ZbD: Notes from the Field

Insights in High-Performance Construction

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Insulated Concrete Forms: Strong Contender?

By: Mike LaCrosse & Jon Haehnel

Zero by Degrees has seen a lot of things this past year in high-performance construction. We've learned a lot, too. Particularly as it relates to building durability. We received a number of calls to help diagnose building failures such as, "Well, we've got a pipe that froze and burst …" or "We've got a roof that we opened up and the framing is rotting out…" or "There's icicles forming from under my clapboards." These various issues are troubling, but that's not even the worst part. These were all calls about high performance buildings that were built within the last 5 years.

A string of calls like this is an important reminder that if you're going to design and build a high-performance building, getting the big details *and* the little details right is more crucial than ever. In some of the cases presented to us, the underlying causes were glaring, and in others they were the smallest of oversights that would be easy to miss.

Thinking about the level of attention required to make a high-performance building truly resilient long-term, we started an internal conversation about what we think is the most durable high performance envelope system out there. We were looking for a system that can perform without having to be perfectly and flawlessly constructed. Insulated Concrete Forms (ICFs) is a strong contender.

On paper, ICF construction looks great from both an energy and durability standpoint. ICF blocks can be purchased with very high R-values, concrete is air tight and resilient to virtually all weather conditions. Not only is it resilient, but should it get wet, it can easily handle the moisture load, unlike high performance wood frame systems. However, with our experience mostly in commercial construction, we haven't had a lot of hands-on experience with ICFs. This past summer, we were fortunate enough to have visited three different ICF homes throughout New Hampshire to get testimonial feedback from homeowners.

The consensus overall is that these homes are comfortable, quiet, and handle temperature swings well. Of the three homes we visited, none have had any durability or maintenance issues and some of these homeowners have been living in their homes for close to 10 years now. It was unanimous that these ICF homes were comfortable and efficient. But there was a two-thirds majority vote for a noteworthy disadvantage: builder competency. Two of three homeowners expressed struggles with the builder short-cutting the building process; something that can go unnoticed for a while in a traditional stick-frame home, but doesn't go unnoticed in an ICF home. Our conversations with the homeowner and ICF supplier/builder taught us that these ICFs require very special

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installation procedures to ensure the walls are plumb and square without any “blow-outs” in the forms. This is especially true in an above grade application.

The other challenge mentioned was in converting conventional home plans to the ICF system. One of the owners we spoke with went to their builder with a design they liked but the plans were for a conventionally framed home. The builder understood the home was to be built completely with ICFs but did not account for the thicker than conventional walls when they poured the footings. The result was interior dimensions that were off and smaller than expected rooms, a huge frustration for the homeowner. This is place where an architect should have been involved but the homeowner and the builder both thought the other party was “taking care of this”.

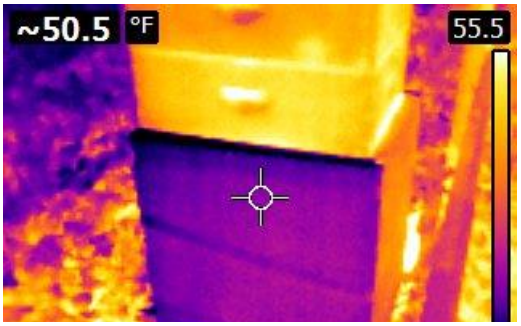
The other primary disadvantage is the apparent high cost of ICF construction. The argument can be made that the higher cost is offset simply by the lower heating load, smaller heating systems, and minimal long-term maintenance. We tend to agree with this argument, but we don’t think that ICF construction has to be as expensive as it is. There aren’t that many builders who build strictly with an ICF system. Most buildings with ICFs as the above grade wall system are being built by conventional contractors who see “ICF” in the plans and jack the price way up to cover the “unknowns” of building with an unfamiliar system. Our thinking is that with a well-vetted set of typical details, timely involvement by an architect, and a broader base of experience with ICF construction, these kinds of buildings can be made competitive with other high performance building systems but with fewer risks in long term durability. We would like to see ICF buildings take a larger role in the residential and light commercial high performance market.

Bees, Freeze and Building Science – Part 2: The Solution

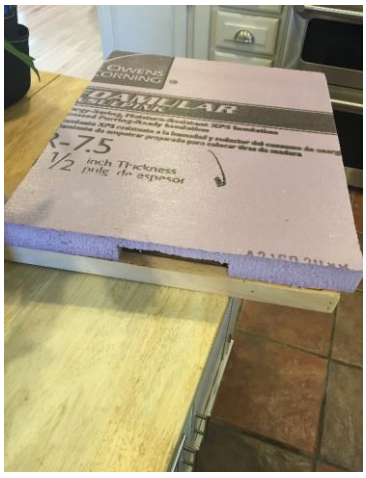
By: Mike LaCrosse

If you read part 1 of my beekeeping article, then you endured my dragging on about seasonal bee behavior, the relevance of building science, and why “superinsulating” a beehive might actually not be a good idea. The main take-away was that successfully wintering a beehive requires striking a balance, meaning helping the bees stay warm but not doing all of the work for them. I ended my last article with this teaser. (Right)

This was just a transition phase into winter, without the full “envelope” solution realized. So, considering the bees’ behavior and ultimate needs, here is the final solution that I landed on for my first winter: (Below)



A transition stage IR image. Insulation wrapped on the sides. Notice the difference in surface temperature now. The top 2 boxes will eventually be removed for winter.



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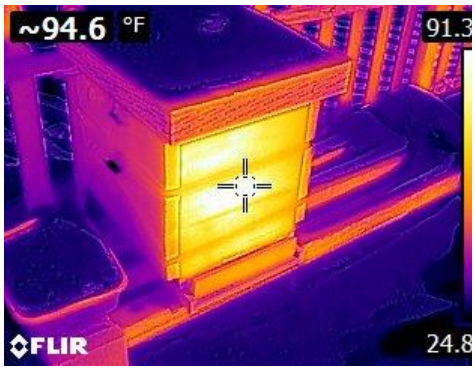
This is to be used at the top of the hive. Notice the hole in the center. This is serving as the hive's inner cover and upper ventilation. The hive entrance with a reduced opening will serve as a lower ventilation inlet, creating a small stack effect through the hive.

Resting on top is a piece of 1.5" XPS with a channel cut out on each end to allow that ventilation air to escape. The circulating ventilation air reduces the effectiveness of this insulation some, but the insulation will still likely retain some heat.



The winterized hive with the outer cover removed. The north, east, and west, elevations of the hive were all insulated with 1.5" XPS. Notice the continuity of the insulation where the walls meet the inner cover – I'm quite proud of that. I chose 1.5" as a thickness with the thinking that natural hives survive in tree hollows all the time which have several inches of wood surrounding them, maybe R-4. The bees don't need more, but I wanted to make it a bit easier on them, hence the 1.5" (R-7.5). (Above left)

Also, notice, the south hive wasn't insulated, but rather wrapped in tar paper to take advantage of solar gains. These solar gains should give the bees a better chance at breaking cluster in order to move to more food in the hive. On a sunny winter day in the mid-30s, the tar paper is radiating a surface temperature of 94F! It's certainly not this warm on the interior, but you can imagine how much this should aid the bees during the day time. (Above right)

So, in itself, the solution I landed on is nothing very complex. I've typically seen other beekeepers choose just one system for an entire hive. Usually just tar paper or just insulation. I couldn't help but feel like both of those approaches came with a significant disadvantage. The hive wrapped fully in insulation struggles to accept to solar heat, while the hive wrapped fully in tar paper struggles to retain heat at night when it's the coldest. Both have been done successfully, but I wanted something that offered some kind of benefit around the clock. I feel like this solution is it, but only time will tell. In writing this article at the beginning of February, the bees are still buzzing inside, so it has been working so far. I got a chance on a warm January day to open the hive and was pleased to find very few dead bees and little to no sign of moisture inside. Once winter is all said and done in a couple months (I hope), I'll check back in to discuss how the hive fared and if there are any changes I might make for the next season... provided I still have bees.

The winterized hive with the outer cover on. The outer cover is oversized so that the ventilation channel in the XPS over the inner cover are not blocked. (Above)

Coming Next Month:

- Insulated Concrete Form (ICF) Homes: Strong Contender? Part 2
- Jon and Mike at the BBD Conference

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