

Cost-Effective High-Performance Unvented Attics

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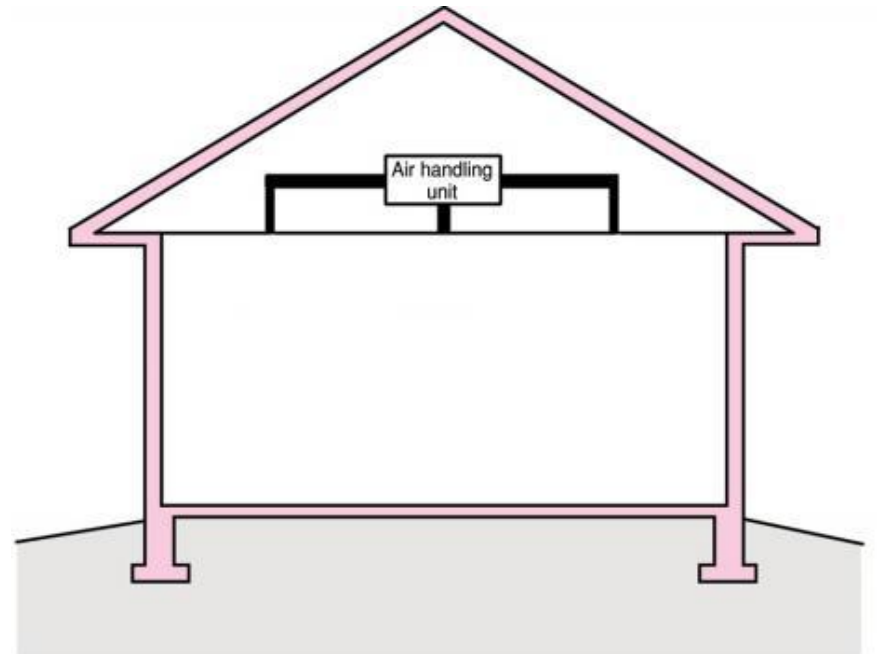
Unvented/Conditioned Attics

Benefits

- Reduces heat loss/gain from HVAC ducts & equipment
- Attic becomes semi-conditioned
- May simplify air sealing (knee walls & ceilings)

Challenges

- Larger insulated area
- Moisture management



Note: Colored shading depicts the building's thermal barrier and pressure boundary. The thermal barrier and pressure boundary enclose the conditioned space.

Image credit: DOE Building America Solution Center, <https://basc.pnnl.gov/>

Typical Solutions

Spray polyurethane foam. Common concerns are:

- Cost
- Health/environmental perceptions
- Moisture management (mainly open cell)



Open cell SPF



Closed cell SPF

Proposed Fiber Glass Option



Wired-up FG Batts

Benefits

- Low material cost
- Single installation step
- “Full-width” batts cover truss top chords
- Secured to minimize compression & gaps

Challenges

- Install quality
- Still must air-seal attic
- Moisture management

≥R-30 batts work best

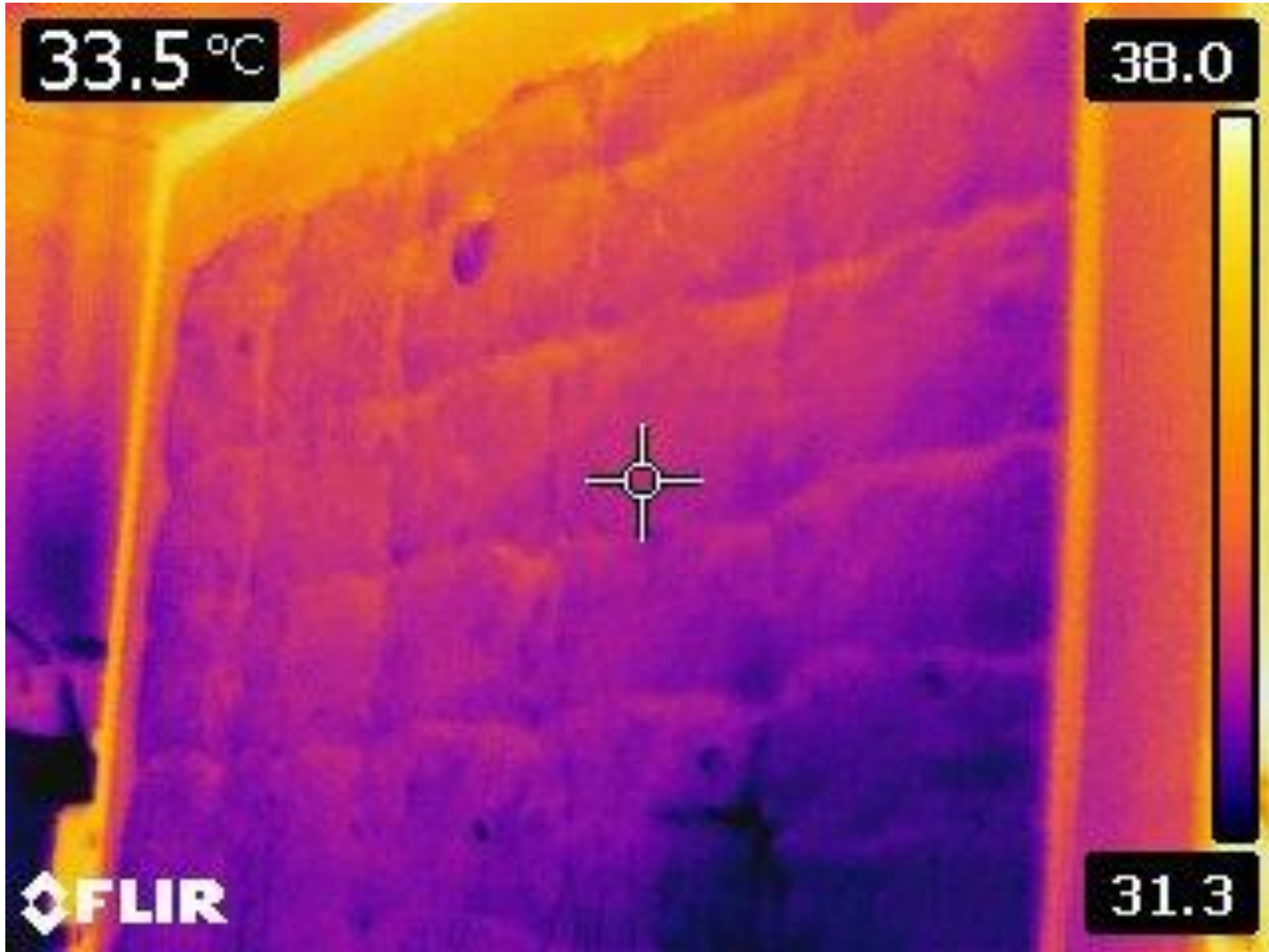
Thermal Performance

Calculated – Parallel Path method

Element	Framing Path	Cavity Path
Ext. air film	0.17	0.17
Roof cladding	0.44	0.44
Roof underlayment	0.06	0.06
OSB roof deck	0.48	0.48
2x4 truss top chord	4.53	--
Cavity insulation	--	10.23
Continuous insulation	27.77	27.77
Attic air	0.80	0.80
Ceiling gyp. Board	0.45	0.45
Int. air film	0.61	0.61
Total R-value	35.31	41.01
Area fraction	7%	93%
System U-factor	0.025	

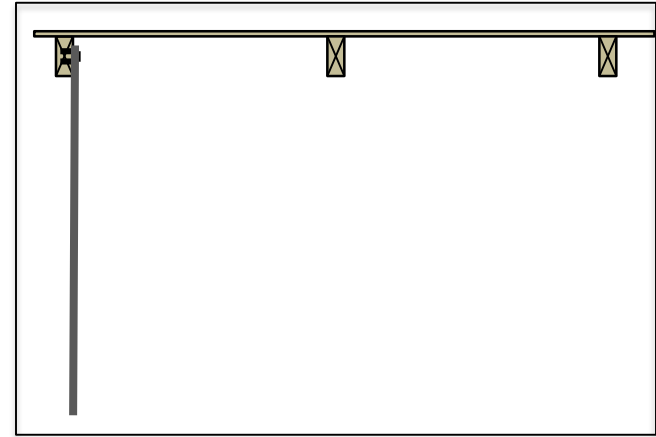
Thermal Performance

Calibrated Hot Box



Installation

1. Staple enough wire to truss to secure 3-4 batts (~15 ft). Space wires every 8"-12"
2. Tuck batt up against roof deck and rotate into place, compressing slightly between truss top chords



Installation (cont'd)

3. Bend wires @ batt surface, bring across & bend again to go back to next truss. Staple in place. Loop wire back out and twist onto itself to form a rigid “leg”. Excess wire is now ready for the next batt.
4. Repeat steps 2 & 3, working across the roof. Repeat for each course.



Install quality



Test Home

- In California, with a vented tile roof



Test Home

- 3 runs of wire per batt
- ~3200 ft² of roof deck
- about 54 man-hours



Test Home



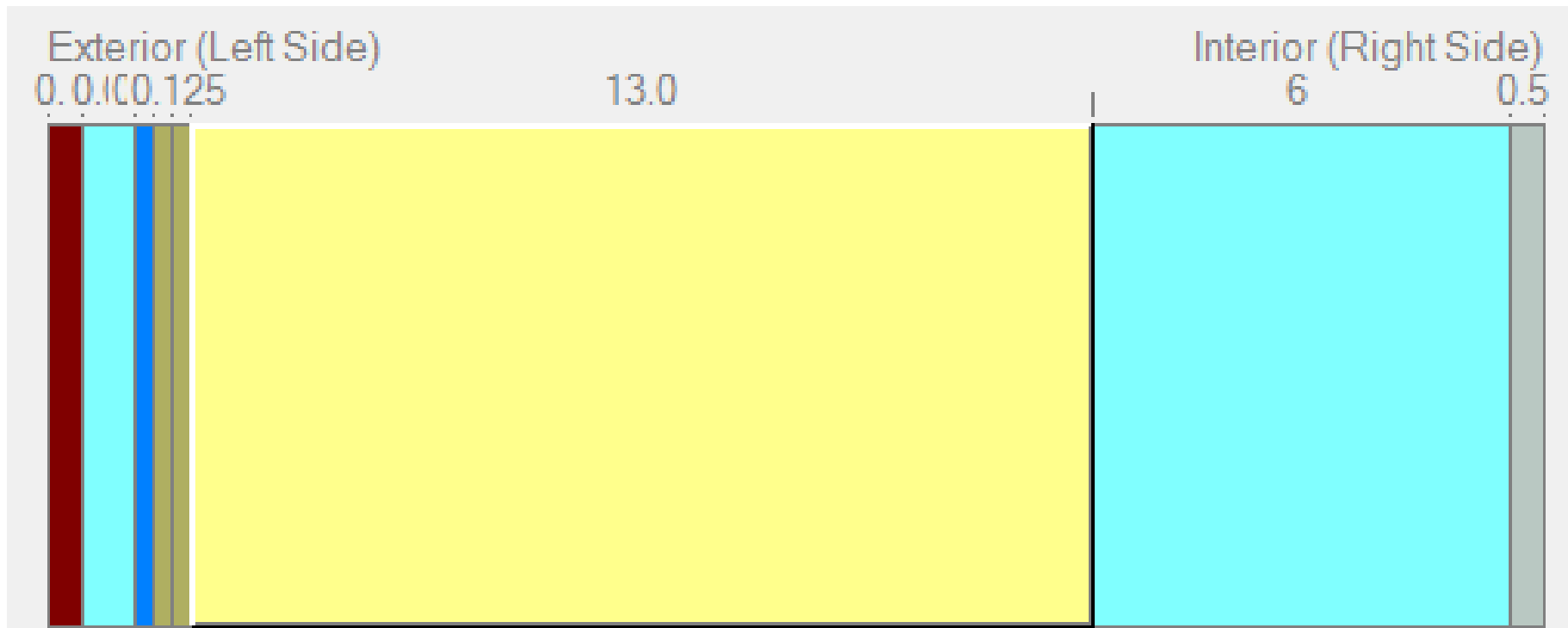
Test Home



Extra wire to support batt ends

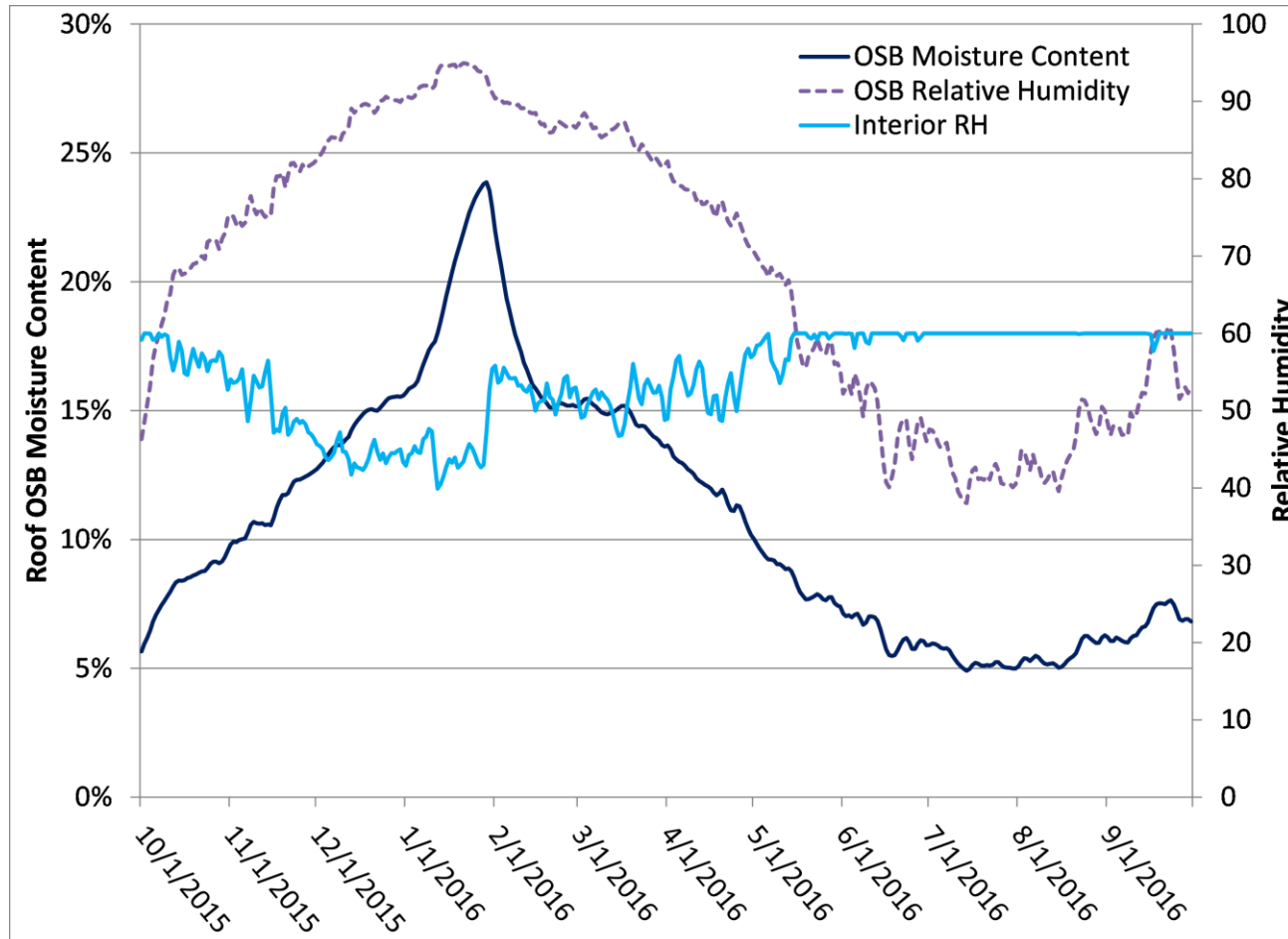
Moisture Management

- Explored with WUFI
- Layers: Roof tile-air space-underlayment-roof deck-insulation-attic air-ceiling
- Looked at deck MC and mold index

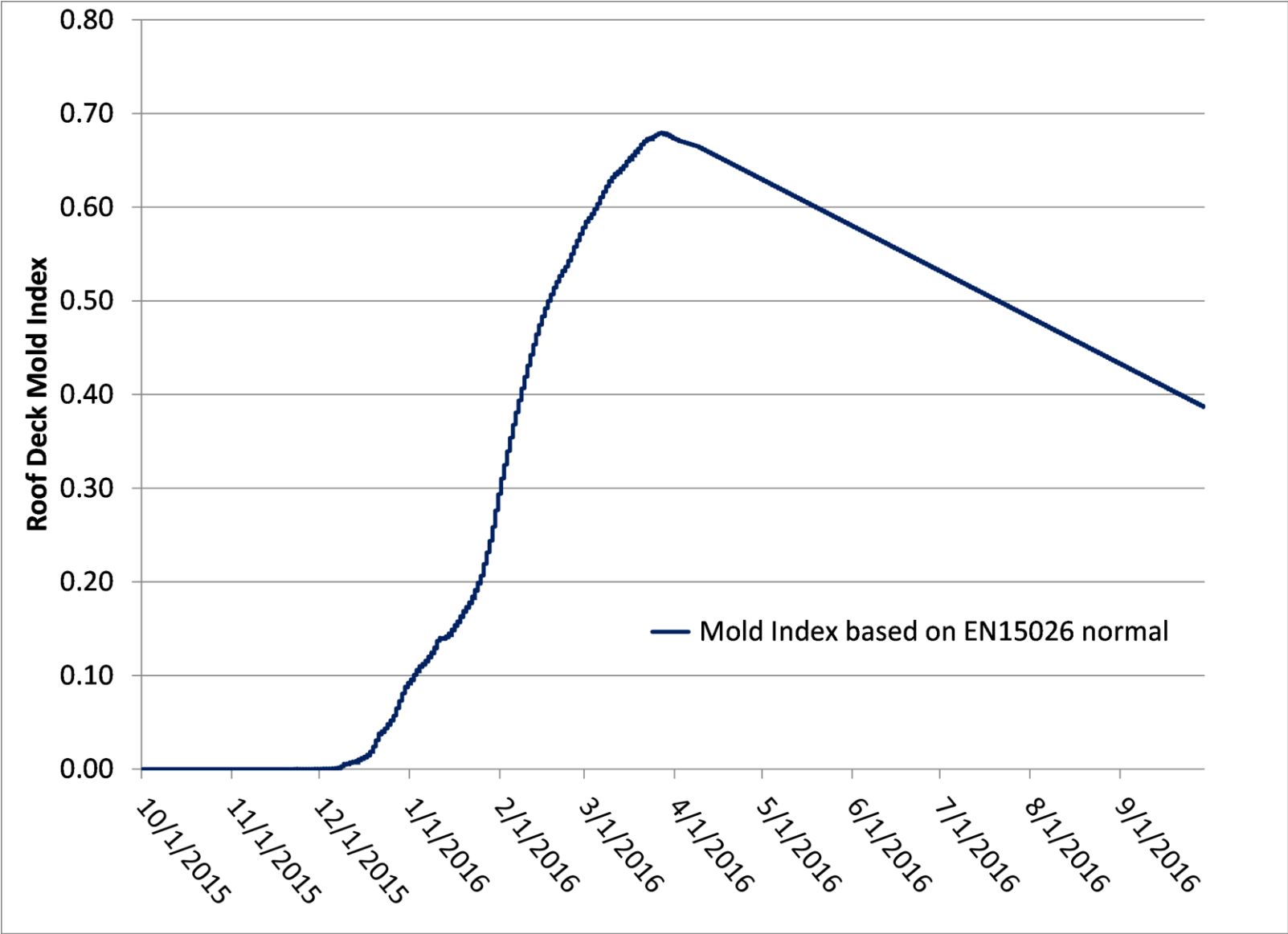


RH & Roof Moisture Content

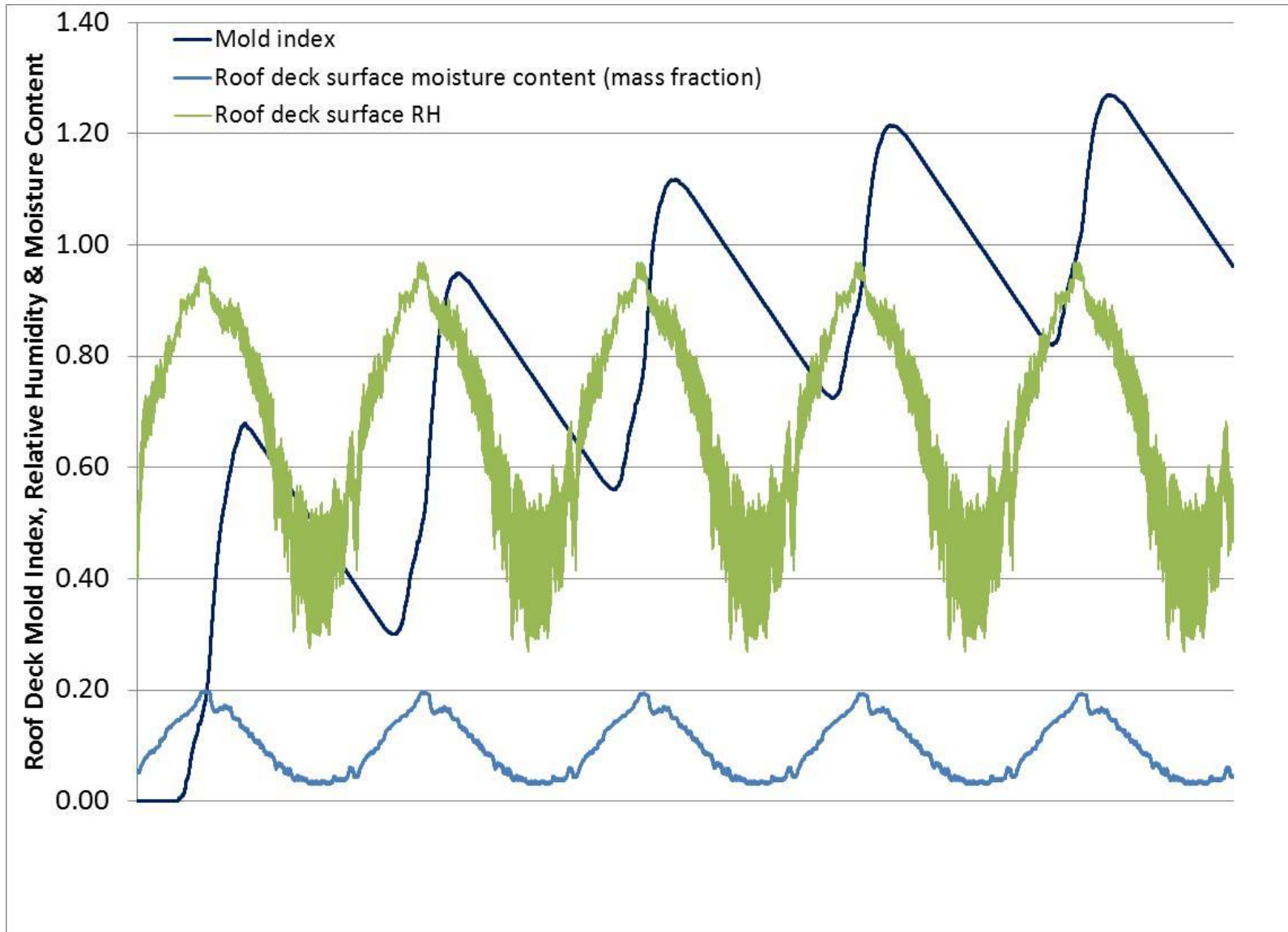
- Recognized that attic conditions driven by interior climate.
- Settled on EN 15026 “Normal”



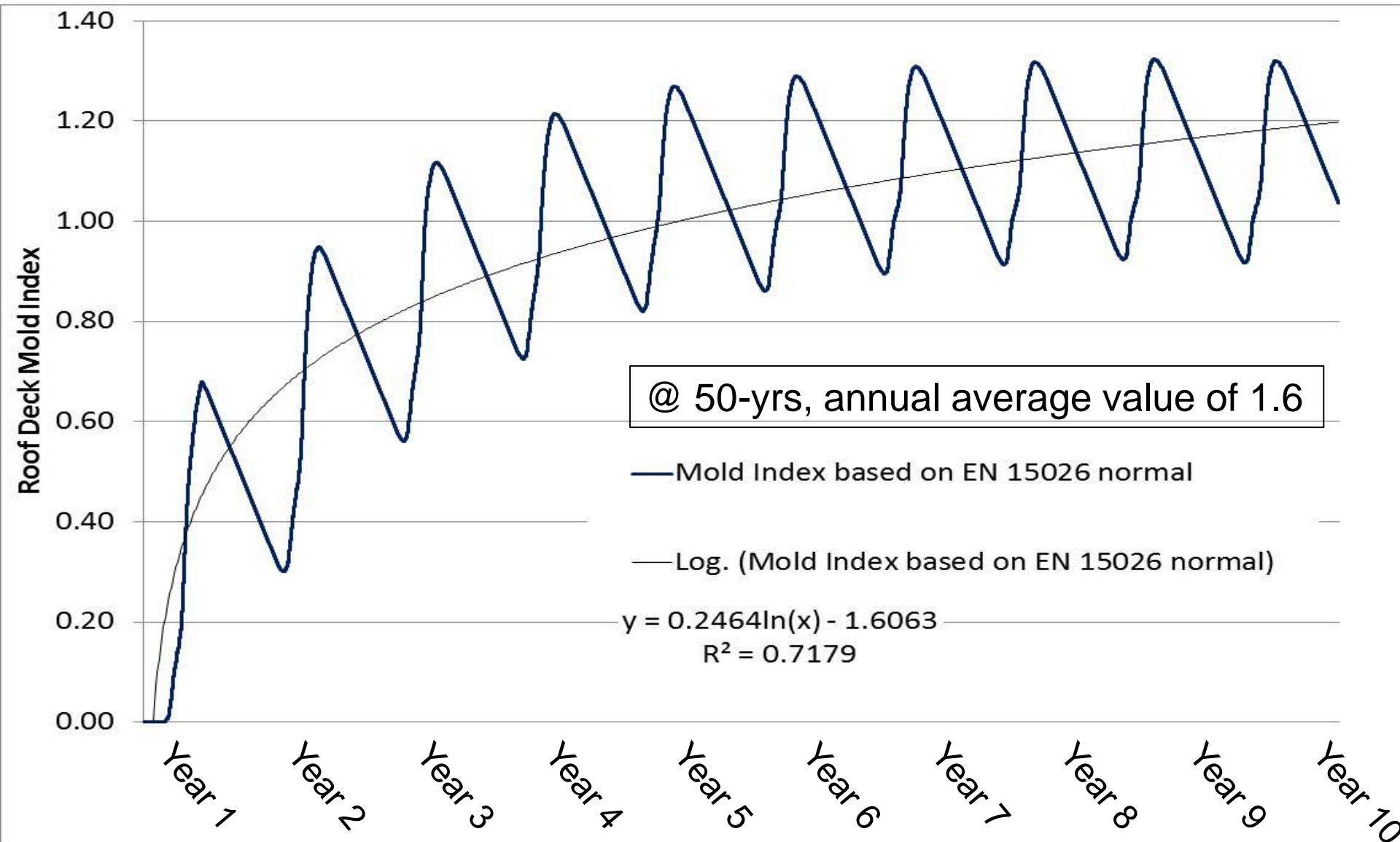
Mold Index



Mold Index vs. MC vs. RH

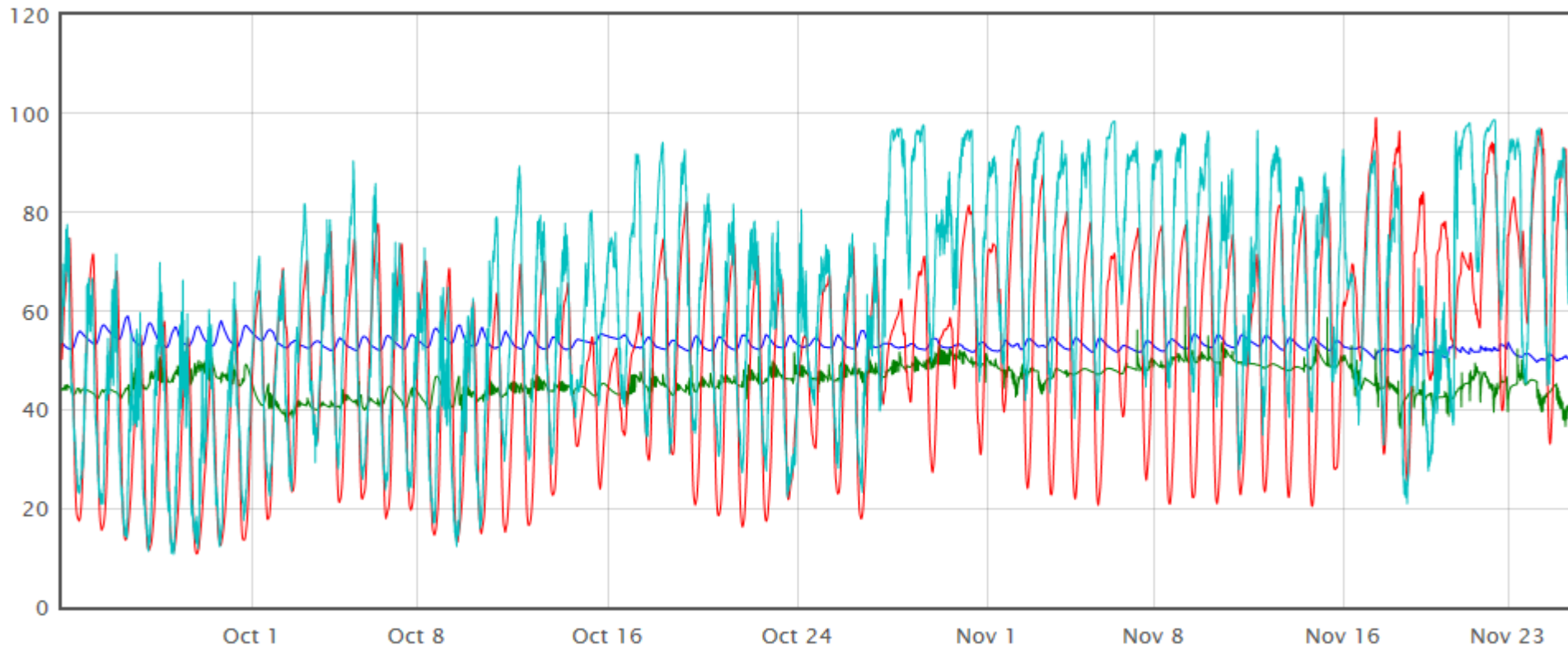


Mold Index – Long Term



Field Data

- Sept 23 – Nov 25, 2016
- RH values: ■ interior, ■ attic air, ■ attic peak, ■ exterior



Summary

- Low-cost unvented attic for dry climates
- Minimize compression & gaps
- Install quality is important
- Moisture performance seems acceptable based on calculations

Next Steps

- Optimize install process
- Confirm thermal performance in Hot Box
- Confirm moisture performance through field monitoring

QUESTIONS?