Newsletter for the
Light Gauge Steel Engineers Association
Winter 2002

INSIDE

Upcoming Events

Association of Wall & Ceiling Contractors International — Mar 12-17
San Antonio, TX
Info: (703) 538-1610
www.AWCI.org

LGSEA Committee Meetings — Mar 13
San Antonio, TX
Info: (202) 263-4488
www.LGSEA.com

SEMINARS: Practical Design of Cold-Formed Steel Structures 2002

Houston, TX	May 6
Dallas, TX	May 7
Phoenix, AZ	Aug 1
Los Angeles	Aug 2
AISI Specification - Aug 3	
San Francisco, CA	Aug 5
Seattle, WA	Aug 6
Chicago, IL	Sep 30
Atlanta, GA	Dec 4
Charlotte, NC	Dec 5
Orlando, FL	Dec 6

Info: (202) 263-4488
- A registration form can be downloaded from www.LGSEA.com -

Pacific Coast Builders Conference — June 26-28
San Francisco, CA
Info: (916) 325-9300
www.PCBC.com

Construction Specifications Institute — Exhibit: June 27-29, Convention: June 27-30
Las Vegas, NV
Info: 1-800-689-2900

Calculated Approach to Fire Rated Assemblies

by Nader Elhajj, P.E., NAHB Research Center

A significant issue that often confronts architects and engineers when designing structures with cold-formed steel is a lack of tested and published fire-rated assemblies. This can be a major issue in multi-family, institutional, and light commercial construction. These construction types are some of the most rapidly growing segments of the construction industry and have some of the most stringent fire/safety requirements. Without documented performance of a steel framed assembly, builders have had to choose between funding full-scale fire tests or using an alternative material in order to satisfy local building department requirements.

Although this may also pose occasional problems with wood framed construction, its broad usage over several generations means that there are many more tested and published assemblies. Should a specific assembly not be available, however, the designer has also had the option of establishing the fire resistance rating of a wood assembly by calculation, also called the "component additive method" (CAM) in UL documents. An alternative to the expensive and time-consuming Experimental Approach (ASTM E 84 and ASTM E 199), this method derives a total fire resistance rating by adding together the rating of individual components in an assembly. Most codes allow alternate materials and methods to be used based on data and engineering analysis in lieu of full-scale tests.

However, there was no record that the theoretical approach had been applied to a cold-formed steel framed structure until recently. Orange County (California) was presented with a party wall and a load bearing exterior wall assembly with fire resistance ratings that had been developed by calculation. The catalyst for using CAM for steel framing was the republication of a HUD document entitled "Fire Ratings of Archaic Materials and Assemblies" (available for free downloads at www.HUDUser.org). Originally printed in 1980, the primary purpose of the document was to "aid the modernization and reuse of the nation's building stock." As noted in the publication, it has since found widespread use and acceptance among architects, engineers, preservationists, and code officials. It also has been incorporated into numerous state and local building codes, three model

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IRC/IBC Allows Shear Values for GWB

The International Code Council (ICC), publisher of the International Residential Code (IRC) and International Building Code (IBC), has made a code change that is favorable for cold-formed steel, allowing the use of gypsum wallboard for shear resistance in seismic areas. This change will be published in the 2002 IBC Supplement.

Significant for steel framing, the revised code permits the same sheathing guidelines used for wood framed systems can now be used for steel. A steel framed system will be subject to the limitations in Table 1617.6, lines 1.L and 2.U, meaning they must be designed with an R factor of 2 or 2.5 and are permitted to a height of 35 feet in Seismic Design Category D, and prohibited in Seismic Design Categories E and F. These revised code limitations are specific to the sheathing materials used, including plywood, oriented strand

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Newsletter for the Light Gauge Steel Engineers Association

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Fire Rated Assemblies

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code publications, and two NFPA standards. The 2000 edition of the HUD document also states that the date a wall or floor/ceiling assembly was built does not matter, "only that they provide the degree of fire resistance required by local building regulations."

One Theoretical Approach extensively discussed in the publication is the "Ten Rules of Fire Endurance Rating," published by T.Z. Harmathy in the May 1965 edition of *Fire Technology*. These rules provide a foundation for application of the theoretical model.

Harmathy's first rule makes the point that a fire rating can be obtained by adding the values of individual components, and that the calculated value will be conservative. The rule states that "The minimum performance of an untested assembly can be estimated if the fire endurance of the individual components is known. Though the exact rating of the assembly cannot be stated, the endurance of the assembly is greater than the sum of the endurance of the components."

Time values for the endurance of wallboard membranes are provided in Section 720.6 of the 2000 International Building Code (Table 709.6.2A and 709.6.2C of the 1999 Standard Building Code, Tables 1.5.1 and 1.5.2 of the HUD Fire Ratings Document, or Table 7-7-W-A of the 1997 UBC). The HUD document also notes that test reports from recognized journals or published papers can be used to support data utilizing Harmathy's Rules. Further, calculations using well-established and recognized computational techniques are valid. These include, but are not limited to mechanical properties, deflections, and load bearing capacity.

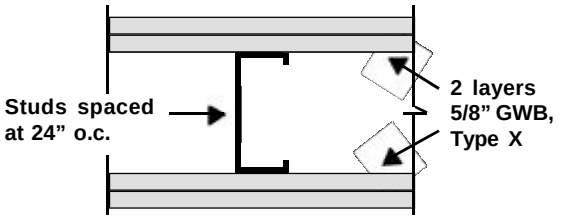
Applying Harmathy's Rules

The following examples illustrate how the Rules can be applied to practical cases.

Example 1: A comparison of calculated and tested performance of a steel stud wall assembly. GA File Number WP 1521 (Gypsum Association Fire Reistance Design Manual, 16th Edition) is constructed with 2 layers of 5/8-inch Type X gypsum board attached to each side of 2 x 4 steel studs (362S) spaced at 24" on-center and has a 2-hour resistance rating (Figure 1).

Using the CAM principles, the recommended values from the building code tables and applying Harmathy's rule that the fire endurance (F1) of the assembly is larger than the sum of the individual layers, or:

GA - WP 1521
Figure 1



F1 > 30 minutes x 2 layer x 2 sides
= 120 minutes (2 hours)

Where each 5/8" Type X gypsum board has a 30 minute rating

This calculated fire endurance rating matches the listed rating of GA WP 1521.

Note that although the IBC does assign values for the contribution of wood framing members, no time values are added or deducted for the steel studs. The footnotes in IBC Table 720.6.2(1) also use 16" on-center spacing as a condition for applicability, thus requiring engineering judgment for cold-formed steel frame assemblies where the studs are spaced at 24" on-center.

Example 2: A comparison of calculated and tested performance of a steel stud floor assembly. The Canadian Steel Construction Council recently tested a floor assembly that was constructed with 5/8" T&G subflooring, attached to steel joists with a web depth of 8" and thickness of 43 mils, spaced at 24" on-center. 2 layers of 5/8" Type X gypsum wallboard were fastened to hat sections which were themselves attached to the bottom flange of

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Fire Rated Assemblies

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the joists (Figure 2). Tests resulted in a fire endurance period of 69 minutes.

Using the IBC table referenced above yields a fire resistance rating of 1-hour – 10 minutes less than the actual test.

Example 3: Party Walls. A common party wall assembly used in wood frame construction (GA File Number WP 3370) is built with 1 layer of 5/8" Type X gypsum applied to each side of a double row of 2x4 studs on separate plates 1" apart. This assembly has a 1-hour fire rating (Figure 3).

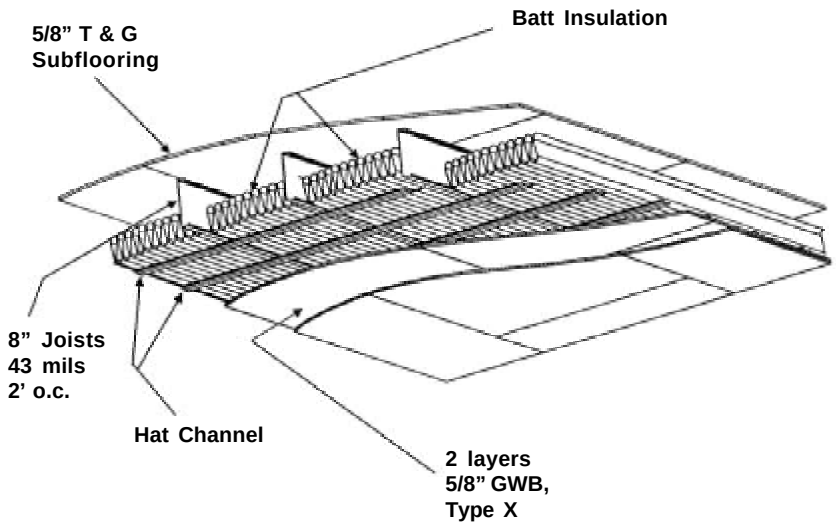
There is no similar assembly using cold-formed steel framing, so a typical solution might be to build two parallel load bearing assemblies (for example, UL 432 or) which would require the installation of gypsum board on the interior of the walls.

Using a Component Additive Method, however, would also allow the builder to replicate the wood assembly using steel studs since each layer of 5/8" Type X gypsum wallboard is assigned a fire resistance rating of 30 minutes (for a total of 60 minutes).

Another advantage of obtaining a fire rating for an assembly using the theoretical approach is the ability to upgrade deficient assemblies by adding a protective "membrane" or layer of brick, plaster, or drywall if there is sufficient economic justification for doing so.

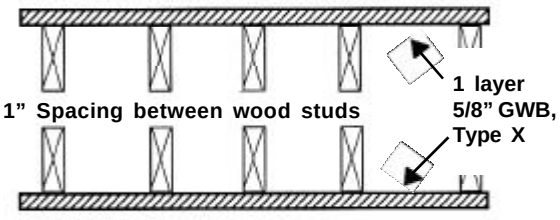
1 Hour Tested Floor/Ceiling Assembly

Figure 2



GA - WP 3370

Figure 3



While the Component Additive or Theoretical approach may be useful in obtaining ratings for untested wall or floor sections, it requires sound engineering judgment and acceptance by the building department within whose jurisdiction the structure lies. In addition, the method does not address every potential assembly that the architect and engineer may conceive and design and there will be some instances where testing is required. In the meantime, this method offers professional designers with a potential solution they can present to a builder that is struggling with this issue. ❒

Commercial CAD Details Available

The Steel Stud Manufacturers Association (SSMA) has compiled 43 isometric autocad details that can be downloaded from the SSMA website (www.ssma.com) in either a pdf or dwg format for application to a specific project. For almost all cold-formed details there is more than one way a detail can be framed and still work for the application. For each of the details available the advantages and disadvantages are listed to assist the user to select the best detail for the specific application. The details if downloaded in autocad can be modified as desired by the user.

The SSMA Board of Directors elected to make these details available to the users of cold-formed steel to help answer questions on how to frame certain applications. As an example, for load bearing door openings there are nine different ways shown in the details to frame an opening. The details can be compared and the best detail of the nine can be selected based on the specific application. The SSMA Board of Directors would encourage users to visit the SSMA web occasionally to see what new details are available as the SSMA detail library is added. ❒

Code Change for GWB

Continued from page 1

board (OSB), and gypsum wallboard.

"We are pleased with the outcome of this code revision, and are encouraged by the ICC's action taken on this issue," said Hank Martin, Director of Construction Codes & Standards for the American Iron and Steel Institute (AISI). "Prior to the code change, under Seismic Design Category D, the code did not allow for the shear capacity of the drywall on steel framed systems to meet code requirements. Now they are allowing it."

For more information on the code change, contact the ICC, www.intlcode.org. For more information on shearwall design, go to 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.

Using the International Residential Code for Steel Frame Design

By Don Allen, P. E., Starzer Brady Fagan Associates, Atlanta, GA

The 2000 International Residential Code for One- and Two-Family Dwellings (IRC) has more design information about using cold-formed steel than any building code previously published in North America.

However, there are certain applicability limits that may preclude the use of the steel design section of the IRC for many residential structures. These limits are found in section R505.1.1 (floors), R603.1.1 (walls), and R804.1.1 (roofs):

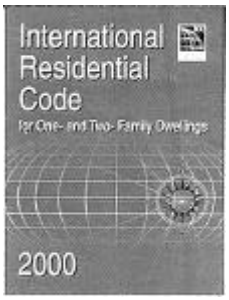
1. 36' max. width.
2. 60' max. length.
3. 2 stories, 10' max. story height
4. Roof slope: 12:12 (max.) 3:12 (min.) (limits on steel rafter framing only).
5. Max. wind speed: 130 MPH, exposure A, B, or C.
6. Max. ground snow load: 70 PSF.
7. Seismic design categories A, B, C, D, D_1, and D_2.

For a wind speed ≥110 MPH, or seismic design category ≥ D1, additional geometry requirements apply to braced wall lines (R603.1.1.1). Design that falls outside these limits is usually acceptable when done by an engineer. If the wind speed, exposure, or snow load exceed items 5 or 6 above, the IRC requires a fully engineered design.

So how can you justify your "L" shaped structure with overall dimensions of 62' x 41' with a carport and sunroom? Here are some tips that may help, depending upon the building official's acceptance of cold-formed steel, and the configuration of the home:

Use the "wing" width as the building width for limiting span calculations

Even if the overall building dimension is 41 feet, the "width parallel to the joist span or truss" must fall within the 36' limit of the code, to design the wall, roof, and floor elements. Hence a "L" shaped structure may have components that the building official may permit you to design in accordance with the code, whereas other structural elements such as collectors, corner supports, and girders may have to be a part of an engineered design.



Design as multiple structures

As long as there are reasonable grounds for separating diaphragms and braced wall lines, certain structures may be looked at as separate for the individual component analysis. The lateral systems (for resisting wind and seismic) may still need to be engineered, and load transfer details may need to be created in the areas where the "buildings" come together.

Floor Joists usually may be designed using the IRC in areas with higher wind and seismic loads than permitted, as long as the support and holddown detailing include the appropriate design provisions for load transfer between walls and through diaphragms.

Pre-engineered roof truss systems may be used with complex geometries, as long as:

- The anchorage to the structure below is appropriate, and in-line framing is maintained.
- The loads from the truss output are used for the design of the supporting members below.
- Bracing is properly designed for both the individual truss members and the overall roof or floor truss system.

Specialty stud and joist products

There are also several specialty products that are either made of steel or made for use with steel that do not meet the code requirements, but with some of the manufacturer's design data and research reports, may be used safely in code based applications.

Fasteners

The code addresses only screw connections using #8 or #10 screws. Before attempting to use an alternative system, make sure and clear it with your building official. Show them the technical backup data, and make sure use of IRC provisions are permitted along with the specific connectors.

Clinch Connectors have been used successfully in residential construction, and at least one manufacturer has ICBO approval.

Pneumatically driven pins, although not referenced in the code, have been used in both commercial and residential construction to attach sheathing, floor decking, and wallboard to steel studs and joists. ICBO reports are available for diaphragm values using these connectors.

Welds. A great deal of data is available, but none is incorporated into the IRC.

By using the code carefully, coordinating design with the building official and specialty subcontractors, and carefully reviewing load paths from all sources, an attractive, efficient, and low cost home can be designed using provisions of the IRC to help save engineering time and owner costs. ❒

Correction

In the October 2001 issue of the LGSEA Newsletter, please note the following corrections to the article *"Design of Bearing Stiffeners in Cold Formed Steel C-Sections"*:

1. Page 2, left column, the equation for the track shear width should be:

w_b = track shear width = $(20t_t + 0.56)$

2. Captions for Figures 2 and 3 (page 3) are reversed.

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 professional are turning to software that is specifically written for design cold-formed steel. The September 1998 issue of the LGSEA Newsletter included a directory of software programs that LGSEA members identified as those they most frequently used. The following directory updates that list, and includes several new engineering design software packages that have come onto the market. The information in this guide was provided by developers of the individual software programs. As space does not permit inclusion of all the capabilities of the individual programs, the LGSEA encourages readers to contact software providers for additional information. The LGSEA does not endorse specific products. The following programs are listed alphabetically. ❒

Program/ Contact Info.	Codes and Standards	Input/Interface Description	Design Modules	Structural Components	Demo?/ Price
AISIWIN v4.0 Clark Steel Framing (888) 437-3244 joew@clarksteel.com www.clarksteel.com	1996 AISI Specification, including the 1999 Supplement, and the 1986 edition with 1989 addenda.	Uniform loads, 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. Allowable span lengths are generated for curtain wall and joist framing checks. Sections can be modified interactively, allowing the user to select the most efficient member for the application.	• Design wall studs (combined loaded or curtain wall), floor joists, ceiling joists, posts and braces (pure axial) and headers or beams. • Single, boxed and back-to-back members.	SSMA and custom databases.	FREE download from www.clarksteel.com
CFS® Version 3.5 RSG Software (816) 524-5596 info@rsgsoftware.com www.rsgsoftware.com	1996 AISI Specification Supplement #1 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. • Elastic buckling analysis using the Finite Strip method.	Databases for SSMA, HUD, and LGSI sections	Yes $550
FRAME D&E JFB & Assoc. (719) 598-7666 www.JFBA.com	ASCE7, BOCA, UBC, SBC, Canadian, Australian, British, French, Japanese, Inter'l, Florida, Puerto Rico, Caribbean, and Philippines	FRAME D&E 6.0 is an integrated analysis and design software program for the design of building walls and floor framing fabricated from light gauge steel sections. The Frame D program will select the most economical framing for specified loads and span conditions. Comprehensive reports, step through menus, and online help make Frame D&E easy to use.	Analysis may include: • Screw, weld, or bolt connections • Seismic Coefficient Calculation • Shear wall analysis • Floor and roof diaphragm analysis • Multiple floor levels • Exterior and interior load bearing wall studs • Headers, beams, floor joists, and support columns.	Knudson rollformers, SSMA, Dale/Incor, Dietrich, AISC, Proprietary shapes, plus others.	Yes, on website. $795

Cold-Formed Steel Design Software

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Program/ Contact Info.	Codes and Standards	Input/Interface Description	Design Modules	Structural Components	Demo?/ Price
KeyBuild® Keymark Enterprises (303) 443-8033 www. keymark.com	1986 AISI Specification, with 1989 Addenda and 1996 Edition	KeyBuild® allows a user to describe the geometry of entire structures using the KeyBuild Model™, a fully functional 3-dimensional modeling program. In addition to the materials and loads, the user defines the walls, trusses, framing materials, and foundation in full 3-D. KeyBuild Mode™ uses "marco" input to allow the user to quickly and easily define complete roof systems, ceiling vaults, even skylight and dormer framing.	• 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 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 software.com www.devcosoftware.com	1996 AISI Specification, including the 1999 Supplement , and the 1986 edition with 1989 addenda	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, back-to-back and built-up members	SSMA, MSMA, individual stud manufacturers, "Z" section, and custom databases	Yes $ 375
LtFramer aecIT Solutions Corporation (407) 645-1303 **sales@aecit.net**	1996 AISI Specification	LtFramer is a 3d modeling and engineering analysis software product for the preparation of engineered CFS light frame components for building systems. The product is based on AutoCAD 2000 graphics and interface technology. AutoCAD ownership is not required. The UI is simplified and focused towards the framing designer and structural analyst minimizing the need to for advanced CAD skills. The majority of the labor required to produce structural models, fabrication and erection documents and reports for Engineered CFS Components is automated, drawing and report formats are flexible.	• The LtFramer Materials Modeling Modules are the Wall, Floor and Roof Workshops – Fabrication drawings & materials lists with cutting information are produced using these modules. • The Engineering Analysis Studio Module provides flexible, powerful Structural Analysis and AISI code checking. This module extends the capabilities of the materials workshops. • Context Sensitive Help System • Materials and analysis reports can export to MS Excel or other CSV capable products. • Online demo, training and technical assistance. • Floor & Roof Workshops are under development check for availability.	Section Databases for MSMA are standard, others can be provided. Built Up Section assemblies can be used. Analysis of standard and custom components that can be fabricated from CFS stud and track materials is supported.	Yes Online Demos available 30 day try before you buy option. Contact salesgroup for lease prices.

RISA-2D & RISA-3D RISA Technologies (800) 332-RISA sales@risatech.com www.risatech.com	AISI-1996 Specification and AISI-1999 Supplement 1 criteria	CAD drawing interface with orthogonal and radial drawing grids. All data, including results, may be viewed and edited graphically or in synchronized spreadsheets. Generation templates for beams, trusses, grids, etc. Physical member modeling that doesn't require segmented members. True-to-scale rendering, including animations for deflected shapes. Graphic member detail summary and color presentation of member stresses and code checks.	• Static, P-Delta, Dynamic & RSA beam or frame analysis • Area loads with 1 or 2 way spans • Automatic top-of-member modeling • Tension/Compression-Only member and springs • Enforced Joint Displacements • Calculates custom shape properties • Automatic effective section properties • ASD/LRFD checks for axial forces, biaxial moments & shears including interaction checks	Databases for AISI sections and custom sections	Free Trial Version from web or on CD RISA-2D: $495 RISA-3D: $1495
Steel Smart System (SSS) ver. 2.1 EnR Solutions (919) 844-0789 www.enrsolutions.com cs@enrsolutions.com	AISI 96 Spec. AISI 96 Spec. w/ Supp. 99 CAN S136-94 Spec. ASCE 7-98 min. loads Stand. ASCE 7-95 min. loads Stand. ASCE 7-93 min. loads Stand.	Windows-based interface. Project component design; wall studs, roof trusses, roof beams, floor joists, openings, connections, and clips, all output in CAD format. Shear wall generator, load calculator, and designer. Utilities for member design, connection design, and min loads. 400 LSF details connections, available in CAD formats. LSF editable specifications and inspection reports. 3-D technology to navigate through your structure. Integrated Help file documentation.	• LRFD and ASD strengths for compression, tension, moments, shears, and web crippling. • Axial/bending, bending/shear, bending/web-crippling interactions. • Stud, track, and built-up sections. • Full, net, and effective section properties. • Screw & bolt connections + fastener & clip selection. • Wind, earthquake, and snow loads on buildings.	Databases for Standard and AISI sections. TSN clips. Hilti fasteners.	Demo Manual Tutorials $1050 Full copy $60 License/ mo.
STRAP Light Gauge Designer ATIR Engineering Software (800) 644-6441 www.ATIR.com STRAP@ATIR.com	Current U.S. (AISI [ASD & LRFD], AISC [ASD & LRFD], ACI 318); Canadian (CSA S136, S16.1, A23.3); Eurocode 2, 3; & other int'l codes	Completely graphical 2-D and 3-D frame and truss, finite element, static and dynamic analysis and design program. 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 creates wind and seismic forces to UBC and other 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 www.JFBA.com	ASCE7, BOCA, UBC, SBC, Canadian, Australian, British, French, Japanese, Intern'l, Florida, Puerto Rico, Caribbean, and Philippines	TRUSS D&E 11.0 is an integrated design and estimating software program for either sloped, flat or arched trusses. Step-through menus guide the user through layout design and detailing. The program offers auto member selection and auto generation of truss geometry. A Cost Estimate and Bill of Materials can be generated for each truss design. Truss D&E can design trusses fabricated from Light Gage Steel, Structural Steel, Stainless Steel, or Aluminum.	Analysis may include: • Standard and odd shaped trusses • Graphical interaction and multiple drawing options • Braced Webs • Multiple supports • In-plane, Out-of-plane, and Offset analysis • Screw, weld, or bolt connections • Hip Roof Generation • Seismic Coefficient Calculation • Project Summary Report • Imperial or Metric units	Knudson rollformers, SSMA, Dale/Incor, Dietrich, AISC, Unimast, Proprietary shapes, plus others.	Yes, on website. Call for Pricing

Light Gauge Steel Engineers Association

LGSEA

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