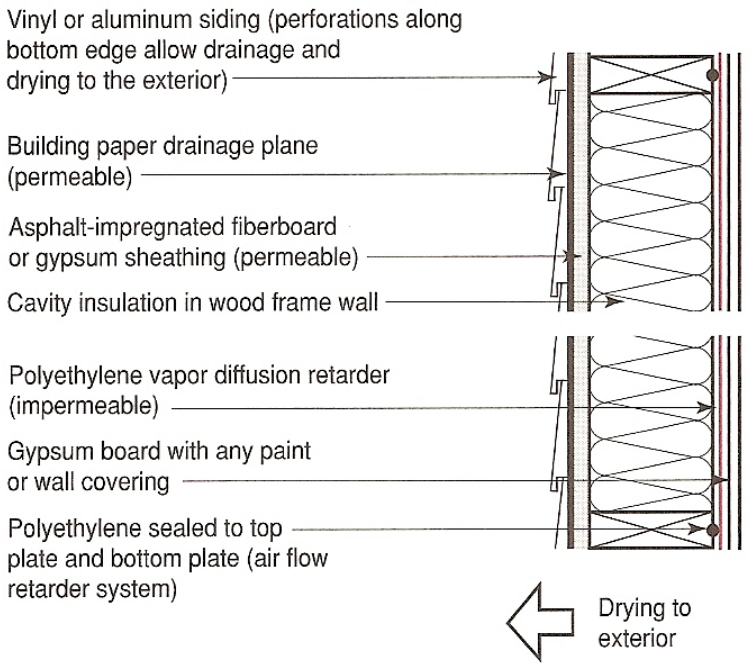



**Figure III.5**
**Classic Severe-Cold Climate Wall Assembly**

- Vapor diffusion retarder to the interior
- Air flow retarder to the interior
- Permeable exterior sheathing and permeable building paper drainage plane
- Ventilation provides air change (dilution) and also limits the interior moisture levels

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

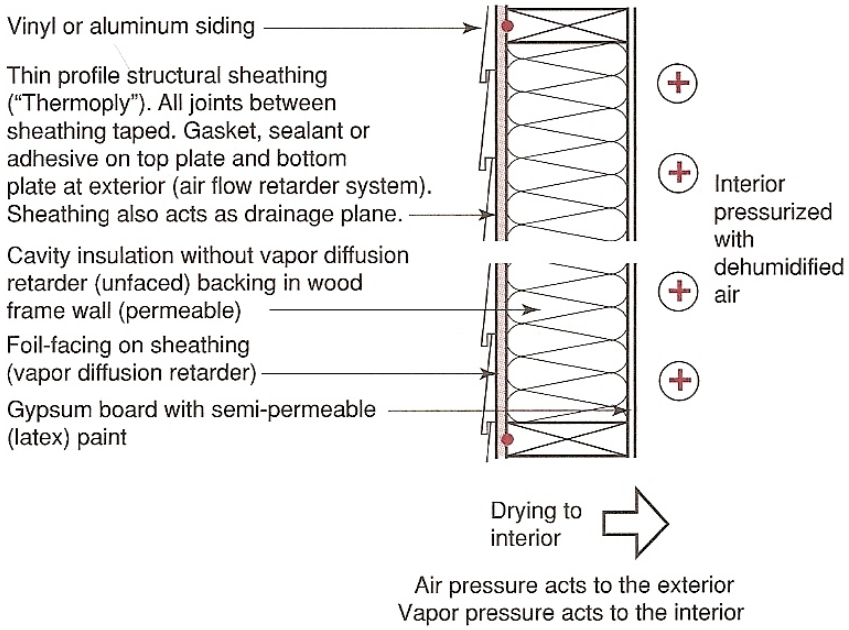



**Figure III.6**
**Classic Hot-Humid Climate Wall Assembly**

- Vapor diffusion retarder to the exterior
- Air flow retarder to the exterior
- Pressurization of conditioned space
- Impermeable exterior sheathing also acts as drainage plane
- Permeable interior wall finish
- Interior conditioned space is maintained at a slight positive air pressure with respect to the exterior to limit the infiltration of exterior, hot, humid air
- Air conditioning also provides dehumidification (moisture removal) from interior

Source: Straube and Burnett, Building Science for Building Enclosures, Chapter 5

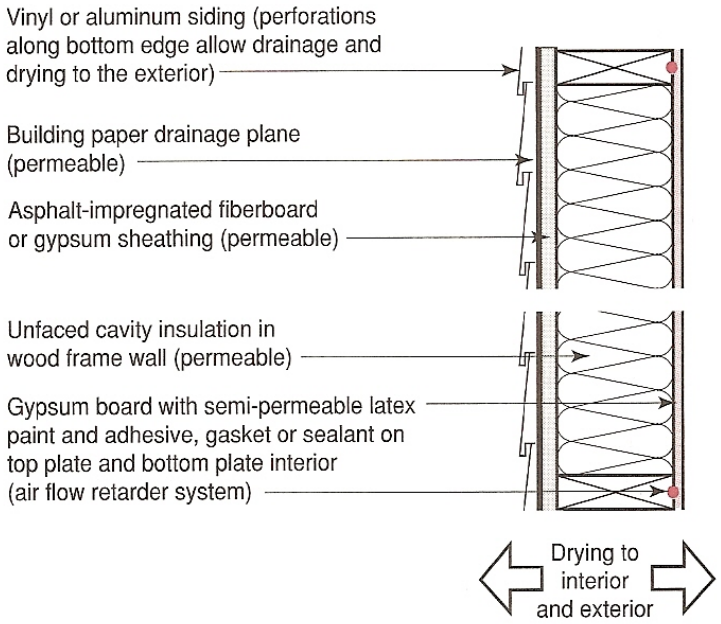



**Figure III.7**
**Classic Flow-Through Wall Assembly**

- Permeable interior surface and finish and permeable exterior sheathing and permeable building paper drainage plane
- Interior conditioned space is maintained at a slight positive air pressure with respect to the exterior to limit the infiltration of exterior moisture-laden air during cooling
- Ventilation provides air change (dilution) and also limits the interior moisture levels during heating
- Air conditioning/dehumidification limits the interior moisture levels during cooling

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

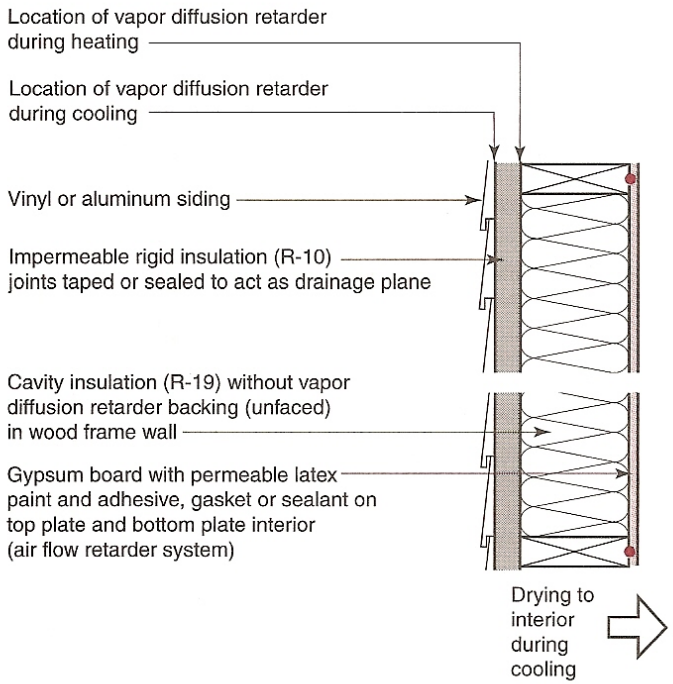



**Figure III.8**
**Vapor Diffusion Retarder in the Middle of the Wall**

- Air flow retarder to the interior
- Permeable interior wall finish
- Interior conditioned space is maintained at a slight positive air pressure with respect to the exterior to limit the infiltration of exterior moisture-laden air during cooling
- Ventilation provides air change (dilution) and also limits the interior moisture levels during heating
- Air conditioning/dehumidification limits the interior moisture levels during cooling
- Impermeable exterior sheathing also acts as drainage plane

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

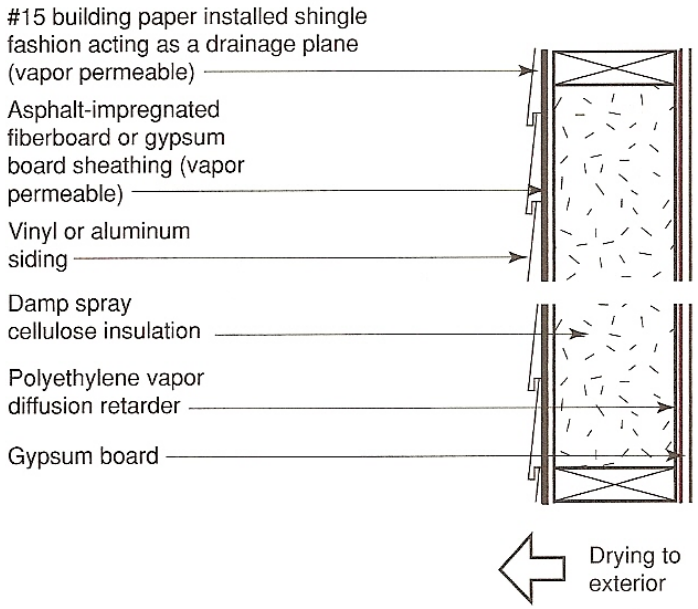



**Figure III.14**
**Drying to Exterior**

- If wood siding is used in this assembly with the damp spray cellulose, furring strips should be used to provide an airspace to promote drying and the wood siding should be back-primed to prevent wetting from the back side.
- The airspace associated with the back of vinyl or aluminum siding, due to its profile, permits drying of the wall assembly.
- Recommended for severe cold climates, not cold climates
- Polyethylene on the inside of building assemblies in cold, mixed-humid, mixed-dry, hot-humid and hot-dry climates is not generally a good idea.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

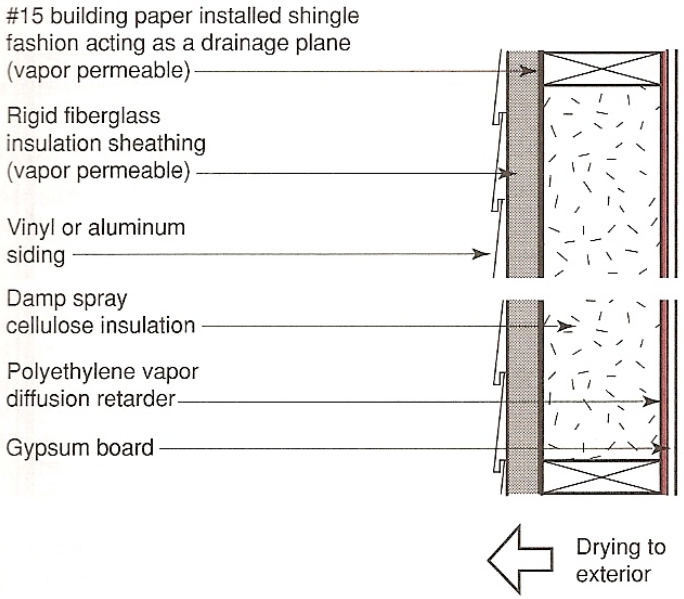



**Figure III.15**
**Drying to Exterior**

- If wood siding is used in this assembly with the damp spray cellulose, furring strips should be used to provide an airspace to promote drying and the wood siding should be back-primed to prevent wetting from the back side.
- The airspace associated with the back of vinyl or aluminum siding, due to its profile, permits drying of the wall assembly.
- Recommended for severe cold climates, not cold climates
- Polyethylene on the inside of building assemblies in cold, mixed-humid, mixed-dry, hot-humid and hot-dry climates is not generally a good idea.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

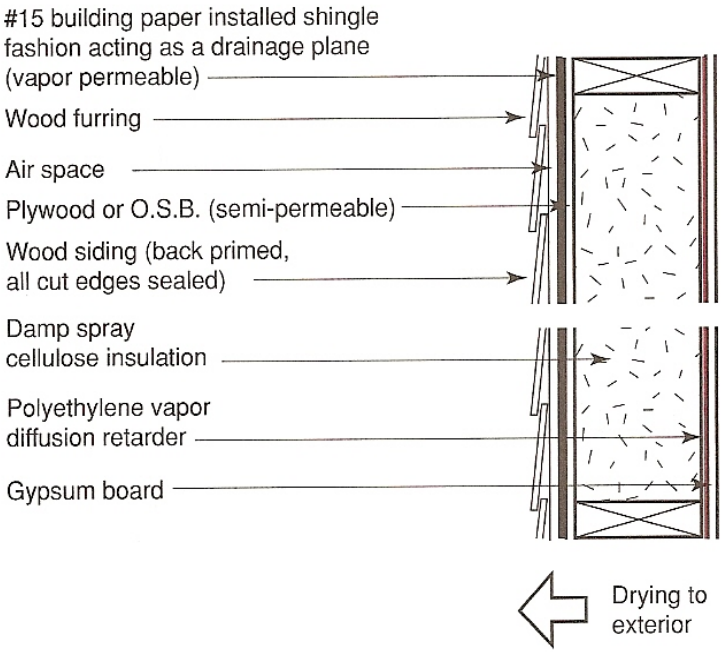



**Figure III.16**
**Drying to Exterior**

- If vinyl or aluminum siding is used in this assembly wood furring providing an airspace is not necessary.
- Recommended for severe cold climates, not cold climates
- Polyethylene on the inside of building assemblies in cold, mixed-humid, mixed-dry, hot-humid and hot-dry climates is not generally a good idea.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

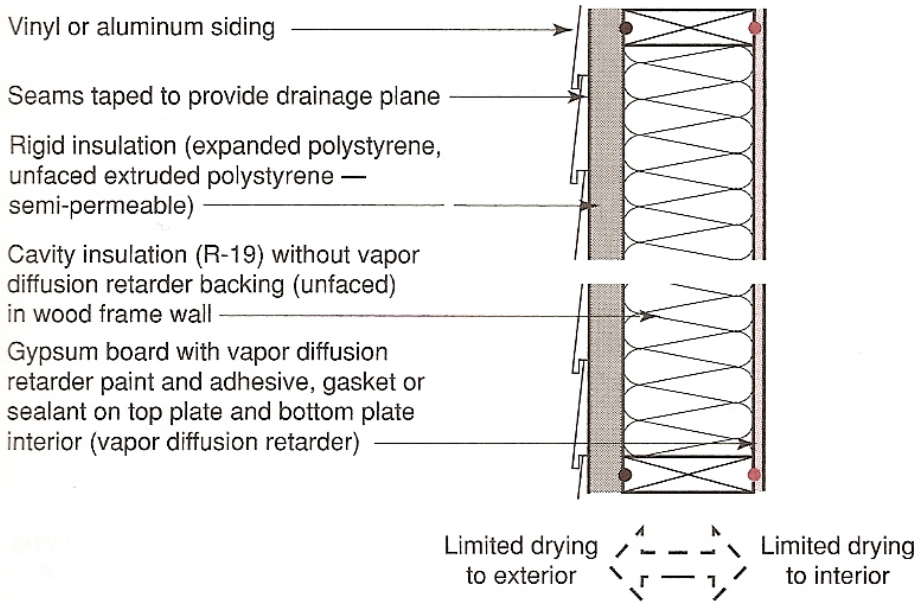



**Figure III.17**
**Limited Drying to Exterior and Interior**

- Although paint is used as an interior vapor diffusion retarder (1 to 2 perms) it is not as impermeable as a polyethylene vapor diffusion retarder (0.3 to 0.5 perms) so that some drying to the interior is possible.
- The semi-permeable rigid insulations permit some drying to the exterior.
- If wood siding is used, it should be installed over furring strip and be back-primed, all cut edges sealed.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

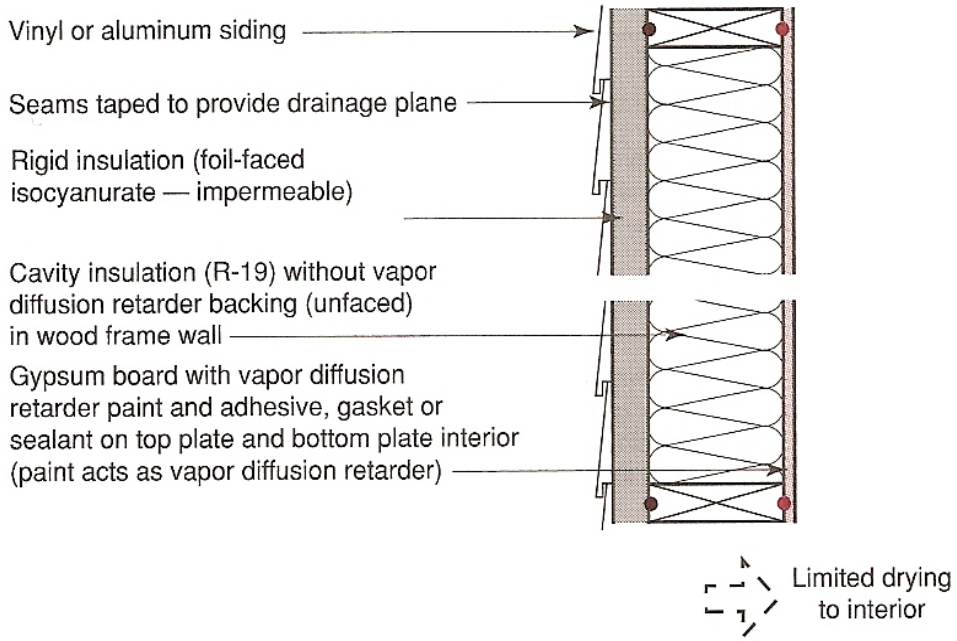



**Figure III.18**
**Limited Drying to Interior**

- Although paint is used as an interior vapor diffusion retarder (1 to 2 perms) it is not as impermeable as a polyethylene vapor diffusion retarder (0.3 to 0.5 perms) so that some drying to the interior is possible.
- If wood siding is used, it should be installed over furring strips and be back-primed, all cut edges sealed.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

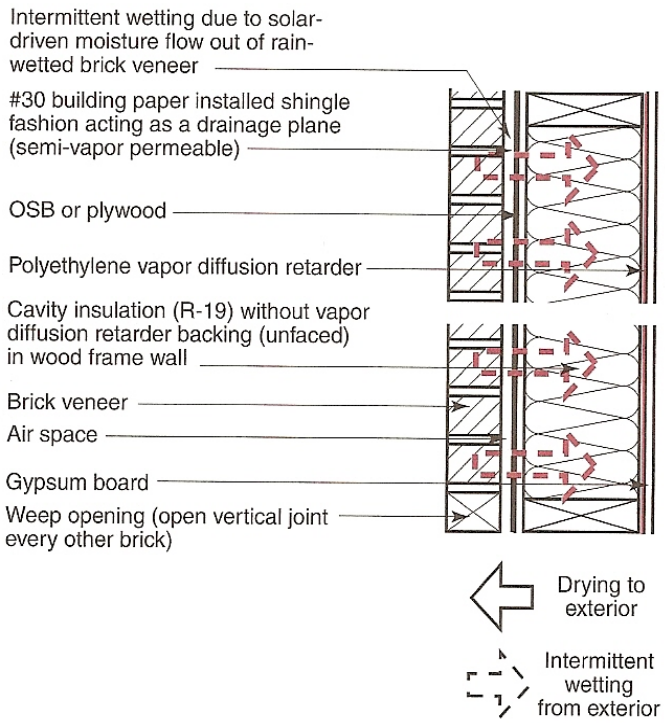
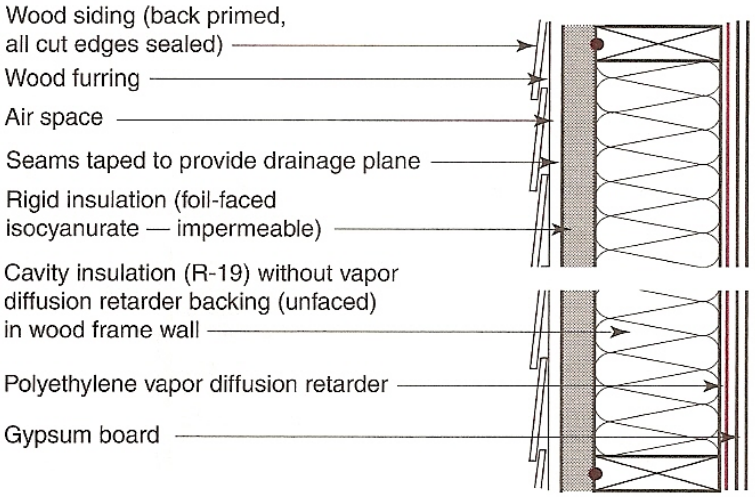



**Figure III.19**
**Drying to Exterior**

- Recommended for severe cold climates, not cold climates
- Polyethylene on the inside of building assemblies in cold, mixed-humid, mixed-dry, hot-humid and hot-dry climates is not generally a good idea
- A rigid, impermeable or semi-permeable insulating sheathing can be used to prevent the wall cavity from getting wet due to solar-driven moisture allowing the removal of the interior polyethylene vapor diffusion retarder
- The heavy #30 building paper (semi-vapor permeable) is preferred over permeable building papers when used with wood siding, brick or stucco due to the potential for moisture flow through the permeable building papers under solar heating with rain-wetted claddings

Source: Lstiburek, Builder's Guide for Cold Climates, 2001




No drying

**Figure III.20**
**No Drying**

- Only dry materials should be used in the construction of this wall assembly.
- If vinyl or aluminum siding is used in this assembly wood furring providing an airspace is not necessary.
- Airspace in this assembly behind the wood siding is to permit drying of the wood siding.
- This is an extremely unforgiving wall assembly.
- Recommended for severe cold climates, not cold climates
- Polyethylene on the inside of building assemblies in cold, mixed-humid, mixed-dry, hot-humid and hot-dry climates is not generally a good idea.

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

| | | | | Compatible with:* |
|---|---|---|---|---|
| **Permeable** | Non-insulating | Asphalt Impregnated Fiberboard | Building Paper Required | Damp Spray Cellulose |
| | | Gypsum Board | Building Paper Required | Damp Spray Cellulose |
| | Insulating | Rigid Fiberglass | Can Come with Building Paper Attached | Damp Spray Cellulose |
| **Semi-Permeable** | Non-Insulating | Plywood | Building Paper Required | Damp Spray Cellulose only with Airspace Between Cladding and Building Paper |
| | | O.S.B. | Building Paper Required | Damp Spray Cellulose only with Airspace Between Cladding and Building Paper |
| | Insulating | Expanded Polystyrene | Building Paper Not Required | Damp Spray Cellulose Not Recommended |
| | | Extruded Polystyrene | Building Paper Not Required | Damp Spray Cellulose Not Recommended |
| | | Fiberfaced Isocyanurate | Building Paper Required | Damp Spray Cellulose Not Recommended |
| **Impermeable** | Non-Insulating | Thermoply | Building Paper Not Required | Damp Spray Cellulose Not Recommended |
| | Insulating | Foil Faced Isocyanurate | Building Paper Not Required | Damp Spray Cellulose Not Recommended |

**Figure III.13**
**Cold Climate Wall Assembly Characteristics**
* All wall assemblies compatible with dry applied cavity insulations

Source: Lstiburek, Builder's Guide for Cold Climates, 2001

# In Summary

Questions and Discussion

# Next Class

- Fenestration
  - Basic Components
  - U-Factor
  - Solar Heat Gain
  - Visible Transmission
  - Air Leakage
  - Condensation Resistance
  - Standards

- Readings
  - HF: Chapter 15
  - HPE: Chapter 3.3.5 to 3.3.8