

The Latest on Steel Stud Walls



Jan Kosny is a senior research engineer at Oak Ridge National Laboratory's Buildings Technology Center.

Q. We are interested in building our own home in Northern California, just east of Sacramento. It is our understanding that steel-framed homes are considered more energy efficient than wood-framed homes. What do you think?

—Northern California Dreamer

A. Steel stud wall systems for residential and commercial buildings are gaining in popularity. If you want to build with steel, you need to know some of its limitations as a building material. Steel is a much better conductor of heat than wood, so steel studs can actually *degrade* the thermal performance of walls. But the technology is improving, and it can be a good choice for use in building your home.

Several wall configurations have been developed to improve the thermal performance of steel framing. During the last decade, ORNL has tested and analyzed most of the steel framing systems available today. Our experimental and theoretical study has focused on the thermal efficiency of different traditional and unconventional methods of improving steel stud wall thermal performance. It proved that steel-framed walls can be as efficient as wood stud walls (see “Steel Stud Walls: Breaking the Thermal Bridge,” *HE* July/Aug ’01, p. 6). After testing more than 40 different steel stud wall assemblies, we came to the following conclusions:

- It is possible to construct steel stud walls that perform as well as, or even better than, similar wood frame walls.
- Traditionally, using insulating sheathing is a simple and effective way of reducing heat losses caused by steel components in steel stud walls. However, this application of foam sheathing adds thickness to the wall. This complicates the installation of win-



dows and doors, and, in general, adds cost to the project.

- Reduction of the contact area between steel studs and wall finish layers (wood or steel furring) is only effective if accompanied by the additional insulating sheathing.

- Use of the expanded channel steel studs, or studs with perforated webs (the stud web area is reduced 40%–65%), is one of the most effective ways of improving the thermal performance of steel stud walls.

- Walls containing combined steel studs (two rows of small steel studs using foam or wood as a connector) can be more effective than similar wood stud walls. However, such designs may be very expensive.

- Walls with foam-covered steel studs perform as well as wood stud walls. These studs are also cheaper than foam sheathing. The use of the foam-covered studs can be the simplest way of dramatically improving the thermal performance of steel stud walls.

There are a lot of new developments in steel stud wall systems here at ORNL, and we welcome commercial collaborators. We are working with SustainBuilt of Houston, Texas, and the Texas Energy Office to develop a novel, affordable panelized steel-and-foam wall system. From the structural point of view, the

proposed building envelope system will be based on the concept utilized by structural insulated panels (SIPs), with structural members that are characteristic of steel-framed technologies. From the thermal point of view, a unique application of thermal mass components (active thermal mass inserts containing PCM—phase change material), an internal radiant barrier installed directly on the panel skin, and a new closed-cell polyurethane foam (with thermal conductivity 15%–20% lower than that of similar foams) will make it possible for the wall system to exceed R-22.

Because the climate is hot and humid, mold and moisture are significant problems in Texas. With this new technology, we’re trying to solve most of the moisture and air leakage problems that sometimes occur with currently used wood frame and SIP technologies, such as air leakage through the walls and roof and the movement of moist or very cold air within the building envelope.

Texas is a high-risk insurance state, due to its expansive Gulf Coast and its exposure to hurricanes and tropical storms. We anticipate that our new envelope technology will substantially outperform conventional wood frame construction when tested for wind and uplift load tolerances. Therefore, a significant residual benefit of this envelope

technology will be a reduction in insurance risks (and therefore insurance premiums) due to higher wind tolerance as well as noncombustibility. Independent laboratories will test the wall system for wind tolerance and for combustion safety certification. With help from DOE, we hope to be ready for structural and fire testing within the next two years.

In addition, the proposed novel envelope system will have the capability to be fully integrated with Active Thermal Core (ATC), a hydronic space conditioning system that has just been developed by ORNL. Hydronic systems combine the radiant heating/cooling system function with the application of thermal mass. We expect that peak-hour loads in residential buildings constructed with the proposed building envelope technology will be 50%–70% lower than peak-hour loads in comparable residential buildings constructed using conventional wood frame technologies. The new wall system will also incorporate a novel structural and energy efficiency concept—self-sealing seams that will serve simultaneously as structural components, similar to conven-

tional studs, and as an air gasket. The panel facing will be made of 26 gauge steel.

A proprietary thermally-reactive component containing phase change material (PCM) is now being considered for this type of building envelope application. Our plan is to bond PCM with a combination of different fibers. This past June, the first material samples were fabricated in collaboration with Advanced Fiber Technology of Cincinnati, Ohio, and BASF-USA. The most likely form for the application is a composite building product containing 30–50 weight % PCM. We expect that computer simulations will give us more information about the optimum fusion temperature range, the necessary amount of PCM, and its optimum location.

We are also working on a second-generation Tri-Chord wall system. Tri-Chord columns (functionally equivalent to 2 x 4 studs) consist of two triangular columns connected together with a highly perforated web. The wall technology will be as energy efficient as traditional wood framing. We have hot-box-tested a Tri-Chord wall using mineral wool for insulation

and are performing detailed computer analysis of all the system architectural interfaces. A series of about ten hot-box tests is planned in the next few months. These tests will compare the energy performance of conventional wood- and steel-framed walls against Tri-Chord wall technology.

Ricky Godwin of Tri-Chord expects that the new steel framing material will cost no more than the Tri-Chord product available today. According to Godwin, “There should be no price increase. We are looking at a dimpling process and other modifications. After the initial tooling costs the same machine can do the job, so no increase in cost should be necessary.”



For more information:

If you are interested in the development of steel frame technology, contact Jan Kosny by e-mail at kjo@ornl.gov.

What Were They Thinking?



COMMUNITY ACTION OF NORTHEAST INDIANA

This photograph was taken by Community Action of Northeast Indiana's Weatherization Inspector Mike Slater on a recent home inspection. If you have trouble discerning what the photo depicts, you'll notice that the water heater is common vented with a furnace (to the right), but the T-fitting above the water heater's draft hood also connects to another appliance to the water heater's left. What would it be? Not shown in the photo is the mystery appliance located on the other side of the wall, which happens to be a range hood exhaust fan! The homeowner kept having to relight the pilot to the water heater after using the range hood vent fan. Hmm... wonder why? The flexible vent connector and the duct tape to secure it all together are just added goodies to this little mess.

Thought your readers might get a chuckle out of this one.

Submitted by
Joel Harms
Weatherization Inspector
Community Action of Northeast Indiana
Fort Wayne, Indiana