A Radiant Idea

YESTERDAY'S TECHNOLOGY, HYDRONIC HEATING, IS BACK WITH A DECIDEDLY 21ST CENTURY FLAIR

Story by Matt Chapuran

"There are no hot or cold spots in any of the rooms, never a feeling of 'It's too hot' or 'It's too cold.' "

ELIZABETH GIBB,
ARCHITECT, CAMBRIDGE, MASS.

At one time, hydronic heating systems were one of the most common sources for heat in American homes. Today, the term has been so arcane that Mary Carson, program director for the Hydronic Heating Alliance in Arlington, Va., complains that "you can't even find the word on your spell check." But with promises of increased comfort, high efficiency energy savings and green wave technology, hydronic heat — and radiant panel heating, one of its offshoots — seems poised to make a comeback, even if there is debate about the claims of its efficacy.

Anyone who has ever laid eyes on an old school radiator in a northeastern home has seen hydronic heat in action. It's a closed heating system that uses a boiler to heat or boil water. The hot water or steam circulates through the building, surrendering its heat to the surrounding air. According to Carson, the GI Bill and a post-war building boom that included a sharp demand for furnace-powered forced air systems that could provide both heat and air conditioning caused the fall from grace. Carrier began marketing a popular dual-purpose system starting in 1948 and by the late 1970s and early 1980s, electric heat pumps continued the marginalization of traditional boiler-powered hydronic systems, which suffered from a perception of being noisy and carrying rust in their copper joints.

Hydronic Flows Back Into Action

In recent years, advances in the delivery systems, boiler efficiency and radiant panel technology have encouraged the hydronic industry to stage a comeback. The Hydronic Heating Association (HHA) based in Dedham, Mass., reports that 70 percent of Americans are "unhappy (dissatisfied) with their heating or cooling system." They further report that nine out of 10 American homes are heated by forced air. Current boilers now operate "at an Energy Star level," Carson says.

As a medium, water carries heat with much less effort than air, by a scale of about 3,500:1, lending credence to the argument that hydronic systems are more energy efficient and thus, more green. "We were green before green was even popular," says Larry Drake, former executive director of the 15-year-old Radiant Panel Association, which represents 815 companies, including manufacturers and installers. Formed in Minnesota, the organization is now headquartered in Pennsylvania, although its major sphere of influence is in New England, followed by the Pacific Coast and Rocky Mountain regions. "Probably 70 percent of our business is in new homes, with the rest in new construction or commercial applications," Drake says. He cites great potential for application of the technology in schools, warehouses, garages, hangers and/or day care centers.

Because a hydronic heating system remains closed, dust or other impurities are not carried by the heating system. Advances in PEX (plastic) tubing allows for current hydronic systems to eschew copper piping. By removing the baseboards or radiators, the home's living space is also increased. The smaller boilers themselves are also space saving.

"They're not big anymore," Carson says. "There's one they call the munchkin." Modern hydronic heating boilers can also service hot water delivery, creating further space savings by having one boiler perform the function of two appliances.

Opposite Page: A Hydronic snow melting system being installed under the TACO, Inc. parking lot.

PHOTO COURTESY OF WWW.MYHOMEHEATING.ORG

Above: Workers installing pavers over a Hydronic snow melting system.

RIght: The snow melting system doing its job during the Winter season.

PHOTOS COURTESY OF WWW.MYHOMEHEATING.ORG

Radiant Floors

While the technology of hydronic heat is mostly associated with baseboards or radiators, hydronic radiant heat works by embedding flexible plastic tubing into the concrete or in the subflooring. By snaking plastic tubes beneath floors, radiant panel systems deliver heat directly into the floors, walls or furniture. Whereas forced air ductwork systems rely on heat or cool air being pushed into an environment, kicking up drafts and resulting in greater circulation of dust and spores, hydronic and radiant systems are closed.

Cambridge, Mass., architect Elizabeth Gibb selected radiant hydronic heat for her new 4,000-square-foot home. “My husband, who is German, grew up in Italy and Germany, where hydronic heating is commonplace. This form of heating produces very even, stable temperatures, produces no sound (therefore is completely silent), and from my point of view as an architect is invisible in the interior spaces.” Gibb also cites cost savings, and an attendant environmental benefit. “The operating cost savings are significant,” Gibb says. “The mass of concrete slab under each floor retains heat for a long time.”

By warming from beneath, the homeowner enjoys an immediate benefit of a warm floor in the morning. By charging the concrete subfloor, the floors themselves and the furniture become the mediums for transferring energy. This allows the heat to be more evenly distributed across the home’s footprint, alleviating drafts.

“There are no hot or cold spots in any of the rooms, never a feeling of ‘It’s too hot’ or ‘It’s too cold.’ ” Gibb says. “It is a gentle, even heat that is calibrated to be at its optimum at about 5-foot-6-inches from the floor. Walking on our wood floors is a pleasure because the floors are always warm and never even cool, even on the coldest days.”

Most systems heat from the top down, where hydronic radiant technology permits for the heat to rise. “There’s very little stratification from floor to ceiling,” Drake says, citing one study where hydronic heat was employed in a building with a 20-foot tall ceiling. The heat at the top of the room was almost identical; within a few degrees, Drake says, of the floor. “There are no drafts at your ankles nor too much heat up at your head,” he says.

Snaking a network of plastic tubing in the subflooring allows for greater sophistication of the system, as well, according to Gibb. Implementation of programmable thermostats allow for temperature zoning, leaving some rooms at cooler temperature than others. “Our guest room is rarely used in the winter months,” Gibb says. “So, we keep the door closed and set the temperature at 60 degrees.”

The plastic tubing network can also provide numerous ancillary benefits, such as running a separate closed system off the radiator into the outside, to provide snow melting in the

driveway, provided an anti-freeze additive is introduced to that portion of the network. The system can heat a hot tub or pool or even run through towel racks to provide hot towels in the morning.

Installation

The efficacy of the system largely depends upon the subflooring. With tubing embedded directly into a concrete slab floor, there needs to be insulation installed directly beneath the piping to direct the heat above, or — in the case of pipes running in air pockets in the subflooring — dehumidifiers to prevent damage from condensation. Radiant heat works best beneath ceramic tile floors, given ceramic's capacity to hold heat. Conversely, deep pile carpet can have an insulating effect, preventing the free passage of heat into the living area.

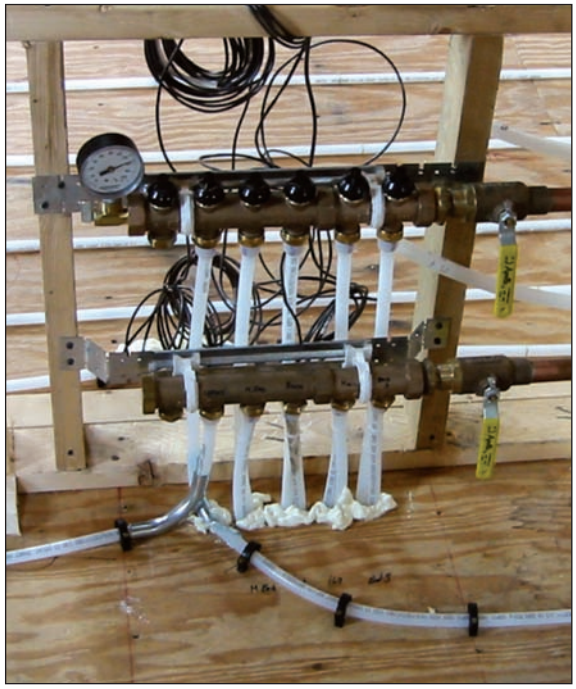
Embedding the system in the concrete obviously poses some threat of damage and could make it difficult to find a leak. "We seldom see a defect in the tube," Drake says. "There could be damage in the tube, but then you drill down into the concrete and repatch when you're done. Otherwise, the tubing is well protected. Once it's there, it's there."

Drake's organization mandates a 100 psi pressure test for the installation of tubing and offers a certification program, including a knowledge exam. The technology probably becomes less desirable, "south of the Mason/Dixon line," Drake says, "where heat becomes subservient to air conditioning."

It Cools, Too?

Hydronic and radiant systems can provide air conditioning, replicating the effect of entering a cool basement by running cold water through the floor. "Your body radiates heat to the cool surface," Drake says. "It's like walking close to the frozen food section in a store."

"We've seen an increase in demand on hydronic air handlers," confirms Lee Ensminger, sales manager for Crown Boiler in Philadelphia. Today, a boiler with a hydronic air handler can be retrofitted onto existing ductwork installed for electric forced hot air to create a hybrid system with multiple uses. Crown Boiler's Santa Fe II series of heating and cooling air handlers not only heats air, but can cool it, as well.



Above: Plastic tubing is laid at precise measurements on the subfloor.

Left: A manifold is designed to provide short piping distances for consistant heat distribution and the ability to have temperature zoning.

PHOTOS BY: BETH GIBBS
WWW.MYHOMEHEATING.ORG

"With a hydronic air handler, you have heat for the house, but also a D/X coil for cooling." Ensminger says, adding that the application of the D/X cool can be very effective for retrofits or households with a standard hydronic baseboard heating system, but with an owner-identified need for additional cooling, such as in a new addition being built off the household.

"Radiant floor tubing is great for rooms like a kitchen, but not as good for carpet," Ensminger says. The D/X coil is hooked up to an outdoor condensing unit to utilize existing duct work

Self leveling lightweight concrete is poured over the hydronic tubing to permanently embed it into place.

PHOTOS BY: BETH GIBBS
WWW.MYHOMEHEATING.ORG

to create cooling. Although the creation of a hybrid system lessens one of the chief advantages of a hydronic system — that its closed nature reduces the circulation of particulates in the household — a hybrid system permits radiant heat in tiled rooms like the kitchen or great room and forced air conditioning in the bedrooms for advanced comfort at night.

Are the Savings There?

Two lingering questions on the advent of radiant heat are the cost of installation and if its claims of higher efficacy and comfort withstand scrutiny. Gibb concedes that, "a hydronic radiant heating installation does come with additional costs."

More troubling is an article in *Environmental Building News* in which Executive Editor Alex Wilson argues that the necessary home modifications in a radiant slab, such as increased insulation in the floor and weather tightening windows to prevent heat loss and drafts, can actually provide much of the desired benefits of increased efficiency and comfort without the additional costs of system installation. Wilson also questions some of the underlying assumptions for its use.

"If the total design heat load of a house is only 15,000 BTUs per hour, a radiant slab can't be maintained more than a degree or two above the indoor air temperature or overheating will occur," Wilson says. "And if the floor slab is only 75 degrees, it's not going to feel warm underfoot, because your feet will still be conducting heat into the slab. As a result, you won't get the benefit of a slab being warm underfoot, one of the most attractive features of this heat distribution system.

"It's not that I'm opposed to hydronic heating or even radiant-floor heating systems; it's just that in new construction, I believe it makes more sense to put your money into envelope improvements."

Energy Star, an environmental advocacy division of the Environmental Protection Agency, cites improved installation as the first step for ensuring increased efficiency in the home. Among its "5 Steps You Can Take to Reduce Air Pollution," one is "Seal up your home. Drafty windows and doors, cold walls or ceilings, and high energy bills are all symptoms of energy leaks. Seal air leaks, add insulation and choose Energy Star qualified windows when replacing old windows." After making these upgrades, spending extra money for a radiant panel system just may not make sense.

"Investing so much money in the building envelope and still putting in an expensive radiant-floor heating system eliminates the potential for offsetting much of the extra cost in building envelope improvements through savings in the mechanical equipment — one of the key principles of integrated, whole-systems building design," Wilson concludes.

Even if one should approach radiant technology with some caution, the U.S. Department of Energy does agree that radiant heating systems are "usually more efficient than forced-air heating because no energy is lost through ducts."