High Performance
Historic Masonry Retrofits

HIGH
PERFORMANCE
BUILDING SUPPLY

131 Union St Brooklyn, NY 11231
718.622.1600 Info@FourSevenFive.com

What is high performance?
User Priorities/Concerns:

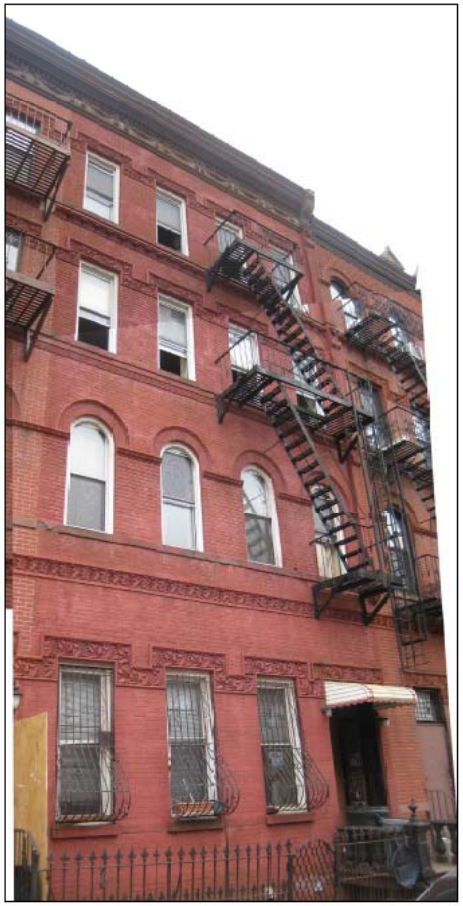
1. Comfortable
2. Healthy
3. Energy Efficient
4. Resilient
5. Affordable
6. Aesthetically pleasing

What is high performance?
Masonry Priorities/Concerns:

as Louis Kahn might have asked

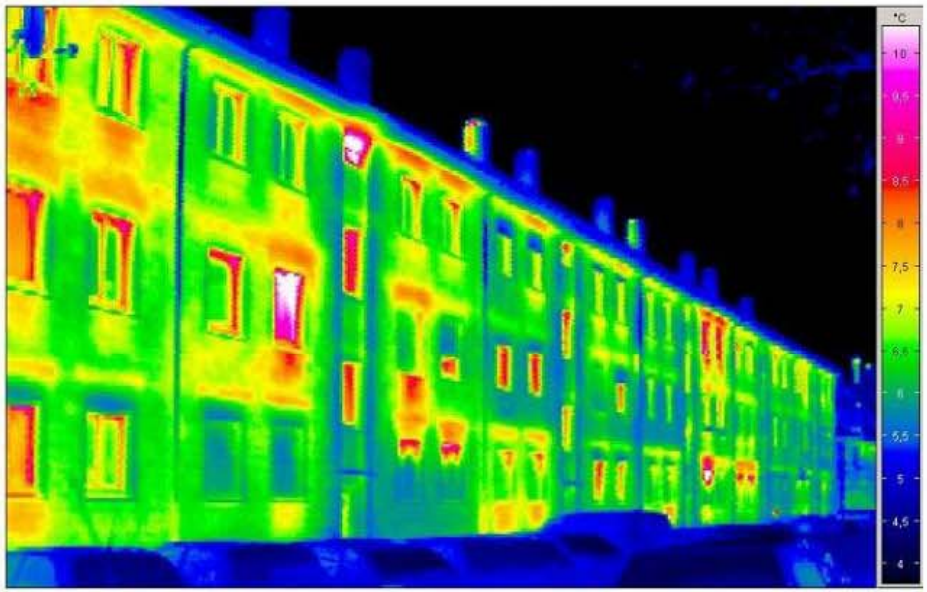
"What does the brick want?"

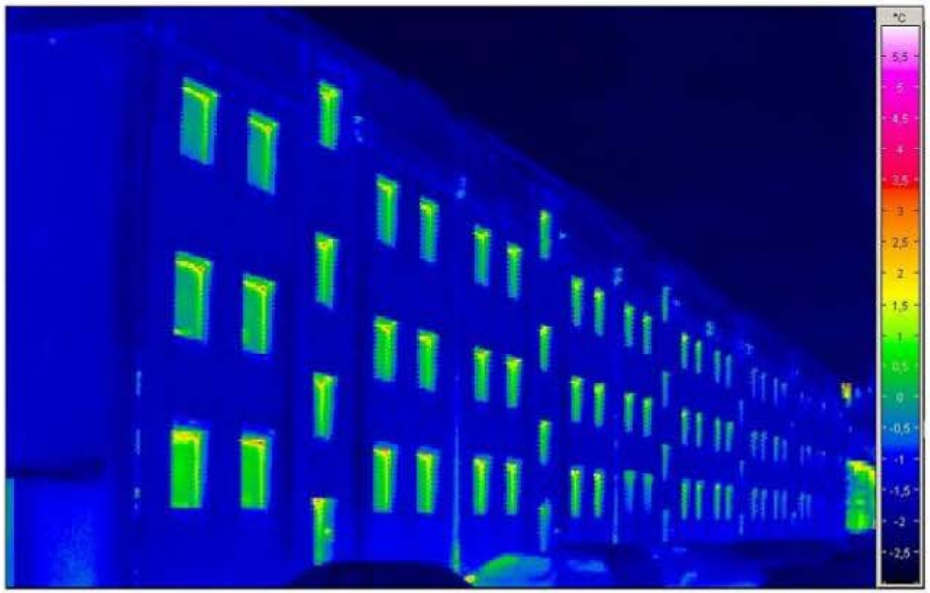
1. It wants to be dry
2. It wants to be seen



“Wants” in Conflict

Dryer Brick vs. **Wetter** Brick





Inefficient/**Uncomfortable** vs. **Comfortable**/Efficient

Freeze-Thaw Damage?

Avoid problem: Insulate Outboard

Figure 5: Exterior insulation retrofit approaches (EIFS left; insulated metal panel cladding right)

Credit: Dept of Energy/Building Science Corp

23 Park Place Passive House

National Trust *for* Historic Preservation
Save the past. Enrich the future.

HISTORIC DISTRICTS COUNCIL




NYC Landmarks Preservation Commission

Preservation Concerns and Aesthetics Often Prevent Exterior Insulation

Recognize that Freeze Thaw Destruction is a Whole Systems Failure

The masonry must be saturated (95% RH).
How did it get saturated?

<u>And</u> the weather must be well below freezing for an extended period.

<u>The Questions Is:</u>
How to Avoid System Failure, and achieve high performance?

Or, how to avoid saturation and maximize comfort:

1. Successfully **shed water**
2. Maximize **airtightness** and **vapor control** (The Drying Potential)
3. Maximize **safe insulation** levels
4. **Great windows** – fully integrated

1847 Brooklyn Townhouse

Formula:

drying capacity > unanticipated wetting
= freedom from damage

Help the Drying.
Increase the resilience.

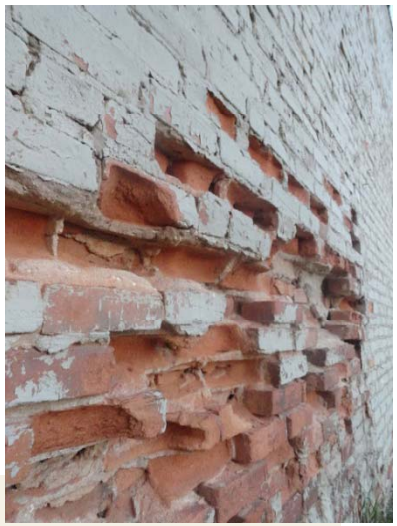
Shed Water

1. Make properly functioning drainage: gutters, leaders and drains.
2. Move water off face: repair/replace cornices, sills, flashings, and drip edges.

Credit: DOE, Building Science Corp.

Shed Water

1. Verify porosity/quality: visual and physical examination. Wide variation. Does it need a coating?
2. Repoint and replace masonry units: as needed.



Karsten Tubes

Soft Mortar Mix Recipe

To repoint most 19th-century rowhouse buildings, the rule of thumb recommendation is for a soft mortar mix. The recipe is as follows:

SOFT MORTAR MIX

1 part white Portland cement

2 ½ parts lime

5-6 parts sand

Parts are by volume. Mix dry ingredients first before adding potable water.

Use dry pigments (natural or synthetic stable oxide pigments) to tint or color mortar.

Mix all ingredients thoroughly.

NYC LPC

Mortar should be softer than the brick

Freeze Thaw? Yes, but not an insulation problem.

Freeze Thaw Damage at top of wall

Expose the Problems & Repair

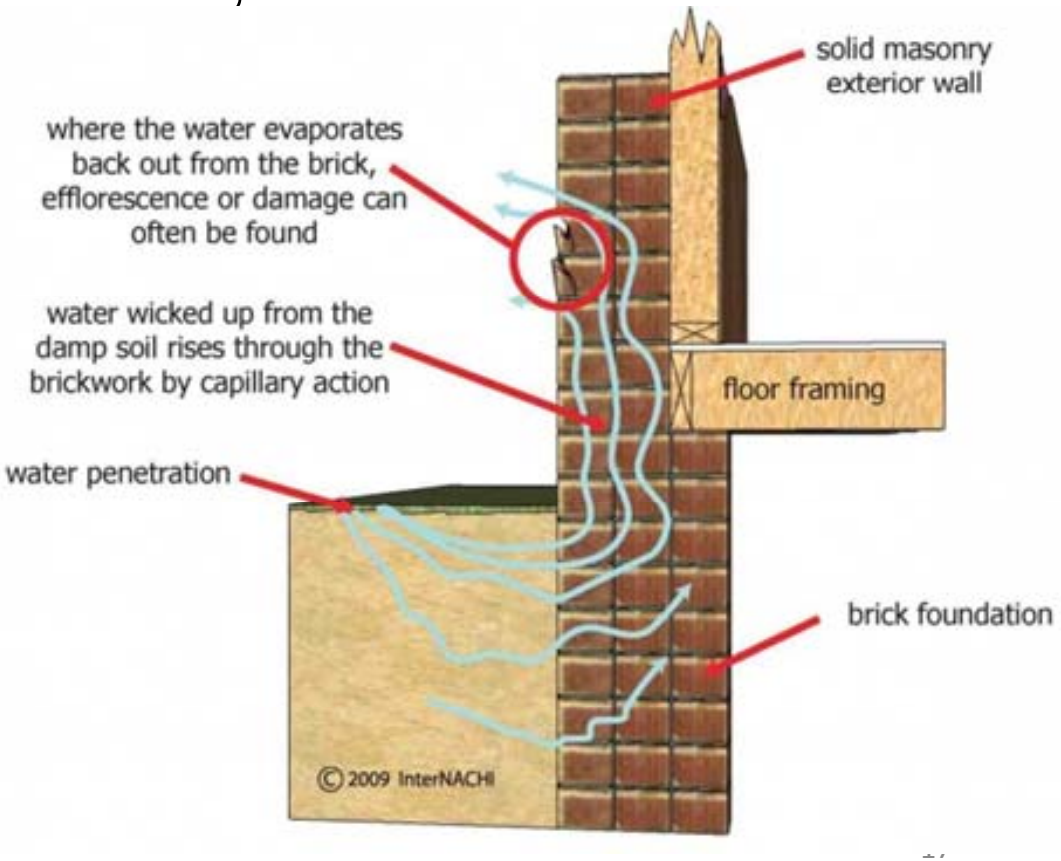
Pull everything away from brick

(with possible exception of plaster at party walls)

Deal with Rising Damp

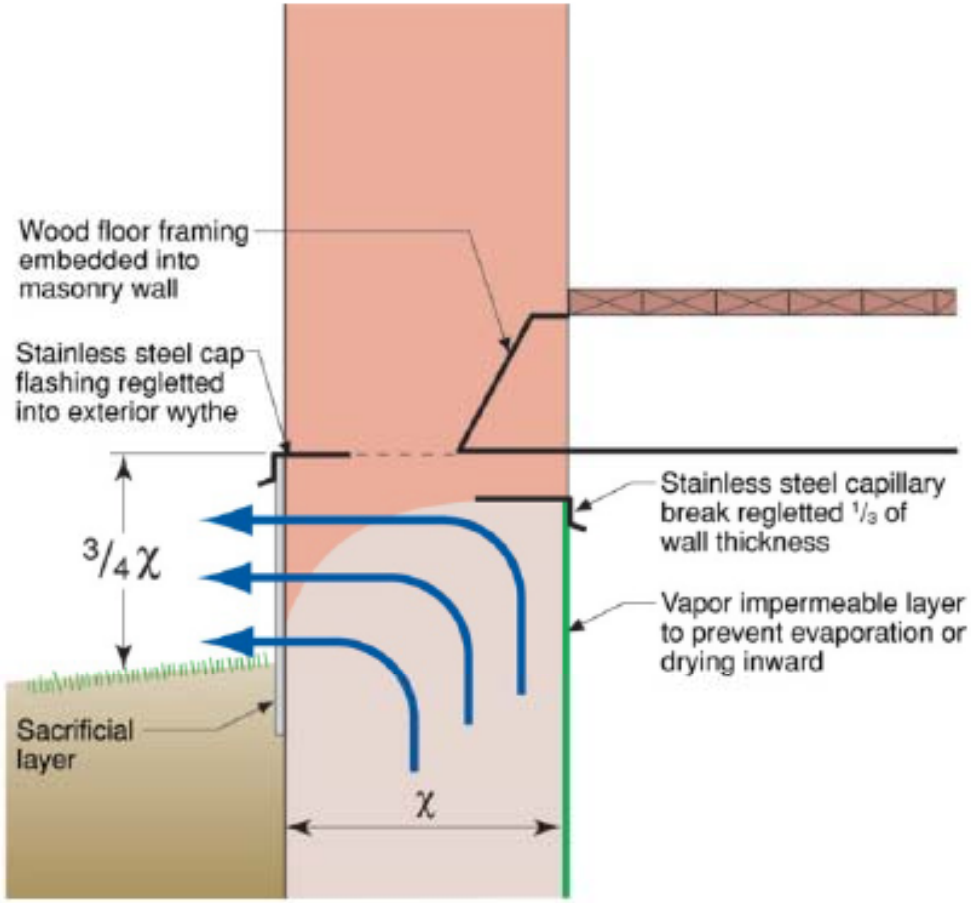
1. Provide interior and/or exterior drainage: pitch grade, drainage matts, perimeter drain pipes, sump pumps.
2. Install water barriers: plastic sheets, waterproofing membrane

Credit: DOE, Building Science Corp.



Drainage Mats & Pipes

Capillary Breaks

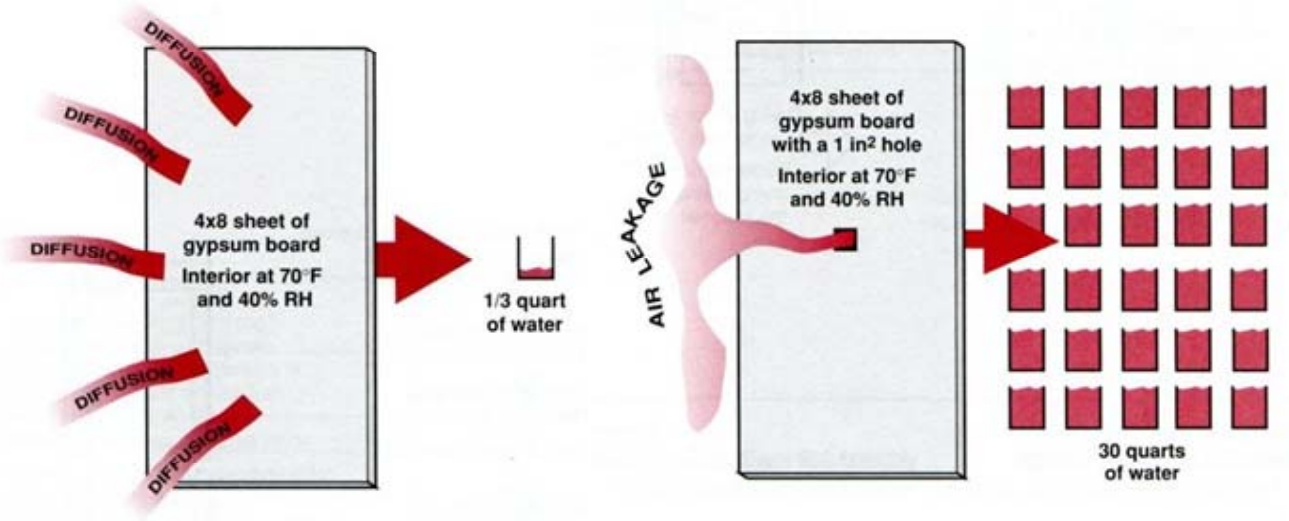


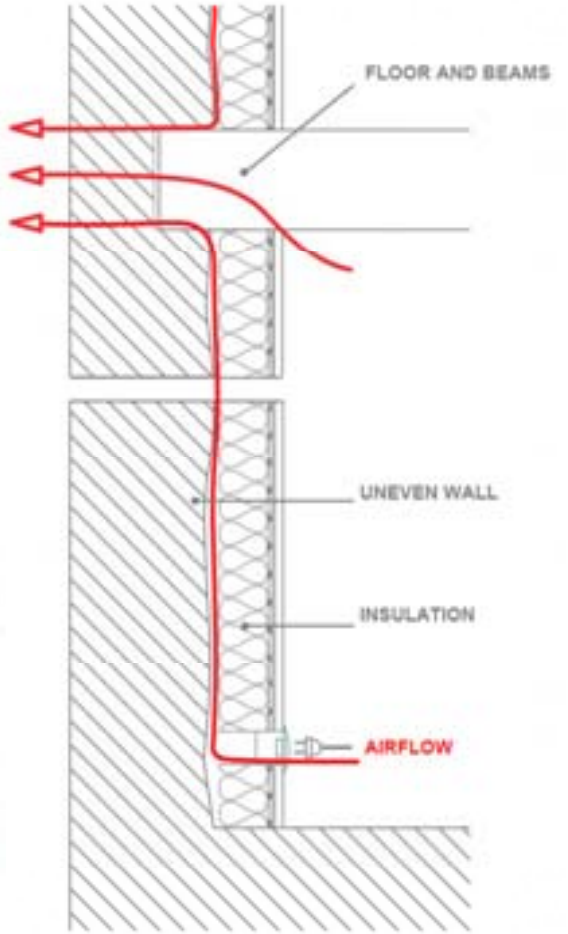
Credit: DOE, Building Science Corp.

Prevent Condensation from Air Transported Vapor

1. **<u>Continuous airtight control</u>**: membranes, tapes, gaskets.

   Air leaks are the biggest liability after bulk water: Stop all air leaks. Make an airtight enclosure.





Credit: DOE, Building Science Corp.

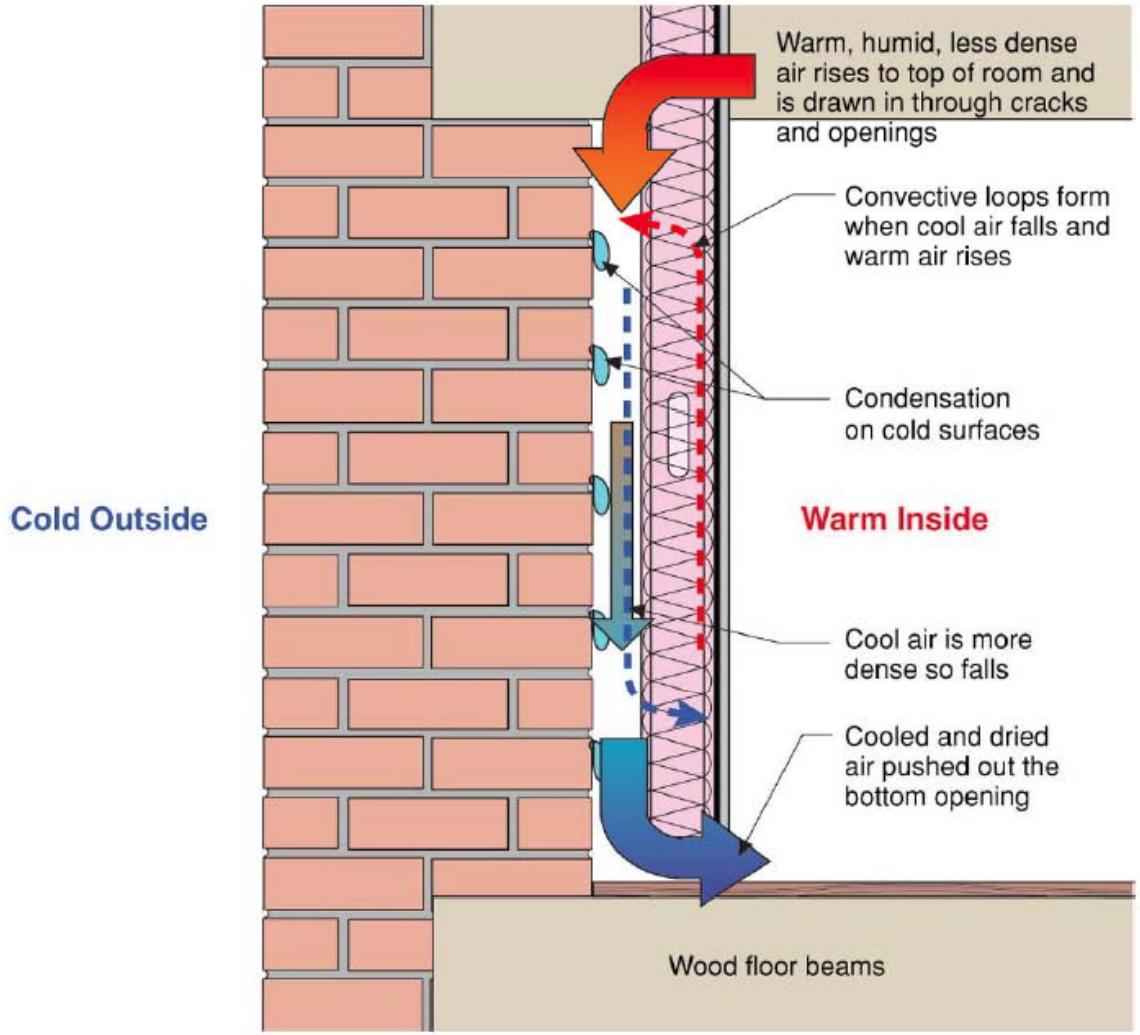


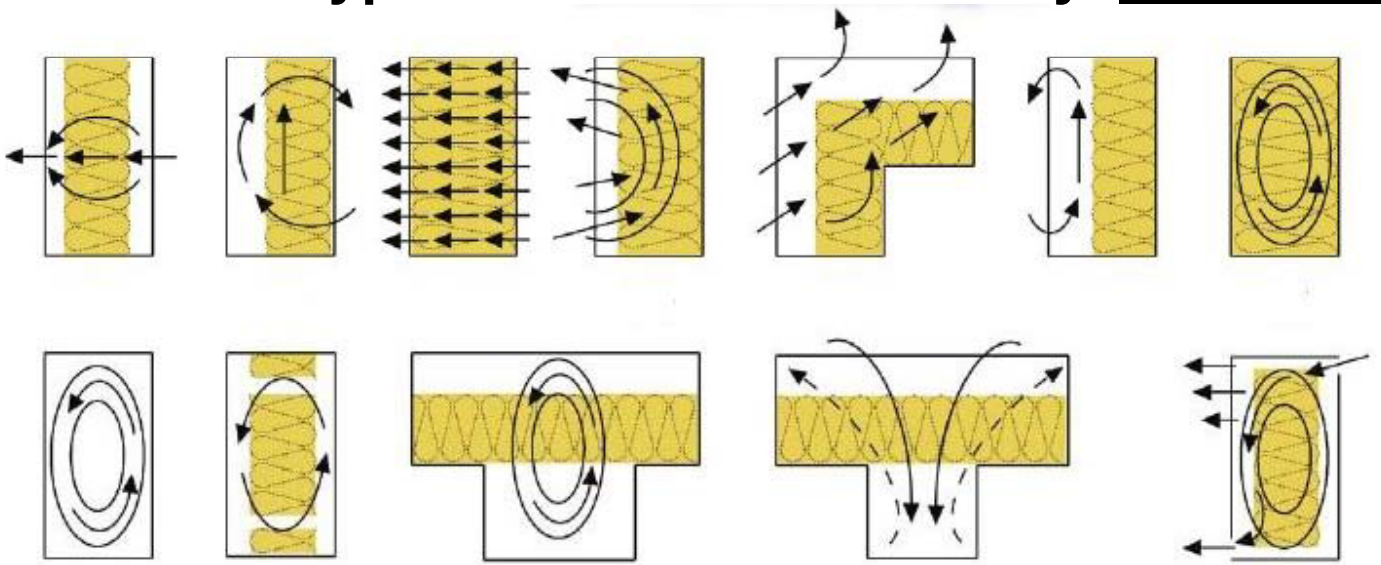
Figure 17: Problematic stud and batt interior retrofit with imperfect airtightness

Credit: DOE, Building Science Corp.

Air Control:
more important than thermal control

Disproportionately effects:

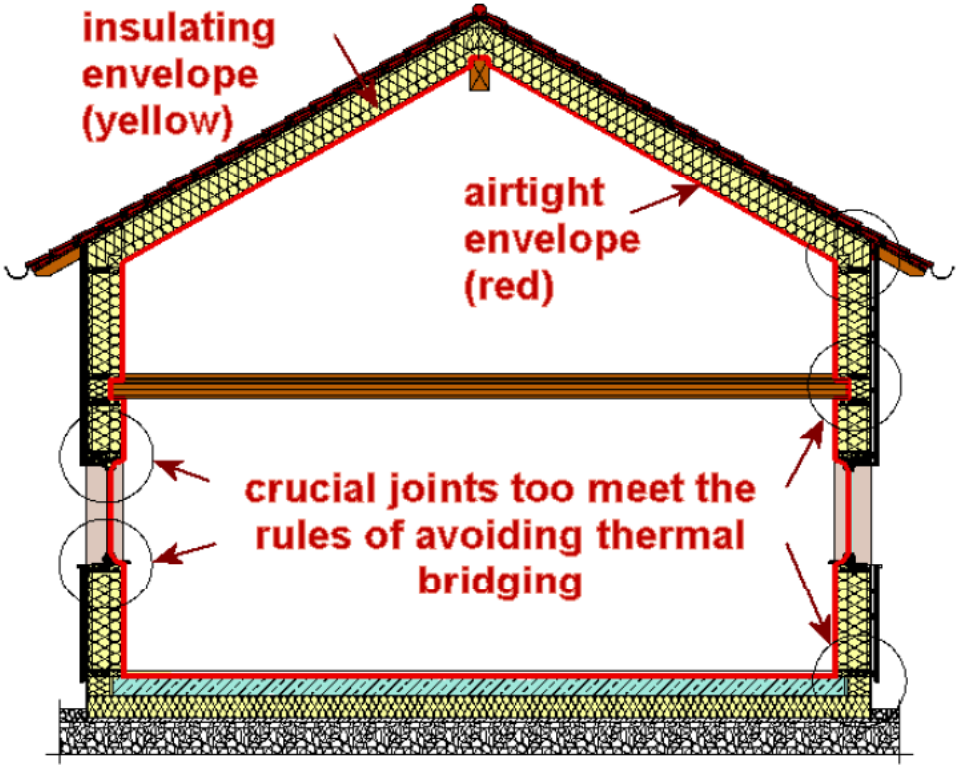
1. **Air transported wetting**
2. **Indoor air quality**: control the air to control the quality
3. **Comfort**: drafts are uncomfortable
4. **Thermal Bypass/Heat Loss/Efficiency**: Factor of 5.



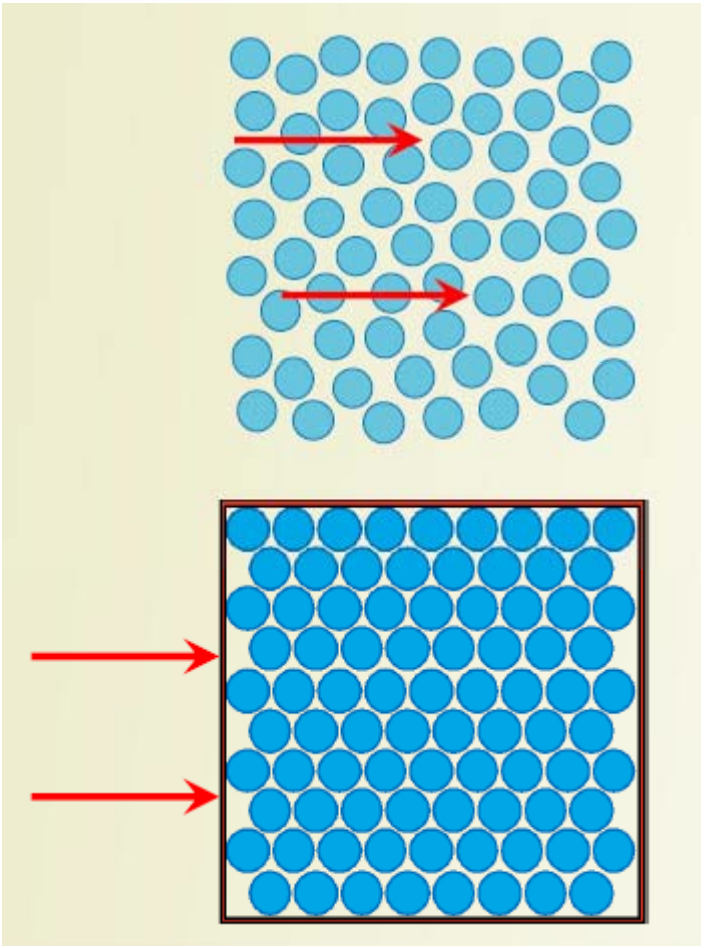
Credit: Mark Siddall, Building Green Magazine

Surround with Airtightness.

Your Conditioned Spaces

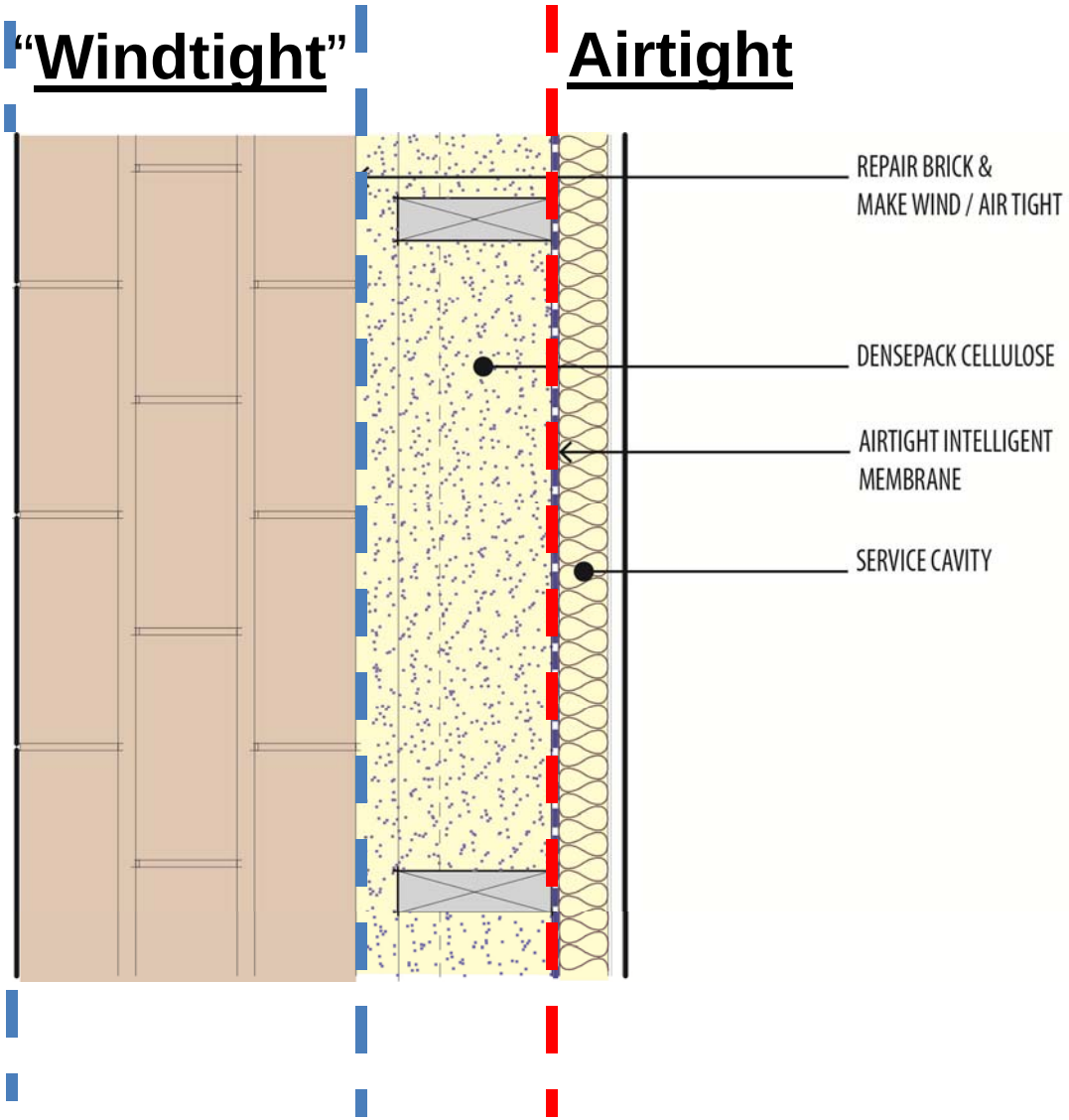


Ref http://passipedia.passiv.de/passipedia_en/



And Verify with Blower Door.

make airtight **inboard** & **outboard**.



Repoint Brick

Making brick “windtight”/airtight.

Repointing is generally enough.

Plaster

Sto Emerald Coat

Airtightness with Liquid Applied Membrane:

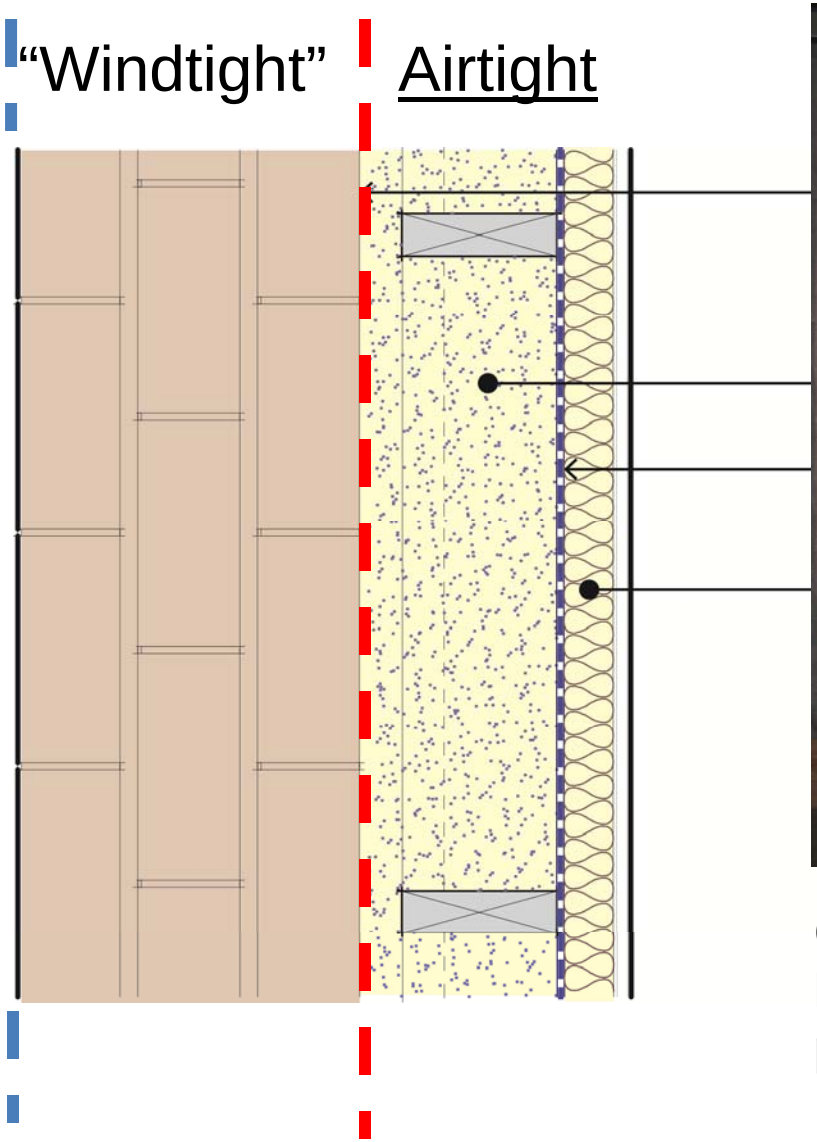
At interior face of brick:

Sto: Gold or Emerald Coat
Dupont: Tyvek Fluid Applied WRB

Very labor intensive with difficult connections to windows etc.

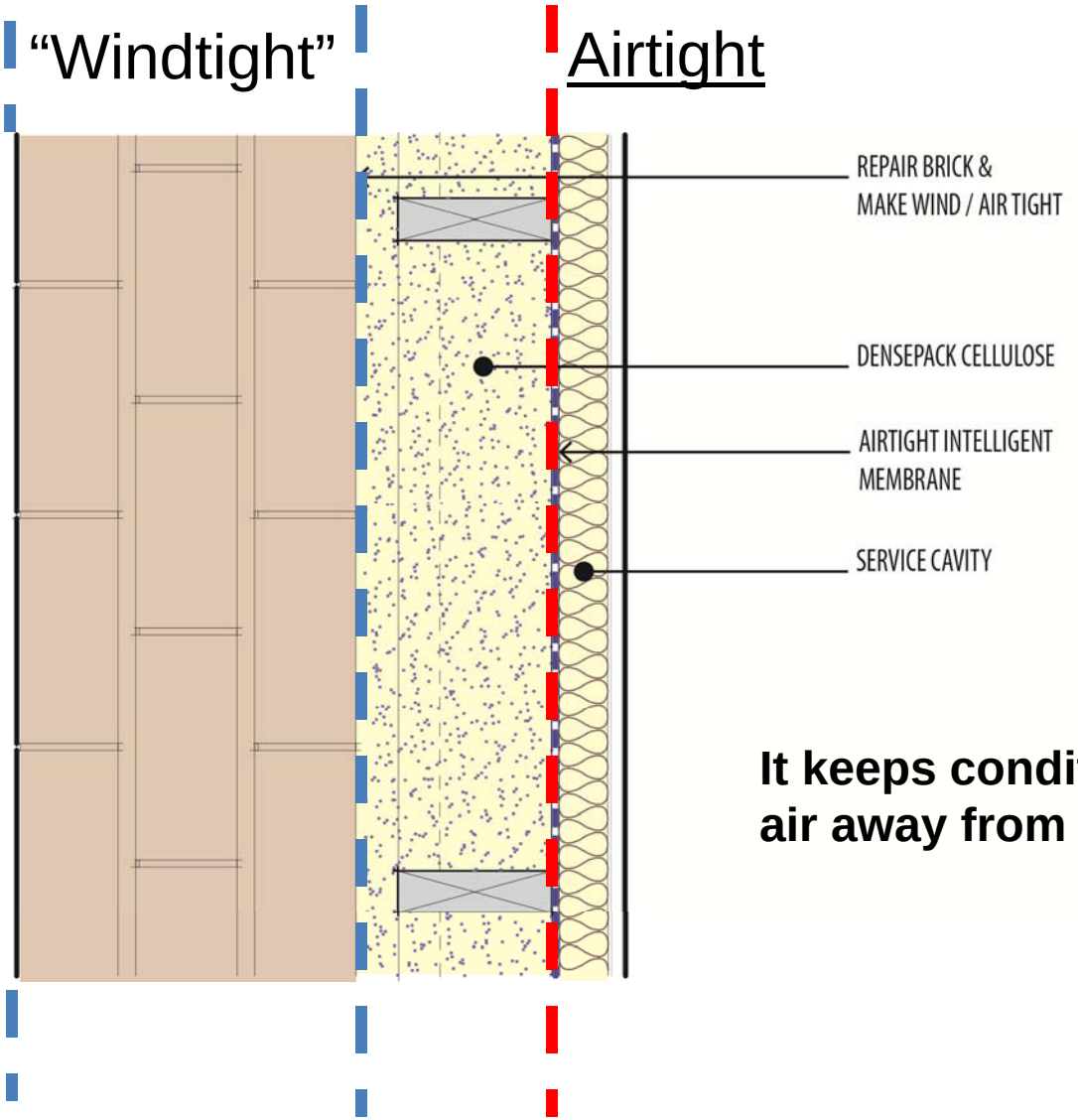
Airbarrier on cold side only

but airtight **outboard:** “wrong side”

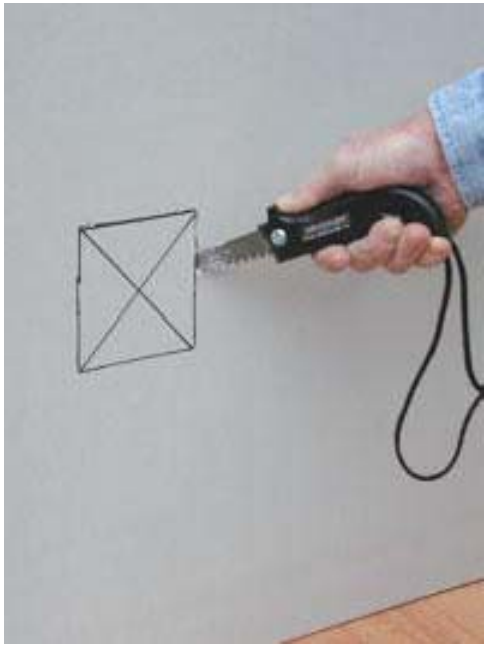


Cellulose can buffer a certain amount of humidity and d help mitigate potential problems.

Optimal Airtightness Inboard of Insulation



It keeps conditioned/humid air away from cold surfaces



Drywall is a sacrificial layer.

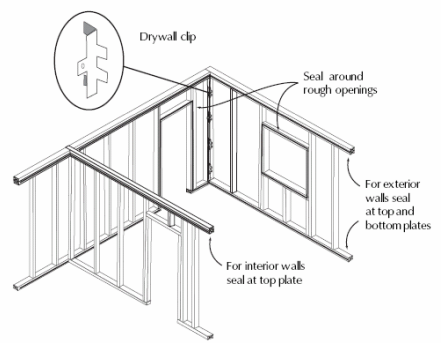
Drywall?

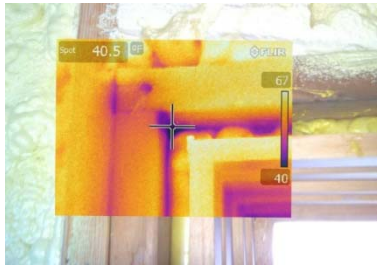
exposed to the occupants

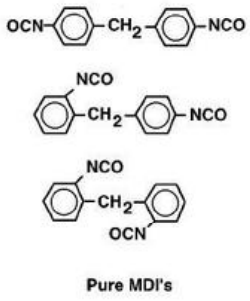
isn't continuous with the insulation (floors, room partitions)

too many junctions at floors and walls

many holes (outlets, plumbing, windows)







Pure MDI's

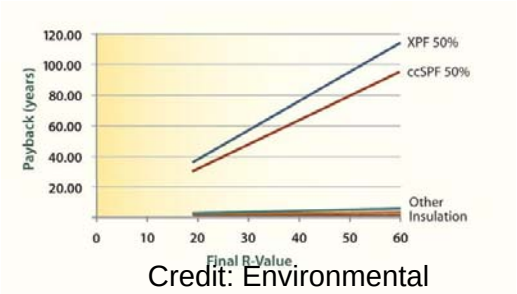
Spray Foam?

Dangerous **Toxic** ingredients
Unacceptable **fire accelerant**
Global warming potential
Installation **problems**
Unreliable performance

(See ***Foam Fails*** series on our **blog**.)

Woods Hole, MA 2011

Reversible?
Not optimal



Credit: Environmental Building News

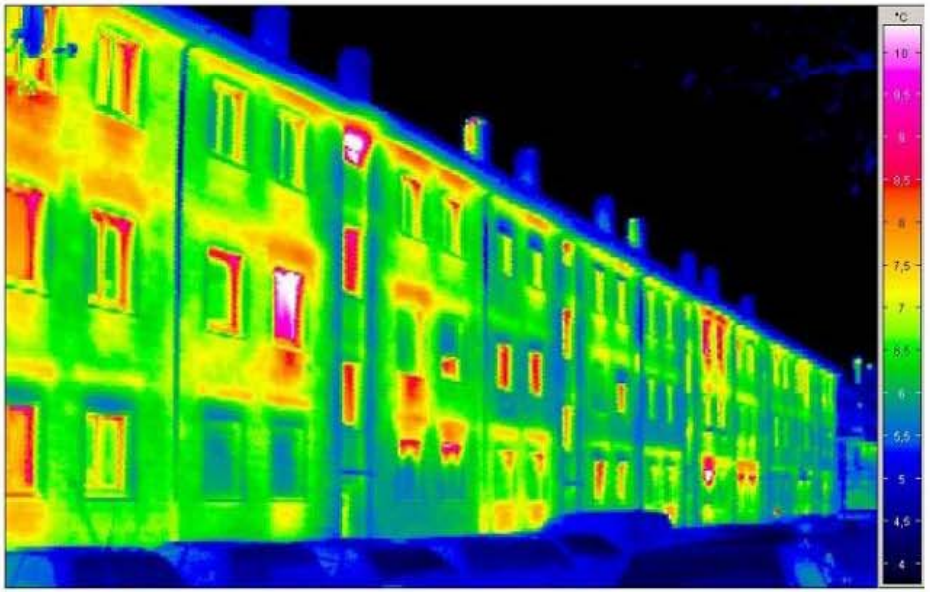
Credit: Journal of Light Construction, *Trouble Shooting Spray-Foam Insulation* by Mason Knowles, Sept 2010

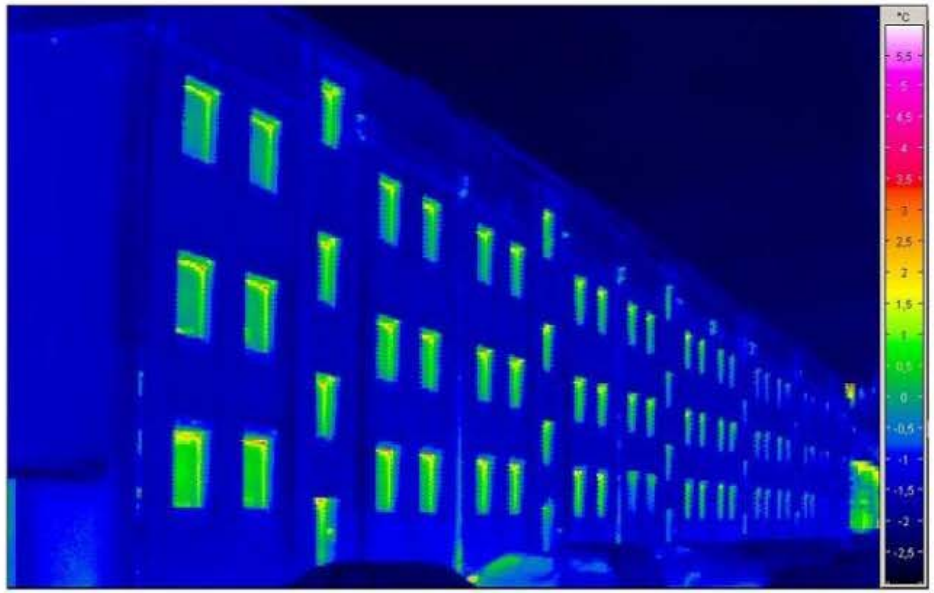
Airtight Membranes

Vapor Control

Maximize the Drying: Vapor Diffusion

Poorly insulated walls are often **heated dry**.





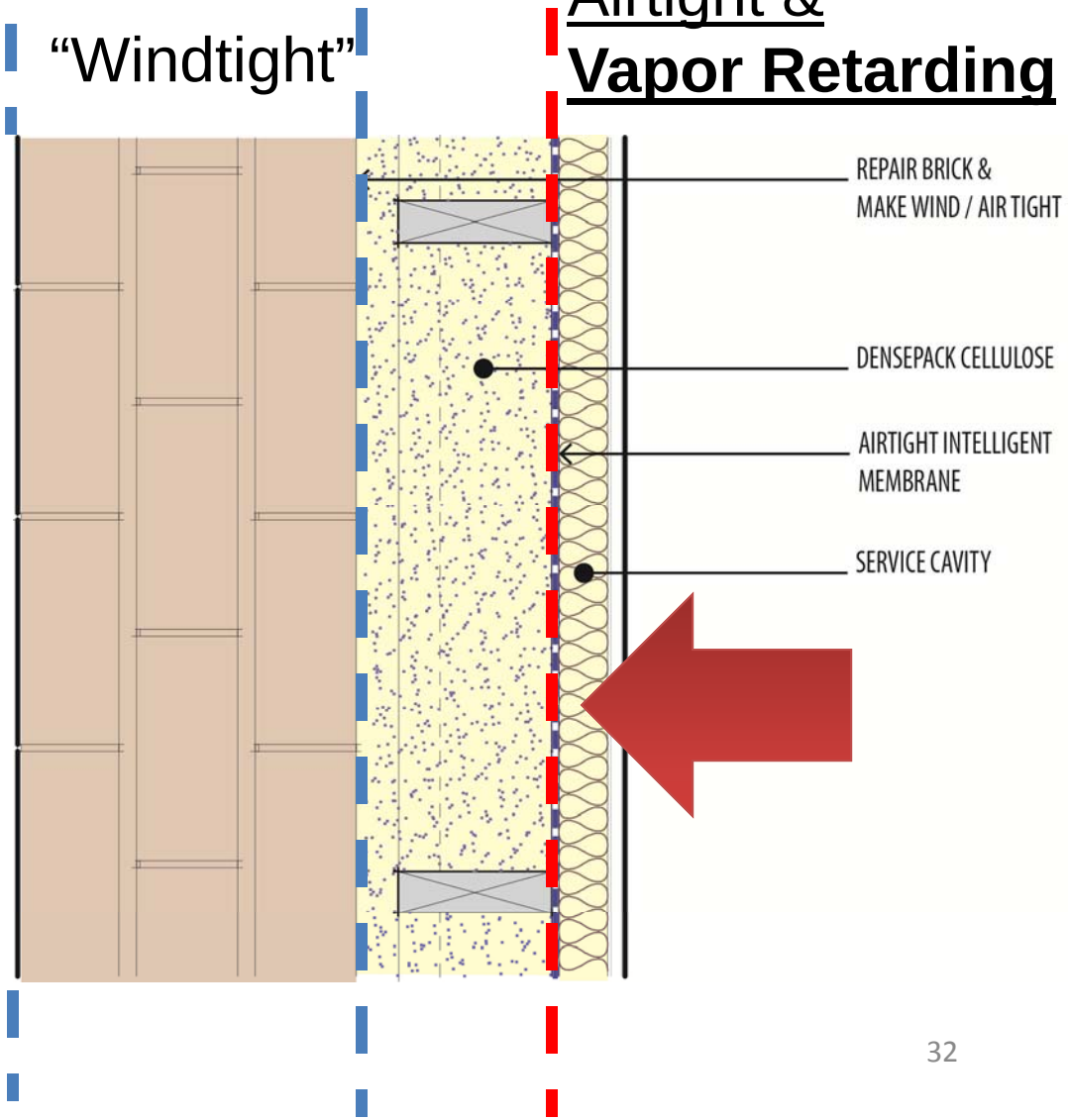
Well insulated walls dry through vapor diffusion.

(or they don't dry)

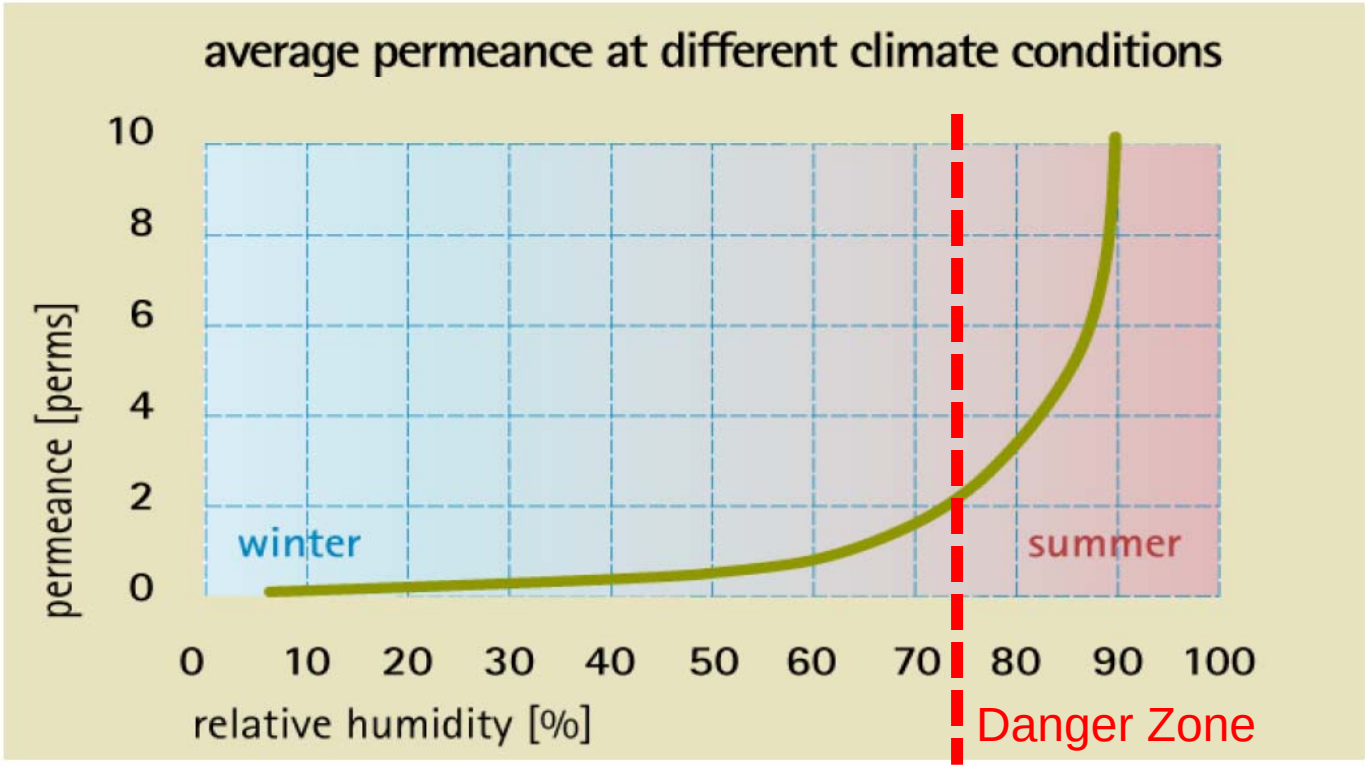
Prevent Condensation from Vapor Diffusion

Interior Vapor Retarders

- Smart membranes
- **No Poly**



Airtight, Vapor **Smart Membrane**



From vapor closed in winter (0.17 perms)
to vapor open in summer (13.2 perms)

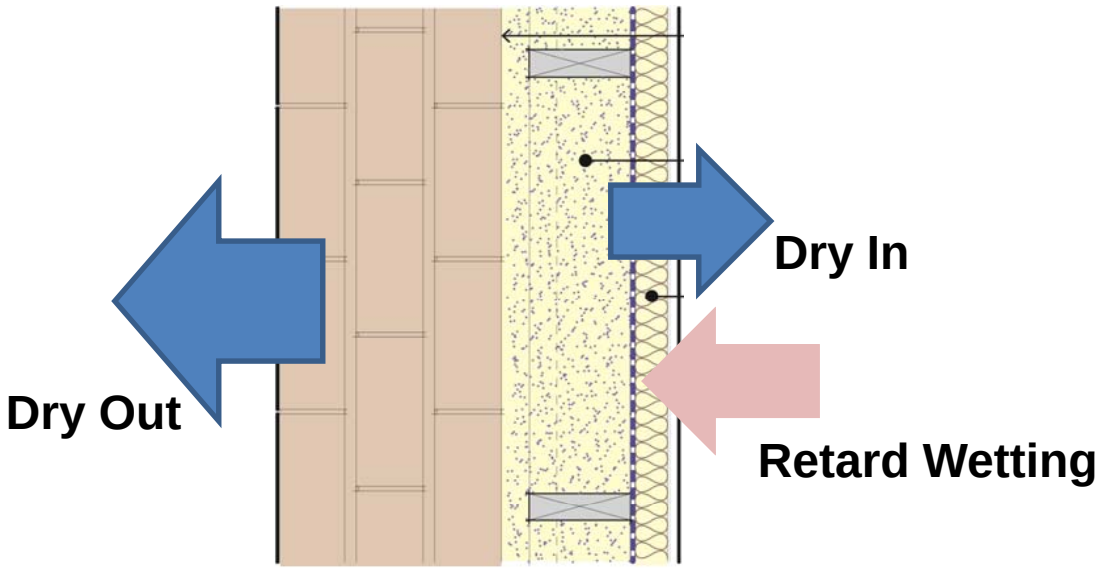
Maximize the Drying: Material Selection

Vapor Open
Brick
Cellulose
Mineral Wool
Fiberglass
Gyp Board
Latex Paint

Vapor Variable – Smart
Membranes

Vapor Retarding
Foam - >1.5” CC
OSB
Plywood
Poly – vapor closed

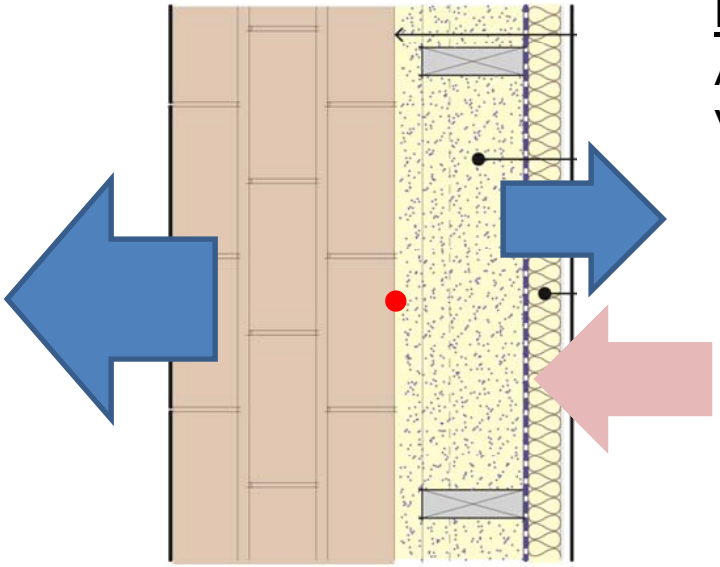
1. **Vapor Open Construction to Exterior**
2. **Smart Vapor Retarding at Interior**



Let’s look at some assemblies

Insulation:
Dense-Pack Cellulose
Fiberglass

Outboard:
Shed water
Windtight
Vapor open

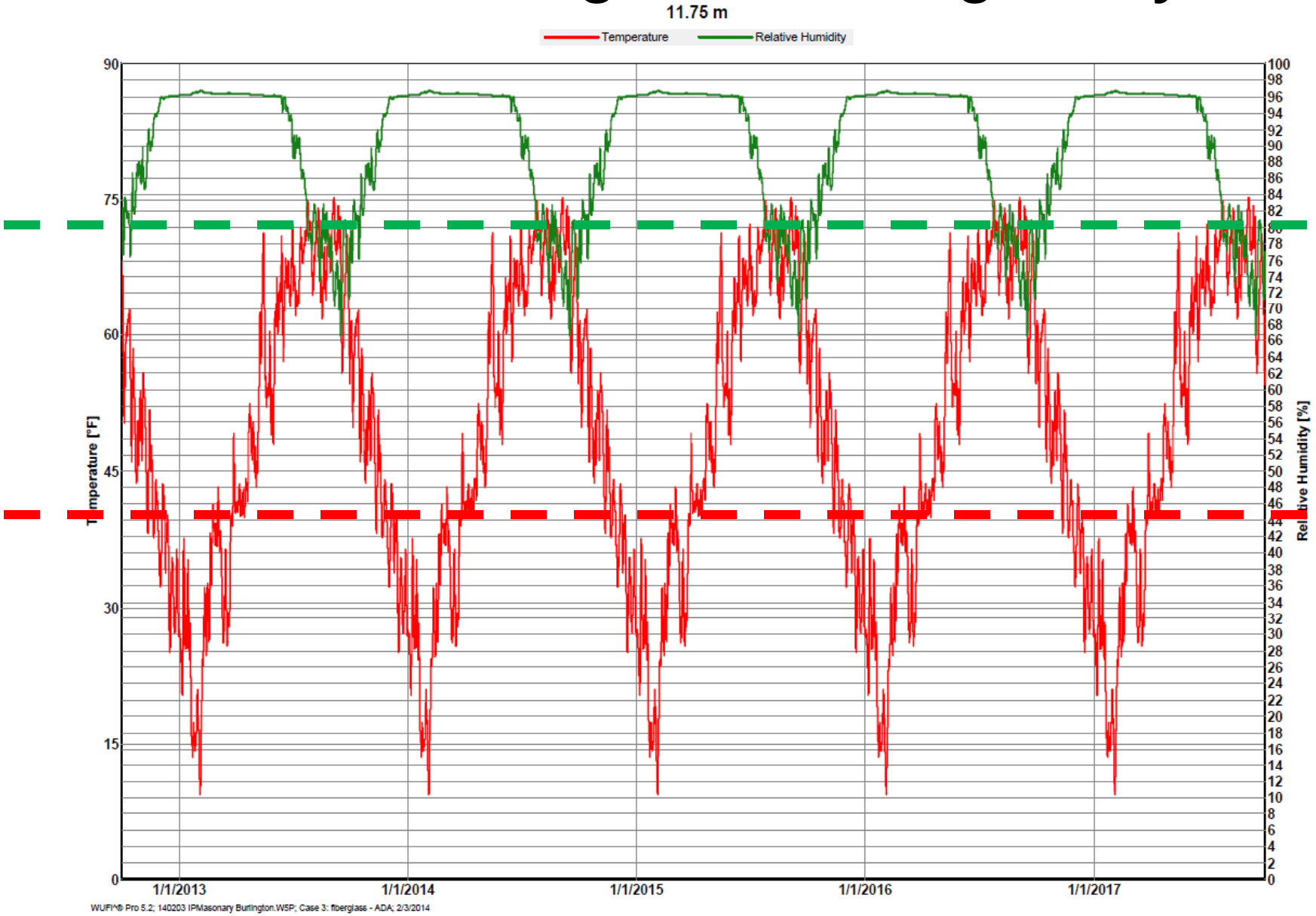


Inboard
Airtight
Vapor Retarding

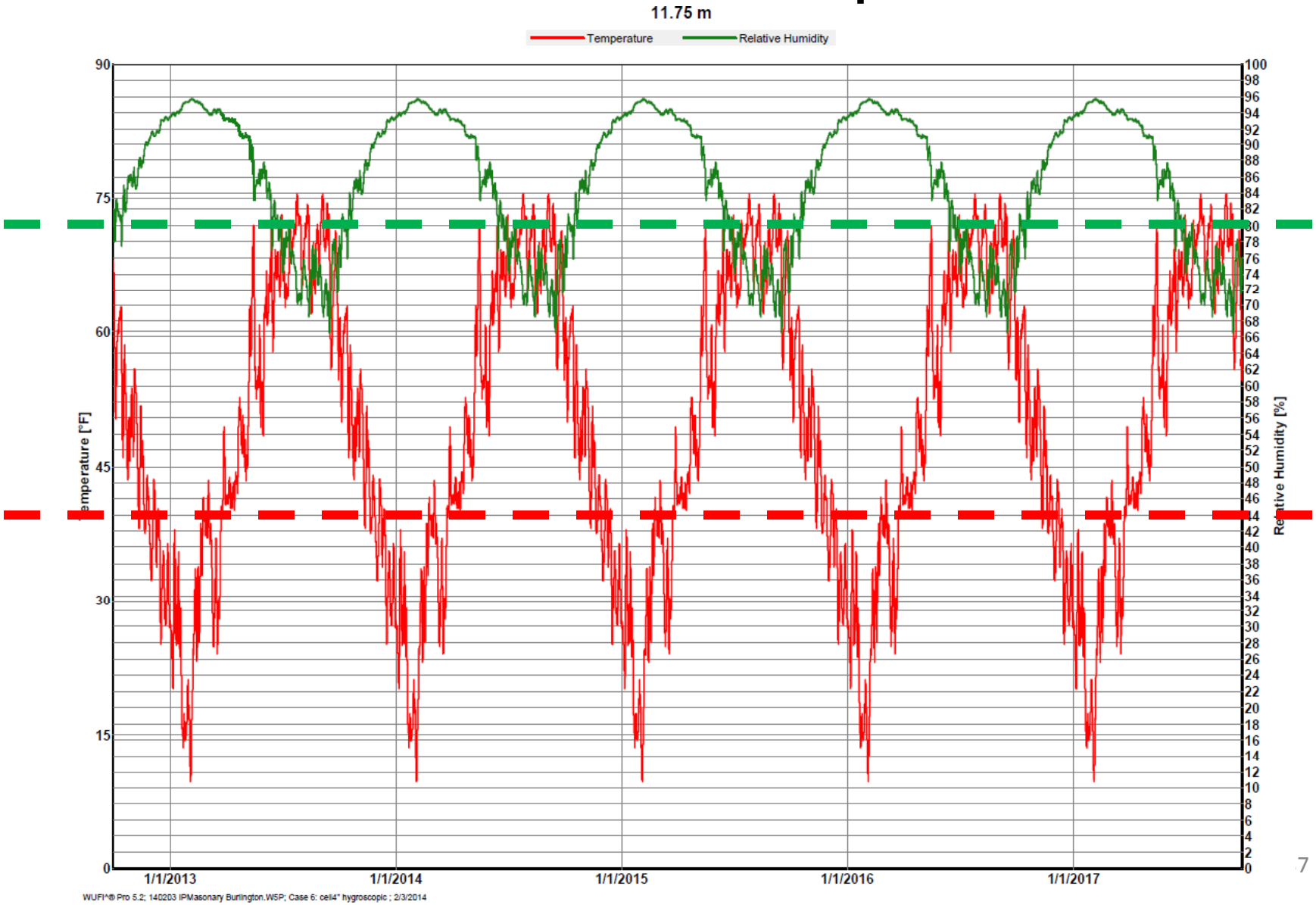
At Red Dot
- Moisture load?
- Mold potential?
- Helping or hurting freeze-thaw potential?

In Burlington Vermont

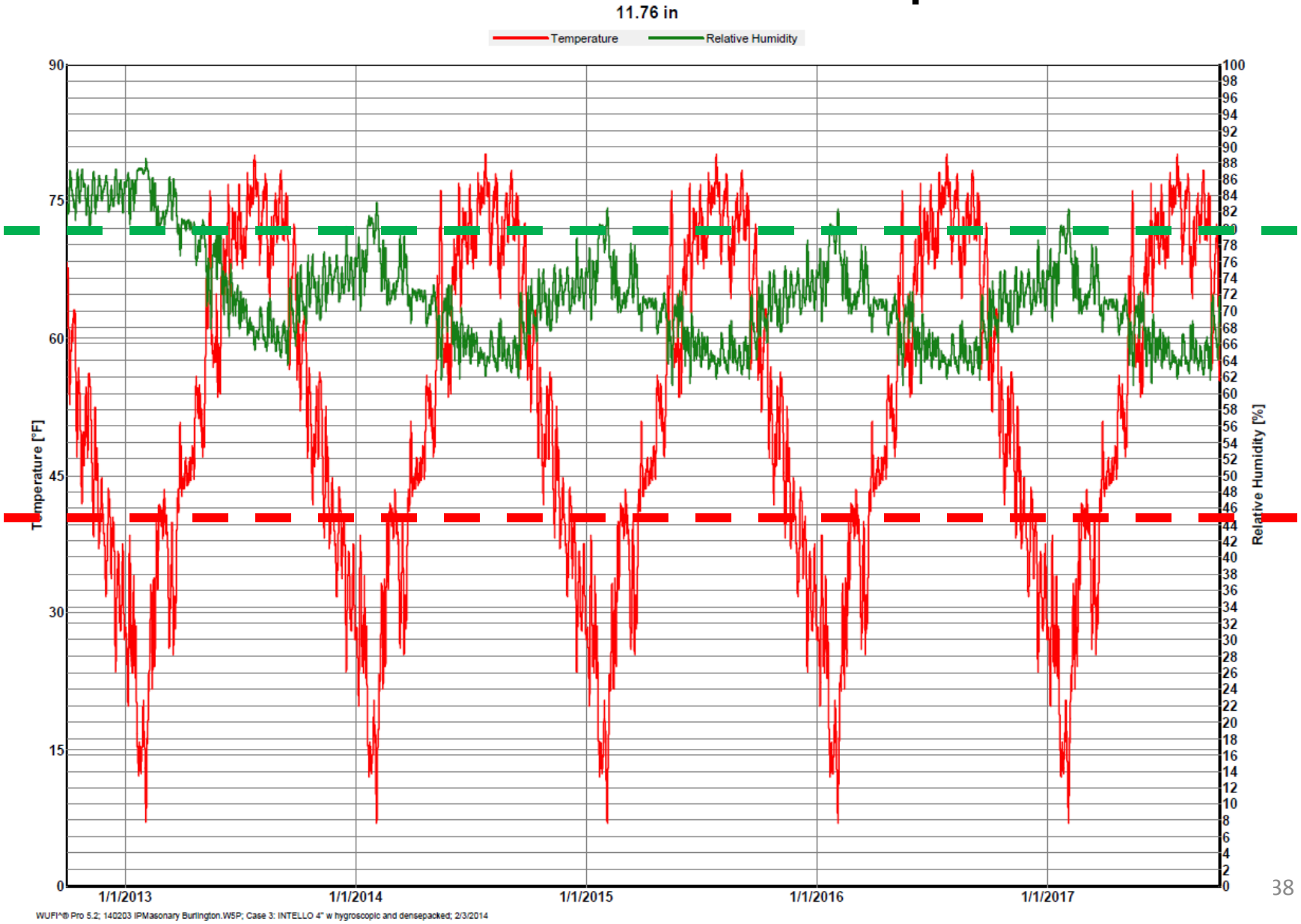
WUFI: 4” Fiberglass & Airtight Drywall



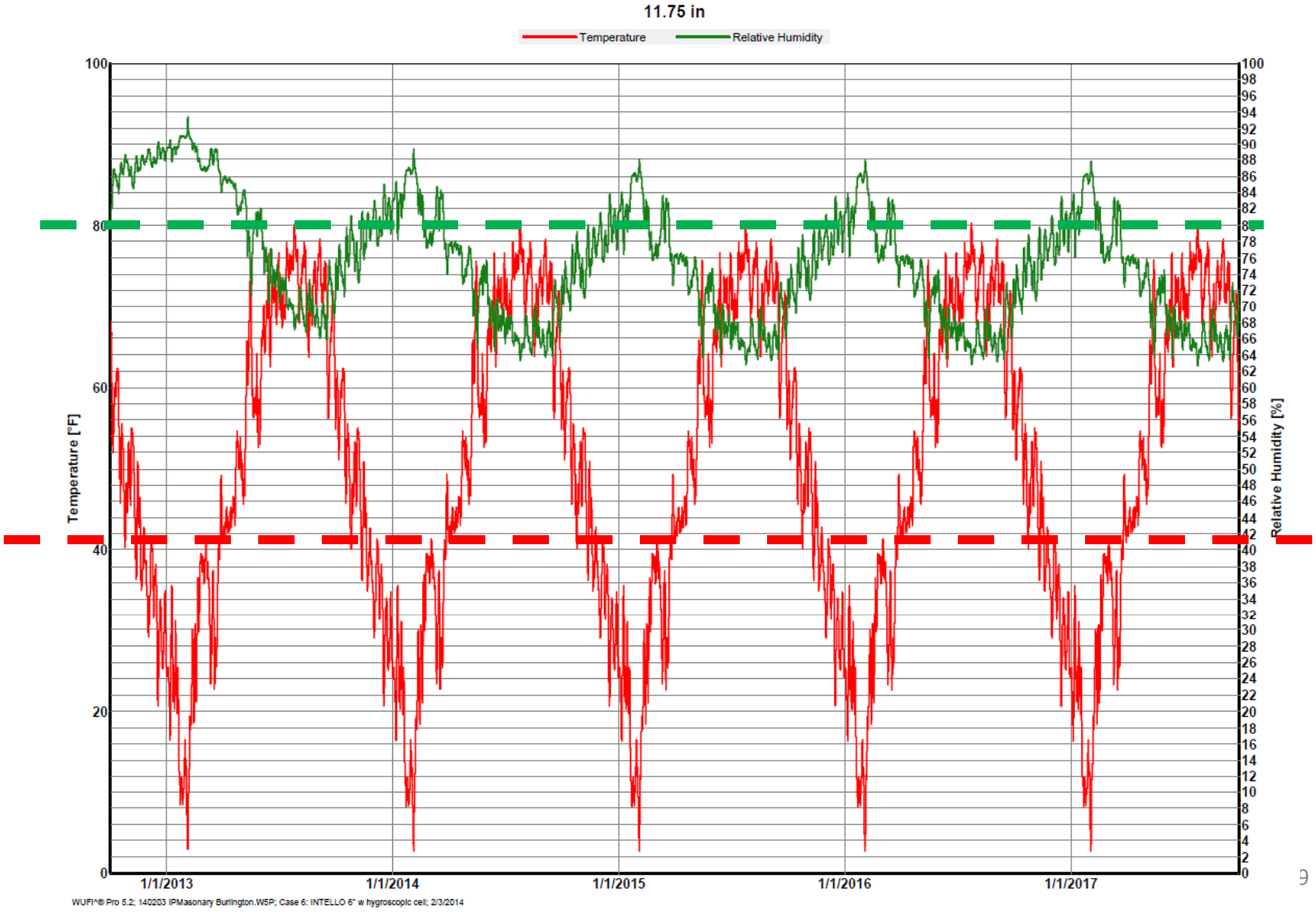
4” Cellulose without vapor control



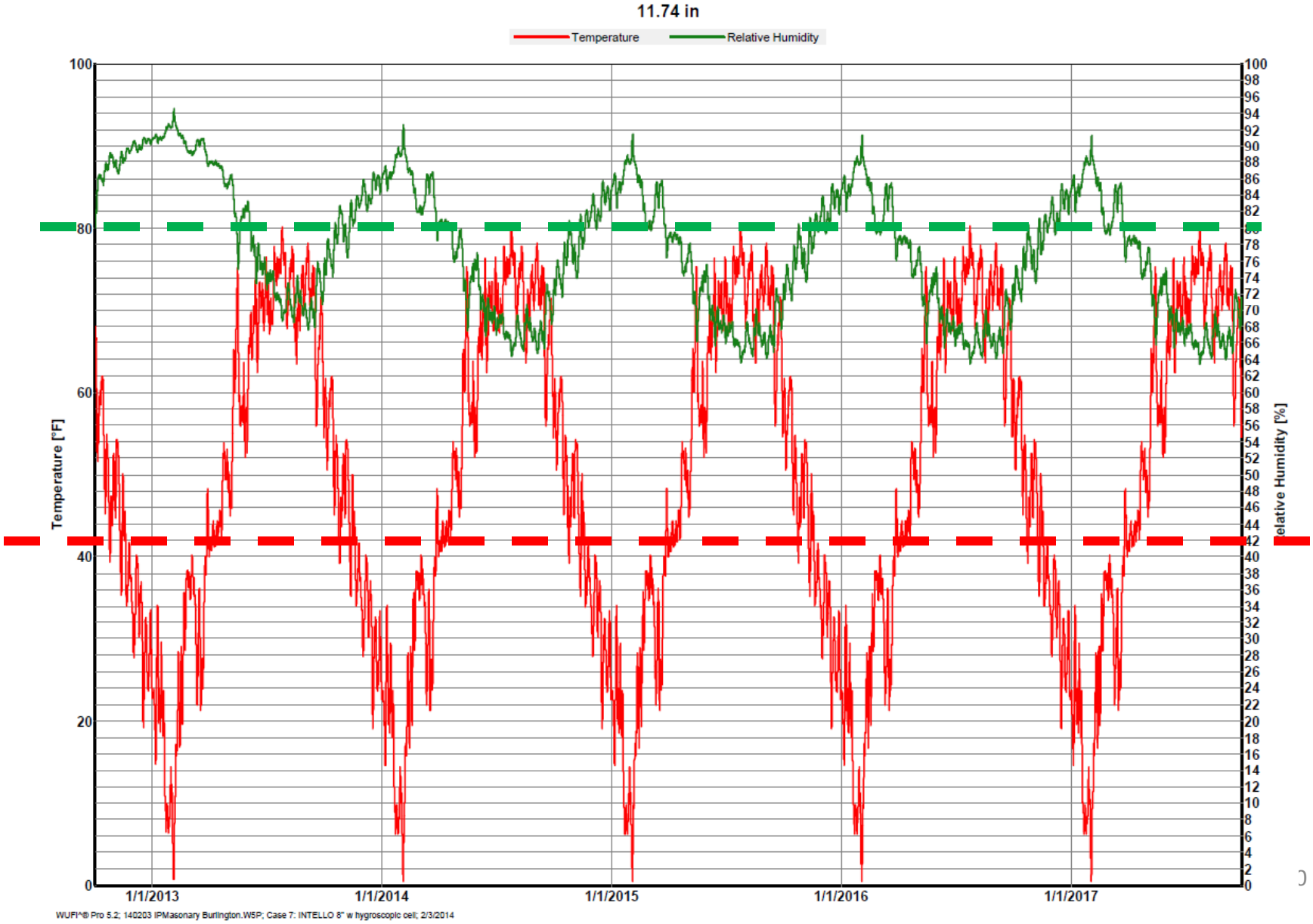
4” Cellulose with smart vapor control



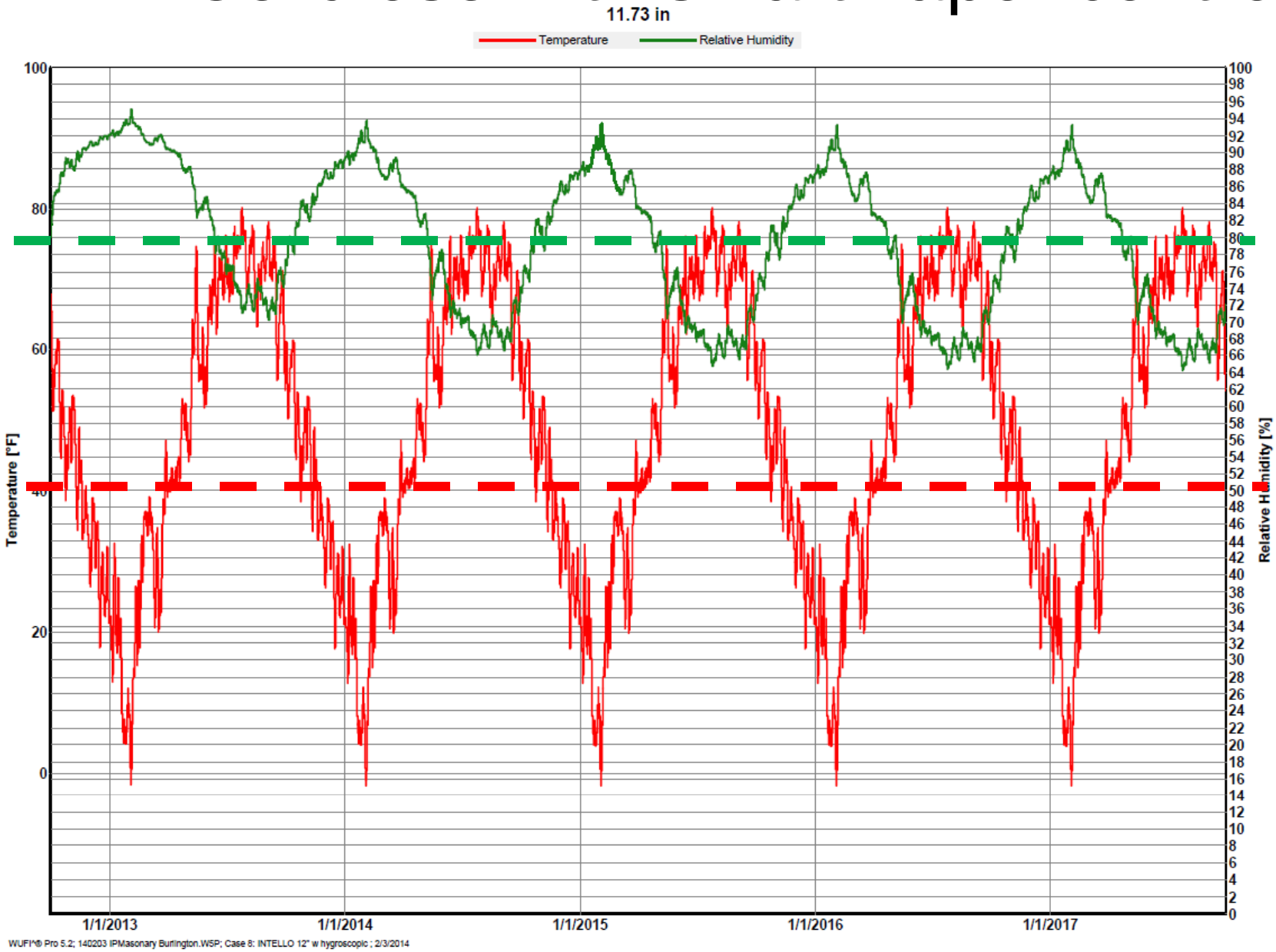
6” Cellulose with smart vapor control



8” Cellulose with smart vapor control



12” Cellulose with smart vapor control



Maximize **Thermal Insulation**: **How much** is too much?

Walls: highly dependent on situational specifics and mold danger may precede freeze-thaw danger. Use WUFI hygrothermal analysis to confirm design suitability. That said, in Burlington VT: **approx R30** with smart vapor control.

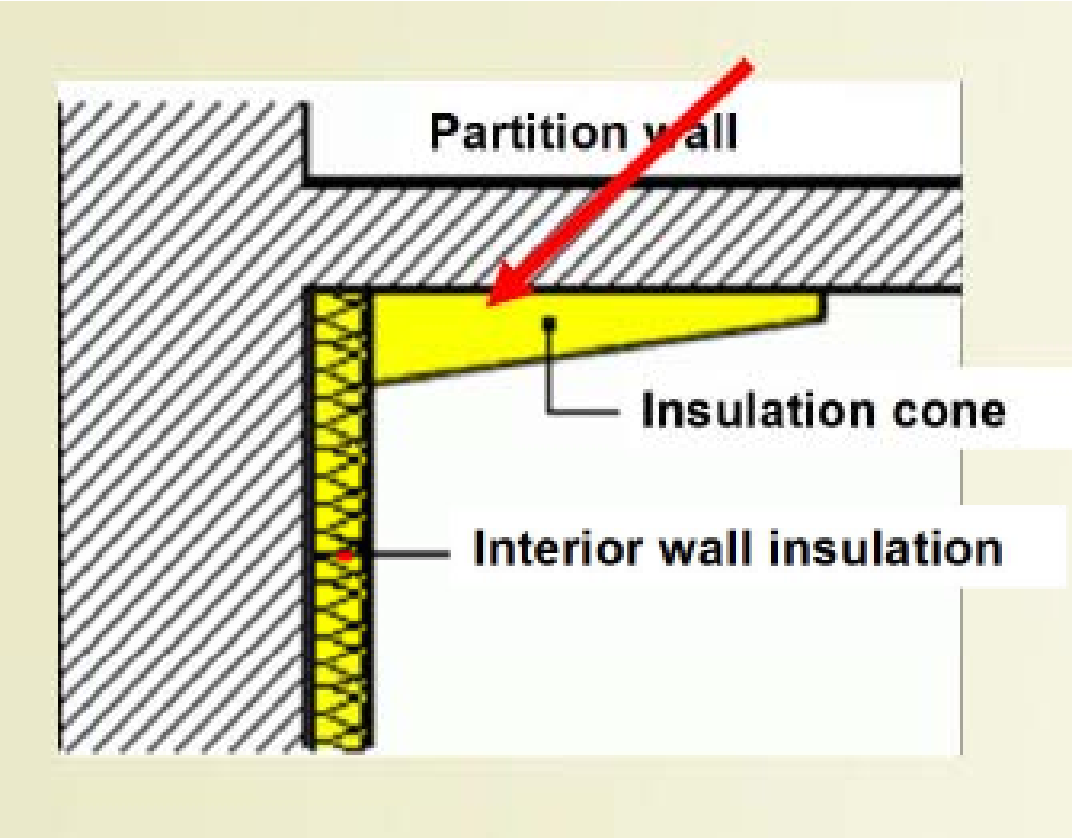
As R value increases, airtightness and vapor control must too.

Windows: R6+ installed (Passive House compatible)

Floor/Grade: R20+ (quickly diminishing returns)

Roof: R50+ (the sky is the limit)

Thermal bridge free: Party Walls

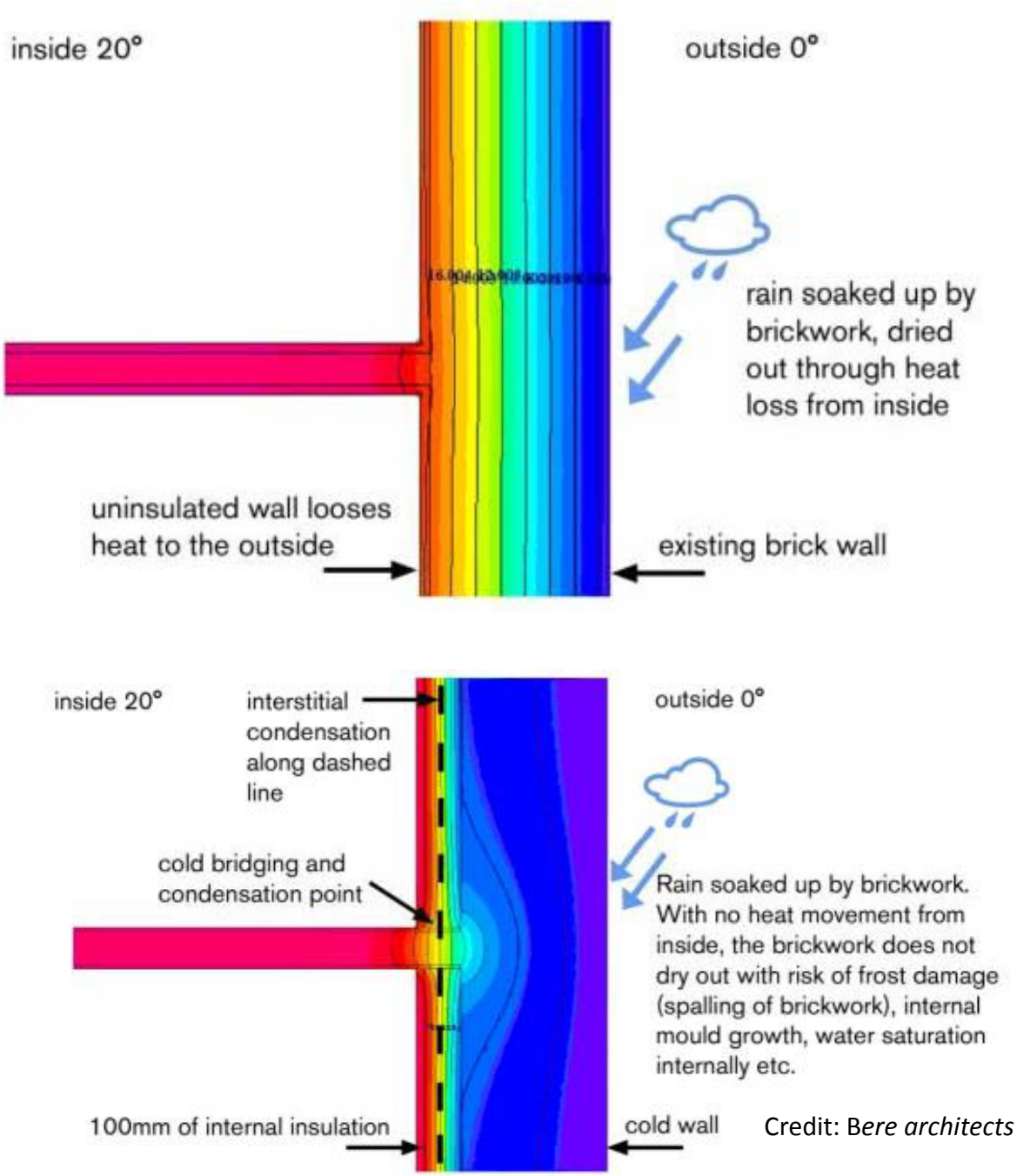


Floors?

Wood 3x as conductive along grain then perpendicular to it.

Keep wall dry.

Airseal joist/beam if it cannot be supported internally/on ledge.



Credit: B*ere architects UK*

Thermally Broken Beam Connection

Prospect Avenue,
Brooklyn

Move beams inboard?

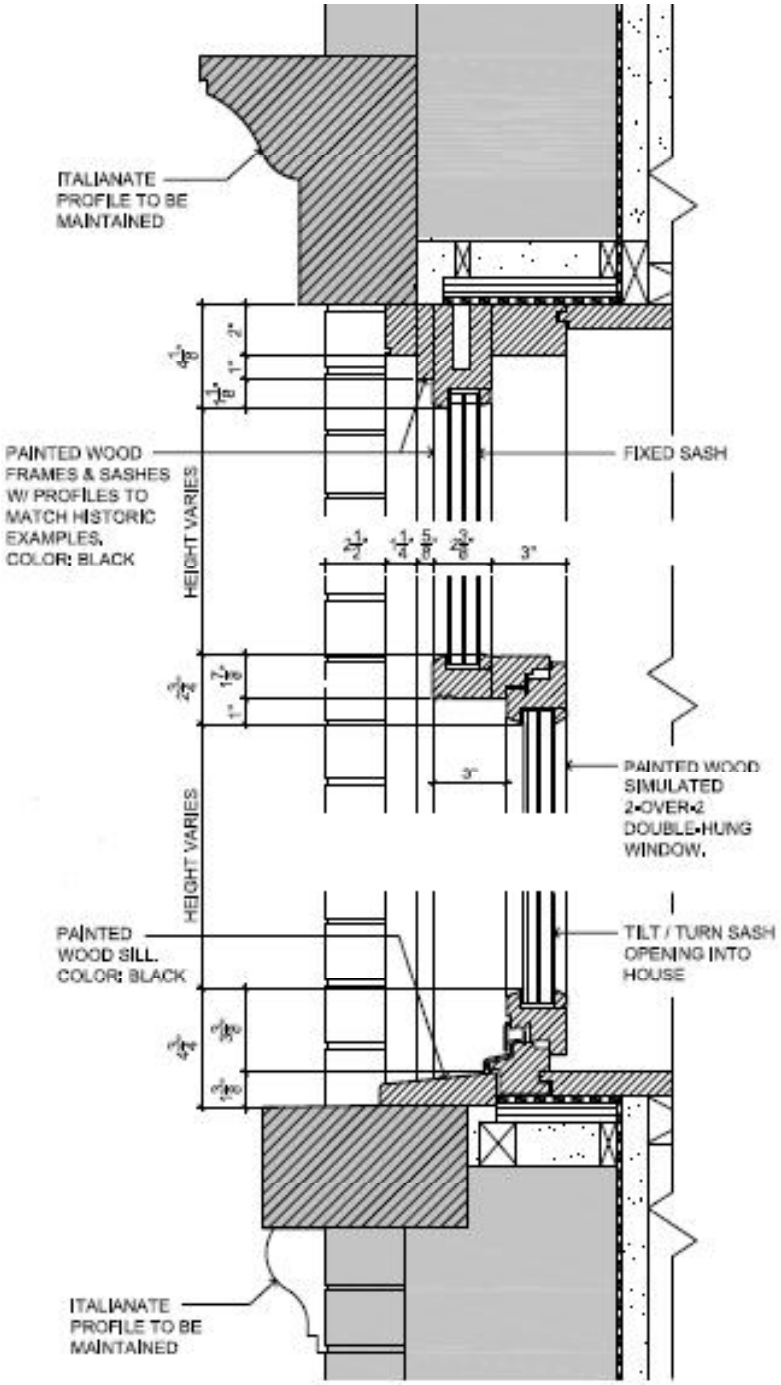
DOE/BSC

…or build a building in a building?

Great Windows

Park Slope, Brooklyn

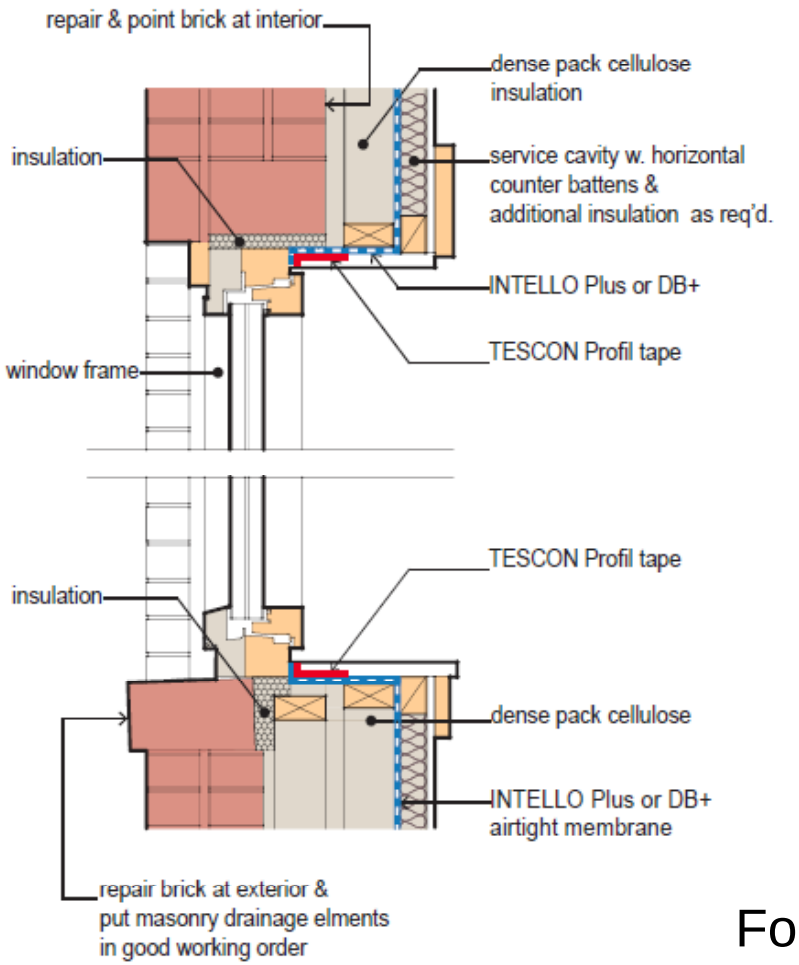
Simulated Historic Double-Hung Windows

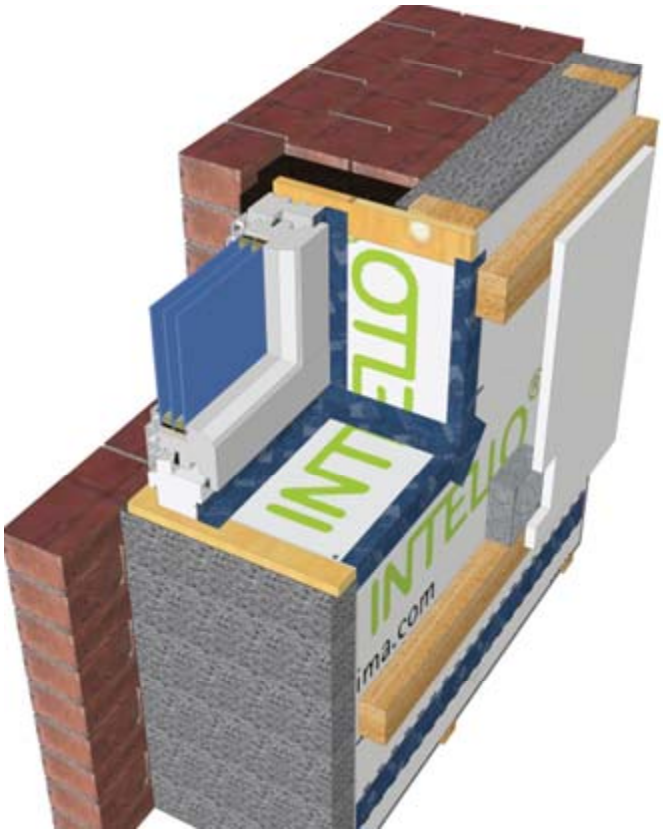


Brooklyn Heights

Prospect Heights

Window integration





Fold membrane into the window opening

“Case Study”

Prospect Avenue, Brooklyn

Brooklyn Heights

Slab on Grade

Brooklyn Heights

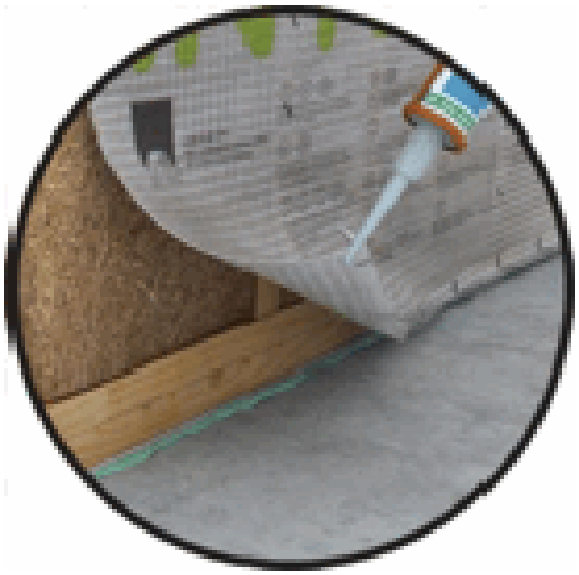
Wall – Slab Connections

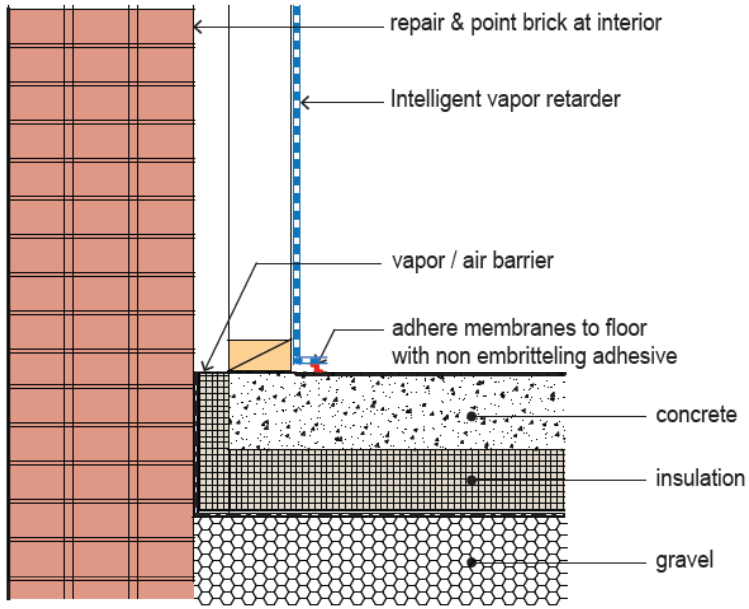
- Felt tape to masonry walls – plastered in

Park Slope Certified PH

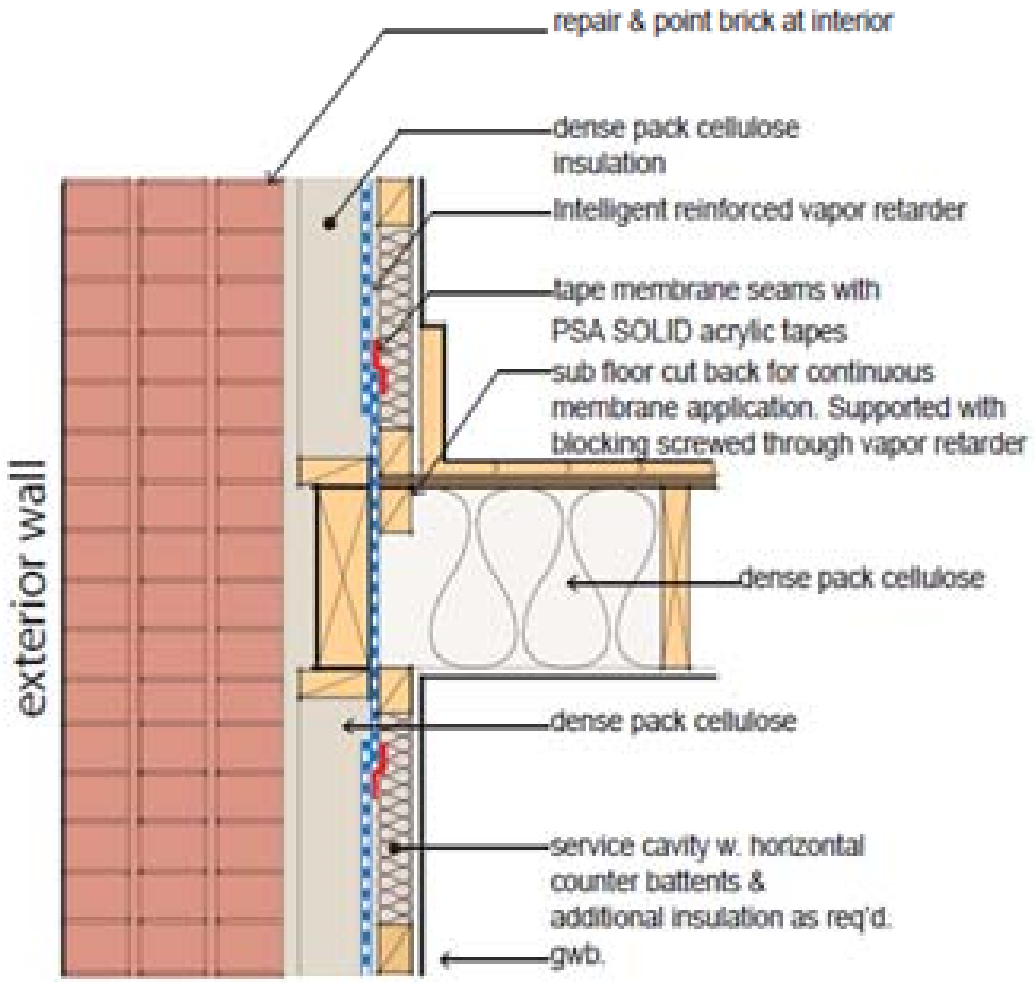
Wall – Slab Connections

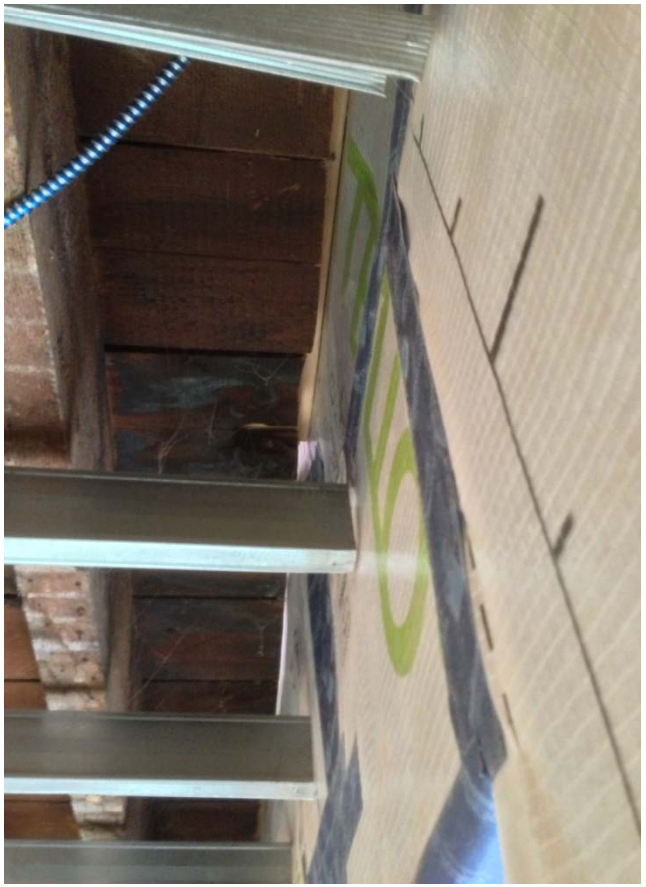
- Acrylic adhesive for uneven and porous materials
  - Doesn't embrittle/dry out, remains flexible





Floor – Wall Connection





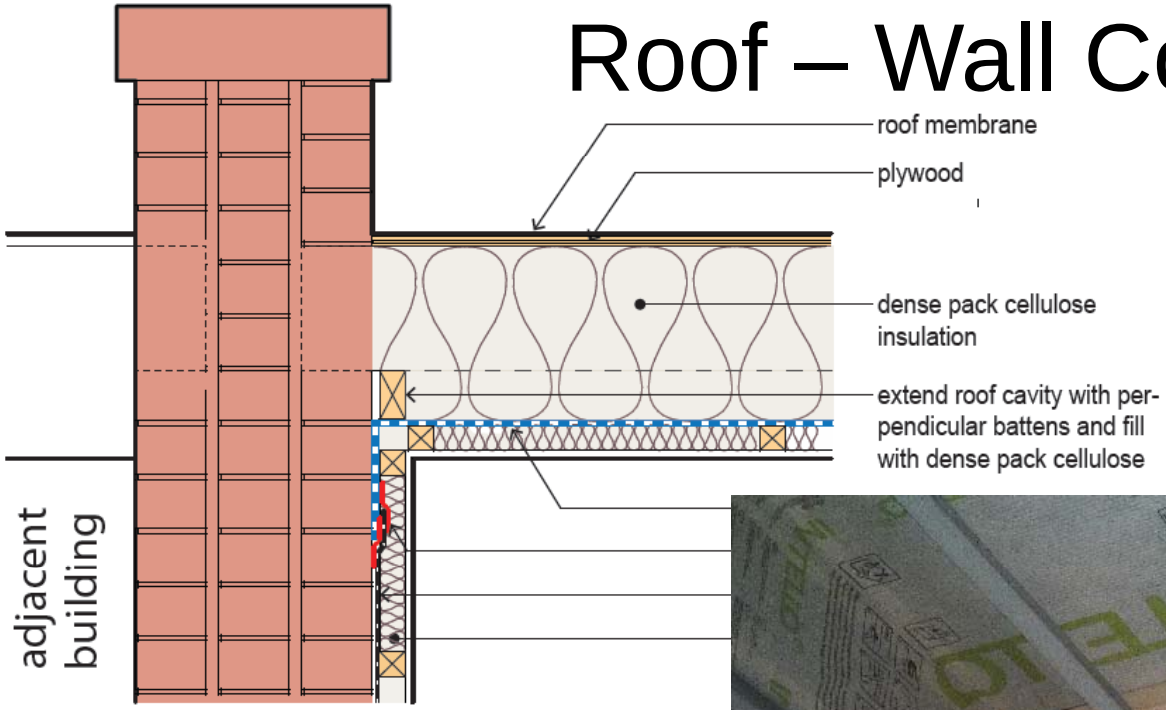
Beam penetrations

you need room to airseal – cut back the floor

Prospect Avenue, Brooklyn

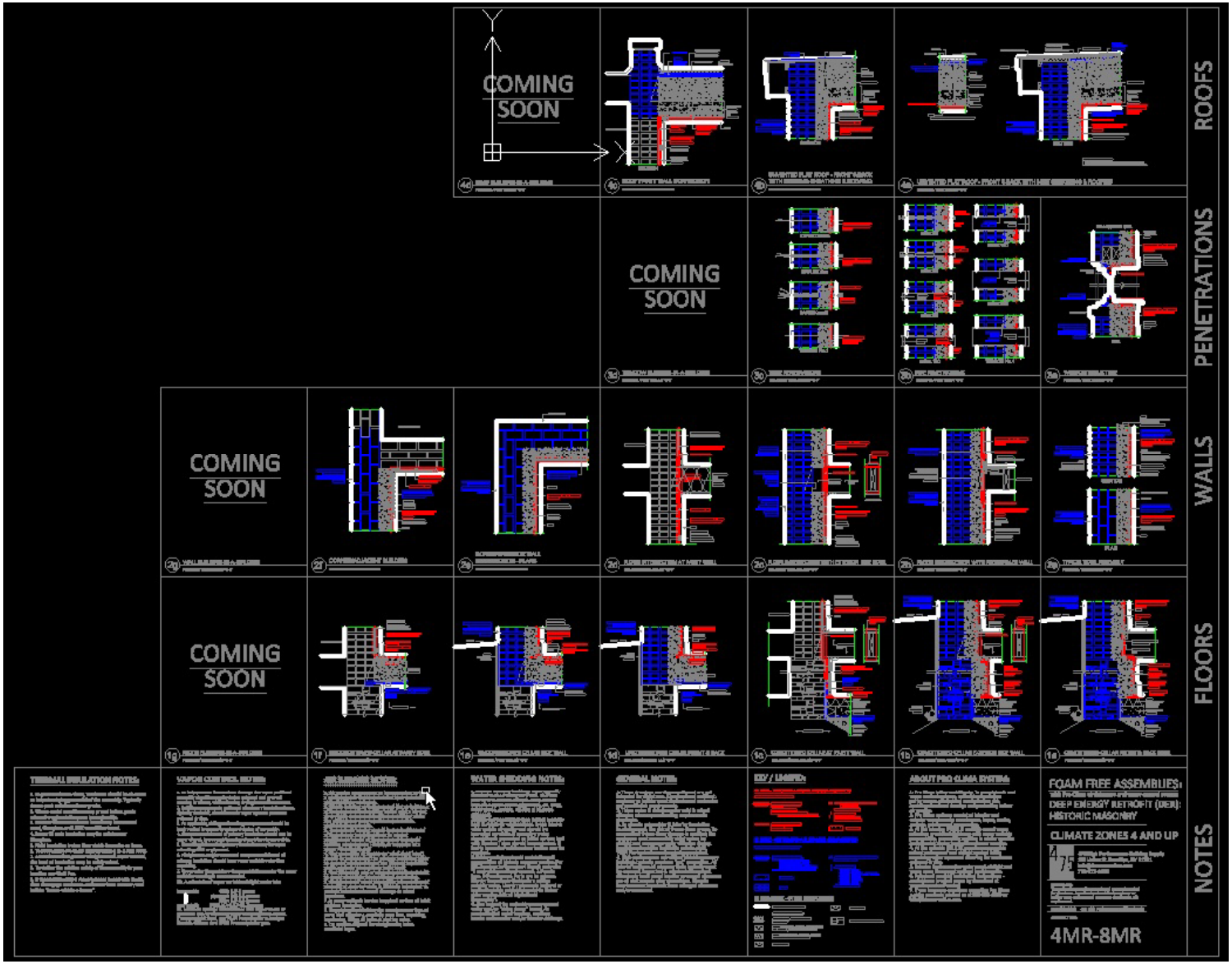
Prospect Avenue,
Brooklyn

Roof – Wall Connection



Prospect Avenue, Brooklyn

Download DWG details



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Brooklyn Heights

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Thank you.

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