FROM THE FIELD

Passive house, anyone? Part 1

BY DAN FOLEY CONTRIBUTING WRITER

A little over a year ago, I received a phone call from David Peabody, an Alexandria, Va.-based architect (www.greenhaus.org) who specializes in energy efficient design. We have worked together on multiple projects over the last few years, on everything from small remodels and additions to energy retrofits and new construction projects. As described in last month's column, we even retrofitted a new mechanical system in David's house.

David said that he had a unique new project and asked whether I would be interested. Without asking any questions, I answered "Yes," trusting his lead. Little did I know what I was getting myself into: David was designing the first certified passive house to be constructed in the Mid-Atlantic region.

My first reaction was to think "passive solar." I recalled two passive solar houses that I "fixed" in the late '80s by installing boilers and a combination of fan coils, radiators and radiant. One that I recall distinctly and that I still service today had rooms that would not get above 50 F in January. The passive solar did not kick in until late May or early June. (I digress; this project has little to do with solar.) Once again, my initial reaction was wrong.

David took the time to educate me on the passive house movement, which began in Germany approximately 20 years ago. The basic premise is to build a super-tight, super insulated building envelope to greatly reduce and minimize the size and capacity of the heating system. "Great," I thought, "this guy wants to put me out of business." My limited capacity for looking beyond the next 15 minutes had struck once again.

Stringent requirements

What I quickly learned was that mechanical system design is critical to the function and operation of a passive house. In order to be certified, passive houses must meet the following strict criteria:

- The tight building envelope must have less than .6 air changes per hour (ACH) @ 50 Pascals as measured by a blower door test.
- Annual heating requirements must be less than 4,746 Btu/sq. ft. annually.
- Primary energy usage (electricity, DHW, heating) must be less than 38,100 Btu/sq. ft. annually.

Other recommendations regarding window U-values, ventilation and thermal bridging vary with the climate. Suffice it to say that these houses are airtight, super-insulated and have three-pane glazed, insulated windows.

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We reviewed the architectural drawings for this structure. I expected either some space-age design with exotic materials or a boring Igloo cooler box-like structure with tiny windows. This project was neither. The architecture was a traditional American Foursquare design that fit right in with the 1930s vintage neighborhood in Bethesda, Md., where the house was being built. There was very little to distinguish this as a passive house just by looking at it. The details were in the skeleton.

The basement had a full 4" perimeter insulation and 6" of slab insulation. The wall structure consisted of 7 1/2" thick SIP (structural insulated panel) panels with another 2" of foam board under the finish element. The windows were a triple-glazed, insulated frame model special ordered from Canada. The roof structure consisted of 12" thick SIP panels. Thermal bridging was eliminated. Every gap or crack was sealed, caulked or insulated. No one was allowed to drill or puncture the building envelope. All penetrations had to be scheduled and submitted to the architect and builder for approval. Once approved, the hole was drilled by the general contractor (GC) and sealed by the GC, after the pipe or cable penetration was run. This house was tight!

A passive house needn't look like a space-age concept or an igloo. All of this home's energy-saving details are under its traditional-style siding.

The house was being built on spec by O'Neill Development Corporation, Gaithersburg, Md. Brendan O'Neill Jr. was the project manager. We held multiple planning meetings with the architect, GC and other trade subs. Everyone had to understand the concept of a passive house and be aboard or this would not work. It was imperative that we coordinated our work and were aware of what everyone else was doing or it would quickly devolve into a disaster. Peabody and O'Neill were the ringleaders that kept this project going in the right direction.

Astounding results

After I reviewed the plans, I did the takeoffs and performed a load calculation. I had to manually enter most of the data, since most of the building envelope structures were not in the dropdown menus provided by the load calculation software. At first, I did not believe the results: Heat loss for the 4,600 sq. ft. structure was less than 24,000 Btu at design conditions or approximately 5 Btu/sq. ft. Keep in mind that we see design conditions for relatively few hours annually. The majority of the heating load hours are at partial load. I found these results absolutely amazing.

I wanted to incorporate radiant floor heating in my design, but this was vetoed by the architect. Radiant was not necessary as MRT (mean radiant temperature) is maintained at a comfortable level by the utter lack of heat loss through the structure. This will have to be proven to me, as I am still not sold on this idea. The house is wired with sensors and data-loggers, so we will see what happens next winter.

Mechanical ventilation is critical in such a tight house. This system runs 24/7 to ventilate the structure, bringing in fresh air while exhausting stale air. The exhaust points, return air and supply duct locations, as well as the ventilation duct penetrations, were carefully detailed with the architect and GC.

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CK and CKT electric fan heaters

The CK & CKT wall-mounted electric fan heaters are ideal for new construction and renovation projects, in bathrooms, kitchens, bedrooms, hallways, playrooms and garages, etc. All CK & CKT heaters feature a built in thermostat (adjustable from 41 - 86°F), a frost protection setting designed to keep a room just above freezing temperatures. The new CKT extends the already impressive list of features by adding a 60-minute timer. Set up to an hour of high-output heat to quickly warm a room. When the timer goes off, the CKT will use the previous thermostat settings to make sure your room stays the temp you want. The CK series of heaters are available in four models: The CK 15E is a 120V, 1500 watt unit. The CK 20E is capable of running at either 208V, producing 1500 watts, or at 240V where it produces 2000 watts. The CKT 15E and CKT 20E share the same electrical specs, but add 60-minute timer-based operation. **Stiebel Eltron**.

Circle 105 on reader reply

Hydronic installation simple

Installing a hydronic system can often be like putting together a jigsaw puzzle. Simplify your boiler setup by selecting one of our newly expanded Caleffi Boiler Trim Kits. Take the guess work out of component selection by simply choosing the boiler trim kit part number that fits your needs. Caleffi offers twenty kit combinations with 2.2, 4.4 or 7.6-gallon expansion tanks and DISCAL™ high-performance air separators with 3/4", 1" or 1 1/4" connections. All kits are equipped with sweat or NPT connections, an automatic filling valve, an expansion tank check valve, two brass nipples and a brass tee. These convenient component packages are available with or without Caleffi backflow preventer to suit your specific needs. **Caleffi**.

Circle 106 on reader reply

Comfort & energy savings for 2-wire retrofits

tekmarNet®2 house controls and thermostats utilize 2-way communication to provide benefits that surpass basic thermostats and outdoor reset controls. Communication benefits include zoning with indoor feedback, heating & cooling interlocking, shared schedules, and outdoor temperature display on any thermostat. tekmarNet®2 thermostats only require 2 wires for communication and power, making them ideal for retrofit installations where new wiring is not feasible. Home automation and/or web access capabilities. **tekmar Control Systems Ltd.**

Circle 107 on reader reply

FROM THE FIELD

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The hot, humid climate in the Washington, D.C., area dictated that air conditioning and de-humidification be given careful consideration.

I learned that most passive houses had been built in cool to cold climates. Not a lot of thought went into the AC systems of the passive houses I studied. Most simply had a ductless mini-split with a wall mounted cassette for the entire house. This may work in Minnesota or Maine, but it was not going to work in a four-level home in Washington, D.C.

This is where I butted heads with the Passive House Institute. You see, no passive house gets certified in the U.S. unless it passes muster with PHIUS (Passive House Institute U.S.). Their mechanical design theory can be summed up thusly: Simple = good, complicated = bad. It took multiple submissions and revisions before we finally came to an agreement. This is a spec house that will market well north of $1M. If we can't keep the house cool in August, we are going to have problems.

Stay tuned next month as I detail the mechanical design and installation on this passive house project and how I managed to navigate through the PHIUS maze and get my mechanical design certified. ●

Dan Foley is owner of Foley Mechanical Inc. His company has 14 full time and two part-time employees. His primary focus is on radiant and hydronics with large custom homes. Foley also does service, replacement, HVAC, sheet metal, controls, piping, renewables (geo and solar thermal), which services the Washington, D.C. metro area.