LGSEA

Newsletter for the *September 1998*

Light Gauge Steel Engineers Association

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Upcoming Events

METALCON Oct. 20-22
San Diego, CA
Info: (617) 965-0055

AISI Residential Sub-committees October 20
San Diego, CA
Info: (202) 452-7202

LGSEA Meetings Oct. 22-23
San Diego, CA
Info.: (615) 279-9251

Seminar - Cold-Formed Steel Design (6-hour) Oct. 23
San Diego
Info.: (615) 279-9251

Seminar - Cold-Formed Steel Design (6-hour) Nov. 20
Atlanta
Info.: (615) 279-9251

Seminar - Cold-Formed Steel Design (6- & 3-hour) Dec. 18-19
Nashville
Info.: (615) 279-9251

Test Results on Wall Height Limits

by Young-ki Lee and Thomas H. Miller, Ph.D., P.E., Oregon State University

A series of composite wall tests were conducted by Oregon State University through the funding and support of the Metal Stud Manufacturer's Association, Metal Lath/Steel Framing Association, Gypsum Association, Drywall Information Trust Fund, and Knorr Steel Framing Systems, Inc.

These tests were conducted to develop experimentally-based limiting heights for interior, non-load-bearing walls under uniformly distributed, out-of-plane, lateral loadings. Testing was in compliance with ICBO ES AC86, "Acceptance Criteria for Determining Limiting Heights of Composite Walls Constructed of Gypsum Board and Steel Studs," and ASTM E 72-80, "Standard Methods of Conducting Strength Tests of Panels for Building Construction," using a uniform, vacuum chamber loading. Cold-formed steel studs were spaced at 24 in. on center, and sheathed on both sides using 1/2 in. gypsum board. Panels were tested in a simply supported, vertical orientation, simulating service conditions. The series consisted of 49 tests of wall panels with the following characteristics:

1) Nominal 4 and 8 ft high panels (43-1/4 in. and 88-1/2 in. actual spans, respectively) were sheathed with one sheet on each side (no joint),
2) Nominal 14 ft height panels (160 in. actual span) were sheathed with one 12 ft. sheet and a second sheet to make up the balance of the span,
3) Nominal 16 ft (184 in. actual span) height panels were sheathed with one 12 ft. sheet and a second sheet to make up the balance of the span.

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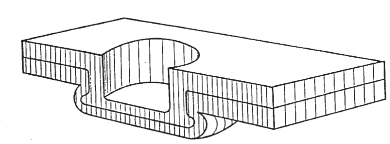
Clinching - for framing without screws

by Dr Hans Bergkvist, ATTEXOR Inc.

A critical aspect of the growth of cold-formed steel framing is the identification of fastening methods that quickly and inexpensively produce strong and reliable connections. In some cases, these methods involve the adaptation of an existing technology to steel framing.

Clinching, for example, has been used for several decades in the automotive and appliance industries as a substitute for rivets, screws and spot welding. Although clinch fastening tools have been available to the steel framing market for a number of years, the potential for lower per-connection costs and faster installation times has increased interest by a number of builders.



Clinching joins sheet materials and profiles by generating a rivet-like joint in the framing members in a punching and squeezing sequence. As demonstrated in other industries, clinching produces strong connections in pre-coated or galvanized material found in the cold-formed steel industry and gives a finished assembly without pre- or post-work. Clinching does not build any thermal stresses into the workpiece which gives a clinched joint exceptional perfor-

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Wall Height Limits

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The chamber method of loading was used with an airtight frame surrounding the specimen. For nominal 4 ft height tests, the lower track was screwed directly into a 1 in. thick wooden base, which was bolted to the bottom of the frame.

Successive incremental loadings were applied for 5 minutes to achieve deflections of L/360, L/240, and L/120, where L was the actual simply supported height of the panel. Failure was defined as when the maximum pressure could not be sustained without sudden or continuous movement of the test specimen.

Conservative limiting heights based on deflection were determined from a thorough analysis of the vertical composite wall test results using an average composite bending stiffness for each wall panel specimen. Linear interpolation between the resulting average composite stiffnesses derived from multiple test heights and linear extrapolation for limiting heights greater than 16 ft were used and are both permitted by ICBO ES AC86. Composite bending stiffness includes the effects of both the gypsum board and steel studs, and was based on the equation for the midspan deflection of a simply-supported beam with a uniformly distributed loading over its entire span.

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Wall Height Limits

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Allowable heights of the wall studs alone based on flexure, shear, and web crippling strength-related failures, (including the effects of local buckling) were calculated in accordance with ICBO ES A46, "Acceptance Criteria for Steel Studs, Joists and Track." The beneficial effect of the gypsum board was neglected in these calculations, except for the restraint provided against lateral buckling. Limiting heights based on ultimate loads from the flexural testing were also derived using ICBO ES AC86. Linear interpolation between the multiple test heights was used, as permitted per ICBO ES AC86, to derive limiting heights based on flexural strength between the panels 8 ft height and taller.

The nominal 4 ft height panel tests were conducted for the 18 mil (25 gauge) studs to determine experimentally 1) shear capacity, 2) strength in a web crippling failure mode, and 3) potential horizontal shear failure along the screw connections between the studs and sheathing in a high shear condition. Where limiting heights based on strength, considering not only flexure but also shear and web crippling, were less than those determined based on deflection from the tests, the lower heights based on strength controlled the limiting height value.

Design applications of these results should include consideration by the design professional of the potential effects of humidity and moisture content, repeated loads, damage to studs and gypsum board, and improper installation. A study of these effects, however, was not within the scope of these tests. The limiting height table (Table A) is considered appropriate for the design of walls with studs having the same nominal dimensions and properties as those tested. *For additional information, contact Thomas Miller, Ph.D., P.E., (541) 737-3322.* ❑

National Training Curriculum Published

The American Iron & Steel Institute (AISI) has released a standardized training program on steel framing techniques that provides step-by-step illustrated framing techniques for both experienced and novice framers.

For more information, contact: Toni Lewis, AISI (202) 452-7202. ❑

Table A

Limiting Height for Interior Non-Load Bearing Walls

18 Mils (25 Gauge)

Stud Web Depth	Deflection Limit	Lateral Pressure 5psf	7.5psf	10psf	15psf
1.625"	L/360	-	-	-	-
	L/240	7'-11"	-	-	-
	L/120	9'-9"	8'-0"	-	-
2.5"	L/360	9'-3"	8'-1"	-	-
	L/240	10'-7"	9'-3"	8'-5"	-
	L/120	11'-10"	9'-8"	8'-5"	-
3.5"	L/360	11'-7"	10'-1"	9'-1"	7'-7"
	L/240	13'-5"	11'-0"	9'-5"	7'-7"
	L/120	13'-9"	11'-0"	9'-5"	7'-7"
4.0"	L/360	12'-4"	10'-9"	9'-9"	8'-5"
	L/240	14'-2"	12'-1"	10'-5"	8'-5"
	L/120	15'-1"	12'-1"	10'-5"	8'-5"
6.0"	L/360	16'-9"	13'-5"	11'-5"	8'-11"
	L/240	16'-9"	13'-5"	11'-5"	8'-11"
	L/120	16'-9"	13'-5"	11'-5"	8'-11"

33 Mils (20 Gauge)

Stud Web Depth	Deflection Limit	Lateral Pressure 5psf	7.5psf	10psf	15psf
1.625"	L/360	7'-9"	-	-	-
	L/240	8'-11"	7'-9"	-	-
	L/120	11'-2"	9'-9"	8'-11"	7'-9"
2.5"	L/360	10'-2"	8'-9"	7'-10"	-
	L/240	11'-9"	10'-2"	9'-1"	7'-10"
	L/120	15'-1"	13'-2"	11'-9"	10'-2"
3.5"	L/360	13'-2"	11'-6"	10'-5"	9'-1"
	L/240	15'-2"	13'-2"	11'-11	10'-5"
	L/120	19'-1"	16'-8"	15'-2"	13'-2"
4.0"	L/360	14'-5"	12'-5"	11'-3"	9'-8"
	L/240	16'-7"	14'-5"	13'-0"	11'-3"
	L/120	20'-11"	18'-3"	16'-7"	14'-5"
6.0"	L/360	19'-0"	16'-8"	15'-1"	12'-9"
	L/240	21'-9"	19'-0"	17'-3"	12'-9"
	L/120	27'-5"	24'-0"	19'-1"	12'-9"

1) Studs tested with 1-1/4 in. outside flange width, and 1/8 in. return lip for 18 mil (25 gauge) studs and 3/8 in. return lip for 33 mil (20 gauge) studs.
2) Stud thicknesses tested were 33 mil (20 gauge) = .0329" minimum base metal thickness and 18 mil (25 gauge) = .0179" minimum base metal thickness.
3) Minimum specified steel yield stress = 33 ksi.
4) Wallboard was attached with #6 screws, self-piercing for 18 mil (25 gauge) and self-drilling for 33 mil (20 gauge), spaced at 12 in. on-center of each flange.

Note: Calculated limiting height is less than the actual test span of 7'- 4-1/2", would not be conservative if based on the results for the nominal 8' test panel, and is thus not reported.

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

Clinch Fastening of Cold-Formed Steel

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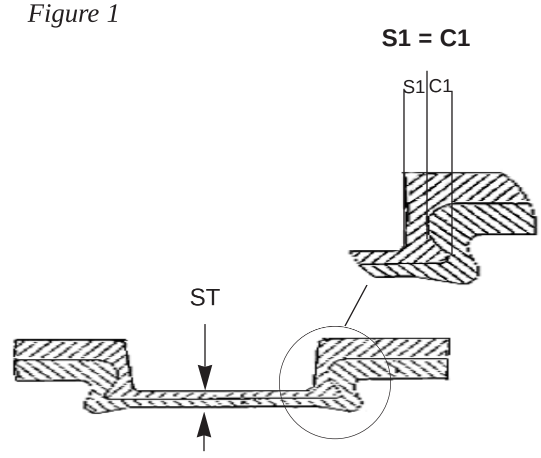
mance in situations of thermal fatigue or fire. Most importantly, the quality of a clinched joint can be controlled at any point in time without destroying or disturbing the assembled structure.

The two basic integral fastener shapes for typical cold-formed steel applications are rectangular and round. In a round clinch connection, the lock is produced throughout the 360 degree circumference. These joints are waterproof and have performed well under cyclic load conditions. Rectangular joint, or variants thereof, also seem to offer many advantages. It is notably highly insensitive to variations in material thickness, has high resistance to rotation and copes well with assembly situations involving more than two layers.

The strength of a clinched joint depends essentially on four factors:

- The material type. A joint in steel will be stronger than one in aluminum
- The material thickness. The clinched connection of two pieces of 68 mil (14 ga.) will be stronger than the same size joint in two 33 mil (20 ga.) pieces.
- The clinch point size. A 5/16" diam.joint will be stronger than a 3/16" diam. joint.
- The material surface condition. A dry surface will give a stronger joint than if it is oiled or greased.

Figure 1



An optimum joint has to meet two seemingly contradictory requirements. In order to have a maximum interlocking of the material members, the dimension "C1" (figure 1) should be as large as possible. This will ensure a high pull-out strength. On the other hand the neck portion "S1" should be as large as possible so as to ensure high shear strength and high fatigue strength.

Generally speaking parameters can be selected to give the joint an optimum strength for the prevailing loading and operating conditions. A good compromise in most situations is simply to aim for C1 = S1 = half the thickness of the punch side material layer (figure 1).

Clinching equipment manufacturers give advice and supply easy-to-read tables guiding the tool kit selection process. Under normal operating conditions, a single tool kit will cover assembly tasks ranging from 2 sheets of 27 mil (22 gauge) material to 2 sheets of 54 mil (16 gauge) without changes or adjustments.

As a rule of thumb, the "ST"-value of a good quality round clinch joint is typi-

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Table 1

Static strength, comparison: clinched joints and screws

Hand-held clinching equipment

Material thickness	Screw size / # of screws in current design	# of clinched joints for same shear strength
2 pieces / 33 mil	6, 8, 10 / 1	1
2 pieces / 43 mil	6, 8, 10 / 1	1
2 pieces / 54 mil	6, 8, 10 / 3	4

Suspended clinching equipment *

Material thickness	Screw size / # of screws in current design	# of clinched joints for same shear strength
2 pieces / 54 mil	6, 8, 10 / 1	1
2 pieces / 68 mil	6, 8, 10 / 1	1

** Further ICBO testing in progress*

Test performed by Architectural Testing (ICBO approved laboratory) using hand-held SPOT CLINCH® 0302 AS and include a safety factor of 2.5.

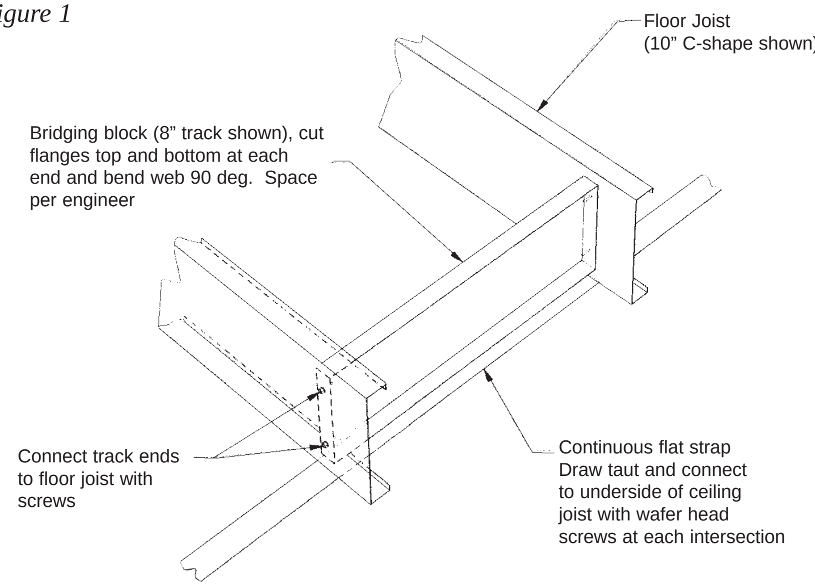
New Detail Speeds Installation of Bridging Block

Typically, the installation of solid blocking in the floor system of a steel framed structure is one of the most time- and labor-intensive elements in any given project. Although the detailing may vary according to the designer, the most common method requires the use of clip angles to attach a section of of the joist (blocking) to the joists. *(NOTE: This detail is not intended to be used at the support ends of the joist, but rather at briding points, as required.)*

Recently, a team of LGSEA engineers and contractors developed a new bridging block detail that is simple, requires fewer pieces, and dramatically cuts the amount of time required for installation. One of the members of this group, Mike Whitticar of Enertech Systems, is already using the new detail on one of his major projects, and he reports that installation times are one-third of the time required for more commonly used details.

In the new detail, the top and bottom flanges of an 8-inch track are cut and the web is bent in either direction at a 90 degree angle. After this member is inserted between the 10-inch "C" shaped floor joists (see figure 1), continuous flat strap is then attached to the bottom flanges of the joists.

Figure 1



This new detail is one of many improvements that have been developed by this team, which is working under contract to update the standard library of cold-formed details published by the American Iron & Steel Institute (AISI). The committee is expected to complete its work in the coming months, for publication by the AISI in 1999. ❑

COFS Subcommittee Meetings in San Francisco

The five subcommittees of the Committee on Framing Standards (COFS) met in San Francisco, CA on June 25, and 26, 1998. The COFS, Executive Committee, and all five subcommittees are scheduled to meeting on October 21 and 22, 1998 in San Diego, CA in conjunction with METALCON.

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

The subcommittee will develop a prescriptive standard for residential construction, using the recently approved CABO code language as a base document. After the first meeting in March, six technical issues were balloted. Three were unanimously approved and are ready for balloting by the full COFS. The remainder will be changed and resubmitted to the subcommittee.

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

The subcommittee agreed: "To develop concensus standards, subject to approval of the COFS, that address topics other than design that are fundamental to construction with cold-formed steel framing for residential and light commercial applications." The first to be developed is the "Standard Practice for Construction with Cold-Formed Steel Framing for One & Two Family Dwellings."

HIGH SEISMIC
Chairman: Neal Peterson,
Metal Stud Manufacturers Association

This new subcommittee will concentrate on developing a residential and light commercial standard for seismic zones greater than 2.

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

In the first meeting of this subcommittee, the chair stated that efforts would be concentrated on developing a residential and light commercial prescriptive standard for wind speeds greater than 90 mph EXP C.

TRUSS
Chairman: John Carpenter,
Alpine Engineered Products

The subcommittee agreed to develop a Truss Design Guide Standard similar to the TIP-1995 working from the currently published AISI Truss Design Guide (RG-9518). ❑

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Cold-Formed Steel Design Software

Cold-formed steel offers engineers and architects with tremendous design flexibility, but performing the necessary calculations can be an extremely repetitive and time-consuming process. To shortcut this process, a growing number of design professionals are turning to software that is specifically written for designing cold-formed steel. Last year, the LGSEA conducted a survey of members to determine which software programs were most commonly being used. The most-frequently-cited programs were listed in the Feburary 1998 issue of the LGSEA Newsletter, and this chart (below) summarizes the main features of these programs. While we have attempted to include sufficient information for the reader to get a general overview, we are not able to include all the capabilities of individual programs. The LGSEA does not endorse specific products, and encourages readers to contact the individual software providers for additional information. The following programs are listed alphabetically. ❑

Program	Codes & Standards	Input/Interface Description	Design Modules	Stuctural Components	Demo/ Price
CFS ver. 3.0 RSG Software (816) 524-5596 support@rsgsoftware.com	1996 AISI Specification 1990 ASCE Specification (for stainless steel)	Windows interface allowing several files open at once. Section Wizard and Analysis Wizard for quick creation of design problem. Graphical display accompanied by numerous editing techniques. Messages on exceeded limits (w/t, D/t, KL/r, etc.). Output shape geometry to .DXF file. Integrated Help file documentation.	• Any general cold-formed steel shape, including closed shapes and built-up sections. • Full, net, and effective section properties. • LRFD and ASD strengths for compression, tension, moments, shears, and web crippling. • Strength increase due to cold work of forming • Axial/bending, bending/shear, bending/web-crippling interactions. • Continuous beam/column analysis with biaxial bending.	Databases for HUD, LGSI, MSMA, MBCI, Unimast, and Dale/Incor sections	Yes $550
COLDSTEEL EnerGCorp (602) 966-4411	1986 AISI Specification	ColdSteel is a cold-formed steel analysisprogram that is menu based, and that prompts the user for all input. It is a DOS based program that will run on any IBM compatible PC.	• Check rectangular tubes and "C" shapes with or without stiffening lips or web punchouts. • Gross and effective section properties and axial, flexural and shear capacities can be calculated, and members can be checked for combined axial and and flexural, or combined shear and flexural loads. • Web crippling strength can be determined for any bearing length.	MSMA and LGSI shapes, plus custom shapes determined by user.	No $ 299
C-Stud Analyzer II Metal Stud Systems (800) 683-3235	1986 AISI Specification, with 1989 Addenda	C-Stud Analyzer II is two programs in one: Stud Analysis and Beam Analysis. The Stud Analysis program evaluates stud or track sections based on bending and axial forces furnished by the user. Beam Analysis integrates up to a six span uniformly loaded beam, overhangs, and 10 point loads. User input also includes axial load, bridging spacing, deflection limit and bearing widths.	Stud Analysis program checks a single, boxed, or "I" shaped C-stud(s) or single "I" shaped track(s) for: • Allowable axial load versus applied axial load • Allowable bending load versus applied bending load • Combined bending and axial interaction Beam Analysis program further checks for shear and combined shear and bending, web crippling, and bending.	"Generic" database of 400 stud and track sections. Includes MSMA descriptions.	Yes $395
"IT" Keymark Enterprises (303) 443-8033 www.keymark.com	1986 AISI Specification, with 1989 Addenda and 1996 Edition	"IT" allows a user to describe the geometry of entire structures using Keymark's "IT" Model program. "IT" Model is a fully functional 3-D modeling program. In addition to the materials and loads, the user defines the walls, trusses, framing materials, and foundation in fully 3-D.	• "IT" designs all joists, headers, beams, and girders. • Roof or floor trusses are designed for standard gravity loads. • Loads from the roof or floor members are passed through the wall, to the level below. Complete wall layout and elevation plots can then be generated. • All of the loads in the structure are tracked, and are available for foundation engineering. • Wind and seismic loads are generated for lateral design. • All materials in the building can then be consolidated, then cut sheets and materials lists can be output.	Proprietary and/or "C" section materials	Yes Call for pricing

LGBEAMER DEVCO Software (541) 757-8991 rob@DEVCO Engineering.com	1986 AISI Specification, with 1989 Addenda and 1996 Edition, ICBO AC-46	Span lengths, loads (uniform, concentrated, and axial), bearing lengths and bracing intervals (flexural and axial) are input from a graphics screen. Sections are chosen from drop-down style database boxes or input from a graphics screen. Sections can be modified interactively, allowing the user to select the most efficient member for the application.	● Designs studs, joists, tracks, headers, and beams of channel "C" or "Z" shapes. ● Graphically model up to three spans with cantilevers. ● Uniform, concentrated, axial and combined loads. ● Single, Boxed, or Back-to-Back "I" orientation. ● Mechanical or sheathing braced design. ● English or metric units.	MSMA, SSMA (joint MSMA and ML/SFA), "Z" section, and custom databases	Yes $ 375
PROP86 for Windows 95 Sure-Tie, Inc. (714) 832-4802 http://members.aol.com/suretieinc	1986 AISI Specification, with 1989 Addenda and 1996 Edition, ICBO AC46	Easy input and concise output reports. Axial, X and Y axis bending capcities. Shear and web crippling, includes continuous beam analysis up to six spans, control of section bracing lengths and deflection requirements.	● Tables for combined axial/bending, floor joist, ceiling joist, wind load only. ● Channel, "C", and "Z" shapes. ● Closed box or back-to-back "I" orientation. ● Unequal flanges. ● Cold working increases. ● Sheathing board restraint. ● Extensive library search/sort functions.	CEMCO, AMS, MSMA, Knorr, Dietrich, generic, custom user defined shapes.	Yes $525
STRAP Light Gauge Designer ATIR Engineering Software (800) 644-6441 www.ATIR.com	1996 AISI (ASD & LRFD), AISC (ASD & LRFD), ACI 318-95, UBC 1994 & 1997 (Plus some international codes)	Completely graphical 2-D and 3-D frame and truss, finite element, static and dynamic analysis and design program intended for a structural engineering office. Analyze and design a structure of any shape in light gauge, rolled steel and concrete using the same program. Design concrete slabs and shear walls. Up to 1,000 load cases and 1,000 load combinations. Tapered members, pre-stress, cables and support settlement. Program automatcially created wind and seismic forces to UBC '97 and international codes. Automatically optimizes the structure for overall deflection.	The same model can have both rolled and light gauge sections and the program will design them in the same run to different codes. The program automatically designs for both strength and deflections. Automatically determines Lt for each load. Composite section design to several U.S. and international codes. Concrete design to U.S., Canadian and other codes.	Standard sections (single and double), Unimast, MBCI, and user defined sections of any shape.	Yes $1,900
TRUSS D&E JFB & Assoc. (719) 598-7666	ASCE7, BOCA, UBC, SBC, Canadian, Australian, British, French, Japanese and Philipines	TRUSS D&E 8.0 is an integrated analysis design and estimating software program for light gauge metal trusses. Step-through menus guide the user through connection design and detailing. The program also offers auto member selection, auto generation of truss geometry, and allows the analysis of odd-shaped trusses. A cost estimate and Bill of Materials can be generated for each truss design.	The analysis is performed for 7 load cases and 10 load combinations which are automaticall generated. Analysis may include: ● Standard and odd shaped trusses. ● Cost estimate and bill of materials. ● Graphical interaction and multiple drawing options. ● Truss-to-truss and truss-to-support connection. ● In-plane, out-of-plane, and offset web analysis. ● Hip roof generation, batch analysis.	Knudson roll-formers, MSMA, Dale/Incor, Dietrich, AISC, plus others.	Yes $5,800

Clinch Fastening

Continued from page 4

cally 1/3 of the total material thickness, and about 1/2 of the total thickness for a rectangular joint.

In tests recently performed on one manufacturer's hand-held product, clinched connections generally matched those made with #6, #8, and #10 screws on a one-for-one basis for gauges up to 2 pieces of steel 43 mils (18 ga.) and thinner and a 3-for-4 rule for thicker steels. In a shop environment where the assembly equipment can be suspended, heavy-duty clinch equipment also matched screws on a one-to-one basis. Additional ICBO approved testing is in progress for 14 and 16 gauge, Grade D.

On June 26, 1998 ICBO's Evaluation Committee after a public hearing approved Acceptance Criteria for Clinched Connections of Cold-formed Steel Structural Members. The details of the ICBO ES criteria will be described in the next Newsletter. Currently, design values for specific clinch tools may be obtained from the individual manufacturers. Three who are LGSEA members include:

ATTEXOR, Inc.
Contact: Dr. Hans Bergkvist
Springfield, MA
(413) 746-0222
www.attexor.com

BTM Corporation
Contact: Don McArthur
Marysville, MI
(810) 364-0470
www.easysteel.com

ECKOLD AG - Switzerland
Contact: Craig Leber
Friendswood, TX
(281) 482-3445 ❑

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