Building Science

Moisture Management

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

www.buildingscience.com
A Building Is An Environmental Separator
A Building Is An Environmental Separator

It Keeps the Outside Out and the Inside In
Damage Functions
Damage Functions
Water
Heat
Ultra Violet Radiation
The Three Biggest Problems In Buildings Are Water, Water and Water…
Rain Is The Single Biggest Thing To Worry About….Duh…. 
Rain Is The Single Biggest Thing To Worry About….Duh….
Do The Best You Can On Rain Control…But Assume Things
Will Get Wet…So Design For Drying…
Water Control Layer
Air Control Layer
Vapor Control Layer
Thermal Control Layer
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.
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
(or building paper over drainage mat)

Vented air space

Stucco with paint - paint layer greater than 10 perms
Hydrostatic head

Cladding
<table>
<thead>
<tr>
<th>Pascals</th>
<th>mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 Pa</td>
<td>20 mph</td>
</tr>
<tr>
<td>100 Pa</td>
<td>30 mph</td>
</tr>
<tr>
<td>150 Pa</td>
<td>35 mph</td>
</tr>
<tr>
<td>250 Pa</td>
<td>45 mph</td>
</tr>
<tr>
<td>500 Pa</td>
<td>65 mph</td>
</tr>
<tr>
<td>1,000 Pa</td>
<td>90 mph</td>
</tr>
</tbody>
</table>
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

Cup can still drain water to exterior

Entire wind pressure taken here
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

Cup can still drain water to exterior

Entire wind pressure taken here
Outer seal sees water but not pressure; no pressure difference across this seal, therefore no rain entry.

Pressure in chamber is same as pressure outside on face of assembly.

Air enters and pressurizes chamber.

Key seal is interior seal as it takes maximum wind load but it does not see water.

Entire wind pressure taken here.

Pressure chamber.
Intent of sealant is to limit this lateral flow of water between sheathing and building wrap.

Flashings tape

Sealant “bedding” joint

Building wrap “wrapped” into opening
Don’t Do Stupid Things