Newsletter for the
October 2000
Light Gauge Steel Engineers Association

INSIDE

INSIDE	Page
Tests Indicate Greater Web Crippling Strength	1
Technical Exchange	4
Pilot Tests on Built Up Floor Headers	
Finish Nails	5
Directory of Cold-Formed Steel Design Guides	6
Approximate Calculation for Stud Bearing in Bottom Track Over Concrete	7

Tests Indicate Greater Strength for Web Crippling at Rim Track/End Joist Bearing Conditions

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

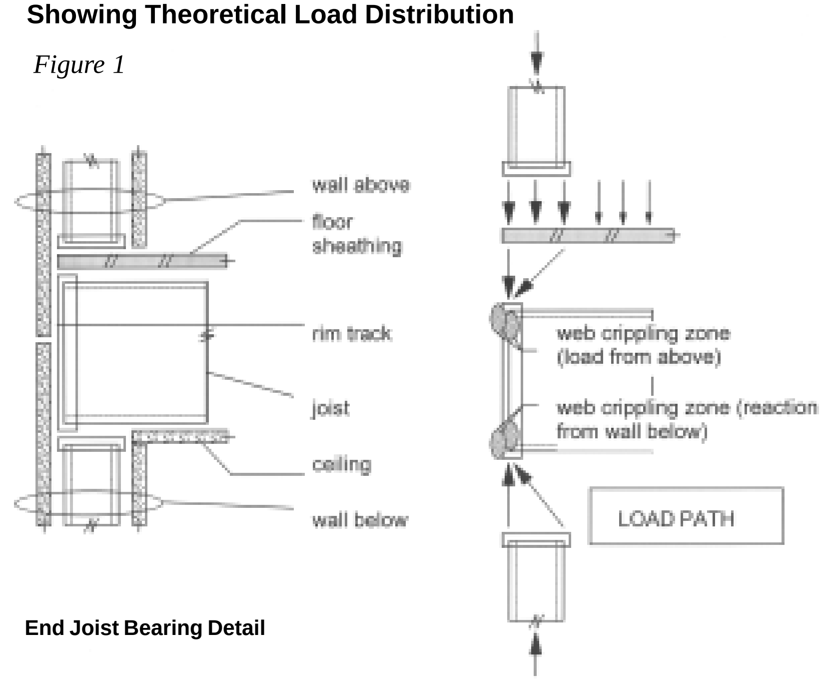
To address the web crippling performance of the rim-track with framing joist and rim joist details as implemented in the field, a pilot study was initiated by the Light Gauge Steel Research Group, Santa Clara University. The primary goal of the study was to compare the results of these limited tests with predictions based on the AISI Specification, Section C3.4.

Two basic configurations (A. rim-track with framing joist, and B. rim joist) were tested with the results of the rim-track with framing joist condition reported here (Figure 1). The scope of the test program included 8-in. and 10-in. floor members with thicknesses of 43 and 54 mils (1 mil = 1/1000th of an inch). The supported and supporting walls were framed with 3-1/2 in. 43 mil studs at 24 in. on center and the wall tracks were either 43 or 54 mils. The minimum nominal yield strengths of the

Continued on page 2

Rim Track with Framing Joist Bearing Details Showing Theoretical Load Distribution

Figure 1



End Joist Bearing Detail

Upcoming Events

METALCON — Oct 31-Nov 2
Atlanta, GA
Info.: (617) 965-0055

STEEL SOLUTIONS Seminars — Oct 31-Nov 2
Atlanta, GA
Info.: (615) 279-9251
(See article on page 3)

LGSEA Committee Meetings — Nov. 2
8:00-9:30 Truss
3:00-4:30 Lateral Load Design
4:30-5:00 Fastener/Connector
Atlanta, GA
Info.: (617) 965-0055

Building Industry Show (BIS) — Nov. 30 - Dec. 1
Anaheim, CA
Info.: (909) 396-9993

International Builders Show — Feb 9-21
National Association of Home Builders
Atlanta, GA
Info.: (800) 368-5242

CHAPTER MEETINGS

For information, call:

Hawaii Chapter	*(808) 485-1400*
Atlanta/Southeast Chapter	*(615) 242-0023*
Europe Chapter	*(615) 279-9251*
Ontario Chapter	*(615) 279-9251*

NASFA Publishes "L"-Header Design Guide

The North American Steel Framing Alliance (NASFA) has published the "L-Shaped Header Field Guide" that provides the information necessary to specify, build, supply or approve the use of the steel L-header. Aimed at the builder, framer, subcontractor, architect, engineer, supplier, code official or anyone engaged in low-rise construction, the

Continued on page 3

Newsletter for the Light Gauge Steel Engineers Association

Web Crippling

Continued from page 1

material were consistent with the requirements of the Steel Stud Manufacturers Association (33 ksi for 43 mil material and 50 ksi for 54 mil material). No material tests were performed.

Based on the theoretical mechanism of load distribution illustrated in Figure 1, the bearing length for the rim-track may be taken as 1-5/8 inch, the stud flange width of the supporting wall below. Two bearing width assumptions are possible for the framing joist: 3-1/2 inch representing the width of the supporting wall or 1-1/4 inch representing the width of the rim-track flange used in the tests.

Based on the load paths illustrated in Figure 1, the critical section of the web is in the "web crippling zone" (WCZ) associated with the reaction from the wall below. Load from the wall and floor above is distributed to the supporting members (rim track with framing joist) through the floor sheathing and the thickness of the sheathing serves to distribute the load over a longer bearing length.

The bearing lengths used for these calculations ignores three aspects of behavior that may affect the distribution of load in the WCZ:

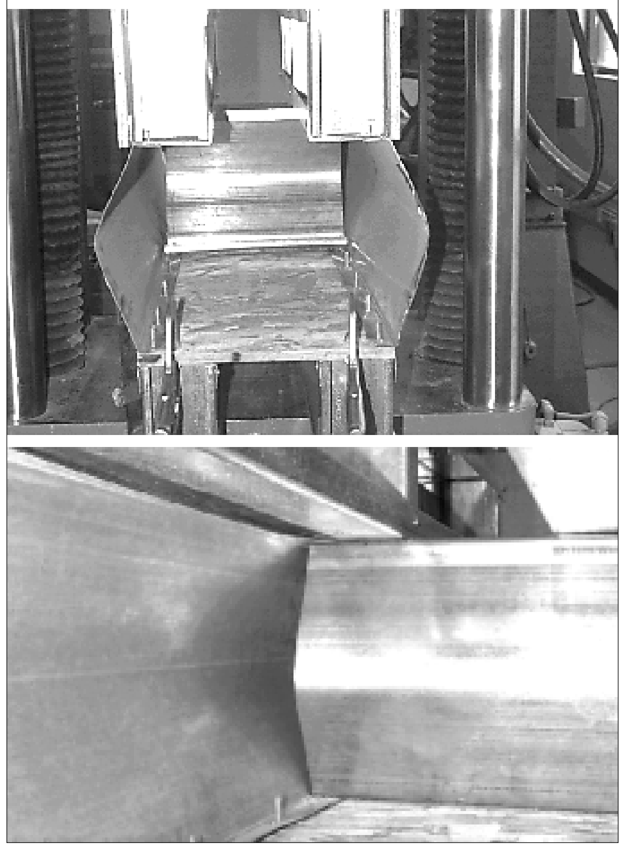
i) The stud reaction is applied to the track at the track corner radius. As a result, the reaction will be distributed over a longer length.

ii) A thicker top track will facilitate a wider distribution of the stud reaction to the floor framing members.

iii) Attached sheathing on the outside face of the wall will also take part in the distribution of the stud reaction.

Using the bearing lengths specified above and the requirements of the AISI Specification, Section C3.4, the nominal web crippling strength for the rim-track with framing joist condition tested were computed and compared to test values. The overall behaviors of the test specimens are illustrated in Figure 2, and the specimen maximum capacities are given in Table 1.

Typical behavior of the rim joist-framing track detail *Figure 2*



For the Rim-Track with Framing Joist condition, the primary mode of failure noted was vertical web buckling in both members (Figure 2). A comparison of test data revealed the following:

- For the 54 mil 8-inch rim tracks with 43-mil framing joists, an increase in the rim track thickness from 43 mil to 54 mil gave a strength reduction of 7% while the same thicknesses with 10-inch members yielded only a 1% increase;
- For the 54 mil 10-inch rim track with 54 mil framing joists, an increase in wall track thickness from 43 mil to 54 mil yielded a strength increase of 3.6%.

Continued on page 3

Web Crippling

Continued from page 2

Using the provisions of the AISI Specification, the capacities of the test specimens were computed using the nominal geometric properties (per SSMA 2000) and AISI Specification equation C 3.4-4 (referred to as condition 2 by SSMA) for the rim-track and equation C 3.4-6 (referred to as condition 3 by SSMA) for the framing joist. The AISI computed nominal capacities are compared with the test values in Table 1.

Overall, Table 1 shows that ignoring all specimens with an h/t ratio greater than 200, tested to predicted strength ratios range from 1.41 to 1.69, depending upon the assumption made for the bearing length of the framing joist. Thus, on the basis of these limited tests, it appears that the maximum strength of built assemblies may be as much as 60 percent greater than the nominal values (that is, not including any safety or resistance factor). Although not reported here, similar measures of conservatism (in some cases higher) were observed in the rim-joist tests.

Acknowledging that the results derived from this study are based on a limited number of tests, a 69 percent increase in capacity is significant enough to warrant further investigation. Another important note is the fact that the test values are based exclusively on maximum resistance attained. At these maximum strength values, the observed (not measured) vertical deflection under the concentrated load was quite large (as evident in Figure 2) and most likely unacceptable in a design condition. It may be appropriate to establish a deflection/deformation criterion for web crippling similar to bearing failure in timber design. A review of existing web crippling test reports indicate that some researchers have casually excluded test results where large or excessive vertical and out-of-plane deflections were observed without providing a definition of what large or excessive means.

Test Configuration	Test Bearing Load, lb.	Predicted (Nominal) Bearing Load, lb. [1,6]	Predicted (Nominal) Bearing Load, lb. [2,6]	Ratio of Test to Predicted Load [1]	Ratio of Test to Predicted Load [2]
8RT54-WT43[4]	4270	2530	2665	1.69	1.60
8RT54-WT54[4]	3969	2530	2665	1.57	1.49
10RT43-WT43[3,4]	1059	1211	1323	0.87	0.80
10RT43-WT54[3,4]	1068	1211	1323	0.88	0.81
10RT54-WT43[5]	4124	2718	2934	1.52	1.41
10RT54-WT54[5]	4274	2718	2934	1.57	1.46

[1] Using a bearing length of 1.625 in. for the rim-track and 1.25 for the framing joist.
[2] Using a bearing length of 1.625 in. for the rim-track and 3.50 in. for the framing joist.
[3] h/t > 200
[4] 43-mil framing joists.
[5] 54-mil framing joists.
[6] Predicted numbers are based on nominal material strength.

Table 1 **Typical behavior of the rim joist-framing track detail**

The work presented here was supported by the School of Engineering-Santa Clara University, CEMCO and USS-POSCO. A more detailed report of this pilot study will be published by the LGSEA in a Research Note, and also can be obtained from the author by calling (408) 554-6868, or at **RSERRETTE @SCU.EDU**. ■

"Steel Solutions" at METALCON

The Atlanta/Southeast Chapter of the LGSEA is sponsoring a series of professional development seminars as part of the STEEL SOLUTIONS program at METALCON. The seminars are designed for anyone who wants to stay on the cutting edge of steel framing design and has Continuing Education needs. Eash session includes valuable information about design techniques, recent research, and the new building codes. For more information about METALCON and Steel Solutions, visit www.metalcon.com or www.LGSEA.com.

SCHEDULE SUMMARY

Tuesday, October 31
8:30 – 10:00 a.m. Serious Strides in Steel Components
10:15-11:45 a.m. Simplified Design of Cold-Formed Steel

Wednesday, November 1
8:30 – 10:00 a.m. Steel Framing and the International Codes:
10:15 – 11:45 a.m. The Specification and Use of Light Gauge Steel Trusses

Thursday, November 2
9:30 - 11:00 a.m. Design for High Wind ■

L-Shaped Header Guide

Continued from page 1

guide contains a fully prescriptive set of span tables and details for the header.

Just as the name suggests, the L-header is an "L" shaped angle that provides similar capacities to the traditional headers assembled with back-to-back or boxed C-sections, but is more efficient to assemble because fewer fasteners and pieces of steel are required.

Using the standardized designation system designed by the Steel Stud Manufacturers Association, the size and thickness of the L-header material can be easily identified for ordering, supplying, and installing the correct product.

A printed copy of the "L-Shaped Header Field Guide" is available by calling 800-79-STEEL, or via a free download from www.SteelFramingAlliance.com. ■

TECHNICAL EXCHANGE

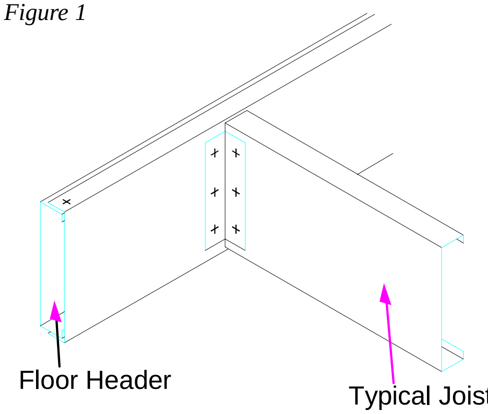
The Light Gauge Steel Engineers Association needs you and your experience. Please mail or fax your opinions, questions, and design details that are relevant to the cold-formed steel industry (fax to Dean Peyton at (253) 941-9939). Upon editorial review, your submission may be printed in the Technical Exchange Section of this Newsletter.

Pilot Tests on Built-up Floor Headers Shed Light on Capacity

By L. Randy Daudet, P.E. S.E., Dietrich Industries

In a small pilot study conducted at Dietrich Industries, it was found that built-up headers used in a floor system, and loaded from one side (see Figure 1), do not always attain full nominal moment capacity. Dietrich tested three header configurations as shown in Figure 2. All configurations were constructed with 10" 54 mil (16 gauge) joist and track material. Each test consisted of a 10 foot, simple-span beam loaded at third points. Load was applied through stiffeners on one side of the header. In addition, adequate bracing was provided in order to prevent lateral buckling, and stiffeners were provided at end bearings to prevent web crippling. All specimens exhibited bending failure in the compression flange near the point of load application. Compression flange failure was much more prominent in the members adjacent to the side of load application.

Figure 1

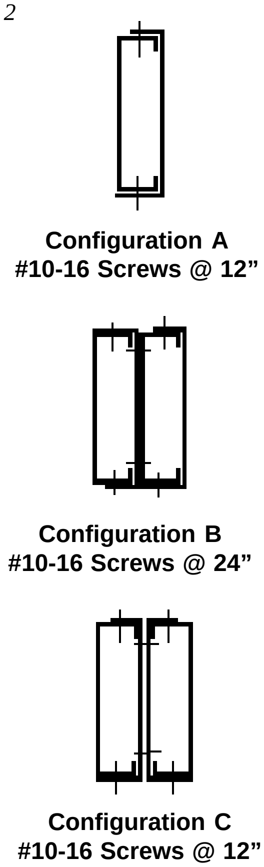


The primary objective of the study was to determine the degree of load sharing between the individual joist and track sections of common floor headers. As expected, Configuration A exhibited the best load sharing capacity, with an average moment ratio Mtest/Mcalc of about 1.0. Configurations B and C yielded Mtest/Mcalc values of about 0.6 and 0.7 respectively. Reducing the screw spacing from 24" on center (Configuration B), to 12" on-center, (Configuration C), resulted in only a marginal increase in load sharing. Clearly, the load sharing capacity of many commonly used floor headers is much less than that normally assumed by engineers.

The reduced capacity of the tested built-up sections appeared to be primarily due to the lack of continuity, or composite action, between individual joist and track sections. Consequently, it appeared that longitudinal shear stresses could not be sufficiently developed, and therefore bending stresses were not adequately shared between members. Therefore, members closer to the side of load application carried a disproportionate share of the load. Shear and warping stresses from torsion did not appear to contribute to premature failure. Test observations seemed to indicate that the lack of continuity between members prevented torsional stresses from developing to any significant degree.

Hopefully, this study will spark additional, more thorough research on the behavior and strength of built-up headers. Until further studies are completed, however, engineers must use good judgement regarding the configuration, number of individual sections, the fastening frequency, and the fastening method employed for these important structural elements. ■

Figure 2



New Developments in Finish Nails Eases Trimming

By Gary Rolih, P.E., SENCO Fastening Systems, Cincinnati, OH

When pneumatic finish nailers and collated finish nails were first introduced thirty years ago, the carpenter's productivity and work quality immediately improved. The nail could now be driven and countersunk with one blow leaving a much smaller countersink hole, and a blunt chisel point on the fastener reduced wood splitting and scrap.

On a steel-framed structure, the trimming task is much more difficult and time consuming. The typical finish nail designed for wood service frequently will glance off the steel and bend, depending on the thickness of the steel, the nail buckling resistance, nail point and, to some extent, the nail driving angle.

When a standard finish nail is required to penetrate two layers of steel where there is an overlapping joint, the nail may perform even more poorly. The nail frequently does not penetrate the first layer but glances off. If the nail does go through the first layer it will not penetrate the second layer of steel but will bend that layer away from the blow, distorting the local assembly. Often the nail will slide between the stud and header, which raises a local bump.

Door and window headers cause the most serious problems because of the thickness used. A standard, cold-formed nail will not penetrate 33 mil (18-gauge) steel except under very special circumstances.

To achieve the same speed of assembly of a wood finisher, a nail fastener with properties designed for cold-formed steel has been developed and is available. This 15-gauge fastener is designed with a diamond point and higher yield strengths resulting from heat treatment.

The stronger nail and sharp point cut through the steel using less tool energy. More layers of steel can be penetrated, and the nail resists buckling unless confronted with steel thickness greater than the diameter of the fastener.

Using this nail, the finish carpenter can use techniques similar to wood methods to attach trim. Because the nail can penetrate more than one layer of steel and can penetrate steel at an angle, the carpenter can draw the trim down to the drywall or draw mitered corners together. He can quickly fasten trim around the door and window frames where heavier gauges are typically used.

With this nail, the resulting connections are stronger and much more durable than those connections clinched to the drywall. The finish carpenter also regains some of the speed he had in working wood-framed projects with pneumatic tools. ■

Directory of Cold-Formed Steel Design Guides

The April 2000 issue of the LGSEA Newsletter contained a partial list of design guides covering the following subjects: "Shear Wall Design," "Component Design," "Truss Design and Bracing," "Durability/Corrosion," "Stud/Track Specification and Design Tables," and "Design Guides/Manuals."

These publications are available through the publishers, and contact and ordering information is provided below. Prices shown are current as of September 2000, and are subject to change without notice. Readers are encouraged to contact the authors for more information about specific publications. ■

SUBJECT: Fasteners/Fastening

Publication Name	Published by*	Cost**
Fasteners for Residential Steel Framing	AISI	$15 or free download from www.steelframingalliance.com
Screw Fastener Selection for Light Gauge Steel Framing, TN 565c, (2/97)	LGSEA	Free to LGSEA members $1 to non-members
Tensile Strength of Welded Connections, CF93-1, (1993)	AISI	$5
Welding Cold-Formed Steel, TN 560-b1 (10/99)	LGSEA	Free to LGSEA members $1 to non-members
Test Methods for Mechanically Fastened Cold-Formed Steel Connections, CF92-1 (1992)	AISI	$5
Clinch (Integral) Fastening of Cold-Formed Steel, TN 560c, (1/99)	LGSEA	Free to LGSEA members $1 to non-members
Pneumatically Driven Pins for Wood Based Panel Attachment, TN 561b, (3/98)	LGSEA	Free to LGSEA members $1 to non-members
Design Guide: Pneumatically Driven Pins for Wood Based Panel Attachment, TN 561b, (10/98)	LGSEA	Free to LGSEA members $1 to non-members
(AWS) D.1.3, "Structural Welding Code – Sheet Steel"1998. 76 pages, softbound, 3-hole punched. ANSI Approved 1998. Catalog No.: D1.3-98.	AWS	$68.00

SUBJECT: Builder/Framing Guides

Publication Name	Published by*	Cost**
C754-99a Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products	ASTM	$30.00, download from www.astm.org or by fax or mail.
C1007-98e1 Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories	ASTM	$25.00, download from www.astm.org or by fax or mail.

* Refer to "Publishers" table below. ** Special membership rates may apply to purchases.

Publishers*

American Iron & Steel Inst. **AISI**
1101 17th Street, N.W., Suite 1300
Washington, D.C. 20036
(800) 79-STEEL www.steel.org

American Society of Testing and Materials **ASTM**
100 Barr Harbor Drive
West Conshohocken,
Pennsylvania, USA 19428-2959
(610) 832-9585 www.astm.org

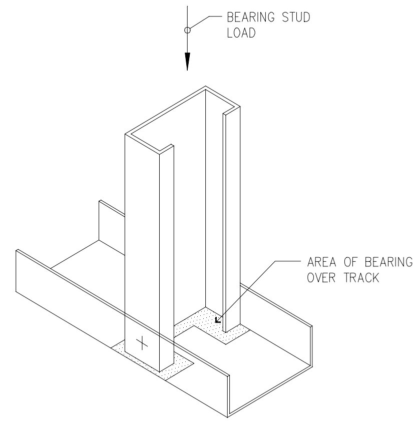
Light Gauge Steel Engineers Association **LGSEA**
2017 Galbraith Drive
Nashville, TN 37215
(615) 279-9251 www.lgsea.com

American Welding Society **AWS**
550 NW LeJeune Road
Miami, FL 33126
(800) 443-9353,
Intl. calls - (305) 443-9353 www.aws.org

For listings of additional technical publications that are useful, visit the web site for the North American Steel Framing Alliance at www.steelframingalliance.com.

Approximate Calculation for Allowable Stud Bearing in Bottom Track Over Concrete

By Dean H. Peyton, P.E.
Anderson-Peyton Structural Engineers, Seattle, WA



Given there are no tests which have investigated the structural support condition for a bearing stud transferring load through its bottom track to a concrete bearing surface below, the following engineering rationale is used to aid the designer. This method for calculating the required bearing area under the bottom track of an axial load bearing stud is based on "The Lightweight Steel Framing Design Manual" by the Canadian Sheet Steel Building Institute, and should be used as an approximation only.

Given:

Allowable Concrete Bearing Stress equals $(0.85\, f'c) / W_c$ (where $W_c = 2.5$)
X = The width of track assumed to cantilever beyond the face of the bearing stud which distributes the bearing stress through the track into the concrete.

Stud Size				Track	f'c	Fy-track	X	Abrg	Pall
Thickness	Web	Flange	Lip	Thickness	(PSI)	(PSI)		(in²)	(#)
0.0451	3.5	1.625	0.5	0.0451	3000	33000	0.14	3.16	3227
0.0566	3.5	1.625	0.5	0.0566	3000	50000	0.22	3.96	4044
0.0713	6	1.625	0.5	0.0713	3000	50000	0.27	6.11	6230

$\mathbf{M_{req}} = 0.85\, f'_c X^2 / 2\, W_c$ The required/applied Moment at the maximum allowable concrete stress.

$\mathbf{M_{all}} = Z\, F_y / W_b$

Z = Plastic Section Modulus $= 0.25\, b\, t_t^{\,2}$

t_t = design thickness of the bearing track

b = 1" unit width

$W_b = 1.67$

Fy = Yield stress of the Track material

Determine:

The maximum "X" is calculated by setting the Required Moment to maximize the concrete stress equal to the Allowable Moment capacity for the bearing track and solving for "X".

$$\mathbf{X = 0.9384\, t_t\, (F_y/f'_c)^{1/2}}$$

t_s = Thickness of the bearing stud

W = stud Web length

F = stud Flange length

L = stud Lip length

Given X then the Total Bearing area is calculated as $\mathbf{A_{brg}}$ and the allowable load as $\mathbf{P_{all}}$

$$\mathbf{A_{brg} = (F + 2X)(L + X)(2) + [W - 2(L+X)]\,(t_s + 2X)}$$

$$\mathbf{P_{all} = A_{brg}\,(0.85\, f'_c / 2.5)}$$

The table shown here demonstrates that allowable bearing stresses in the concrete do not appear to exceed typical stud capacities for axial and flexure strengths for common unbraced floor to floor stud heights. Again, these allowable loads are based on the assumptions listed above and should not be used without confirmatory testing. This calculation does not take into account the potential stiffening advantage of the track flanges nor the track to stud fasteners, which may increase the track bearing area. On the other hand, neither is there consideration given to a potential lack of stud web seating for bearing or the influence of local buckling in the stud web is not accounted for .

This article is intended to raise the issue, that the engineering design community does not have the available test data to substantiate a design solution for this bearing condition.

To obtain a copy of a Microsoft Excel spreadsheet for this calculation, contact the LGSEA by calling (615) 279-9251. The LGSEA is not responsible for proper maintenance and use of the spreadsheets. It is the responsibility of the user to understand and properly use the spreadsheet as a design aid tool. ■

WANTED

Lake Tahoe area engineering firm – emphasis on light gauge steel for housing industry. Needs P.E. with Structural engineering background. Salary negotiable. Contact Lybrand and Associates, (520) 284-1569.

Structural engineer needed, would prefer light gauge experience. Immediate opening. Great pay with benefits. Fax resume to Jay at (770) 483-0014.

Engineer/Designer. Minimum 1 year experience in engineering office. Computer experience required. License desirable, salary negotiable. Our professional engineering office specializes in designs using LGCFS in single family, tract homes, commercial buildings, including mid-rise. Come learn from the best! Call 209-234-0714 or fax resume 209-234-0715.

Light Gauge Steel Engineers Association

LGSEA

2017 Galbraith Drive
Nashville, TN 37215
(615) 279-9251