

Home Innovation Research Labs

Partners

- SIPA
- ACC
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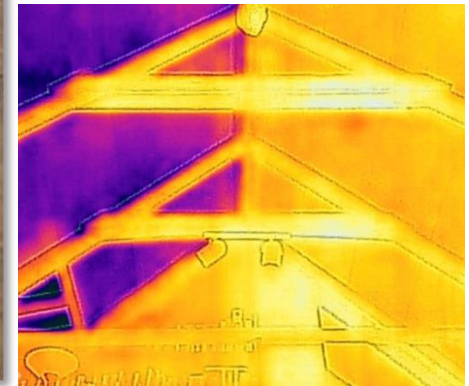
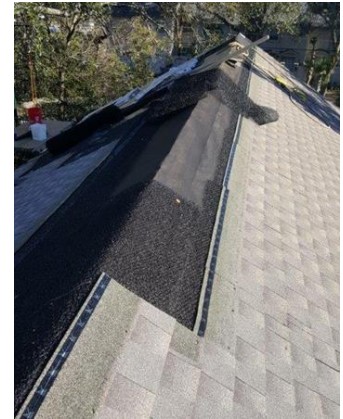
Topic Area

Moisture Managed High-R
Envelopes

Success Metrics: Heating and cooling energy savings of at least 10%, as well as improved comfort.

Attic Retrofits Using Nail-Base Insulated Panels

- Develop and demonstrate a roof/attic energy retrofit solution using retrofit panels for existing homes where traditional attic insulation approaches are not effective or feasible
- Monitor data to confirm acceptable moisture levels



Project Overview

- **Project Purpose:** Develop, demonstrate, and assess a roof/attic energy retrofit solution using nail-base insulated panels (retrofit panels) for existing homes where traditional attic insulation approaches are not effective or feasible.
- **Technology:** Retrofit panels consist of rigid foam insulation laminated to one face of a wood structural panel. The prefabricated panels are installed above the existing roof deck during a re-roofing effort.
- **Project Goals:** 1) Develop design details for two residential demonstration homes (one cold climate, one hot-humid climate); 2) Demonstrate the retrofit panel installations; 3) Assess energy performance, moisture performance, costs, and feedback from contractors and homeowners.
- **Scope:** This presentation summarizes the project from site assessments to installation during the winter of 2016/2017 to data collection through Feb 2018.

U.S. DEPARTMENT OF
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Attic Retrofits Using Nail-Base Insulated Panels

January 2018

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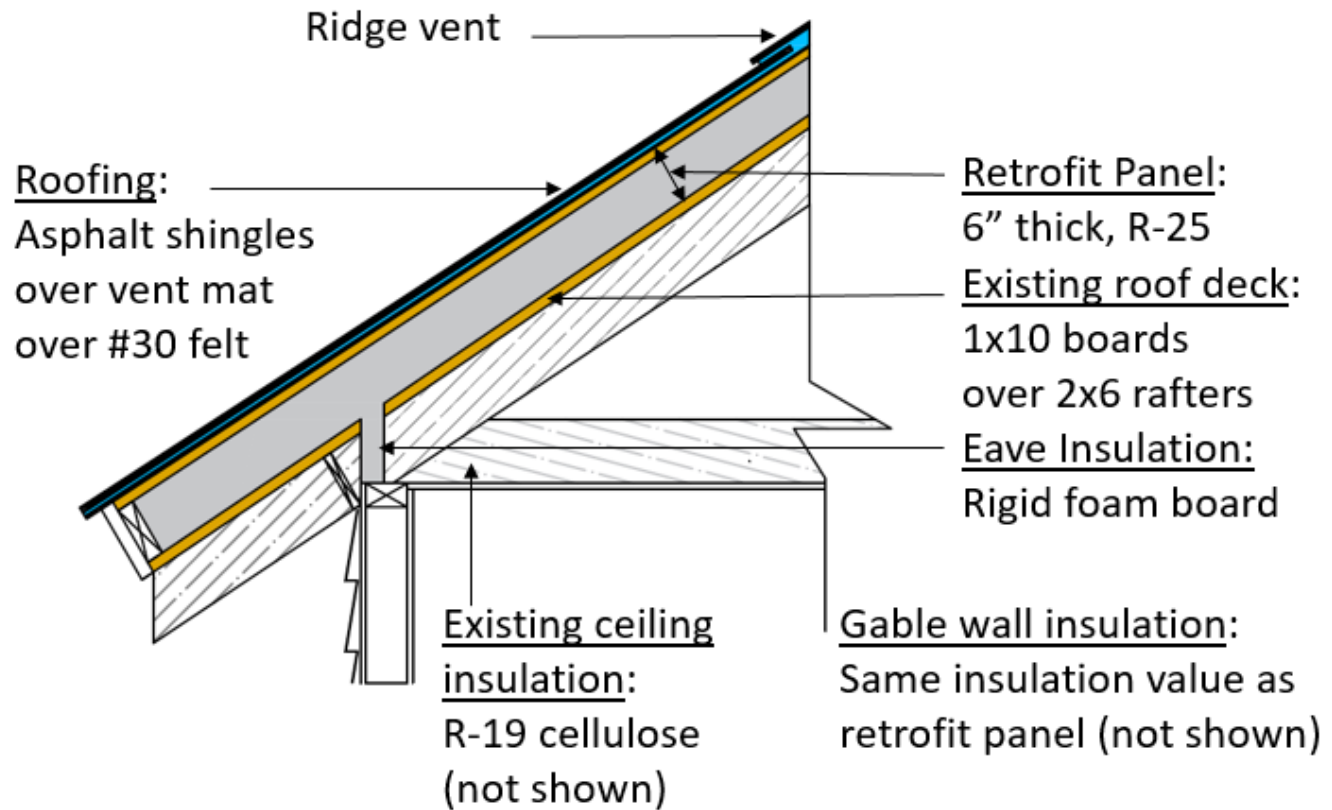


Hot-Humid Climate – St. Simons Island, GA



Design Solution – GA

Georgia Retrofit Design



Eave Area and Attic Access



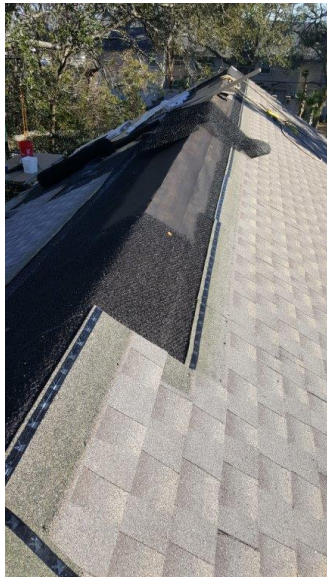
Construction – GA



Construction – GA



Construction – GA



HIRL roof mock up with ventilation mat

Figure 9. Mock-up Roof Deck Assembly and Installation of Underlayment

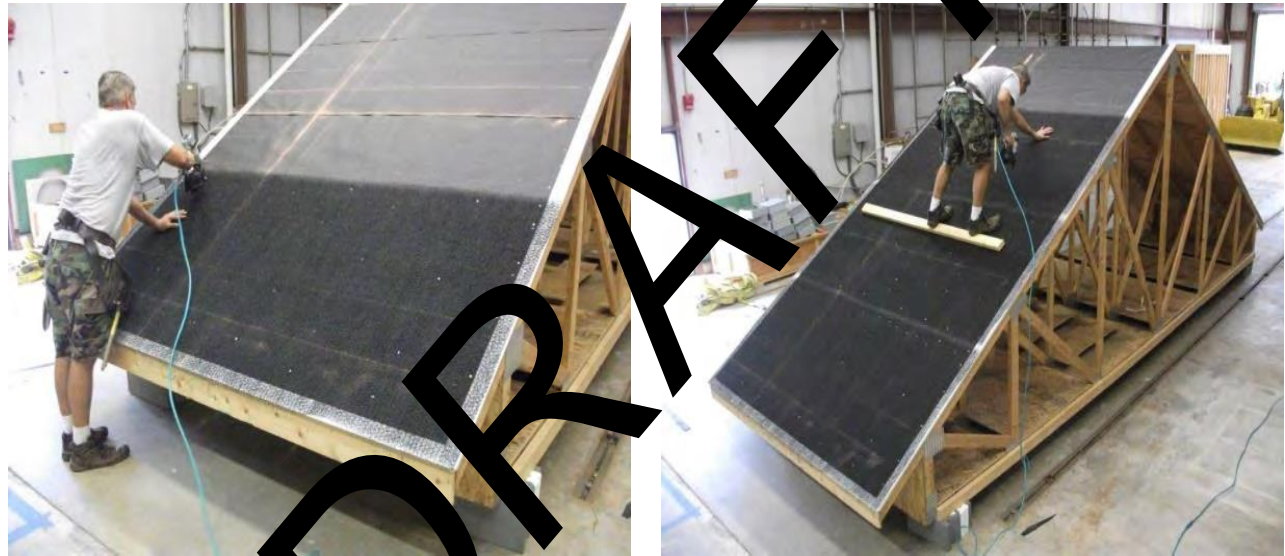
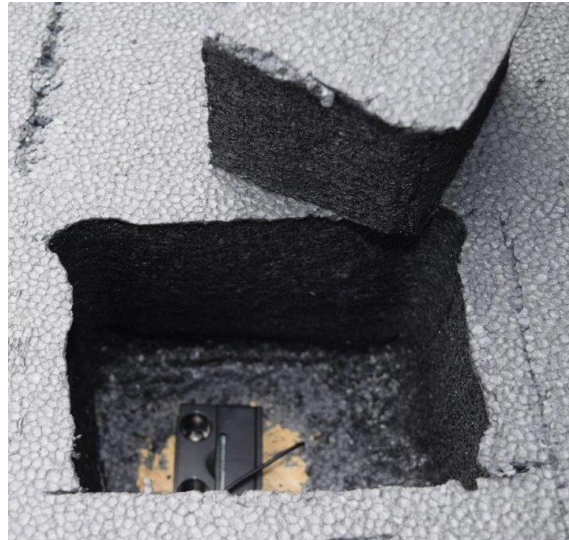
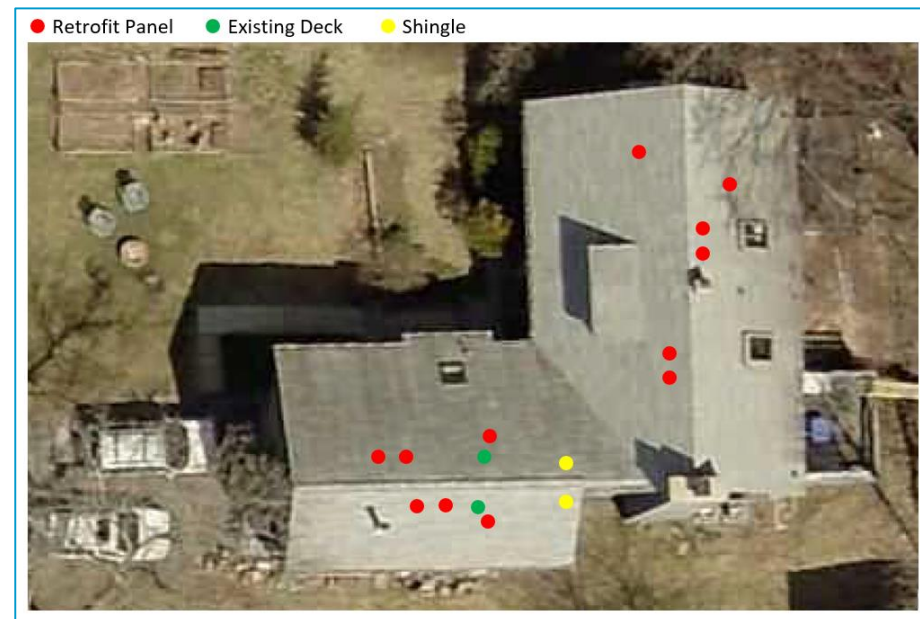
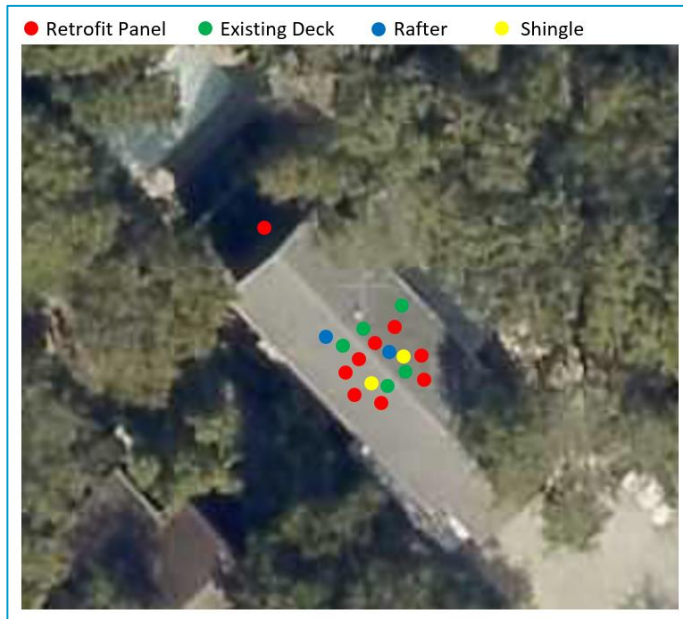
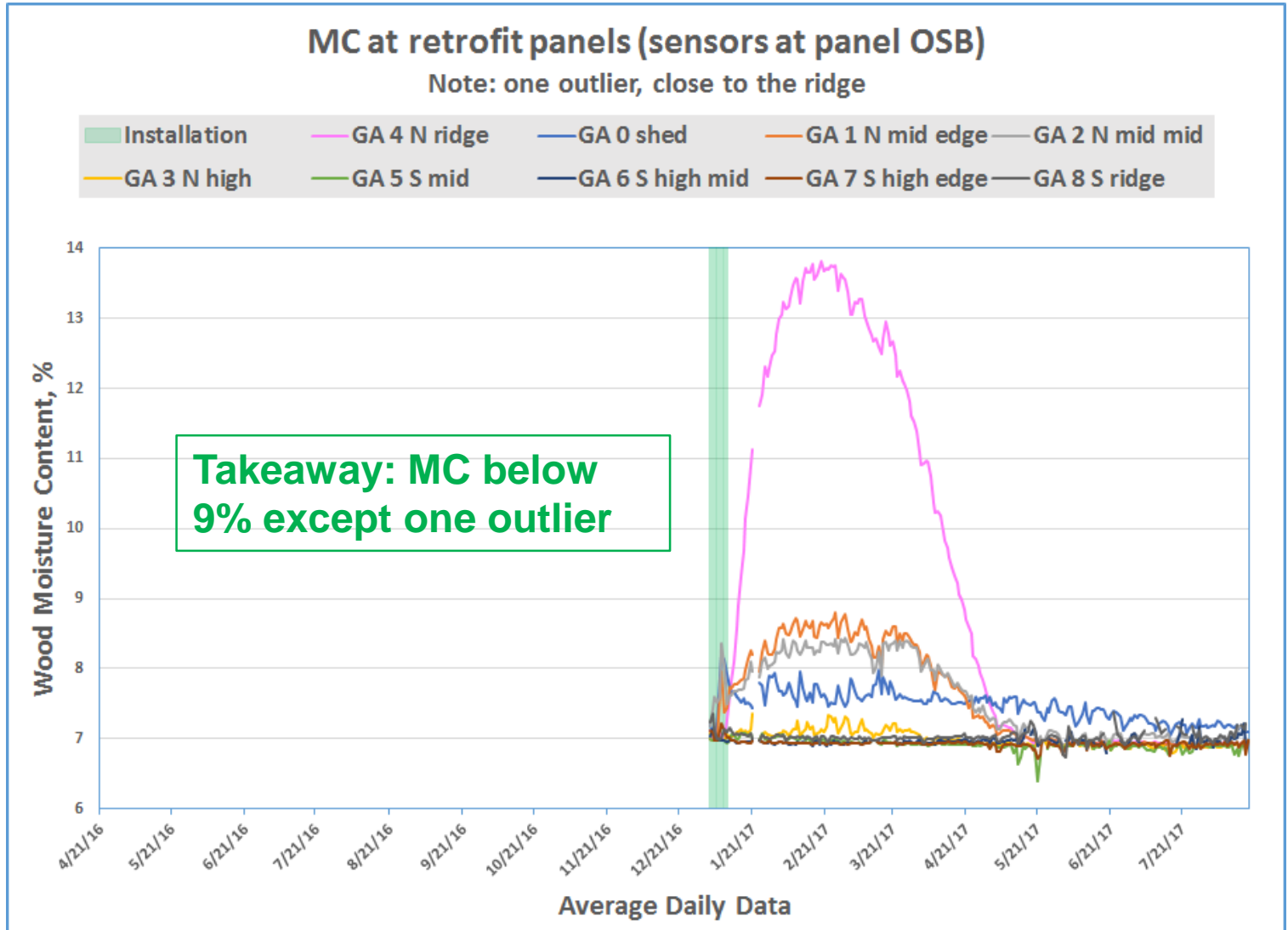


Figure 10. Installation of Ventilation Mat

Sensor Locations



GA Data – MC at Retrofit Panel

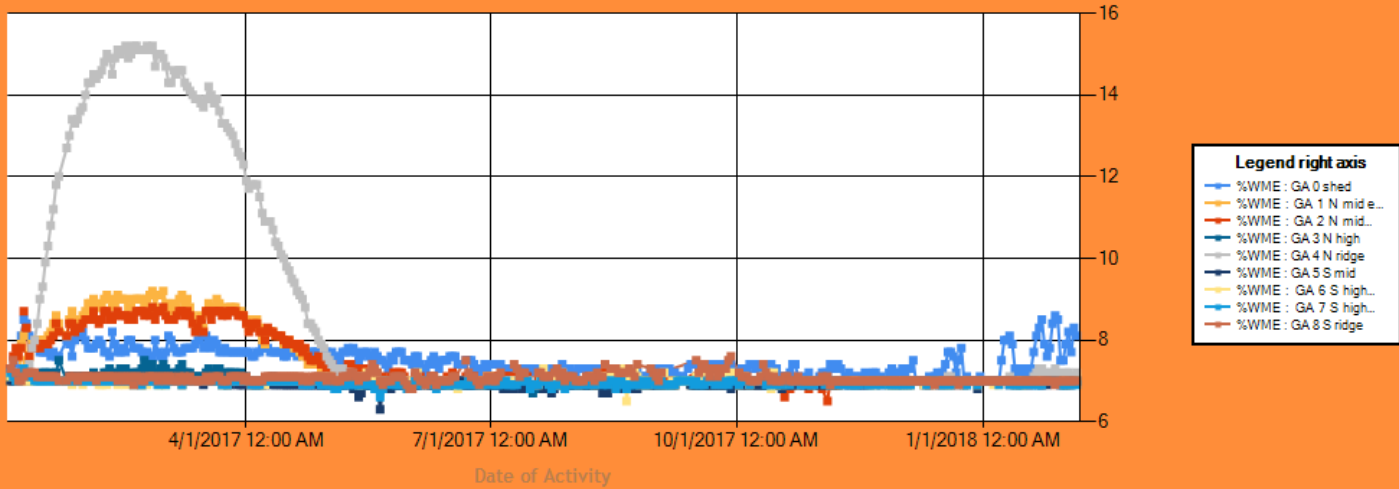


GA Data – MC at Retrofit Panel

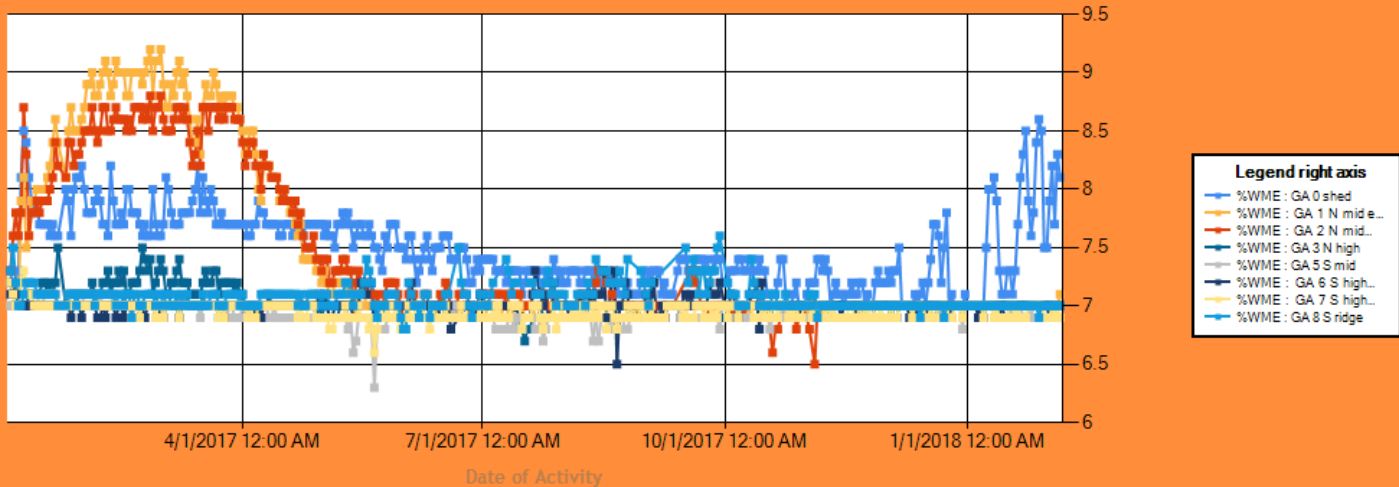
Extended Data: Jan 2017 – Feb 2018

Note: lower graph is without the outlier

Average Sensor Values from 1/1/2017 12:00:00 AM to 2/6/2018 12:00:00 AM using daily averages



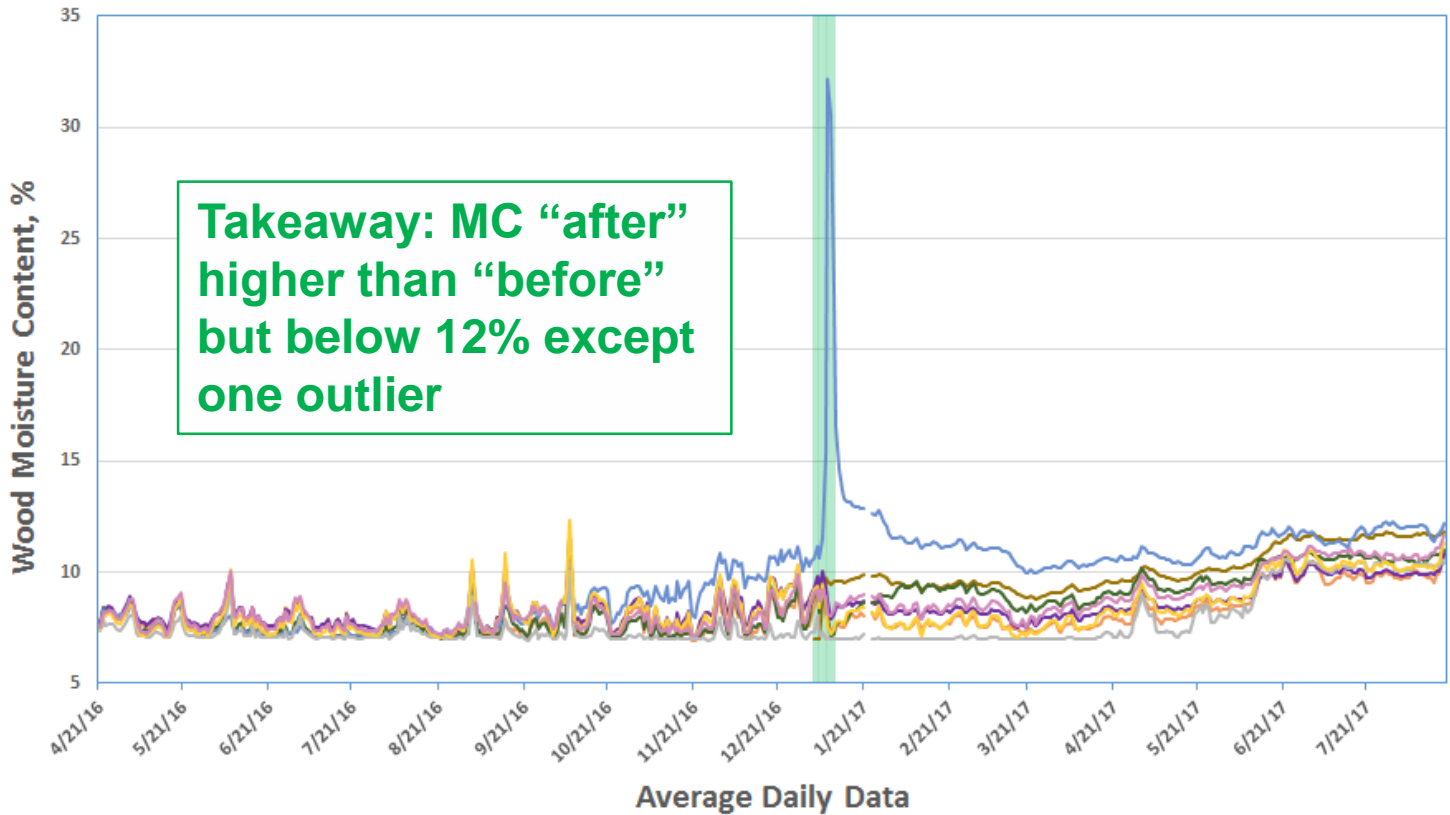
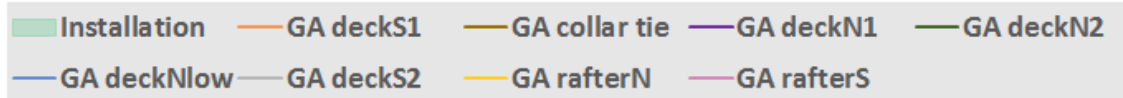
Average Sensor Values from 1/1/2017 12:00:00 AM to 2/6/2018 12:00:00 AM using daily averages



GA Data – MC at Existing Deck/Framing

MC at original roof deck and rafters (sensors in attic)

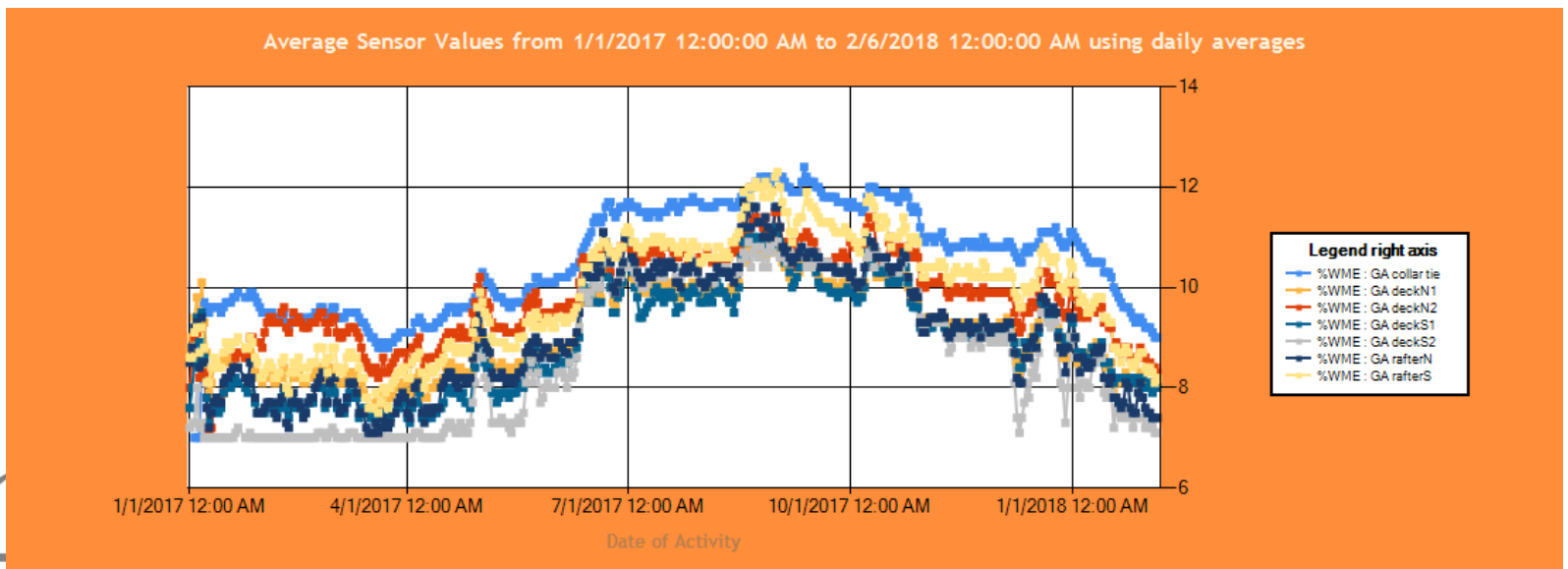
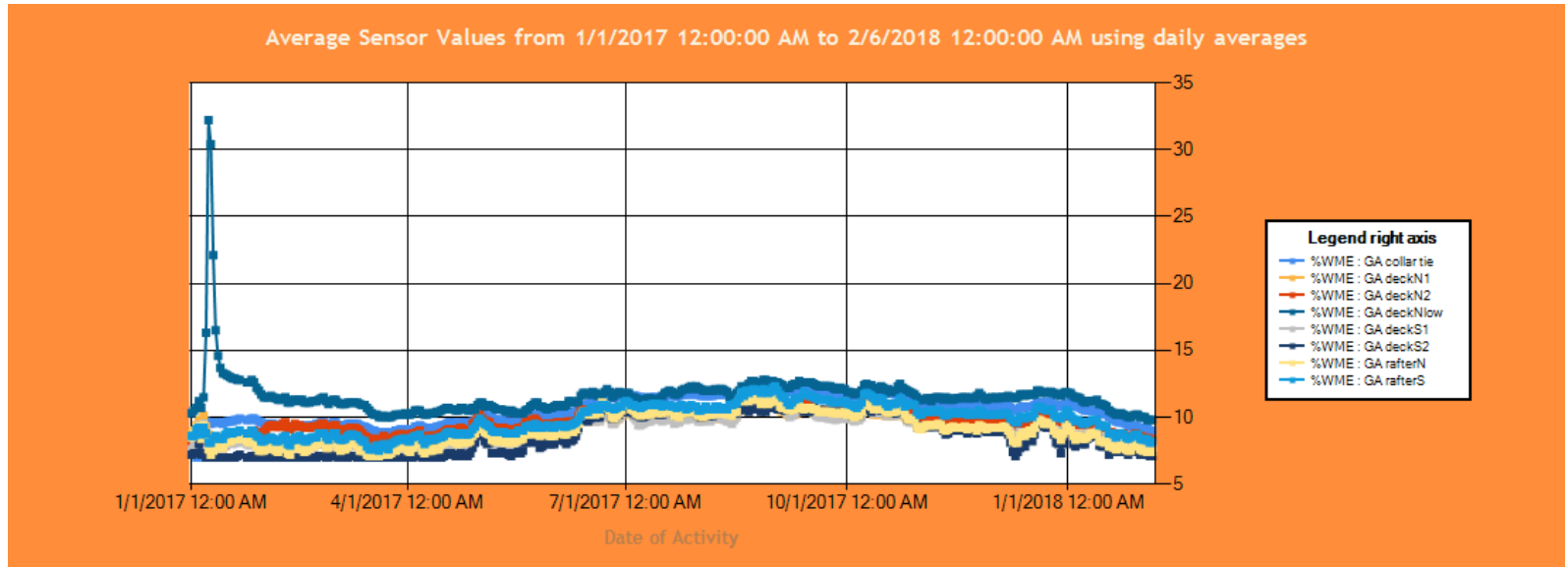
Note: one outlier, at deck, low near ceiling, rained that night



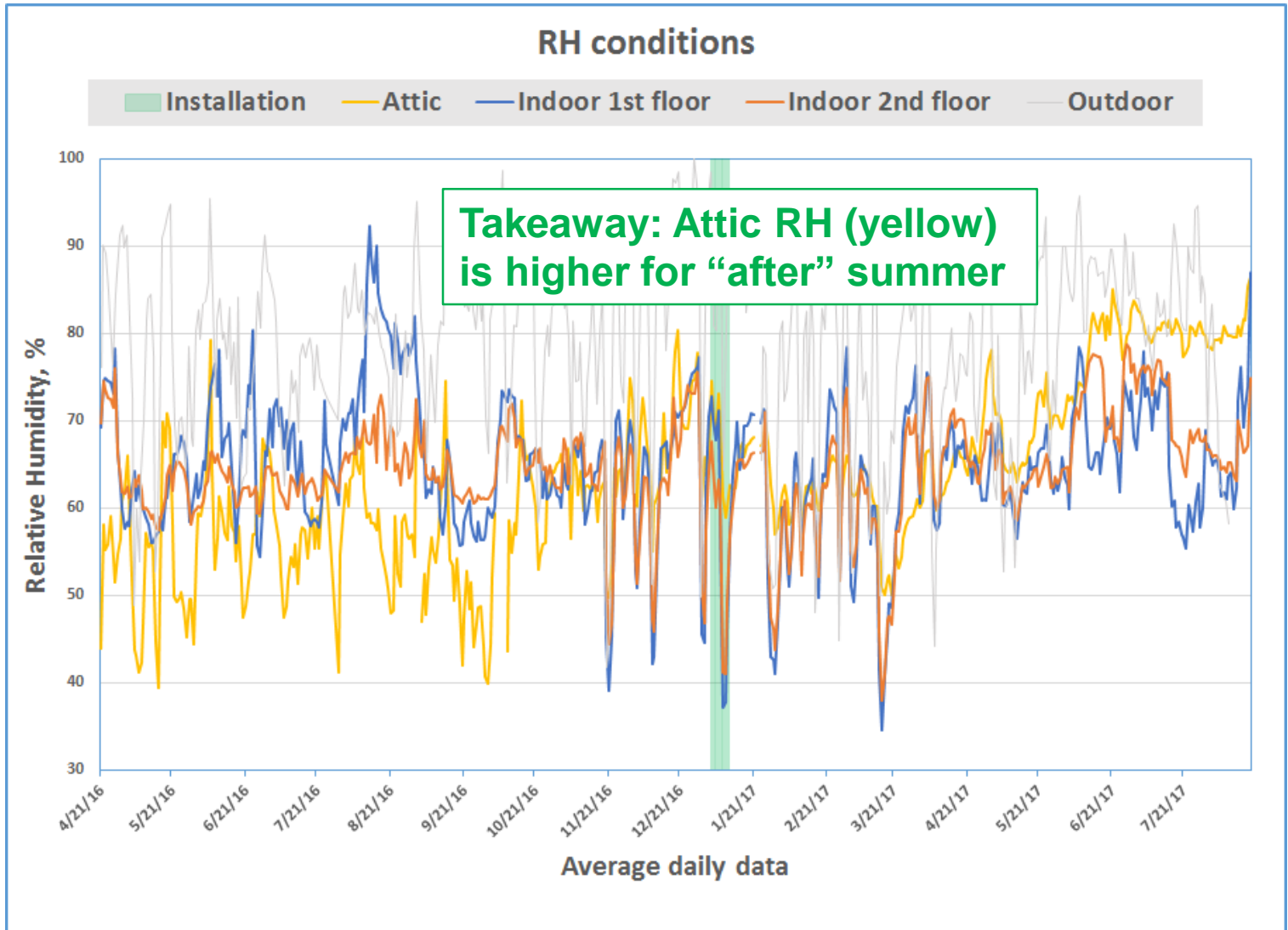
GA Data – MC at Existing Deck/Framing

Extended Data: Jan 2017 – Feb 2018

Note: lower graph is without the outlier



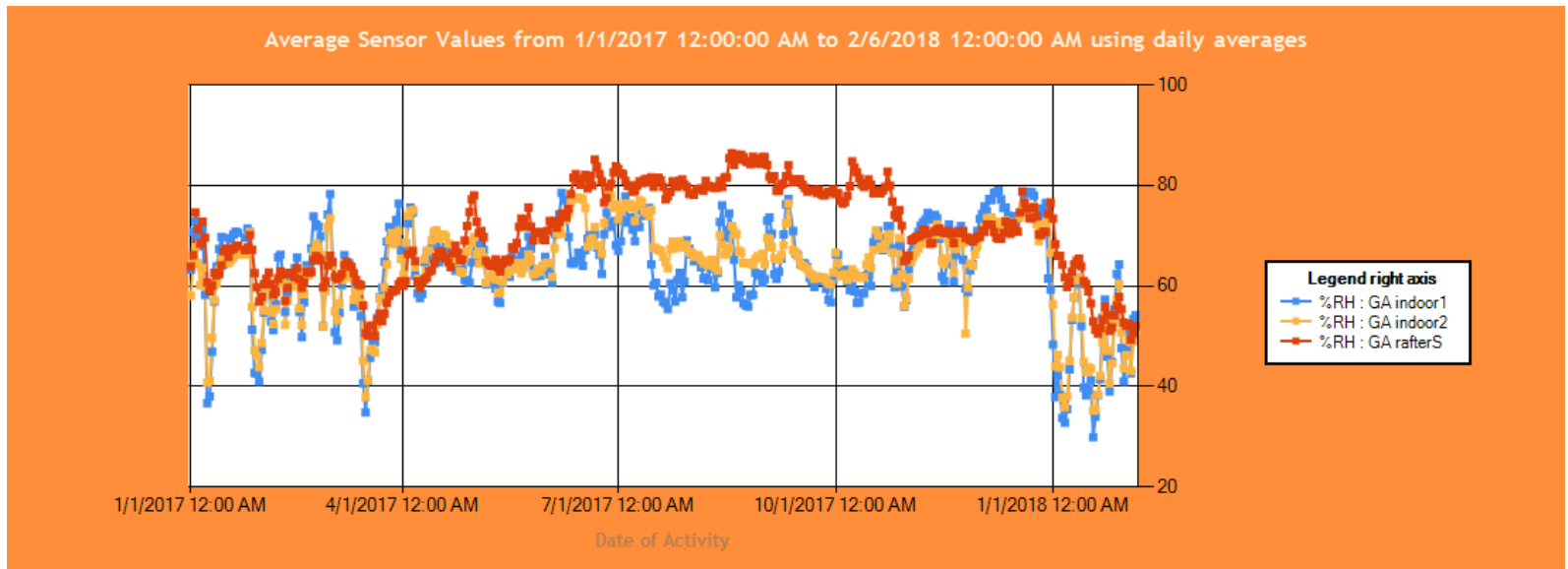
GA Data – RH Conditions



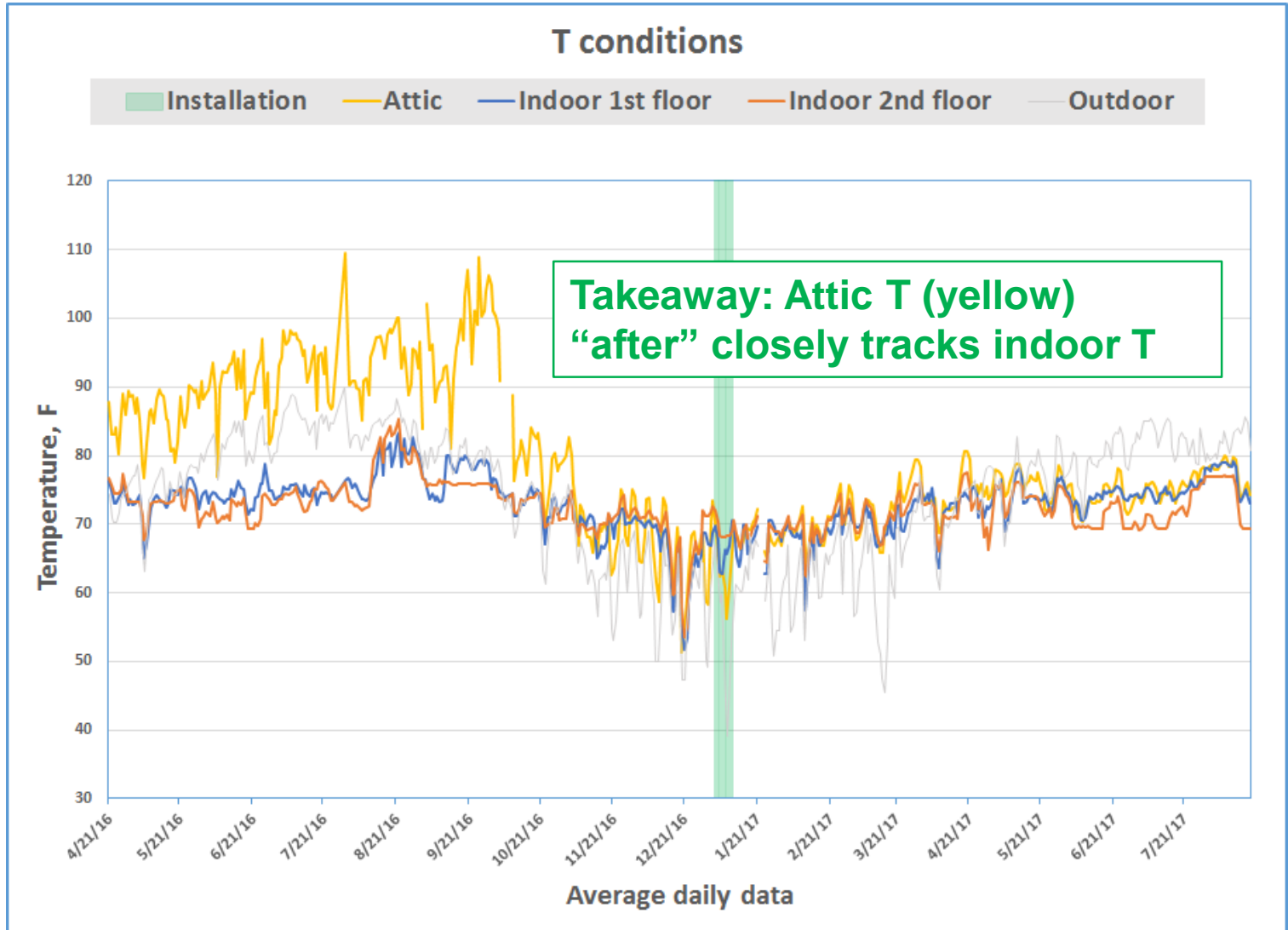
GA Data – RH Conditions

Extended Data: Jan 2017 – Feb 2018

Note: attic RH indicated by red line



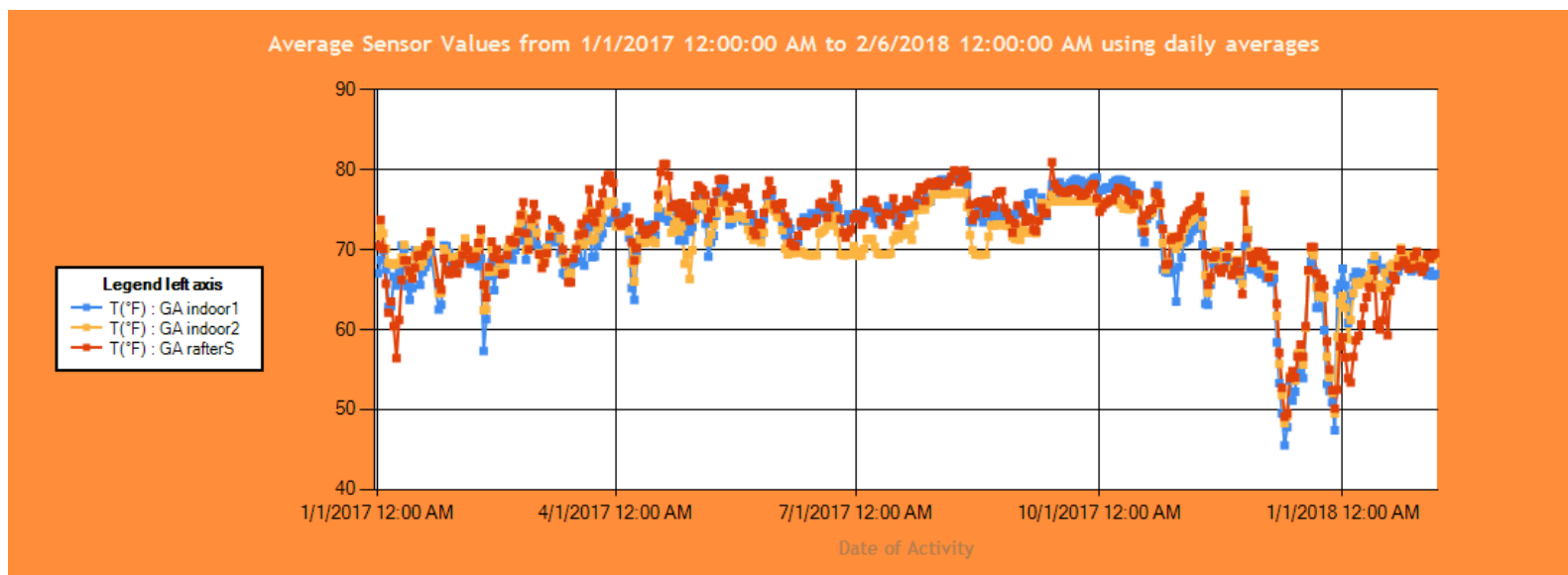
GA Data – T Conditions



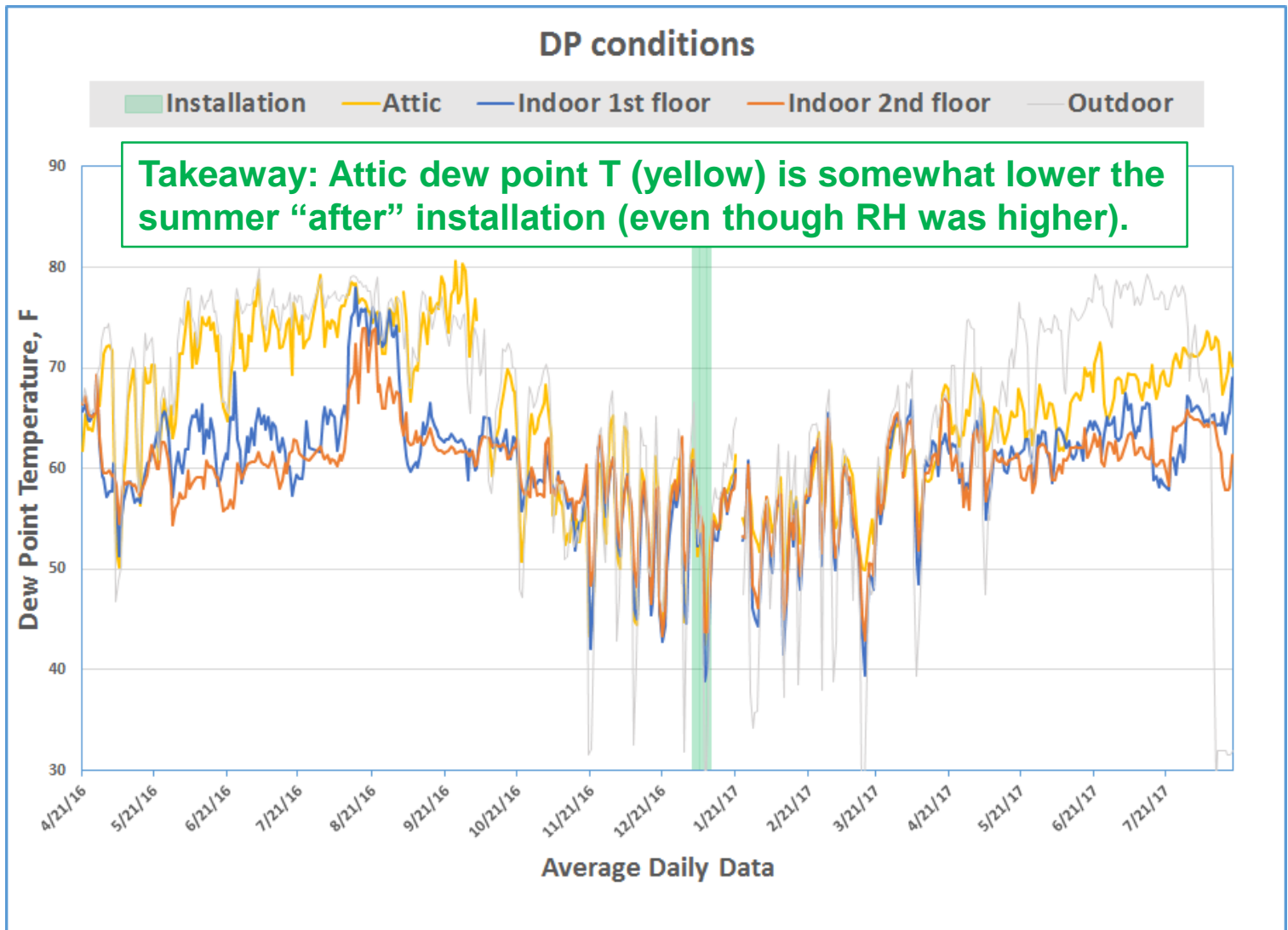
GA Data – T Conditions

Extended Data: Jan 2017 – Feb 2018

Note: attic T indicated by red line



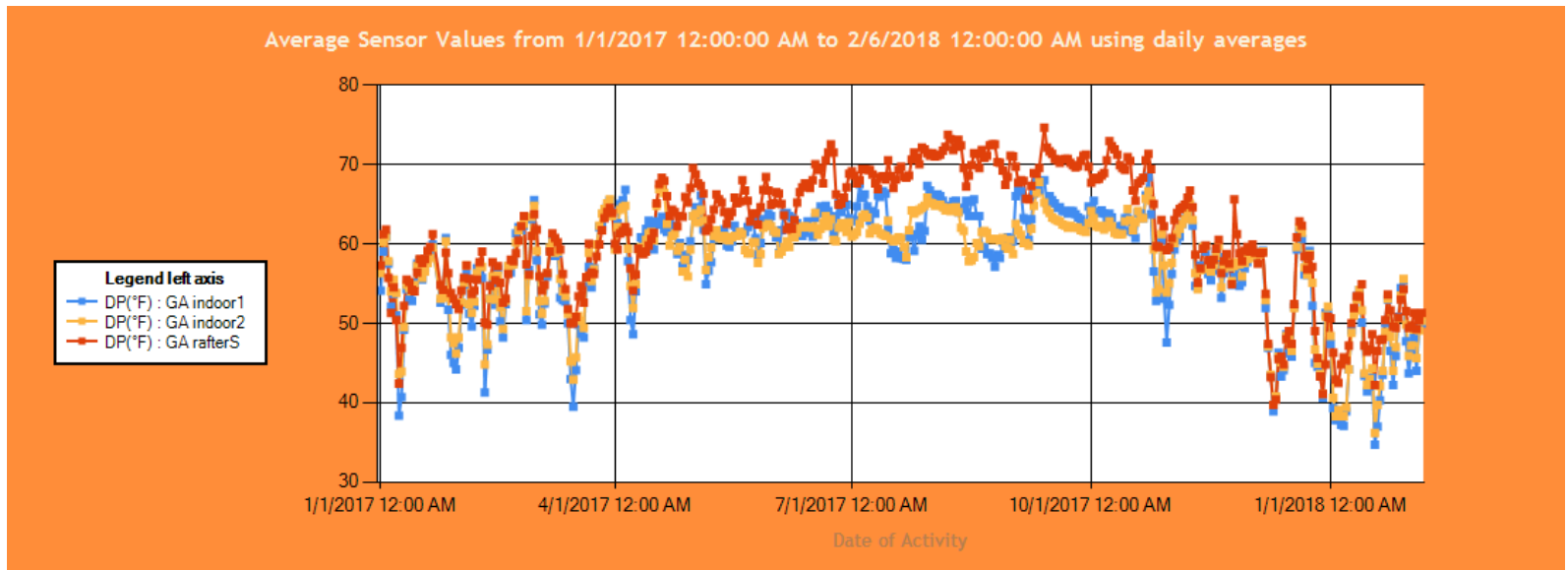
GA Data – DP Conditions



GA Data – DP Conditions

Extended Data: Jan 2017 – Feb 2018

Note: attic DPT indicated by red line

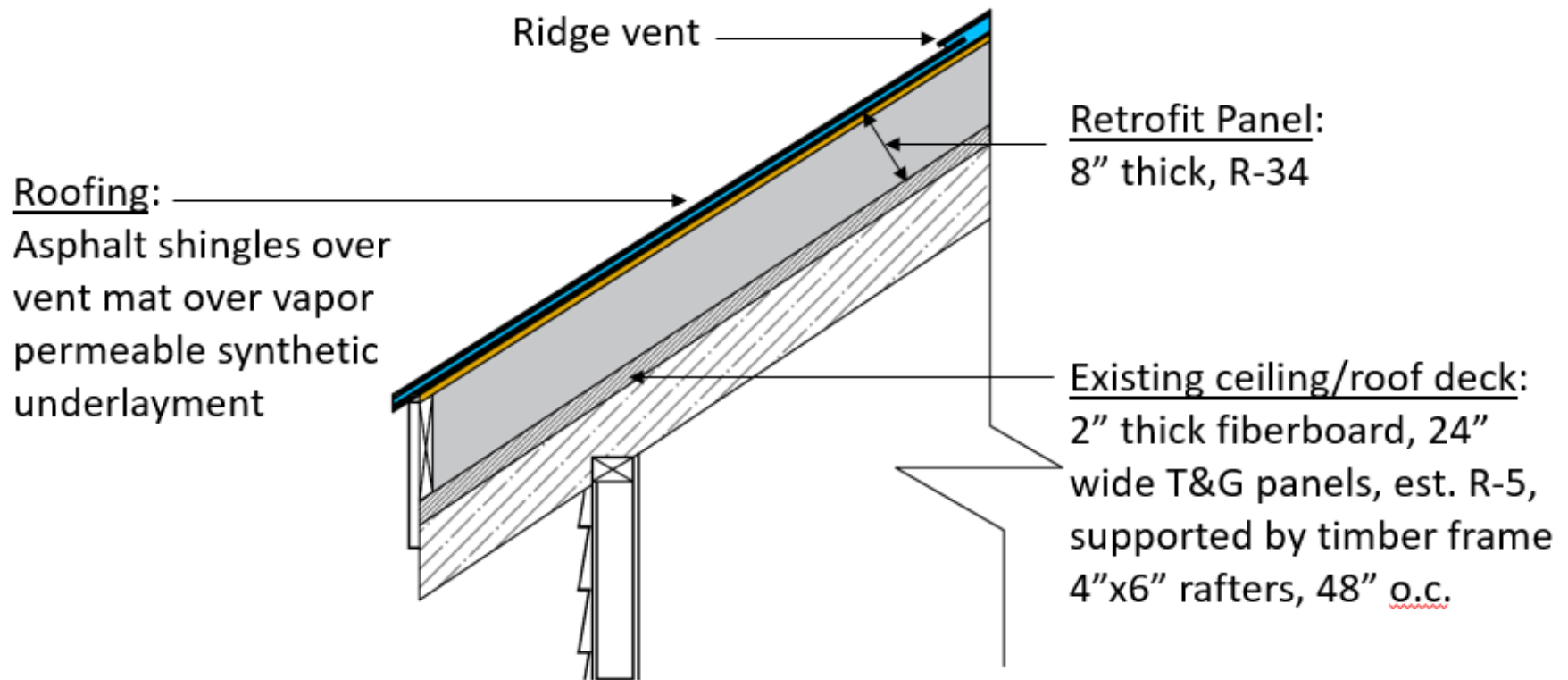


Cold Climate – Ann Arbor, MI



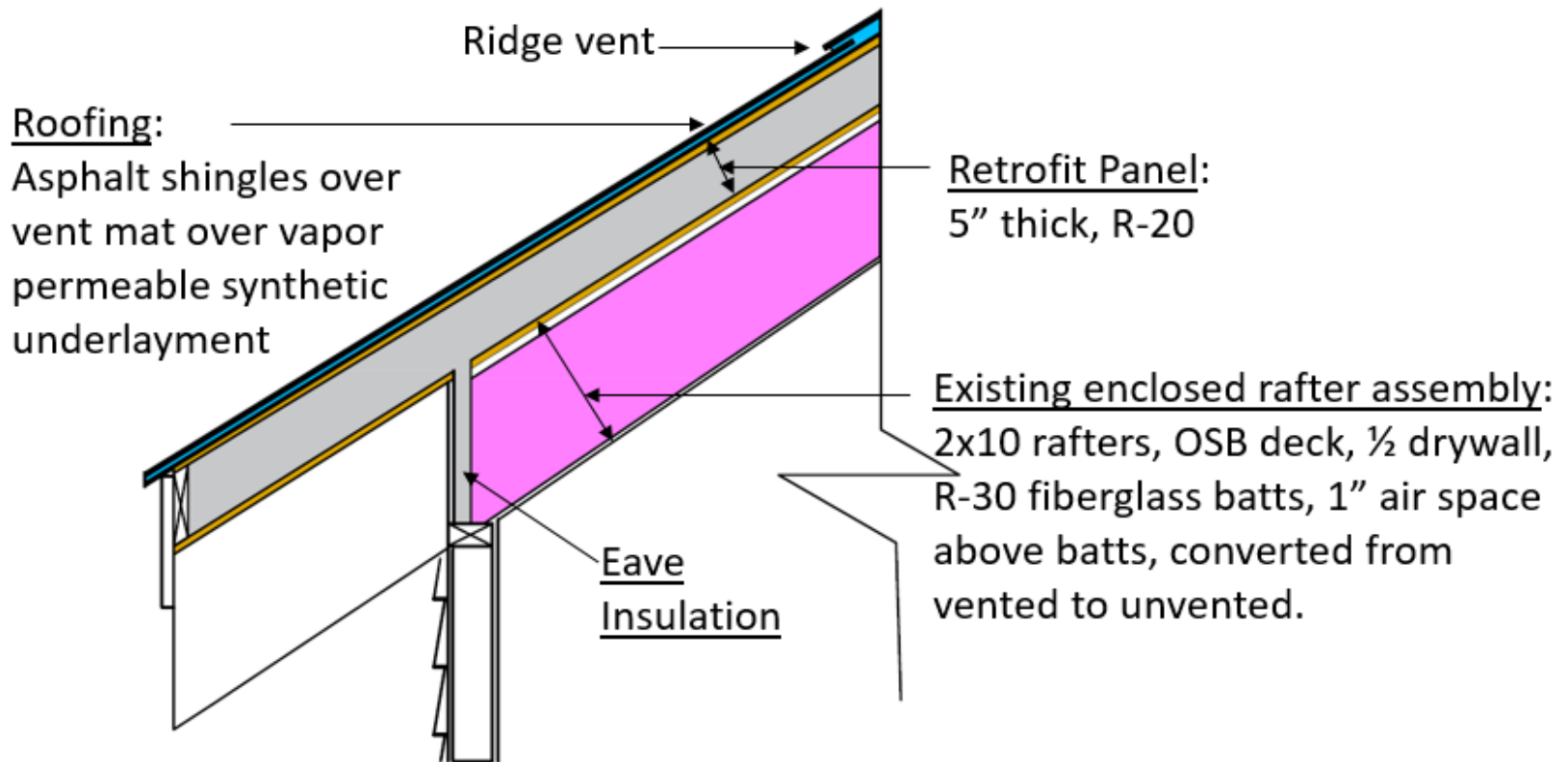
Design Solution – MI

Michigan Main Roof Retrofit Design



Design Solution – MI

Michigan Addition Roof Retrofit Design



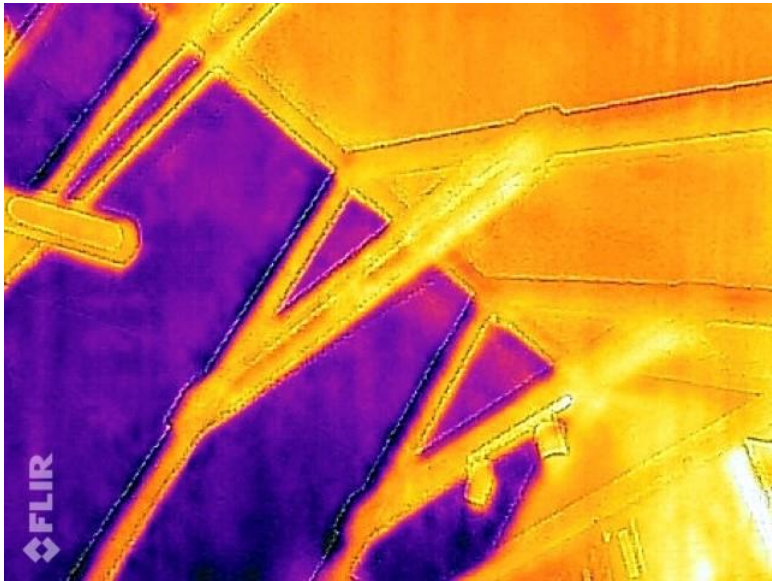
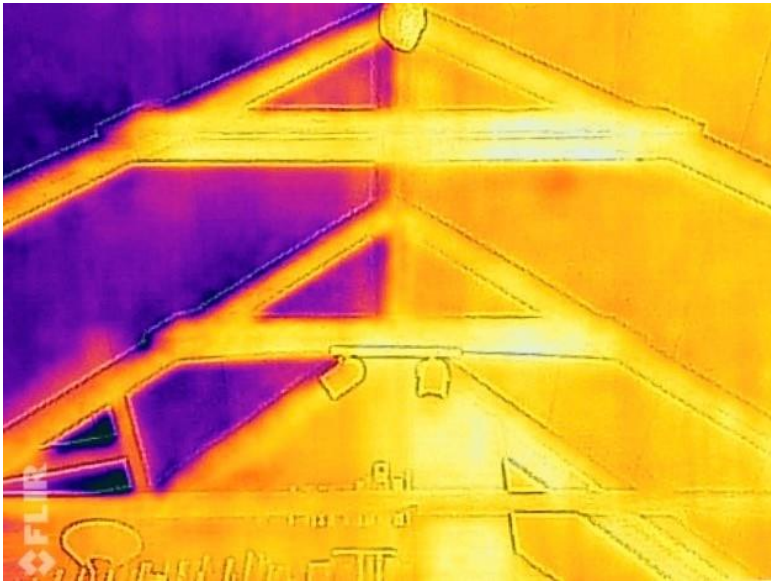
Construction – MI



Construction – MI



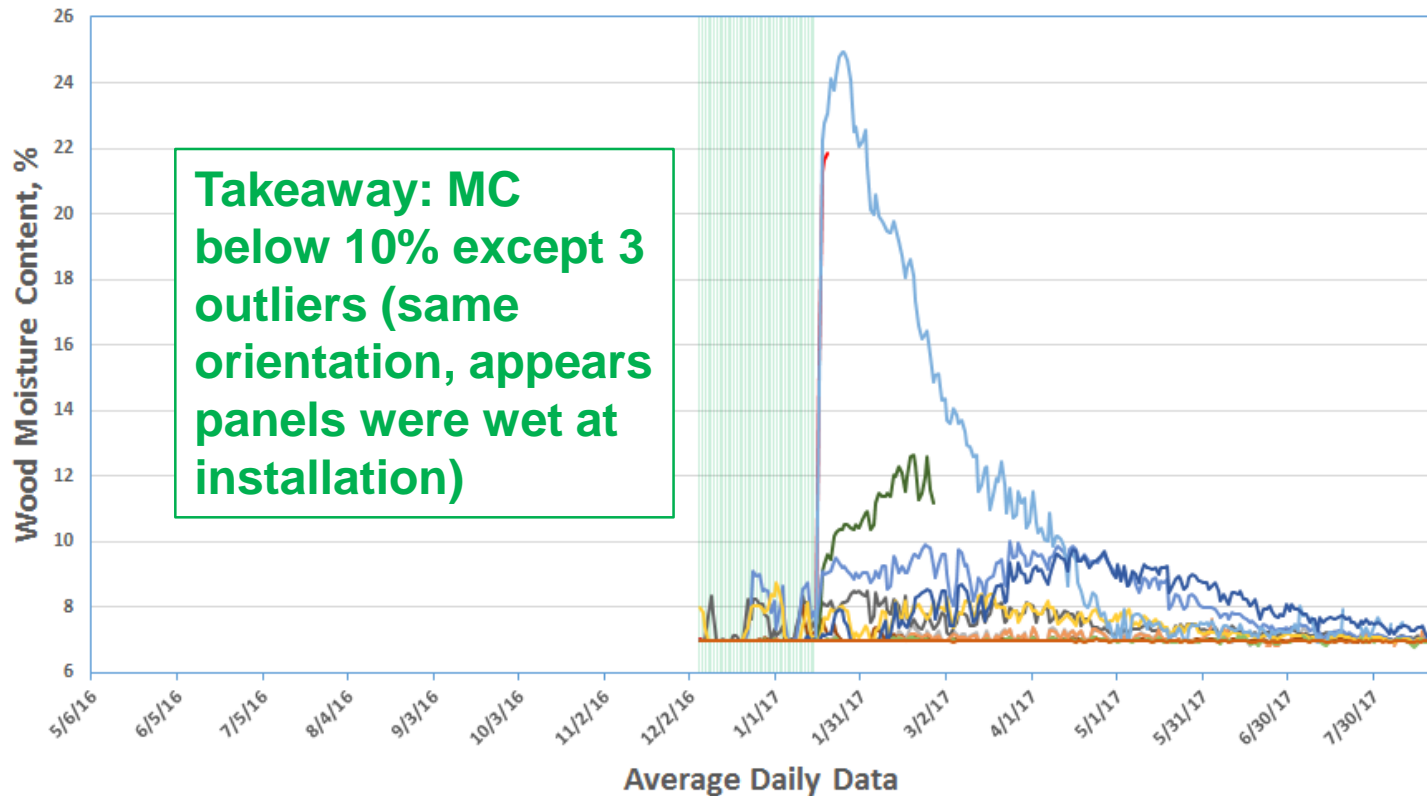
Construction – MI



MI Data – MC at Retrofit Panel

MC at retrofit panels

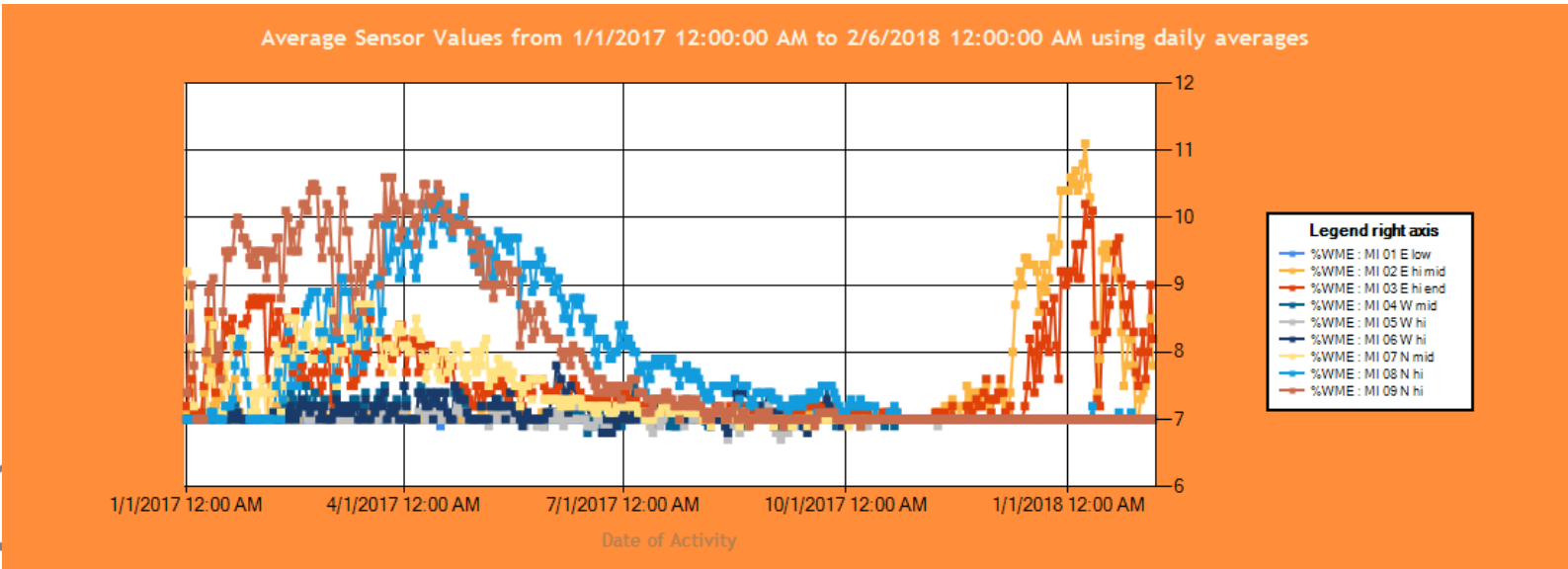
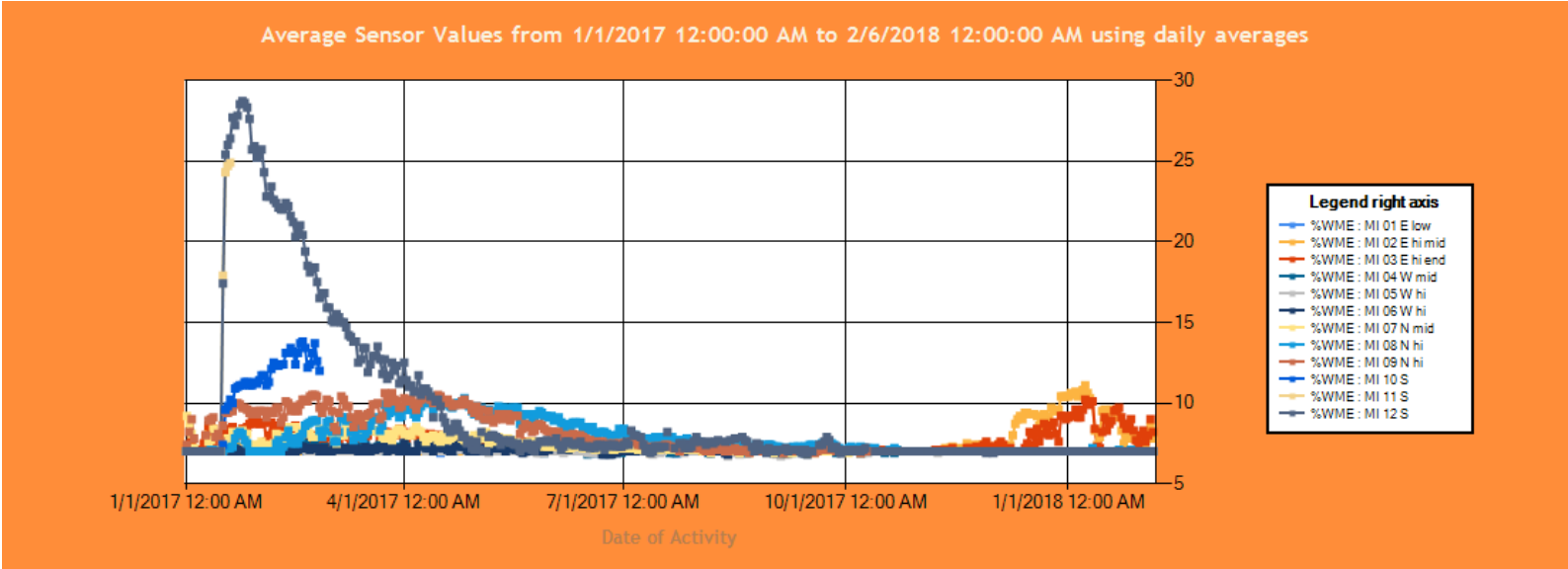
Note: 3 outliers (MI 10/11/12 S), same orientation, appears panels were wet at installation



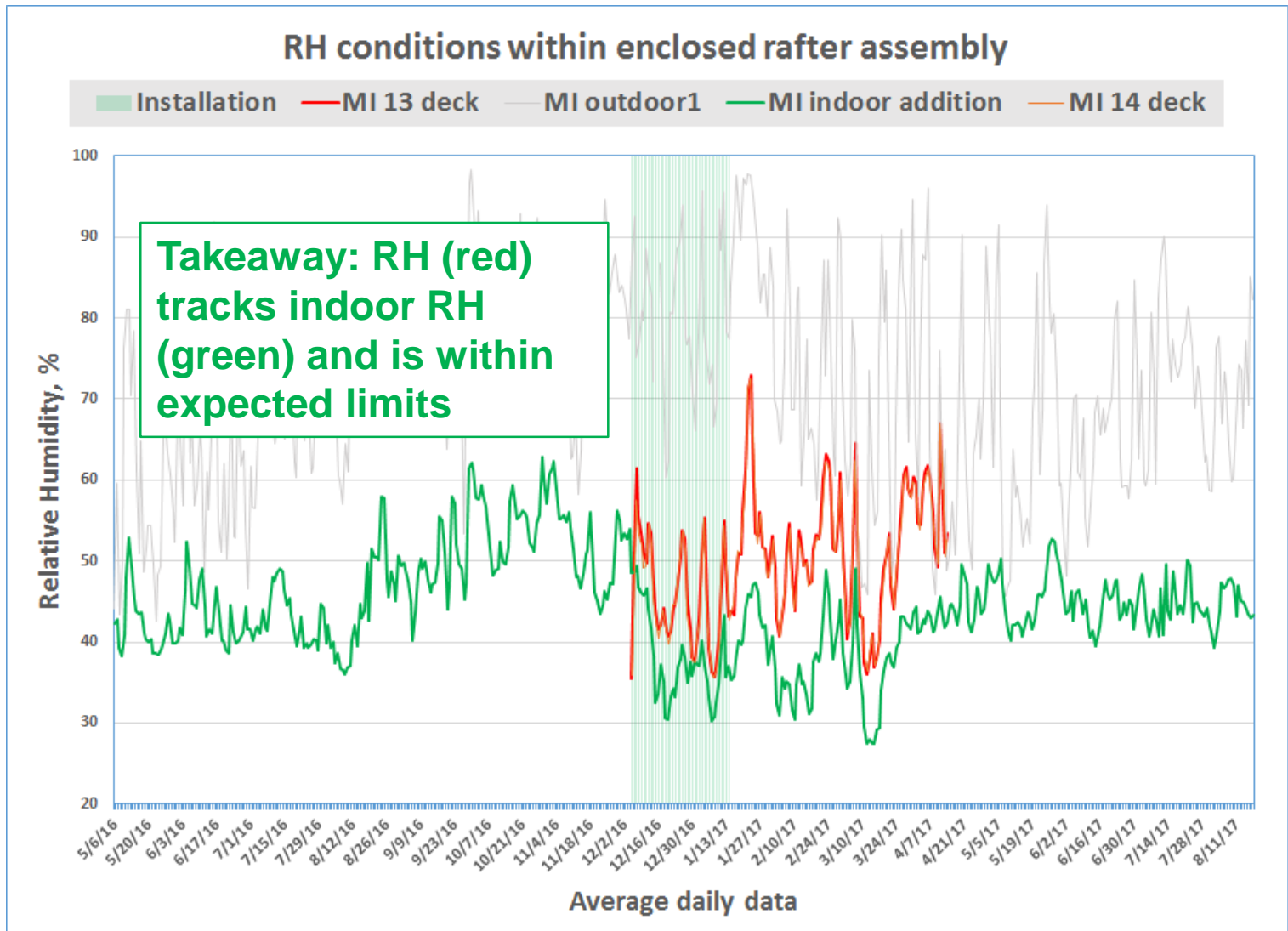
MI Data – MC at Retrofit Panel

Extended Data: Jan 2017 – Feb 2018

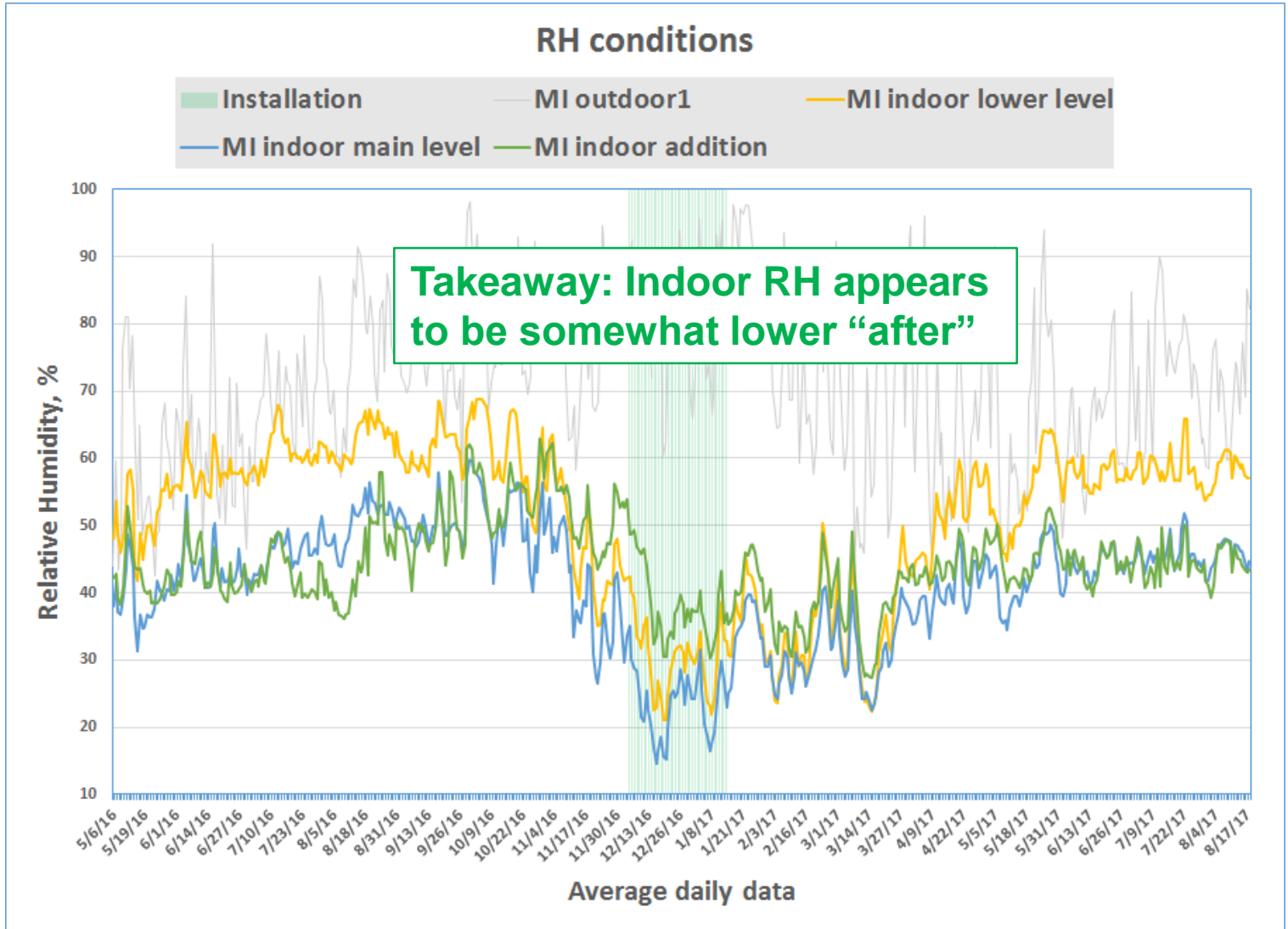
Note: lower graph is without the outliers



MI Data – RH Rafter Assembly

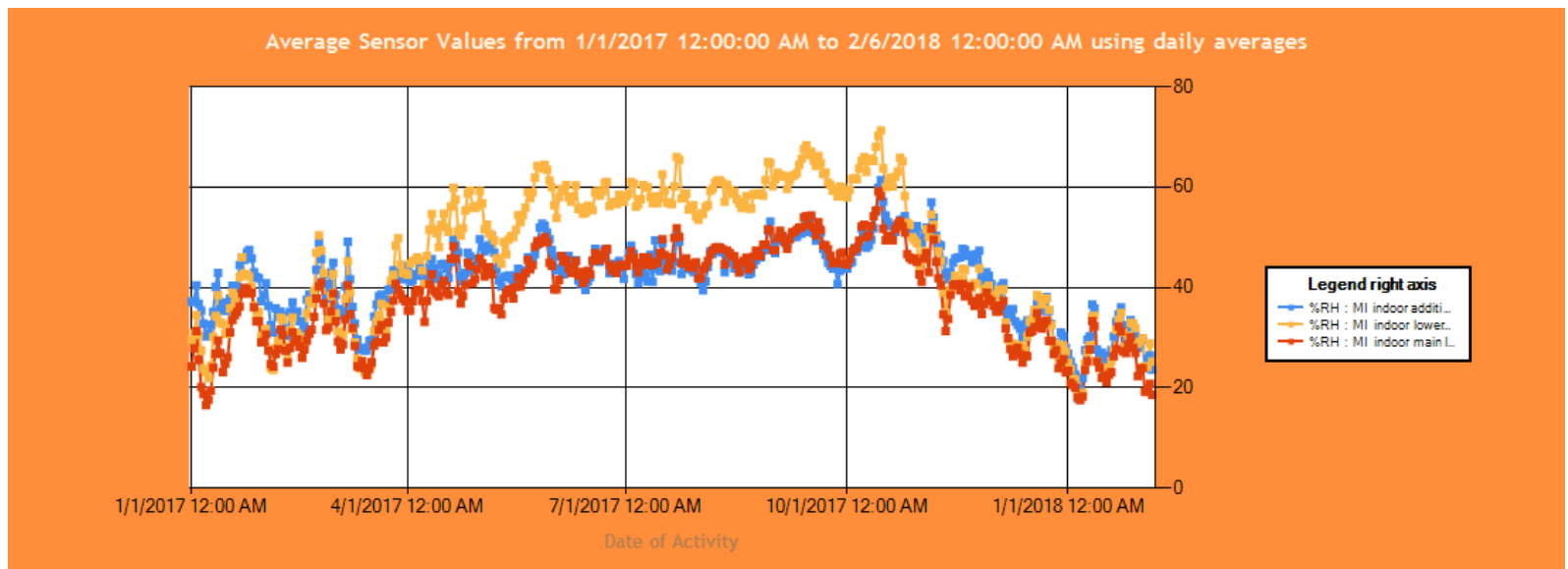


MI Data – RH conditions



MI Data – RH conditions

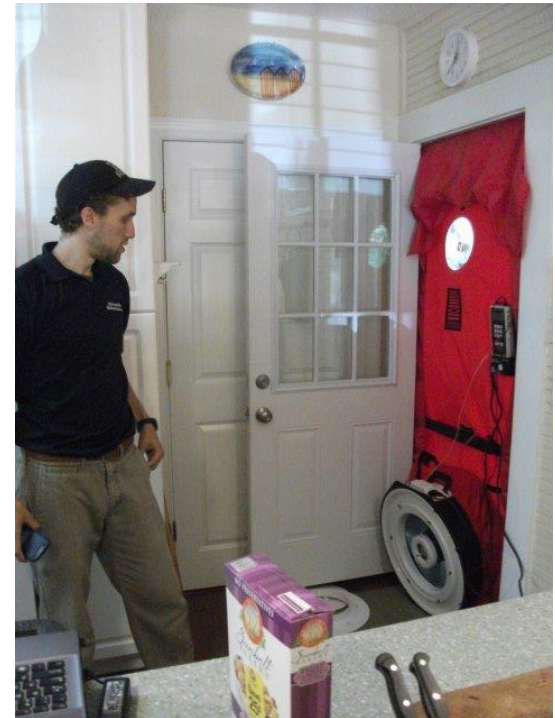
Extended Data: Jan 2017 – Feb 2018



House Tightness Test Results

Blower Door Test Results			
Location	Test-in	Test-out	Improvement
Michigan	9.3 ACH50	6.6 ACH50	29%
Georgia	17.8 ACH50	15.6 ACH50	12%*

*Note: if GA test-in was a more typical 8.9 ACH50 (half) at test-in, the same effort would have provided a 24% improvement.



Energy Modeling

Modeled Heating/Cooling Energy Savings		
Location and Run	Heating	Cooling
MI original est. (7.4 ACH50)	20.8%	13.6%
MI adjusted est. (6.6 ACH50)	22.9%	13.1%
GA original est. (14.0 ACH50)	13.8%	12.8%
GA adjusted est. (15.6 ACH50)	11.3%*	11.0%*

*Note: if GA had all R13 walls and R19 floors, savings would be 21.0% heating, 15.3% cooling, even at measured house leakage.

Estimated Savings Based on Energy Bill Evaluation*		
Location	Heating	Cooling
Michigan	40%	17%
Georgia	16%	16%

*“After” data (3 months heating, 3 months cooling) compared/normalized to same period “before”.

MI Homeowner Feedback Summary

- The house feels warmer during the winter and far less drafty.
- The comfort factor has changed immensely.
- The house seems quieter now, the whole place feels tightened up.
- The furnace definitely ran less this winter and the bills seemed lower.
- The roof is thicker, more prominent fascia, but it all looks great.
- No ice damming whatsoever; we had them every other winter.
- It's a pricey retrofit but it feels like a no-brainer, our house was a particularly bad "before" case, all in all seems totally worth it.
- We're definitely pleased.

GA Homeowner Feedback Summary

- The house definitely feels warmer during the winter.
- The house feels less drafty but marginally so due to the leaky walls.
- It was very noticeable how much less the heating system ran this winter – before, during the coldest parts of the winter, the system rarely shut off and barely maintained a comfortable temperature.
- The utility bills are lower.
- Satisfied with the final appearance and overall very pleased with the results; I hope in the future to upgrade the walls, floors, and HVAC.
- The entire team did a fine job.

Key Findings

- Modeled energy savings were 23% heating, 13% cooling for MI and 11% heating and cooling for GA – an evaluation of the energy bills indicates actual savings may be considerably higher.
- Overall house tightness improved by 29% for MI and 12% for GA (very leaky walls and floors skewed results for GA).
- Monitored data collected for one winter and one summer show moisture conditions at retrofit panels and existing roof decks are well within acceptable limits. It is planned to collect data for one additional winter and summer.
- Average RH within the GA attic was higher during the summer after installation compared to the previous summer. It is planned to install an HVAC supply vent in the GA attic to help control RH.

Key Findings

- Homeowner feedback was very favorable for both sites: comfort was greatly improved; happy with the final appearance; overall pleased with the results; ice damming was eliminated in MI.
- Structural reinforcement of the existing roof assembly was minimal.
- Shingles installed over the ventilation mat looked normal (not wavy); and the ventilation gap appeared to be maintained at full depth (GA).
- Incremental installed cost ranged \$8-\$9/SF roof area. In addition to energy savings, the value of the demonstrated solutions includes significant improvement in comfort and durability of the roof assembly.

Thank You!

