Ventilation for SPF Contractors and other BS
April 14, 2015

Dear Allison,

On behalf of The International Women’s Leadership Association, it is my distinct pleasure to notify you that, in consideration of your contribution to family career, and community, you have been selected as a woman of outstanding leadership.
QUESTION

Why should a spray foam contractor know building science?
Stewart Brand’s 6 Ss
A Building Is a System
Everyone wears blinders.
Building Enclosure

Boundary between conditioned & unconditioned spaces with two key components:

- Air Barrier
- Insulation

Air barrier should be touching insulation (in most cases).
Going with the Flow

Heat, Air, & Moisture take the path of least resistance:
• Hot $\rightarrow$ Cold
• High $\rightarrow$ Low Pressure
• Wet $\rightarrow$ Dry

“In this house, we obey the laws of thermodynamics!”
~ Homer Simpson

2\textsuperscript{nd} Law of Thermodynamics
Going with the Flow

Controlling

Heat
Air
Moisture

Results in

Health
Comfort
Durability
Efficiency
The Physics of Water
The Two Kinds of...

People

Moisture
• Liquid
• Vapor
• *(Ignore solid)*
2nd Law of Thermodynamics for Moisture

Water moves from wet to dry areas.
Law of Gravity for Moisture

Water moves downward.
Wind-Driven Rain

Water will get behind the cladding.

Felt at siding joints
The Drainage Plane

Housewrap
The Drainage Plane

Foamboard

*Seams must be taped*
The Drainage Plane

Taped Sheathing
The Drainage Plane

Liquid-applied
The Drainage Plane

Peel-and-Stick
The Drainage Plane

Felt
Diffusion vs. Infiltration

~100:1 ratio favoring air leakage?
Diffusion vs. Infiltration

Lstiburek now says it’s more like a 10:1 ratio.
Permeance & Vapor Retarders

- **Class I: \( \leq 0.1 \text{ perm} \)**
  - polyethylene
  - nonperforated aluminum foil
- **Class II: 0.1 to 1 perm**
  - Kraft paper facing on batts
  - XPS foam > 1” thick
- **Class III: 1 to 10 perms**
  - latex paint
  - #30 felt
  - plywood

- The lower the number, the less permeance the material has.
- Some people call a Class I vapor retarder a vapor barrier.
Permeance vs. Permeability

- **Permeance** – Depends on thickness; analogous to weight
  - 1” XPS \(\rightarrow\) 1.1 perms
  - 2” XPS \(\rightarrow\) 0.55 perm

- **Permeability** – Does *not* depend on thickness; analogous to density
  - Roughly inversely proportional to thickness
Plywood vs. OSB

Water Vapor Permeance of Sheathing

[Graph showing the comparison of water vapor permeance between Plywood and OSB. The x-axis represents mean relative humidity (%), and the y-axis represents water vapor permeance, US perms. The graph shows a comparison between Dry Cup, Wet Cup, Plywood, and OSB.]
QUESTION

What does this graph say about the effect of the switch from plywood to OSB for sheathing homes?
OSB works if you...

Add an air gap:
- Furring strips
- Crinkled house wrap
- Plastic mesh
Rain Screen vs. Drainable Wrap

Home Slicker

HydroGap

Both made by Benjamin Obdyke
“The three biggest problems in buildings are water, water, and water.”

~ Gus Handegord
Fundamental Rule of Material Wetness

Cold materials tend to be wet and warm materials tend to be dry.

from Water in Buildings by Bill Rose
Condensing Surface

Warm & Humid → Cool & Dry
Condensing Surface

Cold & Dry

Warm & Humid
N3 (5-1/2-in. ocSPF)
N2 (12-in. cellulose)
N1 (12-in. ocSPF)
Attic Ridge Temperature & Dew Point

6/13/14 7:12
6/14/14 7:12
6/15/14 7:12
6/16/14 7:12
6/17/14 7:12
6/18/14 7:12
6/19/14 7:12

Attic Ridge Temp.
Attic Ridge Dew Pt
Choosing a Residential Ventilation Method
Why We Need Ventilation

Airtight enclosures
Infiltration Doesn’t Cut It

**ATTIC**
Insulation fibers, dust, rodent scat

**OUTSIDE**
Pollen, auto fumes, dust

**CRAWLSPACE**
Mold, dust, lead, radon, moisture, termiticide

**GARAGE**
Carbon monoxide, pesticides, gasoline, fertilizers
Bad Stuff in the Air

$\text{CO}_2$

VOCs

Formaldehyde

$\text{NO}_x$

Radon

...and more!
2 Ways to Achieve Good IAQ

Source control

Mechanical Ventilation
“If there is a pile of manure in a space, do not try to remove the odor by ventilation. Remove the pile of manure.”

~ Max von Pettenkofer, 1858
Build Tight
Ventilate Right
3 Types of People

1. Those who can do math
2. and those who can’t.
3 Types of Ventilation

1. Whole house
2. Local
3. Buffer space
3 Types of Ventilation

1. Whole house
2. Local
3. Buffer space
Local Ventilation

• Bathrooms
• Kitchens
Buffer Space Ventilation

- Radon
- Crawl space
- Garage
- Attic
Resources