Newsletter for the *January 1995*

Light Gauge Steel Engineers Association

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See Next Issue for:

Committee Activity

A Standardized Approach to Residential Stud Sizes

The Carpenter/Contractors Cooperation Committee, Inc.and the Light Gauge Steel Industry - Training Programs

Upcoming Events 1995

National Association of Home Builders Conference West Coast Builders	Jan 27-30
Association of Wall & Ceiling Industries - International	Apr 25-29
Pacific Coast Builders Conference	Jun 21-24
METALCON ' 95	Oct 24-26

Builders Look to Alternate Products

Ken Vought, USS -POSCO

Builders are being driven to investigate alternative products for a variety of reasons. One is the problem with wood.

The volatility of wood prices continues to be a major concern to home builders who find they are unable to accurately predict their building costs. As can be seen from the graph, a builder in his planning phase can estimate wood costs but when construction begins a few months later, the wood prices can be dramatically different. This has caused some builders to lose the majority of their planned profits and others to go into bankruptcy.

The weekly wood price volatility makes the matter even worse. If one builder buys his material this week and his competitor buys next week, one builder

(Continued on page 6)

Shear Wall Design and Testing

Light Gauge Steel Research Group, Santa Clara University
by Professor Reynaud Serrette

The use of sheathed metal framed shear walls to resist lateral loads (seismic and wind) is not a new application, however, there is a very limited database of shear values for these walls, compared to wood framed shear walls. The most commonly referred to document is APA's Research Report 154 (Structural Panel Shear Walls--revised 1993, based on tests completed between 1965 and 1990) from which engineers extrapolate to satisfy their particular design. **Table "A"** (see page 2) gives the scope and summarizes the results of the APA test program.

The fastener sizes in the APA tests were determined based on target design shear values for wood framed shear walls. The ultimate shear values given in **Table "A"** are based on single tests and the ASTM E 72-80 test procedure.

In a more recent study, AISI published a set of design values for metal framed shear walls based on the work of Klippstein and Tarpy (1992). The scope of this study and the suggested ultimate shear values are outlined in **Table "B"** (see page 2). The ultimate values in this table were based on both static and "pseudo-cyclic" loading and the ASTM E 564 test procedure.

Apart from the panel materials and wall configurations considered in the APA and AISI tests, the test procedures were also different. The ASTM E 72-80 test procedure is intended to evaluate the strength of the panel materials while ASTM E 564 is intended to evaluate the strength of the entire wall system. The basic differences in the test

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Department Staff

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Officers

TABLE A
Light Gauge Stud Shear Walls (APA Report #154)

Studs[a]	Fasteners	Panel	Fastener Schedule[d]	Ultimate Shear (plf)
2-1/2-in. 14 ga.	No. 10 -- screw	3/8-in. Ply[b]	4-in. / 12-in.	**1666**
3-5/8-in 16 ga	No. 10 -- screw	3/8-in. Ply[b] 7/16 OSB[b]	4-in. / 12-in. 4-in. / 12-in.	**1093** **1248**
3-5/8-in. 18 ga.	No. 8 -- screw	3/8-in. Ply[b] 3/8-in. Ply[b] 7/16-in. OSB[b]	6-in. / 12-in. 4-in. / 12-in. 3-in. / 12-in.	**748** **960** **1095**
2-1/2-in. 14 ga.	0.144" steel pin	5/8-in. Ply[c] 19/32-in. OSB[c]	6-in. / 12-in. 4-in. / 12-in.	**1088** **1865**

[a] Studs framed 24 in. on center; flange width of 1-5/8 in.
[b] Structural I
[c] Rated Sheathing
[d] First number refers to perimeter spacing, the second number refers to field spacing

TABLE B
Light Gauge Stud Shear Walls - (AISI)

Stud Spc'g (in.)[a]	Fastener	Panel	Fastener Schedule[b]	Ultimate Shear (plf)
24	No. 6	1/2-in. GWB (face and back) 1/2-in. GWB (face and back) 5/8-in. GWB (face and back--two ply)	12-in. / 12-in. 6-in. / 12-in. 24-in. / 24-in. (base), 12-in. / 12-in. (cover)	**333** **563** **438**
16	No. 6	1/2-in. GWB (face and back)	12-in. / 12-in.	**425**
24	No. 6	1/2-in. GWB (back), 1/2-in. GSB (face)	12-in. / 12-in.	**263**
24	No. 6	1/2-in. GWB (back), 1/2-in. CDX Ply -- Struct. II (face)	12-in. / 12-in.	**375**
24	No. 8 (for metal lath)	Expanded metal lath / Portland cement plaster (3-coat, face & back)	9-in. / 9-in. (lath)	**450**

[a] 3-1/2-in. 20 gauge studs with 1-1/2-in. flanges
[b] First number refers to perimeter spacing and the second number refers to field spacing

(Continued from page 1)

configurations for these procedures are the hold-down (also "holdown") used at the ends of the wall and the wall dimensions. The two procedures can, however, yield the same result if careful consideration is given to the design of the hold-down system.

In ongoing tests by the author (1994), at Santa Clara University, the behavior of metal framed shear walls with GWB, GSB, Plywood, OSB, and FiberBond panels is being investigated. **Table "C"** (see page 3) summarizes some details of the tests to date.

All the walls in these tests were framed with studs at 24" o/c and the ASTM E 72-80 procedure was followed. The results reported in the above table are based on maximum loads, other criteria (for example drift) may, however, govern the design load.

There are three limit states the designer should consider when specifying the

(Continued on page 3)

(Continued from page 2)

design strength of the metal framed shear wall: (1) Strength Limit State -- defines the maximum strength the wall is capable of resisting, (2) Drift/Deflection Limit State -- maximum allowable lateral deflection of the wall, and (3) Damage Limit State -- reflects significant damage to the wall where panel replacement is needed. The first two limit states (strength and drift) can be narrowly defined. The damage limit state, on the other hand, is somewhat more subjective and is seldom used in design. Qualitatively, the damage limit state may represent a condition in which a wall with some loading history has very low initial resistance to lateral load until the wall goes through some lateral deflection which may exceed the drift limit state.

Another question that may be of concern to the engineer is the maximum aspect ratio (height-to-width ratio) that can be permitted for seismic design. The UBC (1994) allows a maximum aspect ratio 3.5:1(for plywood and OSB). Even though a narrow wall (3.5:1) is calculated to be sufficiently strong for the design loads, the wall may be inadequate deflection-wise.

TABLE C
Light Gauge Stud Shear Walls - (Santa Clara University)

Studs[a]	Fasteners	Panel	Fastener Schedule[b]	Ultimate Shear (plf)
6-in. 20 ga. (600IC20)	No. 8 (strap)	2-in. 20 ga., flat strap tension X-bracing	one screw at each stud (anchored at gusset plate)	**303** (3 tests)
6-in. 20 ga. (600IC20)	No. 6	1/2-in. GWB (back), 1/2-in. GSB (face)	6-in. / 12-in.	**748** (4 tests)
6-in. 20 ga. (600IC20)	No. 6 (GWB) No. 8 (strap)	1/2-in. GWB (back), 1/2-in. GSB (face), 2-in. 20 ga. flat strap tension X-bracing (face)	6-in. / 12-in., one screw at each stud (anchored at gusset plate)	**929** (4 tests)
6-in. 20 ga. (600XC20)	No. 6	15/32-in. Ply APA rated sheathing (face)	6-in. / 12-in.	**1049** (2 tests)[c]
6-in. 20 ga. (600XC20)	0.114-in dia. steel pins	15/32-in. Ply APA rated sheathing (face)	6-in. / 12-in.	**621** (1 test)[c]
6-in. 20 ga. (600XC20)	No. 8	15/32-in. Ply APA rated sheathing (face)	6-in. / 12-in.	976 (2 tests)
6-in. 20 ga. (600XC20)	No. 8	15/32-in. Ply APA rated sheathing (face; perpendicular to framing w/o blocking)	6-in. / 12-in.	**421** (1 test)
6-in. 20 ga. (600XC20)	No. 8	15/32-in. Ply APA rated sheathing (face; perpendicular to framing w/blocking)	6-in. / 12-in.	**980** (1 test)
6-in. 20 ga. (600XC20)	0.114-in dia. steel pins	7/16-in. OSB APA rated sheathing (face)	6-in. / 12-in.	**600** (1 test)[c]
6-in. 20 ga. (600XC20)	No. 8	7/16-in. OSB APA rated sheathing (face)	6-in. / 12-in.	788 (3 tests)
6-in. 20 ga. (600XC20)	No. 8	7/16-in. OSB APA rated sheathing (face; perpendicular to framing w/blocking)	6-in. / 12-in.	**828** (1 test)
6-in. 20 ga. (600XC20)	No. 6	1/2-in. FiberBond wallboard (face)	6-in. / 12-in.	**317** (3 tests)

a MSMA sections (per ICBO Report # 4943)

b First number refers to perimeter spacing and the second number refers to field spacing

c Instantaneous load (all other loads are sustained)

Thus, in the design of narrow walls, more attention should be given to lateral deflection.

The majority of metal framed shear wall values being used today are based on static testing. Recently, based on the observed behavior of residential structures in the Northridge Earthquake, some engineers have started to call for design values based on seismic testing. Before seismic testing becomes standard, there needs to be some agreement among code officials, engineers, and researchers as to what constitutes an adequate seismic test. Attention must also be paid to the reasons for damage to residential structures during the Northridge Earthquake. Was the problem inadequate performance requirements, age of the material, poor workmanship, or poor structural design?

Some of the factors that must be considered in performing cyclic tests include rate of cycling, input motion (displacement- or load-controlled), and the number of cycles. Over the past few months, there has even been some discussion about the use of "shake tables" for testing wall assemblies. An Ad Hoc Committee on the Testing Standards, set up by SEAOSC, has already started work on the cyclic testing of light framed shear walls. The work of this committee is currently being considered for use in cyclic testing of steel framed shear walls. Until the results from cyclic testing become available, engineers can use shear values determined from static tests, keeping in mind that workmanship, drift limits, and poor materials can adversely affect the specified strength of the shear wall.❐

Technical Exchange Section

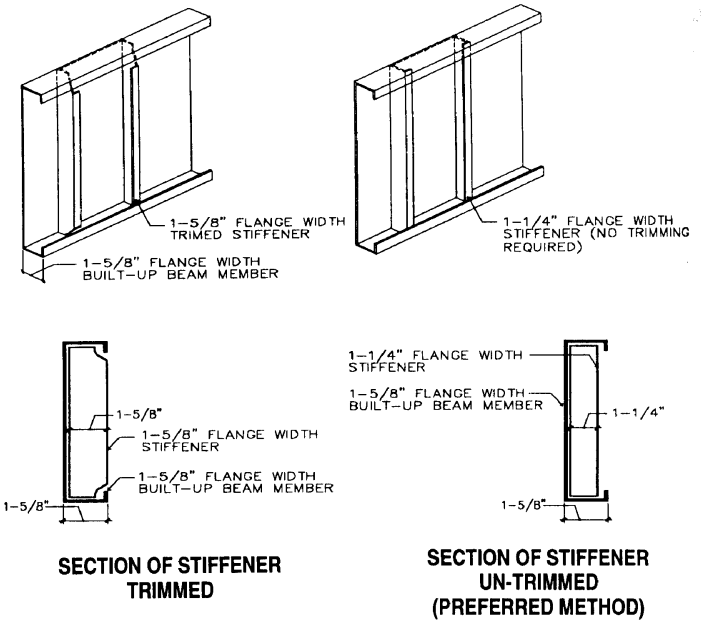
The Light Gauge Steel Engineers Association needs you and your experience. Please mail in opinions, questions, and design details that are relevant to the light gauge industry. Upon editorial staff review your submission may be printed in the Technical Exchange Section of this newsletter.

Construction Tip Concerning Web Stiffeners

By Dean Peyton, P.E.

As a contractor or an engineer there are simple detailing practices that can reduce costly labor time spent in the field during construction. Web stiffeners in built up light gauge beams is one example. Recently I was called to the field to provide a general overview inspection for a contractor who was new to light gauge steel construction. He was concerned that the built up beams were taking his laborers too long to construct. A review revealed that the contractor was attempting to stiffen the built up beam studs which had 1-5/8" flanges with stiffeners that also had 1-5/8" flanges (see the adjacent detail). To construct the detail, the contractor had to trim each end of each stiffener on an angle to allow the flange of the 1-5/8" stiffener to fit inside the 1-5/8" built up beam flange. Because of the contractor's inexperience with light gauge steel he did not observe that the plans called for "SS" type studs to be used for the web stiffeners. "SS" studs have a 1-1/4" flange width allowing each stiffener to easily nest inside a 1-5/8" flange of a built up beam member. Not realizing the labor cost savings, he neglected to order any material of that size.

This simply avoided problem occurs many times by those first timers in the area of stiffener construction. ❐

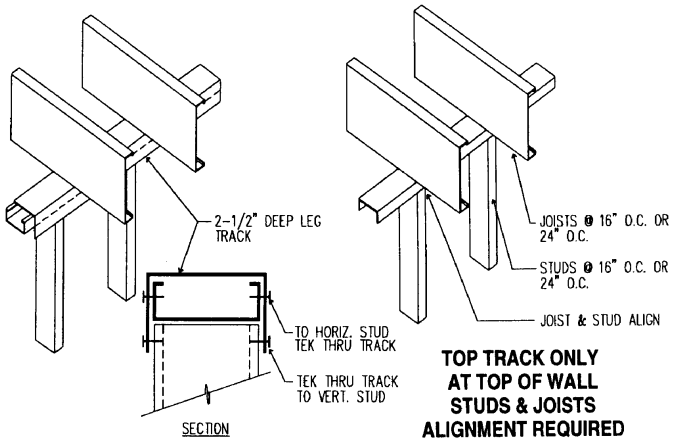


Bearing Walls - Stud / Joist Alignment vs. Non-Alignment A Distributor Plate Detail

by Dean Peyton, P.E.

Construction methods and materials may be intuitive to the timber framing world within the realm of timber products, but the light gauge steel residential construction world is playing catch up. As detailing with light gauge steel continues to evolve through interaction between contractors and engineers, each must keep in mind that there is more than one way to design and construct a light gauge steel residence. Timber residential contractors are cautious about entering new territory when it comes to light gauge steel construction. One selling point for light gauge steel is that steel studs can economically be spaced at 24" o/c, depending on the lateral design criteria (building location - i.e. wind & seismic criteria). However, to help keep as many methods as similar as possible to timber construction, standard timber stud and joist spacing should be considered. The

(Continued on page 6)



Technical Question & Answer Section

By Allan Swartz, P.E.

Technical Question & Answers are submitted as an open forum from the members and may not necessarily be the opinions and views of the LGSEA. We reserve the right to publish the answers that are most applicable. This section of the LGSEA Newsletter will be dedicated to answering questions that are of primary concern to designers, architects and builders of light gauge steel structures. Please address all questions to Light Gauge Steel Engineers Association, Attn: Technical Q&A Section

Question: ***Are there any one hour rated, load bearing party double wall assemblies, sheathed with 5/8 type X gypsum wall board, which have been tested and approved for light gauge steel framed walls?***

Answer: The answer to this question is no. The only rating that we are aware of for this type of assembly is for **non-load bearing** walls. The non-load bearing assembly is covered by Underwriters Laboratory (UL) test number U420. The general requirements for this wall assembly are shown in figure 1: (see UL Fire Resistance Directory for specific requirements).

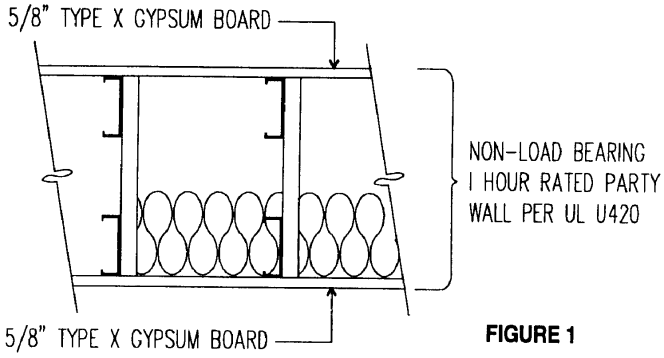


FIGURE 1

It is common practice to modify this assembly to function as a load bearing party wall by increasing the stud gauges as required for the support of design loads. Although many jurisdictions will accept an assembly that meets these general requirements, they are under no obligation to do so. In the event that approval is denied, an alternate approach would be to construct a single **load bearing** 1-hour rated wall per UL U425 and a non-load bearing wall as shown in figure 2 (again, see the UL Fire Resistance Directory for specific requirements).

This approach will add some additional costs to the project and impact the detailing of the connections at the tops of the load bearing walls. In addition, this assembly will not have a sound test rating, but should perform somewhat better than the double wall assembly covered under UL U420. ❐

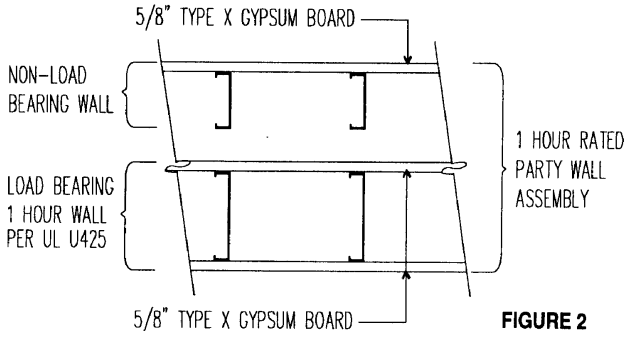


FIGURE 2

The Contractor's Corner

By Bruce Ward

Now that steel is emerging as a viable alternative to wood, how is the contractor benefiting from the efforts of Associations like LGSEA?

1. The Contractor needs to know that there is an attempt being made to standardize the framing material, (i.e. replace a 2x4 with a 3 1/2" steel stud or replace a 2x6 with a 5 1/2" steel stud, etc.....)

2. Education of the engineering design community to design safely and efficiently using the correct criteria for light gauge steel.

3. Standard detailing so the contractor feels confident he can bid and construct houses cost effectively.

The contractor doesn't want to get caught up in discrepancies between:

1. Dimensional lumber and manufactured lumber products.
2. Wood verses steel issues.
3. Inconsistencies in the message the steel industry is sending within itself.

The contractor just wants an option. He wants to continue doing what he's always done, and that's build and sell homes.

The industry is working to provide those options every day and we're trying to keep it simple. ❐

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LGSEA: Engineering a Framework for Residential Construction

In its search for relief from volatile lumber prices, the nation's residential building industry has focused its interest on light gauge steel framing. There is growing evidence of this trend. Just two years after a National Association of Home Builders (NAHB) survey found that 45% of builders were considering a move to steel, the use of residential steel framing has doubled. More recently, the U.S. Department of Housing and Urban Development, American Iron and Steel Institute, and NAHB have joined forces to develop alternatives to dimensional lumber and promote competitiveness in home building.

On the forefront of the rapidly developing market for residential and commercial steel framing is the Light Gauge Steel Engineers Association (LGSEA), which represents some of the nation's most experienced designers of steel framed structures. Its members are dedicated to advancing the use of light gauge steel in residential construction by establishing engineering standards, specifications for tools and materials, and effective building techniques. The long-term objective of the LGSEA is to help guide the development of building codes and standards regarding light gauge steel framing.

Technical information that currently exists is shared with members through the LGSEA newsletter and in future editions of technical briefs. Results of the LGSEA's program to standardize details will also be made available to members. Where there are gaps in knowledge, the LGSEA participates in research and testing programs.

The LGSEA membership is largely comprised of engineers actively designing light gauge steel framed structures. Affiliate members also represent a broad cross-section of the building industry and work with the engineers to ensure that positions taken by the LGSEA are also cost-effective for manufacturers and can be efficiently executed in the field.❒

METALCON '94 Draws Crowd to Atlanta

An increased focus on steel in residential construction and a thorough educational program drew more than 6,400 architects, engineers, developers, and manufacturers to Metalcon International '94 breaking all previous attendance records. The show was held October 11-13 at Atlanta's World Congress Center.

Also on hand were 350 exhibitors representing a broad range of suppliers to the steel framing industry, including tool manufacturers, fastener and connector producers, roofing and framing systems, and stud manufacturers. The exhibit floor's centerpiece was the construction of a 1,000 square foot home.

A major attraction of this year's Metalcon were the many educational sessions which covered all areas of construction from designs and availability of product costs to tools and techniques. Seminars also highlighted the benefits of light gauge steel framing and metal roofing for residential applications.

As interest in the use of metal in residential construction continues, Metalcon continues to grow. "We've already had to add floor space for '95 because of the tremendous response we had from exhibitors at this year's show," said Claire Kilcoyne, show manager.

Metalcon '95 will be held at the Washington D.C. Convention Center from October 24-26, 1995 ❒

Alternative Products *(Continued from p.1)*
can have a substantial cost advantage over the other.

Another frequent complaint of builders is the deteriorating quality of wood. Many builders say they have to discard about 15% of the wood they purchase.

In summary, builders are convinced that wood prices will continue to be volatile, with prices continuing to trend up as seen in the graph. This, coupled with deteriorating wood quality, has builders investigating alternative building products; the most popular one, by far,

Stud Alignment *(Continued from page 4)*
24" o/c spacing will limit the use of 1/2" gypsum wall board, as 5/8" GWB is required for 24" o/c stud spacing. Depending on the light gauge contractor, some may prefer to align the joist above with studs below and therefore avoid the need for a distributor plate to carry the concentrated loads to the supporting studs. Other contractors do not want to insure that their laborers have aligned all joists and trusses with studs below. These contractors recognize that their laborers are more familiar with non-alignment, timber frame methods. In timber frame construction (2) top of wall plates are typically used. For light gauge steel top of wall construction one example of a distributor plate detail is shown on page 4. This detail uses a deep leg stud track with a horizontal stud nested inside and orientated with the open face up. The detail allows for screw attachment which typically is the contractor's economical choice in lieu of welding. An engineer needs to determine the size and gauge requirements to support the particular loads being generated. ❒

LGSEA Membership Information / Application

This has been a complimentary issue of the LGSEA Newsletter. To continue to receive this newsletter and other benefits from the LGSEA fill out the enclosed Application Form and mail it today.