photo courtesy Steel Joist Institute

Steel vs. Wood

Steel is beginning to creep in, even in light construction, and not everyone likes it. To some extent, there's good reason.

by Harris Hyman

My architect partner, who learned his trade in New York and Providence, has an amused tolerance for wood-framed buildings.

Recently, as we walked through an addition we had designed for an office building—a steel-framed structure with a bar joist, pan and concrete roof—the drywall subs were beginning to tape out the sheetrock. We wandered along silently until he turned to me and said, "Looks almost like a *real* building!"

In the major cities, steel stud and joist framing is the standard method of construction on buildings of masonry and steel. Wood framing is rare—and generally regarded as something done by amateurs.

Only out in the suburbs or up here in the North is wood-frame construction common—and then only on residential and small public buildings. Even here, steel replaces wood on commercial and institutional buildings.

Back in the early part of the century, *all* buildings in rural New England were small; there wasn't much difference in size between a house and a store or a schoolhouse. And the fire codes were not particularly sophisticated, so the construction style was the same for most buildings.

Wood was readily available, and it was used for everything. In the larger towns, the churches were stone and the schools were brick, but out in the villages, even these were framed of wood.

Now steel is creeping in, and not everyone likes it. It is a distinctly unnatural material, unfriendly to the hands and to the tools of the carpenter.

But steel is here, and probably to stay. It is used in most shopping centers (which generally are regarded as shabbily built, with some justification) and in schools (which generally are regarded as well-built, also with some justification). And it's used in hospitals and office buildings, and in many structures that rise only a couple of stories.

The Advantages of Steel

Steel-frame construction has a number of advantages, and these are what keep it coming. During the construction of our office addition, I wandered onto the site and saw a cardboard box about eight feet long and 12 inches square, which contained most of the studs for the two-by-three-foot partition framing.

The studs are strong, fireproof and easy to erect, although they require some specialized tools. They're available in a wide variety of sizes—from one and a half inches to two feet—and fit in very well with systems construction. They're always straight and true, and they never require culling. They are rot- and vermin-proof, and they come complete with holes ready for wiring and plumbing. Almost too good to be true.

Hammers aren't much good for steel framing, but the job's a breeze with screws from a screw gun. Steel studs and joists can be easily cut with a power miter box with an abrasive blade. If you are handy with an arc-welder, you can attach them with spot welds; if not, you can screw them together. On the outside, you can screw sheet sheathing directly to the studs; inside, you can screw up drywall directly.

Some builders in the South are beginning to use steel framing in single- family residential construction. One steel-systems supplier invited Michael, our beloved editor, to an affair at which a 1,280-square-foot house was to be erected between lunch and cocktails.

Then there's the ad showing the chapel erected in one day "by six senior church members." This may be abnormal hustle, but I've personally witnessed a four-man crew framing out 2,000-square-foot floors at one a day while concrete was being placed three floors above. Not your typical small-town scene, but impressive.

Energy Drawbacks

But steel isn't perfect, particularly for energy-efficient construction. Steel has only about 0.4 percent the R-value of wood. Heat conducted through a two-by-four stud of steel is about two and a half times the heat conducted through a wooden two-by-four. This is particularly bad in the case of thicker walls and insulation, where heat loss through the steel will render the extra wall thickness meaningless.

Research conducted on actual construction shows that the R-value of an insulated, six-inch steel-framed wall is a third less than that of a two-by-six wood-framed system with equal levels of insulation. The findings generally concur with theoretical analyses, although the measured heat losses are slightly higher than the theoretical values.

It may be possible to overcome this problem with my favorite type of wall construction: a two-by-six stud wall with an inner layer of polystyrene or polyisocyanurate held

in place with gypsum board screwed to the studs. Still, I suspect that wood would do better, because *a* horizontally strapped wall system is a little difficult to install on steel framing.

In addition, all those nice details for cold-climate construction and air-vapor barriers that were developed in Canada are intrinsically for wood construction, so the use of steel studs would require a lot of thought and some experimentation. The two systems are not interchangeable.

Steel might do all right with double-wall construction, but even here there would be heat loss through the plates. (Of course, the steel suppliers have a bunch of active engineers designing away, and they may develop some details. The wood suppliers have sawmills and lawyers and salesmen, but I have yet to see any innovative engineering with wood stud systems in this country.)

Arco is manufacturing an interesting system consisting of steel-framed panels of expanded polystyrene (beadboard). The company claims excellent infiltration control through the walls, but there are other ways to do this. In addition, the four-inch panels have R-values of only 15 or so from the beadboard, but the net R-value is probably less because of the steel.

The system may have some potential in warmer climates, but it's unlikely to make it in the harsher parts of New England. (My personal guess is that other products would be more effective in areas where the number of degree-days exceeds 5,000.)

Other Considerations

Another claim made by the steel folks is that steel has a better strength-to-weight ratio than wood. This may be true, but it isn't particularly significant. If two-by-ten joists are compared, the steel has about one and a half the strength of an equivalent amount of wood. Steel joists just ship in smaller containers.

But the internal damping of wood is much greater than that of steel. This quality lets wood absorb shock—loud noises, walking, running, and the dropping of things—without transmitting it to other parts of the building and without "ringing." As a result, a wood-framed building has a friendlier, more sturdy feel. The purists are right—it is a more satisfying structure with wood.

Nonetheless, steel is with us. US Gypsum appears to be the largest supplier of steel-framing systems, complete with screws, and the company is more than willing to give out information. (It even publishes a handbook that gives lots of details.) My local distributor doesn't stock the material but will get it on special order. Tools are readily available.

How will steel be accepted in the North? Reluctantly and sporadically, I believe. I don't think it will make many inroads in housing construction, however, because of the major problems with energy efficiency and because the only real advantage is speed of framing.

Lower oil prices now are causing us to de-emphasize energy efficiency, but I think the burning we all took in 74 when the prices first jumped will not be forgotten for a long, long time. This will reinforce our heavy conservatism until some builder (or maybe a steel manufacturer) starts putting up energy-efficient, steel-framed houses comparable to those framed with our old standby, wood. ■

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