Revisions Due in Specification for Cold-Formed Steel Structural Members

Will Affect Lightweight Steel Framing Usage

Introduction: This article, the eighth in the Foundation’s series on lightweight steel framing systems, was prepared by the Steel Products News Bureau (420 Lexington Avenue, New York, New York) based on information gathered from the American Iron and Steel Institute.

Structural engineers, architects, specifiers and contractors who employ the studs and joists of lightweight steel framing in building construction or renovation should be aware of upcoming revisions in the specifications.

Changes have been proposed in the current (1986) edition of the American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members. This Specification covers framing members cold formed from carbon or low-alloy steel sheet, strip and plate, a process performed on press-brake or roll-forming machines. When adopted by all major building codes, the Specification’s revisions will lead to improvements in designing and specifying lightweight steel framing members.

A growing segment of structural steel usage, lightweight steel framing (hereafter called LWSF) is used for interior partitions, floor joists, and curtain walls that carry the exterior finish of the building. Steel stud load-bearing walls have also been employed in buildings from a single floor to five stories high. Among the advantages responsible for LWSF’s popularity are these: close dimensional tolerances; high strength-to-weight ratio; durability; non-combustibility; speed of erection; and panelized shipment of complete wall systems.

Proposed Revisions

Because of LWSF’s increasing importance, those who formulate the AISI Specification are determined to keep it up to date technologically and responsive to the needs of LWSF users.

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Accordingly, proposed revisions reflect the findings of continuing research on the behavior of cold-formed steels. They also seek to simplify the Specification’s organization and content. The following are a few of the recommended revisions.

1. Shaped Web Openings. LWSF is manufactured with regularly-spaced holes in the webs of studs, joists and rafters. These serve as raceways for electrical wiring and plumbing lines as well as for snap-in bracing members. Electricians and plumbers don’t have to drill or cut openings, thereby minimizing construction time, cost and the possibility of damage to the LWSF members. Previous versions of the Specification dealt only with circular holes whereas, increasingly, holes of a variety of configurations are being used—ovals, keystones, rectangles, etc. Manufacturers of the cold-formed steel framing have already conducted extensive tests to determine sectional strengths of members with such web holes.

Now, the Specification must arrive at a formula to accurately calculate the effective cross-sectional area and, thus, the load-carrying capacity of members with these varied openings. Code authorities have been insistent on this point. A task force has been formed to accomplish it, with load testing and analyses already done. The work is expected to be finalized in a future revision to the Specification.

2. Through-Fastened Flanges. For beams having the tension flange attached to deck or sheathing and the compression flange unbraced—a roof purlin or wall girt subjected to wind suction—the bending capacity is less than a fully-braced member, but greater
than an unbraced member. This partial restraint is a function of the rotational stiffness provided by the panel-to-purlin connection, primarily a function of the LWSF member thickness, sheet thickness, fastener type and fastener location. To ensure adequate rotational stiffness of the roof and wall systems, the Specification revision provides a formula to calculate strength, instead of having to run costly tests. It also explicitly states the acceptable panel and fastener types.

3. Applicable Steels. The Specification requires the use of steel of structural quality, such as those defined by specifications of the American Society for Testing and Materials (ASTM). Although 14 such steels are listed, the three most used for LWSF members are: A446/A446M (Grades A, B, C, D and F), zinc-coated (galvanized) by the hot-dip process; A570/A570M, a hot-rolled carbon steel; and A792, aluminum-zinc alloy-coated by the hot-dip process. Others include high strength/low alloy steels and steels with improved formability or improved atmospheric corrosion resistance.

4. Diaphragm Construction. Steel deck, when properly attached to a structural frame, becomes a diaphragm capable of resisting in-plane shear forces. The Specification revisions will permit the in-plane structural performance (load-carrying capacity) of floor, roof or wall steel diaphragm construction to be established by a given calculation formula or by test.

The factors of safety required are based on statistical studies from full-scale tests. For example, the studies concluded that the quality of mechanical connectors is easier to control than welded connections, and the variation in the strength of mechanical connectors is smaller than for welded corrections. Thus, their performance is more predictable and a smaller factor of safety is justified. The factors of safety for earthquake loading are slightly larger than those for wind, due to seismic ductility demands.

5. Wall Stud Strength. With the revisions, the safe load-carrying capacity of a stud may be computed on the shell alone (without sheathing) or on the basis that sheathing (attached to one or both sides of the stud) furnishes adequate lateral and rotational support to the stud in the plane of the wall.

Both ends of the stud must be braced to restrain rotation about the longitudinal stud axis and horizontal displacement perpendicular to the stud axis. The sheathing shall be connected to the top and bottom members of the wall assembly to enhance the restraint provided to the stud and stabilize the overall assembly. When sheathing is utilized for stability of the wall studs, it shall retain adequate strength and stiffness for the expected service life of the wall. Additional bracing shall be provided, as required, for adequate structural integrity during construction and in the completed structure.

6. Lateral Buckling Strength. Determining the nominal moment strength of laterally-unbraced segments of flexural members has been restructured. Application of the equations for singly-, doubly- and point-symmetric sections has been clarified.

7. Bibliography. In its bibliography, the commentary on the Specification adds a total of 15 technical articles on the subject, ranging from “The Structural Performance of Cold-Formed Steel Members with Perforated Elements” and “Steel Deck Institute Diaphragm Design Manual, Second Edition” to “Developments and Future Needs in Welding Cold-Formed Steel” and “Behavior of C- and Z-Purlins Under Uplift.”

Research on cold-formed steel construction started under sponsorship of the AISI at Cornell University in 1939. In 1946, the first edition of the Specification was published. It has been revised six times, with the current version dated 1986.
The Revision Process

AISI's Advisory Group on the Specification proposes revisions, develops them on a consensus basis, and brings out a new Specification about every six years. The Advisory Group is comprised of consulting engineers, researchers, specialists from the steel industry, and designers from companies manufacturing cold-formed steel members, components and assemblies. It works through an extensive group of subcommittees such as those on corrections, channel and Z-sections, compression members, diaphragms, flexural members, materials, stud design, test procedures, and welding.

Before publishing a new Specification, revisions are disseminated to groups directly involved with cold-formed steel—architects, engineers, LWSF fabricators, building code organizations, and others—to get their reactions to proposed changes. The revisions described earlier in this article should be finalized by year-end to become part of the new Specification issued by AISI’s Committee on Construction Codes and Standards.

After that, it is presented for adoption by the major code bodies—Building Officials and Code Administrators International (BOCA), and the Southern Building Code Congress International (SBCCI). When the Specification becomes part of these codes, it is then incorporated into law upon adoption by cities, counties and states as part of their building codes.

Future Revisions

As mentioned previously, many past revisions in the Specification derived from research on cold-formed structures. Future revisions may well result from some of these ongoing research projects: strut purlins, bracing of purlins for standing seam roofs, web crippling, effects of web holes in complete wall assemblies, web penetrations in beams, X-bracing against wind load, and determination of stability in C- and Z-sections.

A Technical Center for Cold-Formed Steel Structures was established at the University of Missouri-Rolla to provide academic and industrial organizations with an integrated approach for handling design standards, engineering education, technical services, and research. For further information on the Center, contact Dr. Wei-Wen Yu, Department of Civil Engineering, University of Missouri-Rolla, Rolla, MO 65401-0249.

To obtain a copy of the upcoming new Specification, including revisions from the current edition, contact: American Iron and Steel Institute, 1133 15th St. NW, Washington, DC 20005.