Buildings Get Wet From The Outside
Buildings Get Wet From The Inside
Buildings Start Out Wet
Wet Happens
Buildings Must Be Designed To Dry
Buildings Can Dry To The Outside
Buildings Can Dry To The Inside
Buildings Can Dry To Both Sides
2nd Law of Thermodynamics
Heat Flow Is From Warm To Cold
Moisture Flow Is From Warm To Cold
Moisture Flow Is From More To Less
Air Flow Is From A Higher Pressure to a Lower Pressure
Gravity Acts Down
Water Control Layer
Air Control Layer
Vapor Control Layer
Thermal Control Layer
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
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
Don’t Do Stupid Things
The inside face of the insulating sheathing is the condensing surface of interest.

Wood-based siding
R-7.5 rigid insulation
R-13 cavity insulation in wood frame wall
Gypsum board with any paint or wall covering

Temperature (°F)

Insulation/sheathing interface temperature (R-7.5 sheathing, R-13 cavity insulation as shown in adjacent drawing)
Mean monthly outdoor temperature
Dew point temp. at 35% R.H., 70°F
Potential for condensation

Month}

Building Science Corporation
## Insulation for Condensation Control*

<table>
<thead>
<tr>
<th>Climate Zone</th>
<th>Rigid Board or Air Impermeable Insulation</th>
<th>Total Cavity Insulation</th>
<th>Total Wall Assembly Insulation</th>
<th>Ratio of Rigid Board Insulation or Air Impermeable R-Value to Total Insulation R-Value</th>
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<tr>
<td>4C</td>
<td>R-2.5</td>
<td>R-13</td>
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<td>R-20</td>
<td>R-20</td>
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*Adapted from Table R 702.1 2015 International Residential Code*
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
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
Current Problems With Traditional Stucco
Current Problems With Traditional Stucco
Vancouver Condo Crisis….
Should Have Put Everyone on Notice
What Happened In Vancouver?
OSB Instead of Plywood
Non Traditional Building Wraps
Interior Vapor Barriers
Increased Thermal Resistance
Portland Cement Instead of Lime
Rain Screen
Beer Screen?
Traditional Lime Stucco: Greater than 20 perms
Lime/Portland Cement Stucco: 5 to 10 perms
Portland Cement Stucco: 1 to 5 perms
Polymer Modification: Less than 1
**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

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

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

Drainage plane

Clear 1" air space open at both bottom and top

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

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

Vented air space

Stucco with paint - paint layer greater than 10 perms
Fixing Traditional Stucco….
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
Fixing Traditional Stucco…
EIFS Has None of These Issues….
Fixing Traditional Stucco…
EIFS Has None of These Issues….
Except If You are Stupid and Install an Interior Vapor Barrier…..
Don’t Do Stupid Things
Fire propagates vertically and horizontally outside of cladding, and between the cladding and the cavity insulation.

Cladding ignites, insulation in cavity ignites.

Fire blows out window.