Newsletter for the *May 1997*

Light Gauge Steel Engineers Association

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Upcoming Events

AISI Residential Advisory Group — June 18-19
San Francisco, CA
Info: (202) 452-7202

LGSEA Meetings — June 20-21
San Francisco, CA
Info: (615) 386-7139

Pacific Coast Builders Conference — June 18-21
San Francisco, CA
Info: (916) 325-9300

Southeastern Builders Conference — July 24-27
Orlando, FL
Info: (904) 224-4316

AISI/LGSEAMeetings — Oct. 28-30
Atlanta, GA
Info:
AISI - (202) 452-7202
LGSEA - (615) 386-7139

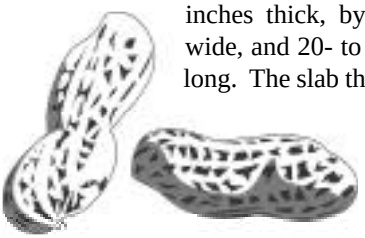
METALCON '97 — Oct. 28-30
Atlanta, GA
Info: (617) 965-0055

Please Pass the Peanuts

By Don Moody, Western Metal Lath

Peanuts! What do peanuts have to do with steel framing? Well, they and a lot of other products (like toilet paper, jelly beans, and charcoal) all sell for more, per pound, than steel studs. This is quite an accomplishment on the part of the steel industry, particularly when you consider what it takes to make a 20 gauge galvanized steel stud.

In order to make the first pound of steel, the basic materials - coal, iron ore, and limestone - must be mined and transported long distances to a steel mill. The steel mill converts the coal to coke and puts specific quantities of these three ingredients, and other materials, into a blast furnace which produces molten iron. A basic oxygen furnace further purifies the molten iron, turning it into steel. Next, slabs are cast in dimensions that typically are 8 to 10 inches thick, by 4 feet wide, and 20- to 30-feet long. The slab thickness now must be substantially reduced so it can be used to create light gauge products. This is done by heating the slab and running it through a series of rollers which convert it into a ribbon of steel that is rolled up into a steel coil, also called hot band. In today's steel world, the minimum thickness that can be achieved through the hot rolling process roughly corresponds to 16 gauge. Due to the constant improvements to steel rolling technology, some mills are now about to produce hot rolled steel in the 18 gauge range.



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Component Framing - Marrying Panelization and Stick-Built Construction

by Scott Shaddix, Nicholas Lane Contractors

To date, a builder had to choose between using the "stick-built" method of framing houses with steel or "panelization" where walls, trusses, and joists of the house are assembled in a manufacturing facility and shipped to the building site where they are fastened together. Both methods offer distinct advantages and disadvantages, but we have found a way to successfully marry both techniques to produce both cost savings and flexibility.

Panelization makes the most of the dimensional consistency of steel studs by allowing a manufacturer to set up factory-style assembly line process. This method is an excellent way to cut the overall time needed to fabricate a house and lower the per unit cost of construction. For example, a typical single story house can be completely framed and ready for the installation of plumbing and wiring in four or five days, 20 percent faster than the average time for wood. Setting up and maintaining a panelizing shop can be an expensive proposition, however, and the greatest efficiencies are realized when the costs are spread out over a large number of homes with similar floor plans.

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Newsletter for the Light Gauge Steel Engineers Association

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Department Staff

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Membership Information
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Peanuts . . . and Steel

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We are interested in 20 gauge, however, so the thickness of our 16 gauge hot rolled band must be further reduced. This is done in an operation called cold rolling and annealing which is similar to hot rolling except that coils are not heated before processing. What started out as a 8-inch slab of steel is converted to our desired thickness of 20 gauge - or thinner. Finally, our 20 gauge coil of steel is sent to a galvanizing mill where the zinc coating is applied through the hot dip process. This is what the stud manufacture receives from the mill.

The stud manufacturer then slits the coil into the widths needed to make various stud profiles. Those slit coils are loaded onto uncoilers and are fed into rollformers where the blank sheet width is formed into the steel stud profile. The studs are cut in line to various lengths and are bundled and packaged and, eventually, shipped to the stud manufacturer's customers. All of this happens on a huge scale every day at a price that is very low, particularly considering all that goes into the manufacturing process.

So, given the relatively low price at which steel is delivered to any number of markets, what does this say about the character of the steel industry and how does that relate to steel studs in residential construction? First, it underscores the fact that steel and steel studs are economic commodities. This concept is critical to understanding the historical and future usage of steel studs in residential construction. By economic commodities I mean that they are generally sold on a large scale to fully enabled markets through highly efficient distribution.

In these markets, consumers are primarily interested in product availability and low price. They know the price of competing brands and they do not assign much importance to nonprice differences within the product class. In these markets, everything it takes to enable the widespread and practical us of these products is in place. The commercial market for steel studs is one such market, as is the residential market for wood studs. In those markets the engineers do the engineering, the framing contractor determines his material needs, and the building material dealers maintain an inventory of product they know the contractors are going to buy. And finally, the rollformers and sawmill operators work to make these products at the lowest possible prices.

Today, residential construction is not a fully-enabled market for steel studs. Therefore, the challenge for the steel stud industry and for all stakeholders in the use of steel for residential construction is in reconciling the commodity nature of the existing industry and products, with the needs of the residential market. How is that being done and what remains to be done? These topics will be the subject of my next article.

Stay tuned . . . And pass the peanuts. ❑

Component Framing

Continued from Page 1

Stick-Built construction offers the advantage of familiarity and flexibility. It is the method that most builders have used for decades so there is no need to re-orient the construction crews or designers. Minor alterations also can be made from house to house without incurring huge costs for set-up changes. Yet, stick-built framing can be less efficient than panelizing.

Although Nicholas-Lane has used the stick-built steel framing since 1992, we recently adopted a hybrid method we call "component framing." With this approach, components of the house that require the greatest number of pieces and connections - usually window and door openings - are pre-assembled on a framing table and then installed into the wall as a unit. A typical high-end home may have up to 120 of these openings. Low end homes may only have between 20 and 40. In either case, a large percentage can be shaved off construction times that a crew might spend looking for the framing pieces, organizing the elements, and then assembling the component. We have built more than 200 homes using "component framing" and have found we are able to stand walls twice as fast and cut overall erection time in half, while seeing construction quality become more consistent. In addition, it is possible to use more efficient tools that might be too cumbersome for field installation.

Although component framing is fairly simple, it is important to think through the framing process for the house or houses in advance. Design software is a valuable tool because it will analyze the component and generate a cut list in a fraction of the time that it takes to do hand calculations. A framing table on which the components are assembled is a key piece of equipment for any operation that involves panelization. The tables must be able to keep the components square while the elements are being fastened, and it should allow for quick and easy adjustments to the width and height of the component. A table that holds the component waist high is also better for productivity than a table that sets at ground level.

Ultimately, the competitiveness of the steel framing industry is still reliant on installers putting things together as fast as they can, using materials and components assembled together in the most efficient way possible. In the search for ways to make steel framing more efficient, we believe that "component framing" is the next step in the evolution of home building. ❑

The ideal table for component framing is waist-high, quick and easy to adjust, and can be easily transported to and set up at the job site.

Research and Testing Update

The following is a partial list of current tests and research in progress being conducted by institutions and organizations known for their achievements in the advancement of cold-formed steel.

Light Gauge Steel Research Group
Santa Clara University
Contact: Reynaud Serrette, Ph.D.
Phone: (408) 554-6868
e-mail: rserrette@mailer.scu.edu

- Stucco shear panels
- Specialty beam shapes
- Web crippling
- Partially seated bearing studs to track connections
- Performance of bearing studs with hole penetrations at ends of studs
- Evaluation of different screw configurations vs load performance

NAHB Research Center
Contact: Nader Elhajj
Phone: (800) 638-8556, ext. 581.

- Light gauge shear walls
- "L"-shape header

Oregon State University
Department of Civil, Construction, and Environmental Engineering
Contact: Thomas H. Miller, Ph.D., P.E.
Pbone (541) 737-3322
e-mail: millert@ccmail.orst.edu

- Out-of-plane behavior of composite wall panels
- Out-of-plane performance of shaft wall panels
- Effects of perforations on column strength
- Modeling of composite wall panels
- Evaluation of connection details.

University of Missouri/Rolla
Contact: Roger LaBoube, Ph.D., P.E.
Phone: (573) 314-4481
e-mail: laboube@novell.civil.umr.edu

- Allowable hole penetration
- Truss tests: C-shape vs proprietary
- Coped C-sections
- Low-ductility steel
- Spacing of connectors for composite action. ❑

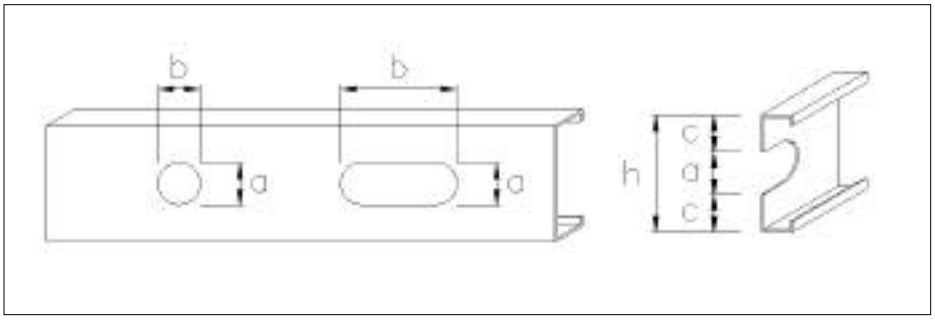
TECHNICAL EXCHANGE SECTION

The Light Gauge Steel Engineers Association needs you and your experience. Please mail or fax your opinions, questions, and design details that are relevant to the light gauge industry (fax to Dean Peyton at 206/941-9939). Upon editorial review your submission may be printed in the Technical Exchange Section of this Newsletter

Design Guide for Web Openings

by R.A. LaBoube, Ph.D., P.E.

Web Openings are often present in cold-formed steel joists to facilitate the installation of plumbing or electrical services. However, there has not been a generally accepted procedure for evaluating the structural integrity of a joist with a web opening. To aid the design engineer when using cold-formed steel framing members, the American Iron and Steel Institute has prepared a design guide for evaluating the strength of a web element with an opening.



This design guide is based on a review of the engineering literature, and summarizes design solutions, or guidelines, pertinent to cold-formed steel web elements with openings. Because the design of uniformly compressed stiffened elements is addressed elsewhere, only flexural member behavior is considered by the design guide.

Studies of the behavior of web elements with opening have been ongoing at the University of Missouri-Rolla since 1991 and serve as the primary basis for the design recommendations. The recommendations consider bending alone, shear, web crippling, and combinations of bending and shear and bending and web crippling.

The design recommendations are based on tests of full-scale C-section beams having web flat-width-to-thickness ratios (h/t) as large as 200, and hole-depth to web-flat-width ratios (a/h) as large as 0.80. The test program considered both industry standard web openings, rectangular with fillet corners, as well as circular openings. The industry standard openings were punched during the rolling process, whereas the circular holes were cut using a hole saw. The circular openings simulated field cut holes. Three hole diameters, 2-in., 4-in., and 6-in., were studied in both 6-in. and 8-in. deep C-section beams.

The provisions contained in the design guide have been presented in an allowable stress design format but are adaptable to the load and resistance factor design format. The design recommendation for pure bending uses the effective width concept consistent with Section B of the AISI Specification. For both shear and web crippling, reduction factors are proposed. These reduction factors can be applied to the present AISI Specification provisions for webs without holes. Present AISI equations for combined bending and shear and bending and web crippling are applicable using the reduced bending, shear, and web crippling capacities.

To obtain a copy of this design guide, call the AISI at (800) 79-STEEL.❑

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An Alternative Design Equation for Self-Drilling Screws

by L. Randy Daudet, P.E.

In February of 1993, the AISI Committee on Specifications approved design provisions for screw connections in light-gauge steel. These are the result of research conducted by Cornell University's Teoman Pekoz. Mr. Pekoz had reviewed existing research and specifications from European Recommendations to better reflect design approaches and factors of safety common to connection design in the United States. His equations are outlined in CCFSS Technical Bulletin, Vol. 2, No.1, and will be included in future editions of the AISI Specification.

A recent study conducted at Dietrich Industries' Material Testing Laboratory has indicated that Pekoz's tilting/bearing equations may be 20 to 30 percent conservative for hex-head, self-drilling screws. This conservatism is understandable since the equations neglect the effects of screw tip size, and the ductility of the connected steel sheet.

The Dietrich study found that depending on the diameter of the screw tip, connection strength can vary by plus or minus 15 percent. Likewise, it was found that steel ductility can also influence connection strength by the same margin. Using the results of 318 single-lap shear connection tests, an empirical strength equation was developed. An LRFD resistance factor and an ASD factor of safety shall be applied to these equations. However, they are not addressed here.

This strength equation was developed using Buildex #10-18, #12-14, and 1/4-14 screws using T1 and T3 tip types. Steel thickness ranged from 0.029 in. to 0.15 in., steel tensile strengths ranged from 27.4 ksi to 114 ksi., and Fu/Fy ratios ranged from 1.61 to 1.01. As a result of being developed from test parameters that reflect screwed connections used in normal U.S. construction practice, the above equation will yield less conservative tilting/bearing results than the Pekoz equations, which were developed for a wide range of screws types.

In the interest of brevity, this article does not address all of the technical aspects concerned with connection strength. A more in-depth review of self-drilling screw connections is contained in a thesis entitled "Self Drilling Screw Connections in Low Ductility Light Gauge Steel" which may be obtained from the University of Pittsburgh, Pittsburgh, PA. The LGSEA has not had the opportunity to review the entire document and may in the future publish a *"Tech Note"* on this subject. ❑

DESIGN EQUATION

For $(e/d_s \geq 2.66)$, $(0.12 \leq t_1/d_s \leq 0.33)$, $(1.1 \leq d_s/d_t \leq 1.4)$, $(1.9 \leq d_h/d_s \leq 2.2)$, $t_1/t_2 \leq 1.0)$

$$P_{tb} = 0.8\, F_{um}\, d_s^2\, C_s\, C_t\, C_{ftb}$$

Where

$$C_s = 2.44\, t/d_s - 0.097$$

$$C_t = 0.81\, d_s/d_t - 0.024$$

$$C_{Ftb} < -1.75\,(F_{u1}/F_{y1})^2 + 4.95\,(F_{u1}/F_{y1}) - 2.35$$

$$C_{Ftb} < -1.75\,(F_{u2}/F_{y2})^2 + 4.95\,(F_{u2}/F_{y2}) - 2.35$$

and Where P_{tb} = tilting/bearing strength of a single hex-head, self-drilling screw.

- e = The distance measured in the line of force from the center of the screw to the nearest edge of an adjacent hole or the end of the connected part (in.)
- d_s = Diameter of screw measured out to out of thread (in.)
- d_t = Diameter of screw drill tip (in.)
- d_h = Outside diameter of screw head
- t_1 = Thickness of steel sheet in contact with the screw head (in.)
- t_2 = Thickness of steel sheet not in contact with the screw head (in.)
- F_{u1} = Tensile strength of steel sheet in contact with screw head (psi)
- F_{u2} = Tensile strength of steel sheet not in contact with screw head (psi)
- F_{y1} = Yield strength of steel sheet in contact with screw head (psi)
- F_{y2} = Yield strength of steel sheet not in contact with screw head (psi)
- F_{um} = Minimum value of F_{u1} and F_{u2} (psi).

❖ NewsBriefs ❖

Aerosmith Receives Code Approvals

Aerosmith has received national code approvals for its U-NOPULpneumatically driven pin fasteners for use in the areas of structural connection for wood to steel, horizontal diaphragms; and shearwalls. The pins are manufactured from AISI 1566 steel, heat-treated to a Rockwell C Hardness between 52 and 56, and have a minimum tensile strength of 240,000 psi and a bending yield strength of 250 ksi. The fasteners are electro-zinc plated with a chromate rinse and are produced in 0.190-, 0.165-, 0.144-, and 0.100 inch diameters with 3/8- 21/64-, 5/16-, and 1/4-inch diameter heads, respectively. Copies of the code approvals and NER-407 are available by request. For more information: Les Butler / (800) 528-8183.

Corrosion Resistant Pins

ET&F Fastening Systems, manufacturers of a code-approved pneumatic fastening system for light gauge steel framing, recently introduced a new coating formula now used on all its pins that is designed to provide maximum protection against corrosion. When tested in accordance with ASTM-8117, pins with the new coating survive more than 1,000 hours salt spray exposure. The company also notes that the elimination of the electroplating process virtually excludes the possibility of hydrogen embrittlement. For more information: John Tillman / (800) 248-2376.

Second Edition of Prescriptive Method

Work is underway on a second edition of the Prescriptive Method, which will expand on the recently approved code change (1996 code cycle) by providing a complete prescriptive requirement for one and two story residential construction in low to moderate wind and seismic regions. The second edition, which is expected to be finalized by the end of May, is being published separately by both the American Iron & Steel Institute and Housing and Urban Development (HUD). The documents should be virtually identical, except for the binding covers. Copies may be obtained by calling the AISI Steel hotline at (800) 79-STEEL, or HUD at (800) 245-2691. For additional information: Nader Elhajj / (800) 638-8556, ext. 581.

AISI Specification Released

A new edition of the AISI "Specification for the Design of Cold-Formed Steel Structural Members" has been released, incorporating both load factor and allowable strength design. To obtain a copy, call the AISI at (800) 79-STEEL.

Simpson Strong-Tie Receives Japanese Approval

Simpson Strong-Tie Company has become the first non-Japanese company ever to earn recognition that the quality of its products meets or exceeds C-MARK standards, a symbol used in Japan to identify construction products approved for conventional Western-style framing. The C-Mark equivalent rating covers a total of 20 Simpson products, ranging from joist hangers to hold-down anchors, encompassing 90 percent of the types of connectors used in Japanese construction. The recognition came only after years of intense testing and evaluation For more information: Art Linn / (800) 925-5099, ext. 934.

ASTM Sheet Steel Standard

The ASTM C-11/A05.11 joint task group is meeting early May in a continuing effort to produce the document "Standard Specification for Steel Sheet Metallic and Non-Metallic Coated for Cold-Formed Framing Members." If approved, the standard will cover steel sheet used in the manufacture of cold-formed framing members such as studs, joists, and track. The document will define terminology, steel classification, chemical composition, mechanical properties, coating properties (including non-metallic coating equivalency), material testing, certification and product marketing.

Tests of Long Shear Wall Sections with Hole Penetrations

The NAHB Research Center recently completed four pilot tests of 8 feet x 40 feet shear walls built with several configurations of door and window openings. The tests were designed to investigate the applicability of an efficient

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shearwall design method known as "perforated shearwalls." One of the main findings of this study was that light gauge steel walls sheathed with APA rated timber panels provide acceptable shear wall values when only the ends of the wall are restrained against uplift. This testing supports the philosophy that multiple hold-downs at individual wall segments between openings may not be required. For more information: Nader Elhajj / (800) 638-8556.

NAHB Builder Survey

The annual survey taken at the January 1997 NAHB Builder's Show in Houston shows a dramatic increase in interest in steel framing over a similar survey taken the year before. The poll found that 10 percent of builders nationwide are using steel framing for load bearing walls and an additional 18 percent are planning to use steel. For more information: Betty Christy / (800) 368-5242, ext. 405.

1997 ICC/CABO Submittal

Four code changes related to cold-formed steel framing were submitted for the 1997 cycle of the One and Two Family Dwelling Code (CABO), including:

CABO Code Change No.:	Description
R63-97	Expanded joist web hole sizes & spacing
R74-97	Wall stud tables for 50ksi steel Header tables
R91-97	Steel roof framing section
R125-97	Editorial

Prepared by the NAHB Research Center and the AISI, R63-97 was unanimously passed while the remaining will be re-submitted with changes during the negative balloting process. The second CABO hearing will be held in October. For additional information: Nader Elhajj / (800) 638-8556, ext. 581. ❑

Congressional Testimony Stirs Interest

by Mike Roddy, Green Framing Systems

Despite major concerns about dwindling supplies of construction grade wood and the environmental impact of many current logging techniques, the U.S. Government continues to maintain a policy to support wood housing construction. This is evidenced through a variety of subsidies and tax breaks offered the timber industry. The Federal Government provides additional funds to the timber industry in the form of free use of the Forest Service laboratories for new product development and tests for code compliance.

On March 4, a presentation on this issue was given before the House Appropriations Committee's Subcommittee on the Interior on the needs for funding to improve light gauge (cold-formed) steel technology. The key theme in this presentation is that steel is an available alternative whereby nearly everyone wins. Builders, designers, and workers are not trapped into using a material that has posed quality and price issues. Environmentalists can point to a positive alternative for building homes without ruining the landscape. In addition, politicians can avoid the constant grief from the struggle over the fate of our forests. As a follow-up, a proposal was submitted for a large research and development budget to be administrered by a qualified organization such as the LGSEA.

Response has been positive from several Senators, numerous Congressmen, members of the Executive Branch, and key leaders of the National Association of Home Builders. Also lending support were the Washington offices of Audubon, The Sierra Club, The Wilderness Society, Western Ancient Forest Campaign, and many grassroots groups which are some of our most powerful - and overlooked - allies.

Although several congressman have shown interest in sponsoring legislation, it is important that we maintain the current momentum. LGSEA members can help out in this effort by asking their local Congressional representatives for support. The response is likely to be positive from members of either party.

For information on how you can help, contact Mike Roddy at (310) 983-8081.❑

Commercial Messages

For infomation about placing Commercial Messages in this newsletter, please contact Larry Williams at (615) 386-7139.

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