Context
Stucco Evolved As A Barrier System
Exterior Insulation Finish Systems
EIFS
Exterior Insulation Finish Systems
EIFS
Barrier System
Face-Sealed Not Water Managed
Life Is Hard Enough As It Is
It’s Harder When You Are Stupid
Don’t Do Stupid Things
Can Barrier or Face Seal Work?
Latex paint

Stucco rendering

Concrete block

Rigid insulation (vapor semi-permeable) — unfaced extruded polystyrene, unfaced expanded polystyrene, glass fiber-faced isocyanurate

Uninsulated steel frame wall

Non-paper faced gypsum board

Latex paint or vapor semi-permeable textured wall finish

Vapor Profile
Vapor semi-permeable rigid insulation — expanded polystyrene, extruded polystyrene, fiber-faced isocyanurate

2x2 wood furring

Non-paper faced gypsum board

Latex paint or other permeable or vapor semi-permeable interior finish

Hold gypsum board up from slab 4"

Wide baseboard

Concrete slab

Granular capillary break and drainage pad (no fines)

Concrete grade beam

Polyethylene vapor barrier extended under grade beam where it also acts as a capillary break

Ground slopes away from wall at 5% (6 in. per 10 ft.)

Vapor permeable coating — greater than 10 perms ("latex paint")

Polymer modified (PM) or standard Portland cement stucco

Masonry wall

Seat in concrete slab

Weep screed
Screen

Precast unit

Stucco

Interior sill

Reflective foil insulation

Gypsum board

Wood furring

Masonry block wall

Secondary seat to provide backdam for window installation;
Note: Min. 1/2" high

Primary seat to provide backing for sill nailing flange

Tiered precast unit

Gypsum board

Wood furring

Vapor semi-permeable rigid insulation

Masonry block wall

Stucco
Reminder…
Don’t Do Stupid Things
What Is Going On With Stucco?
Materials
Inward Drive
Energy
Typical predicted sorption isotherm according to Kelvin equation and modified BET theory
From Straube & Burnett, 2005
Sorption isotherm for several building materials [Kumaran 2002]
From Straube & Burnett, 2005
PERMEABILITY

RELATIVE HUMIDITY

A - Single-layer of absorbed molecules
B - Multiple layers of absorbed molecules
C - Interconnected layers (internal capillary condensation)
D - Free water in pores, capillary suction
E - Supersaturated regime

Relationship between Dry Cup and Wet Cup
Adapted from Joy & Wilson, 1963
Water Vapor Permeance vs. Relative Humidity

\[ \begin{align*}
\text{Mean Relative Humidity, } \% & \\
0 & \rightarrow 10 & 20 & 30 & 40 & 50 & 60 & 70 & 80 & 90 & 100 \\
\text{Water Vapor Permeance, US perms} & \\
0 & \rightarrow 1.0 & 2.0 & 3.0 & 4.0 & 5.0 & 6.0 & 7.0 & 8.0 & 9.0 & 10.0 \\
\end{align*} \]

\( \mu_1 \) = Dry cup permeance
\( \mu_2 \) = Wet cup permeance

Dry cup limits
Wet cup limits

Dry cup test results
Wet cup test results
Rain Screen
Beer Screen?
Hydrostatic head

Cladding
Hydrostatic head

Cladding
Pascals  mph

50  Pa =  20  mph  
100  Pa =  30  mph  
150  Pa =  35  mph  
250  Pa =  45  mph  
500  Pa =  65  mph  
1,000  Pa =  90  mph
EIFS No Longer Has Issues
Stucco

Expanded polystyrene insulation (EPS)

Air gap

Water control layer

Non paper-faced exterior gypsum sheathing, plywood or oriented strand board (OSB)

Uninsulated steel stud cavity

Gypsum board

Latex paint or vapor semi-permeable textured wall finish
Building Science Corporation

Joseph Lstiburek

Stucco

Expanded polystyrene insulation (EPS)

Air gap

Water control layer

Non paper-faced exterior gypsum sheathing, plywood or oriented strand board (OSB)

Insulated wood stud cavity

Gypsum board

Latex paint or vapor semi-permeable textured wall finish
Stucco

Expanded polystyrene insulation (EPS)

Air gap

Water control layer

Non paper-faced exterior gypsum sheathing, plywood or oriented strand board (OSB)

Insulated wood stud cavity

High density spray polyurethane foam (SPF)

Gypsum board

Latex paint or vapor semi-permeable textured wall finish
Back to Barrier and Face Seal....
Exterior seal with weeps

Synthetic stucco rendering wrapped around opening creating “pan flashing”

Interior air seal

20 ga angle supporting back dam of synthetic stucco “pan flashing”

Triple glazed window
Precast panel (installed first)

Corrosion-resistant metal pin to connect panels without penetrating air and water layers

Gypsum board

Steel stud

Cast in place anchor

Structural columns and walls should be held back from slab edge to allow for installation of air and thermal control layers

Note: Precast concrete is the water and air control layer

Outer sealant on backer rod drained at vertical joints

Inner sealant on backer rod continuous for water and air control continuity

Line of outer sealant at panel joints

Line of inner sealant at panel joints
Back To Stucco....
Side Trip To My Backyard....
“Lumpy Stucco”....
Should Have Been The Big Warning....
Side Trip To Vancouver....
Back To America….Pennsylvania…. And Then Pretty Much Anywhere It Rains…
Back To Lumpy Stucco....
Easy Solution....
Recommendations....

Provide a 3/8 inch air space behind all stucco in regions where it rains more than 20 inches per year

Provide a 3/8 inch air space behind all stucco over three stories

Don’t install interior vapor barriers

Air space can be reduced to 1/16 inch where inward vapor drive is limited
Recommendations....
Barrier works in Florida over block
Barrier does not work in Florida over OSB
Don’t install interior vapor barriers in Florida
Don’t drain a drained system into a barrier system
Exterior Conditions
Temperature: 80°F
Relative humidity: 75%
Vapor pressure: 2.49 kPa

Conditions within Cavity:
Temperature: 100°F
Relative humidity: 100%
Vapor pressure: 6.45 kPa

Interior Conditions
Temperature: 75°F
Relative humidity: 60%
Vapor pressure: 1.82 kPa

Solar radiation strikes wall
Brick veneer is saturated with rainwater
1-inch air space
Felt paper
Fiberboard sheathing
Fiberglass insulation
Polyethylene
Interior gypsum board

Vapor is driven both inward and outward by a high vapor pressure differential between the brick and the interior and the brick and the exterior.
Air outlet

Drainage plane

Clear 1" air space open at both bottom and top

Brick veneer back-ventilated to flush inward-driven moisture out of assembly

Air inlet

Seat in foundation acting as flashing
Drainage plane

Impermeable rigid insulation

Drainage space (1/4" or greater)

Drainage or weep opening

Seat in foundation acting as flashing
Interior lining - gypsum board with latex paint

Cavity insulation

Gypsum sheathing, plywood, OSB

Water resistance barrier (WRB)
- 10 to 20 perms

Vented air space - 1 inch

Brick veneer
Interior lining - gypsum board with latex paint
Cavity insulation
Gypsum sheathing, plywood, OSB
Water resistance barrier (WRB) - 10 to 20 perms
Drainage mat with filter fabric
Vented air space
Stone
Interior lining - gypsum board with latex paint

Cavity insulation

Gypsum sheathing, plywood, OSB

Water resistance barrier (WORB) - 10 to 20 perms

Drainage mat with filter fabric (or building paper over drainage mat)

Vented air space

Stucco with paint - paint layer greater than 10 perms
Water Vapor Permeance of WRB’s

Mean Relative Humidity, %

Water Vapor Permeance, US perms

Dry Cup

Wet Cup

Permeance “Sweet Spot”

High Perm Plastic WRB

Low Perm Plastic WRB

Felt

ASK