Newsletter for the *May 1999*

Light Gauge Steel Engineers Association

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Upcoming Events

Atlanta/Southeast Chapter Meeting *(see "Briefs", page 7)* *Info.: (615) 604-9139*	May 21
Hawaii Chapter Meeting *(see "Briefs", page 7)* *Info.: (808) 485-1400*	June 8
Pacific Coast Builders Conference San Francisco, CA *Info.: (615) 279-9251*	June 24-26
LGSEA Meetings San Francisco, CA *Info.: (615) 279-9251*	June 25-26
Seminar - Cold-Formed Steel Design (6-hour) **Los Angeles** *Info.: (615) 279-9251*	July 9
Seminar - Cold-Formed Steel Design (6-hour) **San Franicsco** *Info.: (615) 279-9251*	July 12
Seminar - Cold-Formed Steel Design (6- & 3-hour) **Seattle** *Info.: (615) 279-9251*	July 14

Testing of L-Shaped Headers Completed

by Nader Elhajj, NAHB Research Center, Inc.

While light gauge steel box and back-to-back headers are widely used and can be designed for most applications, often it is necessary to reduce cost by using less material and less screws, and therefore, less labor hours. That was the objective of the Cost Reduction Subcommittee when they funded a program at the NAHB Research Center, Inc., to investigate this cost-reducing technique and verify its application for a sufficient range of span conditions in light-frame residential construction.

The program was completed in two phases. The first phase was an investigative phase, where select sizes and thick-

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NASFA & LGSEA Create a Synergistic Relationship

by Don Moody, President, North American Steel Framing Alliance

A synergistic relationship was recently formalized between our new organization, the North American Steel Framing Alliance (NASFA, an affiliate of AISI), and the LGSEA. Because of the great working relationship established with the American Iron and Steel Institute (AISI) prior to NASFA's formation, the LGSEA and AISI's Residential Construction Program made huge strides in promoting the use of light gauge steel framing. Now NASFA and LGSEA stand to gain much more by working hand-in-glove in specific areas, leveraging the talents of both organizations' staff and members.

NASFA, incorporated last November, is charged with greatly expanding the efforts made thus far by the AISI's Residential Construction Program. NASFA's mission is to enable and encourage the widespread, practical and economic use of light gauge steel framing in residential construction. NASFA's goal, which has been the industry's goal for some time, is to achieve sustained annual residential construction market shipments of light gauge steel framing products equal to 25% of the total residential market, in tons, by 2002.

To do this, NASFA has written a comprehensive 5-year business plan which analyzes the market opportunity, determines steel framing's current market

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Newsletter for the Light Gauge Steel Engineers Association

"L"-Shaped Header Tests

Continued from page 1

nesses of L-shaped headers were tested to properly guide the second phase of the program. The first phase concluded that cold-formed steel L-headers can be safely used in lightly loaded buildings. The second phase of the testing included a more comprehensive set of L-header sizes, thicknesses, and covered both gravity and uplift loads. Before we get into more details, let us give a brief overview of the different components of a typical L-header.

As the name suggests, the main components of an L-shaped header is a piece of cold-formed steel formed into a shape resembling the letter L. An L-header assembly consists of a cold-formed steel angle with one short leg lapping over the top track and one long leg extending down the side of the wall above window or door openings. Each angle is fastened to top track above an opening with #8 (minimum) screws spaced 12-inches on center. "L" angles can be placed on one side or both sides of the steel track to form either a single or a double L-header. The L-shaped header transfers vertical loads to the next available stud along the side of the window or door opening. A detail of the built-up L-header assembly is shown in Figure 1.

Tests were conducted for header spans that were selected to cover a range of the most common construction opening sizes (i.e. 3'-0", 6'-0", 8'-0", 12'-0", and 16'-0"). A total of 69 and 39 L-shaped header assemblies were constructed and consecutively tested for simulated gravity loads and uplift loads.

All test specimen were constructed with 33 mil top tracks, #8 screws, and 43 mil king studs. Additional tests, however, were performed to investigate the impact of screw size, top track thickness, and king stud thickness on the L-header's capacity. The tests showed no significant variation in the header's capacity.

Gravity loads test results showed that L-shaped header specimen failed in a combined web crippling and bending mode. This failure mode was observed for all 3-foot, 4-foot, 6-foot, and 8-foot header tests. The data showed that the AISI Design Specification is rather conservative for all cases when web crippling is considered in design because the C-sections are assumed not to be fully-effective (as web stiffeners in accordance with Section B6.1 of the AISI Design

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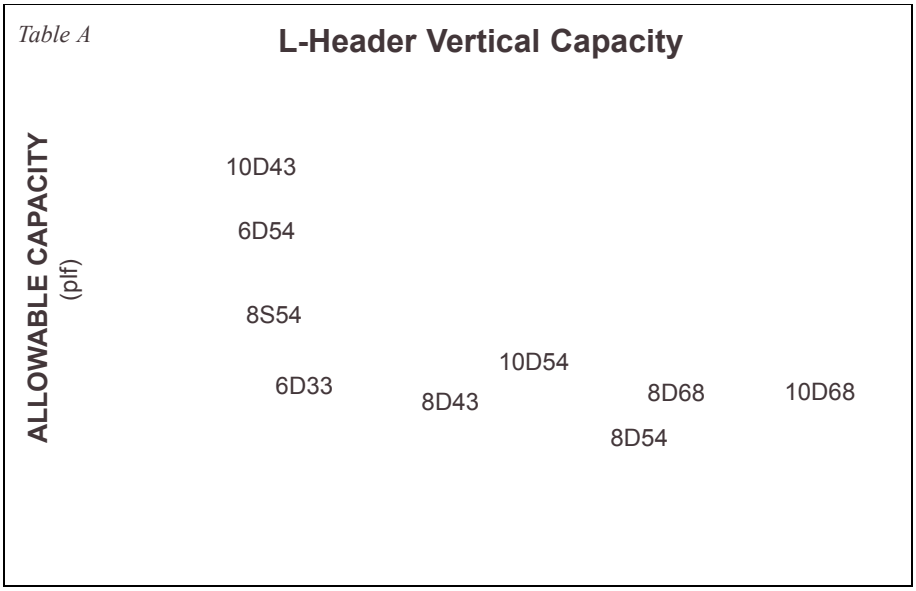
Table A

L-Header Vertical Capacity



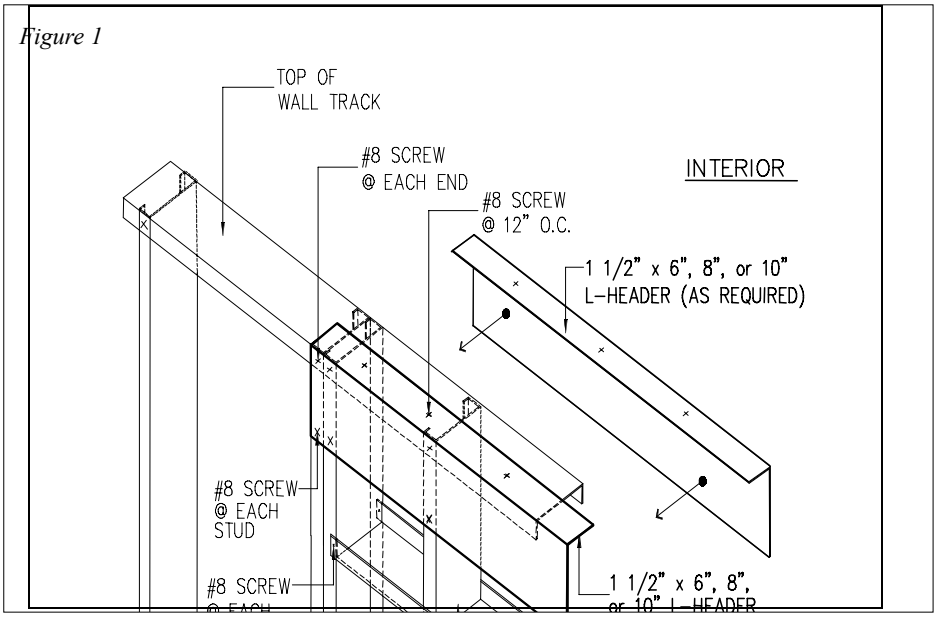
"L"-Shaped Header Tests

Continued from previous page

Specification) as confirmed in this study. Tested headers showed an increase in tested (allowable) capacity by 3% to 336% over design capacity. The observed failure mode for the 3- to 8-foot headers was local buckling of the compression flange directly under the point load (bearing failure) which contributed to a premature bending failure at the location of the L-header horizontal leg compression flange. The deformed compression flange and bending moment also resulted in some localized buckling of the web immediately below the load point. The presence of the cripple studs (acting as a stiffener) helped to control the propagation of the web buckling such that an overall web buckling failure was not observed.

Headers with long spans (12- to 16 feet) showed an increase in tested (allowable) capacity by 15% to 60% over design capacity. The observed failure mode was a bending type failure, where web deformation occurred at and well beyond the location of load points. This observation validates the design methodology of the L-headers where the design load is controlled by a shear and bending interaction equation.

Figure 1



Uplift load test results indicated that all test specimens behaved consistently under the applied load. The header's webs between the point loads showed severe buckling failure at peak loads. High vertical deflections (between 0.5 in. and 1.0 in.) were observed for all headers at peak loads. Lateral deflections (out-of-plane deflections) were also observed to be high at peak loads. Again, the screw size, top track thickness, and king stud thickness had negligible impact on the overall header's uplift capacity.

From the test results, it was concluded that an L-shaped header is a viable alternative to conventional headers in residential applications. It is anticipated that possible applications will include headers supporting short or moderate roof spans and other light structures. Increasing the bearing area between the load point and the top track or increasing the angle's thickness will enhance the strength.

Design aids (i.e. factors, span tables, and design charts) were developed, based on tested capacities, that can be safely used when designing L-shaped headers. These design aids will ne available within the next 60 days and can result in more economical design than would be derived by application of existing engineering specifications when web crippling effects are appropriately considered in the design calculation. ❑

The LGSEA Newsletter is published by LGSEA

The statements and opinions contained in this publication are those of the contributors and not necessarily of the Light Gauge Steel Engineers Association, nor the contributor's employer or professional association. This publication is intended to provide a forum for the exchange of relevant information in the industry and the information is made available with the express understanding that the publisher does not render technical services. All technical matters should be evalutated by a qualified engineer before being relied upon for a particular situation.

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

Preliminary Cyclic Shear Wall Tests: Wood Panels Attached with Pneumatic Pins

by Reynaud Serrette, Ph.D., Santa Clara University

In a recent LIMITED test program, five (5) pilot tests were conducted to evaluate the performance of pin-connected OSB shear walls. The walls were tested under reversed cyclic loading using a protocol similar to that used by AISI in development of the design values in the 1997 UBC. The configurations of four walls tested are summarized in Table 1.

The typical response of the shear walls is shown by the hysteretic curve in Figure 1 (for specimen Test 2). A comparison of this response with curves reported in other tests (see previous editions of LGSEA Newsletter) indicates that the overall performance of the pin-connected shear wall (based in the hysteretic curve) is similar to that of the screw-connected shear wall.

The observed mode of failure in all four tests was pin pullout from the cold-formed steel frame as the material around the pin shank (in the OSB and stud flange) was damaged. Failure initiated along the top and bottom edges and at the corners of the wall. As the thickness of the framing and density of the pins were increased, the pins experienced some bending but the mode of failure remained the same.

Using the same basic principles adopted by AISI in the development of the 1997 UBC shear wall values, the results from these tests are summarized in Table 2. The ultimate load given in Table 2 was taken as the peak load at the second cycle of the last stable (2nd, 3rd, and 4th cycle loads within 10% of the average of the three) set of hysteretic loops (+/- refer to push/pull forces).

Averaging the push/pull values shown in Table 2 and employing the AISI method of determining design loads (IGNORING THE LIMITED NUMBER OF TEST RESULTS), the design values for the four walls tested are summarized in Table 3. As indicated throughout this article, the tests reported here were not intended for the development of design tables. The test program was limited in scope and serves to demonstrate the response of pin-connected light gauge steel framed shear walls when tested under the same regime as screw-connected shear walls.

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Table 1

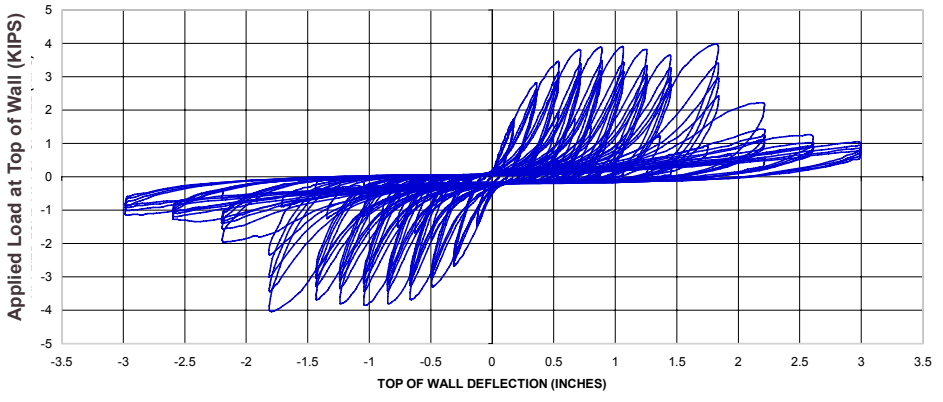
Configuration of Tested Wall Systems

TEST	ASSEMBLY DESCRIPTION	WOOD PANEL ATTACHMENT	PANEL SIZE
1A	STRUCTURAL SYSTEM: 7/16-in. APA rated OSB sheathing one side FRAMING: 3-1/2-in. 43 mil chord studs, 3-1/2-in. 33 mil interior studs, 3-1/2 in. 33 mil track w/studs at 24 in. o.c.	Fastener-0.100 in. diam Perimeter-3 in. on center Field--12 in. on center	4 FT. X 8 FT.
2	STRUCTURAL SYSTEM: 7/16-in. APA rated OSB sheathing one side FRAMING: 3-1/2-in. 43 mil chord studs, 3-1/2-in. 33 mil interior studs, 3-1/2 in. 33 mil track w/studs at 24 in. on center	Fastener-0.100 in. diam Perimeter-2 in. on center Field--12 in. on center	4 FT. X 8 FT.
3	STRUCTURAL SYSTEM: 7/16-in. APA rated OSB sheathing one side FRAMING: 3-1/2-in. 43 mil chord studs, and interior studs, 3-1/2 in. 43 mil track w/studs at 24 in. on center	Fastener-0.100 in. diam Perimeter-3 in. on center Field--12 in. on center	4 FT. X 8 FT.
4	STRUCTURAL SYSTEM: 7/16-in. APA rated OSB sheathing one side FRAMING: 3-1/2-in. 43 mil chord studs and interior studs, 3-1/2 in. 43 mil track w/studs at 24 in. on center	Fastener-0.100 in. diam Perimeter-2 in. on center Field--12 in. on center	4 FT. X 8 FT.

NOTES:
1. Stud dimensions: web depth =3-1/2 in.; flange width = 1-5/8 in.; lip depth = ½ in.; thickness = 0.033 in. (20 GA) or 0.043 in. (18 GA)
2. Track dimensions: web depth = 3-1/2 in.; flange width = 1-1/4 in., thickness = 0.033 in. (20 GA) or0.043 in. (18 GA)
3. Framing screws: No.8-18 x ½ in. self-drilling modified truss head screw

Figure 1

Typical load-displacement curve for the pin-connected shear



NASFA and LGSEA

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share, sets vision statements (how we want the world to look in 5 years), and defines the market barriers. That leads to the development of strategic objectives and specific strategies, defines our areas of activity, determines the kind of organization we need, and implies the budget and funding necessary to accomplish our goals.

Out of our business plan, the following strategies were adopted:

- Maximize current opportunities
- Reduce costs of construction
- Develop the infrastructure
- Implement standards
- Improve thermal performance
- Create a consumer preference
- Develop government and agency support
- Develop and maintain liaisons with stakeholder industries.

LGSEA's role in technical training, infrastructure development and direct engineering is critical to reaching these strategic objectives. As a result, NASFA will substantially help fund LGSEA's budget, allowing us to take advantage of LGSEA's nationwide network of trained engineers, and providing us with many technical resources, foremost among them, education and training.

Currently a major educational focus for both the LGSEA and NASFA is the new Code Officials Seminar, to be launched immediately. Developed by LGSEA under contract with NASFA, the seminar program will be implemented nationwide with assistance from LGSEA, and targets code officials and building inspectors, as well as builders, engineers, and architects who need classroom exposure to basic design and installation of steel framing. The goal of this educational program is to eliminate a significant barrier to the use of steel framing by increasing building officials/inspectors' understanding of, and level of comfort with, light gauge steel framing design and installation, and the appropriate application of the Prescriptive Method.

In addition, NASFA will receive LGSEA's "Tech Notes" and bulletins for distribution to NASFA's membership and anyone who requests them. These are important technical resources when, added to the information currently available through the 800-79-STEEL hotline or NASFA's web site, www.SteelFramingAlliance.com, can provide what the market currently needs.

Larry Williams, LGSEA Managing Director, will attend NASFA's monthly planning and strategy meetings, as well. This puts the LGSEA directly in the loop with NASFA's strategic direction and current activities. NASFA believes strongly in the quality and high level of work that the LGSEA has done thus far and is excited to work even more closely in the future. ❑

Cyclic Tests of Pneumatic Pins

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Questions and comments regarding the data discussed in this article may be addressed to: Reynaud Serrette, Department of Civil Engineering, 500 El Camino Real, Santa Clara, CA 95053 (or via e-mail at RSERRETTE@SCU.EDU) or David Nolan, P.E., ET & F Fastening Systems, 29019 Solon Road, Solon, OH 44139 (or via e-mail at dpnolan@worldnet.att.net).

EDITOR'S NOTE: *The loads indicated in parenthesis (Table 3) are the nominal loads taken from the UBC 1997 for similar shear wall conditions using screwed connections. Based on one (1) test only, it appears that the pin fasteners will provide approximately 48% of the similar shear wall condition utilizing screwed connections.* ❑

Table 2
Summary Test Results

Test	½-in. Lateral Displ.		Ultimate Load	
	Load, (K)	Displ., (in.)	Load, (K)	Displ., (in.)
1A	2.20	0.50	2.60	1.25
	-2.50	-0.50	-2.80	-1.25
2	3.00	0.50	3.40	1.10
	-3.00	-0.50	-3.40	-1.10
3	2.10	0.50	2.50	1.25
	-2.00	-0.50	-3.10	-1.40
4	2.75	0.50	4.00	1.25
	-3.00	-0.50	-4.20	-1.25

Table 3
Nominal and Allowable Design Values

Test	Wall Strength	
	Nominal Strength, plf	Allowable Strength, plf (@ FS =2.5)
1	675 (1275)	270
2	850 (1625)	340
3	700	280
4	1025	410

NOTE: For Allowable Strength, a FS of 2.5 was used. Loads based on one (1) test only.

CSSBI and University of Waterloo Team on Reseach

The Canadian Sheet Steel Building Institute and the University of Waterloo have formed a new research organization called the **Canadian Cold Formed Steel Research Group**. The Research Group will initially focus on the following:

- Focus research on cold formed steel as a structural building material.
- Encourage graduate students to study structural engineering and do research in cold formed steel.
- Carry out research that will improve the design specifications in cold formed steel.
- Provide an organizational structure to develop research proposals and solicit funds from industry and government.

The Executive Director of the group will be Professor Reinhold M. Schuster who is chairman of the Canadian Standards Association cold-formed steel technical committee (CSA-S136) and under the auspices of the AISI chairs the committee of the North American Specification for the design of cold-formed steel structures (with representatives from Canada, the US and Mexico). ❑

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 design.

NAHB Research Center
Contact: Nader Elhajj, P.E.
Phone: (800) 638-8556, ext. 581
e-mail: nelhajj@nahbrc.org

1) Development of an economical built-up king and jack stud, to include testing of several built-up assemblies for greatest efficiency.
2) Development of a top load bearing track to replace double wood top plates when in-line framing is not possible.
3) Cost and energy comparison between steel and wood homes, comparing and contrasting labor and material costs for each type of construction.
4) Proprietary truss joist system.
5) Study of the effectivness of integrating steel floors into conventional wood homes, and come up with actual costs for installing steel floors.
6) Development of L-header tables and construction details.

Canadian Sheet Steel Building Institute
Contact: Steven R. Fox
Phone: (519) 650-1285
e-mail: sfox@cssbi.ca

Projects are currently ongoing at the University ofWaterloo:
1) Bearing Stiffeners for Cold Formed Steel Floor Joists: Testing and analysis of stiffeners typically used in residential cold formed steel construction.
2) Vibration of Cold Formed Steel Floor Joists: Full scale testing on typical residential floor assemblies to determine the effects of bridging, blocking, sheathing connections, span and ceiling finish on the vibration characteristics.
3) Computerized Truss Design Program: For residential design using C-sections.
4) End-Two -Flange and Interior-Two-Flange Web Crippling: Investigating the effects of larger inside bend radius on the crippling of single web members.
5) Stud to Track Web Crippling: Testing of the web crippling capacity of stud to track connections under end-one-flange loading.
6) Cold Work of Forming: Testing to measure the effects of cold work of forming in the flats of the section and verify the AISI design methodology.

University of Missouri/Rolla
Contact: Roger LaBoube, Ph.D.
Phone: (573) 341-4481
e-mail: laboube@novell.civil.umr.edu

1) Use of adhesives for steel to steel connections.
2) Header Design
3) Screw Fastener Connection Design
4) Truss Tests: C-shape vs Proprietary

COFS Subcommittee Meetings in Washington, D.C.

The five subcommittees of the Committee on Framing Standards (COFS) met in Washington, D.C. on April 7 and 8, 1999.

HIGH SEISMIC
Chairman: Neal Peterson,
Steel Stud Manufacturers Association

The subcommittee voted to adopt NEHRP 1997 provisions for seismic design. The committee will review the IBC high seismic submittal, as it will be the base document.

CABO BASE STANDARDS
Chairman: Rich Haws,
American Building Company.

A new method developed by Roger LaBoube for calculating the resistance of header was approved. All the negative ballots on load combinations for stud design (SC98-3) were resolved, and the ballot will be moved to the main committee for final approval. The subcommittee agreed that ASCE7-93 should continued to be used for calculating wind pressures, since ASCE7-98 has not yet been published.

GENERAL PROVISIONS
Chairman: Roger Brockenbrough,
R.L. Brockenbrough & Associates

The subcommittee reviewed a draft of "Standard Practice for Construction with Cold-Formed Steel Framing for One & Two Family Dwellings." A revised draft is being compiled for final review at the June meetings and for final ballot before the October meetings of the subcommittee.

HIGH WIND SUBCOMMITTEE
Chairman: John Matsen,
Matsen-Ford Design Associates, Inc.

The subcommittee agreed to use ASCE7-98 to calculate the wind pressures and will be performing a parametric study on three load combinations: what is currently used in the base standard, ASCE7-98 ASD type 1 with a 1.3 wind factor, and the ASCE7 LRFD load combinations.

TRUSS
Chairman: John Carpenter,
Alpine Engineered Products

Development of the National Design Standard for Cold-Formed Steel Trusses is continuing. Minor changes were made to most sections, and the document has been sent to the editorial committee. Final review will take place in June, for a final ballot in October.

The COFS, Executive Committee, and all five subcommittees will meet in San Francisco, CA:

June 24	Base Standards	1-3 p.m.
	High Wind	3-5 p.m.
June 25	High Seismic	8-10 a.m.
	Truss	10-Noon
June 26	General Provisions	8 - 10 a.m.❑

❖ NewsBriefs ❖

CHAPTERS

ATLANTA/SOUTHEAST

Congratulations to the newly elected Board of Directors and Officers for the Atlanta/Southeast Chapter: Don Allen, BLB Consultants - Chapter President; John Lyons, Walter P. Moore Associates - Chapter Vice President; Roy Baggett, Wallboard & Supply - Chapter Secretary/Treasurer; Harry Collins, Consolidated Systems, Inc.; Shahab Khatami, Structural Design, Inc.; Heath Wolford, Southern Truss & Steel; and Rahim Zadeh, Unimast, Inc.

Next Meeting: Friday, May 21. "*Specifying Light Gauge Steel in a Light Commercial Environment*". Presenter: John Lyons, P.E., of Walter P. Moore and Associates. For reservations, call (615) 604-9139.

HAWAII

Congratulations to the newly elected Chapter Board and Officers: Howard Lau, Shigemura, Lau, Sakanashi, Higuchi & Associates - Chapter President; Dipankar Sengupta, Sato and Associates, Inc. - Chapter Vice President; Sam Galante, S&G Construction - Chapter Secretary; Bud Waters, Hunt Building Corporation - Chapter Treasurer; Ather Dar, Hawaii Engineering Group; Gary Lum, Wesley R. Segawa & Associates, Inc.; Mike Fernandez, Studco Hawaii, Inc.; Les Negata, Structural Analysis Group, Inc.; and Tim Waite, North American Steel Framing Alliance - Immediate Past-President.

Next Meeting: June 8. Presentation on corrosion, by Gregory Zhang. For researvations, call (808) 485-1400.

SEMINARS

Designing Cold-Formed Steel Using the 1996 AISI Specification.

Los Angeles/Orange County, July 9; San Francisco Bay Area, July 12, Seattle, July 14. Registrations are now being accepted. Contact Kathy Woodard at (615) 223-1767.

Seminars for Code Officials, Plan Checkers, and Field Inspectors

Two seminars, 6-hours and 2-hours in length, have been developed by the Light Gauge Steel Engineers Association and North American Steel Framing Alliance to provide building officials in local jurisdictions with the information needed to assure that light gauge steel structures are a) constructed per plan and industry standards, and b) designed in accordance with building codes and industry recommendations. If you are a builder or engineer who would like this program offered to a specific jurisdiction, please call Carmen Gravely at (703) 866-0646 or the LGSEA at (615) 279-9251.

ICBO ES Report Issued for Clinch Fastening System

ICBO Evaluation Service, Inc. has issued an approval for a report entitled "*Attexor Spot-Clinched Connection of Cold-Formed Steel Structural Members*," report number ER-5439. Data in the report addresses connections of two layers of 54, 43, and 33 mil material; round and rectangular clinch shapes; seismic to Zone 4, and high wind conditions. For more information, contact Attexor at (413) 746-0222, or via e-mail: hb@attexor.com. For more information about clinched connections refer to LGSEA Technical Note TN-560c. ❑

WANTED

Builders - The NAHB Research Center is looking for builders who would like to participate in a comparative study between steel and wood homes. Will include engergy usage and labor and material costs for each type of construction. Builders who want to cooperate in this program must be willing to build identical houses with steel and wood in the same subdivision. There will be some benefits to participate in this program.
Contact: Nader Elhajj,
NAHB Research Center
(800) 638-8556, ext. 581

Seeking -Sales/mngt position. 16 years in construction. Sold/erected PEMB, SSMR, pre-cast, cold storage, conv. steel and manu. light gauge metal trusses. Exp. in sales, contract admin., acctg., scheduling, and operations. Can relocate. Contact LGSEA (ref: 499-S) at LGSEA@AOL.com or at amp@unidial.com.

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