A FEW WORDS ABOUT STEEL

STEEL THE BEST CHOICE FOR REBUILDING GULF COAST

By Andrew Marshall

The Gulf Coast will be challenged in a way never before seen in this country, to meet the massive amounts of work needed to be done. And it is but it is also being presented with a great opportunity, to build better than before.

As these communities reestablish their unique looks and feels, deciding where to locate parks, businesses, housing, community centers and traffic flows, they will also adopt new building codes that will require the construction of stronger, better homes and businesses.

Many new building products available today—including concrete, structural insulated panels and cold-formed steel framing—provide a variety of choices in the rebuilding the Gulf South. Of these building choices, I believe cold-formed steel framing provides the best solution.

Cold-formed steel framing is different from traditional wood construction, and not everyone in the workforce knows how to build with steel framing correctly. However, a variety of resources are available to learn the methods to be successful. If the only obstacle to using cold-formed steel framing is lack of knowledge and the perception of increased cost, then shame on our industry.

As homebuilders, we have the ability and duty to provide our customers the best product available. Our industry can no longer say, “That is how we have built homes for years,” and thereby avoid building with products that are better suited for home construction in terms of strength, quality, equal cost, and protection of the environment.

When the material used for countertop construction changed from Formica to solid surface and then to granite, were knowledge and cost the only considerations? The shift from single-speed cooling units to high-energy-efficient two-speed units began at a higher cost, yet we now use both as a standard for our homes.

Selling Points

After all, steel should be an easy sell for many reasons. Its benefits in homebuilding cover ground already familiar to general public.

The impact on the environment and health is one. On average, 20 percent of the lumber used in residential construction becomes waste and ends up in the debris pile and ultimately in landfills, costing more money. Many landfills across the country have reached or are approaching capacity. Cold-formed steel framing offers a better alternative. Waste in cold-formed steel framing averages 2 percent to 3 percent, and that waste is recyclable and gets money.

The beginning of the life cycle of cold-formed steel building products is equally friendly to the environment when one considers the number of cars that are scrapped every year to ultimately become the steel used in producing cold-formed steel.

Personal health of the occupants of the homes we construct is another important factor supporting the use of cold-formed steel framing. Concerns for accumulation of gasses, mold and mildew associated with traditional wood-frame construction are driving up insurance costs and concerns for personal health. Other environmental and health concerns have led to restrictions on the use of certain pesticides to control termites.

In addition, cold-formed steel framing’s hot-dipped galvanized coating for rust prevention extends its life expectancy to more than a century.

Principles

The proof of steel’s viability lies in its commercial use. We can certainly conclude that if steel framing is a better fit for most life-safety regulations in commercial construction that families should be protected in the same way. Homebuilders who care about the safety of their customers, expected life of the home and the future of the

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May-Jun 06
FOR BUILDERS TO SWITCH TO COLD-FORMED STEEL FRAMING.

We have met and continue to meet with builders and framers to better understand how they operate in that regional market. We have listened to their concerns, real and imagined, and are plotting a course that will allow them to feel comfortable using steel in reconstruction efforts.

As aptly articulated in the accompanying column, the builders and framers in that region, as elsewhere, develop a “comfort zone” and resist moving out of that zone. The residential builders and framers often rely on the expertise of the lumber yards, with whom they have an existing relationship. They also have a history of dealing with those yards, especially a credit history.

Most residential builders and framers purchase their materials through local lumber yards. Most commercial construction builders and framers, however, purchase their materials through building material distribution companies.

If the builders and framers have to switch from dealing with their established lumber yard supplier to the building material distribution centers, support problems might be created, and in many cases an inability to enjoy credit terms given by their previous suppliers.

There is talk of major home builders entering the construction market in the affected Gulf area, but at present it appears that most residential construction will be performed by the small to medium-size firms. The major home builders, with their sophisticated purchasing and logistical departments, are not saddled with the same problems as the smaller builders and framers.

While not ignoring the building material houses that traditionally supply cold-formed steel framing to the commercial (tenant improvement and low-rise commercial buildings), we will be working with the lumber yards to insure that they are familiar with basic information that will allow them to be a part of the distribution chain. They will have to be familiar with the requirements and standards to be followed by the building inspectors. It would not be good for a lumber yard to sell framing materials and have the inspectors pull that material off the job. The residential building inspectors will also have to be familiar with the same requirements and standards.

To that end, we will be producing basic and easy-to-understand written materials aimed at the various players.

The bottom line is that because cold-formed steel framing is relatively new to that region, the builders, framers, lumber yards, building material supply centers, code officials and building inspectors will have to be reading off the same page.

This is an interesting challenge, but with the cooperation of all segments of the industry we will make it easy for the builders and framers to build better structures.

Alan MacQuoid is chair of SFA’s Hurricane Katrina Response Team.

STAFF

Larry W. Williams, president
Jay Larson, director of construction standards development
Maribeth Rizzuto, director of training and education
Don Allen, director of engineering
Bill Kraft, director of regional operations
Janice Duncan, finance/administration
Rose Kuria, webmaster/publications
Sarah Humphreys, communications/media relations

Steel Framing Alliance™

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1201 15th Street, NW, Suite 320, Washington, D.C. 20005-2842
(202) 785-2022; Fax: (202) 785-3856 • www.steelframingalliance.org

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environment, will find cold-formed steel is worthy of their embrace for residential construction.

Currently, less than 2 percent of residential construction utilizes cold-formed steel framing. The growth potential of capturing just 5 percent of the market share in this industry is astounding. Achieving this objective requires a change in the mindset of builders and consumers that will ultimately drive a change in the marketplace. The supply chain of raw steel suppliers, cold-formed steel manufacturers, distributors and home builders must coalesce to provide a cost-effective product for the end user—the homeowner—to make this transition more palatable.

When I first started building homes with cold-formed steel, I learned first-hand what everyone else had previously experienced: There was no support in the marketplace for steel home construction. After conducting some research, I found a metal construction trade show in Las Vegas and learned about the Steel Framing Alliance. SFA helped educate me from the outset, and it turned out to be the greatest resource supporting my quest to become a producer of light gauge steel homes.

I learned about the new tools and technology for fastening, cutting, designing and evaluating product quality of the cold-formed steel. I also met other people in the industry who were willing to share their knowledge and experience in using cold-formed steel framing.

My suggestion to all of you other home builders and contractors is to educate yourselves about the resources available today and join the growing movement, now only in its infancy, to use cold-formed steel as the framing material in residential construction, especially those rebuilding in the Gulf Coast.

It is the smart choice when it comes to strength, durability and cost once you educate yourself about the benefits and methods of the trade. After you complete a cold-formed steel-steel-framed home, you will know that you have done your best to ensure a product that offers strength and durability to your customers, while also being friendly to the environment. You can be proud to build with steel. I am!

Andrew Marshall is owner of IM Construction, based in Baton Rouge, La., and Gulfport, Miss.
NEWS FROM LGSEA

BY DON ALLEN
LGSEA COUNCIL HIRING IN DC OFFICE

To facilitate and expedite the development of technical notes, seminars, online content, and other work products helpful for the structural engineer designing with cold-formed steel framing, the Light Gauge Steel Engineers Association (LGSEA) is seeking qualified candidates for a full-time position in the Washington, D.C., headquarters office. Qualified candidates should have minimum two years experience in structural engineering or construction, hold a bachelors degree from a four-year accredited college, and be skilled in technical writing and editing. Applicants may call (202) 785-2022 or e-mail dallen@steelframing.org.

LGSEA COUNCIL MEMBERS TO PRESENT AT ASCE CONFERENCE

Members of the LGSEA Council will make a presentation at the ASCE Structural Engineering Institute Structures Conference. The ASCE SEI will hold its annual Structures Conference May 18-20 at the Adams Mark Hotel in St. Louis, Mo. This year, the theme of the conference is “Structural Engineering and Public Safety.” Special tracks “Extreme Event Loading,” “Special Structures,” and “Infrastructure Engineering” focus on this theme and applications for modern practice. A Friday morning session, from 10:30 a.m. to 12:00 p.m., titled, “Loadbearing, Mid-Rise, Cold-Formed Steel Building Design,” will include papers from three members of the LGSEA Council. Nabil Rahman of The Steel Network will present information on “Cold-Formed Steel Stud-Plank System for Mid-Rise Construction.” Former LGSEA President Dr. Reynaud Serrette of Santa Clara University will present the paper, “Estimating Drift in Cold-Formed Steel Frame Structures.” LGSEA Council Secretary Don Allen will present a paper on “Mid-Rise Construction Detailing Issues with Cold-Formed Steel and Compatible Construction Materials.” Additional information on the conference is available at http://content.asce.org/conferences/structures2006/.

CHAIRMAN OF ASCE SEI COLD-FORMED STEEL COMMITTEE APPOINTED

Dr. Tom Sputo Ph.D., P. E. has been named the chairman of the American Society of Civil Engineers—Structural Engineering Institute Cold-Formed Steel Committee. The retiring chairman of this committee is Dr. Benjamin Schafer, who currently sits on the Board of Directors of the LGSEA Council. Sputo has extensive experience in the design of cold-formed steel framing, and has been a member of the AISI Committee on Specifications for many years. The ASCE SEI CFS committee meets semi-annually in conjunction with AISI COS meetings; under Sputo, additional meetings are projected for industry events such as the CCFSS Specialty Conference to get more involvement and interaction with a broader range of the framing community. The Committee is largely responsible for the current presentiations at the ASCE SEI conference, the Bracing Design Guide, and the current issue of the ASCE Journal of Structural Engineering, focusing on cold-formed steel framing.

SUBMITTALS ACCEPTED IN MAY FOR SEPTEMBER SOFTWARE ISSUE

The September/October issue of the LGSEA Newsletter will contain its biannual listing of software for cold-formed steel framing structural design. Submittals for this issue are being accepted in May. Next month the newly updated LGSEA Council Web site will include a form for software developers, vendors and users to include information on their favorite software for the design of cold-formed steel. Previously, issues of the newsletter from 2002 and 2004 contained this information. With the 2006 issue, the information will be compiled into a technical note for ease of use and reference by members. Information presented in the software survey is merely based on information supplied by software manufacturers and users; LGSEA does not endorse the use of any design software or products. For additional information, see the LGSEA Council Web site in May, or e-mail info@lgsea.com.

HAWAII CHAPTER INSTALLS NEW DIRECTORS AND PRESIDENT

The Hawaii Chapter of the Light Gauge Steel Engineers Association installed its officers and directors for 2006. Tim Waite, who helped found the organization more than 10 years ago, will serve his second term as president of the organization. Waite was the first president of the LGSEA Council Hawaii Chapter, and in Tim’s words “has been recycled” back into the lead position again. Assisting Tim will be newly installed Vice-President Brian Enomoto, Secretary Adrian Lee and Treasurer Marvin Mestanca. Other members of the Board of Directors are Akira Usami, Will Wong and Shane Arnold. This 10th annual officer installation banquet was held at the Oahu Country Club in Honolulu.

COLD-FORMED STEEL BRACING DESIGN GUIDE PUBLISHED BY ASCE

The American Society of Civil Engineers recently published “Bracing Cold-Formed Steel Structures – A Design Guide,” edited by Tom Sputo and Jennifer Turner. Tom Sputo Ph.D., P. E. is a senior lecturer of Structural Engineering at the Department of Civil and
NEWS FROM LGSEA...
CONTINUED FROM PAGE 25

Coastal Engineering, University of Florida. Jennifer L. Turner is a recent graduate and Research Assistant at the University of Florida. The Design Guide documents the current practices related to bracing cold-formed steel structure elements and systems. Content ranges from recent research, including some performed by Sputo and Turner, to a historic paper by George Winter from 1958. Heavy on applications and examples, this book contains design examples illustrating bracing design for various types of cold-formed steel structures, as well as an extensive list of primary reference sources. This report is presented as a design guide and will assist the practicing engineer in designing cold-formed steel structures with greater levels of reliability, safety, and economy. Individual chapters were written by experts in the industry, and edited by members of the ASCE-SEI Committee on Cold-Formed Steel. More than 45 pages of the Guide are devoted to design examples. Topics include:

- Introduction to bracing design.
- Cold-formed framing, including sheathing-braced design, wall systems and floor systems.
- Cold-formed steel truss system and component bracing.
- Shearwalls and roof diaphragms.
- Cold-formed steel in metal building systems.
- Miscellaneous cold-formed steel elements and systems.

The 144-page softcover Design Guide is available from ASCE ($44.25 members; $59 non-members) or from the LGSEA/SFA store at www.steelframing.org ($42 members; $59 non-members).

ASCE Journal Features Cold-Formed Steel Structures

“Cold-formed steel structures” is the theme of the April 2006 (volume 132, issue 4) special issue of the Journal of Structural Engineering, published monthly by the ASCE. LGSEA Board Member Benjamin W. Schafer served as guest editor, and the Committee on Cold-Formed Steel performed nearly all the paper reviews. The majority of the papers appearing are from the Seventeenth International Specialty Conference on Cold-Formed Steel Structures, which was held in Orlando, Fla., in October 2004. This biannual conference is organized by Professor Roger LaBoube of the Center for Cold-Formed Steel Structures at the University of Missouri-Rolla. This issue provides expanded versions of the most highly regarded papers from this conference as selected by the members of the ASCE-SEI Committee on Cold-Formed Steel of the Technical Advisory Committee on Metals.

Priority Survey Results to Guide Alliance’s Technology Development Activities

One of the primary objectives of the SFA/LGSEA Technology Development Committee is to keep the members on the leading edge of technology improvements. To do so, input is needed well beyond the 13 volunteers who fill out the roster of the committee.

During the past year the TDC has been busy canvassing the industry to identify barriers to the use of steel framing and opportunities to improve its competitiveness. The work culminated with a survey of the membership in November to identify priority areas for technology development research projects.

“Training of framers, inspectors, and trade contractors continues to be an important issue for the members,” said Mark Nowak, chair of the TDC. SFA will continue to focus on training as an important service to the industry.

On the technology front, respondents to the survey rated inequities between wood and steel framing as the top priority. “These inequities are a recurring theme in discussions with designers and builders,” said SFA President Larry Williams, “and must be addressed from a research and building codes and standards perspective if we are to create a level playing field for all materials.”

Other “top 5” priorities for the TDC that were identified in the survey include the need for more complete information on the use of strap bracing for walls, sheet steel as an alternative to wood-based sheathing products, clip angles for common loading conditions, and pin fasteners in a broader range of steel-to-steel and sheathing-to-steel connections.

“We thank the 130 members who participated in this priority survey. The direction provided will allow the TDC to focus its efforts to develop more complete descriptions and funding plans for the highest priority projects,” said Jay Larson, secretary for the TDC.

For more information on the survey results and the TDC activities, contact Jay Larson at jlarson@steel.org.

Don Allen is secretary of the LGSEA Council.

LGSEA Launches New Web Site

The web site of the LGSEA Council is more user-friendly than ever before, thanks to a new easy-to-navigate design and a more convenient login feature.

Designed by LGSEA Web site Task Group, the new site allows members to log in directly at www.lgsea.com, without having to visit www.steelframing.org. LGSEA members can now also access the SFA Members Only pages.

Work continues on some pages including a searchable directory specific to LGSEA. In the meantime, LGSEA members appear in the searchable SFA directory, which no longer requires logging in. Their listings appear in blue with the LGSEA logo, designating them from regular SFA members.

Visit the site at www.lgsea.com.
DEFLECTIONS, ANGLES AND FASTENER SPACING

Are there any documents that discuss the issue of deflection compensation at the connection between steel non-loadbearing partitions and the structure above in residential construction? What is the “industry standard” for these partitions?

There are no industry standard documents that discuss the suitability of or requirements for slip connections in non-loadbearing partitions. There are many opinions on this, but it is often left up to the judgment of the architect or the engineer of record.

One school of thought is that everywhere there is the opportunity for movement of the structure above, walls designed to be non-loadbearing need to be isolated from this movement so that the wall will remain non-loadbearing. Because all portions of the structure will move a small amount under any loading, all partitions not designed as loadbearing may need to be isolated from the structure above, or accommodations for a slip connection should be provided.

The other end of the spectrum is that there is some capacity in steel framing members, and the building code even allows non-loadbearing partitions to carry loads (exclusive of sheathing and self-weight) of up to 100 pounds per linear foot. Also, with multi-story structures, similarly loaded and constructed floors will have similar deflections; therefore the relative displacement between levels will be close to zero.

The best guidance on this can be found in LGSEA Council Technical Note 544, “Design of By-Pass Slip Connectors in Cold-Formed Steel Construction.” The first section after the introduction is titled, “Determination of Need for Slip Connectors: Vertical Movement,” and contains a good discussion of the topic.

Am I looking for section properties for cold-formed steel angles. Where could I find that?

The best place to find listed properties for cold-formed steel angles is the 2002 AISI Manual for Cold-Formed Steel Design. The publication number is SG03-1 CFS MANUAL. The manual also gives design examples for developing these properties for angles with or without stiffeners on the legs. You can obtain the manual at www.lgsea.com. You may also calculate the values on your own using the provisions from the “North American Specification for the Design of Cold-Formed Steel Structural Members” (AISI publication #SG02-1 NASPEC) or using software.

Are there any regulations or design requirements for the type, quantity and spacing of fasteners that are to be used for track-to-floor/foundation at door jambs?

The following is from ASTM C754-04:

5.2 Runner (Track) Installation:
5.2.1 General—Runners shall be aligned accurately at the floor and ceiling and securely anchored approximately 2 inches (50 millimeters) from the runner ends, not more than 24 inches (610 millimeters) on center. Runners shall be secured with fasteners at partition corners. One runner shall extend to the end of the corner and the other runner shall butt to it and be gapped to allow clearance for the gypsum panel product thickness. Runners shall not be mitered.
5.2.2 Runners to Concrete Slabs—Shall be fastened with concrete stub nails, expansion anchors, shield screws, or power-driven fasteners not exceeding 24 inches (610 millimeters) on center.

The actual fasteners themselves and their holding power in specific situations is not addressed by these standards. Typically designers will specify a certain strength of fastener based on loading or on concrete requirements. The standard also gives requirements for attachment to wood and to suspended ceilings. There are no special requirements in this standard for loads on the fastener.

Thanks for your questions!

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

ISSUE PAPER ON PRESSURE-TREATED WOOD WITH STEEL REVISED

The Steel Framing Alliance has updated its issue paper on “Pressure Treated Wood and Steel Framing,” which makes practical recommendations on the combined use of these two framing materials.

The original issue paper, released in late 2003, aimed to guide designers and builders on the use of steel and pressure-treated wood as a ban of chromium copper arsenate, a preservative used for decades in pressure-treated lumber, was taking effect. The chemicals positioned to replace CCA were shown to be more corrosive to steel than their predecessors and likely to adversely impact the durability of steel framing.

The new version of the issue paper reflects the two years of experience behind the industry in dealing with the rapidly changing issue. This document was reviewed by the Corrosion and Durability Task Group, a joint task group of the LGSEA Council and AISI COFS. The task group is chaired by Doug Rourke of the International Lead Zinc Research Organization.

Found on the facing page and the page behind it, this issue paper may be torn out for immediate use. It also may be downloaded at www.steelframing.org.

Jay Larson, director of construction standards development, AISI
Steel-frame buildings often include wood components, such as sill plates, top plates, door or window bucks, and sheathing for floors, walls, and roofs. Consumers and regulators of building construction involving wood components often require pressure-treated wood to help protect the components from attack by termites, other insects, and fungal decay. Designers and builders need to be aware that recent changes in the available wood preservatives used in such applications may impact the durability of the steel framing.

**Pressure-Treated Wood**

Wood is pressure treated when there is concern about premature deterioration due to termites, other insects and fungal decay. Pressure treatment is a process that forces preservatives into the cellular structure of the wood. Waterborne, Creosote, and Oil-borne (penta) are the three broad classes of preservatives typically used when pressure-treating wood. Wood treated with waterborne preservatives is typically used in residential, commercial, and industrial building structures. Creosote is primarily used for treating railroad ties, guardrail posts, and timbers used in marine structures. Oil-borne (penta) is most often used for treating utility poles.

Typical Waterborne preservatives used in building applications include Sodium Borate (SBX / DOT), Chromated Copper Arsenate Type C (CCA-C), Alkaline Copper Quat Type D Carbonate (ACQ-D Carbonate), Copper Azole Type B (CA-B), Copper Boron Azole Type A (CBA-A), and Ammoniacal Copper Zinc Arsenate (ACZA). Typical waterborne preservatives used in building applications include Sodium Borate (SBX), Chromated Copper Arsenate (CCA), Alkaline Copper Quat (ACQ), Copper Azole (CA), and Ammoniacal Copper Zinc Arsenate (ACZA). There are a number of variations of these treatments available and they are often referred to by trade name. Please refer to the Web site of the treated-wood industry web site (www.awpa.com) for additional data.

CCA has been used for a number of decades for pressure treating wood. The building construction industry has become familiar with its attributes and its impact on other materials, and CCA has been the most widely used preservative in building construction. However, since December 31, 2003, CCA has not been produced for residential or general consumer use. This was due in part to negative publicity focused on the use of arsenic in CCA. The treated-wood-products industry has transitioned from CCA to alternative preservative systems such as ACQ and CA.

Unfortunately, testing has indicated that ACQ, CA and ACZA are more corrosive to galvanized steel than the former CCA (Reference 1).

This has become a significant concern to the wood fastener, connector and metal plate connected truss industries. It may also have an impact on steel-framed buildings.

Note: The above data are based on accelerated testing per AWPA Standard E12-94, and may or may not have a relation to actual service life.

**Galvanized Steel Framing**

Steel framing members are galvanized to protect the steel from corrosion. Hot-dip galvanizing is a process of providing a protective coating (zinc) over bare steel. In
this process, coils of steel sheet are continuously unwound, cleaned and passed through a bath of molten zinc where a specified zinc coating thickness is applied to the steel sheet. The galvanized coils are later slit into narrower widths and cold-formed into shapes suitable for framing applications.

Industry standard practice is to use G40 for non-structural and G60 for structural framing when the members are “located within the building envelope and adequately shielded from direct contact with moisture from the ground or the outdoor climate” (Reference 2). Heavier coatings, such as G90, are recommended in those cases where additional protection is needed. Oceanfront buildings are one such application (Reference 3).

Several manufacturers now market cold-formed steel framing fabricated from G90 galvanized steel, which, compared to the standard G60, has a zinc coating that is 50 percent thicker. Since the corrosion resistance of zinc is proportional to the thickness of the zinc, these framing members should last approximately 1.5 times longer. However, when using the more corrosive ACQ, CA or ACZA, increasing to G90 may not match the performance of the former CCA with G60. Heavier than G90 coatings are typically not available for framing members, therefore, this would not be considered a practical option.

**Impact of PT Wood on Steel Industry**

Manufacturers of products that come in contact with pressure treated wood, such as fasteners, metal connectors and truss plates, have become aware of the potential for increased corrosiveness of the new generation copper-based products, conducted tests and published recommendations for the specification and use of their products.

It needs to be recognized, however, that the primary focus of this work by others has been in developing recommendations for their products in a wide range of applications including outdoor applications. In many cases, relatively heavy galvanized coatings (>G90) and stainless steel are being recommended; options not readily available or cost effective for cold-formed steel framing.

**Recommendations for Steel Framing**

The following would seem to be viable options for cold-formed steel framing that should be considered:

- Specify Sodium Borate (SBX/DOT)
- Isolate the steel and wood components
- Avoid use of pressure treated wood

**Specify Sodium Borate (SBX/DOT)**

Testing has demonstrated that the Sodium Borate (SBX/DOT) preservative is less corrosive to galvanized steel than the former CCA. However, being water soluble, it is generally not recommended for applications that are exposed to the weather and special care should be taken to ensure the wood is covered during transport and storage at the job site. Producers indicate it is suitable for sill plates and other such applications. However, specifiers and builders are cautioned to first verify local availability of these products for their building projects.

**Isolate the Steel and Wood Components**

Another option is to isolate the steel framing from the pressure treated wood components. This could be done with a polyethylene barrier or other non-absorbent barrier material. However, care needs to be taken during construction to assure that integrity of the barrier is maintained. Consideration also needs to be given to the appropriate selection of fasteners used to connect the steel and wood components and should consider dissimilar metals. Use of typical self-tapping screws, which are not hot-dip galvanized (Reference 4) would not be recommended.

**Avoid Use of Pressure-Treated Wood**

The pressure-treated wood components often used in steel-framed buildings can usually be eliminated. This obviously avoids the problem altogether. For example, building codes do not require a wood sill plate beneath steel framing and, when needed, relatively inexpensive barrier products are available. Wood top plates are generally not required either, as alignment framing or a steel load bearing top track can be selected. Avoiding use of pressure treated wood probably provides the greatest assurance that the design intent will be realized.

**References**


2) AISI, Standard for Cold-Formed Steel Framing – General Provisions, 2001, American Iron and Steel Institute, Washington, DC.

3) LGSEA Technical Note 140, Corrosion Protection for Cold-Formed Steel Framing in Coastal Areas, 2003, Light Gauge Steel Engineers Association, Washington, DC.

4) LGSEA Technical Note 560-b5, Fastener Corrosion, 1999, Light Gauge Steel Engineers Association, Washington, DC.
BULLET-RESISTANT WALL ASSEMBLIES USING COMPOSITE SHEATHING

BY ALLAN SWARTZ P.E.

RECENT AND ONGOING TESTS IN NEVADA HAVE SHOWN PROMISING RESULTS FOR BALLISTIC RESISTANCE OF STEEL-FRAMED WALLS.

The walls, which were filled with granular materials and sheathed with a composite gypsum board and sheet steel, went under fire to test their resistance to ballistic penetrations to the Level 8 UL 752 standard. Tests were conducted by the development team of the patented wall product, known by its trade name as Sure-Board7.

The primary use of this composite has been as shear resistant sheathing on both wood- and metal-framed walls extensively on low- and mid-rise projects across North America. It also has ICC-ES and LA City approvals for this application. The manufacturer initiated its testing to expand the scope of the product’s use.

WALL CONSTRUCTION

All of the samples tested to date have been constructed using an exterior sheet of Sure-Board7 that is composed of cement board and 27-mil galvanized steel, and an interior sheet of “Series 200” Sure-Board7 composed of 5/8-inch gypsum board and various thicknesses of galvanized sheet steel (Figure 1). Some of the assemblies have included exterior finishes such as ceramic or stone tile. The results have ranged from encouraging to excellent depending on the assembly used.

The design philosophy behind the function of the wall was inspired by the results of wind-blown-projectile testing in Florida, where wall samples were subjected to ballistic impact from a piece of 2-by-4 lumber fired into the wall at high speeds. Sure-Board7 with 27-mil sheet steel passed all tests with no penetration, even when the test equipment was operated at its maximum possible settings.

The wall assembly’s resistance to penetration from a large blunt object was very high. However, resisting bullet penetration would prove to be a more difficult proposition. When bullets were fired directly into the board, penetration occurred with a 9mm handgun (the lowest penetration projectile tested).

Bullet penetration is difficult to resist because the force from the projectile is focused on a very small area. The solution appeared to lie in the development of a system that would spread the load over a larger area, causing the load from the bullet to behave more like a large blunt object. The project team decided to pursue a completely different approach from that used by the currently available ballistic resistant rigid panels. These systems (often composed of Kevlar laminates) tend to be very expensive, and provide resistance to penetration by stopping the bullet in a relatively short distance (i.e., the thickness of the panel). This appeared to be unnecessary since the entire thickness of the wall could be used to slow the bullet, absorb its energy, and blunt its impact on the interior Sure-Board7 panel.

In order to achieve the compliance to the Level 8 standard, the team tested several types of “ballistic panels” and “ballistic fills” composed of dry granular materials.

Preliminary informal testing has been completed with promising results. The best outcomes thus far were achieved using the granular ballistic fill approach. Three and one-half-inch-thick wall assemblies tested with ballistic fill completely stopped penetration from all handgun and rifle calibers tested (See Sidebar 1). All shots were fired from a distance of 10 to 15 feet. All the rifle ammunition tested had much greater velocities and penetrating power than the 7.62x39mm (AK47).

THE UPSHOT

The handgun bullets that were recovered from the granular fill test samples were heavily deformed and flattened (Figure 2). None of the handguns managed to dent the Sure-Board7 on the interior face. There appeared to be no damage to the drywall.

The high-velocity rifle bullets were destroyed (Figure 3). The 243 and 7mm bullets were fragmented into small pieces. The copper jackets of the 3006 full metal jacket (FMJ) bullets were turned inside out. The lead core fragmented and completely separated from the metal jacket. None of the

Sidebar 1

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<th>CALIBERS TESTED</th>
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<tr>
<td><strong>HANDGUNS:</strong></td>
</tr>
<tr>
<td>• 9mm Parabellum</td>
</tr>
<tr>
<td>• 357 Remington Magnum</td>
</tr>
<tr>
<td>• 44 Remington Magnum</td>
</tr>
<tr>
<td><strong>RIFLES:</strong></td>
</tr>
<tr>
<td>• 243 Winchester with 100 grain Nosler7 partition bullets (muzzle velocity = 3060 fps)</td>
</tr>
<tr>
<td>• 3006 Springfield with 150 grain full metal jacketed (FMJ) bullets (muzzle velocity = 2900 fps)</td>
</tr>
<tr>
<td>• 7mm Remington Magnum with 140 grain ballistic tip bullets (muzzle velocity = 3370 fps)</td>
</tr>
</tbody>
</table>

Figure 1: Exterior wall panel.

Figure 2: Recovered 30 caliber FMJ bullets.
bullets succeeded in penetrating the wall. The drywall on the inside face was broken by the force of the rifle bullet impact (Figure 4), but no penetration occurred. The 27-mil metal was bulged out slightly and exhibited only minor denting from bullet impact (Figure 5).

The researchers were very surprised by these results. The bullets fired from the 243 and the 7mm Magnum are designed for controlled expansion on impact. They found that these types of bullets tended to be easier to stop because, once deformed, they presented a larger frontal area for the ballistic fill to act upon. The 3006 full metal jacket bullets, however, are designed not to expand thereby providing maximum penetration.

“We fully expected the 3006 FMJ to penetrate the 3½-inch wall. It did not” said Carlton Elliot, who lead the product development team, which also included Kelly Holcomb. “To date, we have yet to find any projectile that is capable of penetrating this wall assembly, but we will keep trying.” If the inner board is breached, the researchers feel that they can easily enhance the assembly’s ballistic resistance by thickening the wall and/or using heavier sheet steel in the manufacture of the interior Sure-Board7 panel. After completing preliminary testing, data will be used to construct test samples for formal evaluation at a certified laboratory per UL 752 Ballistic Standards. Based upon preliminary testing, the researchers feel confident that level 8 ballistic performance, which is suitable for use in many military and other facilities, can be achieved with no difficulty.

The wall assemblies using the prototype configuration could also be easily constructed (either on site or prefabricated) and would be relatively inexpensive. They would also seem to fill a growing need, as inquiries in the marketplace, as well as calls to the LGSEA Council and SSMA technical office, have shown a marked increase in the interest in blast and ballistic resistance in structures.

**MORE ROUNDS**

The next round of ballistic testing will include various thickness configurations with a 50-caliber heavy machine gun round fired at close range, as well as a flexible ballistic mat. With increasing demand in the marketplace for ballistic-resistant walls and structures framed with non-combustible steel framing, several products are expected to be available to structural engineers and specifiers, including “Ballistic Sure-Board7” panels specially configured for both interior and exterior use.

Wall assemblies constructed with this material will provide superior resistance to shear from lateral wind and seismic loads along with the bullet-resistant performance. As these products are developed, design shear values will be available from the manufacturer, and as always, all manufacturers’ instructions and code provisions must be followed when detailing the product’s anchorage to steel framing and addition of the granular fill. Specific inquiries about the current testing may be addressed to Support@Sureboard.com

**Figure 3: Recovered 357 Magnum bullets.**

**Figure 4: Damaged drywall but no bullet penetration.**

**Figure 5: Metal was only slightly dented on interior.**

For additional information on the UL 752 standard, go to http://www.closefocusresearch.com/html/underwriters_laboratory_ul_752.html

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Circle #12
STEEL’S THERMAL FACTORS

By Maribeth Rizzuto

One of the biggest questions that comes up regarding steel framing is its reaction to thermal factors.

The answer is that with the proper insulation and installation techniques, a steel-framed building can be completely thermally efficient.

Different parts of the country have different energy codes. The energy code for a particular area will determine the levels required for a steel-framed house.

Energy codes or standards—including the International Code Council’s International Energy Conservation Code, formerly the Council of American Building Officials Model Energy Code; the American Society of Heating, Refrigeration and Air-Conditioning Engineers Standard 90.2; and California’s Title 24—require steel-framed homes to meet certain energy performance criteria, usually developed around the thermal transmittance (U) values. Thermal U-values indicate the effectiveness of a wall at holding warm or cold air inside. The location of the steel-framed house and governing codes will dictate the amount of insulation required.

Meeting the Energy Code

The IECC provides equivalent thermal values for steel- and wood-framed construction. When comparing the current steel and wood thermal values for 24-inch spaced studs with R-13 insulation in between the studs, the wood-framed wall generally has twice the effective R-value (the thermal resistance of the wall). The tables in the IECC are based on laboratory testing of wall panels called hot box tests.

Following the IECC, extra insulation is usually required on steel-framed houses to increase the effective R-values and it is often more effective to satisfy a portion of the R-value requirement using exterior insulated sheathing than to use cavity insulation alone.

Hot box testing showed studs in the wall form “thermal bridges.” The tables in the IECC show that the thermal efficiency of steel studs is approximately one-half that of wood when tested in this manner.

Practical Experience

Experience has shown that energy bills for steel-framed are not higher than their wood counterparts for similar size, construction and occupancy. The thermal efficiency of a steel-framed home is dependent on:

- Good construction detailing and air tightness (tightness of the joints to prevent air infiltration).
- Clustering of steel studs in walls (can provide cold spots that contribute to heat loss in a home).

Until more testing is conducted and better methods of calculating thermal efficiency for steel-framed houses are developed, applying extra insulation is the preferred method for increasing thermal efficiency. However, one may also examine the house for other energy credits, i.e., fewer window openings and energy-efficient HVAC equipment. Most energy codes allow this type of credit when calculating insulation levels.

Ghosting

Temperature is only one of the factors to be considered when selecting insulation materials and methods.

Ghosting is the deposition of dirt and dust particles on surfaces of the walls, usually at stud locations, when the surface thermal gradient is greater than 3 degrees F. The particles adhere to the colder areas of the wall, highlighting the location of the framing members. Ghosting is not limited to steel framing, but tends to occur more often with steel because of the higher thermal conductance. It also has a higher probability of occurring in homes where occupants smoke or frequently burn candles.

To determine if ghosting protection is necessary, one can examine the mean temperature difference from outside to inside a house. If the difference is 50 degrees or greater for two or more days, there’s a good chance ghosting will occur in one year or less.

Moisture

Condensation also can impact all framing types, including steel. Excessive moisture can degrade thermal insulation and damage architectural finishes, including exterior siding or interior gypsum wallboard. An advantage of using exterior insulated sheathing in a cold climate is that it can move the dew point outside of the wall cavity and away from the steel.

Steel-framed houses usually allow less air infiltration. Although airflow is not viewed as beneficial from an energy perspective, a lack of it can result in a buildup of moisture inside the home. The same moisture control used for wood framing should be applied to steel framing: applying a vapor barrier and taping joints on foam board insulation. Practices vary from region to region.

AISI Thermal Design Guide

The Thermal Design Guide for Exterior Walls provides contractor guidelines for the amounts of insulation needed to properly insulate steel-framed homes. Published in 1993 by AISI, it shows the results of testing and presents three different ways to determine the amount of insulation required for a steel-framed house: a thermal degree-day map and table indicating extra insulation requirements; effective R-values for various types of steel-framed construction, depending on the energy code requirements (see Table 1); and a Thermal Zone map and table. It also includes a chart method and calculation method.

Cavity Insulation

Because a metal stud is open on one side, the wall cavity formed between the
studs is wider than in wood framing. It is important to select fiberglass batt insulation that occupies the full width of the cavity so there is no air space left in the wall cavity. A spray-applied insulation can also be used, as long as it completely fills the cavity.

Fiberglass insulation is held between the wall studs by friction. Full-width batts, which are 16 inches or 24 inches wide, should be used. Kraft-faced insulation should be taped or glued to the wall studs that do not have lips to hold it in place.

Insulating Walls
Insulation should be placed in any area that could produce a cold spot, including:

- Exterior walls.
- Jambs.
- Headers.
- Corner studs.
- Any built-up members.
- Inside multiple studs.
- Behind outlet boxes in exterior walls.

Insulating Ceilings
Insulation for ceilings should be installed in areas including:

- Full width between ceiling joists underneath unheated attics.
- Between ceiling joists of unheated garages or areas where there are rooms above the ceilings used for living purposes.
- Below stairway of an unheated attic.
- In knee walls inside of unheated attics.
- In cathedral ceilings.

Insulating Floors
Installing insulation in floor cavities requires insulation to be placed in spots including:

- Around the joist or track between the joists and along the end walls.
- Between joists that are above an unheated living space.
- Between floor joists over a crawl space.

The insulation will need to be secured between steel joists in the same manner as for wood joists. Strapping, ties or chicken wire can be used to hold the insulation permanently in place. If a gypsum wallboard ceiling is used beneath the joists, ties will not be necessary.

**FOAM BOARD INSULATION**

In colder regions, the Thermal Design Guide for Exterior Walls recommends additional insulation on the exterior of the house in the form of foam board. These products are usually made from extruded polystyrene or polyisocianurate. Depending on the R-value required, the thickness of the foam board will vary, as seen in Table 1.

<table>
<thead>
<tr>
<th>Effective Wall R-Value</th>
<th>Wall Construction</th>
<th>Cavity Insulation</th>
<th>Exterior Insulated Sheathing</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>2x4</td>
<td>R.11</td>
<td>R.13</td>
</tr>
<tr>
<td>20</td>
<td>2x6</td>
<td>R.19</td>
<td>R.10</td>
</tr>
<tr>
<td>15</td>
<td>2x6</td>
<td>R.19</td>
<td>R.5</td>
</tr>
<tr>
<td>15</td>
<td>2x4</td>
<td>R.11</td>
<td>R.7</td>
</tr>
<tr>
<td>13.5</td>
<td>2x4</td>
<td>R.11</td>
<td>R.5</td>
</tr>
<tr>
<td>12.5</td>
<td>2x6</td>
<td>R.19</td>
<td>R.2.5</td>
</tr>
<tr>
<td>10</td>
<td>2x6</td>
<td>R.19</td>
<td>0</td>
</tr>
<tr>
<td>8.5</td>
<td>2x4</td>
<td>R.11</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 1**

**Foam Board Attachment**
Attach the foam board to the exterior of the house using screws, adhesives or nails. The type of attachment directly depends on the type of sheathing or siding being installed.

Table 2 shows recommendations for fasteners. Note that screw length is determined by thickness of materials. It must penetrate siding, foam board, structural sheathing and steel studs, plus a minimum of three exposed threads. The engineer will specify the number of screws. Also, where structural sheathing is used, foam board and exterior finishes may not be required to be fastened to the stud. Refer to the manufacturer’s recommendations for fastening requirements of siding for recommended fasteners.

Specific applications require different fasteners and methods.

For Stucco Houses
- Attach the foam board to the steel, using a long self-drilling screw with
a plastic washer.

• Attach the metal lath to the foam board also using a long self-drilling screw with a washer to hold the lath in place.

For Houses Sheathed with Plywood or OSB
• Attach the foam board to the sheathing with roofing nails or adhesive.
• Attach the siding over the foam board with nails or screws that penetrate through the foam board into the sheathing or studs.

For Vinyl Siding
Use nails, staples or screws to attach the siding into the sheathing or studs according to the siding manufacturer’s recommendations.

### Suggested fasteners for various exterior finishes using foam board

<table>
<thead>
<tr>
<th>Application</th>
<th>To Structural Sheathing</th>
<th>To Steel Studs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foam Board</td>
<td>Roofing Nails</td>
<td>Grabber Bugle Head Self-Drilling #6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>min with plastic washer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compass Darts SD Point Bugle Head</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phillips #6 min with plastic washer</td>
</tr>
<tr>
<td>Vinyl Siding</td>
<td></td>
<td>Grabber Wafer Head Self-Drilling #8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compass Darts Self-Drilling K-lath #8</td>
</tr>
<tr>
<td>Lap Siding,</td>
<td>Ribbed Head Deck Grabber #8</td>
<td>Grabber Wafer Head Exterior Grabber Gard</td>
</tr>
<tr>
<td>Hardboard/OSB</td>
<td>Compass CW-Drill #9</td>
<td>Driller with #3 pt #6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compass C-Wing #8</td>
</tr>
<tr>
<td>Fiber Cement Board</td>
<td>Ribbed Head Deck Grabber #8</td>
<td>Grabber Wafer Head Exterior Grabber Gard</td>
</tr>
<tr>
<td></td>
<td>Compass CW-Drill #9</td>
<td>Driller with #3 pt #6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compass C-Wing #8</td>
</tr>
<tr>
<td>Panel Siding</td>
<td>Ribbed Head Deck Grabber #8</td>
<td>Grabber Wafer Head Exterior Grabber Gard</td>
</tr>
<tr>
<td></td>
<td>Compass CW-Drill</td>
<td>Driller with #3 pt #6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compass C-Wing #8</td>
</tr>
<tr>
<td>Stucco with</td>
<td>Grabber Wafer Head Streaker #8</td>
<td>Grabber Wafer Head Exterior Grabber Gard</td>
</tr>
<tr>
<td>Metal Lath</td>
<td>with plastic washer</td>
<td>Driller with #3 pt #6</td>
</tr>
<tr>
<td></td>
<td>Compass Self-Piercing Modified Truss</td>
<td>Compass Darts Self-Drilling K-lath #8</td>
</tr>
<tr>
<td></td>
<td>with plastic washer</td>
<td>Compass Darts SD Point Bugle Head</td>
</tr>
<tr>
<td></td>
<td>Phillips #8</td>
<td>Washer Head #10</td>
</tr>
<tr>
<td>Brick Ties</td>
<td>Grabber Hex Head Streaker #8</td>
<td>Grabber Hex Head Self-Drilling #10</td>
</tr>
<tr>
<td></td>
<td>Compass RPS Self-Piercing Hex</td>
<td>Compass Darts Sd point Hex</td>
</tr>
<tr>
<td></td>
<td>Washer Head #10</td>
<td>Washer Head #10</td>
</tr>
<tr>
<td>Wood Shingles</td>
<td>Grabber Bugle Head Streaker #6 Plated</td>
<td>Grabber Bugle Head Self-Drilling #6</td>
</tr>
<tr>
<td></td>
<td>Compass Marker S point Bugle Head</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phillips #6 Plated</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2

### Other Types of Insulation

#### Spray-In Foam Insulation
Spray-in foams such as Icenyne are available to fill wall cavities. Gypsum board is usually installed first, and then the foam is injected into the wall cavity. Icenyne expands in the wall cavity to seal off all voids to prevent air infiltration. Insulation products like this are very effective in sealing off all areas of the wall to prevent air infiltration.

#### Loose Cellulose
As with wood-framed houses, loose cellulose is an alternative for insulating a home. Loose cellulose is installed in a steel-framed house the same way as a wood home, by blowing the insulation material into the wall cavity using forced air.

#### Thermal Studs
Another alternative that will either reduce or eliminate the need for foam board insulation is the use of thermal studs. Thermal studs remove a substantial amount of the web to reduce the thermal conductivity of the stud. Some of these studs are so effective they eliminate the need for exterior foam board altogether, also eliminating the cost of foam board and fasteners needed. Thermal-stud manufacturers, including Tri-Chord, can provide thermal-resistance values and the studs’ associated costs and determine their usefulness on the jobsite.

Maribeth Rizzuto is director of training and education for the Steel Framing Alliance.
MEMBER MAKES GRADE IN COMMUNITY INVOLVEMENT

Material donations by SFA member CEMCO have aided steel-framing educational efforts close to its facilities’ communities.

Glendale High School and Laney College in Berkeley received stud and track and educational materials from CEMCO’s City of Industry and Pittsburg, Calif., plants, respectively.

“This was the first time most of the teachers have used steel framing and they enjoyed the experience,” said Glendale teacher Tom Vessella. “It was so successful that some of the teachers brought back wall sections to their classrooms and plan to include the process in their curricula.”

CEMCO’s Executive Vice President Tom Porter said the donations were the company’s way of “just doing its part” to aid in the promotion of cold-formed steel framing.

SFA President Larry Williams encourages all members to get actively involved with local groups to support their needs for training.

“This in the long term,” Williams said, “is an important investment all members can make for a very low cost.”