Specifying Cold-Formed Steel Framing

By Don Allen, P.E.

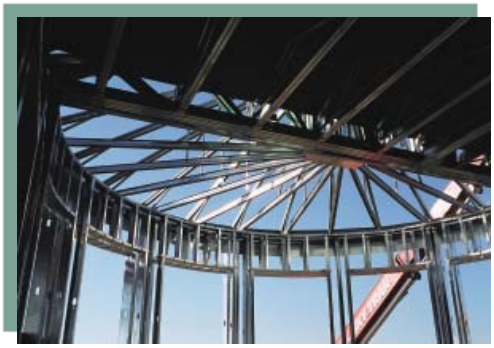
Although the primary responsibility for project specifications usually rests with the project architect, the development of specifications for structural systems (including cold-formed steel framing) is often delegated to the structural engineer. At the same time, structural engineers usually have at least some information on cold-formed steel framing in their structural general notes. This article will help explain some of the key sections of the specifications and general notes for steel framing, and will guide structural engineers to references that may help them specify cold-formed steel framing on their next project.

Multi-story loadbearing projects have become very popular recently, with new developments in steel-framing construction.

Contract documents for building projects typically consist of drawings and specifications. According to the Construction Specifications Institute (CSI), Specifications are the detailed written data about a structure's materials, products and systems. The project manual containing the specifications, along with architectural, structural, and other drawings, becomes part of the contract between the architect and the general contractor, as well as the framing contractor installing cold-formed steel framing. Traditionally, the specification section covering cold-formed steel has been section 05400. In the new MasterFormat® from CSI, the division is now called 05 40 00. (*See Sidebar*)

Specifications typically have three sections: 1. General, 2. Products, and 3. Execution. Within these sections are information about what is required for the design and installation of the metal framing system. On most projects where cold-formed steel is used, the final sizing of the steel framing members, as well as connection design, is often left to the framing subcontractor. When this is the case, the specifications usually call for "engineered drawings and/or calculations" as part of the submittal package. When should the engineer of record design all the framing, and when should he or she delegate this design?

According to the recently released *Code of Standard Practice for the Cold-Formed Steel Structural Framing Industry* (©2005 AISI) section C gives responsibilities for the architect, contractor, and engineer of record. Several of the provisions parallel those given in the Council of American Structural Engineers (CASE) *National Practice Guidelines for Specialty Structural Engineers* (©CASE, 2004). According to the *Code of Standard Practice* (COSP) the architectural plans should convey the design intent, and contain member size constraints, location within the structure, and dimensions. The structural drawings "shall show the structural member locations, sizes, reinforcing and connections in sufficient scale and detail to enable the construction of the building in a reasonable sequence by a competent contractor experienced in the techniques of construction for the specified materials." According to the *Guidelines for Specialty Structural Engineers* (GSSE) "the Structural Engineer of Record (EOR) is responsible for those elements included in the EOR's contract. While some portion of that work may be "delegated" to a Specialty Structural Engineer (SSE) that does not relieve the EOR of responsibility for the scope of work performed by the SSE. Those portions should be reviewed by the EOR to the degree necessary to support that responsibility." The GSSE document goes on to describe the types of services that may be provided by an SSE, the relationship of the SSE to the EOR, and items to be provided by the architect or EOR. Some of these items include design criteria (such as codes and loads), dimensions, details, site conditions and submittals required. A key section of the GSSE document is II.A.3: Parameters. This section states in part, "Parameters or constraints concerning the interface of the delegated design with the remaining portions of the structure should be clearly stated."



Steel framing offers the versatilility of curved wall, roof, and floor systems, including the curved headers and roof trusses shown here. Specuifying these systems is made easier by referencing industry approved standards.

This is a part of the project that often "falls through the cracks" when architectural specifications or structural general notes are poorly written. Although it is clear that the engineer of record is ultimately responsible for the overall structural design of the project, it is often not clear what is to be designed by the contractor or specialty structural engineer. Lines of communication should be kept open between the EOR and SSE, especially if loads from the cold-formed steel framing system are imposed on other structural elements in a manner not intended by the original design. One example would be a steel stud exterior curtain wall system, where kicker braces transferring wind loads from the curtain wall are tied into the bottom of a structural steel spandrel beam. If this beam is not designed for this horizontal load, there could be implications to the overall structural stability of the beam and its connections to other portions of the structure. This is just one example of a situation addressed by the GSSE and COSP documents. Both of these resources should be close at hand for structural engineers designing buildings that contain cold-formed steel framing.

When writing specifications for any structural product, the EOR and architect must remember that there are two basic types of specifications: performance requirements and prescriptive requirements. Performance requirements are rather straightforward: given a certain loading and configuration,

A pre-fabricated truss assembly made from cold-formed steel being "flown" into place at Davis Mothan Air Force Base. Note the rough plumbing and ductwork is already installed in the roof systems.

the framing system has to perform in the specified manner: carry the load, and not deflect or deform beyond prescribed limits. The other type of specification is prescriptive. With this type of specification, the drawings, details, and specifications show exactly what is to be installed. When all materials shown are installed as specified, they should be able to carry the required loads. Both prescriptive and performance specifications have their advantages and disadvantages. However, when prescriptive and performance specifications are combined, they can become confusing for both the specifier and the installer.

In a typical specification section, the **General** section is where items such as performance requirements, deflection limits, and requirements for slip connections are listed. Also, all referenced standards, such as the AISI framing standards and ASTM standards for materials and installation may be included here. It is in the **General** section that the specifications may include the requirement for a specialty engineer, or engineered drawings or calculations. This is usually under the heading of "submittals," but may be included or specified under "Quality Assurance" as well. On projects where steel framing is part of the primary structural system, engineers should specify the size and thickness of framing members, as well as the spacing, locations, and bracing requirements. They may still require engineered drawings or calculations, but a certain level of completeness is required so that framing contractors may accurately bid the project. For projects where steel framing is part of the curtain-wall or other system that carries only out-of-plane loads, the architect or EOR may choose to specify only the wall depth, and show on the drawings and sections where steel framing is required. When the design team takes this approach, stud spacing, thickness, and bracing requirements should be included only where other parts of the building have special requirements (such as 16-inch on-center spacing for brick ties, or a required steel thickness to resist the pullout of

Standards Commonly Specified for Cold-Formed Steel Framing

ASTM International Standards

The following ASTM standards apply to the chemical composition, coating, and properties of the sheet steel used to form steel framing members:

- A1003/A1003M: This standard was developed specifically for steel framing members; whereas other standards in this list are for sheet steel that could be used for a variety of products. A1003 references several other standards for sheet steel and coating; and therefire is the only one that needs to be referenced.
  - o A653/A653M: Before the development of A1003, this had been the most commonly referenced standard for sheet steel used in steel framing,. Note that A1003 references A653; therefore if A1003 is included in your specification, there is no need to include A653.
  - o A792/A792M: This is a similar standard to A653, but includes a 55% aluminum-zinc alloy coated steel sheet. This type of coating is commonly referred to as "Galvalume." Galvalume is typically not specified for framing, since it is a more expensive coating and typically not available on steel thicker than 0.030-inch. A1003 does permit its use.

The following ASTM standards apply to the framing members themselves, and include manufacturing tolerances:

- C645: for non-structural members: typically up to 0.030-inch thick.
- C955: for structural members: typically 0.0329-inch and thicker.

The following ASTM standards apply to the proper installation of members:

- C754: for non-structural members: typically up to 0.030-inch thick. This standard applies only to members that comply with C645, noted above.
- C1007: for structural members: typically 0.0329-inch and thicker.

The following ASTM standards apply to the screws used for attaching framing members, as well as attaching sheathing to framing:

- C1513: this is the newest of the screw standards for steel framing: developed specifically for steel framing connections. Note that it references C645 and C955 for framing members, as well as standard J78 from the Society of Automotive Engineers.
- C954: for steel drill screws attaching gypsum panel products to steel framing.
- C1002: for self-piercing screws attaching gypsum panel products to steel framing.

AISI Standards

Several American Iron and Steel Institute (AISI) Standards apply to cold-formed steel framing. Documents with 2001 dates have been adopted by the 2003 International Codes. Documents with 2001, 2004 dates have a 2001 edition that has been adopted by the building codes, as well as a revised 2004 edition which may be specified. Documents with 2004 dates have not yet been adopted by the codes, but are on track for inclusion in the 2006 editions of the International Codes.

- *North American Specification for the Design of Cold-Formed Steel Structural Members* (2001): This contains the equations for design of members. It applies not only to steel framing, but to all thin and cold-formed steels used in construction.
- *Standard for Cold-Formed Steel Framing – General Provisions* (2001, 2004): Provides basic information about installation tolerances, member design, connections, and other basics for using and installing steel framing for construction.
- *Standard for Cold-Formed Steel Framing - Prescriptive Method* (2001, with 2004 Supplement): Adopted by the International Residential Code, to provide selection tables so that non-engineers can use the tabulated values to design a structure that falls within the applicability limits. This includes one- and two-family dwellings up to two stories, with some additional limits on configuration and loading.
- *Standard for Cold-Formed Steel Framing – Wall Stud Design* (2004): Provides additional guidance for design of wall systems, in both loadbearing and non-loadbearing applications.
- *Standard for Cold-Formed Steel Framing – Header Design* (2001, 2004): Provides guidance for the design of three types of headers: boxed C-shapes, back-to-back C-shapes, and double "L" headers.
- *Standard for Cold-Formed Steel Framing – Truss Design* (2001, 2004): Gives design information for truss design responsibilities, loading, design criteria, quality criteria, installation, bracing, and testing of trusses and truss systems.
- *Standard for Cold-Formed Steel Framing – Lateral Design* (2004): Provides design requirements for shearwalls, diaphragms, and other lateral systems used with cold-formed steel framing.

fasteners). With this type of specification, the framing contractor can work with the specialty engineer to provide the most economical system possible.

In the **Products** section, the specifier may include special requirements on the studs, tracks, joists, and accessories to be provided as part of the steel framing system. Sections under the new MasterFormat® have broken out special sections for floor joists, roof rafters, trusses, and some other specialty products; however most specifications now being written have all of the applicable types listed under the "Product" heading. (*See Sidebar*). The specifier may choose to name specific manufacturers, although these lists can often become quickly outdated. Clever yet unscrupulous sales representatives have been known to create a "closed spec" by encouraging specifiers to list their company, along with several other companies that are either out of business or no longer making steel framing products. One way around this is to require that framing manufacturers be members of the Steel Stud Manufacturers Association (SSMA). SSMA manufacturers are required to maintain a quality control program and undergo annual internal audits to maintain their membership. Manufacturers of accessories do not have a similar trade organization, although many SSMA members make or supply the clips, channels, screws, and other products required to complete the system.

In the **Execution** section, there are some general notes about how members may be cut and fabricated into assemblies such as trusses or wall panels. This is also where the specifier should list the permitted fastening types, which may include screw attachment, welding, clinching, pneumatically driven pins, or other methods. The EOR should be careful when specifying welding: make sure to reference the American Welding Society's standard D1.3 for sheet steel. A wire-fed MIG welder works best on the thinner framing members. For more background on welding cold-formed steel framing, the Light Gauge Steel Engineers Association's tech note 560b-1 covers this subject in detail.

Following the general **Execution** specification section, there will be specific sections on installation of joists, trusses, and walls. The wall portion of the specification may be broken down into "loadbearing" and "non-loadbearing." Note that for interior non-structural curtain wall framing, it is typically specified in the gypsum board section on finishes (division 9), and is not addressed at all in the structural drawings or general notes.

With all of this information needed in specifications and general notes, it is understandable that many structural engineers and designers can get confused. For a concise version of a sample specification, the SSMA has a sample on the last page of their Product Technical Information Catalog: available in their Technical Library at **www.ssma.com**. For a thorough coverage of specifications for steel framing, MASTERSPEC® from Arcom provides a thorough suite of materials to help the architect and engineer develop accurate specifications. Their products are available at **www.arcomnet.com**. The Light Gauge Steel Engineers Association is in the process of developing a technical note on Structural General Notes, and the Steel Framing Alliance is developing a similar publication on architectural specifications for steel framing. The Steel Stud Manufacturers Association is currently considering a joint project with Arcom to develop a version of MASTERSPEC for SSMA products. All of these efforts will make it easier than ever to specify steel framing in both general notes and architectural specifications.▪

Don Allen, P.E. is the Director of Engineering Development for the Steel Framing Alliance and Technical Director of the Steel Stud Manufacturers Association.

The New CSI MasterFormat® Numbers for Cold-Formed Steel Framing

Last year, the Construction Specifications Institute (CSI) issued their new MasterFormat®. The new headings under "cold-formed metal framing" are listed below.

- 05 40 00 COLD-FORMED METAL FRAMING
  - 05 41 00 Structural Metal Stud Framing
  - 05 42 00 Cold-Formed Metal Joist Framing
    - 05 42 13 Cold-Formed Metal Floor Joist Framing
    - 05 42 23 Cold-Formed Metal Roof Joist Framing
  - 05 43 00 Slotted Channel Framing
  - 05 44 00 Cold-Formed Metal Trusses
  - 05 45 00 Metal Support Assemblies
    - 05 45 13 Mechanical Metal Supports
    - 05 45 16 Electrical Metal Supports
    - 05 45 19 Communications Metal Supports
    - 05 45 23 Healthcare Metal Supports

For more on MasterFormat®, visit **www.csinet.org.**