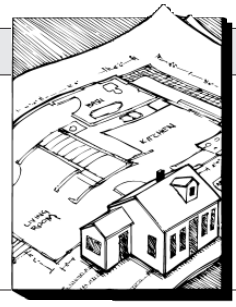
Combining Heating & Cooling Systems



by Gordon Tully

When it comes to choosing mechanical systems, most builders tend to stick with what they are accustomed to. In some cases, however, they may be overlooking systems that will provide better comfort and convenience. Here, I will describe the range of options and a systematic way to approach them.

To Cool or Not to Cool

The fundamental climate-control decision in a house is whether or not to air condition, either now or later. Since cooling is expensive and energy intensive, you should always design the house to minimize the need for cooling.

If you need to cool more than one or two rooms, it pays to install whole-house AC, then seal up the house and keep the cooling on during hot, humid weather. This saves energy compared with intermittent use, because every time you shut off the cooling and open the windows, the house becomes rehumidified — and you pay a lot to drive out that new moisture.

Integrating Heating and Air Conditioning

Once you opt for whole-house cooling, you will usually want to make double use of the AC ductwork system for heating (this is always done with a heat pump system). You can couple central air conditioning with any kind of central heating, however, such as radiant or baseboard hot water. Although you lose the double use of the AC ductwork with these systems, don't discard the option. Sometimes the AC ductwork can be very simple if it is not also used for heating, freeing up money for a separate heating system.

Heating options. Assuming you want to use the AC ductwork for heating, there are two ways to heat the air: directly with a furnace (either fossil-fuel or electric), or indirectly with a fan-coil unit (see Figure 1). A fan-coil unit blows

Central AC with Heating: Three Options

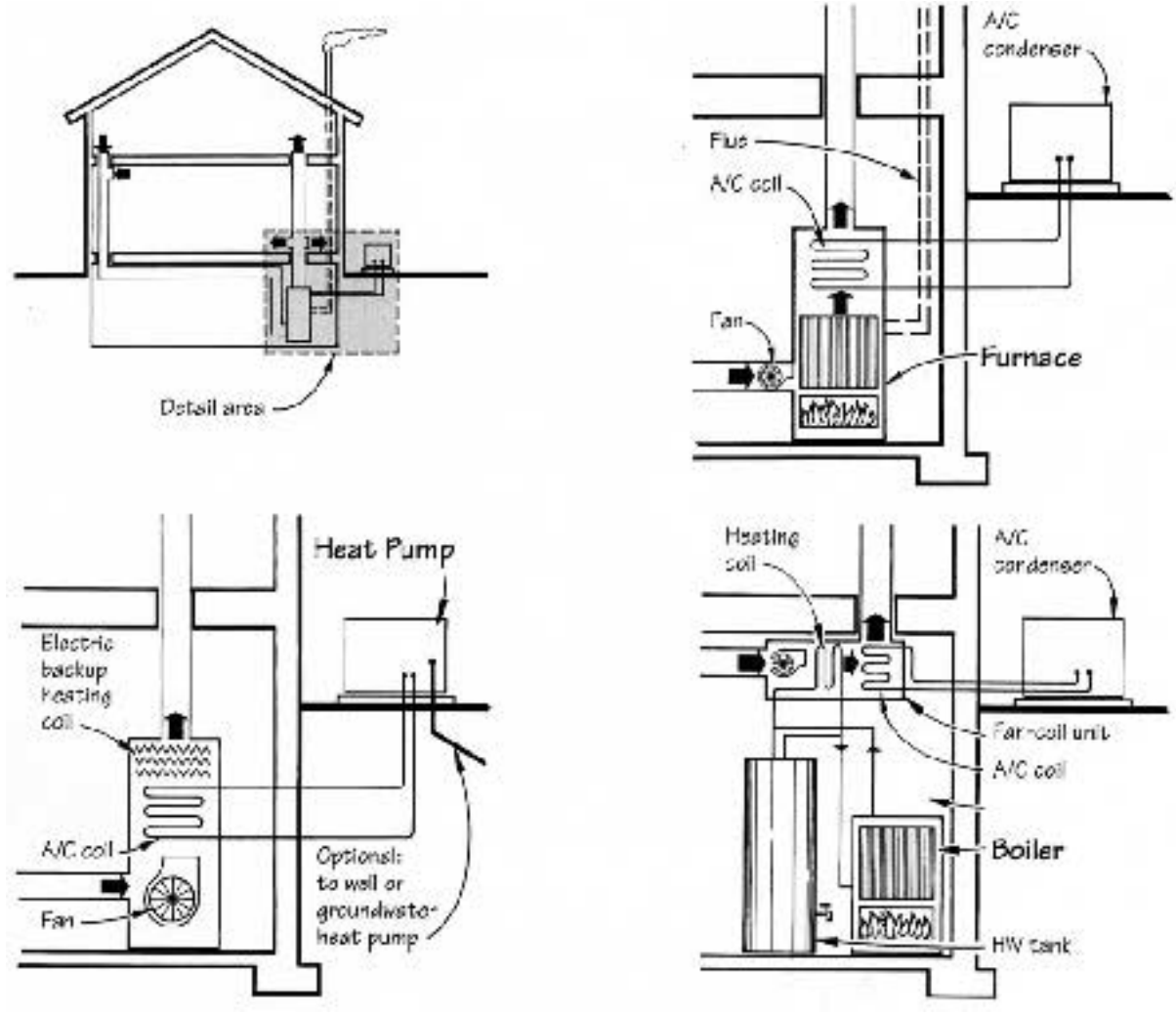


Figure 1. *Once you've decided on central air conditioning, it usually makes sense to use the AC ductwork for heating as well. The heat can come from a furnace (top right) or boiler (bottom right), or from a heat pump that provides both heating and cooling (bottom left).*

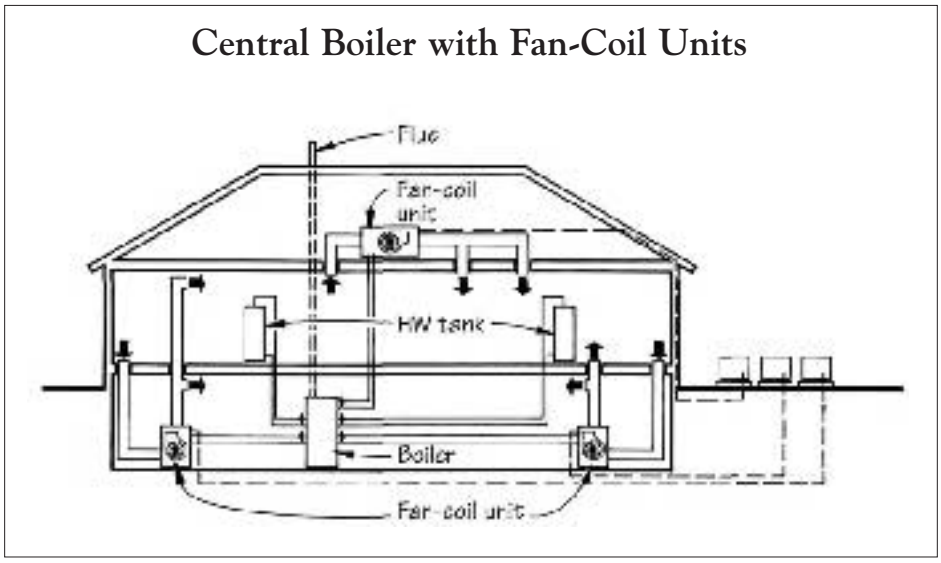


Figure 2. *For large houses, a single boiler can serve several fan-coil units. Advantages of this system include easy zoning, short duct runs, and efficient hot water — all with one flue. For air conditioning, each unit needs its own AC outdoor section.*

air over a coil filled with circulating hot fluid. The hot fluid can, in turn, come from a boiler, a heat pump, or some other source such as solar-heated water.

A furnace is an obvious choice for heating in an air system, especially in colder climates. Furnaces come in a bewildering variety of designs, with varying efficiencies, maintenance needs, airflows, and heat outputs. Choosing the right one is a fine art, which I generally leave to an experienced installer.

Air-source heat pumps are a common choice in moderate climates. They become less economical where winter temperatures are often below freezing or electric rates are high. Groundwater heat pumps are much more efficient for both heating and cooling, but are very expensive to install. Check to see whether the electric utility where you build subsidizes groundwater heat pumps through an energy-efficient-home program. A subsidy can make this excellent system affordable.

A boiler feeding one or more heating coils is also expensive, but has advantages. For one thing, you get the easy control of hot water systems without the need for radiators, which I find annoying because they interfere with furniture placement (but then so do floor registers). Also, in this type of system, one heating unit can serve several fan-coil units throughout a large house, making zoning easier (Figure 2). This is a good way to heat a historic house where you can't add baseboards or ductwork. (One caution: Because of their noise, it is best to install fan-coil units outside the rooms served and use ductwork rather than through-the-wall units.)

AC options. There are several AC equipment options. If you choose a packaged heat pump for heating and cooling, you get both indoor and outdoor sections, which do everything. If you heat with a furnace, you need an outdoor section to generate cool fluid, plus a coil set in the supply plenum of the furnace. If you heat with a boiler, you need a packaged fan-coil unit, which contains a fan and coils for both heating and cooling.

Fewer Flues

With any fossil-fuel system, you need a flue or vent. Most of today's high-efficiency equipment uses 2-inch PVC vent piping for intake and exhaust, eliminating the need for a chimney. But the outside vent piping is pretty ugly, and makes some steam in the winter.

If you use a single boiler with multiple fan-coil units, you have the benefit of multiple heating systems distributed about the building with only a single flue (each fan-coil unit still needs its own AC outdoor section). By taking a loop off a boiler, you also get efficient water heating with no additional flue. In fact, this is the most efficient way to heat domestic water if you use a high-efficiency boiler and a well-insulated storage tank.

To get rid of fossil fuel and the need for vent piping altogether, you can buy an electric furnace, which has a resistance coil in the ductwork as well as the AC coil. This option has a low initial cost but very high operating costs, so I seldom use it.

If you use electric heating, it makes sense to pay more up front to scatter electric baseboards or radiant panels around the house. These can be controlled room by room, holding down operating costs. One place I use electric heat happily is to superheat bathrooms and to serve remote rooms where it is impractical to run ducts or piping.

Zoning Whole-House Systems

Zoning air systems is a big problem, and is generally a waste of time and money, especially in a small house. If you want to let a room get warmer or cooler, just shut off the supply grille. Remember, when air conditioning, don't open up one part of the house and cool the rest, or you are likely to increase and not decrease your energy bill because of the added humidity.

Zoning is a high-end option. So if your customer insists on it, you might as well do it right by installing a separate system for each zone. In a $1 million home I designed (over 6,000 square feet), we had five separate furnaces, each with its own AC unit. The resulting system was unbelievably quiet and accurate, but also very expensive.

There are systems now on the market that allow you to zone the supply ductwork from a central furnace, using motorized dampers and a bypass duct. These were developed for commercial buildings, however. In my opinion, they're of questionable use for houses. Whatever you do, don't create small zones, as most of these systems can't cope with them. Instead, be content with two, or at most three, roughly equal zones.

One advantage of using a separate system for each zone is that in a big house, you cut down on the ductwork. For example, you might have a small system in the attic, serving the top floor, and a larger one in the basement, serving the lower floors. This would eliminate any vertical ductwork in the house, partially offsetting the cost of the second system. ■

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