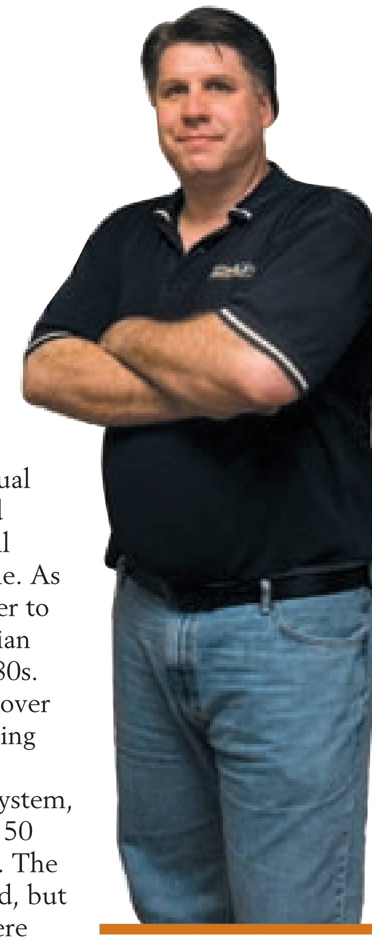
FROM THE FIELD



Hydronic solutions

BY DAN FOLEY CONTRIBUTING WRITER

How many homes in the U.S. are heated by hydronic heat? It all depends on who you ask. The numbers I hear are between five and eight percent. My assumption is that the traditional definition of hydronic heat is either hot water or steam heat. It's a boiler connected to radiators, baseboard or radiant floor heat. My definition is much broader.

A hydronic system is defined as a system that transfers energy through a piping network using water (or a water/glycol solution) as a heat transfer medium. My definition encompasses hydro-air, solar thermal, geothermal, chilled water and radiant cooling. However it is defined, I think we can agree that hydronic heating and cooling comprises a minority of the mechanical systems in residential homes in the U.S.

The fact is that the majority of the mechanical systems existing in residential homes are forced air systems. The majority of systems installed in new construction residential homes are forced air systems. Why is this? After all, hydronic systems offer so many advantages over traditional forced air systems. I don't know that I have a good answer to this question. Cost is frequently given as a reason, but I'm not sure this is the primary reason. Consumers are often willing to pay a premium for desirable products. My guess is that contractors recommend and install the systems they know best.

These thoughts were bouncing around my head as I was surveying a potential project in Kensington, Maryland, last fall. The home was built in the early 1950s in a suburb just north of Washington, D.C. (See photo). The original owner was a mechanical engineer who built the house, and designed and installed the mechanical system. A cast iron American Standard boiler heated the house through wall-mounted convectors with small shaded-pole blower motors. A Bryant AC unit connected to a chiller barrel in the basement provided cooling and dehumidification.

A 1950s colonial in a suburb of Washington, D.C., featuring a complete mechanical system upgrade.

Each room had a convector, which allowed for individual control. This was the "Cadillac" mechanical system of its day. The main disadvantage was that it was a two-pipe system, which required manual change-over each season by opening and closing of isolation valves. Spring and fall weather in the D.C. area is unpredictable. As soon as the system has been changed over to heat, we are bound to get a week of Indian summer with temperatures in the high 80s. The reverse is true in the spring: switch over to cooling in April, only to get sub-freezing temperatures at night. You can't win.

By the time we started servicing this system, its time had come and gone. It was over 50 years old and it was starting to fall apart. The original AC condenser had been replaced, but all other equipment and components were original. The present owner asked that we keep the system running until he could decide what he wanted to do with the property. Large corner lots in the near D.C. suburbs are a rarity. This size lot would fetch a premium for someone looking to scrape off the existing home and build their Taj Mahal on a one-acre lot this close to D.C.

Service calls on this old and tired mechanical system were becoming a weekly occurrence. Motors were failing, drain pans were rotted out, drain lines clogged, pumps failed and capacitors had blown. My client was spending thousands of dollars keeping it going; all the while being inconvenienced by no-heat and no-cooling calls. He had a tough decision to make.

Carrier variable speed air handler with hot deck cool heats the main floor.

After careful consideration, he decided to renovate and update the home and the mechanical system.

He asked me, "Dan, what would you do if this were your house or your family's house?"

He did not give me carte blanche to design the ultimate mechanical system. What he did want was a comfortable, efficient and reliable system that would provide years of reliable service. He wanted a good system without breaking the bank.

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An NTI Trinity high efficiency boiler feeds two hot deck cools and an 80 gal. DHW tank.

My ultimate system would incorporate radiant floor heat, panel radiators and wall-mounted towel warmers. Unfortunately, the budget did not allow for this. We settled for the next best thing: a hydronic system powered by an NTI Trinity 95 percent AFUE modulating condensing gas, wall-mounted gas-fired boiler (See photo). We dropped a PPS flexible liner down the old boiler flue and vented it through the roof.

All of the old wall-mounted convectors were removed, and the wall openings patched. We installed two complete duct systems: the basement system served the basement and first floor while a second attic system served the second floor. Two Carrier variable speed air handlers provided airflow while two Carrier AC units provided cooling. Hot deck coils on the air handlers connected to the boilers provide heat (See photo). An 80-gallon NTI stainless steel DHW tank that replaced a traditional tank-style water heater provided copious quantities of hot water quickly and efficiently.

My client asked me why I would propose this system over a typical forced air system. That was certainly a viable option. Why not just install two gas furnaces, two AC systems, and a new tank-style water heater? There is nothing wrong with this setup. But my hydronic-based solution offered several advantages.

Diversity

Each individual furnace would need to be sized for the peak load in that zone. By using a central boiler, it can be sized for diversity loading. Peak load occurs in each zone at different times of the day, depending on use, solar gains and occupancy. The diversity load is always lower than combined peak loads, allowing for a boiler more closely sized to the actual load. The modulating feature of the boiler also allows for efficient operation during part-load conditions. During peak loads, the full capacity of the boiler can be directed to the zone that requires additional heat. This is not possible with individual, discrete furnaces. The capacity of the furnace is limited to the zone it serves.

Gas piping and flues

Individual furnaces require additional gas piping and flues. My solution minimized the gas piping required. We ran about 10 feet of black steel pipe to the new boiler location. Additional gas piping to the attic or to the water heater was eliminated by simplifying the gas piping. A single flexible PPS vent pipe was run through the existing chimney. No other wall or roof penetrations were required. A typical conventional system would require gas piping and flue pipes for three appliances, two gas furnaces and one gas water heater.

Combustion and maintenance

All combustion is now contained in the basement mechanical room. I have never been comfortable installing combustion appliances in the attic. I have done it many times, and it is common practice, but I am not comfortable doing this if other alternatives available. In my opinion, gas burners belong in a concrete mechanical room in the basement.

In addition, maintenance is minimized. The number of burners, draft motors, ignitors, combustion chambers, etc., to clean and maintain has been reduced to the one high efficiency gas boiler. I would also prefer to work on equipment in a basement mechanical room, rather than crawling around an attic.

Domestic hot water (DHW)

DHW loads are becoming greater with spa-style master baths, rain water shower heads and soaking tubs all competing with dishwashers and washing machines for domestic hot water. In many cases, I have found the DHW load to be greater than the heating load. If the heating load is slightly short, it likely will not be an issue, as design conditions are measured in hours annually. You are likely to coast through design conditions without any issues. But if you are short on hot water, you are likely to receive an angry phone call from your client immediately.

Most tank-style water heaters may have a 40–50k burner, or maybe a 60k burner on a 75-gallon tank. My solution incorporates an 80-gallon stainless steel storage tank heated by the full capacity of the boiler—in this case over 100k BTU/hr. This setup can easily provide over 350 gph of 120°F DHW.

We completed this system in November, and so far my client has been pleased with the results. One week ago we had temperatures in the single digits, and my client was warm and comfortable. The true test will be next week, when temperatures are forecast to drop below zero. I am confident this hydronic system will handle it. ●

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