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FRAMEWORK

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Metal construction products for the residential market.

A FEW WORDS ABOUT STEEL

TRAINING AT THE LOCAL LEVEL

BY MARDIE C. TORRES

WHILE THE STEEL FRAMING ALLIANCE IS AN INTERNATIONAL INSTITUTION WITH A GLOBAL REACH, MUCH OF THE WORK TO IMPLEMENT NATIONAL STANDARDS HAPPENS LOCALLY. LOCAL AFFILIATES OF THE STEEL FRAMING ALLIANCE WORK AT THE GRASS ROOTS (A TERM REFERRED BY FORMER CHAIR GREG RALPH TO THE LOCAL ALLIANCES) TO ENCOURAGE THE WIDESPREAD, PRACTICAL AND ECONOMIC USE OF LIGHT-GAUGE STEEL FRAMING.

Local Alliances represent a growing infrastructure of contractors, builders, manufacturers, roll-formers, design professionals, producers, subcontractors, code officials and others. Members take national standards and best practices, and then adapt them for use in their marketplace. Additionally, they alert the national Alliance of the issues they have in the field and aid in the development of solutions.

At present, the National Steel Framing Alliance has four local alliances under its aegis. These are based in California (CASFA), Hawaii-Pacific (HPSFA), the Mid-Atlantic region (MASFA) and Texas (TXSFA).

Much of SFA's strength is derived from the initiatives exerted by these local Alliances. As resources for those design professionals, builders, framers, carpenters, code officials and others, they have been keeping the momentum in advancing the mission to help encourage and promote the use of cold-formed steel framing in the market.

"GRASS ROOT" LEADERS

One of the most important areas in which local Alliances are helping to promote steel framing is in training, and each is doing its part to further the cause in its respective territory.

CASFA actively participates in trade shows and plant visits, plus SkillsUSA, programs targeted at city officials, and training programs through schools.

Hawaii, home to the HPSFA, has the highest percentage of steel-framed homes being constructed anywhere in the world, with cold-formed steel framing accounting for about 70 percent of all new-housing ventures in the state. Because training in this region is critical, HPSFA participates in a number of educational efforts. These include the SkillsUSA student carpentry competition, steel-proficiency certifications through local schools, and a Steelman Competition.

In addition, at its recent PACRIM Conference, HPSFA also hosted SFA's second two-day Stud University class, which covers the basics of steel framing through classroom instruction and hands-on training. It also conducts seminars for building officials and inspectors.

MASFA holds two education seminars every month designed to explain the reasoning behind steel framing methods from an engineering perspective. The group is planning to hold quarterly seminars geared toward engineers and design professionals, the first of which, held recently, attracted a crowd

TABLE OF CONTENTS

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of nearly 50, including builders. The chapter is also participating in educating code officials and state inspectors. Since 2001, the group has trained about 525 architects, 940 contractors and 1,080 code officials.

TXSFA devoted much of its energy and resources in the last year to hosting its recent Tex-Eco-Build Conference in Fort Worth, which included numerous seminars and events aimed at the builder, code official and designer.

To find the Alliance closest to you, see the sidebar above. The leaders of these local alliances ask and encourage SFA members to join them in promoting the cause of steel in their areas.

If you would like to find out how you can help in your area of interest, please contact them.

The industry can flourish with the active involvement of the grassroots working together in advancing the cause of the Alliance. The local Alliances have everything. Each possesses an exceptionally talented group of diverse people able to provide goods and services to this growing industry.

Mardie C. Torres is executive director of the Hawaii-Pacific Steel Framing Alliance and chairs the Local Alliances Presidents Team for SFA.

MHD

New Officers on Board

The Steel Framing Alliance has appointed new officers to its 2004 board of directors.

Don Moody, general manager of NUCONSTEEL Corp., is chairman, and George Vary, executive director of the American Zinc Association, is secretary/treasurer. Mike Meyers, director of industry marketing for United States Steel, continues as SFA vice chairman.

Moody

Moody, who formerly served as secretary/treasurer, replaces 2003 President Greg Ralph, director of product development for Dietrich Metal Framing, who will concentrate on his responsibilities as chairman of the SFA Operating Team. Elections took place May 13 at the SFA's Spring Meetings in Fort Worth, Texas.

Moody, a registered professional engineer with more than 20 years of experience in the light-gauge steel framing industry, was formerly president and CEO of SFA. Previously, he was president and CEO of Western Metal Lath.

Vary represents the third generation of his family to work in the steel industry. Following serving in a private law practice in New York, he spent 11 years with Armco Inc. in both its legal and international-trade departments. He became AZA's the first executive director in 1991.

Meyers has 30 years of sales and marketing experience with U. S. Steel. In 1996, he took over as chairman of AISI's Residential Advisory Group, the industry's program to grow steel's participation in residential framing and the precursor to what is now SFA.

MHD

Steel Framing Alliance™

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Steel Framing Alliance 2004 Training Schedule

October

20-22, Wednesday-Friday: Alliance-sponsored Stud University and training seminars at METALCON International. Las Vegas. Visit metalcon.com or steelframingalliance.com.

For more information about Alliance training programs, contact Maribeth Rizzuto at mrizzuto@aol.com.

Opportunities For Steel In New Building Codes

By Robert Wills

Building codes are often seen as unavoidable obstacles that restrict planners and developers. This negative perspective can be particularly acute when costly changes and delays destroy plans and schedules. However, rather than viewing codes as a hindrance, early planning can reduce this disruption and, if done wisely, may actually uncover opportunities in the code for steel framing.

The last seven years have been a time of significant change in the code enforcement arena in this country. For decades, most communities enforced requirements that were based on one of three regional model code documents. While these three documents were similar, there were some significant differences. In recent years, the organizations that produce these model codes have joined forces and the three regional codes (SBC, NBC, UBC) have been replaced by a single document, the International Building Code (IBC). The IBC, which was completed in 2000 (and updated in 2003), is now being actively adopted and enforced in local jurisdictions across the United States. This new code contains a number of provisions that are favorable to steel framing and careful use of these provisions can provide new opportunities.

The IBC controls the allowable height and floor area for any project based on the intended use of the building, the materials used in the construction, and the presence of safety features such as sprinkler systems. The method in which these allowable heights and areas are calculated by the code is not difficult, however, fully explaining the required computations is beyond the scope of this article. However, a few basic concepts can be reviewed here, and this article may be able to point out a few observations that should be valuable in the selection of steel framing for residential projects.

Things to Consider

The code's height and area limits are a function of two primary considerations. The first consideration is how the building is going to be used, which is typically described as the building's occupancy classification or use group. The second consideration is how the building is going to be built, which is typically described as the building's type of construction.

Since the scope of this article is limited to multifamily residential and institutional applications, the occupancy classifications related to these uses have been summarized in **Table 1**.

Table 1: Use Group Summary

R-1	Hotel, Motel
R-2	Apartments, Dormitories
R-4	Small Assisted Living (<16 occupants)
I-1	Large Assisted Living (>16 occupants)
I-2	Nursing homes
I-4	Day Care (children and/or adults)

The type of construction classification (TOC) is a little harder to simplify. A building's TOC is determined based on the combustibility (as determined by the ASTM E136 fire test) and the assumed fire resistance rating (as determined by the ASTM E119 fire test) of the primary structural members (i.e., the columns, beams, floors, trusses, and roof). Steel, concrete and gypsum wallboard are recognized as noncombustible materials while wood (including fire retardant treated wood) is classified as combustible. The fire resistance ratings, which are expressed as hourly designations, can be found in listings such as the UL Fire Resistance Directory and the Gypsum Association Fire Resistance Design Manual. Several typical TOC classifications are shown in **Table 2**, along with some examples using common construction materials.

Table 2: Type of Construction Summary

Type of Construction	Structural Element Combustibility	Structural Element Rating	Examples
IIA	Noncombustible	1 hour	Steel Studs with NC floors, roof sheathing and shear resistance. Framing protected with gyp board or other materials to provide 1 hr rating
	Noncombustible	1 hour	Masonry or concrete exterior walls with steel framed floors and roofs. Framing protected with gyp board or other materials to provide 1 hr rating
IIB	Noncombustible	No rating	Steel Studs with NC floors, roof sheathing and shear resistance. Finishes not designed to provide fire ratings for steel
	Noncombustible	No rating	Masonry or concrete exterior walls with steel framed floors and roofs. Finishes not designed to provide fire ratings
VA	Combustible	1 hour	Wood framing protected with gyp board to provide 1 hour rating
	Combustible	1 hour	Steel framing with combustible floor, roof, or wall sheathing. Framing protected with gyp board or other materials to provide 1 hr rating
VB	Combustible	No Rating	Wood framing w/ finishes not designed to provide fire ratings
	Combustible	No rating	Steel framing with combustible floor, roof, or wall sheathing. Finishes not designed to provide fire ratings

Later in this article, it will become apparent that the IBC provides substantial advantages in allowable height and area for Type II construction (noncombustible) in comparison with what is allowed for Type V (combustible). However, these advantages are only applicable if all the requirements for Type II construction are addressed. For example, a hotel built using steel framing for the walls, floors and roof systems will be downgraded from Type II construction to Type V if plywood sheathing is used on the exterior walls to provide the lateral shear resisting system. No advantage would be recognized by the code for the noncombustible framing in this structure. However, code users should always keep in mind that the code provides a variety of exceptions that may apply in specific instances. For example, a steel-framed apartment complex would be assigned a Type V classification if regular wood trusses were used on the roof, but a specific exception in the code will allow the same building to have a Type II classification if FRTW trusses are substituted. The first prerequisite for maximizing the building codes opportunities for steel framing can be stated as follows:

> ***Take advantage of steel's inherent noncombustibility by carefully selecting materials that the code will classify as Type II construction.***

Proper site planning and sprinkler selection can also create height and area opportunities. The IBC has a table that contains the basic allowable areas and heights cross-referenced by occupancy classification and TOC. However, these basic heights and areas can be increased significantly. For example, buildings with portions of the exterior perimeter wall separated horizontally from property lines and adjacent buildings can increase the basic allowable area of each floor. This additional area increase can be as much as 75 percent when the entire exterior perimeter is at least 30 feet from any property lines.

A Sprinkler Here, a Sprinkler There

The increases permitted for sprinklers can be substantial, but the selection of the sprinkler system itself must be carefully considered. The IBC requires all residential and institutional buildings to be provided with a sprinkler system. However, R-1, R-2, R-4, and I-1 occupancies less than four stories in height can choose to provide either a NFPA 13R system or a full NFPA 13 system. Residential and institutional buildings greater than four stories must have a full NFPA 13 system. Detailing the differences in these two types of systems is beyond the scope of this article, however, it should be recognized that full NFPA 13 systems typically cost more than NFPA 13R installations. The increased cost should be considered in light of the potential TOC savings resulting from the way these systems are valued by the building code.

When a NFPA 13R system is provided, the allowable building height can be increased by one story (up to a maximum of four), but no additional increase in building area is permitted. However, when the choice is made to provide a full NFPA 13 system, the height can be increased by one story and the basic allowable area can be tripled for a multistory building (or quadrupled for a single-story building). These area increases for sprinklers can be added to the area increase for perimeter separation.

The percentage increases for sprinklers and separation apply equally for all TOCs. However, since the area increases are based on a percentage of a basic area permitted by the code, the differentiation between wood-framed construction and steel-framed construction can be substantial. **Table 3** compares the allowable heights and areas for Type IIA (one-hour rated steel) and Type VA (one-hour rated wood) residential construction.

Table 3 illustrates several opportunities for steel framing. First, note that for comparable conditions of separation and sprinkler selection, the allowable floor areas for steel construction are approximately double what is permitted for wood. For example, a three-story hotel with full separation and a NFPA 13R sprinkler system could have as much as 42,000 square feet per floor in a steel framed building as compared to 21,000 square feet per floor in a wood structure.

Table 3: Wood vs. Steel Comparison R-1, R-2, R-4
Allowable Area Per Floor* (square feet)

Number of Stories	Type IIA (Steel)			Type VA (Wood)		
	No Separation-NFPA 13R	Full Separation-NFPA 13R	Full Separation-NFPA 13	No Separation-NFPA 13R	Full Separation-NFPA 13R	Full Separation-NFPA 13
1	24,000	42,000	114,000	12,000	21,000	57,000
2	24,000	42,000	90,000	12,000	21,000	45,000
3	24,000	42,000	90,000	12,000	21,000	45,000
4	24,000	42,000	67,500	12,000	21,000	33,750
5	NP	NP	54,000	NP	NP	NP

*- Assuming floors of equal areas. NP=Not permitted

Secondly, note the considerable area advantages provided by a NFPA 13 sprinkler system. The same three-story steel-framed hotel that would be permitted to have 42,000 square feet per floor in the previous example could have as much as 90,000 square feet per floor if the sprinkler system were upgraded to a full NFPA 13 system. Thirdly, this table points out that for five-story R-1, R-2 and R-4 applications, Type IIA construction (with a full NFPA 13 sprinkler system) is an acceptable alternative while Type VA construction is not permitted by the code.

Steel vs. Wood

Table 4 details similar advantages by comparing the code allowable values for steel and wood construction of I-1 facilities (large assisted living facilities). Once again, the floor areas for steel are approximately double what are allowed for wood, and five-story facilities are a permitted alternative for Type IIA construction (with a full NFPA 13 sprinkler system) but not for Type VA.

Table 4: Wood vs. Steel Comparison I-1
Allowable Area Per Floor* (square feet)

Number of Stories	Type IIA (Steel)			Type VA (Wood)		
	No Separation-NFPA 13R	Full Separation-NFPA 13R	Full Separation-NFPA 13	No Separation-NFPA 13R	Full Separation-NFPA 13R	Full Separation-NFPA 13
1	19,000	33,250	90,250	10,500	18,375	49,875
2	19,000	33,250	71,250	10,500	18,375	39,375
3	19,000	33,250	71,250	10,500	18,375	39,375
4	19,000	33,250	53,438	NP	NP	29,531
5	NP	NP	42,750	NP	NP	NP

*- Assuming floors of equal areas. NP=Not permitted

Tables 5 and 6 provide similar area and height comparisons for I-2 and I-4 occupancies. Since NFPA 13R systems are not an option for these use groups, these tables only show values for NFPA 13 systems with full separation. Note that in addition to the increased area values recognized for Type IIA construction, the code permits Type IIA construction to have a two-story advantage over Type VA in these use groups.

Table 5: Wood vs. Steel Comparison I-2
Allowable Area Per Floor* (square feet)

Number of Stories	Type IIA (Steel)	Type VA (Wood)
	Full Separation- NFPA 13	Full Separation- NFPA 13
1	71,250	45,125
2	56,250	NP
3	56,250	NP

*- Assuming floors of equal areas. NP=Not permitted

Table 6: Wood vs. Steel Comparison I-4
Allowable Area Per Floor* (square feet)

Number of Stories	Type IIA (Steel)	Type VA (Wood)
	Full Separation- NFPA 13	Full Separation- NFPA 13
1	125,875	87,875
2	99,375	69,375
3	99,375	NP
4	74,531	NP

*- Assuming floors of equal areas. NP=Not permitted

In total, **Tables 3-6** illustrate that the building code provides considerable advantages for steel framing in comparison with competing building materials.

Properly leveraging the building code opportunities for steel requires attention to building location and sprinkler system selection. In addition, it is important to identify those applications where the code creates market advantages for steel framing based on allowable building area and height.

Readers may question why comparison tables similar to **Tables 3-6** have not been provided for Type IIB construction, where noncombustible framing is required but no fire resistance is provided. For most residential and institutional applications, the building code requires one-hour separation walls between dwelling or sleeping units and one-hour floor systems supporting these separation walls. Essentially, this separation requirement eliminates unrated construction (like Type IIB) from being used in multistory applications for residential occupancies. For single-story facilities, Type IIB construction remains an attractive alternative. In addition, the IBC does have some exceptions that may make the use of Type IIB viable for multistory residential buildings in the future. This subject can be best addressed in a future article.

It is not unusual for construction material choices to be made by force of habit in accordance with the status quo in a community. However, as noted earlier, the IBC represents a change from the existing codes that have previously been enforced in this country. The allowable heights and areas in these three regional codes were far from uniform and there were some distinctive regional anomalies. In creating allowable heights and area limitations for the IBC, a deliberate decision was made to preserve the least restrictive allowable height and area permitted by any of the three regional codes. Table 7 compares the allowable heights and areas for the IBC against the three previous regional codes for multifamily residential and institutional occupancies (based on full separation and NFPA 13 sprinklers).

Table 7: Type IIA Allowable Heights and Areas (NFPA 13 Sprinklers and Full Separation)

Building Code	R-1, R-2, R-4		I-1		I-2		I-4	
	Stories	Area/Floor*	Stories	Area/Floor*	Stories	Area/Floor*	Stories	Area/Floor*
SBC	5	54,000	3[1]	45,000[1]	3[1]	45,000[1]	3[1]	45,000[1]
NBC	5	48,000	4	42000	3	37,125	4	74,250
UBC	4	27,000	2	27,200	1	40,800	2	80,250
IBC	5	54,000	4	42,375	3	56,250	4	71,530

*- Area per floor assuming equal floors. NP- Not permitted.
[1] The SBC occupancy classifications for these use groups did not correlate well with the IBC categories.

Table 7 illustrates that by preserving the least restrictive heights and areas permitted by the regional codes, the IBC significantly changed the limitations in regions that had more conservative values. For example, for Type IIA hotels, the Standard Building Code had previously allowed five stories and 54,000 square feet per floor. The IBC retained that allowance, however, when the IBC is adopted by western states that had previously used the UBC, the IBC values will represent a significant increase in allowable area along with an additional one-story increase in height. For northeastern areas that had previously used the NBC, the change to IBC values provides only a marginal increase in area with no additional height advantage for this use group. As a general rule, for IIA residential and institutional construction, the most significant change in the status quo will occur in areas that had previously used the UBC.

Taking advantage of the new opportunities for steel framing necessitates an awareness of how the IBC provisions differ from the status quo construction practices in various regions of the country.

Robert Wills is regional director for the American Iron & Steel Institute.

MHD

Be Code Savvy

• Take advantage of steel's inherent noncombustibility by carefully selecting materials that will permit a structure to be classified as Type II construction.

• Leverage the building code's height and area opportunities for steel framing through careful attention to building location and sprinkler system selection.

• Identify those applications where the code creates height and area market advantages for steel framing in comparison to competing materials.

• Discover the specific applications where the IBC provides new opportunities for steel framing in comparison with the previously adopted regional code.

From The Forum

Tank On A Hot Tin Roof

We want to build a flat-roof steel-stud home. We will be putting a 500-gallon water storage tank on top. Any comments?

Placing a heavy load on top of the structure creates some interesting structural situations, no matter what the structural material may be. A water tank of that size will weigh over 4,000 pounds, and the design of the supporting structure will depend largely on the location and shape of the water tank.

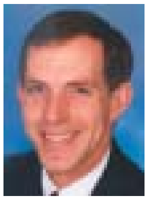
The design has to be for the worst-case condition: a fully loaded tank, in combination with some other possible roof loads. Depending on where in the country your proposed structure will be built, you may have to design for some or all of the following: live and dead loads, wind loads, earthquake loads and snow loads.

A particular serviceability issue that needs special attention on a flat roof is ponding. Ponding is the situation that occurs when either deflection of the roof members or blockage of the primary drainage system causes water or other precipitation to collect on the roof. Added ponding load causes members to deflect more, leading to more buildup of water load at the center of the span. This situation causes the collapse of several roofs every year in North America, and designers are keenly aware of the problems. Having a large water tank on a flat roof can exacerbate the problem, so proper detailing must be performed to ensure that even when the water tank is full that all roof members have sufficient slope to properly drain rainfall or other precipitation.

Seismic design is also very important when tanks or elevated pools are designed. The imparted seismic energy can set up waves in the liquid in the tank, and depending on the frequency of the seismic waves and their relationship to the natural frequency of the liquid, considerable lateral loads can develop. The roof diaphragm must be able to transmit these loads to the walls or other lateral resisting elements of the structure.

As for the basic roof rafter design, the configuration of the tank and its support are very important. If the tank is resting directly on the roof, the load on the rafters is directly proportional to the shape of the tank. A flat-bottomed tank can load the rafters directly. A wide, short tank will provide a more uniform load distribution both along a member and to adjacent members, as opposed to a tall, slender tank. A tank supported on posts or "legs" will not have a uniform load distribution at all, but will require supports for each of the individual legs in their worst case (fully loaded) condition. Either way, typical span tables do not cover this type of loading, and this is not a common configuration shown in the building code tabulated values. Therefore the capacities for the rafters and supporting members must be calculated, using the appropriate adopted version of the American Iron and Steel Institute's Specification for the Design of Cold-Formed Steel Structural Members, or the North American Specification for the Design of Cold-Formed Steel Structural Members. Check with your local building code to see what design standard is required. Also, many of the steel processing companies provide technical services to their customers; they may be able to help you with your member selection and design. This may or may not be a free service, depending on the scope of the information you need, and the amount of product you purchase.

Don Allen, P. E.
Steel Framing Alliance
director of
engineering development



ASK YOUR QUESTION ON THE FORUM!
LOG ON AT www.steelframingalliance.com.

RESEARCH

OFFSET LOADING & FLOOR JOIST STRENGTH

BY STEVEN R. FOX PHD, P.ENG

A RECENT STUDY COMMISSIONED BY THE STEEL FRAMING ALLIANCE HAS PROVIDED IMPORTANT DATA THAT HAS LED TO FURTHER REFINEMENT OF AISI *GENERAL PROVISIONS*. THE STUDY, CONDUCTED AT THE UNIVERSITY OF WATERLOO, CONCLUDED CHANGES WERE NECESSARY IN CURRENT ALLOWABLE OFFSET IN IN-LINE FRAMING, WHICH CREATES THE POSSIBILITY FOR MISALIGNMENT IN THE LOAD PATH AND COULD COMPROMISE THE STRENGTH OF TYPICAL FLOORS.

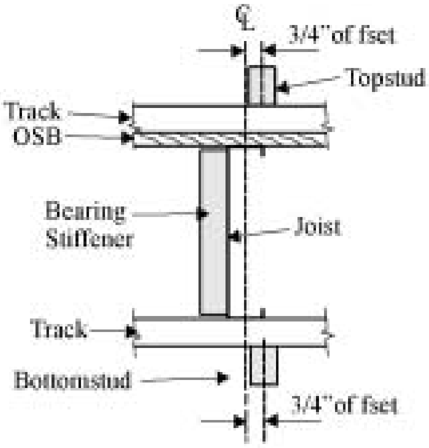


Figure 1: Alignment offset limits allowed in the AISI Standards

As currently defined, offset is the spacing that may occur between the centerline (mid-width) of the joist, rafter, truss and structural wall stud and load-bearing members beneath. AISI's *Standard for Cold-Formed Steel Framing – General Provisions* says that spacing may be up to 3/4 inch (19 mm). The study, which carried out 110 end- and interior-two-flange loading tests of various floor joist assemblies, determined that this amount of offset creates the possibility for a misalignment in the load path from an upper-story load-bearing stud wall, through a joist with a bearing stiffener and onto a load-bearing stud or foundation wall below when the joist bearing stiffener is attached to the back-side of the joist.

The study further concluded that the ¾-inch offset could cause a reduction in the strength of the assembly com-

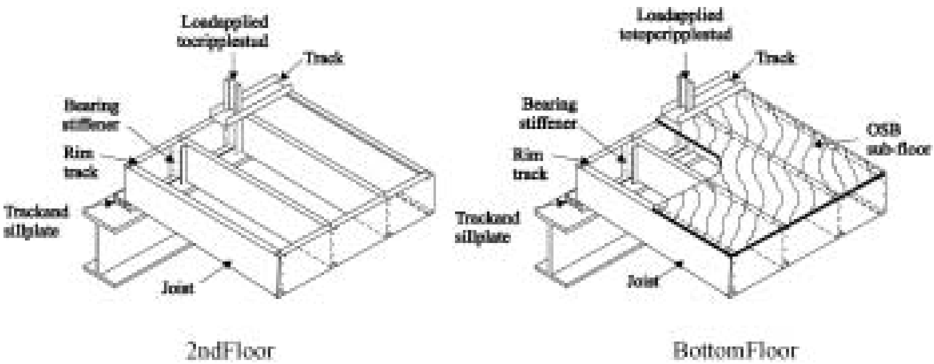


Figure 2: Sketch of test set-up and specimens

TEAM AIDS TECHNICAL ADVANCEMENTS IN COLD-FORMED STEEL

BY MARK NOWAK

IF YOU ASKED A FARMER IN THE EARLY 1880S WHAT HE WOULD WANT TO MAKE HIS LIFE EASIER, HE WOULD HAVE LIKELY REPLIED THAT HE COULD USE A HORSE THAT WAS FASTER AND STRONGER, AND ATE LESS. HE WOULD NOT HAVE THOUGHT TO ASK FOR A TRACTOR.

This statement of unknown origin was used at a technology strategy session a few years ago to illustrate how we need to think outside the box. This is the type of creative thinking the Steel Framing Alliance hopes to bring to the development of steel framing.

The Alliance's Technology Team is pushing the envelope by bringing together builders, framers, manufacturers and others to identify issues and opportunities, then develop solutions. One of its objectives is to continually improve steel framing in terms of its competitiveness at all stages of the process—from the manufacturing through construction and performance. Studies supported by the team are designed to deliver results for practical application in the industry, with a particular emphasis on improving the efficiency of steel framing from the perspective of the builder, trade contractors, and the home buyer.

Three important research projects that have evolved from the team's activities are as follows.

Fire and Acoustic—Residential: One of the more significant issues brought to the team's attention by Alliance members is the unique problems faced when constructing town houses and

OFFSET LOADING
...CONTINUED FROM PAGE 29

pared to the in-line loading, and at a capacity lower than what would be predicted for a joist with a bearing stiffener alone. In addition, deformation (up to 1 inch) can be associated with the failure of assemblies with the ¾-inch offset loading.

Something Amiss

The University of Waterloo initiated the research project to investigate the behavior of cold-formed steel floor assemblies subjected to variations in the alignment of joist, rafter, truss and structural wall stud components.

It investigated details in the *AISI Standard for Cold-Formed Steel Framing – Prescriptive Method for One and Two Family Dwellings* (AISI 2001b), and the ¾-inch allowable offset, which suggested the possibility for a sizable misalignment. One such alignment path is illustrated in **Figure 1**.

Preliminary tests on floor joist assemblies revealed that there could be a reduction in the strength of the assembly with such an offset load path. Based on these findings, researchers decided a more extensive investigation of these assemblies was needed to determine the actual behavior and to define more appropriate alignment rules as needed.

Proving It

The test assemblies were constructed to model actual floor assemblies following the AISI *Prescriptive Method* (AISI 2001b). Each specimen consisted of four floor joist pieces and was 4 feet square. The drawings in **Figure 2** show the test specimens for the second-floor and bottom-floor conditions. The second-floor tests investigated the bearing of the joist on the lower load-bearing wall stud, so the test assembly as shown in **Figure 2** is inverted from what would be the actual construction. The bottom floor specimens simulated a floor joist assembly resting on a continuous bearing wall. Tests were also carried out where the load was applied at the mid-span of the joist to simulate a continuous member over an interior support.

The following are the range of variables investigated in the experimental program:

- Joist depth (8, 10 and 12 inches).
- Joist thickness (0.037 to 0.097 inches).
- Rim track thickness (0.047 to 0.071 inches).
- Wall stud and track sizes (3-5/8 and 6 inches).
- Wall track thickness (0.033 to 0.075 inches).
- Bearing stiffener type (stud and track).
- Bearing stiffener thickness (0.033 to 0.047 inches).
- In-line and ¾-inch offset loading.
- Sub-floor (19/32 OSB).
- Joist bearing width (1-1/2 and 3-5/8 inches).
- Bearing condition (joist bearing on a foundation wall, a continuous joist on an interior load-bearing stud wall, and a joist bearing on a second floor exterior stud wall).

The Results

Failure Modes

There were two basic failure modes: excessive deformation and bearing stiffener failure. The failures accompanied by excessive deformation (up to 1 inch) were usually those assemblies that had the applied load offset from the centerline of the joist, with a thin wall track and without a sub-floor. When excessive deformation was not the primary cause of failure, the assembly was stiff enough that the load was transferred through the bearing stiffener, which eventually would fail in some form of local buckling.

Another type of failure occurred in some of the tests that included a subfloor under the wall track. This mode was punch-through of the sub-floor prior to failure of the bearing stiffener

TEAM AIDS TECHNICAL ADVANCEMENTS...
CONTINUED FROM PAGE 29

other residential buildings that require fire walls between units. There are very few practical assemblies that can meet both the fire and structural requirements. As part of this project, fire tests were conducted and U.L. listings obtained on three load-bearing double-wall steel-stud assemblies. A final report, "Residential Steel Framing—Builder's Guide to Fire and Acoustic Details," is nearly complete and will be published soon. The guide will be useful in assisting designers and framers, and in obtaining code approval.

Load-Bearing Top Track: In-line framing is nearly always mandatory with cold-formed steel framing due to the inability of the typical top track to carry any significant load. Although the industry has developed details and other methods to facilitate in-line framing, this technique places a restriction on steel that most other materials do not have to address. The objective of this project is to provide details and span-load tables for new load-bearing top-track options to the *AISI Prescriptive Method Standard*, including a deep-leg steel track and a steel track with 2x wood top plate options. Investigators will also look at other methods to increase the track's load carrying capacity such as use of 50ksi steel and determining the contribution to strength from the composite action of various members in each assembly. As the results of this project are introduced into the prescriptive methods and building codes, another level of flexibility will be added to steel framing, making life easier for designers, builders and the trades.

Gable End Walls: The AISI *Standard for Cold-Formed Steel Framing—Prescriptive Method for One- and Two-Family Dwellings* addresses a wide variety of building configurations, sizes and shapes, but it is not 100 percent comprehensive. In many cases, a conservative design is used while in others a special, or engineered design, would be

OFFSET LOADING
...CONTINUED FROM PAGE 30

or excessive deformation. This punch-through type of failure only occurred when the load was offset from the joist and the track was thin (i.e., 33 mil).

The tests revealed and the report presents preliminary conclusions on the effects of wall track thickness, offset dimension, interior versus end loading condition, joist web depth and type of subfloor.

Predicted capacity

The AISI Committee on Specifications has accepted (July 2003) a ballot that would add design provisions for calculating the capacity of floor joists with stud and track type bearing stiffeners. Test results were compared to the strength predictor equation for the two-flange loading of C-section members with stud or track bearing stiffeners. These test-to-predicted ratios provided a type of normalized basis for comparing different assemblies. Depending on the size of the components in the assembly, there are some configurations with a ¾-inch offset that have a tested strength less than would be predicted by the NA Specification (AISI 2001c) for the stiffened joist alone.

Conclusions and Recommendations

Based on the results and conclusions, the researchers recommended a change to the wording of the AISI *General Provisions* calling to limit the ¾-inch offset in those assemblies where the bearing stiffener is attached to the back of the joist. In this case, the framing should not be allowed to be offset from the centerline of the joist towards to the joist flange lips. If the bearing stiffener is attached between the joist flanges, the current ¾-inch offset limits would be satisfactory.

As a result of this work, a change to the *AISI General Provisions* was successfully balloted through the Committee on Framing Standards. The 2004 Edition of this standard, to be released later this year, will reflect this significant change.

Acknowledgment

The American Iron and Steel Institute must be acknowledged for financially supporting this project, and the AISI Committee on Framing Standards for its input and guidance.

The complete report, "The Strength of Stiffened CFS Floor Joist Assemblies with Offset Loading," is available for download at www.steelframingalliance.com.

REFERENCES

1. **AISI (2001a).** Standard for Cold-Formed Steel Framing – General Provisions. American Iron and Steel Institute, Washington, D.C.

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3. **AISI (2001c).** North American Specification for the Design of Cold-Formed Steel Structural Members. American Iron and Steel Institute, Washington, D.C., USA.

4. **Black, C., Froese, W., Ready, P., and Fox, S.R., (2002).** Strength of Floor Joists With Offset Loading on Bearing Stiffeners, Canadian Cold Formed Steel Research Group report, University of Waterloo, Waterloo, Ontario.

5. **Fox, S.R., (2003).** The Strength of Stiffened CFS Floor Joist Assemblies with Offset Loading, American Iron and Steel Institute, Washington, D.C.

MHD

Have Issues with Steel?

The Steel Framing Alliance Technology Team is interested in identifying barriers to the use of cold-formed steel framing.

Please use the form on the adjecent page to identify issues you perceive or encounter as a barrier to using cold-formed steel framing in building construction. Or simply use the form as guidance for outlining your ideas, and contact

Mark Nowak at marknowak@newportpartnersllc.com or (301) 889-0017, or Jay Larson at JLarson@steel.org or (610) 691-6334.

TEAM AIDS TECHNICAL ADVANCEMENTS...
CONTINUED FROM PAGE 30

necessary. Gable end walls are a good example. This project scope will include development of text, member selection tables and detail drawings for framing gable end. When complete, the results will allow builders to construct homes with more efficient gable end walls that do not carry the same loads as other exterior walls, and it will provide solutions for walls supporting cathedral ceilings and other configurations that currently require a special design because the height of the wall exceeds the current scope of the prescriptive methods.

These are just a few examples of the activities of the Technology Team at the Steel Framing Alliance. As members of the team, we will continue to seek broad industry input into the technical marketplace needs. We are fortunate to have strong working partnerships with testing facilities, universities (as demonstrated in the accompanying story) and steel-industry associations, and commission these esteemed groups to conduct much of our research. You can play a role in shaping the future of steel framing by contributing your ideas to a member of the Technology Team or by joining us in team meetings. Another way to get us information on your needs is to submit a **Barrier Survey Form** (see sidebar), available from the Alliance staff or on the Web site at www.steelframingalliance.org.

Watch Framework for updates on the progress of these and other studies.

Mark Nowak is the recently appointed leader of Steel Framing Alliance's Technology Team. A senior member of the Newport PartnerLLC, Nowak has spent 20 years in housing and building technology research, including performing research on steel framing and other innovative structural materials. He was one of the people behind the development of the original Prescriptive Method in the 1990s. Nowak is based in Davidsonville, Md.

MHD

Technology Team – Barrier Survey Form

The Steel Framing Alliance Technology Team is interested in identifying barriers to the use of cold-formed steel framing. Please use this form identify the issue you perceive or encountered as a barrier to using cold-formed steel framing in building construction.

1. Barrier: (describe the technical issue): ______________________________

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2. Building element affected: (check all that apply)

❑ Roof Framing	❑ Wall Framing	❑ Floor Framing

❑ Other (describe): ______________________________

3. Market segment affected: (check all that apply)

Residential:	❑ 1-2 Family	❑ Multi-Family
Commercial:	❑ Retail	❑ Office/Bank
	❑ Food Service	❑ Hotel/Motel
Institutional:	❑ Dormitory	❑ Healthcare
	❑ Education	❑ Assisted Living

❑ Other (describe): ______________________________

4. Region affected (states, provinces, etc.): ______________________________

____

5. Influencer affected: (check all that apply)

❑ architect	❑ code official	❑ framer
❑ spec. writer	❑ owner	❑ subcontractor
❑ engineer	❑ builder	❑

❑ other: ______________________________

6. Impact (describe the impact this barrier has on project; e.g., material, labor cost, availability, compliance, etc.): ______________________________

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7. Circumstances that made you aware of this issue: ______________________________

____

____

8. Contact information: Date: ______________

Name: ______________ Company: ______________

Address: ______________________________

Phone: ______________ Fax: ______________ E-mail: ______________

EDUCATION

FASTENERS 102

BY MARIBETH RIZZUTO

AS OUTLINED IN THE LAST ISSUE'S FASTENERS 101 STORY, SELECTING THE RIGHT FASTENER TO GET THE JOB DONE MAKES ALL THE DIFFERENCE ON A CONSTRUCTION PROJECT.

It is no secret that builders and contractors that have been involved in cold-formed steel projects have developed their own personal preferences. The purpose of this article is to provide newcomers to cold-formed steel construction with an overview of methods that are available today and some resources to explore. It is by no means a complete list of all options available. However, it does touch upon some of the most common methods and some places to start your search.

The ultimate selection of the right tool, fastener, and even the steel studs you use on your next project is a decision that only you can make after doing your homework. Manufacturers of products used in construction are more than willing to provide evaluation reports and references to help you make informed decisions. That said, let's take that promised look at pins, clinching and welds this time around.

PINS

Pins

Just as pneumatics have played an important role in wood construction over the years, the use of pneumatics for attaching a whole spectrum of materials to cold-formed steel now provides the same benefits of increased productivity at the job site. From commercial to residential projects, builders are employing these systems to attach gypsum board, OSB, plywood, stucco substrates, and even steel to steel.

Pins

The driving system and the pin work in concert to provide the appropriate connection. Most have ballistic points and are made of hardened steel. Pins are designed with specific knurls or grooves along the shank. While the grooves help to pull the material tight, pressure must be applied to the material being installed to ensure the proper fastening. For wall sheathing installations, some framers will secure the perimeter of the sheathing with screws and use the pins in the field. Others simply tack the sheathing in place until the pins are installed.

Pin Fastening Systems

Pin Fastening Systems

EDUCATION, TRAINING & MORE TRAINING

EDUCATION AND TRAINING OF BUILDERS, CODE OFFICIALS, DESIGN PROFESSIONALS, FRAMERS AND EDUCATORS IS ONE OF THE MOST SIGNIFICANT CHALLENGES FOR THE STEEL-FRAMING INDUSTRY. RECOGNIZING THAT COLD-FORMED STEEL FRAMING IS IN ITS INFANCY THE TASKS TO COMPLETE CAN BE DAUNTING. OUR MISSION IS TO ENABLE THE MARKETPLACE, TO GROW THE NUMBER OF KNOWLEDGEABLE PRACTITIONERS SO THAT COLD-FORMED STEEL CAN BE IN THE RUNNING FOR PROJECTS.

The Alliance receives daily inquiries from parties interested in learning more about steel in residential and commercial construction, finding just the right resource for the caller can sometimes be difficult. However, resources do exist for each phase of the construction industry.

By way of review, the Steel Framing Alliance with its industry partners have trained more than 8,500 code officials, conducted more than 105 live seminars, some with hands-on training, and developed a library of publications addressing the most current industry standards, details and methods of construction. Alliance outreach has been to construction organizations including the National Association of Home Builders, American Institute of Architects, International Code Council, Association of Walls and Ceilings, and has developed, in most cases into strong partnerships.

To meet the current demand the Alliance, with the support of its affiliated local Alliances, has prepared seminars that are conducted across the country and in Canada. The Alliance is a Continuing Education Service Provider with AIA and has gained the approval from many statewide building code officials' organizations so that participants can earn learning units and continuing education credits. Investment in the workforce of tomorrow through our relationships with SkillsUSA and Associated Builders and Contractors has broadened our outreach activities to include state education vocational departments.

This article is the first of a series to address the education and training opportunities available for each area of the construction arena.

Builders, Contractors and Framers

Are you a seasoned veteran of the construction industry, looking for innovative methods to improve your operations? Cold-formed steel may be your ticket to setting yourself apart from the pack, through its durability, strength, stability and environmental attributes. OK, so you don't want to throw all your eggs in one basket—then you can start with one application at a time. Steel interior walls and floor systems are increasingly being used in concert with other construction materials with great success.

EDUCATION, TRAINING & MORE... CONTINUED TO PAGE 36

For pin fastening products, visit these Web sites:

www.ITWbuildex.com
www.Senco.com
www.etf-fastening.com
www.aerosmithfastening.com

For sub-flooring installations, some manufacturers may recommend the use of an adhesive along with the pins. Using the right adhesive and installing the pins prior to drying will avoid the potential for floor squeaks. Regardless of the installation type, following the manufacturers' installation instructions is key. Some of the latest advancements in pin fastening systems include cordless tools such as GypFast, available from ITW Buildex. See the sidebar at right for Web sites that provide other fastening options.

Clinches

Clinching is a process that press-joins pieces of steel together. The system uses a pneumatic tool without the use of screws or pins. It has been used for years in the automotive and appliance industries and is gaining popularity in construction applications.

Clinching Tools

Clinching is a fast and consistent process with no chance of stripped threads or back-out. While found primarily in controlled panelization shop environments, some mobile systems have been developed. Evaluation and testing reports are available from manufacturers verifying the strength of the connec-

Clinching Profile

tion. Visit attexor.com for some additional information.

Welds

As with all fastener systems specific requirements need to be followed in order to achieve the appropriate connection. If welds are used, the

Welds

Structural Welding Code: AWS-Section D1.3 provides the necessary guidance. Today it is common to find welding employed in shop and field applications where repetitive members are built such as headers. It is common to find welds on steel material as thin as 43 mil (18 gauge). During the welding process, the corrosion protection coating on the steel material is burned off and requires touch up with zinc-enriched paint. Welding may also require the employ of certified welders.

Welding is a much more permanent fastening than all other systems discussed to date. Careful alignment and organization are vital for this type of fastening. Additional information and welding education can be found at the American Welding Society site www.aws.org.

There are many options available for fastening cold-formed steel. The task is to review your options and select the methods most conducive for your needs.

Maribeth Rizzuto is director of training and education for the Steel Framing Alliance.

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SkillsUSA and SFA

It has been five years since Steel Framing Alliance began sponsoring Skills- University. Held annually as part of the SkillsUSA National Leadership and Skills Conference, SkillsUniversity is a free series of educational seminars featuring the latest trends, new technology and the best career opportunities. And it's one of the best ways we're training new framers for the field.

SkillsUSA represents America's upcoming workers and leaders. It is a national organization serving more than 260,000 high school and college students, as well as professional members who are enrolled in training programs for technical, skilled and service occupations. Nearly a quarter million student members are organized into 13,000 chapters and 54 state and territorial associations (including the District of Columbia, Puerto Rico, Guam and the Virgin Islands). Taking great pride in the dignity of work, SkillsUSA-VICA prepares America's high-performance workers, providing quality education experiences for students in leadership, teamwork, citizenship and character development.

In addition to being the sole corporate sponsor of SkillsUniversity the Alliance has been an active participant on the SkillsUSA Technical Team for the SkillsUSA Championships Carpentry Competition, providing technical support in the design and coordination for each year's event. Every year the Carpentry contestants have been challenged by a new application of cold-formed steel in their overall project. This year's event, held in Kansas City, Mo., saw the addition of a structural steel wall including a box beam header. The students mastered the project like real pros!

The Alliance's participation has grown to include the TeamWorks Competition, in which teams of four build a joint project, demonstrating their preparation for employment in residential construction. They demonstrate their ability to work as a team performing skills in residential carpentry, plumbing, electricity and masonry.

Continuing support of Alliance members IRWIN Industrial Tools, Grabber Construction Products, Dietrich Industries and DeWalt Industrial Tools through product donations and technical assistance has made the Alliance work possible.

Through participation of Steel Framing Alliance and its members, instructors and students throughout the country are recognizing that steel framing is a technology that is becoming part of the mainstream in construction projects. And they are serious about knowing the latest skills for the workplace.

—Maribeth Rizzuto

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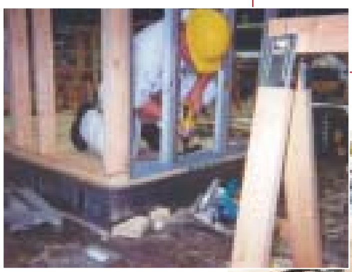
Maribeth Rizzuto is a member of the SkillsUSA Technical Committee—Carpentry. For more information about SkillsUSA or other Steel Framing Alliance education programs, contact her at msrizzuto@aol.com or (412) 521-5210.



EDUCATION, TRAINING & MORE...
CONTINUED FROM PAGE 35

Details on the way to connect to two materials are contained in the following documents:

Hybrid Wood and Steel Details—A Builders Guide—July 2003. Housing and Urban Development and the Alliance commissioned the NAHB Research Center to develop a comprehensive list of connection details, making hybrid homes more economical and affordable for builders and framers to construct. It reviews the characteristics of each material, necessary tools, fasteners and sections on everything from connecting wood sheathing to steel and steel members to wood, with all of the details. The best part is it can be downloaded free at www.huduser.org.

Another free resource at www.huduser.org is:

Prescriptive Method for Connecting Cold-Formed Steel Framing to Insulated Concrete Walls in Residential Construction—February 2003. Prepared by Building Works Inc. for HUD, the Alliance, The Portland Cement Association and The Insulating Concrete Form Association, this document reviews the materials, fasteners, construction methods and details for connecting steel to insulated-concrete-formed walls.

Already sold on cold-formed steel but need a little help to learn the latest requirements for the building codes? Your resource library should include the following documents:

The Standard for Cold-Formed Steel Framing – Prescriptive Method for One and Two Family Dwellings—2001. Developed by the American Iron and Steel Institute and endorsed by the Alliance, this publication and its companions, including **General Provisions, Header Design Standard and Truss Design Standard**, are the primary documents used for the cold-formed steel chapters in the International Residential Code. While much of the content has been rolled into the Code many of the details like the L-Header, are only referenced. You'll find them at www.steel.org.

Steel-Frame House Construction, Tim Waite – 2000. From the Craftsman Book Co., www.craftsman.book.com, is a ready resource in 22 chapters for those self-taught learners.

Lighten Up

What's available for the light-commercial construction industry, you ask? Want to go beyond partition and curtain walls? There are resources for you, as well!

Steel Stud Manufacturers Association—Product Technical Information document outlines identification of how steel products, load and span tables, information on screws and welds, and typical details. Like the publications from HUD, this manual can be downloaded for free from www.ssma.com.

Commercial Metal Stud Framing—Ray Clark, 1999. Another book from the Craftsman Book Co., this publication covers everything from partition walls to parapet walls, soffits and reading blueprints, too! All is covered in 13 easy-to-digest chapters.

For you commercial (and in some circumstances residential) folks, you will also need to tap into some of the more seasoned veterans in the design community. A good resource would be the members of the Light Gauge Steel Engineers Association. Visit www.lgsea.com and do a search for a design professional near you.

Hands On

For those of you that want to get trained up close and personal, the Alliance, in partnership with PSMJ Resources Inc., developed **Stud University**. It's an intensive 16-hour program combining both classroom and hands-on training designed by some of

the experts in the industry, including steel builders that continue in the trenches today! To see the upcoming offerings, visit www.METALCON.com.

In closing, if you haven't found what you need or simply don't know what you need, contact me at msrizzuto@aol.com for assistance.

Until next issue ....

—Maribeth Rizzuto

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