LGSEA

Newsletter for the *April 1995*

Light Gauge Steel Engineers Association

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See Next Issue for:

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

Upcoming Events 1995

Association of Wall & Ceiling Industries - Int'l — Apr 25-29
Nashville, TN
Info.:(703) 534-8300

Pacific Coast Builders Conference — Jun 21-24
San Francisco, CA
Info.: (916) 325-9300

METALCON ' 95 — Oct 24-26
Washington, D.C.
Info.: (617) 965-0055

Shear Wall Design and Testing - Part II

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

Additional test data on the performance of light gauge steel framed shear walls, tested at Santa Clara University, are presented in Table "A" (see page #2). This information is similar to Table "C" of the article on *"Shear Wall Design and Testing" (LGSEA Newsletter, January 1995).* The performance of the walls is described in terms of the load at the 1/2-in. (± 1/15-in.) net lateral displacement at the top of the wall, the instantaneous maximum load (maximum load attained), and the sustained/stabilized maximum load (measured load two minutes after the maximum instantaneous load was attained).

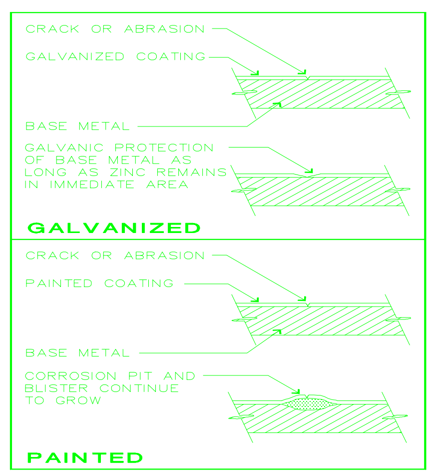
The resistance of the walls with diagonal tension strap bracing was controlled by yielding in the strap. This wall was capable of maintaining its yield load at relatively large displacements. In the sheathed walls, failure resulted from screw rotation about the stud flange followed by either the screw head pulling through sheathing or breaking of the sheathing at the panel edge. In all tests, perimeter fasteners were installed a minimum of 3/8 in. from the edge of the sheathing.

In the plywood shear walls where No. 6 screws were used, some screws broke just below the head as lateral displacement was increased beyond the maximum load. Failure in the plywood and OSB walls in which nails were used was characterized by the nails pulling out of the flanges (the nail and the sheathing remaining intact).

(Continued on page 2)

Galvanizing - Light Gauge Steel Corrosion Protection

Ken Vought, USS -POSCO



Engineers and builders who work with light gauge steel will automatically specify galvanized steel for their projects but may not understand why this material is so resistant to rust. Galvanization provides a tough, metallurgically bonded zinc coating which completely covers the steel surface and seals it from the corrosive action of its environment. In addition, the sacrificial action of zinc protects the steel even where damage or minor discontinuity occurs in the coating.

Zinc is a reactive metal that oxidizes in air to form a corrosion resistant film of zinc oxide. The zinc oxide layer is very thin, hard and tenacious and is the first step in the development of the protective corrosion product layer normally associated with the galvanized coating. When this surface has access to freely moving air in normal atmospheric exposure, the surface reacts with rainfall or dew to form zinc hydroxide. As the surface dries, the zinc hydroxide reacts with

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(***Shear Walls*** - *Continued from page 1)*

In each test, three displacement measurements were recorded. Based on these measurements, it was observed that overall slip and rotation of the wall were relatively small. In a few tests, local buckling in the chord members was evident, but this behavior did not control the strength of the wall. The overall performances of the walls, in terms of applied load

(Continued on page 3)

Table A - Light Gauge Stud Shear Walls

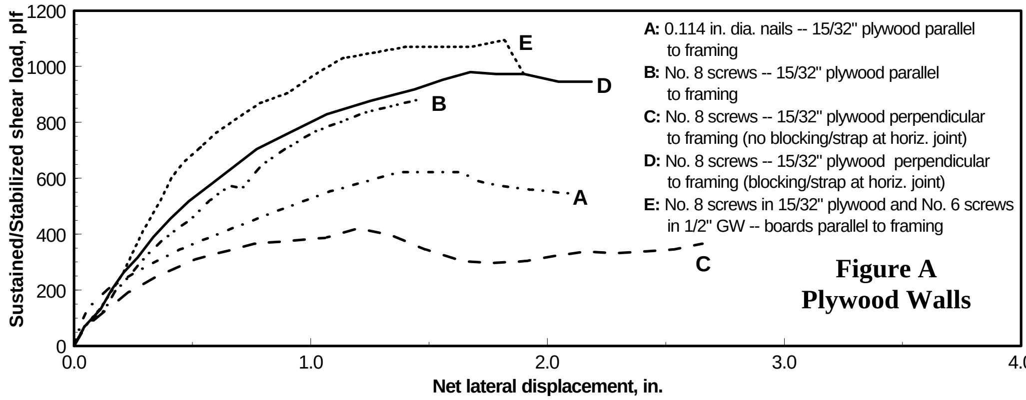
Panel	Fastener Schedule[d]	Ultimate Shear (Instantaneous) (plf)	Ultimate Shear Sustained/ Stabilized[a] (plf)	Ultimate Shear Sustained/ Stabilized at 1/2 in.[c] net lateral deflection (plf)
2-in. 20 ga., flat strap tension X-bracing	No. 8 - one screw at each stud	not monitored	303 (3 tests)[b]	not monitored
1/2-in. GWB (back), 1/2-in. GSB (face)	No. 6 - 6-in. / 12-in.	not monitored	748 (3 tests)[b]	not monitored
1/2- GWB (back), 1/2-in. GSB (face), 2-in. 20 ga. flat strap tension-X bracing (face)	No. 6 @ 6-in. / 12-in. No. 8 @ straps	not monitored	929 (4 tests)[b]	not monitored
1/2-in. GWB (back), 1/2-in. GSB (face)	No. 6 @ 6-in. / 12-in.	808 (1 test)	676 (1 test)	555 (1 test)
1/2 -in. GWB (back), 1/2-in. GSB (face)	No. 6 @ 7-in. / 7-in.	732 (1 test)	645 (1 test)	545 (1 test)
1/2-in. GWB (back), 1/2-in. GSB (face)	No. 6 @ 4-in. / 4-in.	1008 (1 test)	897 (1 test)	697 (1 test)
1/2-in. GWB (back), 1/2-in. GSB (face) -- panels perpendicular to framing w/ blkg	No. 6 @ 6-in. / 12-in.	794 (1 test)	676 (1 test)	517 (1 test)
15/32-in. PW (face)	No. 6 @ 6-in. / 12-in.	1049 (2 tests)	not monitored	not monitored
15/32-in. PW (face)	0.114-in. dia. pins @ 6-in. / 12-in.	621 (1 test)	not monitored	not monitored
15/32-in. PW (face)	No. 8 @ 6-in. / 12-in.	1122 (2 tests)	976 (2 tests)	317 (2 tests)
15/32-in. PW (face) -- panels perpendicular to framing w/o blocking	No. 8 @ 6-in. / 12-in.	462 (1 test)	421 (1 test)	296 (1 test)
15/32-in. PW (face) -- panels perpendicular to framing w/ blocking	No. 8 @ 6-in. / 12-in.	1070 (1 test)	980 (1 test)	517 (1 test)
7/16-in. OSB (face)	0.114-in. dia. pins @ 6-in. / 12-in.	600 (1 test)	not monitored	not monitored
7/16-in. OSB (face)	No. 8 @ 6-in. / 12-in.	918 (3 tests)	788 (3 tests)	399 (3 tests)
7/16-in. OSB (face)- panels perpendicular to framing w/blocking	No. 8 @ 6-in. / 12-in.	980 (1 test)	828 (1 test)	393 (1 test)
1/2-in. FiberBond wallboard	No. 6 @ 6-in. / 12-in.	367 (3 tests)	317 (3 tests)	257 (3 tests)
1/2-in. FiberBond wallboard	No. 6 @ 4-in. / 12-in.	452 (2 tests)	396 (2 tests)	350 (2 tests)
1/2-in. GWB (back), 15/32-in. PW (face)	No. 8 @ 6-in. / 12-in. (PW) - No. 6 @ 7-in./7-in. (GWB)	1263 (1 test)	1094 (1 test)	535 (1 test)

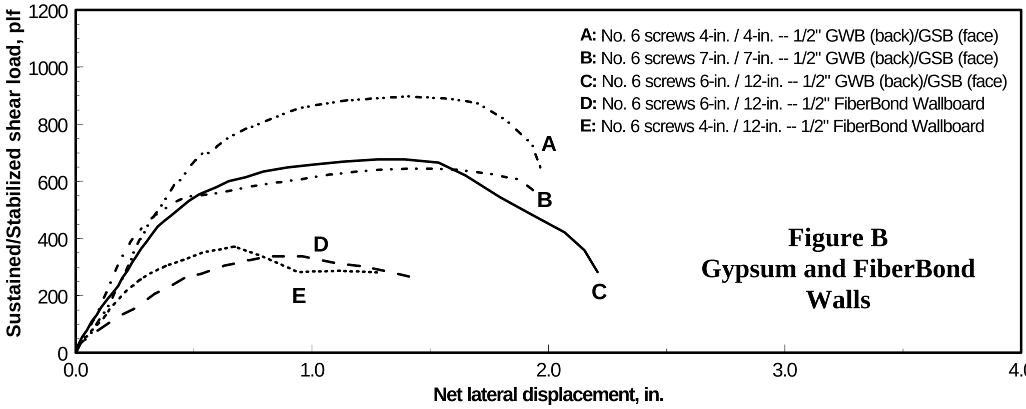
[a] based on a 2 minute holding period
[b] based on a 30-60 second holding period
[c] ± 1/15- in.
[d] 6-in./12-in. represents a 6-in. spacing on the perimeter and a 12-in. spacing in the field.
Note: All PW (plywood) and OSB are APA rated sheathing.

*(**Shear Walls** -Continued from page 2)*

versus net lateral deflection curves, for the different fastener schedules and sheathing materials, are given in Figures "A" and "B" (see figures at right).

The data provided here gives some basic information on the performance characteristics of light gauge steel shear walls with different sheathing materials. More information is still needed on the behavior (particularly dynamic) of the light gauge steel framed shear wall system in the as-built condition.❒





Proposed Cyclic & Static Shear Wall Tests

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

A test program designed to evaluate the behavior of light gauge steel framed shear walls under static and low frequency cyclic loading will begin this month. The scope of the test program and the test procedure are described in this article.

A series of tests will be conducted to investigate the behavior and evaluate the nominal shear strength values of 4-ft. by 8-ft. and 8-ft. by 8-ft. light gauge steel framed shear walls sheathed with (i) 1/2-in. CDX plywood (Structural I) on one side and 1-1/2-in. flat strap or 1/2-in. gypsum wallboard (GWB) on the other side, and (ii) 7/16-in. OSB APA Rated Sheathing one side and 1-1/2-in. flat strap or 1/2-in. GWB on the other side. The walls will be constructed using No. 8 sharp point screws for attaching plywood and OSB and No. 6 dry-wall screws for attaching GWB. All framing screws, including strap attachment, will be No. 8 self-drill. In tests where flat straps are used to prevent torsional buckling of the studs, blocking will be installed in the end bays and the straps will run horizontally over the blocking.

All studs will be 3-1/2 in. deep to conform to the new standard size under consideration by NAHB. The 20 gauge studs with 1-5/8" flanges will be used at both 16" and 24" o/c spacings.

The overall test set-up will be similar to that described in ASTM E 564, except commercial hold-downs (Simpson's S/HD8) and 1/2-in. (minimum) shear bolts will be used to anchor the wall panel to the test frame. The wall will be braced against out-of-plane displacement along the top track.

Displacement of the wall will be measured electronically (using DCDTs) at four points: two vertical displacements at the hold-downs and lateral displacement at the top and bottom of the wall.

For both static and cyclic tests, the walls will be loaded using displacement control. The static loading procedure will be completed as

(Continued on page 6)

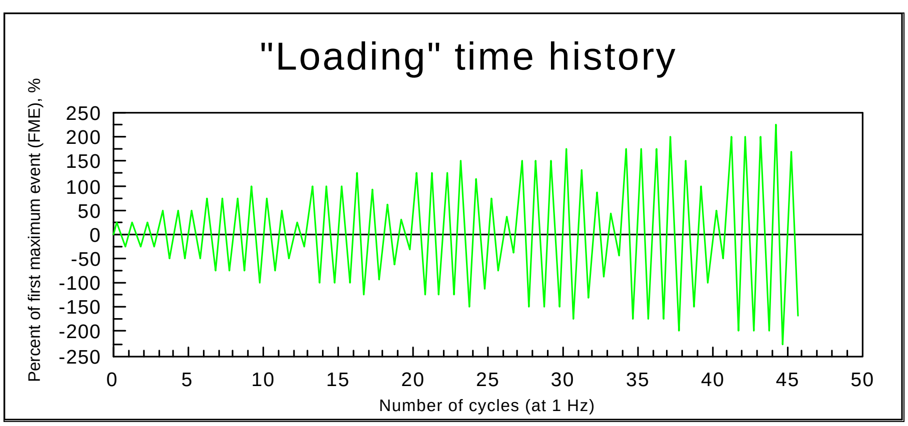


Figure A - Loading pattern for cyclic loads

Technical Exchange Section

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

Beam / Header Detail - A Contractors View

By Bruce Ward

As a framer I'm always looking for ways to simplify my life. I try to solve framing related problems without creating additional grief for those lucky sub-contractors who follow me. The load bearing header is one of the most important details we have.

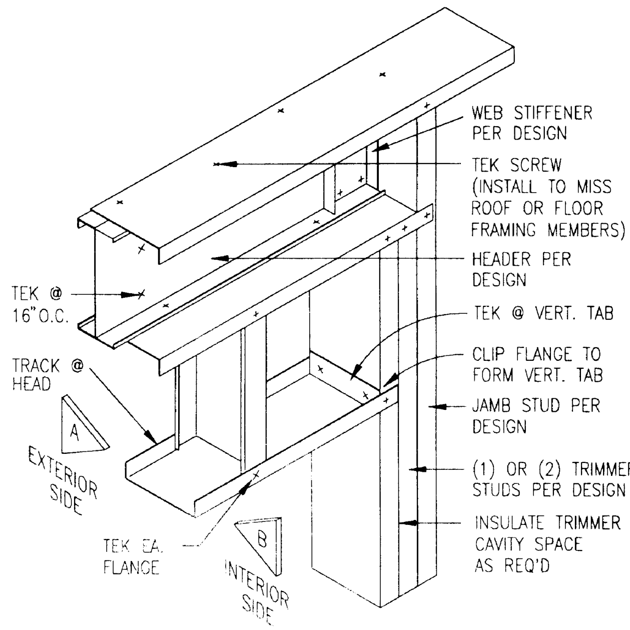
I use two methods of building headers, either back to back, or box header. I prefer the back to back for ease and speed of assembly, but I use the same theory when using both types.

For at least 90% of the homes I build, the headers are the same throughout the house. I asked an engineer familiar with light gauge steel design to help formulate some rules of thumb for steel frame similar to wood frame. A pair of 8" x 1-5/8" flange 16 gauge, either box or back to back, perform adequately in most 6-foot or smaller openings. If more support is necessary, increasing gauge and/or flange size may suffice without the need to increase web dimension. I try to stay with the same size header (8") so my vertical members are ordered in only two lengths, full height (king stud) and full height, less 8 inches (trimmer).

Since I always use at least one trimmer under each end of each header, I don't have to use heavier gauge king studs. Some header details show the header fastened to the king stud through the web after cutting and coping the flanges of the header. This is a very labor intensive chore seldom done with the accuracy or fit and finish acceptable on my projects. The extra layers of steel and screws cause drywall problems later on.

My first choice is to have the stud manufacturer cut my header material for me. Even if I have to cut headers with a chop saw or shear, I still use a square cut.

My headers are cut 9-1/2" over rough opening dimension. This allows me room for two trimmers at each end of the header and 3" of wood backing inside my steel stud rough opening to accommodate my finish carpenter. Add 1-1/2" of wood each side, which equals 3", to the 6-1/2" of trimmer material and you have a 9-1/2" rough opening.



TYPICAL LOAD BEARING HEADER

N.T.S. (SINGLE OR DOUBLE TRIMMER)

I'm also not concerned that using 8" x 16 gauge headers on my smaller openings is costing me too much money. I would much rather have all my header material exactly the same (except length) to avoid confusion, than try to design each individual opening and try to track various sizes and gauges to match each opening.

I've found that using this theory on my headers makes my cut list easier to develop, reduces confusion for my manufacturer, reduces costly mistakes by my framers in the field, eliminates many dangerous field cuts and allows me to make cleaner and more accurate finished details.

These all add up to more savings in time and expense. ❐

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Technical Question & Answer Section

By Allan Swartz, P.E.

A question often asked by building officials (both plan checkers and field inspectors) is: ***"What are the things I should be looking for when checking or inspecting a building that is being constructed of light gauge steel?"*** What follows is a partial list of some of the items that I believe should be included in any plan check or field inspection. I have divided the areas of concern into two subheadings, the first being ***Materials***, the second ***Installation***. This list is not intended to apply to interior non-load bearing drywall partition studs.

Note: The check list below is a partial list only. An LGSEA Committee is working on a comprehensive "Field Inspection Check List". Write or call the LGSEA for a copy of this list as it becomes available. This list is intended to be a general guide/ aid for the inspector/engineer during field inspections and may not include project specific items.

MATERIALS

1. Minimum base metal thicknesses (without coating) in the field should conform to the minimum thickness requirements given on the structural drawings. This information should always appear on the drawings because it establishes the basis of the engineer's design assumptions with regard to section properties of the framing members.

2. All studs, joists, tracks, bridging and accessories for structural applications should be formed from steel having a minimum G60 galvanized coating meeting the requirements of ASTM A525 (see article on new ASTMs page #8). Note: environmental considerations may dictate more stringent requirements for galvanized coatings.

3. The minimum ratio of Fu/Fy steel strengths should be 1.08. The minimum total elongation shall be 10 percent for a two inch length.

4. In the absence of proper documentation, random test samples should be taken from on site material verifying material strength and items 1 through 3 above (per ASTM A370 and ASTM A90). A minimum of 5 samples from each different thickness of framing member shall be tested per shipment of 20 tons or less. In lieu of random testing, mill certifications shall be provided with each material shipment by the manufacturer for the specific material being supplied. Copies of all material testing and/or mill certifications should be available on the job site for review by the Building Official.

INSTALLATION

1. Web punch-outs in vertical studs should not be located closer than 1.5 times the web depth of the stud from the stud ends. Field cut holes in any stud or track should not exceed the size specified in the approved drawings.

2. Field cuts through the flanges of studs or tracks should not be permitted unless specifically detailed and approved by the Engineer.

3. Verify that gaps between the ends of vertical load bearing wall framing members and tracks do not exceed 1/16" at each end of the wall stud.

4. Check edge and field screw spacing at all sheathing edges per plan requirements. Edge screws at multiple studs should be driven into the member connected to the holdown device (if applicable). ❒

Standard Detail Manual Under Development By the LGSEA

A critical link in the information chain is being forged by the LGSEA through the development of a Standard Details Manual which is expected to be ready for distribution by the Fall of 1995.

The manual will identify details that meet the criteria for efficiency and structural integrity, and provide them in a form that will help ease the design process for engineers and architects. In addition, the manual is intended to aid building inspectors and plan checkers by providing them with better information about residential steel framing plans and construction techniques.

The evaluation process is being conducted in a series of steps. First, nearly 1,000 individual details were collected earlier this year and turned over to the Carpenters/Contractors Cooperation Committee who had assembled a review board consisting of major builders. Their task has been to evaluate the details for cost effectiveness, design feasibility, and constructability.

Currently, the number of details is being substantially reduced by a panel of 10 engineers who are eliminating nearly identical details and determining which are the most technically sound and highest ranked. Ultimately, the Manual will offer two or three suggested details per type of assembly connection.

Soon after first release of the manual, the details will be available on disk in Autocad format. The Details Committee has not yet set a sales price for the manual, but LGSEA members will be entitled to discounts.❒

(**Galvanization** -*Continued from page 1)*
carbon dioxide in the air and is converted into a microscopically thin but extremely tough and adherent layer of basic zinc carbonate. Because it is relatively insoluble, this layer is weather-resistant and, once formed, minimizes further corrosion.

The zinc coating weight directly influences the degree of protection afforded the steel. In a severe exposed industrial environment, chlorides and sulfur gases increase the solubility of zinc so that it corrodes faster. A dry interior condition may require a thinner zinc coating to achieve the same service life as the harsh environment. As a result, a *G-60* galvanizing weight is frequently specified for exterior wall studs and a *G-40* for interior studs.

Zinc is more anodic than steel in the arrangement of metals in galvanic series. Consequently if zinc and steel are connected in the presence of an electrolyte (i.e. air's moisture), then the zinc will be consumed preferentially to protect the steel.

Because zinc "sacrifices" itself in this way, small areas of steel exposed at cut edges and drill holes or as the result of severe abrasion or impact, will remain rust free as long as zinc remains in the immediate area (see figure page #1).

Painted steel cannot offer the same thorough protection against corrosion. When the surface of painted steel is scratched, the exposed steel corrodes and forms a pocket of rust. This action lifts the paint film from the metal surface, to form a blister and corrosion pit which will continue to grow.❐

NAHB-HUD-AISI Form A Committee to Develop
Prescriptive Code Approach to Light Gauge Steel Design
By Neal Peterson, P.E.

The NAHB Research Center recently received a three year grant from the U.S. Department of Housing and Urban Development, the National Association of Home Builders, and the American Iron and Steel Institute to develop a prescriptive standard for light gauge residential steel framing. The NAHB Research Center has organized a committee made up of officials from across the United States to develop a prescriptive standard document. It is the intent of the NAHB Research Center to prepare a document that would ultimately be accepted by CABO as part of their One and Two Family Dwelling Code.

There have been two meetings by the committee to establish the framework for development of the standard. Part of the standards adopted are shapes, thickness of material, and cross-section dimensions from which standard load tables and charts can be developed. The prescriptive method will include developing tables and charts for stud spacings, joists, rafter spans, header tables, and fastener schedules. For wall framing, a standard 1-5/8" flange width and 3-1/2" or 5-1/2" stud depth will be used for developing wall load tables. Floor joist assemblies will utilize 1-5/8" wide flanges x full depth floor joist members (i.e. 8", 10", etc.).

The schedule established by NAHB Research Center requires that the structural element of the prescriptive methods be generated into a draft document form by the middle of the 1995. It is the intent of NAHB to develop a document that closely parallels the wood section of the CABO One and Two Family Residential Code.

Once the draft document has been developed and has received public input, the document will be proposed to the various model codes for

(***Cyclic SW Tests***-*Continued from page 3)*
outlined below:

◆ Defining the elastic limit displacement as the First Maximum Event (FME), the wall will be loaded to produce target lateral deflections of 25%, 50%, 75%, and 100% of the FME. At each target displacement, loading will be stopped for a period of two minutes to allow the wall to stabilize. After stabilization, the load will be released and the permanent set recorded. The wall will then be loaded to the next target displacement.

◆ After 100% of FME, the wall will be loaded to a maximum displacement of 3 inches. The FME for these tests is in the range of 1/2-in. to 1-in.

The loading sequence for the cyclic tests is illustrated in Figure A (see page #3). The tests will be run at a frequency of 1 Hz (1 cycle/sec) and load and displacement measurements will be taken at a minimum rate of 100 samples per second.

To obtain a complete copy of the proposed shear wall tests procedure and panel types to be tested contact Prof. Reynaud Serrette. Comments on the scope of these tests and the test procedures are welcomed. ❐

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New ASTM Designations for Galvanized

In late 1994, ASTM (American Society for Testing and Materials) re-wrote the specifications that cover Galvanized Sheet products. The new specifications are streamlined and simplified for ease of use by steel specifiers. There is no direct effect on the products in terms of the types of steel available or steel performance.

Two ASTM specifications dealing with Steel Framing were revised. ASTM A-525 General Requirements for Steel Sheet Zinc-coated (Galvanized) by the Hot Dip process was streamlined, and given a *new* designation of ***ASTM A-924***. ASTM A-446 structural quality was streamlined, and given a *new* designation of ***ASTM A-653***.

For copies of specifications or for additional information concerning ASTM specifications, contact ASTM at 1916 Race Street, Philadelphia, PA 19103-1167. Their phone number is (215) 299-5585.❒

AISI Releases Thermal Design Guide

An important report on the thermal conductivity of steel in exterior walls has been released by the American Iron & Steel Institute, showing that exterior walls framed with steel attain high R-values through the use of foam sheathing as a thermal break. The report notes that the ASHREA Zone Methods tend to underestimate the R-value of a wall sheathed with foam. The report also offers zone correction factors.

The study, conducted at the National Association of Home Builders (NAHB) Research Center, included full scale calibrated hot box tests (ASTM C976) conducted by Holometrix, Inc., as well as analysis by NAHB and thermal modeling by the Oak Ridge National Laboratory.

Copies of the thermal design guide, including test results for wall assemblies, can be obtained by calling the AISI at (800) 79-STEEL.❒