Joseph Lstiburek, Ph.D., P.Eng, ASHRAE Fellow

Building Science

Moisture Management for Energy Efficient Homes

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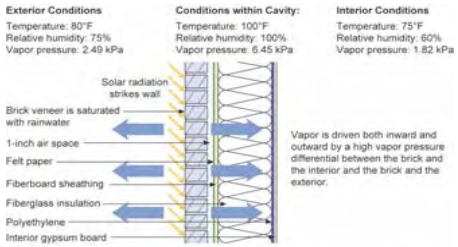
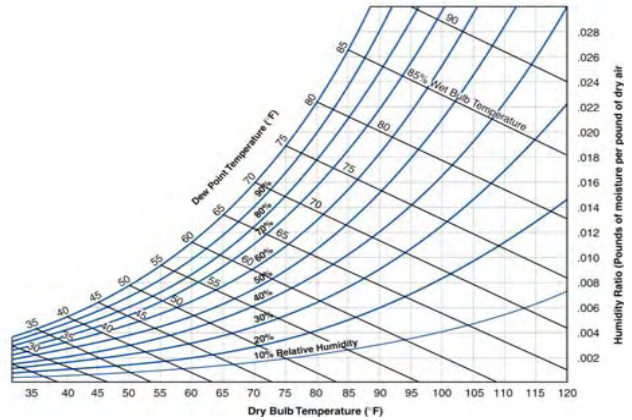
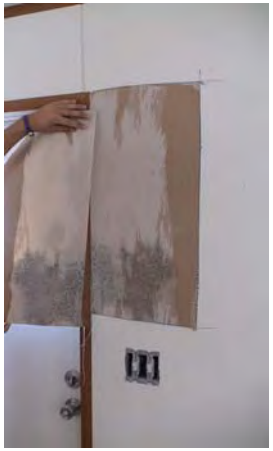
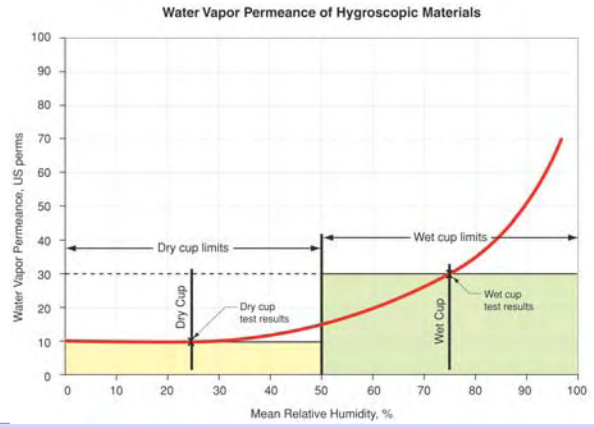
Things are Different



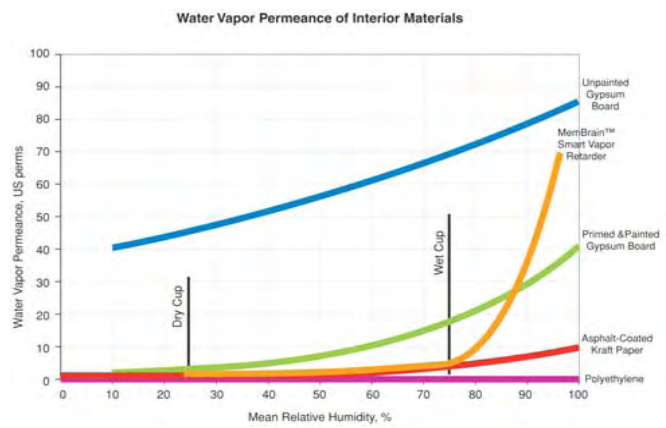
- It is not a good idea to install a vapor barrier (polyethylene) on the inside of an air conditioned assembly. Vinyl wall coverings and foil-backed batt cavity insulation should also be avoided.
- Vapor permeable exterior sheathings, housewraps or building papers should not be used with absorptive claddings such as brick veneers unless a ventilated cavity is provided in conjunction with high inward drying potentials (i.e. no interior polyethylene vapor barriers).
- Failure will occur when brick is installed over a frame wall constructed with felt paper, fiberboard sheathing and an interior polyethylene vapor barrier. Kraft-faced fiberglass batts should be used in place of unfaced batts and a polyethylene vapor barrier. OSB, plywood or foam sheathing should be used in place of the fiberboard sheathing.
- Similar problems occur with stucco.

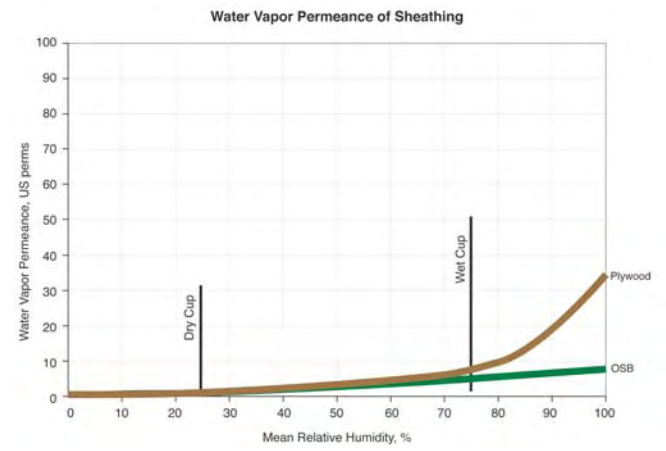


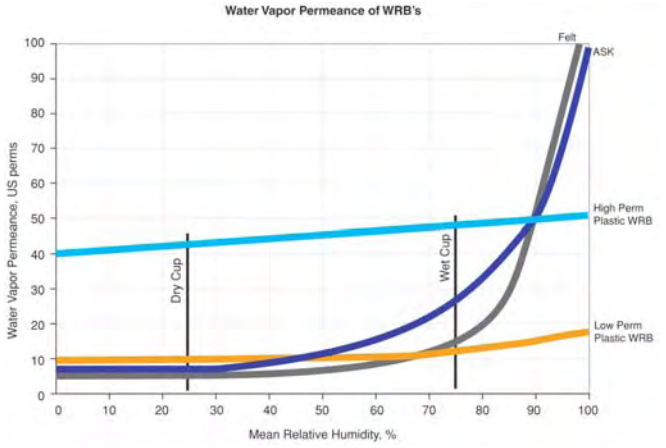


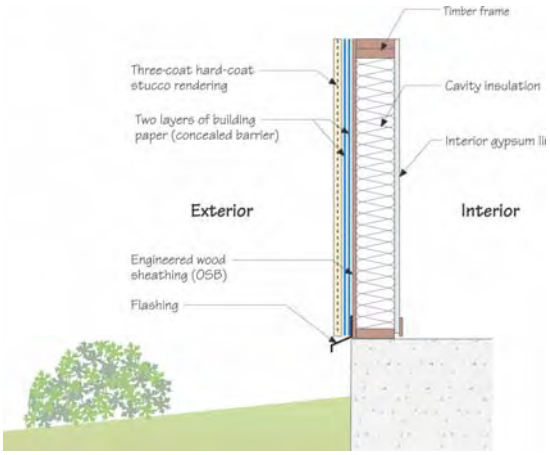



R-11 3½
OWENS-CORNING
Fiberglas
Building
Insulation


Water Vapor Permeance of Interior Materials
Water Vapor Permeance, US perms
Mean Relative Humidity, %
Dry Cup
Wet Cup
Unpainted Gypsum Board
MemBrain™ Smart Vapor Retarder
Primed &Painted Gypsum Board
Asphalt-Coated Kraft Paper
Polyethylene


Water Vapor Permeance of Sheathing
Water Vapor Permeance, US perms
Mean Relative Humidity, %
Dry Cup
Wet Cup
Plywood
OSB


Water Vapor Permeance of WRB's
Water Vapor Permeance, US perms
Mean Relative Humidity, %
Dry Cup
Wet Cup
Felt
ASK
High Perm Plastic WRB
Low Perm Plastic WRB
0
10
20
30
40
50
60
70
80
90
100



Surface Tension

- "non-wetable" surface
- water repellent surface
- hygrophobic surface
- water more attracted to itself than to surface
- surface energy of water greater than surface energy of surface
- water "beads up"
- "greasy" surface
- high contact angle "θ"

- "wetable" surface
- non-water repellent surface
- hygroscopic surface
- water more attracted to surface than itself
- surface energy of surface greater than surface energy of water
- water "spreads out"
- "non-greasy" surface
- low contact angle "θ"


Prime Wrap
emier House Wrap by CS Fabric
Air and Moisture Barrier
Tear Resistant
Easy Installation


Fabric Int'l
d Moisture Barrier
esistant
codes
eport No . NER – 655


Prime Wrap
Premier House Wrap by CS Fabric Int'l
Air and Moisture Barrier
Tear Resistant
Easy Installation
Meets all national building codes
See National ES Report No . NER – 655


Premier HouseWrap


TYPAR
HouseWrap
TYPAR
HouseWrap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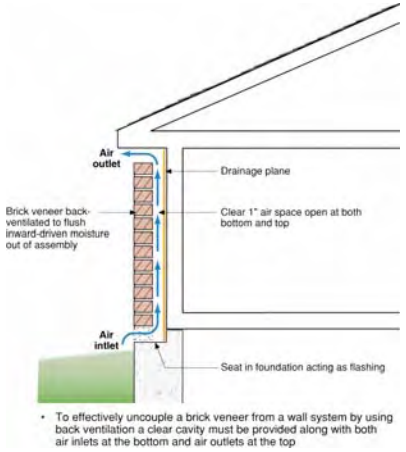
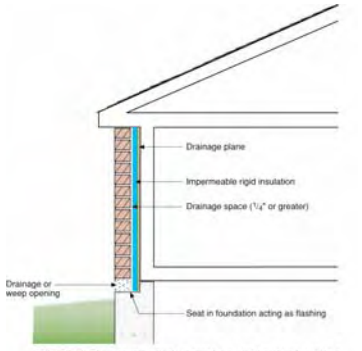
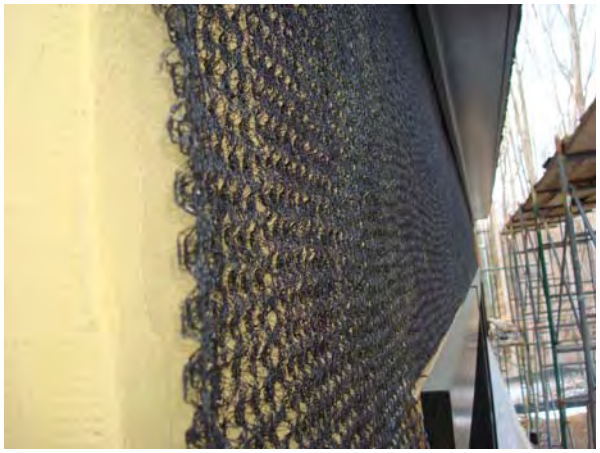
Rboard
Rboard



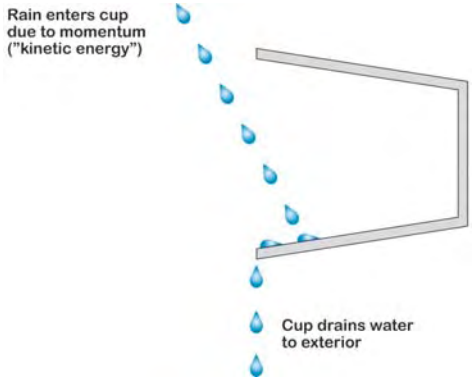
- To effectively uncouple a brick veneer from a wall system by using back ventilation a clear cavity must be provided along with both air inlets at the bottom and air outlets at the top

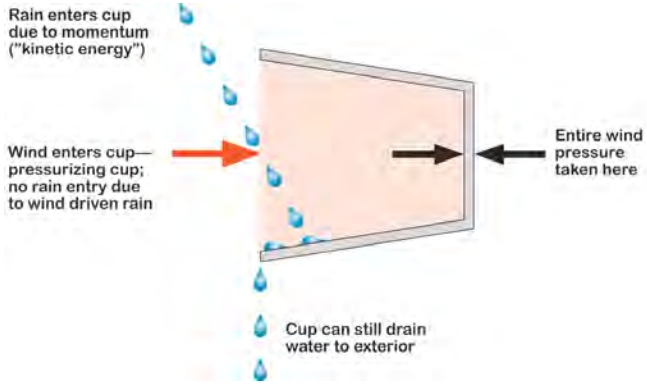


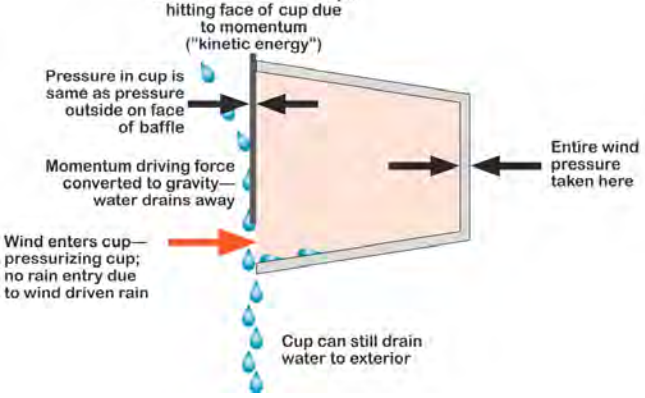
- To effectively uncouple a brick veneer from a wall system by using a condensing surface the drainage plane must also be a vapor barrier or a vapor impermeable layer (i.e. rigid insulation) must be installed between the drainage plane and the brick veneer. Alternatively, the rigid insulation can be configured to act as a both the drainage plane and vapor impermeable layer.
- When a condensing surface is used to uncouple a brick veneer from a wall system a ventilated air space is no longer necessary. Additionally, the width of the drainage space is almost irrelevant.

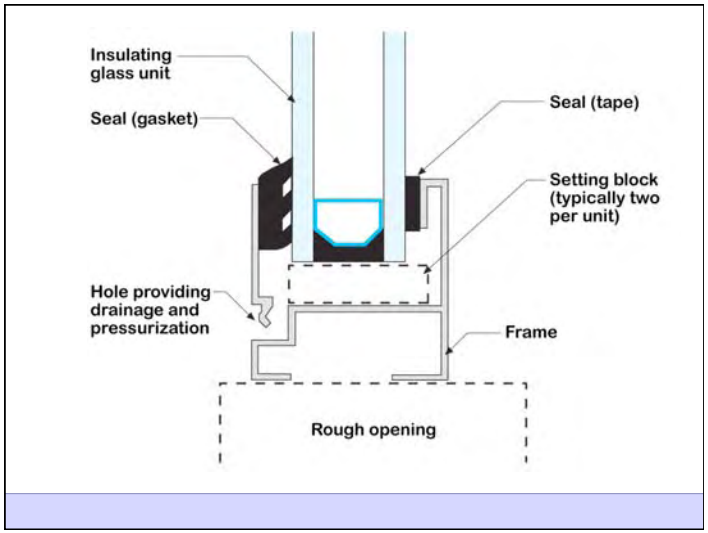


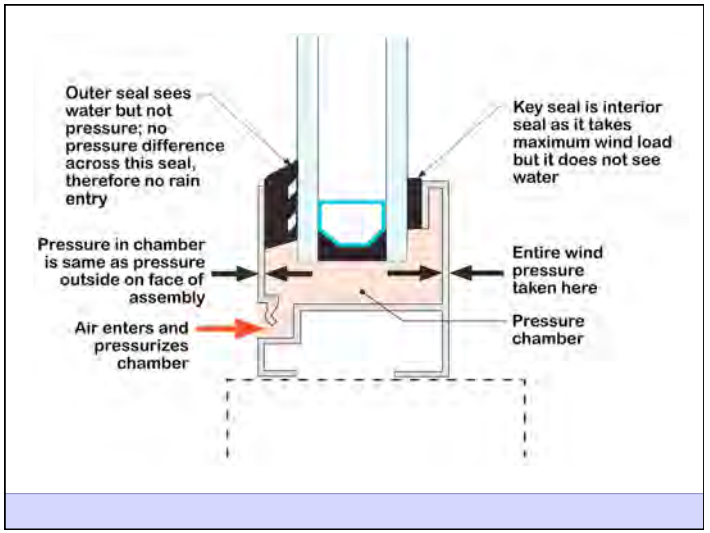

PARR LUMBER
DUPONT
Tyvek
Moistop E-Z Seal

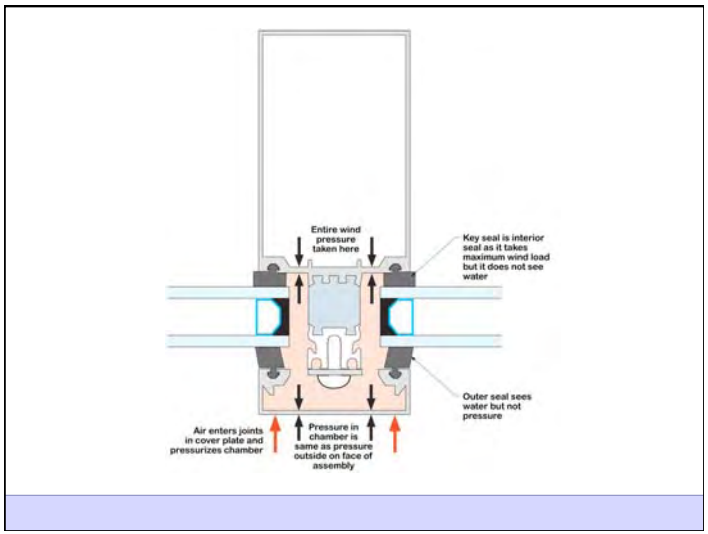

Rain enters cup due to momentum ("kinetic energy")
Cup drains water to exterior

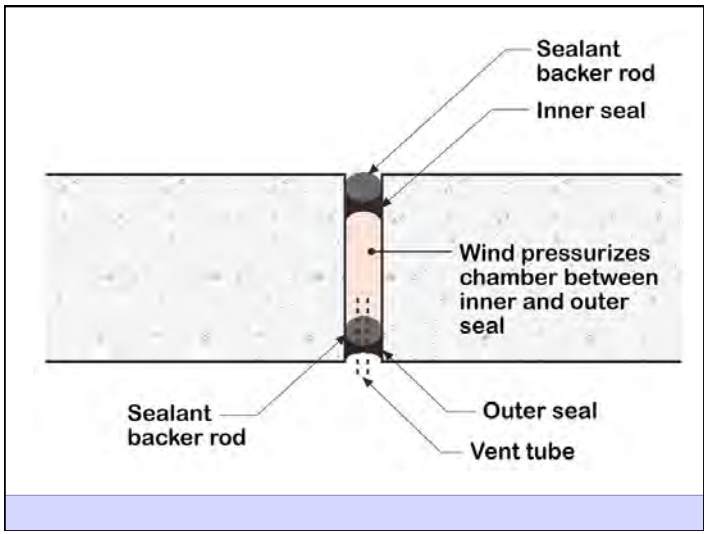

Rain enters cup due to momentum ("kinetic energy")
Wind enters cup— pressurizing cup; no rain entry due to wind driven rain
Entire wind pressure taken here
Cup can still drain water to exterior

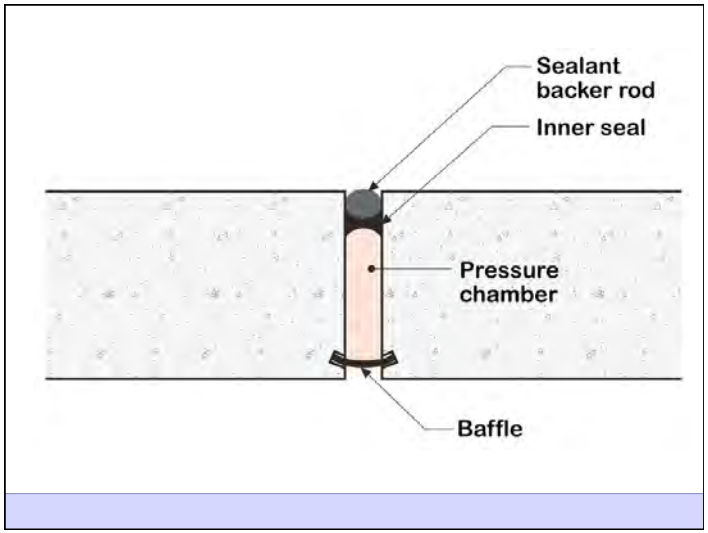

Baffle to deflect raindrops hitting face of cup due to momentum ("kinetic energy")
Pressure in cup is same as pressure outside on face of baffle
Momentum driving force converted to gravity— water drains away
Wind enters cup— pressurizing cup; no rain entry due to wind driven rain
Entire wind pressure taken here
Cup can still drain water to exterior

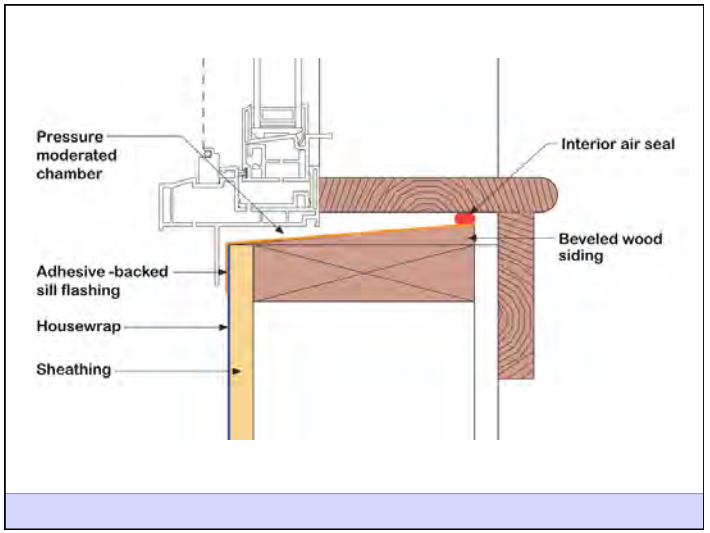


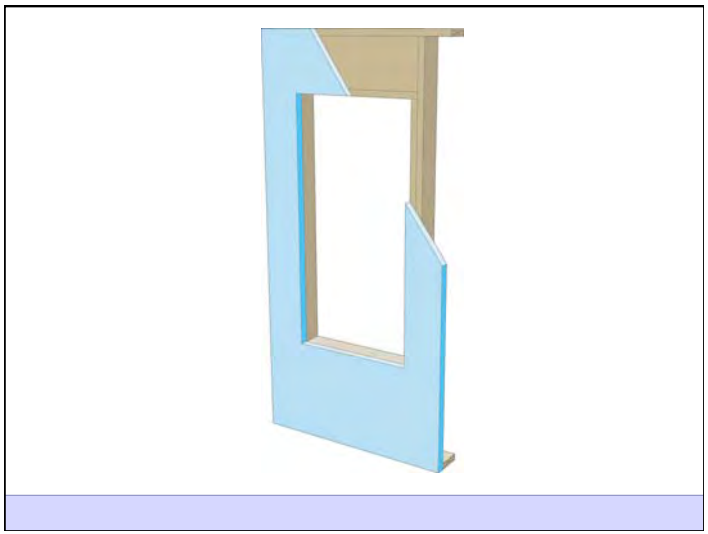


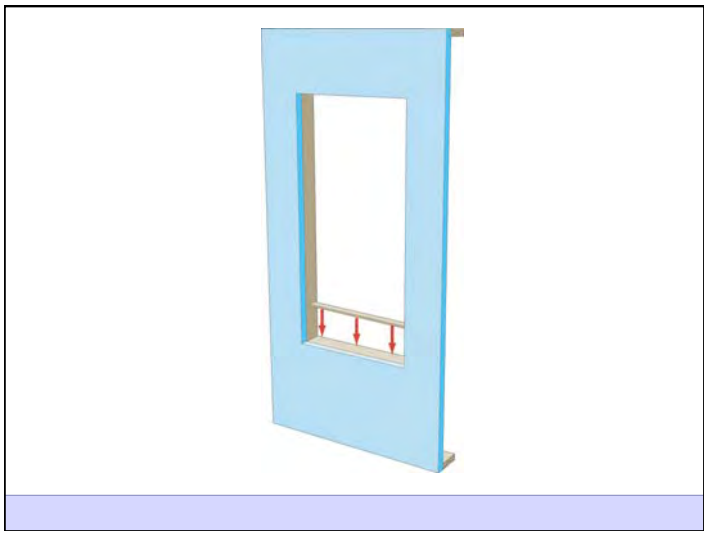


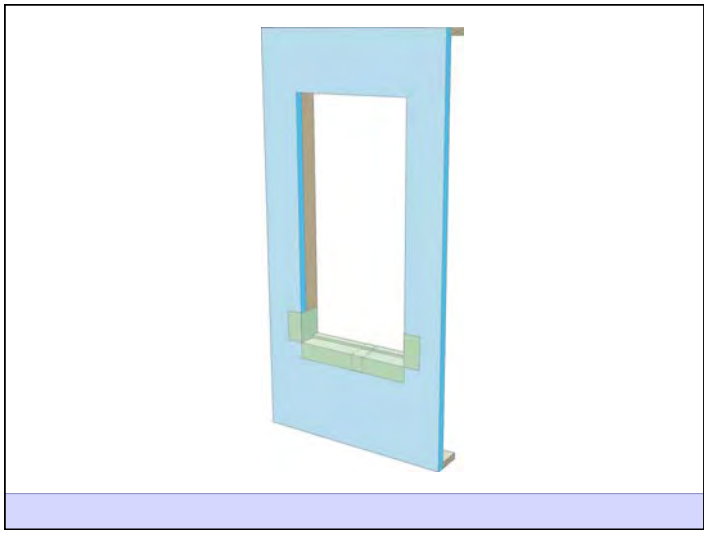


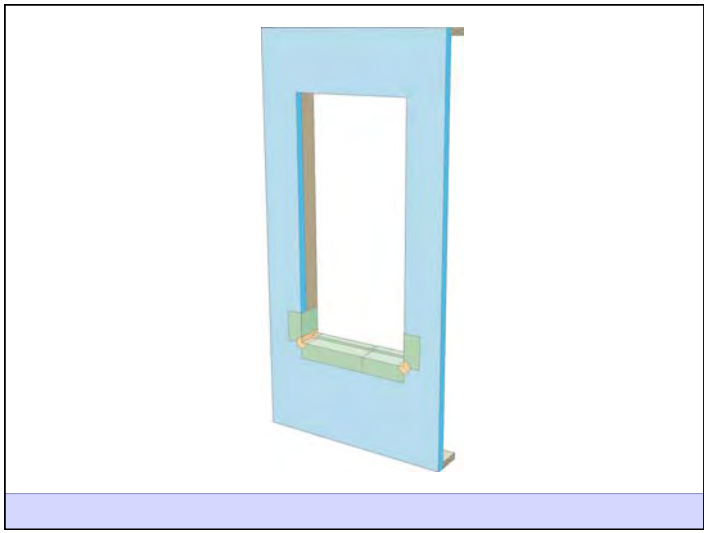


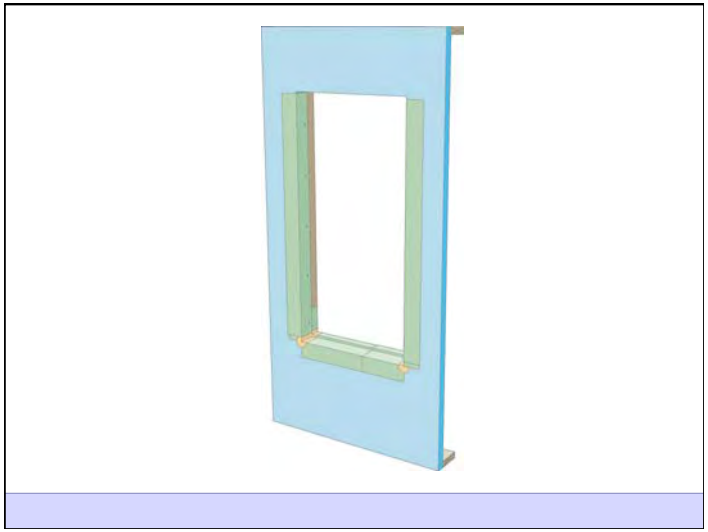


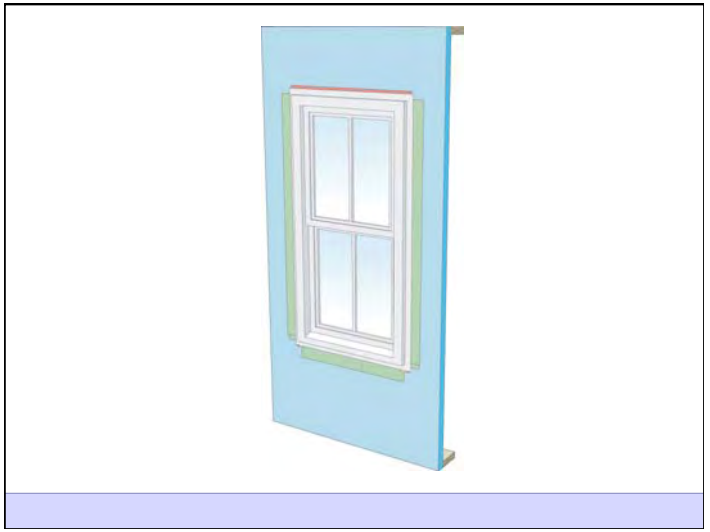


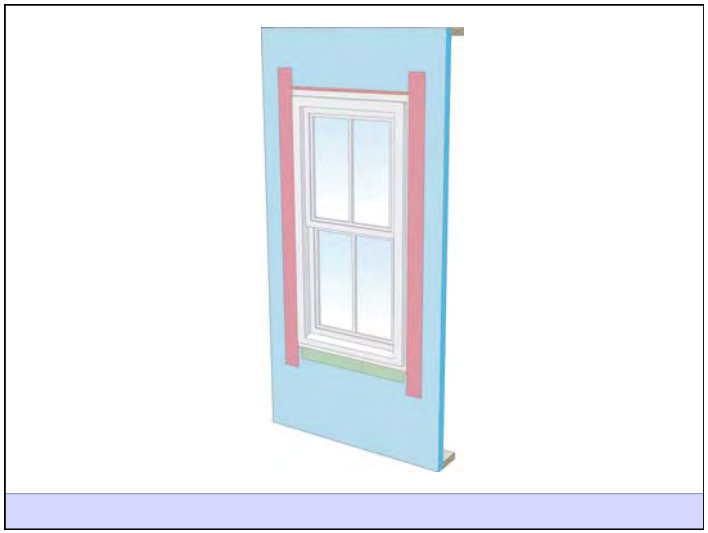


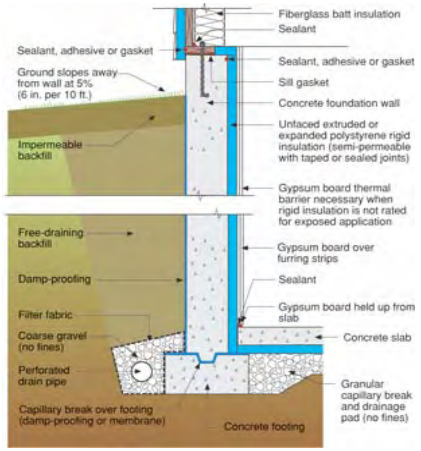


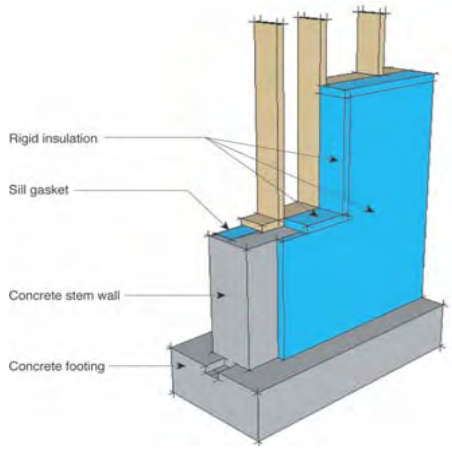


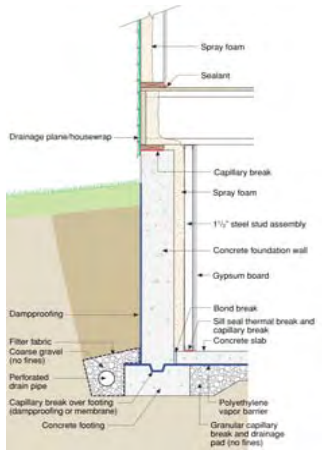


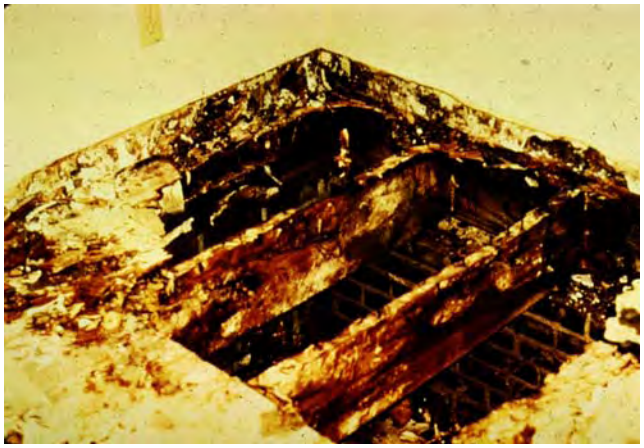


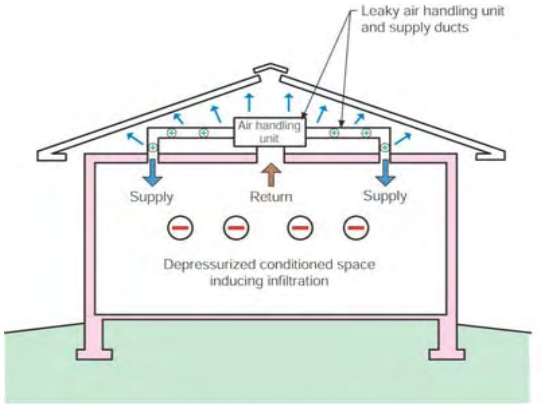



Fiberglass batt insulation
Sealant
Sealant, adhesive or gasket
Ground slopes away from wall at 5% (6 in. per 10 ft.)
Sealant, adhesive or gasket
Sill gasket
Concrete foundation wall
Unfaced extruded or expanded polystyrene rigid insulation (semi-permeable with taped or sealed joints)
Impermeable backfill
Gypsum board thermal barrier necessary when rigid insulation is not rated for exposed application
Free-draining backfill
Gypsum board over furring strips
Damp-proofing
Sealant
Filter fabric
Gypsum board held up from slab
Coarse gravel (no fines)
Concrete slab
Perforated drain pipe
Granular capillary break and drainage pad (no fines)
Capillary break over footing (damp-proofing or membrane)
Concrete footing

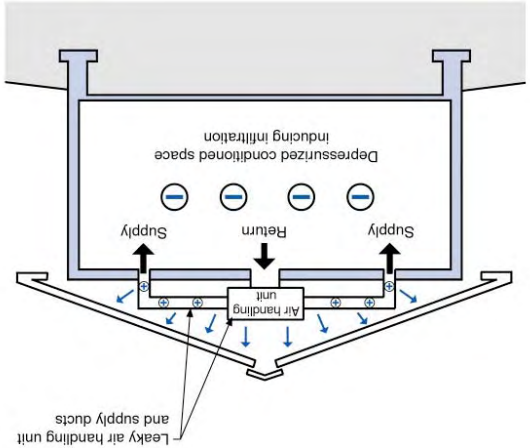

Rigid insulation
Sill gasket
Concrete stem wall
Concrete footing

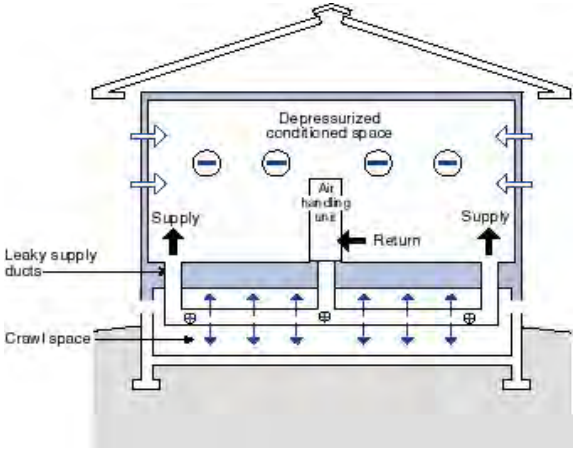

Spray foam
Sealant
Drainage plane/housewrap
Capillary break
Spray foam
1½" steel stud assembly
Concrete foundation wall
Gypsum board
Dampproofing
Bond break
Sill seal thermal break and capillary break
Concrete slab
Filter fabric
Coarse gravel (no fines)
Perforated drain pipe
Capillary break over footing (dampproofing or membrane)
Concrete footing
Polyethylene vapor barrier
Granular capillary break and drainage pad (no fines)

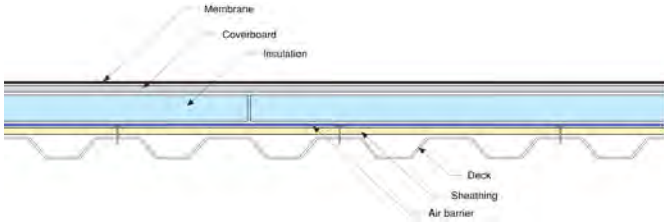


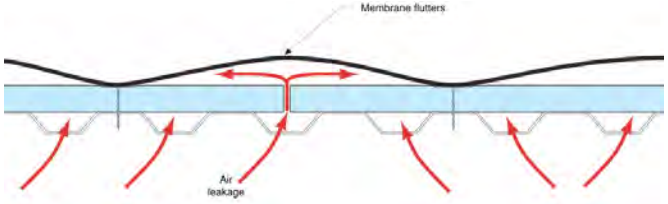


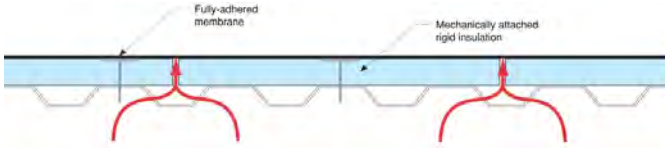
Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.










Fully-adhered membrane
Mechanically attached rigid insulation