

Think Steel



The exterior of this steel-framed home looks like any other. It uses OSB or plywood sheathing over steel studs and can have any kind of siding, including brick veneer.

by
Jack
Dahlgren

Big free spans, no shrinking, and termite protection are some of the pluses of pre-cut steel homes

People have a lot of funny ideas about steel-framed houses. They think if you knock on a wall it will echo like a steel drum. They think whole beams will rust out the way the underside of an old car does. Some even think steel-framed houses attract lightning and are hazardous during thunderstorms.

These are myths. Steel-framed houses can look just like stick-built houses. The drywall, the siding, the windows, and the doors are all standard building materials. You can build familiar styles -- Colonial, contemporary, or rustic. Of course if you want a steel house that looks like steel, that can be done too.

Why Steel?

After many years of putting up steel structures for general contractors, I'm partial to steel and comfortable assembling steel components. As a construction consultant for Tri-Steel Structures (Irving, Texas), a steel-house manufacturer, I meet many builders who are switching from wood to steel. One of the reasons they

give is the poor quality of the wood.

Most steel-house builders rely on one of the eight pre-engineered kit manufacturers for design help and building components. When you're building from a kit, the pieces come cut to length with holes predrilled where they bolt together. It's like working with an erector set - A goes to A, and B to B. You just follow the plans.

The manufacturer I work with has been making house kits for nine years. The company offers 85 standard house designs that range from 900 to 8,000 square feet and cost between \$5,000 and \$100,000. The unassembled kits include the pre-cut, C-channel framing steel for exterior walls and rafters, non-structural metal studs for partitions and exterior walls, metal roof purlins, metal furring for ceilings, metal sub-fascia and soffit framing material, fasteners, bolts, instruction manuals, and house plans. Kits are banded together on pallets and delivered by truck to your job site.

Most of the major companies require you to become a distributor to purchase a



Figure 1. Like a commercial building, a steel house starts with a heavy frame of posts, rafters, and girts set with a crane. Foundation bolts embedded in the concrete secure the columns in place.

kit. You pay a one-time distribution fee, which is applied to your purchases, and you can use their construction consultant to guide you through the construction process.

Many builders are convinced that steel-framed homes cost more than wood. However, it's tough to accurately compare costs. Steel framing does cost more in materials, but it goes up quickly, saving on labor.

Nuts and Bolts

The first step in construction is to provide the right foundation. You have to use reinforced concrete foundations with steel homes because reinforced concrete distributes the concentrated load coming from the columns (see Figure 1). You can build the house on a basement, crawlspace, or slab, as long as you use reinforced concrete.

Your foundation subs must follow the

exact dimensions specified on the plans. If the plans call for a foundation 30 feet across, it cannot be 29 feet 11 inches. When you set the steel framing on top, it will hang an inch over the sides of the foundation wall, and will not be properly supported.

Structural frame. Steel's strength is measured by its gauge. The lower the gauge, the stronger the steel. The steel used for residential framing is usually not as strong as that used for commercial construction. It is called "cold-formed" because it is shaped mechanically, without heat, in a rolling mill. Production costs for this type of steel are low.

When you build a steel house, you assemble the structural components first. The columns are 12- to 16-gauge C-channel, 8 inches deep and with a 2-1/2- or 3-1/2-inch-wide flange, depending on snow load. Rafters are 8

to 10 inches deep. Although they are steel, we call these pieces "red iron" because the components are painted with a rust inhibitor that gives them their red color.

Where rafters and columns join, you install a 1/2-inch-thick plate, and bolt the assembly together. Ceiling beams can also be part of this assembly. Depending on the length of the span, the floor joists may be red iron or the same C-shaped galvanized steel members used in non-loadbearing exterior walls. These are normally 18- to 20-gauge and are set at 16 inches on-center.

The roughly A-shaped structural-steel modules are bolted together on the ground. (Instead of working aloft, I like the safety and ease of assembling the units on the ground.) Once the structural frame is assembled, a crane hoists the units and sets them in place on the foundation as in a commercial metal building. However, the framing is surprisingly light; with smaller homes, my crew can drag the members into place.

We space the columns 8 feet on-center. Once the units are upright, we secure the column bottoms to the foundation with J-bolts or chemical anchors. The C-channel modules face the same direction so batt insulation

good energy efficiency.

To finish our ceilings, we install a lighter-gauge hat channel (only 7/8-inch deep) perpendicular to the structural members. The 16-inch spacing keeps our drywall from sagging. Most of the time we use conventional drywall screws, but where we bump into the red iron, we may have to use 1-1/4-inch #6 self-tapping screws.

Roofing and sheathing. Because the structural members are spaced 8 feet apart, you need additional support for roof sheathing. We use 2-1/2-inch-deep, 18-gauge hat-channel purlins and space them 2 feet on-center. These run perpendicular to the red iron.

We then attach oriented-strand board (OSB) or plywood sheathing with a screw gun and self-tapping screws, and shingle in the normal way. You can also use metal roofs, either M-panels or R-panels. These are 3 feet wide and run the length of the roof.

For wall sheathing we use OSB or plywood. Many builders wrap the walls with Tyvek. Windows or doors can be wood or metal, and any type of siding or brick veneer can be used.

The Right Tools

Subs unfamiliar with metal construction often balk at putting down their



Figure 2. Interior walls are made from 3-5/8-inch metal studs, the exact dimension of a 2x4. Roof purlins that run perpendicular to the steel are 2-1/2-inch-deep hat channels, spaced 2-feet on-center.

will fit evenly into all the cavities.

Depending on the size of the home, the whole framing procedure can take as little as one day. The relative speed and ease of assembly means you can get the framing in place and the house weathertight quickly. Even if rain slows you up, you don't have to worry about the steel warping or rotting.

Interior and exterior walls and ceilings. Interior walls are 3-5/8 inches - the exact dimensions of a 2x4 - so we can use off-the-shelf interior doors and finish materials. The studs, like those you find in commercial construction, slip into a metal track anchored to the floor.

The exterior wall studs have to match the thickness of the structural steel, so for these we use 22-gauge, 8-inch-deep studs and space them 2 feet on-center, a convenient spacing for sheathing, insulation, and drywall (see Figure 2). Because the wall studs give us a full 8 inches, I use R-30 insulation. Not only does it keep the house comfortable; it deadens outside noise. Heat loss through the studs doesn't seem to be a major problem. Our hvac contractor downsizes the heating and cooling system, and our buyers report

hammer and picking up a screw gun. I find it's best to hire subs and crew who are experienced in commercial construction or who are at least familiar with the tools.

Builders contemplating steel construction may need some new tools. I use a 0- to 2,500-rpm variable-speed screw gun with a Philips-tip and nut setters. A pair of right- and left-hand metal cutters are very handy for slicing small metal pieces. A 4-foot or 6-foot magnetic level will hold directly to the beams. I use a spud wrench to pull the steel members close enough to line up bolt holes and set a number-11 welder's vice-grip pliers to hold pieces together while I work.

I almost never use nails -- even on finishing work. In my mind, nails are used for temporary fastening and screws for permanent holding power. With steel houses, I think in terms of permanence. ■

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Why I Like Steel

Steel has lots of advantages. First is its strength. You can clear-span up to 40 feet with steel, which is difficult to do with wood. This makes steel frames ideal for contemporary homes, which often feature vast open areas.

Steel will rust, but you'd have to leave it exposed to the elements for a long time before the rust could significantly weaken a member. On the other hand, steel resists termites and rot. This is especially important in states where termites are a real threat.

Steel-framed homes are especially useful in areas with severe weather or those prone to seismic activity. Because of steel's inherent strength, it will withstand seismic loads and heavy snow and wind loads better than other types of homes.

Many insurance companies offer homeowners who are living in steel-framed homes a discount on their fire insurance. Steel is non-combustible. In many cases, steel homes can be rebuilt following a fire since the framing is intact.

The stability of steel is another asset. Steel doesn't buckle, twist, warp, or rot like wood. A 2x4 might look straight when it's fresh from the mill, but once the water starts to evaporate, the board can begin twisting and bending. Meanwhile, the drywall that covers it starts bowing and the nails pop. If the 2x4 is part of a load-bearing wall, then you've lost some of the strength. A steel beam stays as straight (or as crooked) as the day you put it in.

I had a real estate agent come into one of my homes a few months ago. The buyers liked the house from the outside and wanted a closer look. Once they'd looked around, the agent asked me if it was a steel house. After I told him it was, I asked him how he knew. "By the walls," he said. "The walls are so straight and even. I know you can't get walls like that in a wood-frame house."

—J.D.