INTRODUCTION

Cold-formed steel is widely used in buildings, automobiles, equipment, home and office furniture, utility poles, storage racks, grain bins, highway products, drainage facilities, and bridges. Its popularity can be attributed to ease of mass production and prefabrication, uniform quality, lightweight designs, economy in transportation and handling, and quick and simple erection or installation.

In building construction, cold-formed steel products can be classified into three categories: members, panels, and prefabricated assemblies. Typical cold-formed steel members such as studs, track, purlins, girts and angles are mainly used for carrying loads while panels and decks constitute useful surfaces such as floors, roofs and walls, in addition to resisting in-plane and out-of-plane surface loads. Prefabricated cold-formed steel assemblies include roof trusses, panelized walls or floors, and other prefabricated structural assemblies. Cold-formed steel possesses a significant market share because of its advantages over other construction materials and the industry-wide support provided by various organizations that promote cold-formed steel research and products, including codes and standards development that is spearheaded by the American Iron and Steel Institute (AISI).

This article presents the profile of cold-formed steel in building construction through a historical review of the development of the AISI Cold-Formed Steel Specification and related standards, discusses the major cold-formed steel applications in building con-
Cold-formed steel applications can be traced back as early as the 1850s in both the United States and Great Britain. In the late 1920s and early 1930s, cold-formed steel entered the building construction arena with products manufactured by a handful of fabricators. Although these products were successful in performance, they faced difficulties with acceptance for two reasons: (1) there was no standard design methodology available, and (2) cold-formed steel was not included in the building codes at that time. Many of the cold-formed steel applications were unable to be used due to the lack of design methodology and product recognition.

To face this challenge, AISI convened a technical committee in 1938, known as the Committee on Building Codes, with the mission of developing a specification for the design of cold-formed steel structures. Research work was conducted at Cornell University, led by Professor George Winter. In 1946, the first Specification for the Design of Light Gage Steel Structural Members was published, and in 1949, the first Design Manual was available for use by design engineers. After the publication of the second edition in 1956, the Specification was formally adopted by the building code body, opening the door towards acceptance of cold-formed steel products. To increase the market share of cold-formed steel, AISI has been continually providing research funding to broaden the design coverage, improve the design technology, and cultivate a cold-formed steel research and design community.

With the establishment of the North American Free Trade Agreement (NAFTA) in 1990, it became clear that codes and standards would be at the frontlines in eliminating the trade barrier and
promoting the usage in steel in North America. In 1995, AISI initiated the development of a unified cold-formed steel specification among NAFTA countries. After 10 years of mutual effort, the first edition of the *North American Specification for the Design of Cold-Formed Steel Structural Members* was published in 2001. This document was immediately adopted by the 2003 International Building Code (IBC) and was recognized by the American National Standards Institute (ANSI) as the National Standard in the United States, by the Canadian Standards Association (CSA) in Canada, and by Camara Nacional de la Industria del Hierro y del Acero (CANACERO) in Mexico. This unified *Specification* raised cold-formed steel design technology to the same level among all NAFTA countries, allowing faster introduction of new technologies and opening up the marketplace for a wide variety of cold-formed steel products and derivatives such as steel framing and steel decks, as well as design aids and educational materials.

In the early 1990s, as the residential construction industry expanded and lumber prices escalated, the steel industry recognized a new potential market for cold-formed steel applications. A Residential Advisory Group was formed in 1991 to explore the avenues for penetrating this potential market. In the mid-1990s, the first edition of the *Prescriptive Method for One- and Two-Family Dwellings* was published and adopted into the CABO One- and Two-Family Dwelling Code. In 1996, the Residential Advisory Group was reorganized into the North American Steel Framing Alliance (NASFA). In 1998, NASFA was renamed the Steel Framing Alliance (SFA) and expanded its focus to cover the light commercial market as well. Also in 1998, in its role as an ANSI-accredited standards development organization, AISI launched the Committee on Framing Standards with a 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. As a result, additional ANSI-approved design standards, such as the *Standard on Cold-Formed Steel Framing—General Provisions*, —Truss Design and —Header Design, were developed and published in 2001. These standards, as well as the expanded and updated *Prescriptive Method*, were adopted by the 2003 International Building Code, and have been recognized by ANSI as American National Standards. In 2004, these standards were updated, and new ANSI-approved *Standards on Cold-Formed Steel Framing—Lateral Design* and —Wall Stud Design were completed. In 2007, the Limit States Design (LSD) method was incorporated into the cold-formed steel framing standards, which enabled those standards to be adopted in Canada and Mexico as North American standards.

A detailed summary of specification and standard development by AISI is provided in Appendix 1.

**Organizations Related to Cold-Formed Steel**

To expand the cold-formed steel market, steel manufacturers and suppliers have formed several organizations to develop and improve cold-formed steel products, provide services to the user group, and promote and expand manufacturers’ product lines. These organizations include:

**American Iron and Steel Institute (AISI)**: The American Iron and Steel Institute's history spans almost 100 years. AISI is recognized as a leader in the cold-formed steel industry, engaging in a wide variety of collective and collaborative activities. This role allows AISI to play a pivotal role in expanding and growing the markets for steel applications. In addition to advancing the case for steel in the marketplace as the preferred material of choice, AISI also serves as the voice of the North American steel industry in the
public policy arena and plays a lead role in the development and application of new steels and steelmaking technology.

Over the last half century, AISI has developed and maintained the *North American Specification for the Design of Cold-Formed Steel Structural Members*, which provides fundamental design methodology for all cold-formed steel members in construction. Since 1990, a series of cold-formed steel framing standards have been developed. These standards have established a solid foundation for the cold-formed steel framing industry. In addition, AISI has published and maintained a number of cold-formed steel design manuals and design guides.

In 2008, AISI announced the establishment of the AISI Steel Market Development Institute (SMDI) with the mission “to advance the competitive use of steel through a market-driven strategy that promotes cost-effective, steel-based solutions.” SMDI operates as a business unit of AISI.

**Metal Building Manufacturers Association (MBMA):** MBMA was formed by metal building manufacturers and suppliers in 1956. MBMA members represent the majority of the total metal building systems built in the United States.

To ensure the good quality of metal building systems, MBMA requires its member companies to be accredited by the International Accreditation Services (IAS) through the Inspection Programs for Manufacturers of Metal Building Systems (AC472). In addition, MBMA periodically updates its *Metal Building System Manual* and
Metal Roofing System Design Manual to assist architects and engineers in selecting metal building systems.

With advanced computer design tools, metal building systems have been expanded from simple building configurations such as warehouses and factory buildings to applications with varying architectural appearances found in churches, schools, shopping centers, and office buildings. Metal buildings and roofing systems are increasingly being recognized as reliable, aesthetically pleasing, and cost-effective building alternatives.

Steel Deck Institute (SDI): Founded in 1939 by the manufacturers of steel decks and associated products, the Steel Deck Institute has played an important role in providing uniform industrial standards for engineering, manufacturing and field installation of steel decks. Representing Majority of the steel decks produced in the United States, SDI member companies produce cold-formed steel decks with various configurations for different types of applications.

Technical information published by SDI includes the SDI Design Manual for Composite Decks, Form Decks and Roof Decks; Roof Deck Construction Handbook; Diaphragm Design Manual; and the SDI Manual of Construction With Steel Deck.

Steel Stud Manufacturers Association (SSMA): The SSMA was formed in 1999 through a merger of the Metal Lath and Steel Framing Association Division of the National Association of Architectural Metal Manufacturers and the Metal Stud Manufacturers Association. The products produced by SSMA member companies include studs, tracks, and steel framing accessories such as cold-rolled channels and flat straps. In 2001, SSMA published its first product catalog using a unified designation for both stud and track sections, which greatly simplified product identification for
both contractors and design professionals. SSMA also publishes technical notes and CAD Details on cold-formed steel framing.

**Steel Framing Alliance (SFA):** The SFA, previously known as the North American Steel Framing Alliance, was established in 1998 to enable and encourage the practical and widespread use of cold-formed steel framing in the residential market. Since then, it has expanded its scope to include commercial and institutional markets. The SFA is a leading organization for promoting steel studs and related products by providing builders and engineers with cost-effective alternatives. On the technical front, SFA has supported many research and development initiatives, and has published a series of issue papers and builder guides. The SFA has also published design guides on fire-resistance and acoustic ratings, and on thermal design and code compliance.

**Metal Construction Association (MCA):** The MCA was formed in 1983 by entities engaged in manufacturing, engineering, selling and installing metal products. Its mission is to expand the usage of metal in construction through marketing, innovation, and education. MCA organizes the annual industry event called METALCON, which provides a showcase for manufacturers and a learning opportunity for consumers and design professionals. In addition, MCA manages a metal roofing certification program to promote the widespread use of appropriate metal roofing products that have met the designated quality standards. The organization also publishes a series of metal wall and roof design and selection guides.

**Rack Manufacturers Institute (RMI):** The RMI was formed in 1958 by rack manufacturer companies, and is currently affiliated with the Material Handling Industry of America (MHIA). The member companies of the RMI produce cold-formed steel industry racks that are classified as either stationary or portable racks. Different
from other cold-formed steel members, storage rack members contain slots (openings) for connecting members flexibly. In addition to considering the *North American Cold-Formed Steel Specification*, storage racks are designed to follow the Specifications developed by RMI, such as the Specification for the Design and Utilization of Industrial Portable Storage Rack; Specification for the Design, Testing and Utilization of Industrial Steel Storage; Specification for the Use of Industrial and Commercial Steel Storage Racks—Manual of the Safety Practices/A Code of Safety Practices.

**Metal Roofing Alliance (MRA):** The MRA is a coalition of metal roofing manufacturers, paint suppliers and coaters, dealers, metal industry associations, and roofing contractors. The mission of the MRA is to promote metal roofing products by demonstrating to both consumers and installers the outstanding value and the superior longevity that a metal roof provides. The MRA provides information, resources, and the Find a Contractor function via its website to introduce consumers to the benefits of metal roofing.

**Wei-Wen Yu Center for Cold-Formed Steel Structures (CCFSS):** Established at the University of Missouri-Rolla (UMR) in 1990 under the leadership of Professor Wei-Wen Yu and the sponsorship of the American Iron and Steel Institute, the Center provides integrated services related to cold-formed steel research and education. CCFSS organizes a biennial International Specialty Conference on Cold-Formed Steel Structures, which showcases the worldwide state-of-the-art practices in cold-formed steel research and technology. Many innovative ideas and design provisions presented through the International Specialty Conferences have been adopted by design specifications and standards. CCFSS also organizes a biennial cold-formed steel design short course and offers online courses for design professionals, researchers and college students. The Center also maintains a technical library of cold-formed steel-related research publications and research.
documents from around the world. This information can be accessed via the Center’s website at [www.ccfssonline.org](http://www.ccfssonline.org). The Center’s technical bulletins provide valuable information to the cold-formed steel community. Currently, the Center is co-sponsored by AISI and other industrial organizations.

**Cold-Formed Steel Engineers Institute (CFSEI):** The membership of the CFSEI (which was formerly known as the Light-Gauge Steel Engineers Association) includes design engineers, manufacturers, builders, and contractors in cold-formed steel construction. The organization conducts educational seminars and develops a series of technical notes that supplement cold-formed steel design standards and provide assistance to design engineers.

Based on their functions, the organizations listed above can be classified as follows:

a. Organizations emphasizing the promotion and technical development of their product lines: AISI, MBMA, SFA, SDI, SSMA;

b. Organizations emphasizing the promotion of steel products: MCA, MRA;

c. Organizations emphasizing the technical issues related to cold-formed steel: CCFSS, CFSEI.

The organizations can also be categorized according to their products:

a. Building Systems: MBMA, SFA, RMI

b. Structural Members: SSMA

c. Steel Decks: SDI

d. Roof Panels: MCA, MRA

e. Wall Panels: MCA

f. Storage Racks: RMI

A summary of technical documents and standards published by each organization is provided in Table 1.
Cold-formed steel products are shaped at ambient temperatures from steel sheet, strip plate or flat bars by roll-forming machines, press brakes or bending brake operations. They can be produced in large quantity and at high speed with consistent quality. A typical automated rolling machine can run at a speed range of 75-400 feet per minute, and the products can be as small as a three-quarter inch wide cold-rolled channel section to as big as a thirty-six inch wide roof deck section.

Cold-formed steel possesses many advantages over other construction materials:

1. **Lightweight** - Cold-formed steel components weigh approximately 35% to 50% less than their wood counterparts, which means that they are easy to handle during construction and transportation.

2. **High-strength and stiffness** – As a result of the cold-forming process, cold-formed steel possesses one of the highest strength-to-weight ratios of any building material. This high strength and stiffness result in more design options, wider spans and better material usage.

3. **Fast and easy erection and installation** – Building components made of cold-formed steel can be fabricated with high accuracy in a plant and then assembled on job sites, which greatly increases erection efficiency and ensures construction quality.

4. **Dimensionally stable material** - Cold-formed steel does not expand or contract with moisture content. In addition, it does not split or warp as time goes by. Therefore, it is dimensionally stable. Cracked gypsum sheathed walls, nail head popping and other common problems with wood-
framed structures can be virtually eliminated in buildings with cold-formed steel stud walls.

5. *No formwork needed* – The use of cold-formed steel decks eliminates the formwork for pouring concrete floor. In addition, composite action between the steel deck and concrete increases floor strength and stiffness.

6. *Durable material* - Cold-formed steel is durable because it is resistant to termites and rotting. In addition, galvanized cold-formed steel products provide long-term resistance to corrosion.

7. *Economy in transportation and handling* - Lightweight cold-formed members or panels are easy to handle and transport. In addition, they can be nested and bundled, reducing the required shipping and storage space.

8. *Non-combustible material* - Steel is a non-combustible material and will not contribute fuel to the spread of a fire. This results in better fire resistance and lower insurance premiums.

9. *Recyclable nature* - Steel is North America’s No. 1 recycled construction material, with a minimum 25% recycled content. Steel products used in construction are infinitely recyclable, with no degradation in structural properties. It can be recycled and reused. Steel-framed housing dramatically reduces the amount of trees consumed for residential construction, thus conserving one of nature's most precious resources.

10. *Energy efficiency* – A variety of color options for metal roofs and panels provides consumers with many choices to select products that save energy. For low-heating degree day climates (such as Miami), high-emissive white or light painted Galvalume™ roofs display solar reflectance of at least 65% and thermal emittance of 80 percent. This results in reducing air conditioning costs and the smog and pollution that are created by the production of that energy. For
high-heating degree-day climates, on the other hand, heat gain can be obtained by using low-emissive unpainted Galvalume™ roof and wall products, which reduce the load on the building’s heating system and save energy.

APPLICATIONS OF COLD-FORMED STEEL

In building construction, cold-formed steel products are mainly used as structural members, diaphragms, and coverings for roofs, walls and floors. There are varieties of cold-formed shapes available as structural members, which include open sections, closed sections, and built-up sections. Cee-, zee-, double channel I-sections, hat, and angle sections are open sections while box sections and pipes are closed sections. The built-up members are formed by connecting two or more cold-formed steel members together, such as an I-section member built up by connecting two channel sections back-to-back. These structural shapes can be used in buildings as eave struts, purlins, girts, studs, headers, floor joists, braces, and other building components. Various shapes are also available for wall, floor, and roof diaphragms and coverings.

Metal Building Construction

In pre-engineered metal buildings, the entire building structure is made from steel products, and approximately 40-60% of the total steel used is cold-formed steel. A typical metal building system consists of primary rigid frames, secondary members, cladding, and bracing. The primary rigid frames are usually built up using welded plates with sizes optimized to satisfy the design requirements. The secondary members, such as purlins and girts, support the roof and wall coverings and provide lateral stability to the primary rigid frame members. The cold-formed metal roof and wall panels are often used as building claddings. They transfer the loads (such as wind and snow) to the secondary members and...
Cold-formed steel products are used for wall coverings and wall framing.

- **Wall Coverings.** Wall panels are widely used as wall covering for metal buildings and office buildings. With technology improvement, wall panels can be made with a variety of shapes and textures, such as embossed, granular-finished metals, to meet structural and architectural requirements. Insulated wall panels can greatly simplify the construction process and achieve significant cost savings.

- **Wall Framing.** In a metal building, C- or Z-shaped cold-formed steel girts are often used to provide lateral support to the metal wall panels. They are normally connected to the rigid frame at each end and are suspended from the roof eave purlins for vertical support.

Cold-formed steel stud wall framing has been widely used in commercial buildings for both exterior and interior wall construction. For exterior applications, steel stud wall framing is often used as a backup system for brick veneer, stucco, and exterior insulating finishing systems (EIFS). For interior applications, steel stud wall framing is used to
support the partition walls, shaft walls, ceilings, and duct enclosures.

Stud wall framing is a system with studs connected to top and bottom tracks and braced with cold-rolled channel bridging or flat strap bracing. The stud wall system can be used to carry the floor load (load bearing wall), to divide building space (partition wall), to resist the lateral load such as wind or seismic load (curtain wall), or to provide lateral stability for the building (shear wall). In the last decade, stud wall framing has seen a significant increased usage in residential and light commercial load-bearing construction.

Floor Construction

In floor construction, floor decks, steel joists (studs) and trusses are often used as floor coverings, diaphragms and floor framing, respectively.

- **Floor Deck.** Cold-formed steel decks are widely used in commercial and institutional building construction. They are made by forming cold-formed steel sheet into corrugated profiles, which greatly increases the bending capacity of the sheet steel and results in a very high strength-to-weight ratio. One of the great advantages of using steel deck in building construction is that it can function as a working platform and serve as a stay-in-place form that carries construction loads and concrete weight during construction, and as a permanent part of load resistance system in service. There are two types of floor decks: form deck and composite deck. While both types are widely used in building construction, the composite decks usually provide means such as embossments to interlock the deck
Cold-Formed Steel Profile (Updated in 2010)

to the concrete so that higher shear resistance can be achieved. The composite decks usually possess higher strength and are capable of achieving a longer span.

Multi-function steel decks, such as a cellular deck, can carry electrical wires and communication cables, as well as heating and air conditioning ducts.

- **Floor Framing.** Cold-formed steel can also be used as a part of sub-floor structures. They usually consist of C-shaped cold-formed joists or cold-formed steel trusses spaced at 16 in. or 24 in. on center and braced with diagonal or horizontal bridging at 8- to 10-feet on center. Either concrete or plywood floors can be installed on top of the cold-formed steel sub-floor.

  The cold-formed sub-floor structures are used in light commercial structures such as apartments, educational buildings, and single-family homes.

**Roof Construction**

- **Roof Panels.** Cold-formed steel roof panels function as structural components, resisting wind uplift and snow load, and maintaining the integrity of the building under lateral wind and seismic loads. They also fulfill appealing architectural requirements. The roof panels can be fastened to the purlins as in a through-fastened roof system, or be connected to purlins with concealed sliding clips as in a standing seam roof system. The standing seam roof system can accommodate roof panel movement due to temperature changes, which makes standing seam roof panels effective weather-resistant products. The standing seam roof panels are not only used in new buildings, but are also
widely used in the renovation and restoration of existing buildings.

Cold-formed steel roof decks can serve as part of the roof sub-structure, resisting roof diaphragm forces and supporting roofs with insulation and waterproofing membrane. Steel roof decks are usually 1½” or 3” deep, depending on the span requirement.

- **Roof Framing.** Cold-formed steel can also serve as the roof sub-structure in the form of roof purlins or roof trusses. In a metal building, Z-shaped and C-shaped roof purlins are usually used to support the roof panels and to transfer the roof wind and snow loads to the primary frames, while providing lateral stability to the primary frame members.

Cold-formed steel trusses are used in residential and light commercial buildings. They can be made from regular C-section studs or from other proprietary shapes. Cold-formed steel trusses provide the same span capabilities and design flexibilities as wood trusses, yet they are lighter and more dimensionally stable than wood trusses. Most of the cold-formed steel roof trusses are pre-engineered and prefabricated with the help of computer software, which makes it possible to accommodate various roof configurations and layouts. This design flexibility makes cold-formed steel trusses ideal for almost any building type, including residential, commercial, institutional, educational and industrial structures.

Cold-formed steel will continue to be a viable material in building construction because of its unique

![Roof Trusses](image-url)
characteristics and advantages. However, to maintain and increase market share, the steel industry must focus in the long-term on enhancing design, improving manufacturing processes and innovating new construction technologies.

**Research and Accomplishments.** To keep cold-formed steel design at the cutting-edge of technology and to be competitive in the codes and standards arena, research work continues to be carried out through AISI committees, partner associations, and affiliated research institutes. The following are some of the highlights of ongoing and accomplished (completed?) research and standards development:

- **Direct Strength Method (DSM).** This is a design methodology that has been adopted by the *North American Cold-Formed Steel Specification* as an alternative method to the traditional effective width design approach. The DSM does not require effective width calculations or iterations, but instead uses gross properties and the elastic buckling behavior of the cross-section to predict the member strength. With the assistance of computer software, this design procedure is applicable to cold-formed steel prismatic members with virtually any cross-section configuration and will result in a more reliable and realistic design. Research work has extended this design method to perforated members such as studs with web openings or rack structural members with patterned cutouts. The DSM for shear has been completed at the University of Sydney.

- **Seismic Design.** To facilitate cold-formed steel design in high seismic areas, a *North American Standard for Cold-Formed Steel Framing - Lateral Design* has been developed by the AISI Committee on Framing Standards (COFS). A *Standard for Seismic Design of Cold-Formed Steel Structural Systems-Special Bolted Moment Frames* has been published by the AISI Committee on Specifications (COS). The 2008 edition addresses cold-formed steel structural design with an emphasis on bolted moment
frames formed by cold-formed steel channel beams with tubular columns.

- **Wind Load Effects on Metal Roofing.** A series of wind tunnel tests and electromagnetic uplift simulations have been carried out by MBMA with co-sponsorship by AISI, MCA and Factory Mutual Global (FM Global). The objective of this research is to study how metal roofs respond to instantaneous wind load and determine a correlation factor which can be applied to roof panel uniform static air pressure tests while taking wind load dynamic effects into consideration. The outcome of this research has resulted in improved design provisions for metal roof systems.

**Building Performance.** Over the years, the North American steel industry has committed to enhancing building performance through the improved performance of cold-formed steel products. Some examples include:

- **Cool Metal Roofing.** Formed by AISI, MBMA, MCA, the National Coil Coaters Association (NCCA) and Zinc Aluminum Coaters Association (ZAC), the Cool Metal Roofing Coalition sponsored research to evaluate the energy efficiency of metal roofs. The objective of this research was to formulate and validate design tools for predicting metal roof energy efficiency during the cooling and heating seasons. The metal panels, each with different coatings, were compared with each other and with asphalt shingle roofs in different geographical regions to determine their energy efficiency. Department of Energy computer models were used to show the annual energy savings of metal roofing products. The Cool Metal Roofing Coalition also provides technical information and educational materials, and promotes metal roofing as a “green” building product due to its energy efficiency, durability, recyclability and low weight.
• **Durability of Steel Framing.** Coordinated by the International Lead and Zinc Research Organization (ILZRO), a five-year study of steel framing viability under different climatic conditions has been carried out by the National Association of Home Builders (NAHB). The on-site monitoring of steel framing was carried out at Miami, FL; Leonardtown, MD; Long Beach Island, NJ; and Hamilton, Ontario in Canada. The test results indicated that for cold-formed steel with minimum coating weight (G60), the estimated life expectancies ranged from 235 to more than 841 years, with an average of 490 years for all of the samples at all of the locations. The research has substantiated that metallic-coated metal studs are long-lasting and corrosion-resistant.

• **Fire Endurance and Acoustic Performance of Steel Framing.** A design guide that collects a series of fire endurance and sound transmission data for residential and light commercial steel framing (steel-framed?) wall and floor systems has been developed through the joint efforts of the Steel Framing Alliance (SFA) and the Canadian Steel Construction Council (CSCC). In addition, a Residential Steel Framing Builder’s Guide for Fire and Acoustic Details has been developed by the National Association of Home Builders Research Center, Inc. and sponsored by The U.S. Department of Housing and Urban Development (HUD) and the Steel Framing Alliance. These documents provide valuable information for design engineers and architects in selecting steel framing walls and floor systems.

**Construction Safety.** To address the ironworkers’ concern about traction on lubricated steel decking and roofing surfaces, the OSHA/SENRAC Steel Coalition was established with its member associations of AISI, MBMA, MCA, SDI, NCCA, and Steel Joist Institute (SJI) in 1996. After more than eight years of research and experimentation, a Voluntary Lubricant Compliance Program (VLCP) was developed which recommends that participants use
highly evaporative lubricants during the manufacturing of roof and deck products. This VLCP provides an innovative and responsible approach to mitigating potential risks of slip and fall accidents on steel decking and roofing.

**Manufacturing and Construction.** Metal buildings and cold-formed products have evolved over the years. A streamlined price estimating, designing and manufacturing process has greatly increased the productivity and product quality. In addition, advanced computerized design tools provide flexibility so that metal buildings and light-framed cold-formed steel buildings can be rapidly designed to meet architectural requirements.

To meet the demand for more steel framing construction workers, the SFA has developed a series of “How To” educational materials for frame workers, plumbers and electricians. To encourage builders to use cold-formed steel framing, many manufacturers provide customized price estimates and framing design services. In addition, many panelized wall and floor products are being developed by manufacturers to speed up and simplify the construction process.

As a result of the steel industry’s efforts, the building construction industry is benefiting from new design, manufacturing and construction technologies.

**SUMMARY**

Cold-formed steel has become a competitive building material as a result of industry-wide efforts. To ensure sustained market growth for cold-formed steel in building construction, AISI and the Steel Market Development Institute will continue to play an important role to increase collaboration between different organizations, to improve the design specification, and to enhance the image and awareness of cold-formed steel in the marketplace. The American Iron and Steel Institute has
been and will remain at the forefront of developing codes and
standards to pave the way for cold-formed steel to enter a new
era.

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   d. Steel Stud Manufacturers Association: www.ssma.com
   e. Steel Framing Alliance: www.steelframing.org
   f. Wei-Wen Yu Center for Cold-Formed Steel Structures:
      www.ccfssonline.org
g. Cold-Formed Steel Engineers Institute: www.cfsei.org
h. Metal Construction Association: www.metalconstruction.org
i. Metal Roofing Alliance: www.metalroofing.com
j. Cool Metal Roofing Coalition: www.coolmetalroofing.com
k. Rack Manufacturers Institute:
   www.mhia.org/psc/PSC_Products_Racks.cfm
### TABLE 1 – TECHNICAL DOCUMENTS ON COLD-FORMED STEEL DESIGN AND CONSTRUCTION

<table>
<thead>
<tr>
<th>Organization</th>
<th>Publication Name</th>
</tr>
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| AISI         | 1. AISI Cold-Formed Steel Design Standards:  
AISI S100, North American Specification for the Design of Cold-Formed Steel Structural Members  
AISI S110, Standard for Seismic Design of Cold-Formed Steel Structural Systems – Special Bolted Moment Frames  
AISI S200, North American Standard for Cold-Formed Steel Framing – General Provisions  
AISI S201, North American Standard for Cold-Formed Steel Framing – Products Standard  
AISI S202, Standard for Cold-Formed Steel Framing – Code of Standard Practice  
AISI S210, North American Standard for Cold-Formed Steel Framing – Floor and Roof System Design  
AISI S211, North American Standard for Cold-Formed Steel Framing – Wall Stud Design  
AISI S212, North American Standard for Cold-Formed Steel Framing – Header Design  
AISI S213, North American Standard for Cold-Formed Steel Framing – Lateral Design  
AISI S214, North American Standard for Cold-Formed Steel Framing – Truss Design  
AISI S230, North American Standard for Cold-Formed Steel Framing – Prescriptive Method for One- and Two-Family Dwellings |
|              | 2. AISI Test Standards for Cold-Formed Steel Members, Connections and Assemblies  
AISI S901, Rotational-Lateral Stiffness Test Method for Beam-to-Panel Assemblies  
AISI S902, Stub-Column Test Method for Effective Area of Cold-Formed Steel Columns  
AISI S903, Standard Methods for Determination of Uniform and Local Ductility  
AISI S904, Standard Test Methods for Determining the Tensile and Shear Strength of Screws  
AISI S905, Test Methods for Mechanically Fastened Cold-Formed Steel Connections  
AISI S906, Standard Procedures for Panel and Anchor Structural Tests  
AISI S907, Test Standard for Cantilever Test Method for Cold-Formed Steel Diaphragm  
AISI S909, Standard Test Method for Determining the Web Crippling Strength of Cold-Formed Steel Beams  
AISI S910, Test Method for Distortional Buckling of Cold-Formed Steel Hat Shaped Compression Members  
AISI S911, Method for Flexural Testing Cold-Formed Steel Hat Shaped Beams  
AISI S912, Test Procedure for Determining a Strength Value for a Roof Panel-to-Purlin-to-Anchorage Device Connection  
AISI S913, Test Standard for Hold-Downs Attached to Cold-Formed Steel Structural Framing |
| Cold-Formed Steel Profile (Updated in 2010) |  
|---|---|
| **AISI S914, Test Standard for Joist Connectors Attached to Cold-Formed Steel Structural Framing** |  
3. **Cold-Formed Steel Design Manual**  
4. **Cold-Formed Steel Framing Design Guide**  
5. **Steel Stud Brick Veneer Design Guide**  
6. **Direct Strength Method Design Guide**  
7. **Design Guide for Cold-Formed Steel Purlin Roof Framing Systems**  
8. Various Research Reports (go to [www.steel.org](http://www.steel.org) and refer to the Quick Link: Research Reports on the AISI Codes and Standards page under Steel Markets: Construction.) |
| **MBMA** |  
1. **Metal Building System Manual**  
2. **Metal Roofing Systems Design Manual**  
5. **Seismic Design Guide for Metal Building Systems**  
6. Various Brochures |
| **SDI** |  
1. **Design Manual for Composite Decks, Form Decks and Roof Decks**  
2. **Roof Deck Construction Handbook**  
3. **Diaphragm Design Manual**  
4. **SDI Manual of Construction with Steel Deck**  
5. **Composite Steel Deck Design Handbook**  
6. **Standard Practice Details** |
| **CFSEI** |  
1. **Design Guide: Cold-Formed Steel Framed Wood or Steel Sheathed Shear Wall Assemblies**  
2. **Technical Note Series:**  
   D001-07, Durability of Cold-Formed Steel Framing Members  
   D100-08, Corrosion Protection of Screw Fasteners |
<table>
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<th>No.</th>
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<tr>
<td>D200-07</td>
<td>Corrosion Protection For Cold-Formed Steel Framing In Coastal Areas</td>
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<td>Welding Cold-Formed Steel</td>
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<td>Pneumatically Driven Pins For Wood Based Panel Attachment</td>
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<td>G000-08</td>
<td>Cold-Formed Steel Design Software</td>
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<td>Using Chapter F of the North American Specification for the Design of CFS Structural Members</td>
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<td>G100-08</td>
<td>Design Aids and Examples for Distortional Buckling</td>
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<td>G100-09</td>
<td>Designing CFS Using the Direct Strength Method</td>
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<td>G800-07a</td>
<td>ASTM Standards For Cold-Formed Steel</td>
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<td>G801-08</td>
<td>ASTM A1003 - No Cause for Rejection</td>
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<td>G900-08</td>
<td>Design Methodology for Hole Reinforcement of CFS Bending Members</td>
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<td>Changes from the 1997 UBC to the 2006 IBC for Lateral Design with Cold-Formed Steel Framing</td>
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<td>Design of Diagonal Strap Bracing Lateral Force Resisting Systems for the 2006 IBC</td>
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<td>L200-09</td>
<td>Roof Anchorage Forces: MWFRS or C&amp;C</td>
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<td>L300-09</td>
<td>Design of End Posts for Diaphragm Shear Walls: A Perspective</td>
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<tr>
<td>T001-09</td>
<td>Suggested Cost Effective CFS Fire and Acoustic-Rated Assemblies for Multi-Unit Structures</td>
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<tr>
<td>W100-08a</td>
<td>Single Slip Track Design</td>
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<td>W101-09</td>
<td>Common Design Issues for Deflection Track</td>
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<td>W200-09</td>
<td>Header Design</td>
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<td>3.</td>
<td>Technical Notes - Produced by the former Light Gauge Steel Engineering Association (LGSEA)</td>
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<tr>
<td>360</td>
<td>Acoustic Insulation and Sound Transmission in Cold-Formed Steel Construction</td>
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<td>420</td>
<td>Fire-Rated Assemblies for Cold-Formed Steel Construction</td>
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<td>542</td>
<td>Introduction to Curtain Wall Design Using Cold-Formed Steel</td>
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<td>550</td>
<td>Design Values For Vertical and Horizontal Lateral Load Systems</td>
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<td>551d</td>
<td>Design Guide: Construction Bracing of Cold-Formed Steel Trusses</td>
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<td>551e</td>
<td>Design Guide: Permanent Bracing of Cold-Formed Steel Trusses</td>
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<tr>
<td>551f</td>
<td>Specifying Pre-Engineered Cold-Formed Steel Floor and Roof Trusses</td>
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<td>552</td>
<td>Cold-Formed Steel Joists</td>
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<td>544</td>
<td>Design of By-Pass Slip Connectors in Cold-Formed Steel Construction</td>
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<td>556a-4</td>
<td>Shear Transfer at Top Plate: Drag Strut Design</td>
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<td>556a-6</td>
<td>Vertical Lateral Force Resisting System: Boundary Elements</td>
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<td>558b-1</td>
<td>Lateral Load Resisting Elements: Diaphragm Design Values</td>
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| MCA | 1. Single or Dual Level Roll Former Operation and Maintenance Manual  
2. Smooth-Faced Uninsulated Metal Wall Panels  
3. Metal Roof Design for Cold Climates  
4. Performed Metal Wall Specification Guidelines  
5. Selection Guidelines for Metal Composite Foam Roof Panels  
6. Other Various Technical Bulletins |
| SSMA | 1. SSMA Product Technical Information  
2. Cold-Formed Steel Details  
3. Technical Notes:  
   - Single Deflection Track Selection  
   - Unsheathed Flange Bracing  
   - Track Within A Track Deflection  
   - Interior Non-Structural 30 Mil Framed Walls  
   - Metric Conversion – SSMA Tables |
| SFA | 1. Design Guide for Cold-Formed Steel Beams with Web Penetrations  
2. Thermal Design and Code Compliance for Cold-Formed Steel Walls  
3. Low-Rise Residential Steel Construction Details and Guidelines (CD-ROM)  
4. L-Shaped Header Field Guide |
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<tr>
<th>Steel Floor Guide</th>
<th>5. Steel Floor Guide</th>
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<td>Stacker Rack Nomenclature</td>
<td>4. Stacker Rack Nomenclature</td>
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<td>Testing Guidelines for Pallet Stacking Frames</td>
<td>5. Testing Guidelines for Pallet Stacking Frames</td>
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## APPENDIX 1

### CHRONICLED SUMMARY OF AISI COLD-FORMED STEEL STANDARDS

<table>
<thead>
<tr>
<th>Year Published</th>
<th>Significance</th>
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<tbody>
<tr>
<td>1946</td>
<td>The first edition of the AISI Specification for the Design of Light Gage Steel Structural Members was published.</td>
</tr>
<tr>
<td>1949</td>
<td>The first edition of the AISI Light Gage Steel Design Manual was published.</td>
</tr>
<tr>
<td>1956</td>
<td>The AISI Design Manual with the AISI Specification was published, and the Specification was adopted by the building code officials.</td>
</tr>
<tr>
<td>1960 &amp; 1961</td>
<td>The basic safety factor was reduced from 1.85 to 1.65 in the Specification.</td>
</tr>
<tr>
<td>1962</td>
<td>Strength increase due to cold work of forming was recognized.</td>
</tr>
<tr>
<td>1968</td>
<td>Compression member lateral-torsional buckling consideration was added.</td>
</tr>
<tr>
<td>1980</td>
<td>Specification scope was extended to cover cold-formed steel up to one inch in thickness, and was expanded to include plate and bar steels, as well as sheet steels.</td>
</tr>
<tr>
<td>1986</td>
<td>The unified approach was adopted for determining the cold-formed member strength in considering local buckling.</td>
</tr>
<tr>
<td>1991</td>
<td>The first edition of LRFD Specification was published. The AISI Advisory Group was renamed to Committee on Specifications for the Design of Cold-Formed Steel Structural Members.</td>
</tr>
<tr>
<td>1996</td>
<td>The first edition of the combined ASD and LRFD Specification was published.</td>
</tr>
<tr>
<td>2001</td>
<td>The first edition of the North American Specification was published by AISI and CSA.</td>
</tr>
<tr>
<td>2004</td>
<td>Supplement No. 1 to the 2001 Edition of the North American Specification was published, which included the Direct Strength Method.</td>
</tr>
<tr>
<td>2007</td>
<td>2007 Edition of the North American Specification was published, and designated as AISI S100.</td>
</tr>
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</table>

### Cold-Formed Steel Framing Standards

<table>
<thead>
<tr>
<th>Year</th>
<th>Significance</th>
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<tbody>
<tr>
<td>1996</td>
<td>The first edition of the Prescriptive Method for Residential Cold-Formed Steel Framing was published by HUD.</td>
</tr>
<tr>
<td>1997</td>
<td>The second edition of the Prescriptive Method for Residential Cold-Formed Steel Framing was published by HUD and was adopted by IRC 2000.</td>
</tr>
</tbody>
</table>
| 2001 | The following AISI standards were first published:  
  1. Standard for Cold-Formed Steel Framing – Prescriptive Method for One- and Two-Family Dwellings  
  2. Standard for Cold-Formed Steel Framing – General Provisions  
  3. Standard for Cold-Formed Steel Framing – Truss Design  
  4. Standard for Cold-Formed Steel Framing – Header Design  
| 2004 | The following AISI standards were first published:  
  5. Standard for Cold-Formed Steel Framing – Lateral Design  
  6. Standard for Cold-Formed Steel Framing – Wall Stud Design |
2007 The following standards were published as 2007 editions, and new designations were adopted:

- AISI S200, North American Standard for Cold-Formed Steel Framing — General Provisions
- AISI S201, North American Standard for Cold-Formed Steel Framing — Products Standard
- AISI S210, North American Standard for Cold-Formed Steel Framing — Floor and Roof System Design
- AISI S211, North American Standard for Cold-Formed Steel Framing — Wall Stud Design
- AISI S212, North American Standard for Cold-Formed Steel Framing — Header Design
- AISI S213, North American Standard for Cold-Formed Steel Framing — Lateral Design
- AISI S214, North American Standard for Cold-Formed Steel Framing — Truss Design
- AISI S230, North American Standard for Cold-Formed Steel Framing — Prescriptive Method for One- and Two-Family Dwellings

Cold-Formed Steel Standard for Seismic Design

- 2008 The first edition of AISI S110, Standard for Seismic Design of Cold-Formed Steel Structural Systems-Special Bolted Moment Frames, was published.

- 2009 The Supplement to the 2008 edition of AISI S110, Standard for Seismic Design of Cold-Formed Steel Structural Systems-Special Bolted Moment Frames, was published.

Cold-Formed Steel Test Standards

- 2008 A new designation for AISI test standards was adopted. The new standards S909-S914 were added during 2002 and 2008. See Table 1 for complete list of the published test standards.