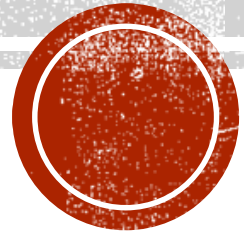
ENERGY DESIGN
conference & expo

BUILDING SCIENCE PUZZLES:
GAMING TO BETTER YOUR BUILDING SCIENCE



PETER YOST
BUILDING - WRIGHT

IN ACCORDANCE WITH THE DEPARTMENT OF LABOR AND INDUSTRY'S STATUTE 326.0981, SUBD. 11,

"THIS EDUCATIONAL OFFERING IS RECOGNIZED BY THE MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY AS SATISFYING 1.5 **HOURS** OF CREDIT TOWARD **BUILDING OFFICIALS AND RESIDENTIAL CONTRACTORS CODE /1 HOUR ENERGY** CONTINUING EDUCATION REQUIREMENTS."

FOR ADDITIONAL CONTINUING EDUCATION APPROVALS, PLEASE SEE YOUR CREDIT TRACKING CARD.

INFO TOOLS I USE

- Building Assessment Form
- Hygrothermal Assessment Summary
- GBA blogs
- Info materials from client

PRE-BUILDING ASSESSMENT CLIENT INFO

PETER YOST
BUILDING - WRIGHT

Consulting Services - Building Performance:

Investigations, Enclosure Design Review & Commissioning, Training, Research

What is a hygrothermal building assessment, anyway?

Hygro refers to water, and *thermal* refers to heat. In buildings, you really can't manage heat without also managing moisture. In a hygrothermal building assessment, we inspect and measure to map and understand how heat and moisture are moving on, off, into, and out of your building.

DISTINGUISHING YOUR HP WORK…

How (Older) Homes Work

Interviewing Your Building Professional (northeast US)

1. Do you attend any of these educational conferences?
   a. Building Energy (NESEA)
   b. Better Building by Design (Efficiency VT)
   c. Home Performance (new affordable comfort events)
   d. JLC LIVE New England

2. Are you a Building Performance Institute certified professional or do you have a working relationship with one or more BPI professionals?

3. What high performance building/building science trainings have you completed?
   a. Building Science Corp
   b. EEBA Houses That Work
   c. Building Materials Supplier-sponsored high performance building/building science events
   d. HeatSpring
   e. SEON's training and/or attends the monthly Building Science Guild meetings.

Building Science

How (Older) Homes Work

A two-evening building science class for homeowners

By Peter Yost | March 28, 2019

Premises

Things get wet, heat dries them out.

Energy efficiency measures reduce heat loss.

Energy & moisture must be managed with equal intensity.

Follow the water.

MOLD/ROT BASICS

- Temperature/Food/Water
- Molds (spores) are everywhere, all the time…
- They like the same temperatures we do…
- They like many of the materials out of which we like to build…
- Mold generally shows up at 19% MC or higher
- Rot requires 25- 28% MC
- The easiest/most effective approach to control mold/rot is, almost always, managing moisture.

WHAT ABOUT INTERIOR SOURCES OF MOISTURE?

SOURCES - HOUSEHOLD MOISTURE

Source	Quantity (pints)
Showering	???
Clothes drying	4 - 6/load
Cooking (dinner)	1.2 (+1.5 gas)
5 house plants	1/day
1 cord “green” wood	600 - 800/season
4 people	.5/hour
Building materials	???
Ground moisture	0 - 100/day

Source: Minnesota Extension Service (also, see GBA blog…)

SOURCES - HOUSEHOLD MOISTURE

Source	**Quantity (pints)**
Showering	**.5 (5 - min shower)**
Clothes drying	4 - 6/load
Cooking (dinner)	1.2 (+1.5 gas)
5 house plants	1/day
1 cord “green” wood	600 - 800/season
4 people	.5/hour
Building materials	**6 - 17/day**
Ground moisture	0 - 100/day

Source: Minnesota Extension Service (also, see GBA blog…)

1 - WESTERN MASSACHUSETTS

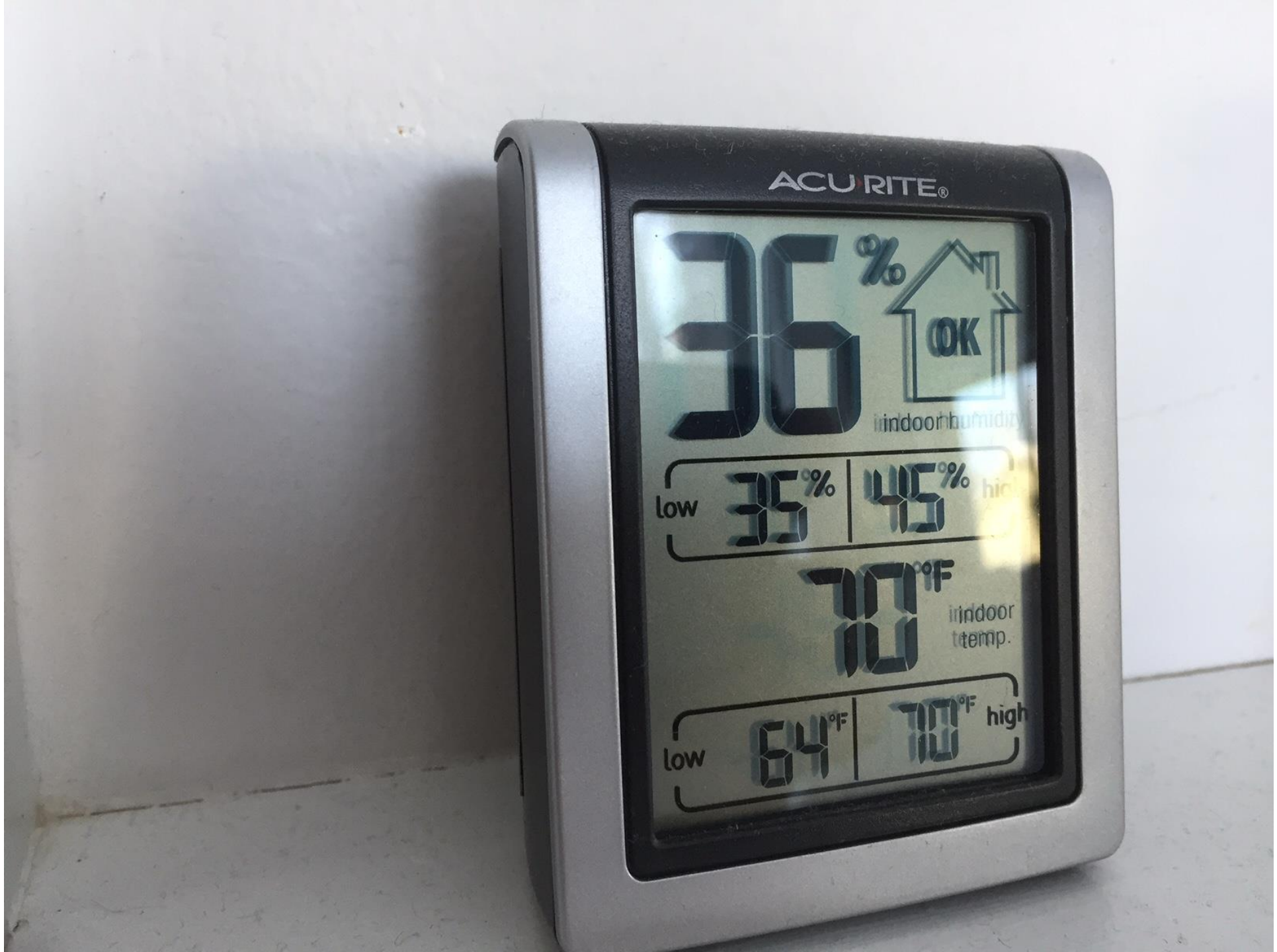
INFO FROM HOMEOWNER

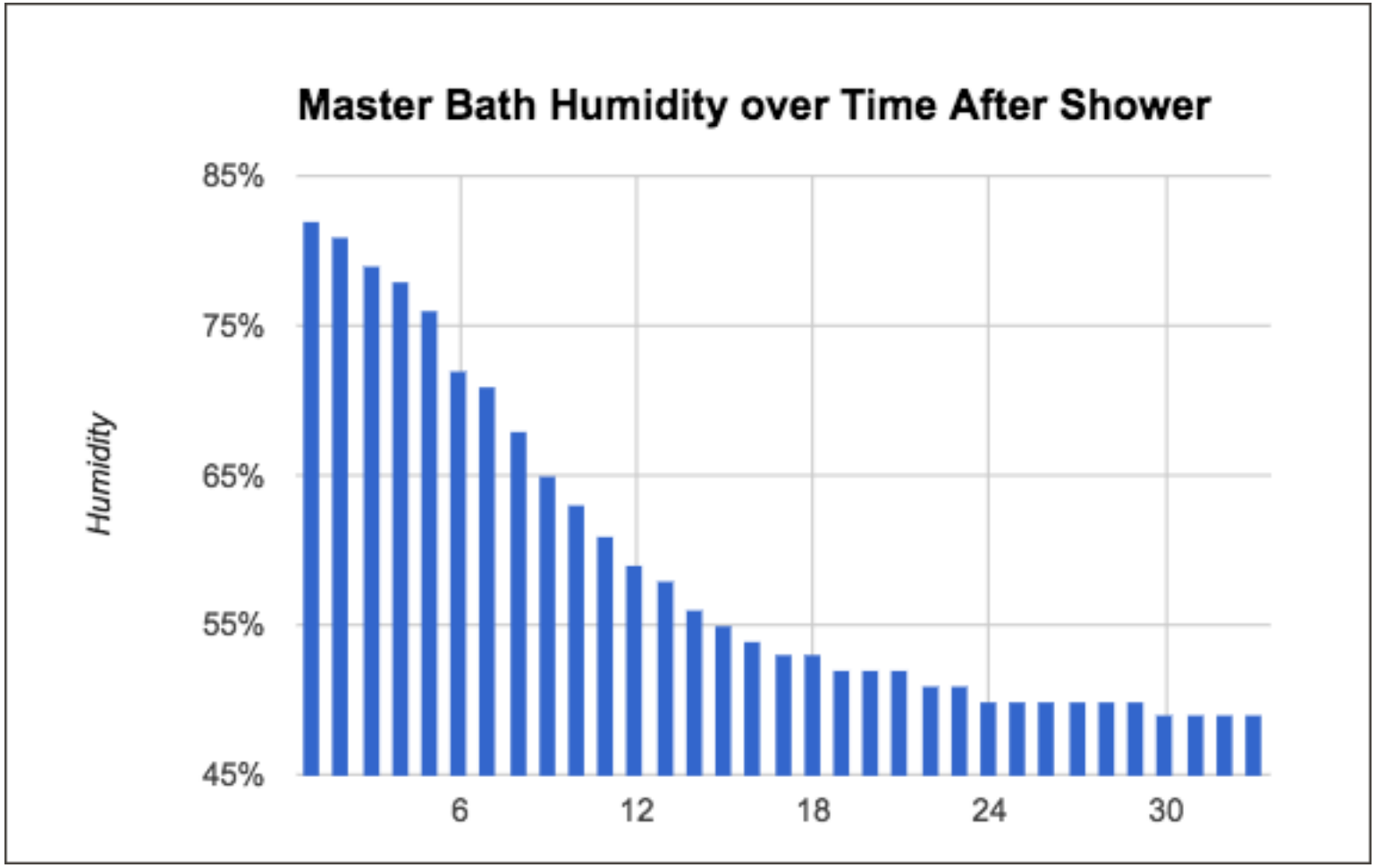
- Built in 1850s, renovated extensively in 2002
- Full-time work from home for one of the owners
- Insulation: cellulose blown-in wet into walls
- Standing-seam metal roof
- Replaced masonite siding with HardiPlank on the East, South and most of the West sides, leaving masonite on the north side and North end of west side.
- Attic is unconditioned, with cellulose in the floor and no insulation in the roof.

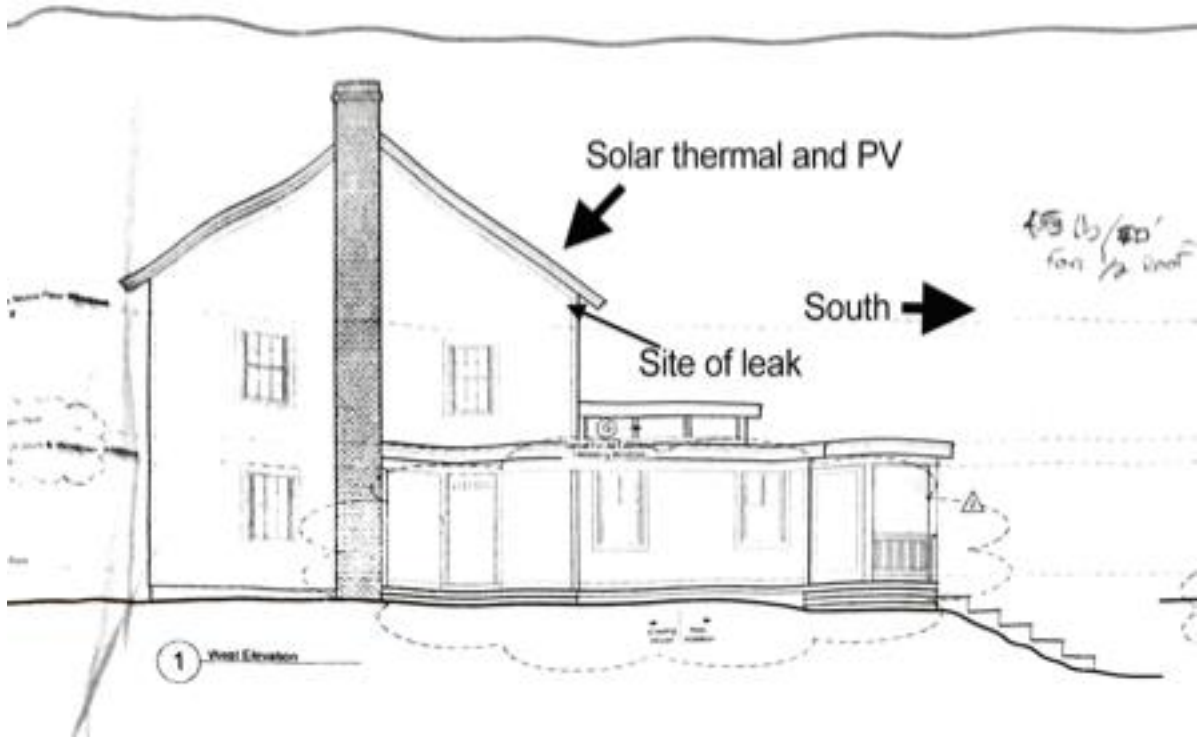
INFO FROM HOMEOWNER

- Rubble foundation north and west
- Walkout basement south and east, insulated: cellulose & 2-inch PI, then drywall
- No insulation or moisture barrier between basement & 1st floor
- Exterior repainted 5 years prior, paint peeling in just a couple years
- Increasing condensation on 2nd floor windows in winter
- Leaking ceiling in 2nd floor bedroom, just below pipes in attic for solar hot water, but no leaks apparent in piping


Southwest bedroom, 2nd floor
12/26/16 11:34am
Ext temp: 33, Int temp 68, hum 38

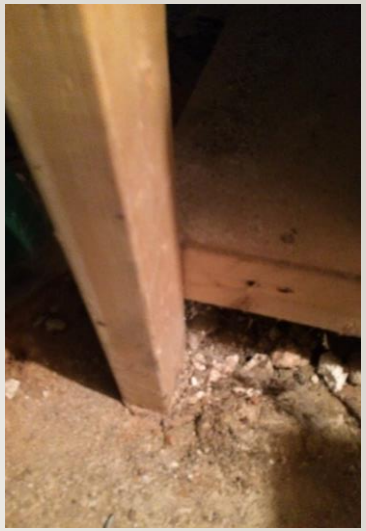

ACU RITE
36 %
OK
indoor humidity
low 35 %
45 %
70 °F
indoor temp.
low 64 °F
70 °F high


Master Bath Humidity over Time After Shower
Humidity
85%
75%
65%
55%
45%
6
12
18
24
30


Solar thermal and PV
South
Site of leak
1

EXTERIOR

BASEMENT



Q&A Spotlight

How to Vent a Dryer

Can the exhaust from a clothes dryer be vented into the basement without creating major problems?

By Scott Gibson | August 1, 2016

GAS CLOTHES DRYER?


Domino

KEY TAKEAWAYS

- Good to get info from the client, but don't let it direct you
- Follow all the water
- One-day building assessments are a snapshot in time

2-A BASEMENT CASE STUDY?

BACKGROUND INFO

- 3 finished floors, occupants on each floor
- Full basement, "empty," insulation installed in first floor cavities, dense-pack cellulose
- 1st floor – elderly retired couple
- 2nd floor – middle age couple
- 3rd floor attic – grown son
- Extensively renovated for this configuration
- I got called in by their current remodeler—who had taken BS training and felt that any work she did on the house needed experienced assessment/guidance


JACK DANIEL'S
Tennessee
HONEY

Basement T/RH

Temp: 40 F

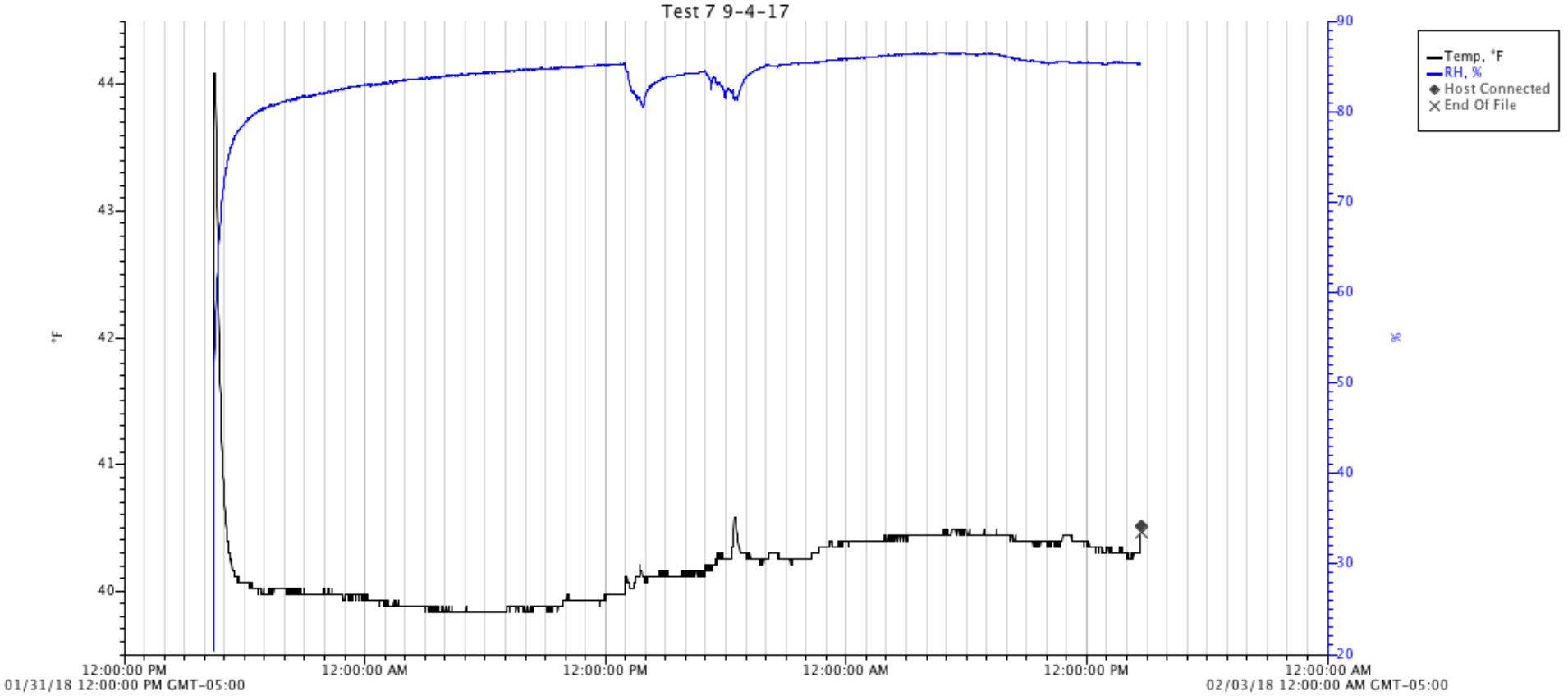
RH: 80%


HOW TO COOK
EVERYTHING
affinity


THE
VELVET
DEVIL
MERLOT
MERLOT


VELUX

BASEMENT


Test 7 9-4-17
Temp, °F
RH, %
Host Connected
End Of File
°F
%
44
43
42
41
40
90
80
70
60
50
40
30
20
12:00:00 PM
01/31/18 12:00:00 PM GMT-05:00
12:00:00 AM
12:00:00 PM
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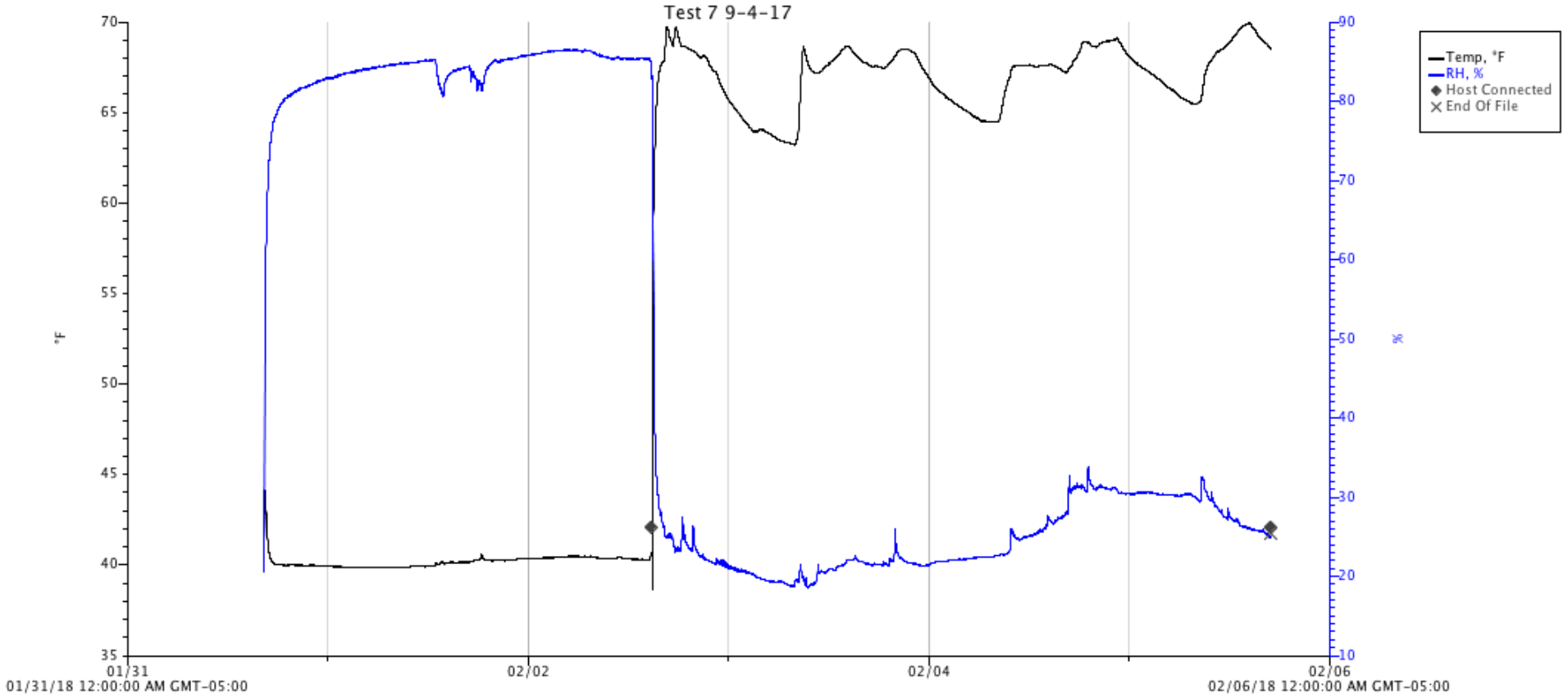
12:00:00 PM
12:00:00 AM
02/03/18 12:00:00 AM GMT-05:00

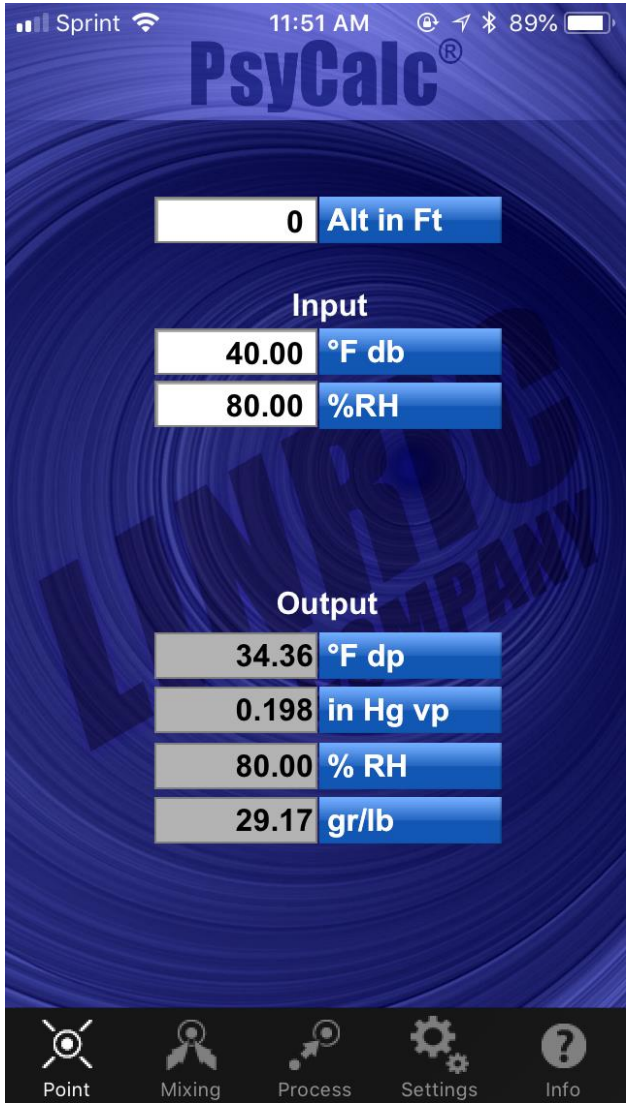
BASEMENT TO 1ST FLOOR



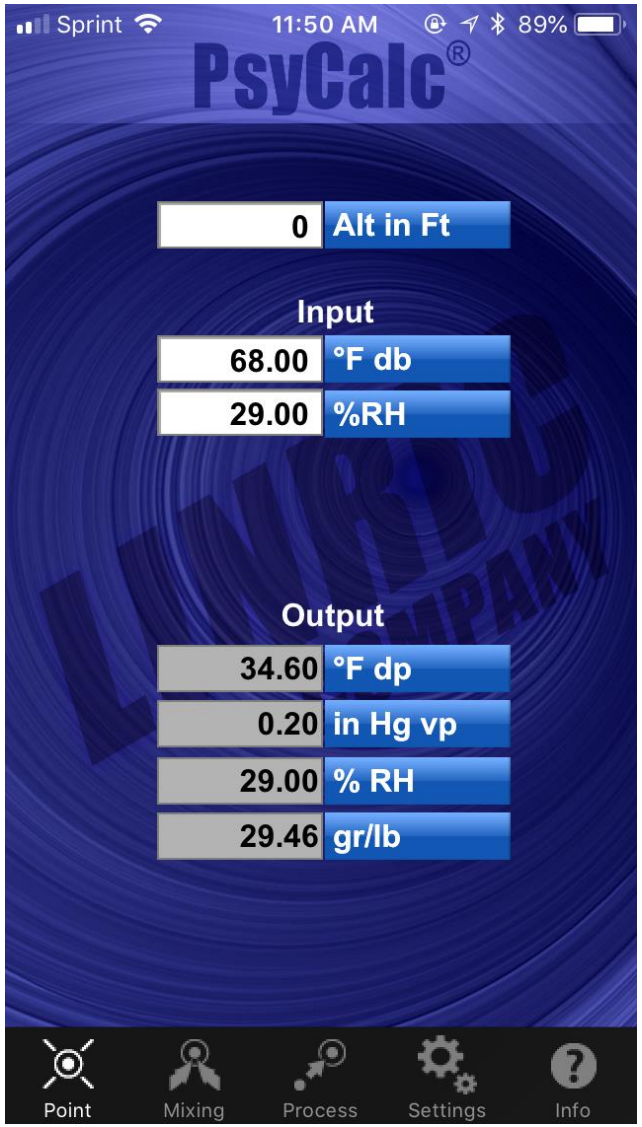
Temp: 40 F

RH: 80%

BEWARE: RH VS DEWPOINT OR ABSOLUTE MC

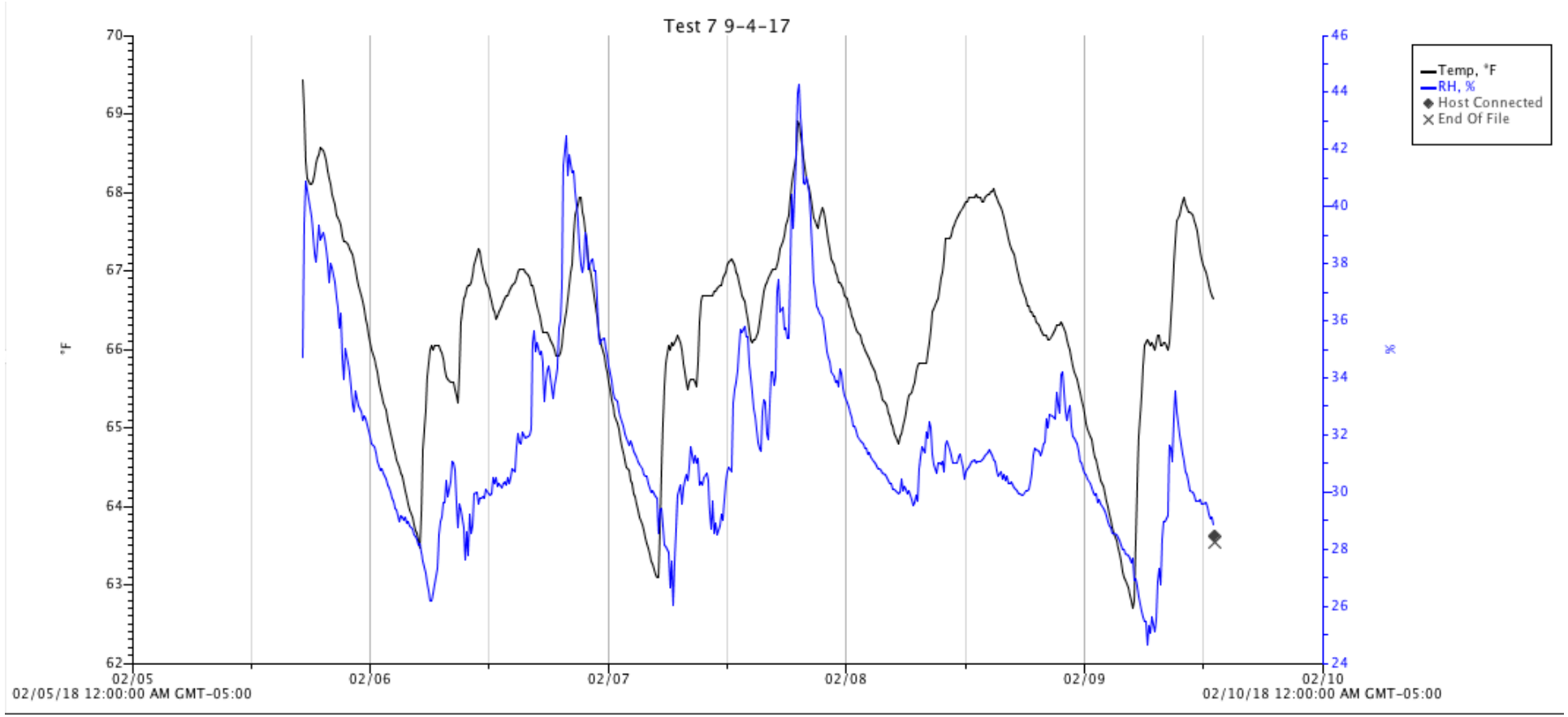


Basement



1st Floor

1ST FLOOR TO 2ND FLOOR: WHY DOES THIS ATTIC WORK?



When temperature drops at night, RH goes down; and when temp rises during the day RH goes up? Huh?

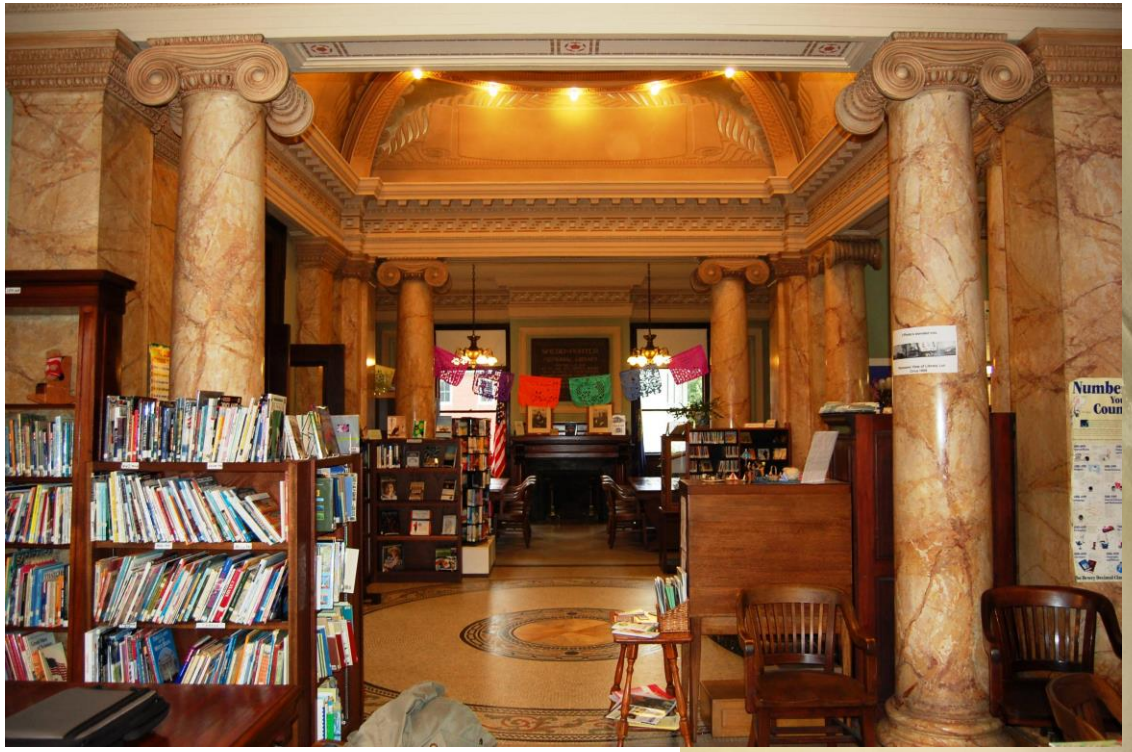
KEY TAKEAWAYS

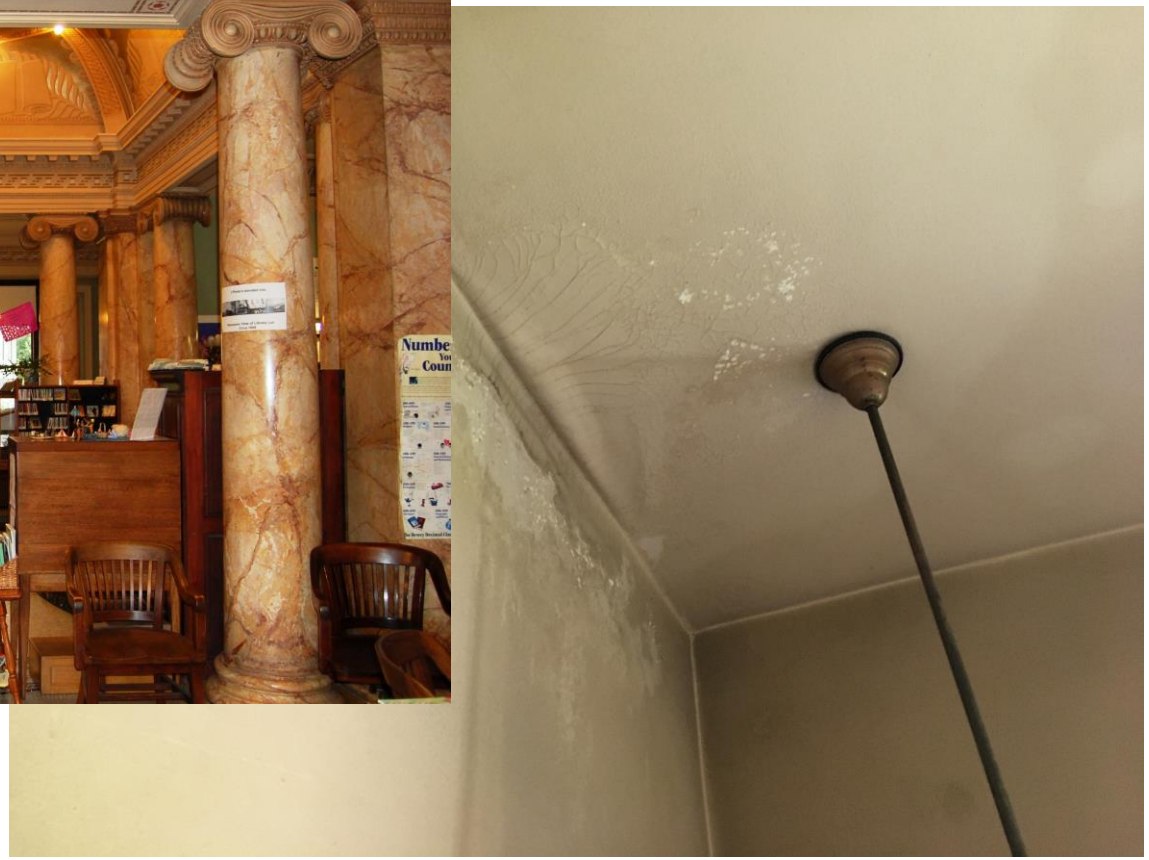
- Think/translate into dewpoint or absolute humidity, not just RH
- Data always beats a snapshot
- Occupants often have the answer, they just don't know it!

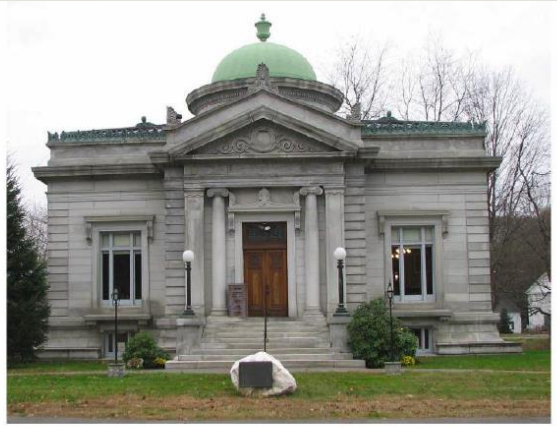
NEW ENGLAND HISTORIC LIBRARY

FRONT ENTRY

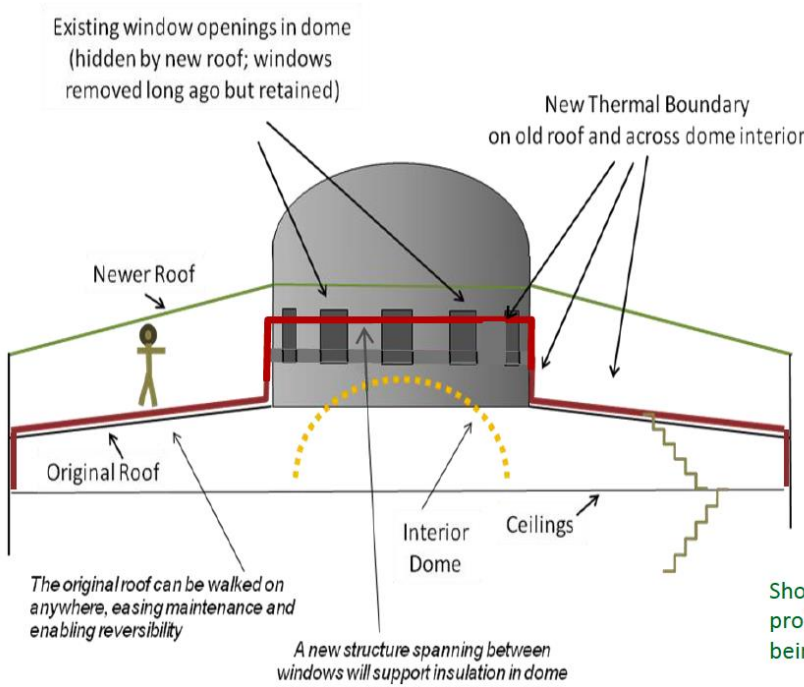
MAIN READING ROOM





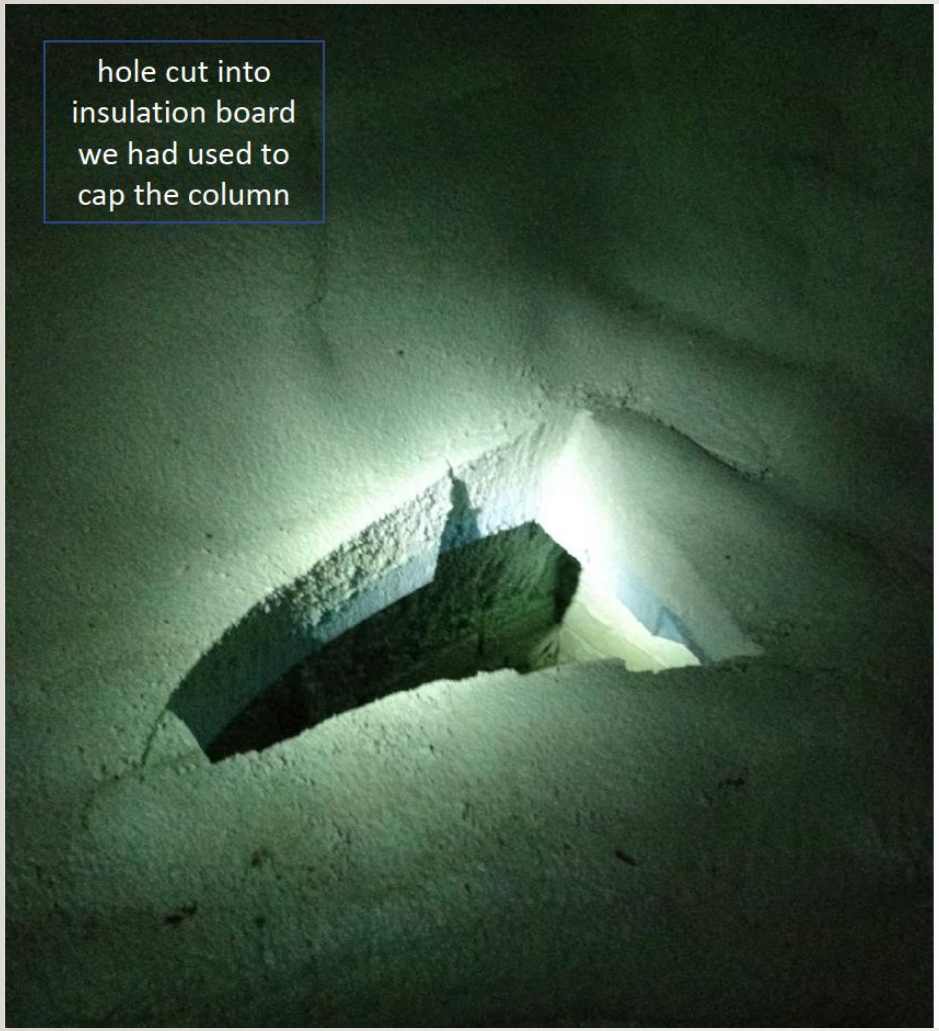


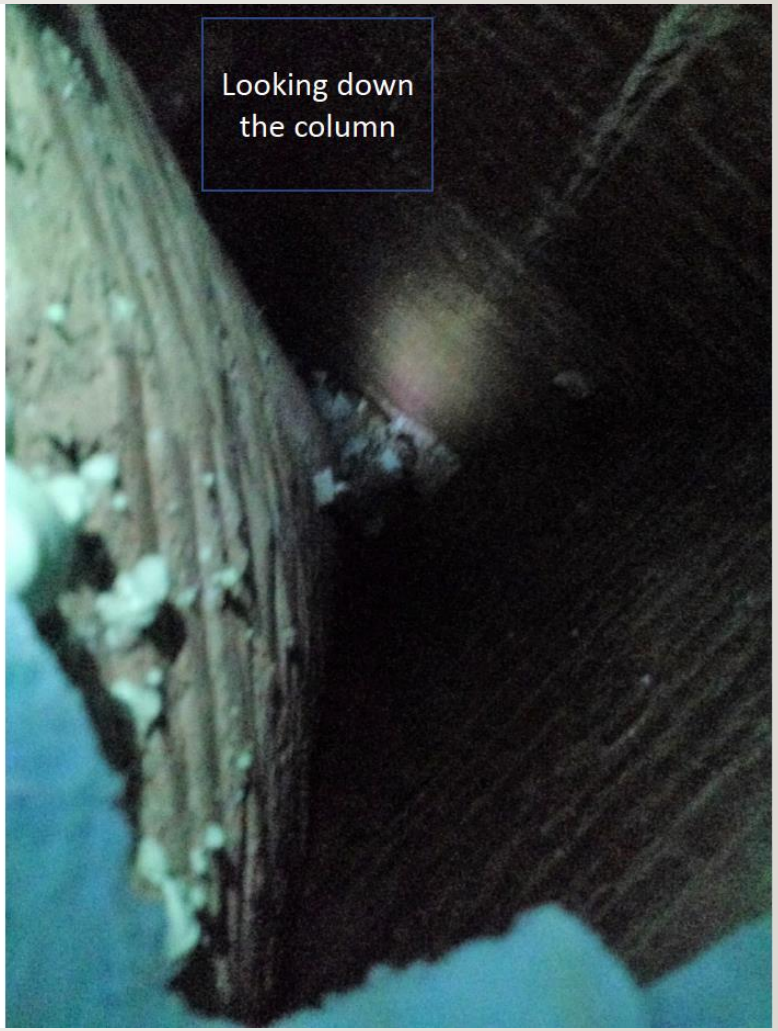
The basic scheme was to construct a fully air-sealed, insulated upper "thermal boundary"

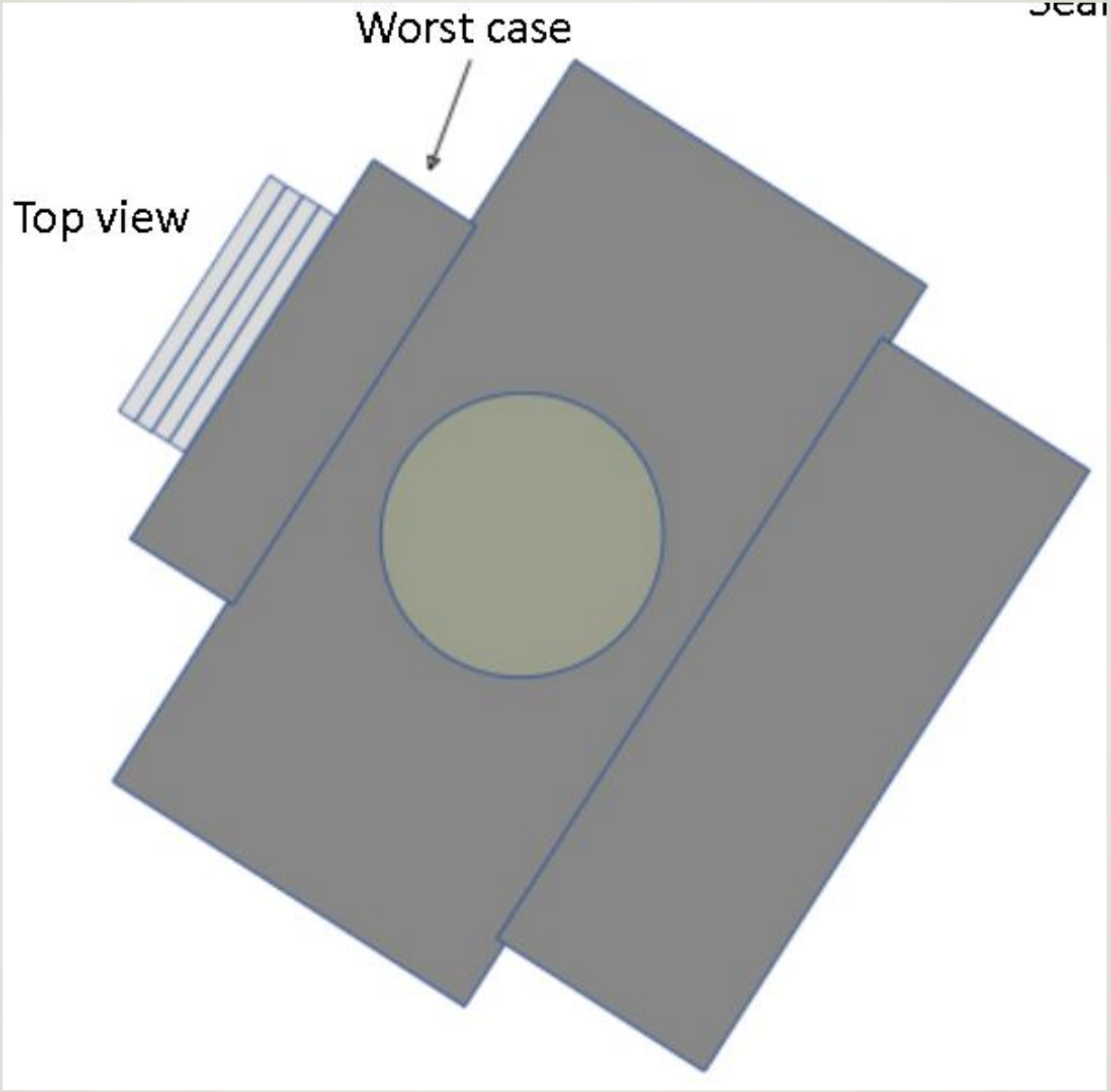


Shortly after the library was built, roof problems led to a second copper roof being built, hiding the dome's windows

ATTIC BETWEEN OLD AND NEW ROOF

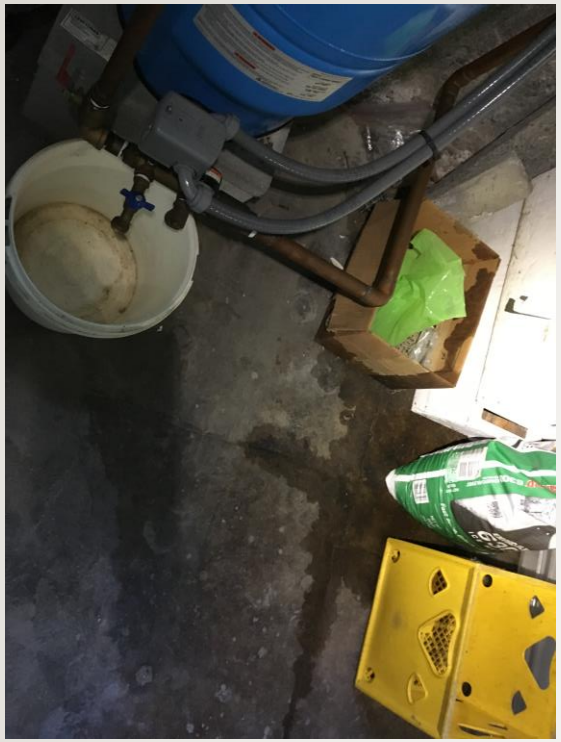

hole cut into insulation board we had used to cap the column


Looking down the column

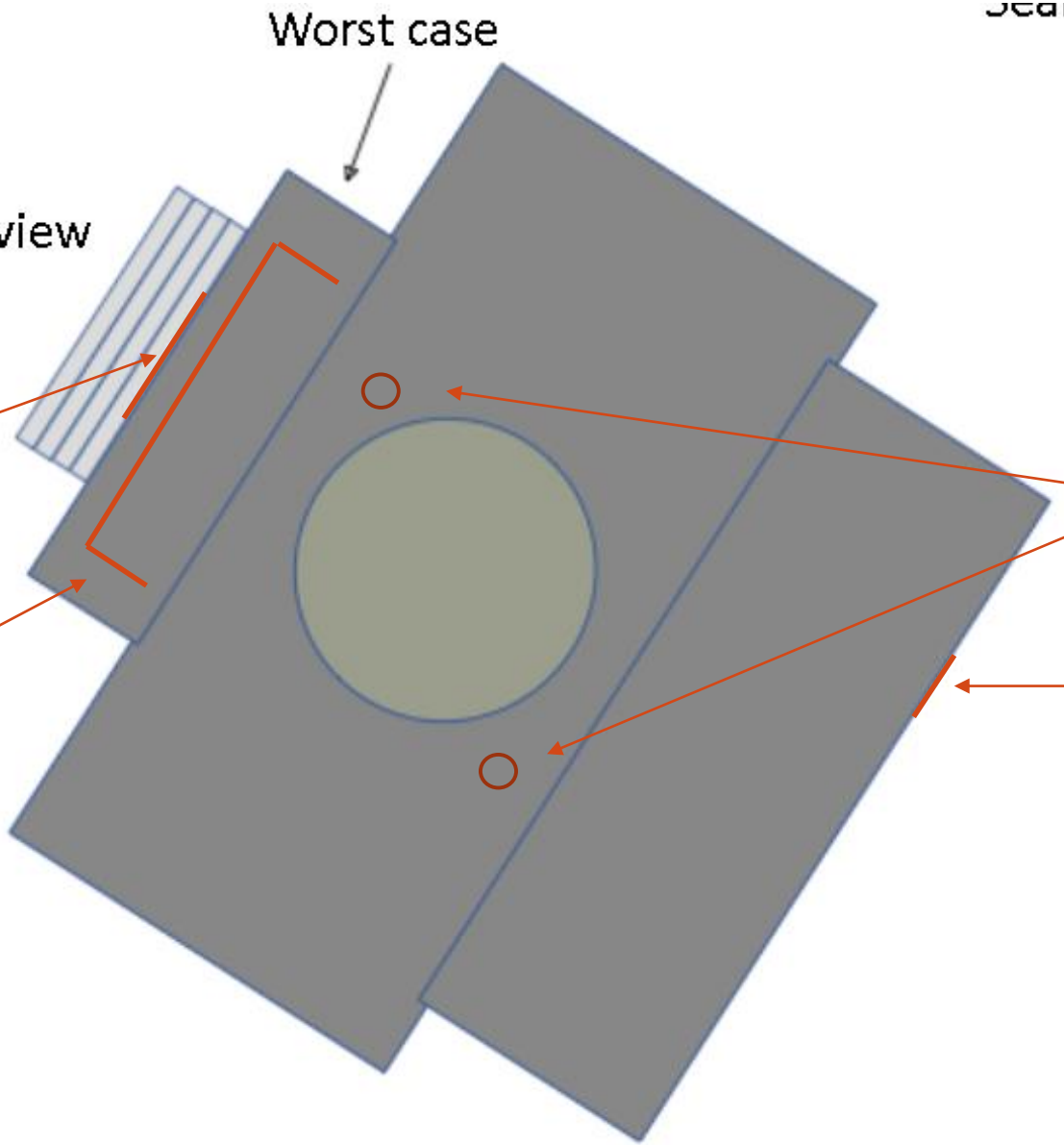

Worst case
Top view

ROOF ENTABLATURE

A VENT FROM OLD ATTIC



MECHANICAL HALF OF BASEMENT



Space under front stairs damp and open to finished basement

Displaced stone moldings in many places but clearly in section over front entry

Roof drains original, never worked on, uncertain pathways

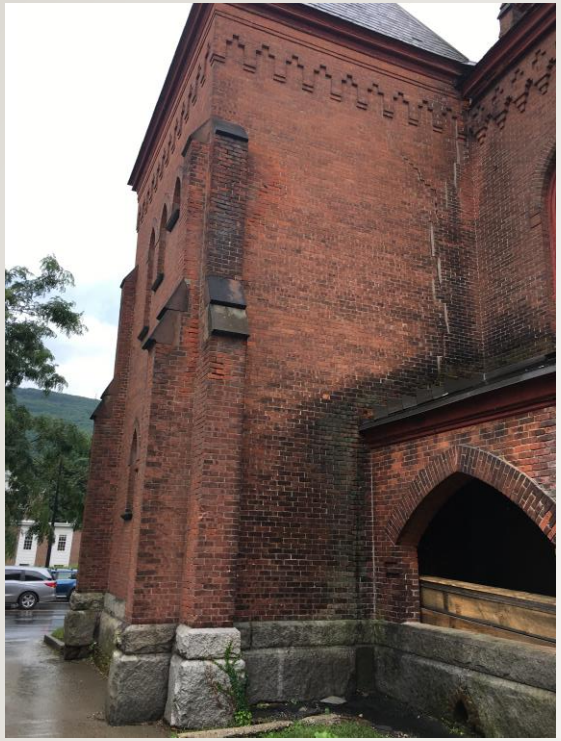
Vestigial attic vents leak and one is right over main room ceiling leak

KEY TAKEAWAYS

- Honor hygrothermal balance and equal intensity management
- Solve any bulk water mismanagement first, THEN re-evaluate
- When in doubt, call Bill Rose…(building science historian and author of Water in Buildings)

NE HISTORIC CHURCH

EAST FACING STREET SIDE



ALLEY NORTH SIDE

BACK OF BUILDING WEST FACING

BLDG ASMNT:
WHEN DO YOU GIVE UP ON A BUILDING?

Wicking water...

When we moved in, the washer was draining straight into the French drain

Sump pump

Unusable (and unsealed) window

Rim joist rotting? Home inspector thought the beam was thick enough

Entrance to the crawl space under the kitchen

Rotted wood?
Damp stones?

The separation between the crawl space and basement. The bulkhead door is to the right.

Water streams down when it rains… straight into the French drain

One fall afternoon. The view from the deck.

Sometimes it's helpful to remember why we bought the house.

https://drive.google.com/open?id=0B9T8PEgvm922VEtlUlh1WEtyakZTOUNEdl9TbGt5R0ZwZDVN

We did have a home inspector come. The report is linked.

CRAWLSPACE UNDER KITCHEN

DUG WELL

ONLY FULL BATH

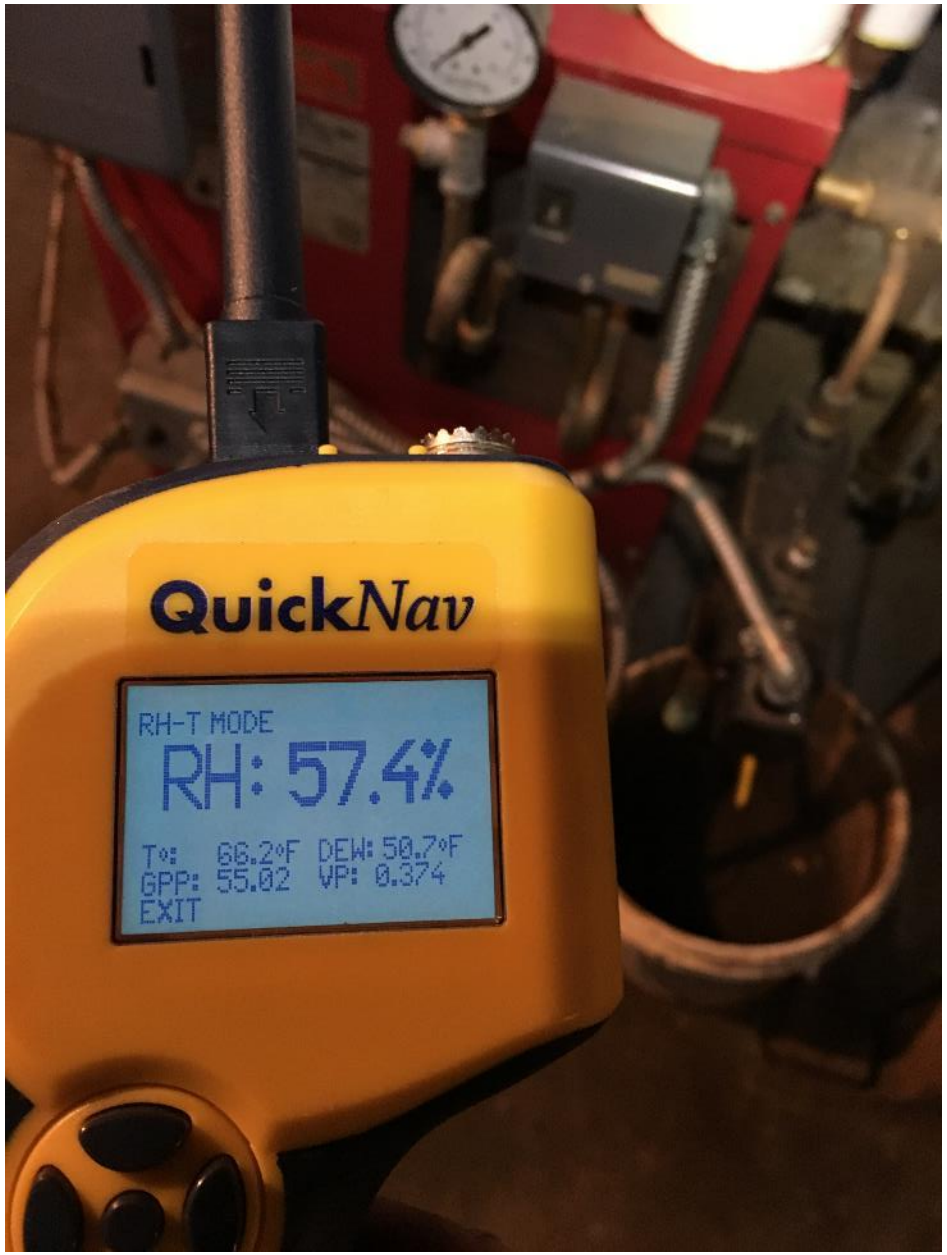
KEY TAKEAWAYS

- Bulk water management needed?
- Plumbing, heating challenges
- Vermiculite insulation in attic
- Awkward room configurations
- Awkward situation with long-standing neighborhood/community

SOUTHERN VT BLDG ASMNT

SOUTHERN VT BLDG ASMNT

FULL BASEMENT


QuickNav
RH-T MODE
RH: 57.4%
T°: 66.2°F DEW: 50.7°F
GPP: 55.02 VP: 0.374
EXIT


QuickNav
MC: 12.0%
WET

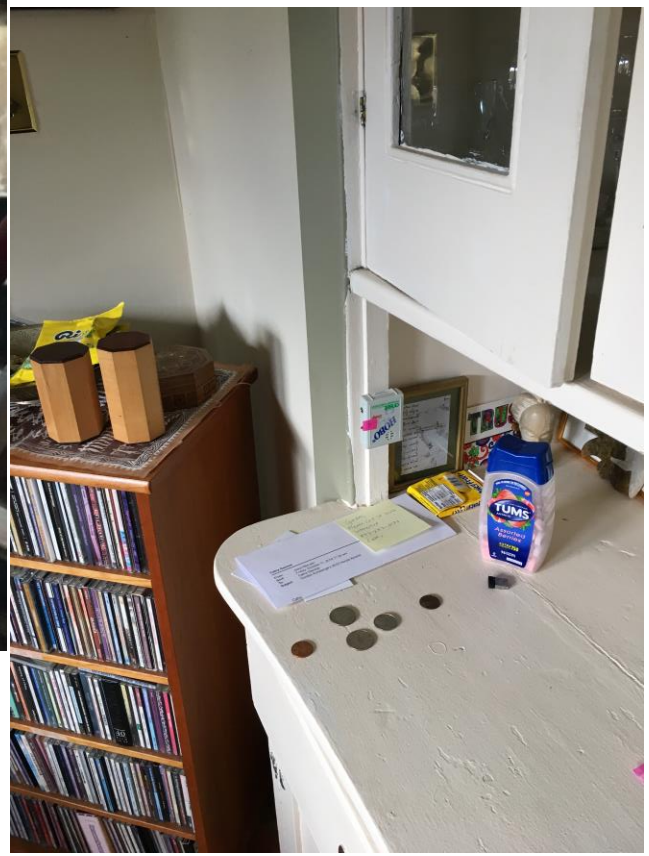

PIN MODE - WOOD
MC: 19.1%
DRY
WET
EXIT
OFF

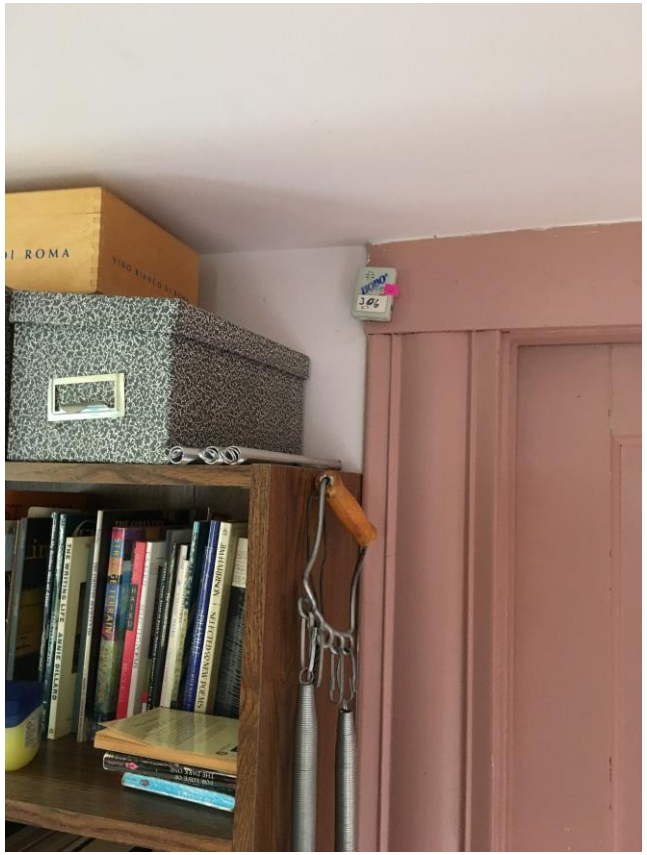

QuickNav
PIN MODE - WOOD
MC: 27.2%
DRY
WET
EXIT
OFF

KEY INFO

- Basement foundation clearly wet but what about sill beams?
- Attic bone dry?
- No blower door test but home leaky/owners-occupants perfectly happy when they are home…


HOBO


TUMS


ROMA
HOBO


HOBO

SUMMARY

- Track moisture in order of priority: bulk, capillary (water) – air-transported, diffusion (vapor) [and household sources]
- Snapshots may not be enough/collect data over time when you can
- Look for balance/imbalance in energy-moisture management
- Photograph everything, first…

WARNING: NEVER PRESENT PUZZLES IN "MIDAIR…"

PETER YOST
BUILDING - WRIGHT

PUZZLE FATIGUE...