Organizing the Mechanicals

Without a clear plan, large-house systems can get out of hand

BY DOUG HORGAN

When we build a normal-sized house, future maintenance and repair work is often straightforward. If the upstairs is hot in July, the upstairs HVAC system is the culprit. If the lights in "bedroom 2" aren't working, you just go find the breaker in the panel box. And the two hose faucet drains are in the basement, near the hose faucet locations.

But not every house is normal. In a mega-house, the HVAC, electrical, and plumbing systems are extensive and complex. We've built houses as large as 30,000 square feet—so large that we need to take extra steps to organize and document the house systems, or they will cause hours of headaches later. Here are some of the ways we make bigger houses manageable.

ELECTRICAL

If you don't start with a good plan, you'll have a lot of trouble with electrical systems. Large houses have multiple breaker panels, and it's a good idea to locate and organize them the way a homeowner will think about them. For example, a panel on the second level can have all the second- and third-level circuits, or the two panels on the north end of the basement can do everything on the north half of the house, and so forth. If half of the circuits on the second floor are on a nearby panel, but the rest are on two different panels in the basement, frustration and wasted time can result.

Labeling panels early on helps a lot too. Later trades can note on their equipment where it's fed from, if the panels are labeled early.

Photos by Doug Horgan

The wiring circuits for a huge house **(1, 2)** can pose a challenge to installers and to maintenance or remodeling companies. The author recommends terminating wiring runs in panels in a way that will make sense to the owners and future electricians **(3, 4)**, and labeling every wire with its purpose and the location of the devices or receptacles it serves.

We usually distribute multiple generator sub-panels and lighting-control-system panels in a similar manner. The home-automation systems we normally use are wired so every lighting circuit goes straight to a large panel full of the system switches and dimmers. Because people change their minds and add things later, it's helpful to have these scattered around a large home. It also saves a lot of wire to have them near the areas they control. In a house that's 150 feet long and 40 feet tall, this can add up.

The electricians should keep a detailed list by room, noting where lighting and outlets are wired to. "Bedroom 4 plugs: panel 5 (upstairs laundry room). Bedroom 4 lights: lighting control panel 3, controller 2, load 4. Bedroom 4 bath lights: lighting control panel 3, controller 2, load 5." A neat copy of this should be left with the house, though our best electricians keep a copy with them as well and can answer questions over the phone.

Labeling individual wires inside panel boxes is another helpful practice. Changes are inevitable and can be extensive, and large crews will be more productive if any electrician can understand each panel.

Ground fault protection is another area where some organization is crucial. In a smaller house, a few GFCI breakers are manageable. In a house with six breaker panels, eight bathrooms, four unfinished mechanical and garage spaces, and another 10 outdoor plugs, we've ultimately found that it's simpler to install GFCI plugs at each location where protection is needed. Yes, it meets code to wire three utility rooms on one GFCI breaker, or to put the porch and garage plugs all on a GFCI plug located in some random spot like the powder room. But it's a giant pain to find and reset them, and we get the phone calls when clients can't figure it out. We even find ourselves creating elaborate maps on some of our remodels. It's much easier to have a GFCI in the garage, a GFCI on the porch, every outdoor plug its own GFCI, every bathroom its own.

Even in kitchens where we sometimes use plug strips or other decorative devices, we find a spot on a side wall or in a cabinet for the GFCI reset button.

PLUMBING

We don't usually make extra efforts to valve off or label individual bathrooms (unless we're using a manifold-type plumbing system). But there are a few extras that can improve a plumber's day at some point down the road.

First, it's a decent idea to break the house up into a few sections that can be closed off individually. That way, if something goes wrong, part of the house can keep running. A house with no bathrooms is much worse than a house with at least one working bathroom. We let the layout of the house decide where and how to do this. In our area, larger houses usually have more than one mechanical room in the basement, and we have the plumbers run a large line from one to the other and branch out from there; each half can be shut off independently.

A house with six or 12 hose faucets can be a challenge to drain down for winter. We've remodeled large houses where plumbers scattered shut-offs and drains all around the house, and clients can't remember where some of them are. A few winters later, they change maintenance people, and we get a call about a flood from a frozen pipe. To simplify the process, we group hose shut-offs into a manifold. One shut-off closes off the water to all the faucets, and we put a boiler tap on the manifold for a hose to the drain.

It's common these days to run a gas-line manifold as well, particularly with corrugated stainless steel tubing (CSST) installations. Labeling the valves accurately is obviously important. When we have more than one manifold, we include tags on each, noting the other locations.

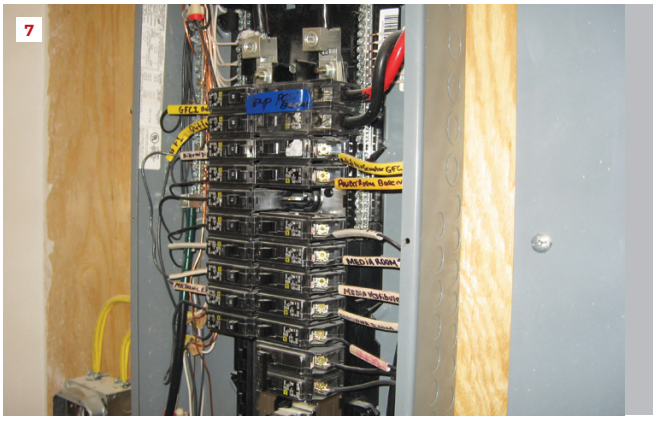
Another trick we've learned is to add some extra valves to double hot-water-tank installations. A number of our luxury homes have two tanks. With a little bit of thought, these can be installed so one can stay operational even when the other needs to be shut off for service or replacement. This turns a leaky water heater from a "must be replaced today" emergency to a simple matter of turning a few ball valves and scheduling the work when convenient.

We even have a few houses with two wells, and an interconnection between them can be a great convenience to the clients. Even if one well was installed for the irrigation system, when lighting zaps the main house well pump, we can turn some valves and keep the house operational for the time being. Another key is installing a bypass around water-treatment devices, so the house can still have water even when they break.

Be careful with recirculating hot water. We can't seem to get away from hot-water recirc lines with the spread-out designs we are given, but our unfortunate experience with them is that they literally wear out the piping, sometimes within a decade. Hard or acidic water accelerates the process, but it can happen with any water. The key is to minimize the rate and time of pumping. We use minimally sized pumps (if your plumber is


5


6


7

When power circuits and lighting-control circuits are extensive enough to fill several panels **(5)**, it can be helpful to organize some circuits into sub-panels located around the building **(6)**. Every circuit should be clearly labeled to indicate what it's for and where it leads **(7)**.

A manifold system **(8)** is a good way to keep dozens of hot- and cold-water runs organized. The author recommends organizing outdoor-hose-bibb piping lines and gas lines at a central location **(9, 10, 11)**, with the capability of shutting all the lines down at once as well as individually, and with all lines clearly labeled to indicate what they serve and where they terminate.

nervous about a small pump, have them use a multi-speed pump and set it to the lowest option), and always install an "aquastat" thermostatic device to turn the pump off when the line is hot.

Our attempts to use timers have had mixed results. Typically, we find the timers bypassed or set to "always on" within a couple of years. The pump shown in photo 13 on page 34 thinks it's 11:30 at night when it's 1:40 in the afternoon. The clients have switched it from "timer" to "on" because of frustration with the timer.

One setup that seems reliable is using the home automation system. It usually has an accurate clock that resets itself after power outages. For our second-home clients, we include the recirc pump on the "away mode" list so it turns off when they are away from the house.

If you find your plans require more than one recirc line, definitely put valves on each one so they can be balanced. Shorter or larger-diameter lines may need to be throttled back in order to ensure that the other lines get flow.

Our standard is Type L copper piping. It's a bit thicker than the standard Type M, which helps with recirc line durability. If I understand, in commercial buildings, Type K (even thicker yet) is sometimes used on recirc lines, but our plumbers have pointed out that standard copper fittings are the same thickness as Type L, and they don't feel an additional upgrade to the tubing is warranted.

Pipe expansion loops. We did a renovation on a large house with the mechanical room at one end and the master bathroom on the opposite end. The hot-water supply and recirc lines were more than 100 feet long. While we were working there, three leaks in this long run appeared. On investigation, we found that CPVC piping is supposed to be installed to account for expansion and contraction. Long runs can move quite a bit with temperature changes. A simple offset arrangement will handle the movement, and is spelled out in the manufacturers' manuals.

Pipe calculations. Some luxury baths have amazing amenities,


12


13


14

When a large house is served by a well with possibly limited water production, large buffer tanks **(12)** can ensure that water does not run out during high-demand periods. Recirculating timers can go out of synchronization, in the author's experience **(13)**. One way to reduce wear on recirculation lines is to use an aquastat **(14)** that turns the pump off when the line is hot.

but the design process needs to be thorough. We recently installed a shower with a total of 13 heads between the body sprays, rain head, and handhelds. The plumbing supplier calculated that we needed four instantaneous heaters to support the shower, and the directions for the heaters called for a 1 1/2-inch cold supply line to the four heaters.

So far so good, but it turned out the house was on a well with a 3/4-inch supply line into the house. There are ways to adapt to such a situation, but they need to be figured out in advance.

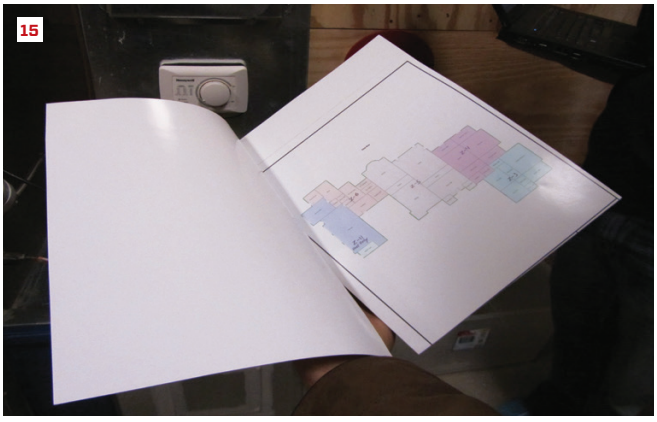
Many of our largest homes are on well service. If a shower has multiple heads or if a large family may simultaneously run water, the draw could be 15, 20, or even more gallons per minute, much more than most wells can put out. We install a storage tank in the basement for this situation. Two hundred gallons of stored water smooths out the high draws and allows the well to catch up even if it puts out only five gallons a minute.

HEATING, VENTILATION, AND AIR CONDITIONING

A relatively simple house may have two or three HVAC systems, and for that, a formal HVAC schematic may not be needed. But we've been involved with homes with eight or 12 systems, and some of those had zone controls with 20 or 30 thermostats. In such a large house, an easily understood floor plan showing which rooms are on which HVAC systems is essential.

This drawing should also show unit locations, thermostat locations, and outdoor compressors. If systems have automatic zone dampers directing air to separate parts of the ductwork, obviously these need to be documented. It's even important to make an early decision on unit names. If the HVAC company calls a unit "attic system 2" but the electricians label it "north attic compressor," it slows everything down.

The same situation applies to floor heat zones—a layout with manifold locations, zone pumps, and systems is a must for future



A clear schematic indicating which parts of the house are served by which HVAC systems **(15)** can help with troubleshooting and modifications. Screens to hide outdoor HVAC equipment **(16, 17)** should allow plenty of airflow and should leave ample space and easy access for maintenance and repair workers **(18)**.

service. (If you don't have that, you have a good excuse to finally buy that infrared camera, so you can figure out which loop is where.)

To facilitate future maintenance, it's much better to install the same size filters on the big systems, if at all possible. That way, filters can be ordered by the case. And if any unusual filters are installed, like the one 12-by-12-by-1-inch filter back grille in the bonus room, an obvious label on the machine can help future techs find them.

A checklist of all devices and filters is a necessity. The rear crawlspace dehumidifier has its own little filter, the attic ERV has two, and the third-floor south system has a humidifier cartridge that needs annual replacement. It's easy to forget something.

Be sure to walk the HVAC installers through the house and verify the operation of every piece of equipment. We once found a humidifier had never been wired up because the electricians forgot all about it. It was one of more than 50 devices on that house—an easy mistake to make if you don't check.

Geothermal systems have their charms—and are very expensive to install. One thing for sure, though, it's much easier to deal with the indoor-only equipment, compared with finding places to put five, 10, or more outdoor air-conditioning compressors.

Finding ways to somewhat hide outdoor units while keeping them fully functional can take some creative thinking. Normal units need full flow of outdoor air from the sides and an open area above them. A solid fence or even a thick hedge can block airflow in; a deck or porch can block the hot air leaving. Either will cause the hot discharge air to recirculate down through the coil, which reduces capacity (which clients will notice) and also causes premature wear and high energy use (not necessarily a priority, but best to avoid). An open lattice fence seems to be acceptable to most clients and visually blocks the equipment while allowing normal function.

Doug Horgan is vice president of best practices at BOWA.