Oct 26th, 12:00 AM

AISI Standards for Cold-formed Steel Framing

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Eighteenth International Specialty Conference on Cold-Formed Steel Structures
Orlando, Florida, U.S.A, October 26 & 27 , 2006

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Abstract

The Committee on Framing Standards of the American Iron and Steel Institute has continued with earnest its mission to eliminate regulatory barriers and increase the reliability and cost competitiveness of cold-formed steel framing through improved design and installation standards. Its suite of six ANSI-approved, building code adopted, 2004 edition standards was enhanced with a new *Code of Standard Practice for Cold-Formed Steel Structural Framing* in 2005 and a *Standard for Cold-Formed Steel Framing – Product Data* in 2006. Work has begun on new standards related to quality and testing. This paper provides an overview of the significant documents that have been produced by the AISI Committee on Framing Standards and describes the ongoing work of the committee.

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Introduction

The efforts of the American Iron and Steel Institute (AISI) in construction standards development began in the 1930's with the sponsorship of research at Cornell University and culminated in the first publication of the AISI *Specification* in 1946. This initial work was started because "the acceptance and the development of cold-formed steel construction in the United States faced difficulties due to the lack of an appropriate design specification. Various building codes made no provisions for cold-formed steel construction at that time" (Yu et al., 1996). AISI has continued its investments in research and development in this area and has worked towards continuous improvement of the *Specification*: the latest being a 2004 Supplement (AISI, 2004a).

In 1997, the AISI Construction Marketing Committee authorized the formation of the Committee on Framing Standards (COFS). This was done due to the "increased interest in cold-formed steel for residential and light commercial framing" and the sense that "there were a number of design issues that were not adequately addressed for this emerging market. (Bielat and Larson, 2002).

The COFS established as its mission: "To eliminate regulatory barriers and increase the reliability and cost competitiveness of cold-formed steel framing in residential and light commercial building construction through improved design and installation standards." The committee also established as its primary objective: "To

develop and maintain consensus standards for cold-formed steel framing, manufactured from carbon or low alloy flat rolled steel, that describe reliable and economical design and installation practices for compliance with building code requirements."

The COFS organized itself under the same ANSI-approved operating procedures that govern the Committee on Specifications. These procedures provide for balance between producer, user and general interest categories; voting, including the resolution of negatives; public review, interpretations and appeals. The consensus process is open and balanced. Voting on the standards is by letter ballot. AISI serves as the Secretariat.

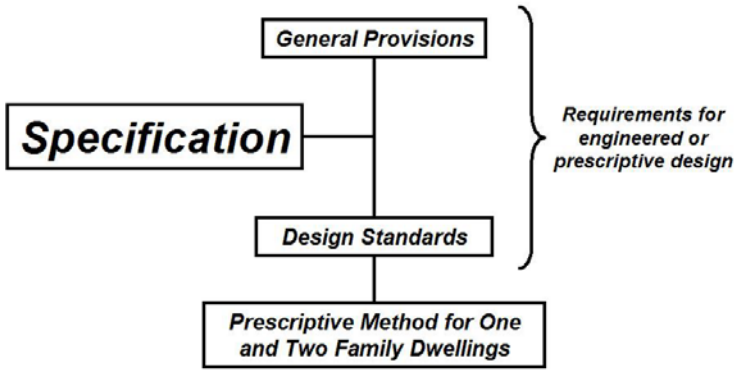

Figure 1: Standards Hierarchy

A hierarchy of documents was established, as shown in Figure 1, and a plan was developed to supplement the *Specification* with a General Provisions standard and a

series of design and installation standards, which would be used for engineered or prescriptive design. A Prescriptive Method would then be developed using these standards as the basis.

The COFS got off to a very good start. The Main Committee established subcommittees and task groups, recruited active members and initiated standards development projects. By 2001, the COFS had completed four standards for cold-formed steel framing on *General Provisions*, *Truss Design*, *Header Design*, and a *Prescriptive Method for One and Two Family Dwellings*. In 2003, a commentary on the *Prescriptive Method*, including design examples, was completed.

By the end of 2004 these initial ANSI-accredited documents were updated and new standards on *Wall Stud Design* and *Lateral Design* had been introduced. AISI was well on its way towards "effectively leveraging its experience and expertise in standards development to support the growing needs of the cold-formed steel framing industry" (Larson, 2004).

However, the mission of the COFS was anything but completed. It has continued to improve the existing standards and initiated new projects to develop an industry *Code of Standard Practice for Cold-Formed Steel Structural Framing* (AISI, 2005) and a *North American Standard for Cold-Formed Steel Framing – Product Data*.

Existing Standards

General Provisions

The *General Provisions* standard (AISI, 2004b) addresses those things that are common to prescriptive and engineered design, and applies to the design, construction and installation of structural and non-structural cold-formed steel framing members where the specified minimum base metal thickness is between 18 mils (0.0179 inches) (0.457mm) to 118 mils (0.1180 inches) (3.00mm). It provides general requirements that are not addressed in the *Specification* for material, corrosion protection, products, member design, member condition, installation, and connections.

Header Design

The *Header Design* standard (AISI, 2004c) provides general, design and installation requirements for headers made from cold-formed steel for use over door and window openings. The standard covers box and back-to-back headers, and double and single L-headers used in single-span conditions for load carrying purposes in buildings. The design methodologies are based on testing at the NAHB Research Center, the University of Missouri-Rolla and industry, and were developed under the guidance of Dr. Roger LaBoube of the University of Missouri-Rolla.

Lateral Design

The *Lateral Design* standard (AISI, 2004d) addresses the design of lateral force resisting systems to resist wind and seismic forces in a wide range of buildings constructed with cold-formed steel framing. It contains design requirements for shear walls, diagonal strap bracing (that is part of a structural wall) and diaphragms that provide lateral support to a building structure. Prior to this standard, these requirements were scattered among various building code provisions, design guides, technical notes and research reports. This document, which was developed under the guidance of Dr. Reynaud Serrette of Santa Clara University, pulls them together into one document that is recognized by the codes.

Truss Design

The *Truss Design* standard (AISI, 2004e) provides technical information and specifications on cold-formed steel truss construction, and applies to cold-formed steel trusses used for load carrying purposes in buildings. The standard is not just for design. It also applies to manufacture, quality criteria, installation and testing as they relate to the design of cold formed steel trusses. The requirements of the truss standard apply to both generic C-section trusses, as well as the various proprietary truss systems and were developed, in part, based on extensive research at the University of Missouri-Rolla.

Wall Stud Design

The *Wall Stud Design* standard (AISI, 2004f) provides technical information and specifications for designing wall studs made from cold-formed steel. It addresses certain items not presently covered by the *Specification*, including load combinations specific to wall studs, a rational approach for sheathing braced design, and methodologies to evaluate stud-to-track connections and deflection track connections.

Prescriptive Method

The *Prescriptive Method* (AISI, 2004g) provides prescriptive requirements for cold-formed steel-framed detached one- and two-family dwellings, townhouses, attached multi-family dwellings, and other attached single-family dwellings. It includes numerous tables and details to allow buildings complying with the limitations therein to be constructed. Alternatively such dwellings may be designed by a design professional.

New Documents

Code of Standard Practice

Work towards the industry *Code of Standard Practice for the Cold-Formed Steel Structural Framing Industry* (AISI, 2005) began in 2002. Developed by the COFS, reviewed by several peer committees within the industry, and already endorsed by the Association of the Walls and Ceilings industry (AWCI), Steel Framing Alliance (SFA) and Steel Stud Manufacturers Association (SSMA), this document helps define the lines of responsibility in cold-formed steel framing design and construction, which have previously been vague and unclear. It represents a significant step forward for the industry and is available as a free download from the Steel Framing Alliance website.

The *Code of Standard Practice* defines accepted norms of good practice for fabrication and installation of cold-formed steel structural framing. Among the many topics covered are general requirements, classification of materials, plans and specifications, installation drawings, materials, manufacture and delivery, installation requirements, quality control, and contractual relations. The document helps define the roles of the owner's representative, architect of record, engineer of record, specialty engineer, manufacturer, framing contractor and truss/wall panel supplier in the design and construction of cold-formed steel framed structural systems. It is loosely based on similar documents by the American Institute of Steel Construction (AISC) and Steel Joist Institute (SJI),

and was guided by documents by the Steel truss and Component Association (STCA) and the Council of American Structural Engineers (CASE).

Product Standard

The COFS began development of a *North American Standard for Cold-Formed Steel Framing – Product Data* in 2004 to standardize requirements for cold-formed steel-framing products with the intent to establish and encourage the production and use of standardized products in the United States, Canada and Mexico. This *Product Standard*, expected to be issued later this year, will provide criteria, including material and product requirements for structural and non-structural cold-formed steel framing members where the specified minimum base steel thickness is between 18 mils (0.0179 inches) (0.455mm) and 118 mils (0.1180 inches) (2.997mm). The components covered in the *Product Standard* will include C-shape studs, joists, track, U-channels, furring channels and angles.

Consistent with the *General Provisions*, the *Product Standard* requires that framing members be cold-formed to shape from metallic-coated sheet steel complying with the requirements of ASTM A1003/A1003M (ASTM, 2002a). Cold-formed steel framing has traditionally been manufactured from galvanized, Galvalume® or Galfan® sheet steel complying with the requirements of ASTM A653/A653M (ASTM, 2002b), A792/A792M (2002c) or A875/A875M (ASTM, 2002d), respectively. One of the purposes of the new ASTM A1003 standard was to provide

a common standard for these various materials as a means to simplify the process for the specifier and supplier.

The *Product Standard* requires that framing members be cold-formed to shape from sheet steel with a prescribed minimum base steel thickness. These standard thicknesses, as shown in Table 1, are given a designation thickness, which is defined as the minimum base steel thickness expressed in mils and rounded to a whole number. It is intended that this designation thickness be used in describing the products, rather than decimal thickness or gauge number.

Table 1: Standard Thicknesses

Designation Thickness	Minimum Base Steel Thickness		Design Thickness	
	(inch)	(mm)	(inch)	(mm)
18	0.0179	0.455	0.0188	0.478
30	0.0296	0.752	0.0312	0.792
33	0.0329	0.836	0.0346	0.879
43	0.0428	1.087	0.0451	1.146
54	0.0538	1.367	0.0566	1.438
68	0.0677	1.720	0.0713	1.811
97	0.0966	2.454	0.1017	2.583
118	0.1180	2.997	0.1242	3.155

Consistent with the *General Provisions*, the *Product Standard* requires that references to structural and non-structural members use a four-part product designator that

identifies the size (both web depth and flange width), style, and thickness. The product designator is to consist of the following sequential codes:

A three or four-digit numeral indicating member web depth in 1/100 inch.

A letter indicating:

S = Stud or joist framing member which have lips (i.e., C-shape)
T = Track section
U = channel or stud framing section which do not have lips
F = furring channels
L = angle or L-header

A three-digit numeral indicating flange width in 1/100 inch, followed by a dash.

A two or three-digit numeral indicating designation thickness.

The same designator is to be used for both the US Customary and the SI Metric units. The product designators are to be based on the US Customary units and use the format illustrated by the following example:

400S162-54

where,

400 = web depth, (inch/100)
S = section designation for a C-shape stud or joist
162 = flange width (inch/100)
54 = designation thickness

The *Product Standard* prescribes cold-formed steel members types, as shown in Figure 2, and standard dimensions including web depth, flange width, inside bend radius, lip length, and punchout sizes and locations.

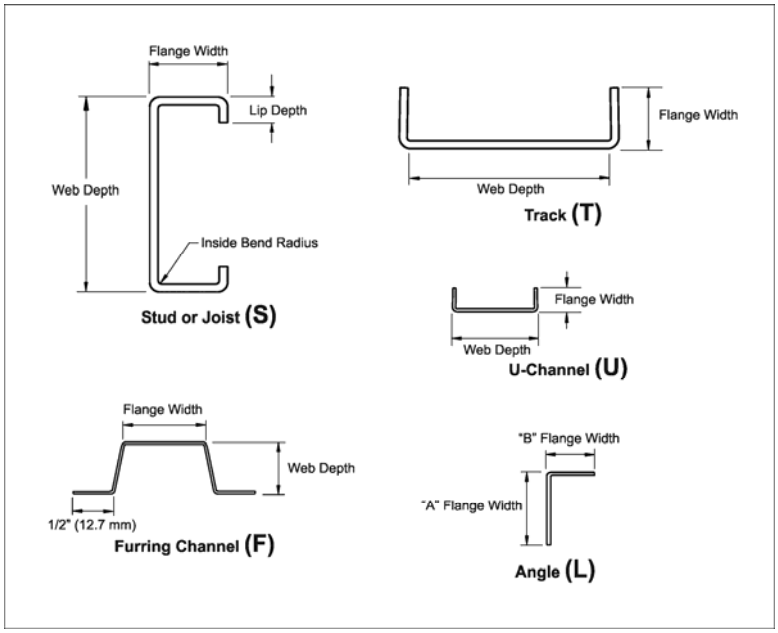

Figure 2: Cold Formed Steel Framing Member Types

The Product Standard requires members to be marked to indicate manufacturer, steel designation thickness, minimum coating weight and minimum yield strength. The Product Standard also addresses manufacturing tolerances and quality assurance, tying-in with existing industry standards where possible.

Conclusions

The AISI Committee on Framing Standards (COFS) has continued with earnest its mission to eliminate regulatory barriers and increase the reliability and cost competitiveness of cold-formed steel framing through improved design and installation standards.

The COFS has built on the internationally recognized AISI *Specification* and has developed and published six ANSI-accredited consensus standards, including:

- *General Provisions*
- *Header design*
- *Lateral Design*
- *Truss Design*
- *Wall Stud Design*
- *Prescriptive Method*

The COFS has facilitated the development of a much-appreciated industry *Code of Standard Practice*.

Work continues towards development of a North American *Product Standard* to standardize requirements for cold-formed steel-framing products with the intent to establish and encourage the production and use of standardized products in the United States, Canada and Mexico.

The COFS documents are readily available from the American Iron & Steel Institute (www.steel.org) and the Steel Framing Alliance (www.steelframingalliance.com).

Acknowledgements

The members of the committee, subcommittees and task groups responsible for bringing these standards to fruition are to be commended for their time and effort. It is through the participation of representatives from steel producers, fabricators, users, educators, researchers, and building code officials in this consensus process that such progress is made. The partner organizations, Steel Framing Alliance, Light Gauge Steel Engineers Association, Steel Stud Manufacturers Association, Canadian Sheet Steel Building Institute and Center for Cold Formed Steel Structures, are to be thanked for their active participation. Particular gratitude is owed to the member companies of the American Iron & Steel Institute for their long-term vision for this market and financial support of this technical effort.

AISI's Construction Market Companies include AK Steel Corporation, Dofasco Inc., IPSCO Inc., Mittal Steel USA, Nucor Corporation, Severstal North America Inc., Steelscape, Inc., Stelco Inc., United States Steel Corporation and USS-POSCO Industries.

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