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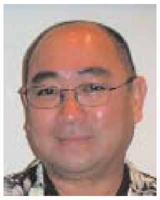
A FEW WORDS ABOUT STEEL

A Victory For Cold-Formed Steel

By Les Nagata



As a long-standing member of the Light Gauge Steel Engineers Association, I am very pleased with the planned merger of LGSEA with the Steel Framing Alliance. This union will bring two great organizations into alignment.

Both organizations have done a great deal for the cold-formed steel industry. By combining resources, efforts and manpower, even greater possibilities exist for both organizations. Indeed, LGSEA, the technical entity of the cold-formed steel industry, is essential for the attainment of SFA's goal to establish prominence for cold-formed steel in the construction marketplace. Conversely, LGSEA needs SFA's support to conduct the technical programs that the industry demands and to disseminate this information. This logical marriage creates a synergy that is not only desirable but essential.

Here in Hawaii, our local LGSEA chapter is very strong and active. Likewise, our local SFA has many programs throughout the year and is very visible throughout the state. Both organizations have worked closely for many years. Our local LGSEA and SFA organizations have participated in joint functions, co-sponsored joint seminars and collaborated on many projects for the benefit of the cold-formed steel industry.

As an example, Hawaii's SFA and LGSEA have created a joint scholarship program in conjunction with the University of Hawaii, with SFA funding the scholarship and LGSEA overseeing the award of this scholarship to a student interested in pursuing an engineering career preferably focusing on cold-formed steel. It is this kind of cooperation and joint effort that has ensured a thriving steel industry in Hawaii.

> By uniting both organizations, significant efficiencies can be realized.

The progress made in cold-formed

Behind the Alliance

The Light Gauge Steel Engineers Association members, by a significant margin, recently approved a proposal to become a council of the Steel Framing Alliance. With this approval, the LGSEA will serve as the steel framing industry's home for professional designers.

LGSEA board members, by majority vote, endorsed the union. The Board of LGSEA is preparing for transition into its new entity and an advisory panel created by SFA is currently guiding LGSEA's new role and focus in its new capacity.

Watch upcoming issues of Framework for updates on the formation of this new council.

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steel design and construction in Hawaii would not have been possible without both the SFA and the LGSEA. Many individuals in Hawaii belong to both organizations and have served on both Boards. Thus it makes sense, especially here in Hawaii, that SFA and LGSEA unite and streamline their operations.

By uniting both organizations, significant efficiencies can be realized. Duplication of effort and programs will be virtually eliminated and each group can focus on what is germane to its existence. The engineers will be able to focus on technical issues (without administrative distractions) and SFA will have a strong technical arm, which is necessary for its mission to spread the use of cold-formed steel in the construction industry.

By uniting under one umbrella, SFA's and LGSEA's finite resources can be put to more efficient use. The volunteer manhours engineers donate to these organizations will be more focused. More money can be directly infused into research projects and spent to develop and disseminate technical information. It takes a tremendous amount of manhours and money to conduct research, develop technical documents, publish documents, maintain a Web site and do all the administrative functions that accompany these processes.

Rolling the Steel Framing Alliance Technology Team into the LGSEA Research and Development Committee will create one cold-formed engineering brain trust, and will provide a venue for the development of ideas and programs that will help everyone in the industry, from the owner through the design team and suppliers, down to the builder and framer.

Recognizing that the LGSEA is a very special arm of the SFA, a set of "Operating Procedures" has been created specifically for this committee. These operating procedures define an administrative structure for the committee, as well as a procedure for developing technical research projects and for producing technical documents for publication. These procedures create a consensus process that gives LGSEA technical autonomy to pursue projects beneficial to the design profession and gives SFA oversight on this committee. The procedures will streamline the processes required to get technical documents and information out to the engineering community. Also, the creation of a Technical Review Committee will ensure the quality of technical documents, seminars, and other products distributed by the Steel Framing Alliance.

This is an exciting time to be an engineer involved in cold-formed steel design. Although cold-formed steel has been around a long time, only now are we realizing the structural potential of this material. New products, processes and design knowledge are constantly emerging. Designers are stretching the limits of possibilities. Steel is a very consistent and versatile product, making it a very efficient structural material. Knowing that I can rely on and have the support of the SFA/LGSEA gives me much confidence to recommend and design cold-formed steel for appropriate projects. I am excited at the possibilities that this union will produce, and am extremely pleased to be a part of the Light Gauge Steel Engineers Association and the Steel Framing Alliance.

Les Nagata is president of Structural Analysis Group Inc.

MHD

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RESEARCH

SHEAR WALL ASSEMBLIES OF COLD-FORMED STEEL

BY JEFF ELLIS P.E., S.E.

DESIGN PROVISIONS FOR COLD-FORMED STEEL SHEAR WALL ASSEMBLIES AND UNDERSTANDING OF THEIR PERFORMANCE HAVE CERTAINLY GROWN SINCE THE EARLY 1990S. SIGNIFICANT ADVANCES AND ADDITIONS IN THE PROVISIONS FOR THESE SYSTEMS HAVE OCCURRED SINCE THE INCLUSION OF THE FIRST CODE PROVISIONS IN THE 1997 UNIFORM BUILDING CODE, SUCH AS ADDITION OF VALUES FOR STEEL AND GYPSUM SHEATHING, ALLOWANCE FOR THICKER FRAMING MEMBERS, SHEAR WALLS WITH OPENINGS, AND DEFLECTION EQUATIONS.

The recently published "Standard for Cold-Formed Steel Framing – Lateral Design, 2004 Edition" **(Figure 1)** from the American Iron and Steel Institute provides additional information and clarifies design and detailing requirements of cold-formed steel lateral-force resisting systems. This article discusses and illustrates the information and requirements of this new standard.

Figure 1

LIGHT-FRAMED SHEAR WALLS

A typical light-framed shear wall transfers lateral loads, in the plane of the wall, through sheathing that is attached with mechanical fasteners to the framing members. The in-plane shear loads are transferred from the shear wall to the floor framing or foundation below along the length of the bottom horizontal member (plate) while the induced overturning forces are transferred through the vertical boundary members (studs) and over-turning restraint system (holdowns) at the ends of the wall, as shown in **Figure 2**.

Typical lateral loads on shear walls result from either wind or seismic demand. Design wind loads are the actual expected wind forces, whereas design seismic loads are reduced from the actual expected seismic forces based on the type of lateral system used, how many lateral elements are used in the structure, and the level of seismic detailing performed. Designing for a reduced seismic load reduces the cost of construction significantly, but the tradeoff is damage in the structure during a major earthquake. Typically, shear wall assembly strengths are determined through monotonic tests per ASTM E72 for wind load resistance and cyclic tests per the Sequential Phase Displacement or the CUREE protocol for seismic resistance.

Member strengths and system failure modes are important considerations for seismic design. Generally, a brittle system is considered one that will fail suddenly, and a ductile system is one that has been designed and detailed to sustain more deformation without loss of load carrying capability. This is typically done by designing the connections and members that are not supposed to yield (or are incapable of yielding, such as compression columns) to have a design strength in excess of that needed to fully develop the strength of the designated yielding elements. Use of the special load combinations that employ the overstrength factor to determine the design level demand of the non-yielding components is one way to

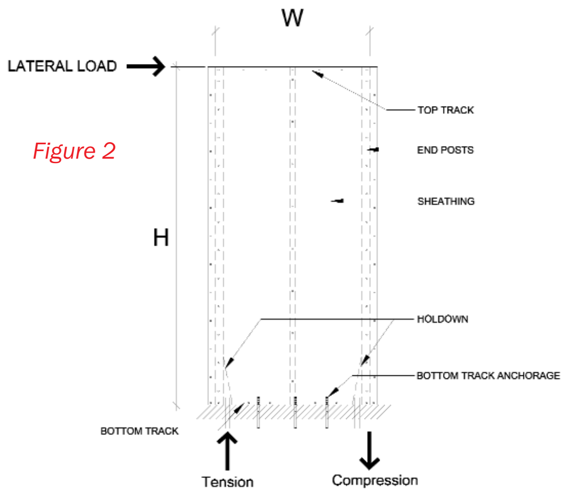


Figure 2

ensure that yielding of the designated ductile elements will occur. Codes encourage the use of ductile systems by assigning them a higher R-value, which results in lower required design loads.

Codes and standards

Cold-formed steel framed shear wall assemblies have been in the codes for several years with an initial inclusion in the 1997 Uniform Building Code. In that code, recognition was given to wood sheathed, 33- and 43-mil cold-formed steel-framed shear walls for wind and seismic resistance.

The new AISI standard and commentary includes additional design information and requirements based on the latest research. These additions include gypsum board sheathed assemblies, steel sheathed assemblies, shear wall with openings (Type II), 4:1 aspect ratio allowances in regions of moderate to high seismic risk, shear wall and diaphragm deflection equations, and wood-sheathed cold-formed steel-framed diaphragm assembly strength.

Figure 3

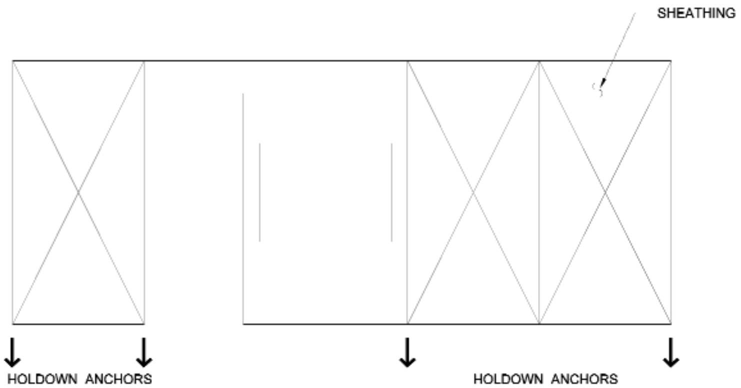
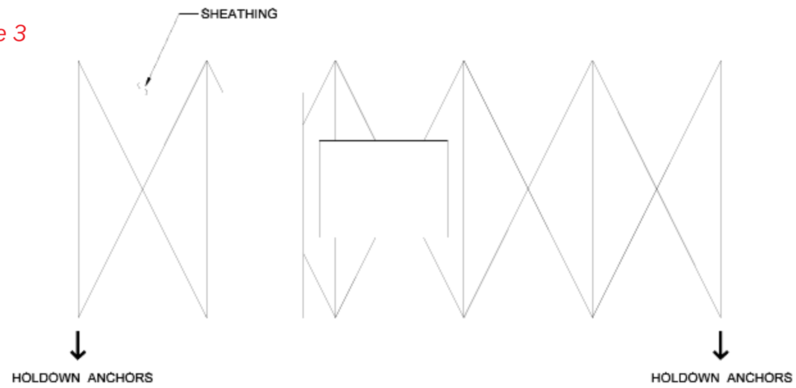


Figure 3



Shear wall types

The Lateral Standard recognizes two basic types of cold-formed steel-framed shear walls: Type I and Type II. A Type I shear wall is defined as a fully sheathed wall resisting in-plane forces, with holdowns at each end of each wall segment, and where "detailing for force transfer around the openings is provided" if the wall has openings. A Type II shear wall is defined as a wall containing multiple wall segments resisting in-plane forces, with wood or steel sheathing that contains openings between wall segments, and with holdowns only at the ends of the wall. There is no requirement to detail for shear transfer around openings in a Type II wall. **Figure 3** illustrates Type I and Type II shear walls.

Basically, Type II shear walls use Type I shear wall published strength values modified by a coefficient based on wall and opening height (shear resistance adjustment factors). Type II shear walls also have special considerations including design for a uniform uplift force along the wall bottom plates in addition to the typical Type I shear wall design for uniform shear at the bottom plates.

Shear Wall Tables

The Lateral Standard has three shear wall tables tabulating nominal strengths based on sheathing material, fastener spacing, framing thickness, and seismic or wind loading. The first table is wood- or steel-sheathed assemblies resisting wind loads, the second is gypsum-board-sheathed assemblies resisting wind or seismic loads, and the last table is wood- or steel-sheathed shear wall assemblies resisting seismic loads.

The values in the tables represent the nominal, or in this case ultimate, wall capacities. These nominal values have to be adjusted to obtain the appropriate design resistance, and this is done by multiplying by a resistance factor (ö, phi) to obtain an LRFD factored resistance, or dividing by a safety factor (Ù, omega) to obtain and ASD level resistance. Ù is 2.0 for wind and 2.5 for seismic, whereas ö is 0.65 for wind and 0.60 for seismic.

General requirements

Some of the Lateral Standard shear wall basic requirements include use of framing members with a minimum thickness of 33-mils, no shear panels less than 12 inches in width, and 24-inch maximum framing spacing. For seismic applications, it is not permitted to have a framing member thickness beyond the limits set in the table. Summing the strength of shear walls with different sheathing material on the same wall face is not permitted. One may increase the wood- or steel-sheathed shear wall strength by 30 percent if gypsum board is used on the opposite side as permitted by the first table in the Lateral Standard.

Other specifications are that the

SHEAR WALL ASSEMBLIES... CONTINUED FROM PAGE 27

wood-sheathed and steel-sheathed shear panels may be installed either perpendicular or parallel to the framing members and all panel edges are to be blocked. In addition, when the height (h) to width (w) aspect ratio of a shear wall segment is between 2:1 to 4:1, the tabulated nominal shear wall strengths shall be reduced by 2w/h.

Design procedure

A general procedure for design of shear wall assemblies is:

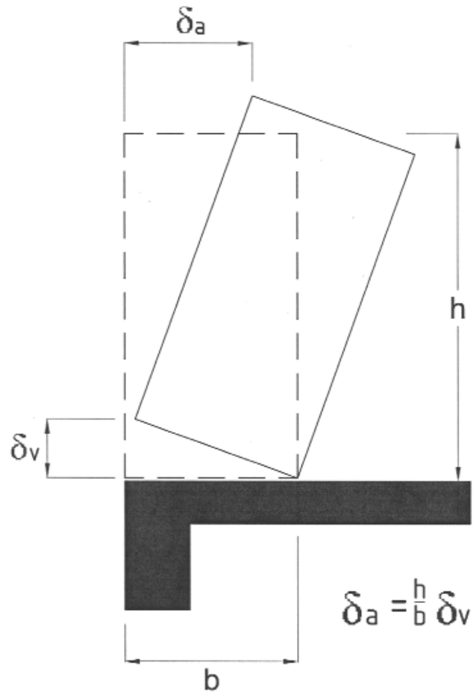
1. Determine design loads (gravity, wind, seismic, etc.).
2. Determine shear wall sheathing/fastener/ spacing/framing type based on published strengths in code or standard.
3. Design connection of member delivering the shear load to the shear wall (collector).
4. Design boundary members and supporting elements of the structure.
5. Design wall stud bracing (Ref. AISI Wall Stud Design Standard).
6. Determine the overturning restraint (holdown) and anchorage required.
7. Analyze top of shear wall horizontal displacement (story drift) to determine compliance with code requirements and adjust as necessary. Note that one may have to verify the initial load distribution based on the final shear wall stiffness if a rigid diaphragm is used.
8. Design the foundation for all induced forces, including anchorage embedment and transfer of over turning compression.

Deflection

Consideration of top of shear wall horizontal deflection is important, whether the wall is governed by wind or seismic forces, as excessive deflection can lead to building or unsightly cracks or failures in finish materials (stucco, gypsum board, glass windows, etc.). In addition, excessive deflection can lead to member or assembly failure and collapse.

Currently, there is no code drift limit for walls loaded in-plane for wind. However, ASCE7-02 commentary section CB.1.2 reads, "An absolute limit on inter-story drift may also need to be imposed in light of evidence that damage to nonstructural partitions, cladding and glazing may occur if the interstory drift exceeds about 3/8 inch unless special detailing practices are made to tolerate movement."

Figure 4



Drift from Anchorage / Holdown Deformation

For seismic loading, the drift limit is checked at the anticipated "real" position of the shear wall as it undergoes some sort of yielding, or inelastic, response to the design earthquake. To accomplish this, the codes require the amplification of drifts computed at the LRFD level by a factor that is 0.70R for UBC designs and denoted as Cd for IBC designs. While drifts must be computed by amplifying the calculated LRFD deflections, at the ASD level this does translate to a limit of approximately ½ inch for an 8-foot-tall wall.

The Lateral Standard provides a deflection equation for blocked cold-formed steel framed wood or steel sheathed shear wall assemblies. This equation is a function of four basic parts: linear elastic cantilever bending, linear elastic sheathing shear, non-linear effects, and holdown deformation. The vertical deflection due to holdown deformation is to be multiplied by the shear wall height-to-width ratio (h/w) to obtain the holdown contribution to top of wall horizontal drift, as shown in **Figure 4**.

The deflection equation is for a Type I shear wall. However, 2003 IBC states that one may compute deflection of wood framed shear walls with openings (Type II) by taking the maximum individual deflection of shear wall segments and dividing it by the shear resistance adjustment factor used in the design of the Type II shear wall. This same methodology appears appropriate as well for cold-formed steel framed shear wall assemblies.

As discussed in this article, the current codes and AISI standards and commentaries developed over the last several years provide a wealth of additional information and clarification for the designer and builder of cold-formed steel lateral-force resisting systems.

JEFF ELLIS WILL PRESENT THIS SUBJECT AS A SEMINAR AT METALCON, ON OCT. 4, 2005.

Jeff Ellis P.E., S.E. is a branch engineer for the southwest region of Simpson Strong-Tie Co. Inc. He also serves as LGSEA Structural Assemblies Committee chairman and is a member of the AISI COFS Lateral Task Group.

MHD

MASFA a Huge Success

THE MID-ATLANTIC STEEL FRAMING CONFERENCE AND SPRING FORUM, HOSTED IN ANNAPOLIS, MD., LAST MONTH BY THE MID-ATLANTIC STEEL FRAMING ALLIANCE, HAS BEEN PROCLAIMED A SUCCESS BY ORGANIZERS AND ATTENDEES ALIKE.

MASFA President and owner of Premium Steel Building Systems Danny Feazell credited supporters, including organizers Chris David (left) and Nader Elhajj, and sponsors for a fine conference at the General Membership Meeting and Dinner.

An early post-event tally counts about 160 participants in the well-rounded three-day schedule. Especially popular were the more than one dozen educational seminars—many presented to standing-room-only audiences—as well as the new-product Expo. The Welcome Reception, Membership Meeting and Dinner, and lively Dinner Cruise on the Chesapeake Bay combined entertainment with networking in festive style. And tours of the steel-making plant at Sparrows Point and a Premium Steel Building Systems jobsite provided first-hand glimpses of steel in two critical phases.

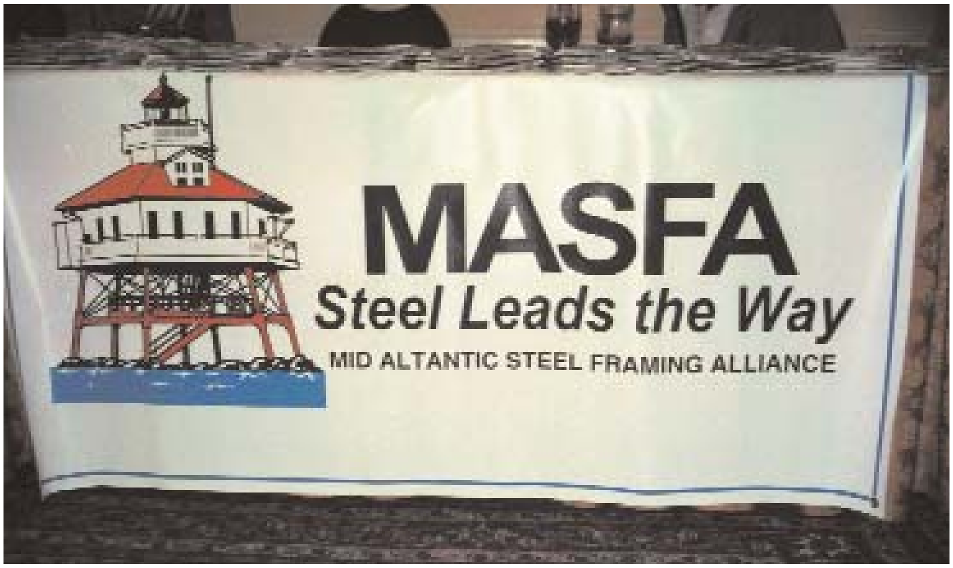
Conference sponsors were Steel Framing Alliance, Clark-Western, Nucon Steel, Premium Steel Building Systems, All-Span, Dietrich Metal Framing, Super Stud, Mittal Steel USA, Marino\Ware and Alpine TrusSteel.

"The conference set a new benchmark for Alliance programs," says SFA President Larry Williams. "MASFA did a first-rate job of organizing the conference, and ensuring that there were a broad and rich educational program and unparalleled networking opportunities."

Don't miss the 2006 Spring Forum and Membership Meetings, to be host-

MASFA A HUGE SUCCESS...
CONTINUED FROM PAGE 29

ed by the California Steel Framing Alliance! Read future issues of Framework for details.



Alliance President Larry Williams praised the event for providing an important forum for people in the industry to gather and share ideas, as well as implement those ideas into their own businesses.

Attendees packed the more than one dozen educational seminars.

Attendees were dressed up and ready to tour the steelmaking plant at Sparrows Point, hosted by Mittal Steel USA.

Speaker gets Frank about use of Steel

Andy Coelho, construction manager for Sunrise Senior Living, laid out steel's pros and cons to a rapt and receptive audience during his keynote speech at the MASFA Conference's Membership Dinner.

While both the steel-framing industry and the assisted-living business have identified this segment as a major opportunity for steel due to its non-combustibility and load span advantages, said Coelho, the use of load-bearing cold-formed steel on two recent "mansion" projects revealed widespread use of the material remains a challenge due to a lack of experienced contractors able to complete a quality and timely job.

Sunrise's "mansions" are typically two- to four-story buildings constructed with structural steel and concrete, using cold-formed steel framing for non-load-bearing applications. Of the company's 384 communities, about 80 percent are mansions. About 160 of the communities have been built under the direction of Sunrise's in-house construction team.

Despite its limited use thus far, Coelho remains optimistic that the use of load-bearing cold-formed steel at Sunrise may still be on the horizon.

"We're definitely open entertaining the idea of using cold-formed steel framing in a load-bearing capacity if it can conform with our three major requirements: safety and comfort of residents, schedule and cost," said Coelho. "If those three requirements can be met, we will absolutely revisit using steel."

MASFA A HUGE SUCCESS...
CONTINUED FROM PAGE 30

The evening's entertainment pulled a sleight of hand on an unsuspecting and highly amused Larry Williams and crowd.

Member companies showcased new and popular products at a bustling Expo.

Many witnessed steel framing in action at a Premium Steel Building Systems jobsite tour.

A dinner cruise on the Chesapeake Bay was a highlight of the event.

MHD

Education

More on Non-Structural Walls

by Maribeth Rizzuto

THIS ISSUE, AS PROMISED, WE RESUME OUR DISCUSSION OF NON-STRUCTURAL WALLS, TAKING A LOOK AT FRAMING ROUGH OPENINGS, THE USE OF ISOLATORS, AND THE INSTALLATION OF ACCESSORIES.

Rough openings

It was common practice in years gone by to frame rough openings with lumber. Much has changed due to the desire to build non-combustible and pest-resistant structures, as well as the development of appropriate fasteners to attached doors and windows to steel. Today the majority of steel-frame builders have abandoned the dated practice in favor of an all-steel rough opening.

To accomplish a rough opening that will withstand lots of abuse, use a 33-mil structural stud or double your studs at these locations. This will give you the extra support necessary to absorb the abuse found in high-traffic areas, like bathroom doors. Make sure to install the studs with the hard side of the web facing the opening so that you have a solid surface to fasten any attachment. Additional cripple studs should be placed above and below any opening where gypsum board will be applied (**Figure 1**).

Gypsum wallboard

Gypsum wallboard panels may be attached either parallel or perpendicular to the studs.

Place all the ends over the framing members. When working with parallel installations, stagger the joints in successive courses so the joints are not running the full length of the panel. Maximize the lengths of the material to cut down on taping end joints. This reduces the amount of taping and plastering. Fit the edges closely together, but do not force them.

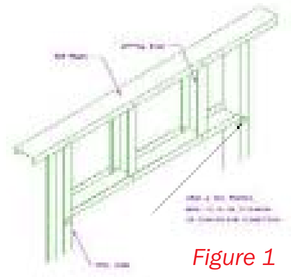


Figure 1

Use 1 1/4-inch self-piercing screws spaced 16 inches on center in the panel field and edges for non-structural walls; on structural walls, use 12 inches on center. (See Table E3-11 of the Prescriptive Method 2001 Edition with 2004 Supplement.) For double-layer applications, apply the base layer with the length of the panel parallel to the framing and the face layer perpendicular to the studs. The face layer may also be parallel but with the joints offset. Use longer screws spaced 24 inches on center for the base layer and 16 inches on center for the face layer.

Baseboard

There are three basic ways to attach the baseboard. Construction adhesives work well and provide an acceptable bond. Finishing nails applied at an angle tack the baseboard in place by "bradding" (tacking and bending) against the steel. Finishing screws are also available with small heads that leave an acceptable finish. Putty can be applied over the heads, or the hole can be left as is.

Chair railing and ceiling molding

Size will determine the best attachment method for chair railing and ceiling molding.

Screw or nail the molding directly to the studs or track. For large ceiling molding, use deep flanges on the top

MORE ON NON-STRUCTURAL WALLS...
CONTINUED FROM PAGE 33

track. The deeper flanges will extend farther down the wall to provide a backing for attachment.

As covered in earlier issues, tool and fastener manufacturers have really kept the pace by manufacturing specialty tools and fasteners with the trim carpenter in mind. Check out www.etf-fastening.com, and www.Senco.com for their latest products (**Figures 2 and 3**).

Figure 2

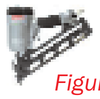


Figure 3

Cabinets and Shelving

Cabinets and shelving may be attached directly to wall studs or steel blocking. Use No. 8, 2-inch self-drilling screws to attach cabinets to wall studs (**Figure 4**).

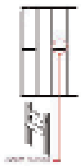


Figure 4

Isolators

In some instances, such as commercial construction where there may be deflection from above, non-structural walls may require the use of isolators. Installation of isolators may reduce the likelihood that the gypsum wallboard will crack if deflection is significant.

In residential applications, because of smaller loads, the amount of deflection is not significant to add isolators. The top track is usually tightly secured against the ceiling joists.

Remember to have grommets for wiring runs (**Figure 5**) and pipe isolators to separate any copper pipe from the cold-formed steel material (**Figure 6**), installed to complete your wall.

Figure 5

Maribeth Rizzuto is director of training and education for the Steel Framing Alliance.

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S: Stud or joist sections with flange stiffeners (C-shapes).
T: Track sections.
U: Cold-rolled channel of channel studs (without flange stiffeners).
F: Furring channels (or hat shapes).

NEW Thickness Designation	Minimum Thickness (inch)	OLD Reference Gauge Number
18	0.018	25
27	0.027	22
30	0.030	20
33	0.033	20
43	0.043	18
54	0.054	16
68	0.068	14
97	0.097	12
118	0.118	10

Out With Gauge, In With Mils

Remember your Mils with this handy guide when referring to the thickness of cold-formed steel-framing members. Mils replace the outdated measurement term "gauge" in the new Universal Designator System, which is now being used in all technical manuals and building codes.

From The Forum

Steel Safe from Lightning and Mold

Can you explain why steel-framed homes are not constant targets for lightning strikes and what happens when a steel-framed home is struck by lightning?

Steel-framed homes are no more likely to be struck by lightning than a wood- or other-framed home. If lightning does strike a steel-framed home and finds a path to the steel framing, it is less likely to cause a fire and more likely to discharge the strike directly to the ground. Steel framing is required (by code) to be isolated from the electrical wiring; therefore, in the unlikely event of a lightning strike, there should be no adverse effect on the electrical system. Problems with electrical surges from lightning strikes come from lighting hitting power poles or above-ground outdoor wiring.

Thanks for your inquiry!

Can mold grow on steel studs?

That's a good question, and it requires a little background for the answer. Mold requires three things to grow:

- The mold spores, which exist everywhere there is air. Every breath we take, unless we are in a medical clean room, contains thousands of mold spores.
- Moisture.
- Organic material, which provides the food for the mold.

Steel does not contain any organic material, and therefore cannot support mold growth. However, if someone or something has left a residue of organic material on the steel framing, there is a chance that given the right conditions, mold could grow.

As with any framing material, the best practice is to keep the steel studs dry. Even if they get wet during construction, or there is a one-time event such as a pipe bursting in a wall, there should be no long-term problem if the cavity is dried out properly. It is persistent wetting, such as a steady plumbing or roof leak, which causes the greatest risk of supporting mold. Even then, the mold will most likely grow on organic surfaces, such as the paper facing of the gypsum board or wood framing members, rather than steel. In steel framing, when everything is clean and dry, there will be no opportunity for the mold to grow.

The Steel Framing Alliance has an excellent publication on this issue: listed under the "About Steel Framing" bar on the home page, go to "Issue Papers" for a free download of the issue paper on mold.

Thanks for asking!

Don Allen P.E.,
Steel Framing Alliance director of engineering development, and LEED 2.0 accredited professional.

ASK YOUR QUESTION ON THE FORUM!
LOG ON AT
www.steelframingalliance.com.