A Little Heat

by Harris Hyman, P. E.

It's been a good year. We've all been busy designing and building some good houses. Now it's winter. How do we heat them?

In 1970, a quality, energy-efficient house consumed about 11 Btu per square foot per degree day (DDay), but today we'd be foolish to be satisfied with a house that used more than 2 Btu.

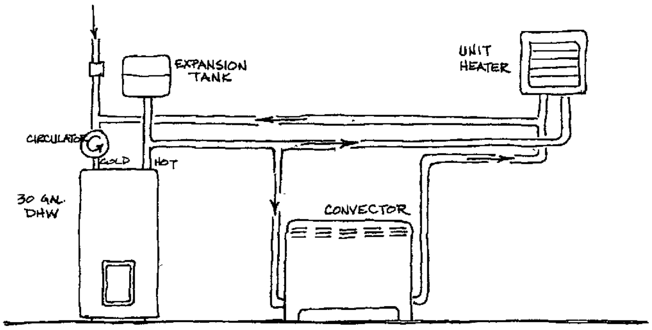
The state of Maine has voluntary standards of about 4.7. A few of us work in the area of 1 (and solar engineer and inventor Norm Saunders has more than a casual acquaintance with 0.0), but most reasonable builders aim for between 2 and 3.

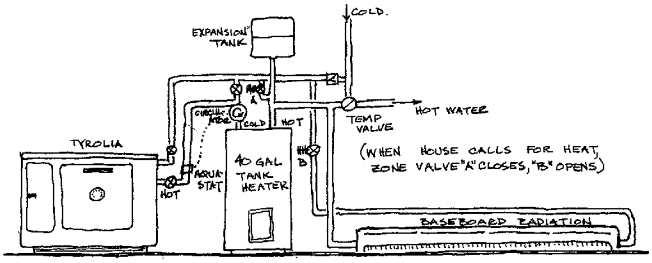
Assuming our 1970 house had 2,000 square feet, it had a heating-power demand of 82,500 Btu per day. (11 Btu / sq. ft. / DDay / 24 hr. x 2,000 sq. ft. x 90 degrees.) Today the same family would build only 1,500 square feet, so the demand would be 11,250 Btu per day.

A heating plant for the '70s house is easy to find. Allowing a 25 percent oversize to take care of a cold winter and compensate for sloppy furnace maintenance, a 105,000 Btu/hour oil furnace or boiler would do the job nicely.

Today's heating system requires about 100 percent oversize—24,000 Btu/hour—to take care of the solar contribution and the more significant effect of errors. But the smallest locally available systems push out significantly more—65,000 Btu/hour for an oil burner, and 50,000 Btu/hour for a gas unit. This much excess power is both extremely inefficient and uncomfortable. Something else is appropriate.

If it wasn't for the fact that wood stoves are hardly automatic, they would be ideal, since they look nice and typically generate 20,000 to 40,000 Btu/hour.





Drawings by Harris Hyman

Using DHW for Space Heat

I raised these points a year ago and suggested some possible alternatives. Now I'd like to fill you in on my experiences with one of them: the use of domestic hot-water (DHW) heaters for space heat.

A look in the equipment catalogs shows that small, tank-type water heaters put out about 30,000 Btu/hour, whether they are electric (9,000 watts) or gas. They cost about $250, fit into a 24-square-inch space and make for a reasonable and effective automatic heating system.

(The selection of gas or electric usually is determined by the cookstove chosen. Gas usually is preferred if it's available; in my area of Maine, it costs about $14 per million Btu compared to $28 for electric.)

The first system I installed was for a retired couple who had a small place and were enamored with the Tyrolia stove—an excellent stove for cooking, with a good water heater, but it's so well insulated that it doesn't function as well as other wood stoves in the radiant-heat department.

Because the owners were away from the house for long periods, automatic heat and hot water were required.

The system I devised for this situation is a little unusual, because it connects the domestic hot water with the heating system. But the most difficult problem seems to be dealing with the skepticism the system engenders. It seems to function well, however, and is beginning its fifth season.

There's no evidence of a strange taste in the potable water, although it is a little flat because it's de-aerated; however, aeration nozzles on the sinks seem to take care of this. It seems as if there should be *something* wrong with it, but I'm not sure what it might be.

Another alternative is to be a little more conventional and limit your innovation to the heating plant. I know of a half-dozen houses that have been outfitted with two water heaters—one for space heat and the other for DHW—and the owners seem pleased with the results.

(...Which brings up another issue: Maybe I'm getting a little burned out, but I've come to the conclusion that unless strange ideas present a really clear advantage, life's a lot easier if we don't go too far afield and instead take on one innovation at a time.)

Heat Distribution

For heat distribution, there are four possibilities: hydronic baseboard radiators, convectors, industrial-type unit heaters and radiant slabs.

The standard baseboard hydronic units seem to be the least workable, but the one house I know of with these units uses a wood stove for primary heat.

Hydronic baseboards are somewhat inefficient heat-transfer gadgets, but they are relatively simple and inexpensive to install, and they do work well with water in the range of 220 F.

This may be fine with a standard boiler, but it doesn't work with a DHW tank. Hot-water tanks usually run at lower temperatures (140 F to 180 F), which isn't high enough for baseboard heaters put out a comfortable level of heat. Averaged throughout the day, baseboard heaters are okay; they just are slow to respond to temperature fluctuations.

One of my favorite heat-transfer devices is convectors, which do run properly at lower temperatures, although the heat output cannot be determined from suppliers' tables for temperatures between 180 F and 210 F.

As part of a heating system, these units are oversized to compensate for the lower water temperatures, but no more than a half dozen units should be needed for most homes with a heating demand of 20,000 Btu. They are far more space-efficient than baseboard heaters; three feet of convector can transfer 8,000 Btu, the equivalent of 10 to 12 feet of baseboard.

Convectors also are a lot more rugged and resistant to dings and kicks. They derive their efficiency from the cabinet, which allows air passing the fin-tubes to acquire velocity so it can strip heat off faster.

Most of the objection to convectors is aesthetic, and I've heard more than one client remark that they are reminiscent of the old PS 137 units.

Another objection concerns subcontractors. Some are into a nice working groove with baseboard and can't handle the switch to another system very easily. I'm not particularly sympathetic, but it's foolish not to recognize that this does happen.

Actually, my *real* favorite devices are cast-iron radiators, but they are available only from salvage. These are probably the most efficient heat-transfer devices of all, and they give buildings a nice Victorian quality, which I personally like.

Unit heaters are also effective, but these are "high tech" at best and do not appeal to everyone. They also require electricity to drive the associated fan, and a contact aquastat to control it.

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They are most appropriate where the total space consists of a couple of large rooms. A relatively small unit heater can move a lot of heat, and they may be workable where space is tight or, more commonly, where they can be located overhead.

I've worked with radiant slabs but have never tried one in combination with a DHW boiler. Radiant slabs—concrete filled with hot-water piping—became quite popular in the '50s but fell into discredit when their copper tubing corroded out after 10 or 15 years. (These problems have been overcome somewhat by the advent of rubber and plastic tubing in lieu of copper or iron pipes.) When they work, the heat is wonderful—comfortable and unobtrusive.

About six years ago, a new form of radiant slab hit the market with the advent of a synthetic rubber product called "Solaroll." This material—purported to have a life of 50 years or so, which is compatible with the life of the average house (or at least the mortgage)—looks promising with water boilers. It works well and is soft enough to absorb its own thermal expansions without cracking.

New innovations like these are helping to bring radiant slabs back in vogue in some areas.

Of course, things are always changing in the wonderful world of heating systems. By the time this article appears in the January issue of *NEB*, I will have attended a seminar on small heating systems, so perhaps some of these thoughts will go through another stage of rethinking. But after all, I guess that's what we're working for. •

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