
Code of Standard Practice for Steel Buildings and Bridges

April 14, 2010

Supersedes the March 18, 2005 AISC *Code of Standard Practice for Steel Buildings and Bridges* and all previous versions.

Prepared by the American Institute of Steel Construction
under the direction of the AISC Committee
on the Code of Standard Practice.



AMERICAN INSTITUTE OF STEEL CONSTRUCTION
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Code of Standard Practice for Steel Buildings and Bridges, April 14, 2010
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PREFACE

As in any industry, trade practices have developed among those that are involved in the design, purchase, fabrication and erection of structural steel. This Code provides a useful framework for a common understanding of the acceptable standards when contracting for structural steel. As such, it is useful for owners, architects, engineers, general contractors, construction managers, fabricators, steel detailers, erectors and others that are associated with construction in structural steel. Unless specific provisions to the contrary are contained in the contract documents, the existing trade practices that are contained herein are considered to be the standard custom and usage of the industry and are thereby incorporated into the relationships between the parties to a contract.

The Symbols and Glossary are an integral part of this Code. In many sections of this Code, a non-mandatory Commentary has been prepared to provide background and further explanation for the corresponding Code provisions. The user is encouraged to consult it.

Since the first edition of this Code was published in 1924, AISC has continuously surveyed the structural steel design community and construction industry to determine standard trade practices. Since then, this Code has been periodically updated to reflect new and changing technology and industry practices.

The 2000 edition was the fifth complete revision of this Code since it was first published. Like the 2005 edition, the 2010 edition is not a complete revision but does add important changes and updates. It is the result of the deliberations of a fair and balanced Committee, the membership of which included structural engineers, architects, a code official, a general contractor, fabricators, a steel detailer, erectors, inspectors, and an attorney. The following changes have been made in this revision:

- The scope in Section 1.1 has been revised to cover buildings and other structures in a manner that is consistent with how buildings and other structures are treated in AISC 360 (the *AISC Specification for Structural Steel Buildings*). A similar and corresponding revision has been made in Section 1.4.
- The list of referenced documents in Section 1.2 has been editorially updated.
- Section 1.9 has been added to emphasize that not all tolerances are explicitly covered in the Code, and that tolerances not covered are not to be assumed as zero.
- Clarification has been added in Section 2 that base plates and bearing plates are considered structural steel if they are attached to the structural frame, but not if they are loose items that do not attach to the structural steel frame.
- Editorial improvements have been made in the Commentary to Section 3.1 to improve upon the list of items that should be provided in the contract documents, as well as to link column differential shortening and anticipated deflections to information that has been added in the Commentary to Section 7.13.
- Explicit requirements have been added in Section 3.1.2 as “option 3” for when connection design work is delegated by the Structural Engineer of Record (SER) to be performed by another engineer. Provisions covering connection design by the

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SER (option 1) and selection or completion of basic tabular connections by a steel detailer (option 2) also have been revised for consistency with and distinction from option 3. Additionally, the defined term *substantiating connection information* has been added to the Glossary, and revisions also have been made in Section 4 to correspond with the addition of option 3 in Section 3.1.2.

- Information has been added to the Commentary in Section 4.1 to summarize the importance and benefits of holding a pre-detailing conference to open lines of communication and develop a common understanding about the project.
- Section 4.7 has been added to address requirements for erection drawings.
- Section 6.4.3 has been modified to better address incidental camber in trusses.
- Information has been added in the Commentary to Section 7.10.1 to better describe the provisions that relate to special erection conditions or other considerations that are required by the design concept, as well as to highlight special considerations in the erection of cantilevered members.
- The intent in Section 7.13.1.2(d) has been clarified in the text as well as with the relocation of supporting Commentary.
- The intent in Section 10.2.5 has been editorially clarified for groove welds in butt joints and outside corner joints.
- The document has been editorially revised for consistency with current terms and other related documents.

The Committee thanks Glenn Bishop, the Council of American Structural Engineers (CASE), and its Guidelines Committee for their assistance and partnership in the development of Section 3.1.2 in this edition of the Code. Also, the Committee thanks Rex I. Lewis and Homer R. Peterson, II for their contributions as members of the Committee for part of this cycle of development, and honors Committee member Leonard R. Middleton, who passed away during this cycle.

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GLOSSARY

The following abbreviations and terms are used in this Code. Where used, terms are italicised to alert the user that the term is defined in this Glossary.

AASHTO. American Association of State Highway and Transportation Officials.

Adjustable Items. See Section 7.13.1.3.

AESS. See *architecturally exposed structural steel*.

AISC. American Institute of Steel Construction.

Anchor Bolt. See *anchor rod*.

Anchor Rod. A mechanical device that is either cast or drilled and chemically adhered, grouted or wedged into concrete and/or masonry for the purpose of the subsequent attachment of *structural steel*.

Anchor-Rod Group. A set of *anchor rods* that receives a single fabricated *structural steel* shipping piece.

ANSI. American National Standards Institute.

Architect. The entity that is professionally qualified and duly licensed to perform architectural services.

Architecturally Exposed Structural Steel. See Section 10.

AREMA. American Railway Engineering and Maintenance of Way Association.

ASME. American Society of Mechanical Engineers.

ASTM. American Society for Testing and Materials.

AWS. American Welding Society.

Bearing Devices. Shop-attached base and bearing plates, loose base and bearing plates and leveling devices, such as leveling plates, leveling nuts and washers and leveling screws.

CASE. Council of American Structural Engineers.

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Clarification. An interpretation, of the *design drawings* or *specifications* that have been *released for construction*, made in response to an RFI or a note on an approval drawing and providing an explanation that neither revises the information that has been *released for construction* nor alters the cost or schedule of performance of the work.

the Code, this Code. This document, the AISC *Code of Standard Practice for Steel Buildings and Bridges* as adopted by the American Institute of Steel Construction.

Column line. The grid line of column centers set in the field based on the dimensions shown on the structural *design drawings* and using the building layout provided by the *owners designated representative for construction*. Column offsets are taken from the *column line*. The *column line* may be straight or curved as shown in the structural *design drawings*.

Connection. An assembly of one or more joints that is used to transmit forces between two or more members and/or connection elements.

Contract Documents. The documents that define the responsibilities of the parties that are involved in bidding, fabricating and erecting *structural steel*. These documents normally include the *design drawings*, the *specifications* and the contract.

Design Drawings. The graphic and pictorial portions of the *contract documents* showing the design, location and dimensions of the work. These documents generally include plans, elevations, sections, details, schedules, diagrams and notes.

Embedment Drawings. Drawings that show the location and placement of items that are installed to receive *structural steel*.

EOR, Engineer, Engineer of Record. See *structural engineer of record*.

Erection Bracing Drawings. Drawings that are prepared by the *erector* to illustrate the sequence of erection, any requirements for temporary supports and the requirements for raising, bolting and/or welding. These drawings are in addition to the *erection drawings*.

Erection Drawings. Field-installation or member-placement drawings that are prepared by the *fabricator* to show the location and attachment of the individual shipping pieces.

Erector. The entity that is responsible for the erection of the *structural steel*.

Established Column Line. The actual field line that is most representative of the erected column centers along a line of columns placed using the dimensions shown in the

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structural *design drawings* and the lines and bench marks established by the *owner's designated representative for construction*, to be used in applying the erection tolerances given in this Code for column shipping pieces.

Fabricator. The entity that is responsible for fabricating the *structural steel*.

Hazardous Materials. Components, compounds or devices that are either encountered during the performance of the contract work or incorporated into it containing substances that, notwithstanding the application of reasonable care, present a threat of harm to persons and/or the environment.

Inspector. The *owner's* testing and inspection agency.

MBMA. Metal Building Manufacturers Association.

Mill Material. Steel mill products that are ordered expressly for the requirements of a specific project.

Owner. The entity that is identified as such in the *contract documents*.

Owner's Designated Representative for Construction. The *owner* or the entity that is responsible to the *owner* for the overall construction of the project, including its planning, quality, and completion. This is usually the general contractor, the construction manager or similar authority at the job site.

Owner's Designated Representative for Design. The *owner* or the entity that is responsible to the *owner* for the overall structural design of the project, including the *structural steel* frame. This is usually the *structural engineer of record*.

Plans. See *design drawings*.

RCSC. Research Council on Structural Connections.

Released for Construction. The term that describes the status of *contract documents* that are in such a condition that the *fabricator* and the *erector* can rely upon them for the performance of their work, including the ordering of material and the preparation of *shop* and *erection drawings*.

Revision. An instruction or directive providing information that differs from information that has been *released for construction*. A *revision* may, but does not always, impact the cost or schedule of performance of the work.

RFI. A written request for information or clarification generated during the construction phase of the project.

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SER. See *structural engineer of record*.

Shop Drawings. Drawings of the individual *structural steel* shipping pieces that are to be produced in the fabrication shop.

SJI. Steel Joist Institute.

Specifications. The portion of the *contract documents* that consists of the written requirements for materials, standards and workmanship.

SSPC. SSPC: The Society for Protective Coatings, which was formerly known as the Steel Structures Painting Council.

Standard Structural Shapes. Hot-rolled W-, S-, M- and HP-shapes, channels and angles listed in ASTM A6/A6M; structural tees split from the hot-rolled W-, S- and M-shapes listed in ASTM A6/A6M; hollow structural sections produced to ASTM A500, A501, A618 or A847; and, steel pipe produced to ASTM A53/A53M.

Steel Detailer. The entity that produces the *shop* and *erection drawings*.

Structural Engineer of Record. The licensed professional who is responsible for sealing the *contract documents*, which indicates that he or she has performed or supervised the analysis, design and document preparation for the structure and has knowledge of the load-carrying structural system.

Structural Steel. The elements of the structural frame as given in Section 2.1.

Substantiating Connection Information. Information submitted by the *fabricator*, if requested by the *owner's designated representative for design* in the *contract documents*, when option (2) or option (3) is designated for *connections* per Section 3.1.2.

Tier. The *structural steel* framing defined by a column shipping piece.

Weld Show-Through. In *architecturally exposed structural steel*, visual indication of the presence of a weld or welds on the side of the member opposite the weld.

CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES

SECTION 1. GENERAL PROVISIONS

1.1. Scope

This Code sets forth criteria for the trade practices involved in steel buildings, bridges, and other structures, where other structures are defined as those structures designed, fabricated, and erected in a manner similar to buildings, with building-like vertical and lateral load resisting elements. In the absence of specific instructions to the contrary in the *contract documents*, the trade practices that are defined in this Code shall govern the fabrication and erection of *structural steel*.

Commentary:

The practices defined in this Code are the commonly accepted standards of custom and usage for *structural steel* fabrication and erection, which generally represent the most efficient approach. This Code is not intended to define a professional standard of care for the *owners designated representative for design*, change the duties and responsibilities of the *owner*, contractor, *architect* or *structural engineer of record* from those set forth in the *contract documents*, or assign to the *owner*, *architect* or *structural engineer of record* any duty or authority to undertake responsibility inconsistent with the provisions of the *contract documents*.

This Code is not applicable to steel joists or metal building systems, which are addressed by SJI and MBMA, respectively.

1.2. Referenced Specifications, Codes and Standards

The following documents are referenced in this Code:

AASHTO Specification—The 2010 AASHTO *LRFD Bridge Design Specifications*, 5th Edition.

AISC Seismic Provisions—AISC 341-10, the 2010 AISC *Seismic Provisions for Structural Steel Buildings*.

AISC Specification—AISC 360-10, the 2010 AISC *Specification for Structural Steel Buildings*.

ASME B46.1—ASME B46.1-02, Surface Texture (Surface Roughness, Waviness and Lay).

AREMA Specification—The 2010 AREMA *Manual for Railway Engineering, Volume II—Structures, Chapter 15*.

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ASTM A6/A6M—09, *Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.*

ASTM A53/A53M—07, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.*

ASTM A325—09, *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.*

ASTM A325M—09, *Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric).*

ASTM A490—08b, *Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.*

ASTMA490M—08, *Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric).*

ASTM A500/A500M—07, *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.*

ASTM A501—07, *Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.* No metric equivalent exists.

ASTM A618/A618M—04, *Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing.*

ASTM A847/A847M—05, *Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance.*

ASTM F1852/F1852M—08, *Standard Specification for "Twist-Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.*

AWS D1.1—The AWS D1.1 *Structural Welding Code—Steel*, 2008.

CASE Document 11—*An Agreement Between Structural Engineer of Record and Contractor for Transfer of Computer Aided Drafting (CAD) files on Electronic Media*, 2000

CASE Document 962—*The National Practice Guidelines for the Structural Engineer of Record*, Fourth Edition, 2000.

RCSC Specification—*The Specification for Structural Joints Using High-Strength Bolts*, 2009.

SSPC SP2—SSPC *Surface Preparation Specification No. 2, Hand Tool Cleaning*, 2004.

SSPC SP6—SSPC *Surface Preparation Specification No. 6, Commercial Blast Cleaning*, 2004.

1.3. Units

In this Code, the values stated in either U.S. customary units or metric units shall be used. Each system shall be used independently of the other.

Commentary:

In this Code, dimensions, weights and other measures are given in U.S. customary units with rounded or rationalized metric-unit equivalents in

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brackets. Because the values stated in each system are not exact equivalents, the selective combination of values from each of the two systems is not permitted.

1.4. Design Criteria

For buildings and other structures, in the absence of other design criteria, the provisions in the AISC Specification shall govern the design of the *structural steel*. For bridges, in the absence of other design criteria, the provisions in the AASHTO Specification and AREMA Specification shall govern the design of the *structural steel*, as applicable.

1.5. Responsibility for Design

- 1.5.1. When the *owner's designated representative for design* provides the design, *design drawings* and *specifications*, the *fabricator* and the *erector* are not responsible for the suitability, adequacy or building-code conformance of the design.
- 1.5.2. When the *owner* enters into a direct contract with the *fabricator* to both design and fabricate an entire, completed steel structure, the *fabricator* shall be responsible for the suitability, adequacy, conformance with *owner-established* performance criteria, and building-code conformance of the *structural steel* design. The *owner* shall be responsible for the suitability, adequacy and building-code conformance of the *non-structural steel* elements and shall establish the performance criteria for the *structural steel* frame.

1.6. Patents and Copyrights

The entity or entities that are responsible for the specification and/or selection of proprietary structural designs shall secure all intellectual property rights necessary for the use of those designs.

1.7. Existing Structures

- 1.7.1. Demolition and shoring of any part of an existing structure are not within the scope of work that is provided by either the *fabricator* or the *erector*. Such demolition and shoring shall be performed in a timely manner so as not to interfere with or delay the work of the *fabricator* and the *erector*.
- 1.7.2. Protection of an existing structure and its contents and equipment, so as to prevent damage from normal erection processes, is not within the scope of work that is provided by either the *fabricator* or the *erector*. Such protection shall be performed in a timely manner so as not to interfere with or delay the work of the *fabricator* or the *erector*.

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- 1.7.3. Surveying or field dimensioning of an existing structure is not within the scope of work that is provided by either the *fabricator* or the *erector*. Such surveying or field dimensioning, which is necessary for the completion of *shop and erection drawings* and fabrication, shall be performed and furnished to the *fabricator* in a timely manner so as not to interfere with or delay the work of the *fabricator* or the *erector*.
- 1.7.4. Abatement or removal of *hazardous materials* is not within the scope of work that is provided by either the *fabricator* or the *erector*. Such abatement or removal shall be performed in a timely manner so as not to interfere with or delay the work of the *fabricator* and the *erector*.

1.8. Means, Methods and Safety of Erection

- 1.8.1. The *erector* shall be responsible for the means, methods and safety of erection of the *structural steel* frame.
- 1.8.2. The *structural engineer of record* shall be responsible for the structural adequacy of the design of the structure in the completed project. The *structural engineer of record* shall not be responsible for the means, methods and safety of erection of the *structural steel* frame. See also Sections 3.1.4 and 7.10.

1.9. Tolerances

Tolerances for materials, fabrication and erection shall be as stipulated in Sections 5, 6, 7, and 10.

Commentary:

Tolerances are not necessarily specified in this Code for every possible variation that could be encountered. For most projects, where a tolerance is not specified or covered in this Code, it is not needed to ensure that the fabricated and erected *structural steel* complies with the requirements in Section 6 and 7. If a special design concept or system component requires a tolerance that is not specified in this Code, the necessary tolerance should be specified in the *contract documents*. If a tolerance is not shown and is deemed by the *fabricator* and/or *erector* to be important to the successful fabrication and erection of the *structural steel*, it should be requested from the *owner's designated representative for design*. The absence of a tolerance in this Code for a particular condition does not mean that the tolerance is zero; rather, it means that no tolerance has been established. In any case, the default tolerance is not zero.

SECTION 2. CLASSIFICATION OF MATERIALS

2.1. Definition of Structural Steel

Structural steel shall consist of the elements of the structural frame that are shown and sized in the structural *design drawings*, essential to support the design loads and described as:

- Anchor rods* that will receive *structural steel*.
- Base plates, if part of the *structural steel* frame.
- Beams, including built-up beams, if made from *standard structural shapes* and/or plates.
- Bearing plates, if part of the *structural steel* frame.
- Bearings of steel for girders, trusses or bridges.
- Bracing, if permanent.
- Canopy framing, if made from *standard structural shapes* and/or plates.
- Columns, including built-up columns, if made from *standard structural shapes* and/or plates.
- Connection materials for framing *structural steel* to *structural steel*.
- Crane stops, if made from *standard structural shapes* and/or plates.
- Door frames, if made from *standard structural shapes* and/or plates and if part of the *structural steel* frame.
- Edge angles and plates, if attached to the *structural steel* frame or steel (open-web) joists.
- Embedded *structural steel* parts, other than bearing plates, that will receive *structural steel*.
- Expansion joints, if attached to the *structural steel* frame.
- Fasteners for connecting *structural steel* items: permanent shop bolts, nuts and washers; shop bolts, nuts and washers for shipment; field bolts, nuts and washers for permanent *connections*; and, permanent pins.
- Floor-opening frames, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame or steel (open-web) joists.
- Floor plates (checkered or plain), if attached to the *structural steel* frame.
- Girders, including built-up girders, if made from *standard structural shapes* and/or plates.
- Girts, if made from *standard structural shapes*.
- Grillage beams and girders.
- Hangers, if made from *standard structural shapes*, plates and/or rods and framing *structural steel* to *structural steel*.
- Leveling nuts and washers.
- Leveling plates.
- Leveling screws.
- Lintels, if attached to the *structural steel* frame.
- Marquee framing, if made from *standard structural shapes* and/or plates.

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Machinery supports, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame.
Monorail elements, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame.
Posts, if part of the *structural steel* frame.
Purlins, if made from *standard structural shapes*.
Relieving angles, if attached to the *structural steel* frame.
Roof-opening frames, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame or steel (open-web) joists.
Roof-screen support frames, if made from *standard structural shapes*.
Sag rods, if part of the *structural steel* frame and connecting *structural steel* to *structural steel*.
Shear stud connectors, if specified to be shop attached.
Shims, if permanent.
Struts, if permanent and part of the *structural steel* frame.
Tie rods, if part of the *structural steel* frame.
Trusses, if made from *standard structural shapes* and/or built-up members.
Wall-opening frames, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame.
Wedges, if permanent.

Commentary:

The *fabricator* normally fabricates the items listed in Section 2.1. Such items must be shown, sized and described in the structural *design drawings*. Bracing includes vertical bracing for resistance to wind and seismic load and structural stability, horizontal bracing for floor and roof systems and permanent stability bracing for components of the *structural steel* frame.

2.2. Other Steel, Iron or Metal Items

Structural steel shall not include other steel, iron or metal items that are not generally described in Section 2.1, even where such items are shown in the structural *design drawings* or are attached to the *structural steel* frame. Other steel, iron or metal items include but are not limited to:

Base plates, if not part of the *structural steel* frame.
Bearing plates, if not part of the *structural steel* frame.
Bearings, if non-steel.
Cables for permanent bracing or suspension systems.
Castings.
Catwalks.
Chutes.
Cold-formed steel products.

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Cold-rolled steel products, except those that are specifically covered in the AISC Specification.

Corner guards.

Crane rails, splices, bolts and clamps.

Crane stops, if not made from *standard structural shapes* or plates.

Door guards.

Embedded steel parts, other than bearing plates, that do not receive *structural steel* or that are embedded in precast concrete.

Expansion joints, if not attached to the *structural steel* frame.

Flagpole support steel.

Floor plates (checkered or plain), if not attached to the *structural steel* frame.

Forgings.

Gage-metal products.

Grating.

Handrail.

Hangers, if not made from *standard structural shapes*, plates and/or rods or not framing *structural steel* to *structural steel*.

Hoppers.

Items that are required for the assembly or erection of materials that are furnished by trades other than the *fabricator* or *erector*.

Ladders.

Lintels, if not attached to the *structural steel* frame.

Masonry anchors.

Miscellaneous metal.

Ornamental metal framing.

Pressure vessels.

Reinforcing steel for concrete or masonry.

Relieving angles, if not attached to the *structural steel* frame.

Roof screen support frames, if not made from *standard structural shapes*.

Safety cages.

Shear stud connectors, if specified to be field installed.

Stacks.

Stairs.

Steel deck.

Steel (open-web) joists.

Steel joist girders.

Tanks.

Toe plates.

Trench or pit covers.

Commentary:

Section 2.2 includes many items that may be furnished by the *fabricator* if contracted to do so by specific notation and detail in the *contract documents*.

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When such items are contracted to be provided by the *fabricator*, coordination will normally be required between the *fabricator* and other material suppliers and trades. The provisions in this Code are not intended to apply to items in Section 2.2.

In previous editions of this Code, provisions regarding who should normally furnish field-installed shear stud connectors and cold-formed steel deck support angles were included in Section 7.8. These provisions have been eliminated since field-installed shear stud connectors and steel deck support angles are not defined as *structural steel* in this Code.

SECTION 3. DESIGN DRAWINGS AND SPECIFICATIONS

3.1. Structural Design Drawings and Specifications

Unless otherwise indicated in the *contract documents*, the structural *design drawings* shall be based upon consideration of the design loads and forces to be resisted by the *structural steel* frame in the completed project.

The structural *design drawings* shall clearly show the work that is to be performed and shall give the following information with sufficient dimensions to accurately convey the quantity and nature of the *structural steel* to be fabricated:

- (a) The size, section, material grade and location of all members;
- (b) All geometry and working points necessary for layout;
- (c) Floor elevations;
- (d) Column centers and offsets;
- (e) The camber requirements for members;
- (f) Joining requirements between elements of built-up members; and,
- (g) The information that is required in Sections 3.1.1 through 3.1.6.

The *structural steel specifications* shall include any special requirements for the fabrication and erection of the *structural steel*.

The structural *design drawings*, *specifications* and addenda shall be numbered and dated for the purposes of identification.

Commentary:

Contract documents vary greatly in complexity and completeness. Nonetheless, the *fabricator* and the *erector* must be able to rely upon the accuracy and completeness of the *contract documents*. This allows the *fabricator* and the *erector* to provide the *owner* with bids that are adequate and complete. It also enables the preparation of the *shop* and *erection drawings*, the ordering of materials and the timely fabrication and erection of shipping pieces.

In some cases, the *owner* can benefit when reasonable latitude is allowed in the *contract documents* for alternatives that can reduce cost without compromising quality. However, critical requirements that are necessary to protect the *owner's* interest, that affect the integrity of the structure or that are necessary for the *fabricator* and the *erector* to proceed with their work must be included in the *contract documents*. Some examples of critical information may include, when applicable:

Standard specifications and codes that govern *structural steel* design and construction, including bolting and welding.

Material specifications.

Special material requirements to be reported on the material test reports.

Welded-joint configuration.

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Weld-procedure qualification.
 Special requirements for work of other trades.
 Final disposition of backing bars and runoff tabs.
 Lateral bracing.
 Stability bracing.
Connections or data for *connection* selection and/or completion.
 Restrictions on *connection* types.
 Column stiffeners (also known as continuity plates).
 Column web doubler plates.
 Bearing stiffeners on beams and girders.
 Web reinforcement.
 Openings for other trades.
 Surface preparation and shop painting requirements.
 Shop and field inspection requirements.
 Non-destructive testing requirements, including acceptance criteria.
 Special requirements on delivery.
 Special erection limitations.
 Identification of non-*structural steel* elements that interact with the *structural steel* frame to provide for the lateral stability of the *structural steel* frame (see Section 3.1.4).
 Column differential shortening information (see Commentary to Section 7.13).
 Anticipated deflections and the associated loading conditions for major structural elements, such as transfer girders and trusses, supporting columns and hangers (see Commentary to Section 7.13).
 Special fabrication and erection tolerances for AESS.
 Special pay-weight provisions.

- 3.1.1. Permanent bracing, column stiffeners, column web doubler plates, bearing stiffeners in beams and girders, web reinforcement, openings for other trades and other special details, where required, shall be shown in sufficient detail in the structural *design drawings* so that the quantity, detailing and fabrication requirements for these items can be readily understood.
- 3.1.2. The *owner's designated representative for design* shall indicate one of the following options for each *connection*:
- (1) The complete *connection* design shall be shown in the structural *design drawings*;
 - (2) In the structural *design drawings* or *specifications*, the *connection* shall be designated to be selected or completed by an experienced *steel detailer*; or,
 - (3) In the structural *design drawings* or *specifications*, the *connection* shall be designated to be designed by a licensed professional engineer working for the *fabricator*.

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In all of the above options,

- (a) The requirements of Section 3.1.1 shall apply; and,
- (b) The approvals process in Section 4.4 shall be followed.

When option (2) above is specified, the experienced *steel detailer* shall utilize tables or schematic information provided in the structural *design drawings* in the selection or completion of the *connections*. When such information is not provided, tables in the AISC *Steel Construction Manual*, or other reference information as approved by the *owner's designated representative for design*, shall be used.

When option (2) or (3) above is specified, the *owner's designated representative for design* shall provide the following information in the structural *design drawings* and *specifications*:

- (a) Any restrictions on the types of *connections* that are permitted;
- (b) Data concerning the loads, including shears, moments, axial forces and transfer forces, that are to be resisted by the individual members and their *connections*, sufficient to allow the selection, completion, or design of the *connection* details while preparing the *shop* and *erection drawings*;
- (c) Whether the data required in (b) is given at the service-load level or the factored-load level;
- (d) Whether LRFD or ASD is to be used in the selection, completion, or design of *connection* details; and,
- (e) What *substantiating connection information*, if any, is to be provided with the *shop* and *erection drawings* to the *owner's designated representative for design*.

When option (3) above is specified:

- (a) The *fabricator* shall submit in a timely manner representative samples of the required *substantiating connection information* to the *owner's designated representatives for design* and *construction*. The *owner's designated representative for design* shall confirm in writing in a timely manner that these representative samples are consistent with the requirements in the *contract documents*, or shall advise what modifications are required to bring the representative samples into compliance with the requirements in the *contract documents*. This initial submittal and review is in addition to the requirements in Section 4.4.
- (b) The licensed professional engineer in responsible charge of the *connection* design shall review and confirm in writing as part of the *substantiating connection information*, that the *shop* and *erection drawings* properly incorporate the *connection* designs. However, this review by the licensed

professional engineer in responsible charge of the *connection* design does not replace the approval process of the *shop* and *erection drawings* by the *owner's designated representative for design* in Section 4.4.

- (c) The *fabricator* shall provide a means by which the *substantiating connection information* is referenced to the related *connections* on the *shop* and *erection drawings* for the purpose of review.

Commentary:

There are three options covered in Section 3.1.2:

- (1) When the *owner's designated representative for design* shows the complete design of the *connections* in the structural *design drawings*, the following information is included:

- (a) All weld types, sizes, and lengths;
- (b) All bolt sizes, locations, quantities, and grades;
- (c) All plate and angle sizes, thicknesses and dimensions; and,
- (d) All work point locations and related information.

The intent of this approach is that complete design information necessary for detailing the *connection* is shown in the structural *design drawings*. Typical details are shown for each *connection* type, set of geometric parameters and adjacent framing conditions. The *steel detailer* will then be able to transfer this information to the *shop* and *erection drawings*, applying it to the individual pieces being detailed.

- (2) When the *owner's designated representative for design* allows an experienced *steel detailer* to select or complete the *connections*, this is commonly done by referring to tables or schematic information in the structural *design drawings*, tables in the AISC *Steel Construction Manual*, or other reference information approved by the *owner's designated representative for design*, such as journal papers and recognized software output. Tables and schematic information in the structural *design drawings* should provide such information as weld types and sizes, plate thicknesses and quantities of bolts. However, there may be some geometry and dimensional information that the *steel detailer* must develop. The *steel detailer* will then configure the *connections* based upon the design loads and other information given in the structural *design drawings* and *specifications*.

The intent of this method is that the *steel detailer* will select the *connection* materials and configuration from the referenced tables or complete the specific *connection* configuration (e.g., dimensions, edge distances and bolt spacing) based upon the *connection* details that are shown in the structural *design drawings*.

The *steel detailer* must be experienced and familiar with the AISC requirements for *connection* configurations, the use of the *connection* tables in the AISC *Steel Construction Manual*, the calculation of dimensions and adaptation of typical *connection* details to similar situations. Notations of loadings in the structural *design drawings* are only to facilitate selection of the *connections* from the referenced tables. It is not the intent that this method be used when the practice of engineering is required.

- (3) Option 3 reflects a practice in some areas of the U.S. to have a licensed professional engineer working for or retained by the *fabricator* design the *connections*, and recognizes the information required by the *fabricator* to do this work. The *owner's designated representative for design*, who has the knowledge of the structure as a whole, must review and approve the *shop* and *erection drawings*, and take such action on *substantiating connection information* as the *owner's designated representative for design* deems appropriate. See Section 4.4 for the approval process.

When, under Section 3.1.2, the *owner's designated representative for design* designates that *connections* be designed by a licensed professional engineer employed or retained by the *fabricator*, this work is incidental to, and part of, the overall means and methods of fabricating and constructing the steel frame. The licensed professional engineer performing the *connection* design is not providing a peer-review of the *contract documents*.

The *owner's designated representative for design* reviews the *shop* and *erection drawings* during the approvals process as specified in Section 4.4 for conformance with the specified criteria and compatibility with the design of the primary structure.

One of these options should be indicated for each *connection* in a project. It is acceptable to group *connection* types and utilize a combination of these options for the various *connection* types involved in a project. Option (3) is not normally specified for *connections* that can be selected or completed as noted in Option (2) without practicing engineering.

If there are any restrictions as to the types of *connections* to be used, it is required that these limitations be set forth in the structural *design drawings* and *specifications*. There are a variety of *connections* available in the AISC *Steel Construction Manual* for a given situation. Preference for a particular type will vary between *fabricators* and *erectors*. Stating these limitations, if any, in the structural *design drawings* and *specifications* will help to avoid repeated changes to the *shop* and *erection drawings* due to the selection of a *connection* that is not acceptable to the *owner's designated representative for design*, thereby avoiding additional cost and/or delay for the redrawing of the *shop* and *erection drawings*.

The structural *design drawings* must indicate the method of design used as LRFD or ASD. In order to conform to the spirit of the AISC

Specification, the *connections* must be selected using the same method and the corresponding references.

Substantiating connection information, when required, can take many forms. When option (2) is designated, *shop* and *erection drawings* may suffice with no additional *substantiating connection information* required. When option (3) is designated, the *substantiating connection information* may take the form of hand calculations and/or software output.

When *substantiating connection information* is required, it is recommended that representative samples of that information be agreed upon prior to preparation of *shop* and *erection drawings*, in order to avoid additional cost and/or delay for the *connection* redesign and/or redrawing that might otherwise result.

The *owner's designated representative for design* may require that the *substantiating connection information* be signed and sealed for option (3). The signing and sealing of the cover letter transmitting the *shop* and *erection drawings* and *substantiating connection information* may suffice. This signing and sealing indicates that a professional engineer performed the work but does not replace the approval process provided in Section 4.4.

A requirement to sign and seal each sheet of the *shop* and *erection drawings* is discouraged as it may serve to confuse the design responsibility between the *owner's designated representative for design* and the licensed professional engineer's work in performing the *connection* design.

- 3.1.3. When leveling plates are to be furnished as part of the contract requirements, their locations and required thickness and sizes shall be specified in the *contract documents*.
- 3.1.4. When the *structural steel* frame, in the completely erected and fully connected state, requires interaction with non-*structural steel* elements (see Section 2) for strength and/or stability, those non-*structural steel* elements shall be identified in the *contract documents* as required in Section 7.10.

Commentary:

Examples of non-*structural steel* elements include diaphragms made of steel deck, diaphragms made of concrete on steel deck and masonry and/or concrete shear walls.

- 3.1.5. When camber is required, the magnitude, direction and location of camber shall be specified in the structural *design drawings*.

Commentary:

For cantilevers, the specified camber may be up or down, depending upon the framing and loading.

- 3.1.6. Specific members or portions thereof that are to be left unpainted shall be identified in the *contract documents*. When shop painting is required, the painting requirements shall be specified in the *contract documents*, including the following information:
- (a) The identification of specific members or portions thereof to be painted;
 - (b) The surface preparation that is required for these members;
 - (c) The paint specifications and manufacturer's product identification that are required for these members; and,
 - (d) The minimum dry-film shop-coat thickness that is required for these members.

Commentary:

Some members or portions thereof may be required to be left unpainted, such as those that will be in contact and acting compositely with concrete, or those that will receive spray-applied fire protection materials.

**3.2. Architectural, Electrical and Mechanical
Design Drawings and Specifications**

All requirements for the quantities, sizes and locations of *structural steel* shall be shown or noted in the structural *design drawings*. The use of architectural, electrical and/or mechanical *design drawings* as a supplement to the structural *design drawings* is permitted for the purposes of defining detail configurations and construction information.

3.3. Discrepancies

When discrepancies exist between the *design drawings* and *specifications*, the *design drawings* shall govern. When discrepancies exist between scale dimensions in the *design drawings* and the figures written in them, the figures shall govern. When discrepancies exist between the structural *design drawings* and the architectural, electrical or mechanical *design drawings* or *design drawings* for other trades, the structural *design drawings* shall govern.

When a discrepancy is discovered in the *contract documents* in the course of the *fabricator's* work, the *fabricator* shall promptly notify the *owner's designated representative for construction* so that the discrepancy can be resolved by the *owner's designated representative for design*. Such resolution shall be timely so as not to delay the *fabricator's* work. See Sections 3.5 and 9.3.

Commentary:

While it is the *fabricator's* responsibility to report any discrepancies that are discovered in the *contract documents*, it is not the *fabricator's* responsibility to discover discrepancies, including those that are associated with the coordination

of the various design disciplines. The quality of the *contract documents* is the responsibility of the entities that produce those documents.

3.4. Legibility of Design Drawings

Design drawings shall be clearly legible and drawn to an identified scale that is appropriate to clearly convey the information.

Commentary:

Historically, the most commonly accepted scale for *structural steel* plans has been $\frac{1}{8}$ in. per ft [10 mm per 1 000 mm]. There are, however, situations where a smaller or larger scale is appropriate. Ultimately, consideration must be given to the clarity of the drawing.

The scaling of the *design drawings* to determine dimensions is not an accepted practice for detailing the *shop* and *erection drawings*. However, it should be remembered when preparing *design drawings* that scaling may be the only method available when early-submission drawings are used to determine dimensions for estimating and bidding purposes.

3.5. Revisions to the Design Drawings and Specifications

Revisions to the *design drawings* and *specifications* shall be made either by issuing new *design drawings* and *specifications* or by reissuing the existing *design drawings* and *specifications*. In either case, all *revisions*, including *revisions* that are communicated through responses to RFIs or the annotation of *shop* and/or *erection drawings* (see Section 4.4.2), shall be clearly and individually indicated in the *contract documents*. The *contract documents* shall be dated and identified by *revision* number. Each *design drawings* shall be identified by the same drawing number throughout the duration of the project, regardless of the *revision*. See also Section 9.3.

Commentary:

Revisions to the *design drawings* and *specifications* can be made by issuing sketches and supplemental information separate from the *design drawings* and *specifications*. These sketches and supplemental information become amendments to the *design drawings* and *specifications* and are considered new *contract documents*. All sketches and supplemental information must be uniquely identified with a number and date as the latest instructions until such time as they may be superseded by new information.

When *revisions* are made by revising and re-issuing the existing structural *design drawings* and/or *specifications*, a unique *revision* number and date must be added to those documents to identify that information as the latest instructions until such time as they may be superseded by new information. The same unique drawing number must identify each *design drawings* throughout the duration of the project so that *revisions* can be properly tracked, thus