

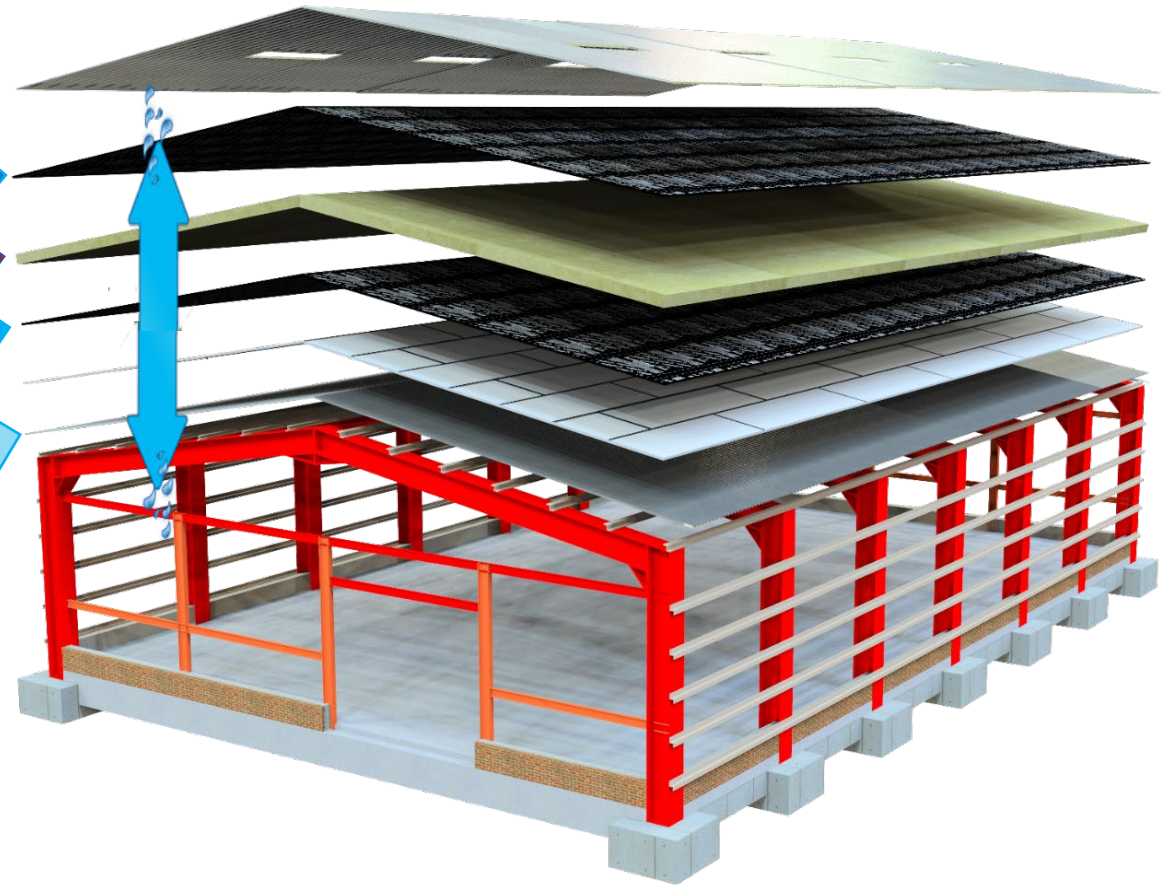


Prevention and Mitigation of Interstitial Roof Condensation

Basic Requirements for a Roof Assembly

Controls:

- Moisture flow
- Heat flow
- Air flow
- Vapor flow



Historical Perspective

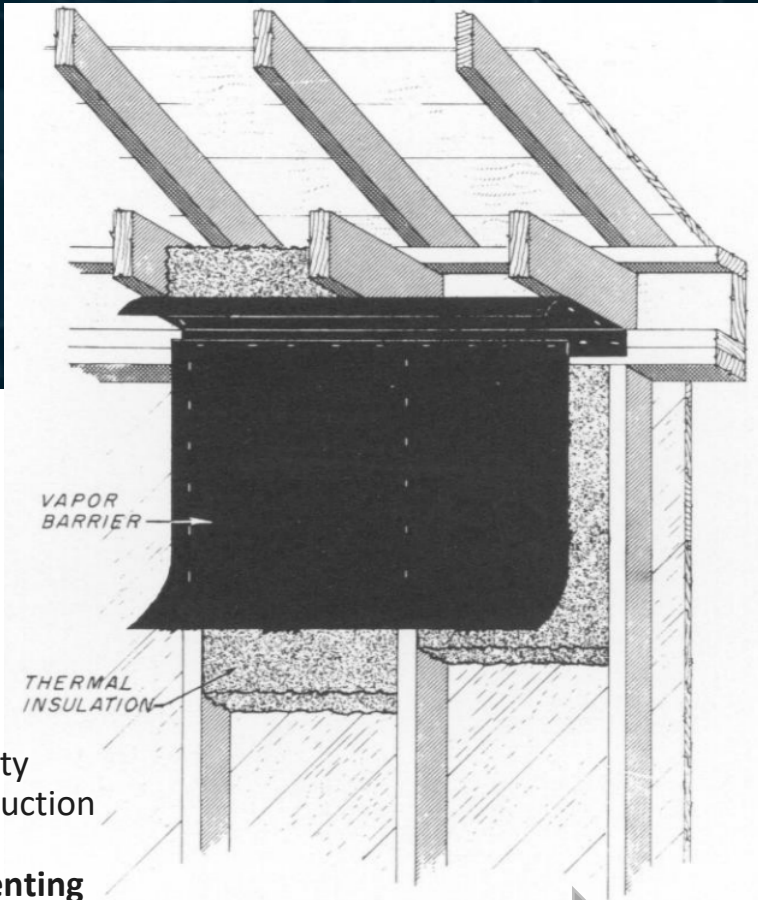


Image by Mark Hertzberg

- FLW Wingspread

- U.S. Federal Housing Authority Property Stan. & Min. Construction Requirements for Dwellings
1 perm 1/300 attic venting

Prehistory

1920's

1930

1937

1930-40

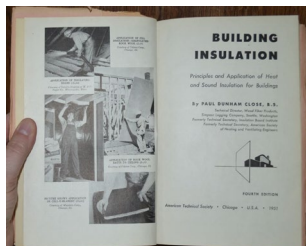
1942

1948

2009

- Caves to Huts

- Glass Wool Insulation



- Paul Close exterior side in contact with roof sheathing to Prevent Mold

- Vapor Barriers & Vented Attics
Larry Teesdale
Tyler Rogers &
Frank Rowley

- BOCA's model building code published

- IRC Vented or Unvented Attics

Insulation to Prevent Condensation

- 1920s Thermal insulation installed to prevent mold growth in industrial buildings.
- In 1930, Paul Close of ASH&VE: placing insulation to the exterior and in close direct contact with the sheathing, to prevent condensation and mold growth.




Vapor Barriers

- Not much change since the 1948 BOCA model building code
- 1930-40's Vapor Barriers introduced as the “cure”. Larry Teesdale, Tyler Rogers & Frank Rowley
- 2006 IECC Vapor Barriers: Class I (>0.1 perm),
Class II (0.1-1 perm), Class III (1-10 perm)



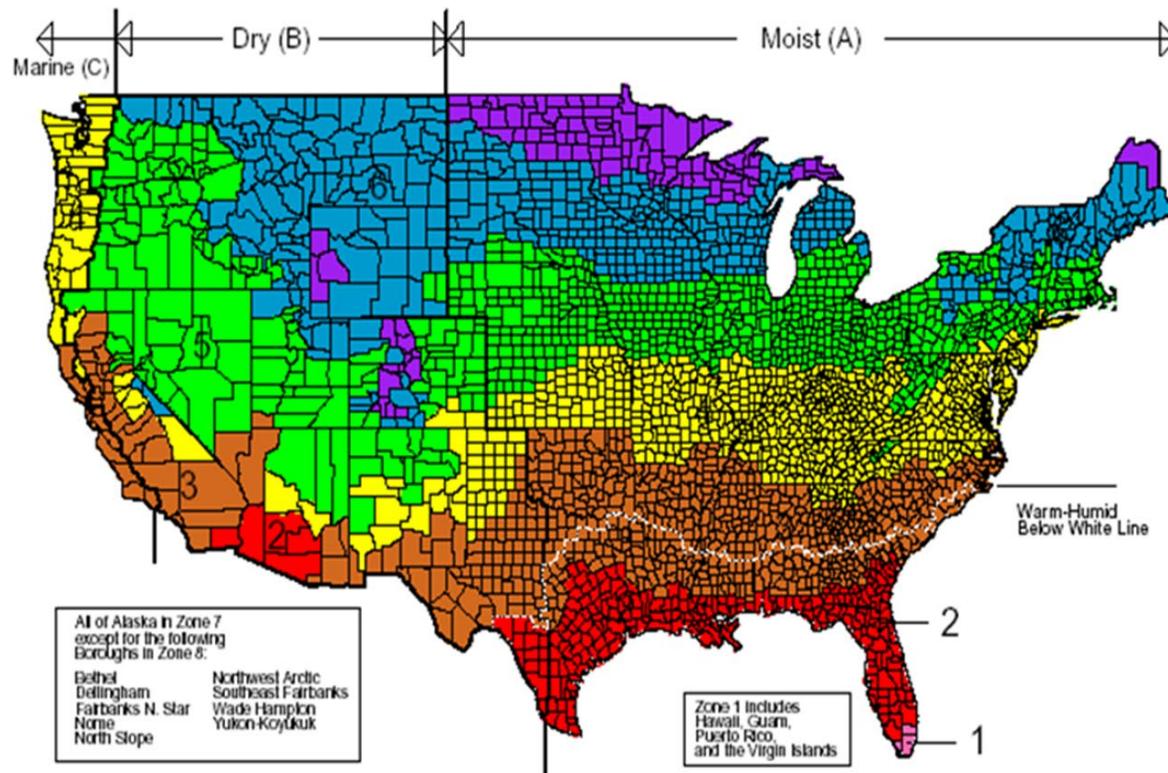
Vapor Barriers

- Restrict (NRCA's criteria):  NRCA
Average exterior temperature $<40^{\circ}\text{F}$ &
interior $>45\%\text{RH}$
or when Interior $>60\text{-}70\%\text{RH}$



Hgrothermal Modeling

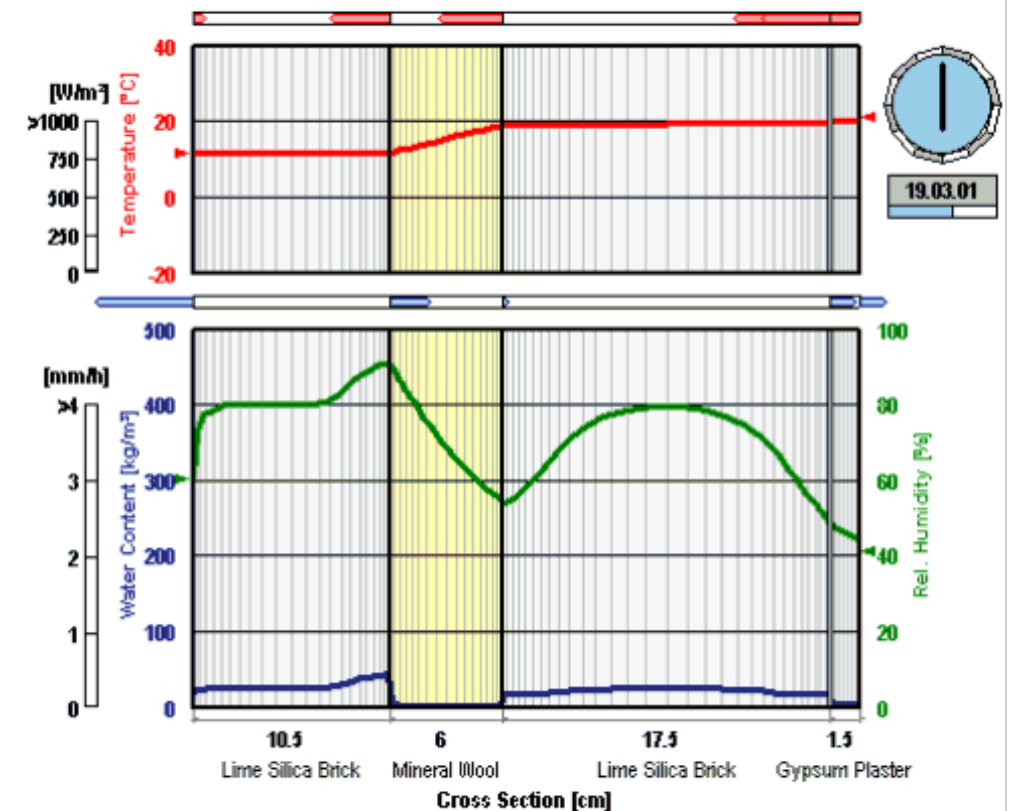
Evaluate Your design



Location: Holzkirchen

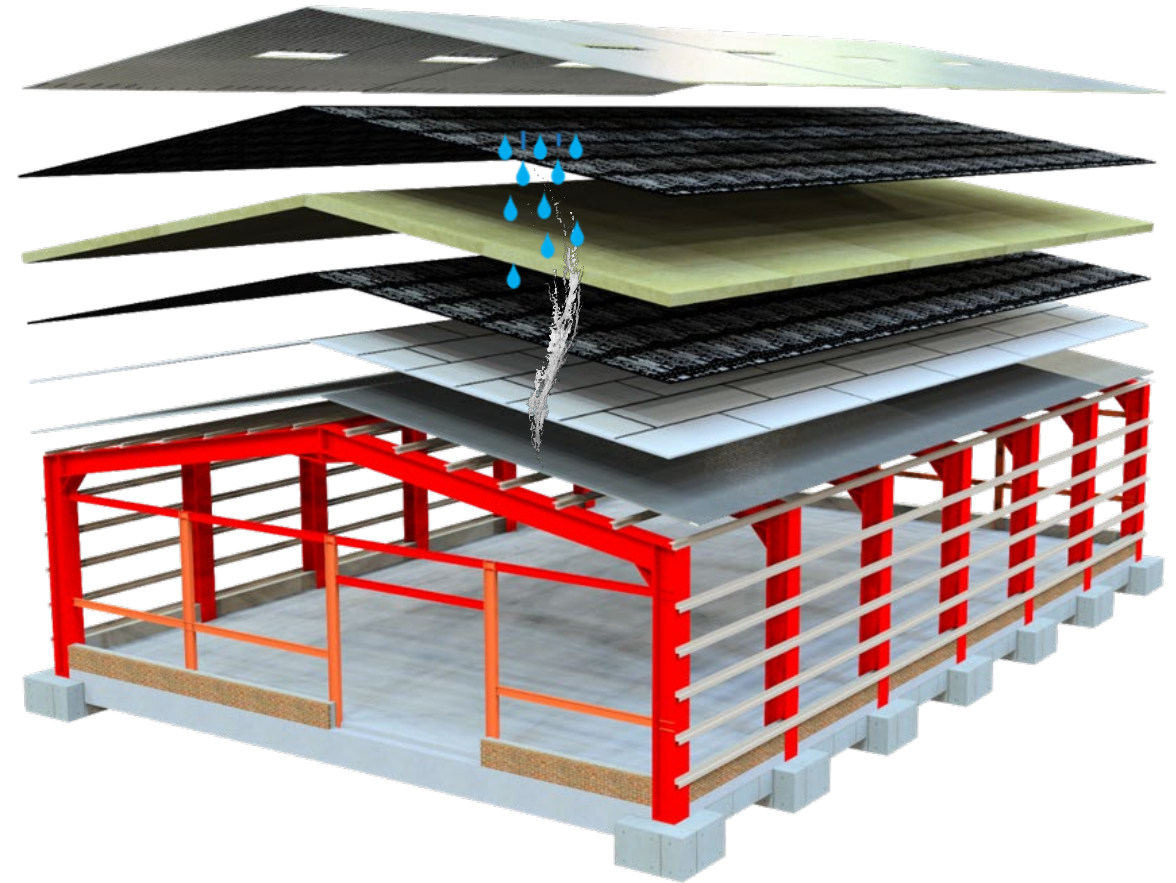
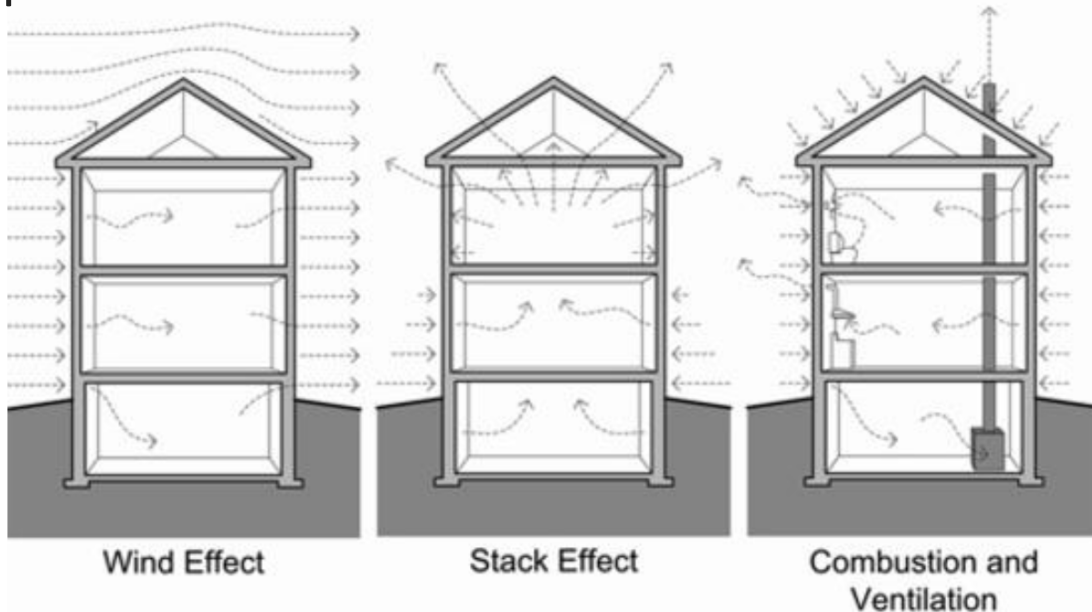
double-leaf masonry wall exposed to driving rain

WUFI®



Interstitial Condensation – Air Movement

The majority of moisture is transported by air from induced pressure differences.

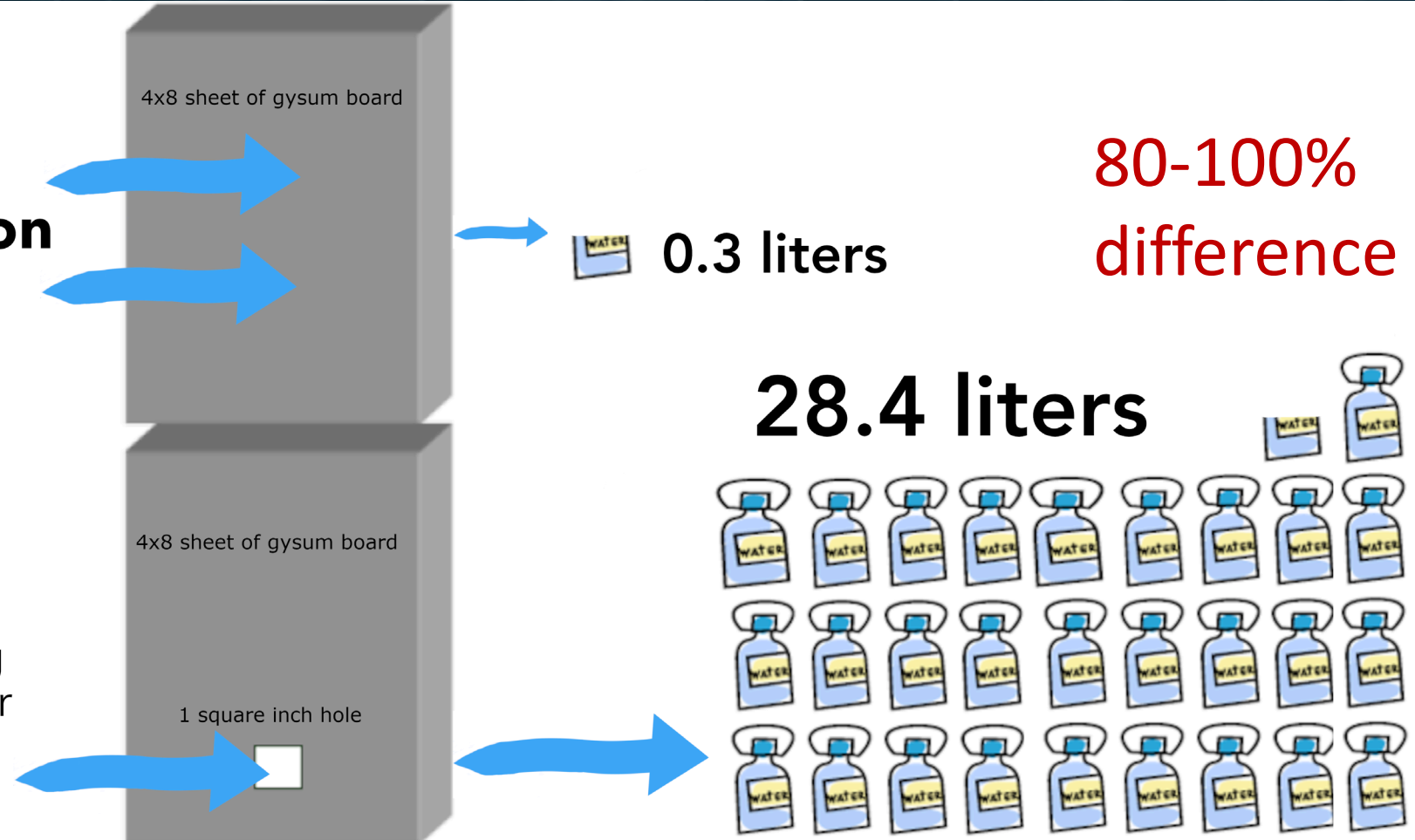


Air Barriers and Vapor Barriers

Comparison of
Vapor diffusion
and

Air flow

during the heating
season with indoor
conditions:
70°F 40%RH



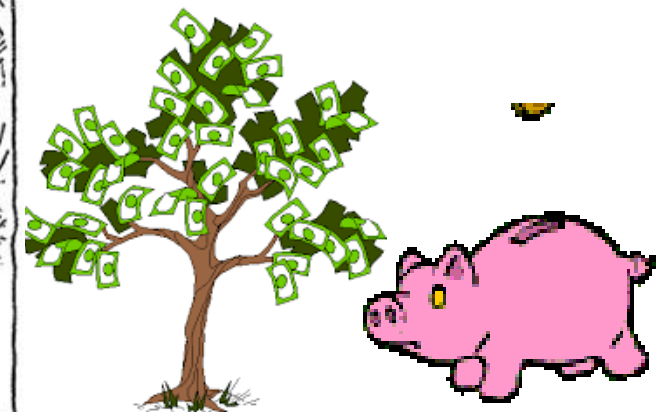
Energy Savings

Insulation & Air tight

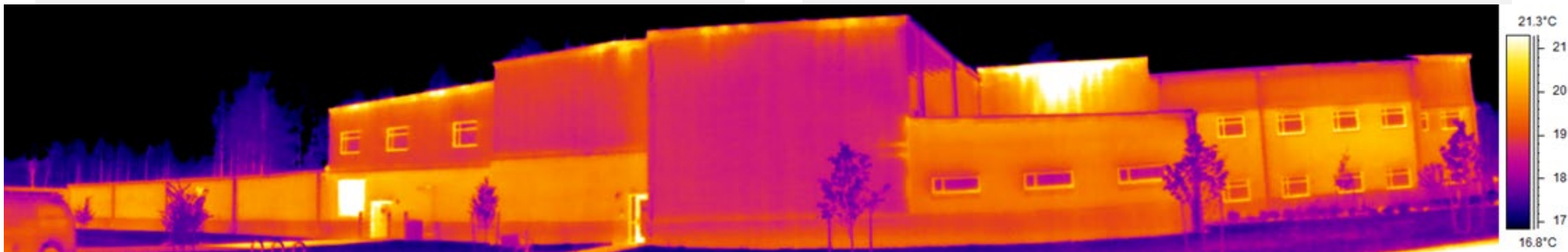
Energy consumption for heating
& cooling savings of 3-50%

“Seal tight Ventilate right!”

Jack Hébert, founder of
the Cold Climate Housing Research Center



Air Movement into the Roof Assembly



Air Movement into a Cool Ceiling

Typical condensation for warm humid climates

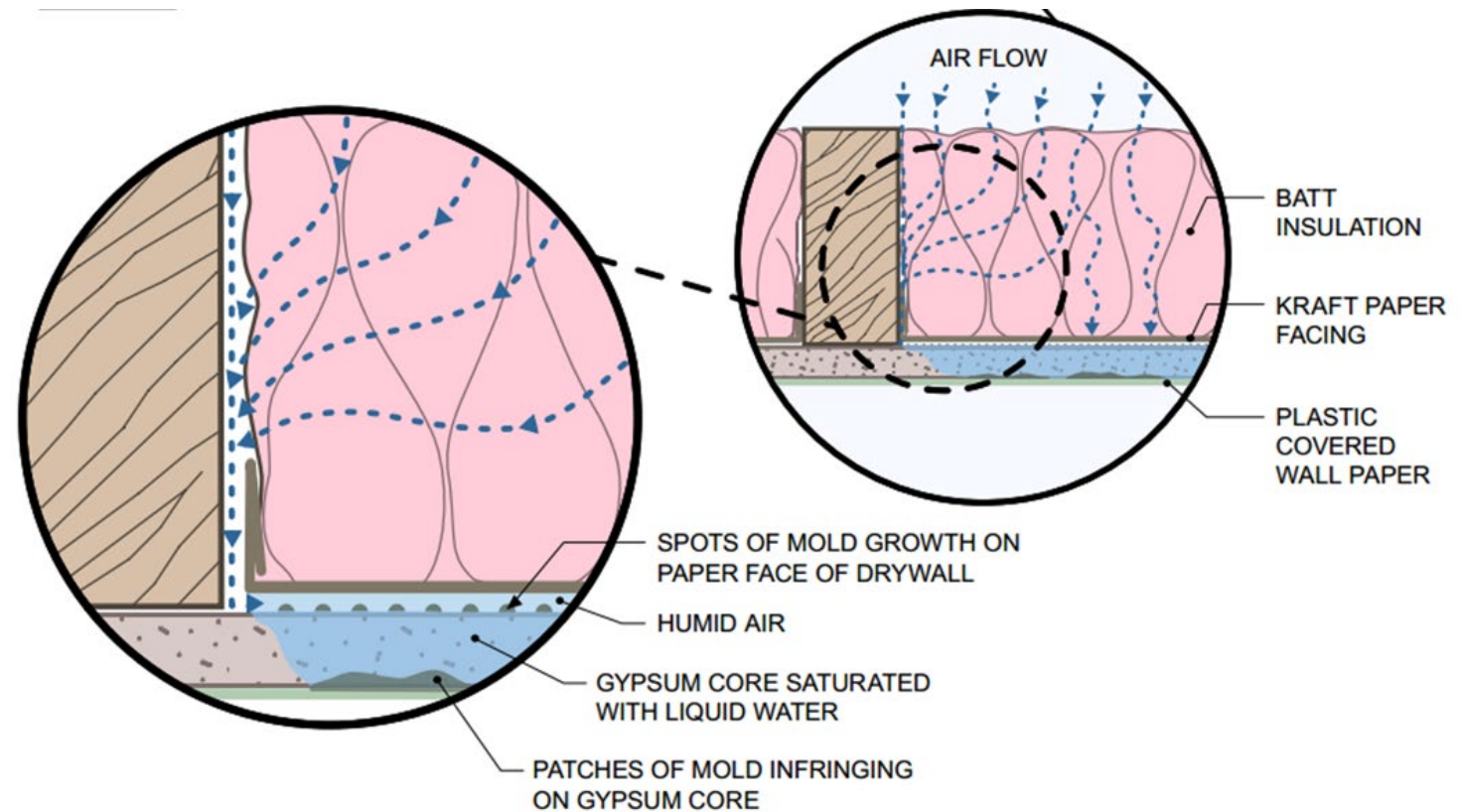
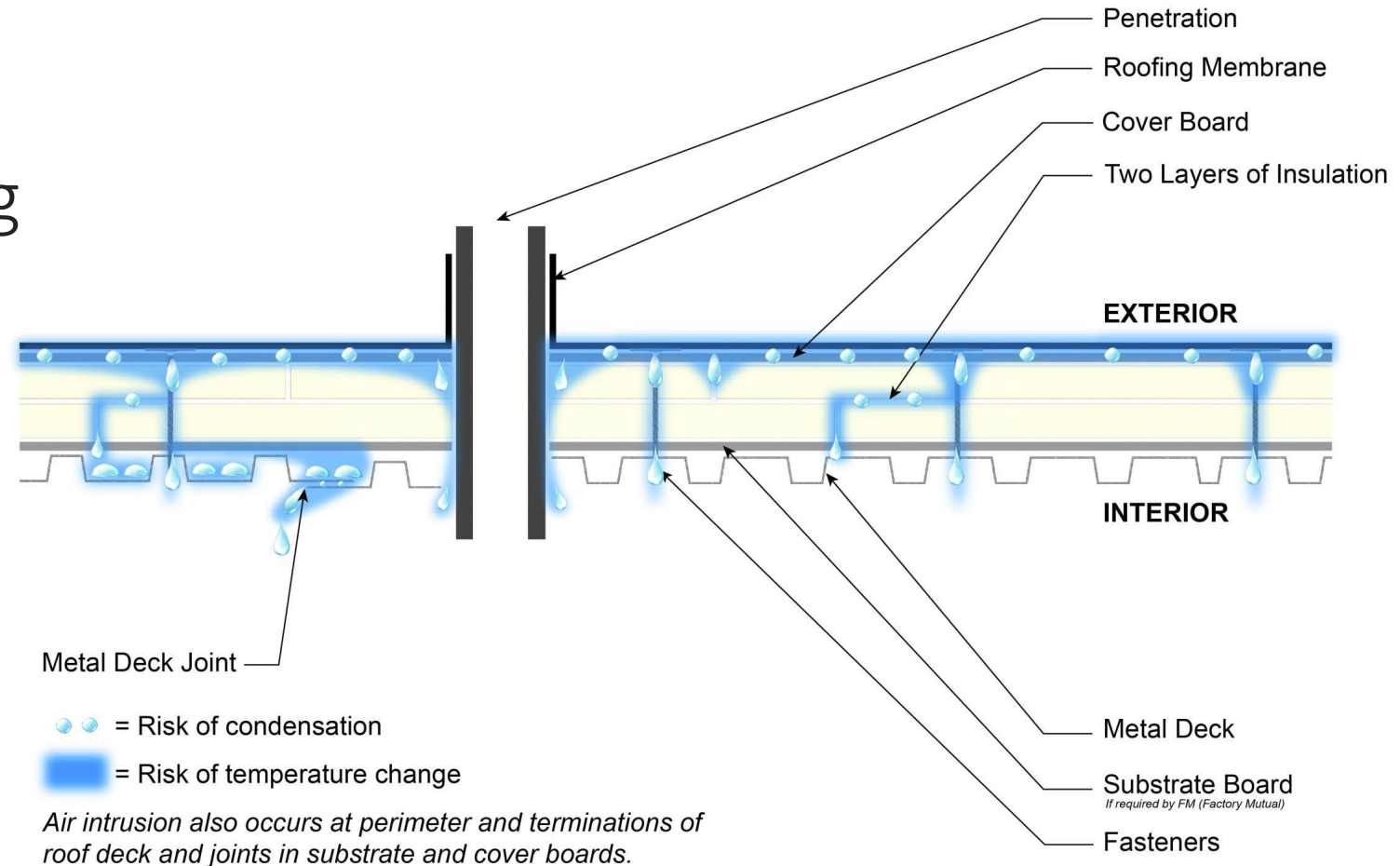


Image from Roger Morse, 2008 BEST1, Air Barriers vs. Vapor Barriers

Air Movement and Interstitial Condensation

- Daytime solar heating
- Night sky radiant cooling
- Summer / Winter



Air Barriers

Warrantee claim that the roof was leaking.

Condensation due to lack of an air Barrier

Insert Image of roof

Interstitial Condensation

Moisture accumulation due to air leakage.

A white “cool” roof contributed by lower the day time roof temperature.

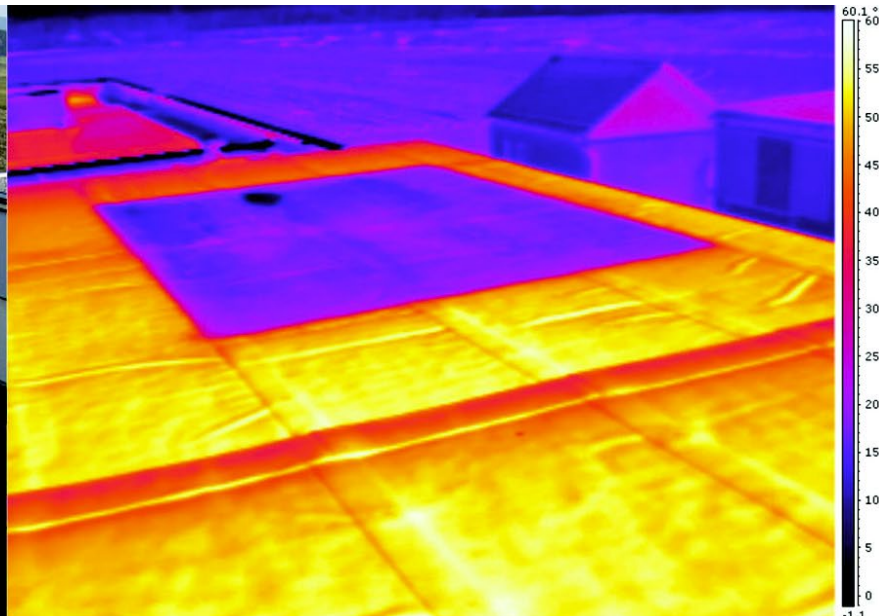


Image from Phil Dregger Vice President at Salas O'Brien Company

Cool Roof

Though it reduces summer temperatures, it reduces drying potential.

Hygrothermal Performance of Flat Roofs with Construction Moisture. Christian Bludau, Hartwig M. Künzle, Daniel Zirkelbach. ASHRAE. 2010



Self-Drying Roofs

Used when the average vapor pressures are into the conditioned space.

Insert Image



Discussion using references



The background of the slide is a dark blue, textured pattern consisting of many 3D cubes or hexagonal prisms arranged in a staggered, overlapping grid. The lighting creates shadows and highlights on the faces of the cubes, giving it a three-dimensional appearance.

Thank You

NIBS Logos

**For dark backgrounds only*



**For light backgrounds only*

