

Healthy Homes of Louisiana, llc
Robert (Bobby) Parks, mm

Relative humidity and spray foam insulation in the south

Although the use of foam insulation is hardly a new technology, it is relatively new to many areas of the southern United States. It brings with it numerous new learning curves for many of the trades involved with both residential and commercial construction.

One of the most difficult hurdles to get over is the change in our traditional way of thinking. Typically, we are more concerned with the heat and humidity outside getting in our buildings and with foam insulation and tighter construction, we now have to be even more concerned with the moisture we create inside the building and how do we get it out!

Recently there has been a lot of discussion about controlling the humidity in the attic space of these foam insulated homes. Some feel that this *"indirectly conditioned space"* should be converted to *"directly conditioned space"* by adding both conditioned supply air and return air at a rate of 50cfm per 1000sq ft of attic space. While others seem to believe we need more *"communication"* between the two spaces.

Others, like myself believe that this is unnecessary and potentially problematic. It is my belief that as long as we properly control the humidity in the living space, then the attic should not be a concern.

Of course, there are still many questions to be answered which is why in May of 2016 I started monitoring both the living space and attic space of three foam insulated homes in north Louisiana.

As I have said many times, *"if you're not testing, you're guessing"* so... all three homes were tested for building tightness, duct leakage, ac and heat sizing, commissioning of fresh air ventilation, exhaust ventilation and balance of conditioned air flow throughout the home.

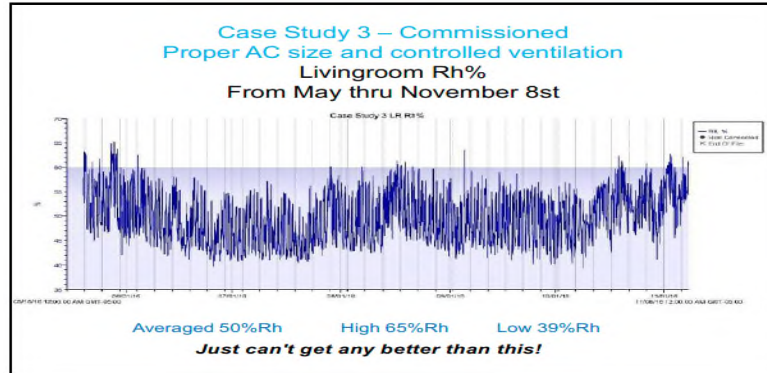
The homes have reached the end of the first year of monitoring and much has been observed. We have received permission to continue monitoring all three homes for another year and additional monitors have been added. As of March 2017, we are now monitoring the wood moisture equivalent (WME) of the roof decking at two heights in the attic. One monitor is located approximately 4ft from the ceiling level and the other, one foot from the roof peak on the north facing roof. A fourth home was added to the study which has conventional insulation (R30 ceiling) and a ventilated attic which will be used to establish a baseline for comparison. In this attic the monitors were mounted one on the North and one on the South facing roofs.



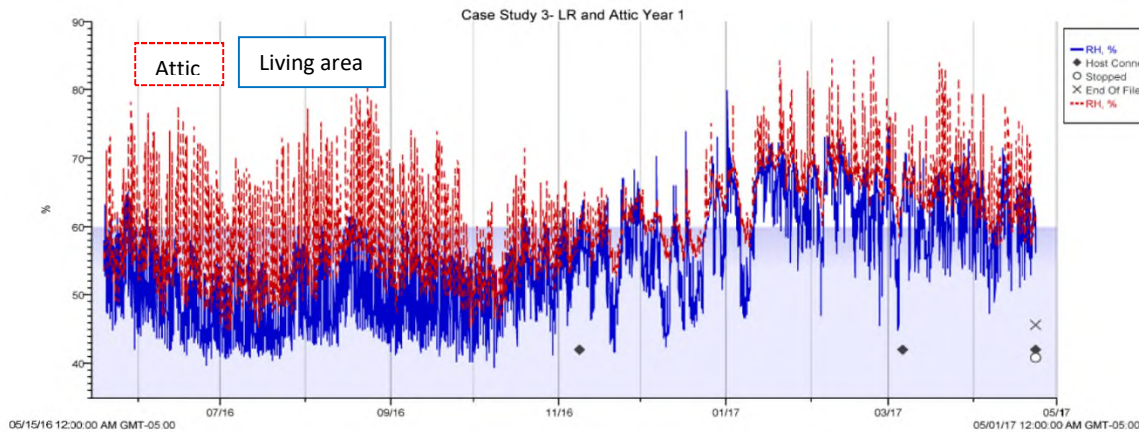
Figure 1 and 2 A portion of the foam was removed, the monitor was attached to the bottom of the roof decking, covered with plastic and the spray foam was reapplied to



I will use selected excerpts of the data retrieved to highlight a little of what I believe has been observed so far. It must first be said that education never ends. I believe science to be the process that humbles the “know it all”. Although some may conduct experiments to prove who’s right or wrong, this study was initiated to hopefully retrieve some consistent and reliable data that can be studied and hopefully learned from.

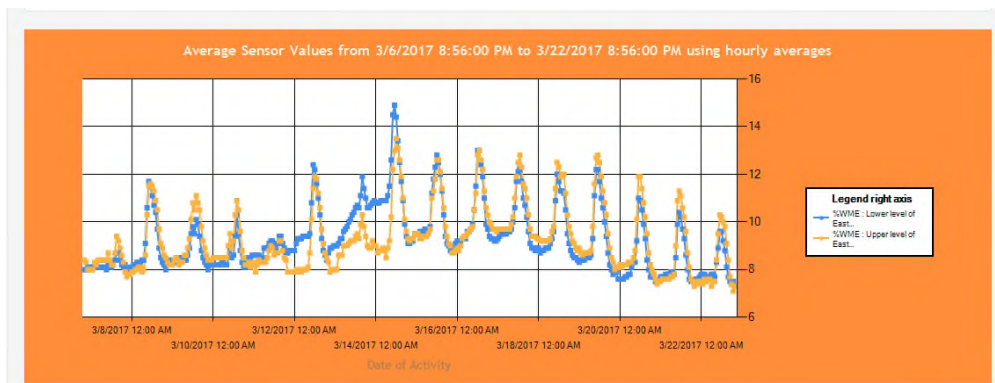


Of the three homes, Case Study 3 was fully commissioned and from the beginning it was expected to be the best performing home. This was found to be true after the first down load of data which covered from May 2016 to November 2017 however...



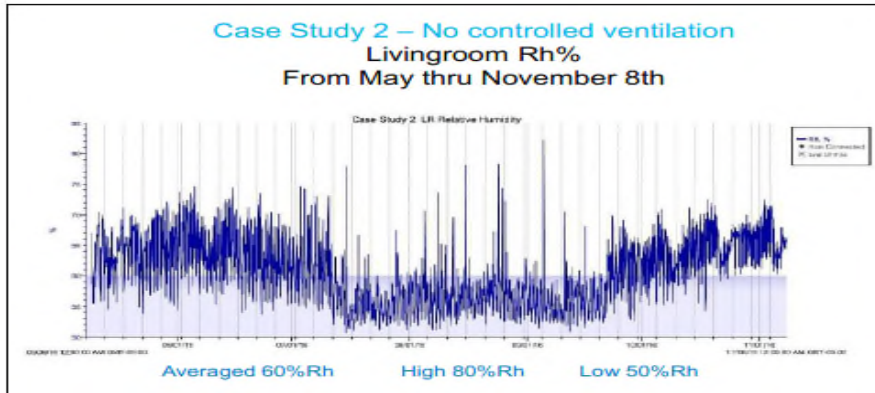
With the attic incorporated into the graph, as you would expect, the indirectly conditioned space (a.k.a. attic average 56%Rh) is slight warmer and more humid than the conditioned space (a.k.a. living area averaged 52%Rh)

.... When we entered into the winter months and we became almost totally reliant upon the ventilation systems to provide dehumidification, because the air conditioning system was no longer needed, the relative humidity became much more erratic. The average RH% was still approximately 56% during these months but there were sustained periods greater than 60%. Understanding the normal relative WME to be 12%-15%, the erratic RH% did not seem to have any significant effect on the roof decking.

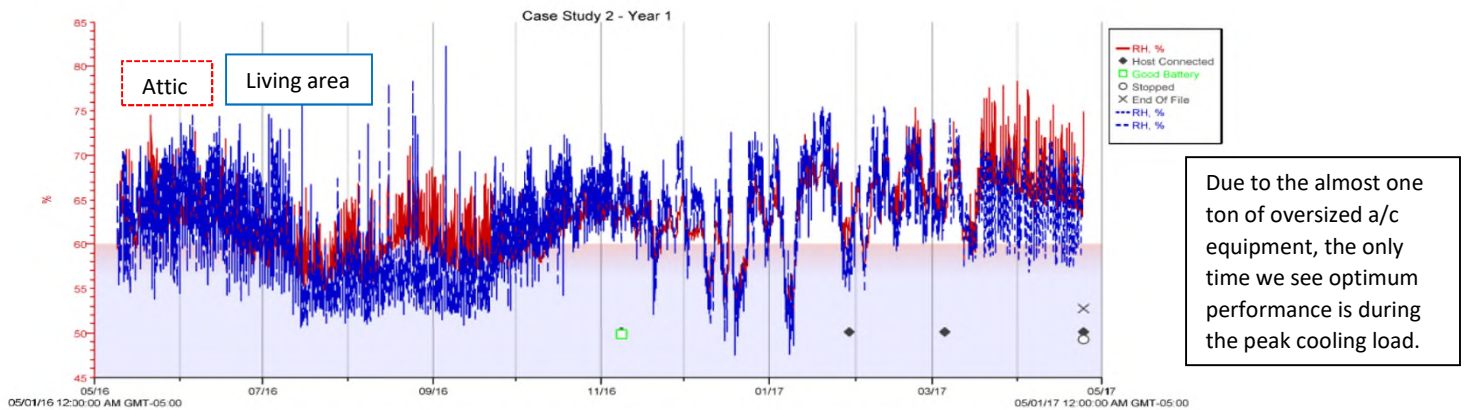


Highest level of WME detected during was during the cold weather not the cooling season. See final attic chart

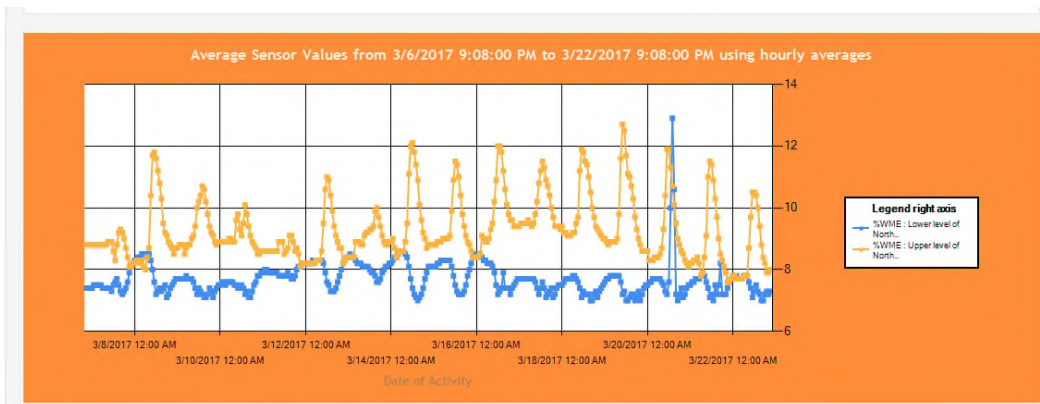
Case Study 2 also showed some interesting highlights which align with traditional thinking.



The “shoulder seasons” seemed to show themselves more definitively in this home. During the heat of the summer months, the humidity was kept in check however during the cooler weather patterns of the shoulder seasons, when the ac system wasn’t operating enough, the Rh% increased higher than desired. Like Case Study 3, we saw the Rh% become erratic during the cooler winter months.

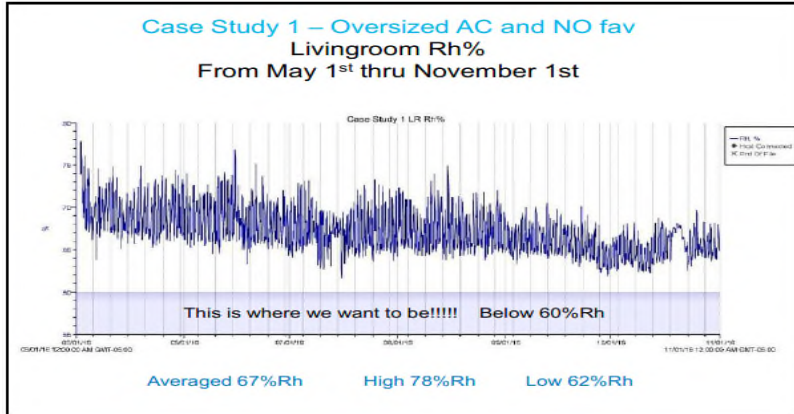


However, consistent with Case Study 3 it seemed to have no significant effect on the WME of the roof decking. The stratification between the upper and lower monitors was much more defined in Case Study 2 most likely due to the greater roof pitch.



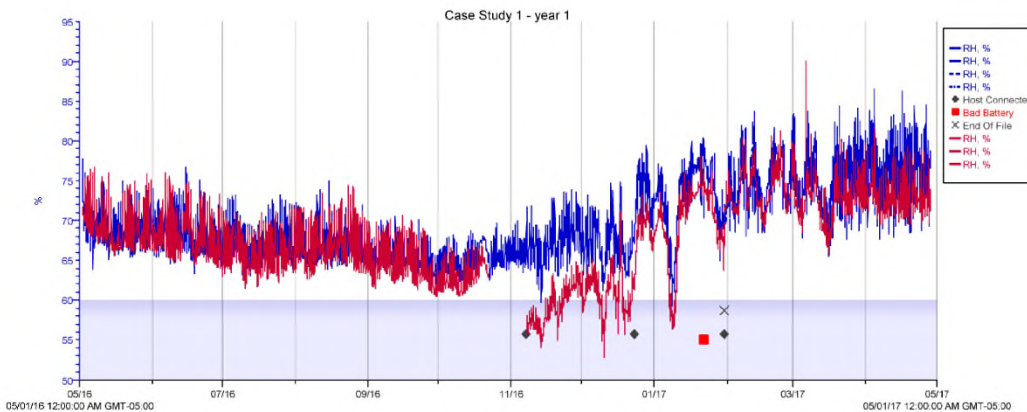
Again, the highest level of WME detected during the cold weather not the cooling season. See final attic chart

And then there is Case Study 1. This home exhibited the highest consistent Rh% in both the living space and attic. The numerous issues with this home (including the a/c equipment being greater than 1.5-tons oversized) resulted in consistent high RH%, as was expected and as a result, a slight increase in the WME was detected in the roof decking as well.



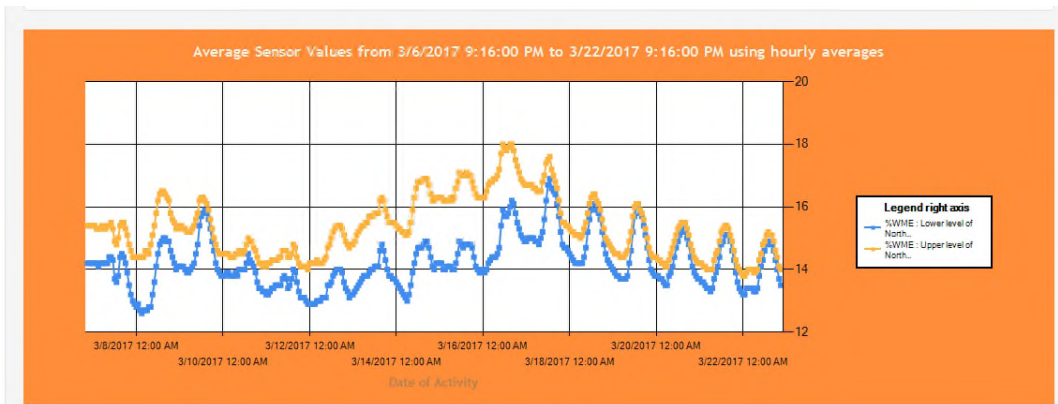
The good news is that for year number 2, we have replaced the 4-ton a/c with a 3-ton (still slightly oversized but due to specific considerations, this was as small as we were allowed to go), we sealed the leaky ducts (this 1800 sq. ft. home was re-tested to have >230 cfm of duct leakage) and verified all ventilation controls. The results have been spectacular

and will be published in a follow-up and more detailed report shortly.



One consistent trait showed by all three homes, there is obviously significant communication between the two spaces. When the Rh% is out of control (and which is derived

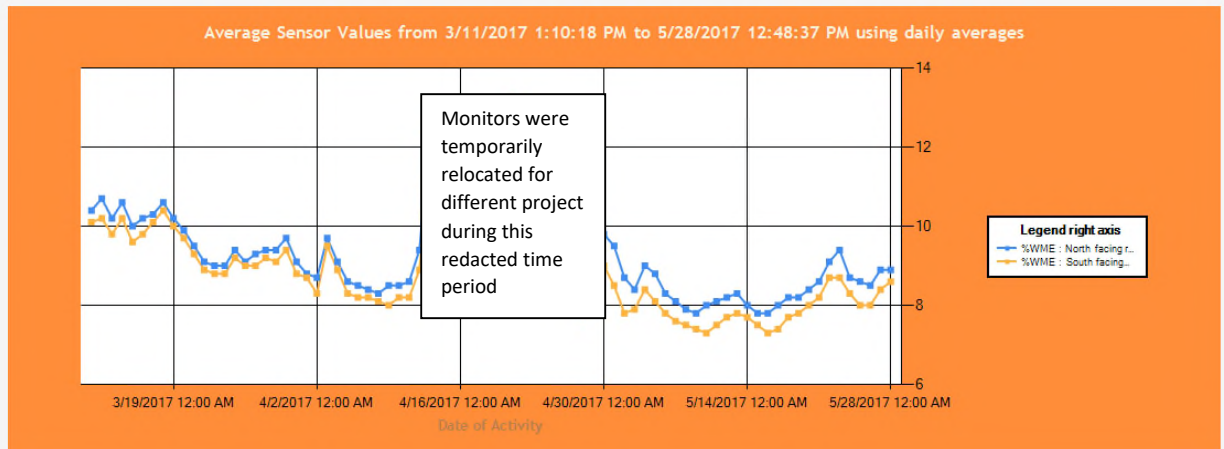
from the home's interior with such things as cooking, bathing and even the people themselves) then the living space and attic equalize and the diffusion through the open cell foam of the roof decking allows for an increase in the WME of the roof decking.



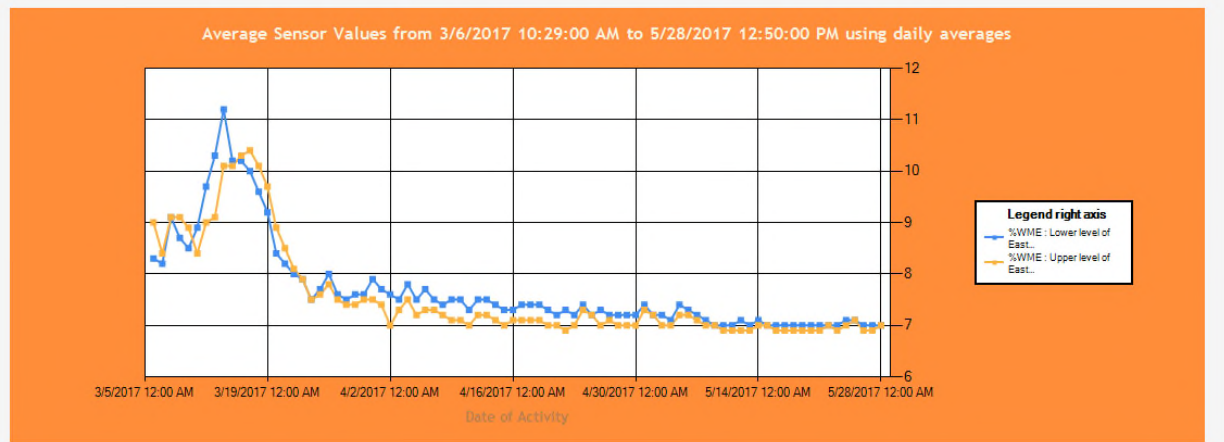
Case study 1 exhibited the highest WME as would be consistent with the higher humidity present in the home.

Roof decking WME comparison from 03.2017 through 05.2017

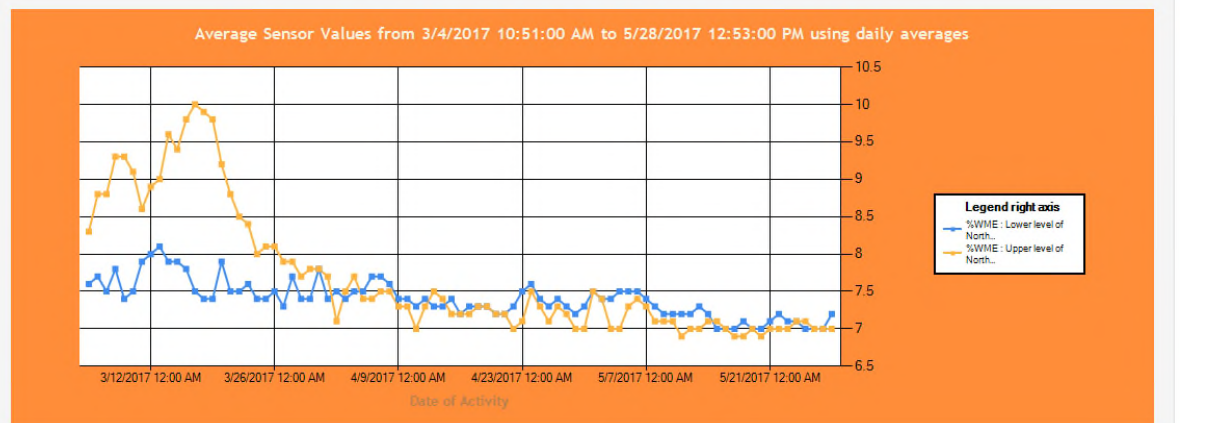
Conventionally Insulated/ventilated attic



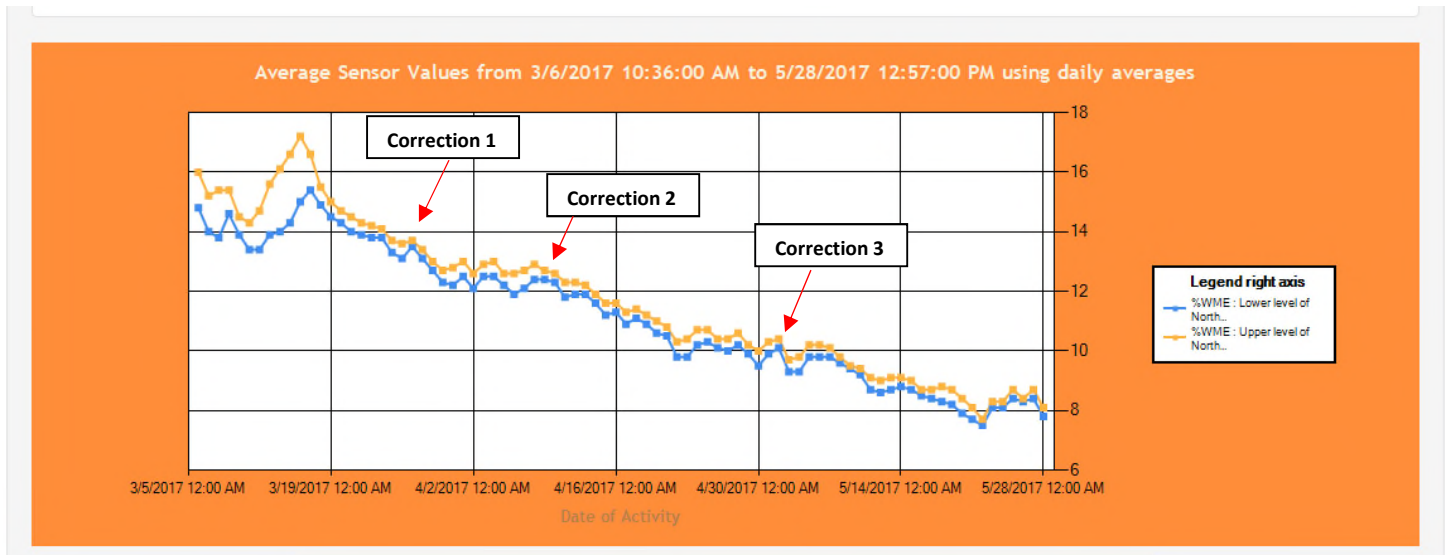
Case Study 3 – Best performing with a/c less than 1/2 of load calculations



Case Study 2 – A/c unit slightly less than 1-ton oversized based on load calculation.



Case study 1 - A/c unit greater than 1.5-ton oversized based on load calculation.



Correction 1 – Shoulder season began (more significant a/c runtime, aligns with other 2 foam homes)

Correction 2 – duct leakage was corrected from >230cfm to <50cfm and air flow was balanced

Correction 3 – 4-ton unit replaced with 3-ton

Conclusions

If we do it right, it works! If we always do what we've always done, we are screwed! The better we construct and insulate buildings, the smaller the margin for error. There is definitely value in designing, sizing, installing and verifying properly.

I have long since been opposed to the use of additional dehumidification systems. It has traditionally been my opinion that if the Heating, Ventilation and Air Conditioning (HVAC) systems are properly sized and installed, then additional dehumidification shouldn't be needed.

After watching these homes, over what could be considered a mild winter for Louisiana, I am beginning to believe that there may actually be a good argument for "additional seasonal dehumidification". I believe the data for year one (an extremely humid year for north Louisiana) has shown that the need for properly sized and designed HVAC system becomes increasingly important with the construction of tighter and better insulated homes.

It also indicates that higher humidity within the home and attic space can have a negative effect on the moisture content of the roof decking when open cell foam is used. Although it is still not known as to what level and for how long the elevated RH% would have to exist before it becomes problematic for the roof decking.

I remain opposed to the addition of conditioned air and return air to the indirectly conditioned space (meaning the attic of course). However, all three homes did show that they could have benefited from some additional dehumidification during the winter months. I am looking forward to year two of the monitoring and establishing some consistency to the data while hopefully bring Case Studies 1 and 2 in line with the performance of Case Study 3.

More to come....

- NOTE

This data and my view of it, is being shared as a courtesy. This study is of my own doing and has not been commissioned by any other entity, so there is no hidden agenda! Believe me, I wish it was as it has been an expensive journey already, with at least another year to go. But it has been well worth it so far. Interpret all data and comments as you see fit, as they are what they are and nothing more.

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05.28.2017