July 2010 Newsletter from Building Diagnostics

Welcome to the August newsletter. In this issue we continue with useful math and discover that infrared imaging is not magic. Plus some suggested reading for the time between my newsletters.

To follow up on a note from last month; the folks at Fannie and Freddie are being quite adamant in their resistance to PACE. I know that there are several congress people who have said they will introduce legislation to clear the situation, but I don't believe that anything has actually been filed yet. A polite but firm note to your congress person and senators on this topic would be helpful.

And, of course, the most pressing topic, the lawyer joke was missing. The intended joke was part of a topic that I pulled at the last minute because of length and relevance. And wouldn't you know it, the entire editing and continuity staff was off on their annual sabbatical.

So here are two old standards for you. And of course the politically correct disclaimer, I do not publish any lawyer jokes that I haven't heard from at least two lawyers.

#1 Q: What do you have when you have a bunch of lawyers buried up to their necks in sand?

A: Not enough sand.

#2, My favorite, a lawyer questioning a medical examiner:

Q: Doctor, before you performed the autopsy, did you check for a pulse?

A: No.

Q: Did you check for blood pressure?

A: No.

Q: Did you check for breathing?

A: No.

Q: So, then it is possible that the patient was alive when you began the autopsy?

A: No.

Q: How can you be so sure, Doctor?

A: Because his brain was sitting on my desk in a jar.

Q: But could the patient have still been alive, nevertheless?

A: Yes, it is possible that he could have been alive and practicing law.

This Month’s Topics: #1: Last month's math, and more.

I had some requests for the formula I used to determine the energy use across the attic ceiling in last month's newsletter. I was also taken to task for only calculating the difference in transmission rate not the actual transmission.

To address the last part first. The total transmission rate doesn't matter. The task was to determine the savings from the application of the fan. No matter whether you compute the heat transfer at say 120F and at 90F and subtract one from the other or if you just compute a 30F transfer the result is the same. I used a shortcut, but through the wonders of arithmetic it works. If you read the next few paragraphs you will be able to check it out for yourself.

We know that heat transfer is driven by temperature **difference**. The difference is like the pressure in a water hose. Unlike water, heat will move through solid materials so that analogy has it's limits. But, like the hose, the bigger the opening the greater the volume of water at the same pressure. But heat isn't measured in gallons, it's measured in **Btu's**.

All materials conduct heat, but at different rates. (If you find a material that does not conduct heat at all please call me. We'll be rich.) The rate of conduction for a given material is it's **U** factor. It is expressed in Btu per hour per square foot of material per degree Fahrenheit temperature difference. Aren't you glad you asked.

A square foot of concrete which is 10” thick conducts one Btu in one hour at a one degree F temperature difference so it has a U factor of 1.0. A square foot of blue or pink foam insulation board one inch thick conducts $1/5^{th}$ of a Btu in one hour at a one degree F temperature difference, it has a U factor of 0.20. Yes I assumed an fraction conversion, $1/5^{th}$ and 0.20 are the same thing.

Since you're a clever bunch you have figured out that if the temperature difference were 5 degrees F that concrete would conduct 5 Btu's, but it is still a 1.0 U factor.

That was a long and boring trip get to: $q(Btuh) = U \times A \times \Delta T$.

Now it gets less exciting. q is the energy in Btu per hour, U we covered above, A is area and ΔT is the temperature difference on either side of the surface.

OK geeks, the amateurs are now all asleep, so lets complete the exercise. Lets take a 3 x 5 foot energy star window, U = 0.33 and then look at a 3 x 5 section of well insulated wall. It is 70F inside and 20F outside (slightly wishful thinking after this summers heat).

0.33 x 15 x 50 =247.5 Btu per hour passing through the window. Is that a lot? Let's take a look at the wall.

I didn't specify a wall U value did I? Let's call it an R19 wall. Where the heck did R come from? We're using U values! The whole thing is messed up now, drat.

R is the **reciprocal** of U. to get from R to U divide 1 by either to get the other. 1/R = U, or 1/U = R. The usefulness and origin of R values is a story for another day, but they are directly related to one another.

We will assume a whole wall R value of 19, because I haven't told you about calculating U values for walls with a variety of materials. Like the real walls we have in the world. Today we will use a fantasy wall which is R19.

0.0526316 x 15 x 50 = 39.47368. You got it, I divided 1 by 19 and got 0.0526316, which I'm sure could have been safely rounded off to 0.052632. But the point is that wall area conducts only 39.5 Btuh against the window at 247.5. Thats more that six times as much through the window,and that is considered a good window by current standards.

So there is a real world way to use this stuff. You can compare different wall designs, different windows and balance the two. And all you really need is a spreadsheet.

Now if you want to get deeply interactive a full fledged energy modeling program helps. But sometimes all you really need to do is look at the difference.

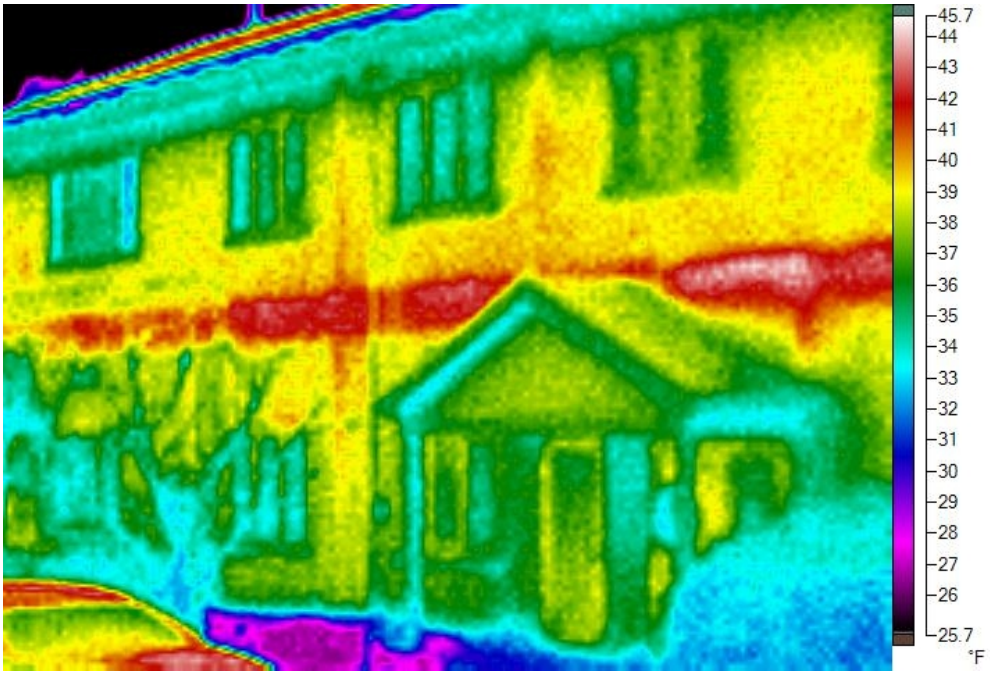
I know this isn't necessarily exciting but I do think it is important. Not that everyone needs to do detailed calculations on everything in the house, but understanding the concepts matter.

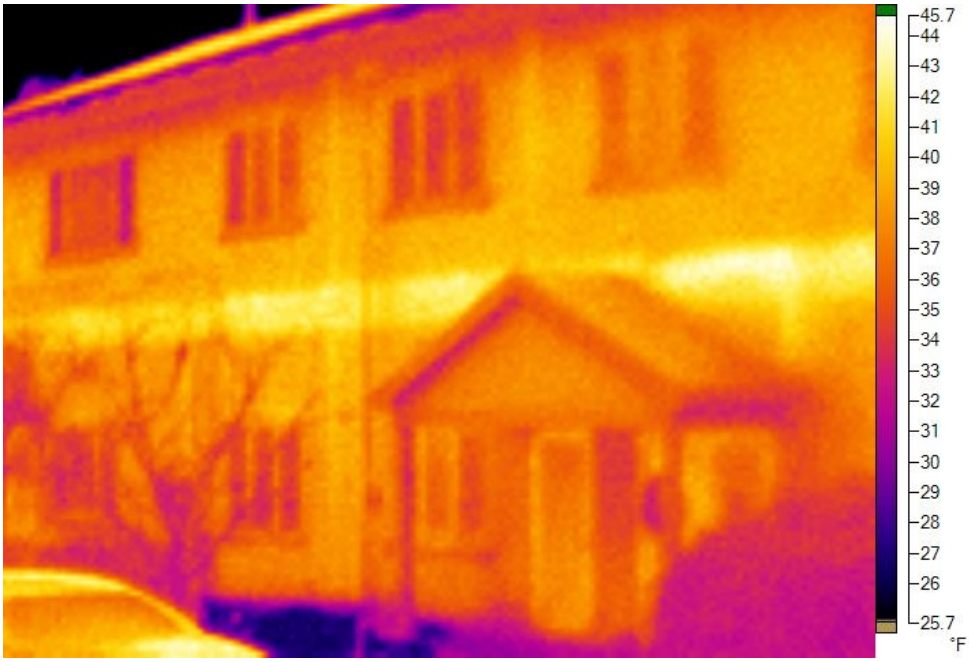
I know I complained about science illiteracy last month but too often people just don't do critical thinking. That's why certain replacement window companies will still tell people spending $1,500.00 a year on heating fuel that the $20,000.00 replacement windows will save enough to pay for themselves in 5 – 6 years. Hmm, maybe I could get those window folks to do some investing for me.

I hope I didn't overdo the geek speak. I promise to include something a little more readable next month. But there is a bit of an ulterior motive to this. I frequently find that I have to convey this type of information to people, and I'm trying to develop a combination of handout sheets/illustrations to cover some of the really basic math and science.

My goal is to create something that covers a topic but doesn't cause too much eye glazing (or comas). Would the section above been better with illustrations? Did you require medical attention to restart your breathing? I'm looking for ideas. Whatever I come up with will be freely available to anyone who finds it useful.

Topic #2: Infrared interpretation





Infrared imaging has made huge inroads in the auditing business over the past 2 – 3 years. The availability of lower cost imagers and increased ease of use are two of the most important reasons, but I think equally important is peer pressure. If "everyone" has IR capabilities then everyone feels the need to compete. IR can bring a tremendous amount of information to customers about their homes in a way that thousands of words couldn't match. But like words, images are subject to interpretation.

Take a look at the two images above. It's the same building, but what is different? Is one

showing considerably more heat loss than the other? Which one? How much time passed between the two images, and how can you tell?

OK, some of you caught on right away. It's the same image presented using different color palettes. All other display parameters are the same (more on them in a bit). Most people tend to see the upper image as showing greater heat loss. The palette used is called high contrast, and it is popular to use for advertising images both in print and on the web. It is attention grabbing for sure but it also is a bit, um, "overstated".

The lower image uses a palette called ironbow. I think this is the most moderate and "realistic" depiction in most cases. I used realistic in quotes because that is a totally subjective interpretation on my part.

When someone shows you an IR image look to the legend on the side of the image. That tells you what range of temperatures is represented in the image. The processing software that comes with every major IR imager takes the raw data and assigns colors based on the temperature the imager perceives on the objects surface. The temperature legend will tell you how wide a range is being displayed. The narrower the range, the higher the apparent contrast.

The palette and range can be controlled either at the time the image is captured or afterwards using the processing software. Almost all IR images benefit from a little tuning to get a realistic reading of what is important in the image.

Take a look at the upper left corner of either image, notice that it is black. The legend on the right tells you that black is the coldest temperature(ignore the green and brown boxes at the top and bottom of the legend. That is an artifact of the export to jpeg process that I can't get rid of). I compressed the range until that went black because it was way out of range of the items I was interested in, namely the building. On the upper end of the scale I let some parts of the image just go white, again because they were outside what I considered a useful range to display.

So if someone shows you an image look for large areas that have reached the scale limits. Unless the thermographer can come up with a good reason (there can be some) be a bit skeptical.

Remember all you are seeing is the imagers interpretation of the surface temperature of the objects before it. It does not see through walls, it doesn't see moisture, and it doesn't see heat loss. All it does is present information that we can interpret to infer all of these things. The person doing the interpretation needs to understand all the things that could be happening on or behind that surface and draw the correct conclusions.

Now, for a bit of fun, who can tell me about the buildings structure? For extra credit, what time of day was the image taken and what direction is the building face you see pointing? To help with the last part the date was February 23rd and there were light clouds. Good luck.

Energy tips:

This month I'm going to recommend some reading. First a very interesting take on why we humans have such a hard time making rational choices, Why Isn't the Brain Green? from the NY Times. If the link expires contact me for a Word version.

Once you've read that and understand how to manipulate people into making better decisions you might want to read about becoming a Pigou. No, it won't make you fat, but since it's about economics and taxes it may make your brain wither.

Finally as an ongoing source of thought the groups on Linkedin generate some interesting discussions. Granted some are less than enlightening but over all the Resnet/BPI group has a fairly good quality of discourse.

Blatantly Commercial Content:

I do have to justify the time spent on this effort, so I am charging myself an exorbitant fee to sponsor this newsletter. I get one ad per newsletter and free coffee refills in the kitchen.

Business update: I continue to do a mix of residential and commercial energy consulting work; I'm looking for more of both. Please visit my website, http://www.buildingdiagnosticsnh.com/ for information on my capabilities and background.

I'm still always on the lookout for a good stinker of a building. Actually when someone calls and says "My building smells bad" I really get interested. So whether a bad smell or just too much energy use, give me a call.

Closing thoughts:

As mentioned above, I need feedback for this little venture to succeed. I would like to include notices for events that relate to energy, the environment and community building, so if you have any announcements please send them in to newsletters@buildingdiagnosticsnh.com. I also welcome rebuttals and amplifications for anything I write.

Please forward this to anyone who you think would like it, if you don't like it use the email address above to unsubscribe.

Thank you, I'll see you next month.