Code of Standard Practice for Steel Buildings and Bridges

May 9, 2022

Supersedes the Code of Standard Practice for Steel Buildings and Bridges, dated June 15, 2016, and all previous versions

Approved by the Committee on the Code of Standard Practice
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Revised November 2022
DEDICATION

This edition of the AISC Code of Standard Practice for Steel Buildings and Bridges (the Code) is dedicated to two former Chairs of the Committee on the Code of Standard Practice who led us in succession to the sound, consensus Code platform we enjoy today: Frank Wylie and James Stori. Their pivotal influences as Committee Chairs combined for nearly 20 years of progress, which began in the mid-1990s.

Frank became the first Chair of a newly constituted and fundamentally different Committee that had a balance of representation across all major interests in design, contracting, and steel construction. With methodical precision, he managed a list of ideas and improvements so large and significant in impact that it spanned his tenure of two successive updates and continued into Jim’s tenure as the next Chair. Frank could help the group out of even the deepest divide with his trademark transition: “Okay, … here’s what we’re going to do.” Everyone knew it was time then to focus on what’s in common among our views and craft a successful outcome from that. And so we did!

Jim built upon that with his own savvy ability to see who in each discussion could best create the starting point through which the group would find a workable path forward. He led a number of next-generation improvements that made the earlier successes all the more valuable to the design community and construction industry. As they developed, he would skillfully bring the group along by summarizing: “Here’s what we agree on,” following with the next-closest opportunity to find agreement. And so we did!

A wonderful virtue Frank and Jim share is their thoughtful, respectful leadership style. They both ensured the opinions of all Committee members and all perspectives were heard, even when they personally disagreed. This made both of them incredibly successful at building consensus.

Their Committees did amazing work because they are capable leaders with clear vision. We celebrate Frank and Jim for their contributions and all they mean. They built the foundation upon which this edition and future ones are built.
PREFACE

(This Preface is not part of ANSI/AISC 303-22 but is included for informational purposes only.)

As in any industry, trade practices have developed among those that are involved in the design, purchase, fabrication, and erection of structural steel. The Code of Standard Practice for Steel Buildings and Bridges (ANSI/AISC 303-22), hereafter referred to as the 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 associated with construction in structural steel. Unless specific provisions to the contrary are contained in the contract documents, the existing trade practices 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.

It is important to note the differences in design requirements between buildings and bridges. AISC 360 and AISC 341 establish the design requirements for buildings and building-like structures, and this Code sets complementary commercial and technical requirements. For highway bridges, the governing design requirements are established by AASHTO and implemented by the contracting agency; the commercial provisions of the Code are applicable, but technical provisions, such as tolerances, are not addressed. For railroad bridges, the governing design requirements are established by AREMA and implemented by the contracting agency; the commercial provisions of the code are applicable, but technical provisions, such as tolerances are not addressed.

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

This Code is written—and intended to be utilized in practice—as a unified document. Contract documents may supersede individual provisions of the Code as provided in Section 1.1, except when doing so would violate a requirement of the applicable building code.

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, 2010, and 2016 editions, the 2022 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, general contractors, fabricators, a steel detailer, erectors, and inspectors. The following changes have been made in this revision:

- New terms are added to the Glossary that are tied to new provisions regarding specific instructions to the contrary in Section 1.1, and other new concepts summarized herein.
- A new Abbreviations sections is added to compile all relevant organization names and commonly abbreviated terms.
• Section 1.1 provisions were revised to strengthen the Code and provide clear requirements when specific instructions to the contrary are included in contract documents.
• Commentary to Section 1.1 was expanded and clarified to achieve a common understanding of the responsibilities and expectations of each party.
• New Section 1.7 was added with provisions on construction scheduling.
• New commentary to Section 1.10 was added to provide guidance on erector safety.
• Steel used as piling or other piling accessories was added to Section 2.2 as “Other steel, iron, or metal items”.
• Section 3.0 and commentary was revised to coordinate with ANSI/AISC 360-22.
• New Section 3.1 was added with provisions on structural design documents and specifications issued for construction. This section also contains updated requirements and guidance on painting responsibilities.
• New Section 3.2 was added with provisions for structural design documents and specifications issued as contract documents.
• In Section 4.5, requirements were added for the review of fabrication and erection documents, including additional commentary guidance.
• In Section 6.1, preferred material specifications were updated to parallel what will appear in the 16th Edition AISC Steel Construction Manual.
• In Section 6.4 the paint and steel cleaning provisions were expanded.
• In Section 10.4, the AESS fabrication requirements were updated.
• Table 10.1 was revised to align with Section 10.4 AESS requirement revisions.
• New commentary was added to Section 10.6 to provide guidance on weld access holes.
• New Section 11 was added to compile all fabrication and erection tolerances. This addition also included the removal of Section 6.4 and 7.13 from the 2016 Code.
• Section 11.2 includes new and expanded fabrication tolerances, included those applicable to camber. Additional guidance was added to the commentary.
• Section 11.3 includes new and expanded erection tolerances.
• All figures in Section 11 were updated to align with code language revisions and glossary terms.
• The document has been editorially revised for consistency with current terms and other related documents.

The Committee thanks Lawrence Griffis, Ron Johnson, Mark Holland, Larry Muir, Lawrence Kruth, and Tom Schlafly for their contributions to the coordination of ANSI/AISC 303-22 with ANSI/AISC 360-22 regarding structural design documents and specifications. The Committee also thanks Larry Kloiber and Susan Burmeister, who authored AISC Design Guide 36, Design Considerations for Camber, which drove the language revision for camber tolerances in ANSI/AISC 303-22.

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GLOSSARY

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

Adjustable items. See Section 11.3.1.3.

AESS. See Architecturally exposed structural steel.

Allowance. A monetary amount included in a contract as a placeholder for work that is anticipated but not defined at the time the contract is executed.

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.

Applicable building code. Building code under which the structure is designed.

Approval documents. The structural steel shop drawings, erection drawings, and embedment drawings, or where the parties have agreed in the contract documents to provide digital model(s), the fabrication and erection models. A combination of drawings and digital models also may be provided.

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

Architecturally exposed structural steel. See Section 10.

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.

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

Camber. Curvature in a beam or truss so as to compensate for deflection induced by loads.

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.

Connection. An assembly of one or more joints that is used to transmit forces between two or more members.
Construction documents. Written, graphic, and pictorial documents prepared or assembled for describing the design (including the structural system), location, and physical characteristics of the elements of a building necessary to obtain a building permit and construct a building.

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

Design documents. Design drawings, design model, or a combination of drawings and models.

Design drawings. Graphic and pictorial portions of the contract documents showing the design, location, and dimensions of the work. These documents generally include, but are not necessarily limited to, plans, elevations, sections, details, schedules, diagrams, and notes.

Design model. Three-dimensional digital model of the structure that conveys the structural steel requirements given in Section 3.1.

Detailer. See Steel detailer.

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

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 documents. Erection drawings, erection model, or a combination of drawings and models.

Erection drawings. Field-installation or member-placement drawings showing the location and attachment of the individual structural steel shipping pieces.

Erection model. Three-dimensional digital model produced to convey the information necessary to erect the structural steel. This may be the same digital model as the fabrication model, but it is not required to be.

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

Fabrication documents. Shop drawings, fabrication model, or a combination of drawings and models.

Fabrication model. Three-dimensional digital model produced to convey the information necessary to fabricate the structural steel.

Fabricator. The entity that is responsible for detailing (except in Section 4.5) and fabricating the structural steel.

Finish line, column finish line. The as-erected top of a column shipping piece at a tier splice or top of column, including all tolerances per Section 11.2.1.
**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’s representative.

**Issued for construction.** The engineer of record’s designation that the design documents are authorized to be used to construct the steel structure depicted in the design documents, and that these design documents incorporate the information that is to be provided per the requirements of Section A4 of the AISC Specification for Structural Steel Buildings (ANSI/AISC 360).

**Issuing of design documents and specifications.** The process by which the owner’s designated representative for design (ODRD) delivers design documents and specifications for the purpose as designated and dated therein under contract to their client. See also Releasing of design documents and specifications.

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

**Other structures.** Structures designed, fabricated, and erected in a manner similar to buildings, with building-like vertical and lateral load-resisting elements.

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

**Owner’s designated representative for construction (ODRC).** 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 jobsite.

**Owner’s designated representative for design (ODRD).** 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.

**Protected Zone.** Areas of members or connections of members in which limitations apply to fabrication and attachments.

**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 or fabrication and erection models.

**Releasing of design documents and specifications.** The process by which an owner, ODRC, or other party delivers design documents and specifications prepared by the ODRD for the purpose designated therein, to another party. See also Issuing of design documents and specifications.
**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.

**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.

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

**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/A500M, A501/A501M, A618/A618M, A847/A847M, A1065/A1065M, or A1085/A1085M; and steel pipe produced to ASTM A53/A53M.

**Steel detailer.** The entity that produces the *approval documents*.

**Structural engineer of record (SER).** 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* in support of *connections* either selected by the *steel detailer* or designed by the licensed *engineer* working for the *fabricator*.

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

**Transfer force.** A force local to the intersection of structural members that is required to be transferred across that intersection through a *connection* and its elements to assure the continuity of the load path in a structural frame.

**Upper finished splice line.** The top surface of a column shipping piece in a multi-tier building. The top of the shipping piece does not include detail material such as splice plates or erection aids.

**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.

**Working points.** *Work points*, or *working points*, are points that occur at the intersection of working lines. Working lines are the centerlines of members in trusses, beams, columns, or vertical and horizontal bracing, except in an unsymmetrical cross section for which the working line is the neutral axis. This definition does not apply to member work points and working lines as defined in Section 11.2.2.2 or Section 11.3 of *this Code*. 
ABBREVIATIONS

The following abbreviations are used in this Code. The abbreviations are written out where they first appear within a Section.

AASHTO (American Association of State Highway and Transportation Officials)
AESS (architecturally exposed structural steel)
AISC (American Institute of Steel Construction)
ANSI (American National Standards Institute)
AREMA (American Railway Engineering and Maintenance of Way Association)
ASD (allowable strength design)
ASME (American Society of Mechanical Engineers)
ASTM (American Society of Testing and Materials)
AWS (American Welding Society)
CAD (computer-aided design)
HSS (hollow structural section)
LRFD (load and resistance factor design)
ODRC (owner’s designated representative for construction)
ODRD (owner’s designated representative for design)
OSHA (Occupational Safety and Health Administration)
RCSC (Research Council on Structural Connections)
RFI (request for information)
SER (structural engineer of record)
SSPC (SSPC: The Society for Protective Coatings, which was formerly known as the Steel Structures Painting Council)
CODE OF STANDARD PRACTICE
FOR STEEL BUILDINGS AND BRIDGES

SECTION 1. GENERAL PROVISIONS

1.1. Scope

The Code of Standard Practice for Steel Buildings and Bridges, hereafter referred to as the Code, sets forth criteria for the trade practices involved in the design and construction of steel buildings, bridges, and other structures, and shall apply to all projects that involve fabricated structural steel. 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. Specific instructions to the contrary shall not violate any provisions of applicable building codes. The contract with the fabricator or erector shall identify by Code section number any specific instructions to the contrary not contained in the design documents or specifications. If specific instructions to the contrary have not been provided as required in this section, the provisions of the Code shall apply as written herein.

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. Some provisions in this Code have been incorporated by reference into the International Building Code; see www.aisc.org/303IBC. These sections include, but are not limited to, (1) requirements for structural design documents and specifications issued for various purposes as defined in Section 3; (2) definition of structural steel as defined in Section 2.1; (3) consideration for initial system imperfections, including fabrication and erection tolerances, as set forth in Section 11; (4) surface preparation and painting requirements as set forth in Section 3; (5) fabricator and erector quality control requirements as set forth in Section 8; and (6) requirements for fabricator and erector approval documents as set forth in Section 4. Reference is also made herein to AISC Specification for Structural Steel Buildings (ANSI/AISC 360-22) Section A4, which contains requirements for design documents and specifications issued for construction. ANSI/AISC 360 is incorporated by reference into the International Building Code (IBC) and is therefore part of the building code.

The Code is a copyrighted document and has important legal consequences. Its language has been carefully written to apply to the construction of steel buildings, bridges, and other structures. Some projects may warrant specific modifications to Code provision(s) to suit project conditions. In such cases, any modifications to the specific language of the Code should be clearly set forth in the contract documents.
The Code is a balanced, consensus document written in a “party-neutral” manner and should not be modified for the purpose of dictating a commercial advantage. To that end, Section 1.1 requires any specific instructions to the contrary unrelated to design elements (e.g., relating to commercial terms) to include a reference to the specific Code section number. This requirement is intended to ensure that all parties are aware of and specifically agree to specific instructions to the contrary that may work to the advantage of one party and to the disadvantage of another.

Extreme care should be taken to ensure that any modification is written in mandatory code language where applicable and is consistent with all other sections of the Code to result in a unified document. No modifications should be made to any Code section that violates the life safety or serviceability provisions of the applicable building code or results in a commercial advantage for any party that violates the intention of the Code to serve as a fair, balanced consensus document.

A meeting is recommended with the project stakeholders, including the owner’s designated representative for construction (ODRC), the owner’s designated representative for design (ODRD), the fabricator/erector and other parties, as appropriate, to discuss the scope of the project prior to the design documents and specifications being designated as released for construction as required by Section 3. This meeting can benefit the stakeholders in achieving a common understanding of the responsibilities and expectations of each party. Specifically, a discussion of any instructions to the contrary that modify any provisions of the Code that are applicable to the project and are included as part of the contract with the fabricator/erector should be clearly reviewed among the parties.

It is noted that the Code applies to all projects that involve fabricated structural steel regardless of what delivery method is selected by the owner. Refer to Section 3.2.

This Code is not intended to define a professional standard of care for the owner’s 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; nor 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. Dates of Referenced Specifications, Codes, and Standards

The following dated versions of documents are referenced in this Code:


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ASME B46.1—ASME B46.1-19, *Surface Texture (Surface Roughness, Waviness, and Lay)*

AREMA Manual—2021 AREMA *Manual for Railway Engineering, Volume II—Structures, Chapter 15*


ASTM A53/A53M-20, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*

ASTM A500/A500M-21, *Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes*

ASTM A501/A501M-21, *Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing*

ASTM A572/A572M-21e1, *Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel*

ASTM A618/A618M-21, *Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing*

ASTM A847/A847M-20, *Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance*

ASTM A992/A992M-20, *Standard Specification for Structural Steel Shapes*


ASTM A1085/A1085M-15, *Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)*


AWS D1.5M/D1.5—AWS D1.5M/D1.5:2020, *Bridge Welding Code*

AWS D1.8/D1.8M—AWS D1.8/D1.8M:2021, *Structural Welding Code—Seismic Supplement*

RCSC Specification—*Specification for Structural Joints Using High-Strength Bolts, 2020*

SSPC SP2—*SSPC Surface Preparation Specification No. 2, Hand Tool Cleaning, 2018*

**Commentary:**

Additionally, the following dated versions of documents are referenced in the Commentary on this Code:

AIA Document E202—2008 *Building Information Modeling Protocol Exhibit*

AIA Document E203—2013 *Building Information Modeling and Digital Data Exhibit*

AIA Document G201—2013 *Project Digital Data Protocol Form*

AIA Document G202—2013 *Project Building Information Modeling Protocol Form*

1.3. Units

In this Code, the values stated in either U.S. customary units or SI 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 SI-unit equivalents in 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 Responsibility for Identifying Contract Documents

The owner’s designated representative for construction (ODRC) shall identify all contract documents. When the design drawings and a design model are both provided, the owner’s designated representative for design (ODRD) shall specify which document is the controlling contract document. The contract documents shall establish the procedures for communicating changes to the contract documents, permitted use of design and other digital models, and restrictions on the release of these digital models to other parties.

**Commentary:**
There can be many combinations of drawings and digital models used as part of the contract documents, and to transfer information between the many entities in the design and construction processes. The communication of design information to the fabricator through the design model is permitted in this Code. This Code does not designate which of these possible documents takes precedence because of the variation in current practice. The document hierarchy is left to the ODRD and communicated through the ODRC. The ODRC must provide guidance as to which information is to be considered to have precedence if conflicts exist.
1.5. **Design Criteria**

For buildings and *other structures*, in the absence of other design criteria, the provisions in ANSI/AISC 360 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.

1.6. **Responsibility for Design**

1.6.1. When the *ODRD* provides the design, *design documents*, and *specifications*, the *fabricator* and the *erector* are not responsible for the suitability, adequacy, or building-code conformance of the design.

1.6.2. 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.

1.7. **Construction Schedule**

The *ODRC* shall provide a construction schedule in the bid documents. The period of performance by the steel *fabricator* and *erector* shall be mutually agreed upon with the *ODRC* prior to contract award.

1.8. **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.

1.9. **Existing Structures**

1.9.1. 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* or the *erector*.

1.9.2. 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*.
1.9.3. 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 the approval documents 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.

1.9.4. 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 or the erector.

1.10. Means, Methods, and Safety of Erection

1.10.1. The erector shall be responsible for the means, methods, and safety of erection of the structural steel frame.

1.10.2. The structural engineer of record (SER) shall be responsible for the structural adequacy of the design of the structure in the completed project. The SER shall not be responsible for the means, methods, and safety of erection of the structural steel frame. See also Section 7.10.

Commentary:
The erector normally establishes the methods and sequence of the work for the erection process, including the safety of the personnel involved in these activities. Special requirements should be included in the bid documents when another party prescribes erection means and methods. The erector is also in control of the stability of the structure during this activity. A site-specific or project-specific erection plan and erection bracing drawings can provide the work plan and control mechanisms to maintain safety for personnel and structural stability during erection. The ODRC, per OSHA 29 CFR 1926 Subpart R—Steel Erection, provides information and support to the erector to assure safety and structural stability. The ODRD provides the required information related to structural stability as required by Section 7.10.1.

1.11. Tolerances

Tolerances for materials, fabrication, and erection shall be as stipulated in Sections 5, 10, and 11. Tolerances absent from this Code or the contract documents shall not be considered zero by default.

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 11. 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.

1.12. Marking of Protected Zones in Seismic Force-Resisting Systems

The fabricator shall permanently mark protected zones that are designated on the structural design documents in accordance with ANSI/AISC 341, Section A4.1. If these markings are obscured in the field, such as after the application of fire protection, the ODRC shall re-mark the protected zones as they are designated on the structural design documents.
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 documents*, essential to support the design loads and described as follows:

- **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
- Machinery supports, if made from *standard structural shapes* and/or plates and attached to the *structural steel* frame
- Marquee framing, if made from *standard structural shapes* and/or plates
- 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*
The *fabricator* normally fabricates the items listed in Section 2.1. Such items
    should be shown, sized, and described in the structural *design documents*.
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.

**Commentary:**

Base plates, if not part of the *structural steel* frame
Bearing plates, if not part of the *structural steel* frame
Bearings, if nonsteel
Cables for permanent bracing or suspension systems
Castings
Catwalks
Chutes
Cold-formed steel products
Cold-rolled steel products, except those that are specifically covered in ANSI/
    AISC 360
Corner guards
Crane rails, splices, bolts, and clamps
Crane stops, if not made from *standard structural shapes* or plates

**2.2. Other Steel, Iron, or Metal Items**

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

Base plates, if not part of the *structural steel* frame
Bearing plates, if not part of the *structural steel* frame
Bearings, if nonsteel
Cables for permanent bracing or suspension systems
Castings
Catwalks
Chutes
Cold-formed steel products
Cold-rolled steel products, except those that are specifically covered in ANSI/
    AISC 360
Corner guards
Crane rails, splices, bolts, and clamps
Crane stops, if not made from *standard structural shapes* or plates

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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
Ornamental metal framing
Other miscellaneous metal not already listed
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
Steel used as piling or piling accessories
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. 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.

Stainless steel is not covered in this Code. AISC 370, AISC 313, and Design Guide 27, Structural Stainless Steel, are sources of useful information regarding the practical fabrication and installation issues associated with structural stainless steel components.
SECTION 3. DESIGN DOCUMENTS AND SPECIFICATIONS

The issuing of design documents and specifications shall be by the owner’s designated representative for design (ODRD). The releasing of design documents and specifications shall be by an owner, owner’s designated representative for construction (ODRC), or other party. Design documents and specifications shall be released in accordance with Section A4.2 of ANSI/AISC 360.

**Commentary:**
Refer to the ANSI/AISC 360, Commentary Section A4.2, for guidelines related to the issuance and release of design documents and specifications on a project.

3.1. Structural Design Documents and Specifications Issued for Construction

Structural design documents and specifications issued for construction for all or a portion of the work shall be based upon a completed design for the scope of work represented and provide the following information, as applicable, to define the work to be fabricated and erected:

(a) Information as required by the applicable building code.
(b) Information as required in ANSI/AISC 360 Section A4 and ANSI/AISC 341 Section A4.
(c) Shop painting and surface preparation requirements. Specific members or portions thereof that are to be left unpainted shall be identified. When shop painting is required, the paint system requirements shall be specified, including (1) the identification of specific members or portions thereof to be painted; (2) the surface preparation that is required for these members; (3) the paint specifications and manufacturer’s product identification, including color requirements, if any, that are required for these members; (4) the minimum dry-film shop-coat thickness that is required for these members; (5) identification of compatible shop applied and field applied paint systems in multi-coat application; and (6) the party or subcontractor responsible for field touch-up including repair of shipping and handling damage after shop application(s). The absence of the foregoing information for bidding purposes shall result in provisions for related work to be absent from the bid. When the actual information becomes available subsequent to bidding, the contract price and schedule shall be adjusted equitably in accordance with Sections 9.4 and 9.5.
(d) Designation of members to which the requirements of Section 10 for AESS apply.
(e) Where leveling plates are to be furnished, their locations and required thickness and sizes.

The structural design documents, specifications, and addenda shall be numbered and dated for the purposes of identification. Three-dimensional digital models shall contain a unique identifier.
Commentary:
In the interests of public safety, structural design documents and specifications issued for construction for all or a portion of the work must be based upon a completed design for the scope of work represented. The items listed should include contractual requirements addressed in the Code.

The engineer of record should also consider all or a portion of the specified information to be shown on structural design documents and specifications used for ordering structural steel or placing mill orders. Changes made after ordering structural steel or placing mill orders will likely lead to change orders if not properly coordinated and addressed in a timely manner prior to construction. Revisions to the design documents and specifications are covered under Section 3.6.

In some cases, the owner can benefit when reasonable latitude is allowed in the contract documents for alternatives that can reduce costs without compromising quality. However, critical requirements that are necessary to protect the owner’s interests that affect the integrity of the structure or that are necessary for the fabricator or erector to proceed with their work must be included in the contract documents issued for construction. A list of important information and requirements are provided to supplement items required for documents issued for construction in ANSI/AISC 360. This list should be modified or supplemented, if necessary, to suit actual project conditions.

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, those areas near or within connections, or those that will receive spray-applied fire protection materials. The contract documents should clearly indicate where the change in finishes start and stop so there is no confusion between all parties.

This section refers directly to “painting”. The contract documents should clearly state its applicability to other coatings, such as intumescent paint, i.e., fireproofing.

This section applies to shop painting. If project requirements are to include field painting, these requirements must be explicitly identified in the contract documents; see Section 7.17. SSPC Painting Manual, Volumes 1 and 2, 5th Edition is a useful reference for coatings and painting.

The surface preparation used for a paint system must carefully consider the intended use of the steel (i.e., interior, exterior, AESS, etc.) as it affects both the aesthetics of surface irregularities and durability against paint failure. For most interior commercial applications, durability is not normally a concern as discussed in the ANSI/AISC 360, Commentary Section M3. However, if surface irregularities from mill scale, whether coated or not, or accumulated rust would be visually objectionable, then an SP6 preparation should be considered because a less aggressive preparation will not remove all tightly adhered mill scale and may not remove all rust from material stored outside. A mockup can be useful to demonstrate the impact of an SP6 preparation on surface irregularities.

For interior corrosive environments and exterior applications, an SP6 preparation is generally regarded as the minimum level of preparation necessary to provide adequate durability against paint failure. However, for other types of coatings (e.g., hot dip galvanizing), that may not be the case.
3.2. Structural Design Documents and Specifications
Issued as Contract Documents

3.2.1. Traditional Design-Bid-Build Delivery Method

Structural design documents and specifications issued as the basis for contract documents shall provide the information as specified in Section 3.1 for structural design documents and specifications issued for construction.

3.2.2. Alternate Delivery Methods

When an alternative delivery method is implemented and structural design documents and specifications not meeting all the listed requirements of Section 3.2.1 are issued as contract documents, the listed information not specified shall be acknowledged in the contract with the fabricator and the erector. The contract documents shall convey the character, quantity, and complexity of the structural steel to be fabricated and erected so that the fabricator and erector can provide bids that are accurate and complete. The information furnished shall include the following items as minimum requirements:

(a) The section, size, material grade, and location of members.
(b) Geometry and work points necessary for layout.
(c) Column base, floor, and roof elevations.
(d) Column centers and offsets.
(e) When the requirements of ANSI/AISC 341 are applicable, the information required in ANSI/AISC 341, Section A4.
(f) The lateral force-resisting system and connecting diaphragm elements that provide for lateral strength and stability in the completed structure.
(g) Requirements for all connections and member reinforcement as required by Sections 3.2.3 and 3.2.4. For connections that are delegated by Option 3, the engineer of record shall provide project-specific schematic connection details for all connection types based on realistic design forces to define the design intent and sufficient information for the delegated connection designer (the licensed engineer to whom the work is delegated) to understand the scope and nature of the delegated work and its relationship to the overall design. The information that is required to perform the delegated design shall be commensurate with the character and complexity of the project.

Where any of the information required for a complete design as defined in Section 3.1 for design documents and specifications issued for construction is not specified, including member reinforcement and connections that are delegated with Section 3.2.3, Option 3, allowances shall be specified in the contract and the provisions of Section 9.1.5 shall apply.

When the actual quantity and/or details of any of the required items differ from the specified allowances, including connections and all member reinforcement where delegated with Section 3.2.3, Option 3, the final contract price and schedule shall be adjusted equitably in accordance with Section 9.1.5.

When an alternative project delivery method is selected, release of the structural design documents and specifications shall constitute a release for the purpose stated on the design documents and specifications that were issued by the ODRD, as specified.
in Section 3, regardless of the status of the architectural, electrical, mechanical, and other interfacing designs and contract documents. Subsequent revisions, if any, released after the design documents and specifications are released for construction, shall be the responsibility of the owner and shall be made in accordance with Sections 3.6 and 9.3.

Commentary:
The Code has been modified to clarify the requirements for design documents and specifications issued for construction (refer to the Glossary for the definition of issued for construction) and issued for contract documents (design drawings and/or digital model, where applicable, specifications, and the contract with the fabricator or erector). Documents issued for construction for all or a portion of the work are subject to the requirements of Section 3.1. Design documents issued as the basis of a contract for structural steel fabrication and erection are covered in a new Section 3.2. Section 3.2 now addresses all the items formerly located in Sections 3.1.1 and 3.1.2 of the 2016 Code, including member reinforcement (such as stiffeners, web doubler plates, and beam bearing stiffeners) away from connections and at locations of connections. Any of these items, or other items that are not defined on partially complete documents issued for contract documents as stated in Section 3.2.2 for alternate delivery methods, should be treated as an allowance by the various stakeholders to a contract. The requirements for an allowance are covered in Section 9.1.5, including the commentary, which further explains their purpose and application.

Contract documents can vary greatly in complexity and completeness depending on the delivery method utilized for the project. Nonetheless, the fabricator and erector must be able to rely upon the accuracy and completeness of the contract documents for bidding. This allows the fabricator and erector to provide the owner with bids that are adequate and complete.

This section lists the minimum requirements for contract documents. If partially complete documents are issued for contract documents, the parties (including, but not limited to, the owner, owner’s representatives for design and construction, the fabricator, and erector) should collaborate to reach mutual agreement on what information is not specified and document in writing what allowances are to be included with appropriate contingencies for the uncertainty (including allowances for member reinforcement and connections where Option 3 is specified). Any contracts can then be executed according to the provisions of Section 9.1.5 for reconciliation by change order after the design of the missing information is completed. Refer to Commentary Section 9.1.5.

Alternative project delivery methods other than the traditional design-bid-build method generally provide for a condensed schedule for the design and construction of a project in an effort to reduce overall cost of a project. The owner elects to release for construction the structural design documents and specifications, which may be partially complete, at a time that may precede the completion of and coordination with architectural, mechanical, electrical, and other design work and contract documents. The release of the structural design documents and specifications may also precede the release of the General Conditions and Division 1 Specifications.
Release of the structural design documents and specifications to the fabricator for ordering of material constitutes a release for construction. Accordingly, the fabricator and the erector may begin their work based upon those partially complete documents. As the structural, architectural, mechanical, electrical, and other design documents for the project are completed, revisions are likely required in design and/or construction. Thus, when considering these alternative project delivery methods, the owner should evaluate the potential benefits to the project schedule and cost along with the added cost of changes that are likely to occur. A project cost contingency is necessary to allow for these subsequent changes. The potential cost savings to the project is net of the cost of these design and construction changes.

3.2.3. Requirements for Connections

The ODRD shall indicate one of the following options for each connection:

(1) Option 1: The complete connection design shall be shown in the structural design documents.

(2) Option 2: The connection shall be designated in the structural design documents or specifications to be selected or completed by an experienced steel detailer. The experienced steel detailer shall utilize reference information provided in the design documents in the selection or completion of the connections. A list of other reference information, if any, provided by the detailer shall be approved by the ODRD.

(3) Option 3: The connection shall be designated in the structural design documents or specifications to be designed by a licensed engineer working for the fabricator. The following additional requirements apply:

(a) Substantiating connection information shall be provided for Option 3.

(b) The fabricator shall submit in a timely manner representative samples of the required substantiating connection information for all types of connections in the structural steel frame to the ODRD. The ODRD shall confirm in writing in a timely manner that these representative samples are consistent with the requirements of the contract documents, or shall advise what modifications are required to bring the representative samples into compliance with the requirements of the contract documents. This initial submittal and review is in addition to the requirements in Section 4.4.

(c) The licensed engineer in responsible charge of the connection design shall review and confirm in writing as part of the substantiating connection information, that the approval documents properly incorporate the connection designs. However, this review by this licensed engineer in responsible charge of the connection design does not replace the approval process of the approval documents by the ODRD in Section 4.4.

(d) The fabricator shall provide a means by which the substantiating connection information is referenced to the related connections on the approval documents for the purpose of review.
When Option 2 or 3 is specified, the owner’s designated representative for design shall provide the following connection design criteria in the structural design documents and specifications:

(a) Project specific connection details that show the conceptual configuration for the order of magnitude forces to be transferred
(b) Any restrictions on the types of connections that are permitted
(c) Data concerning the loads including shears, moments, axial forces, and transfer forces that are resisted by the individual members and their connections, sufficient to allow selection, completion, or design of the connection details while preparing the approval documents
(d) Whether the data required in Option 3 is given at the service-load level or the factored-load level
(e) Whether LRFD or ASD is to be used in the selection, completion, or design of connection details
(f) What substantiating connection information is to be provided with the approval documents to the ODRD

In all three of the preceding options, the approval process in Section 4.4 shall be followed.

Commentary:
There are three options covered in this Section:

(1) In Option 1, the ODRD shows the complete design of the connections in the structural design documents. The following information is included:

(a) All work point locations and connection geometry
(b) All plate and angle sizes, thicknesses, dimensions, and material grades
(c) All weld types, sizes, lengths, locations, and strengths
(d) All bolt sizes, grades, locations, and quantities
(e) Member setback distances from the specified work point
(f) Surface preparation at faying surfaces for bolting or for corrosion protection
(g) Any member end preparation required such as copes, blocks, cuts, or chipping
(h) In seismic applications, the information specified in ANSI/AISC 341, Section A4.2
(i) Any member reinforcement required at connections (see Section 3.2.4)
(j) Consideration of all applicable strength limit states
(k) Consideration of fit-up and constructability
(l) Any other items required for consideration in the particular connection design and detailing so that a steel detailer can detail the connection on the fabrication documents

The intent of this approach is that complete design information necessary for detailing the connection is shown in the structural design documents. 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 approval documents, applying it to the individual pieces being detailed.

(2) In Option 2, the ODRD allows an experienced steel detailer to select or complete the connections. This is commonly done by referring to loads embedded in the digital model, tables or schematic information in the structural design documents, tables in the AISC Steel Construction Manual, or other reference information approved by the ODRD, such as journal papers and recognized software output. Tables and schematic information in the structural design documents 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 documents 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 documents.

The steel detailer must be experienced and familiar with 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 documents 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 the practice to have a licensed engineer working for or retained by the fabricator design the connections, and recognizes the information required by the fabricator to do this work. The ODRD, who has the knowledge of the structure as a whole, must review and approve the approval documents, and the substantiating connection information that is requested. See Section 4.4 for the approval process.

When, under Section 3.2.3, the ODRD designates that connections are to be designed by a licensed engineer employed or retained by the fabricator, this work is incidental to, and part of the requirements for fabricating and constructing the steel frame. The licensed engineer performing the connection design is not providing a peer review of the contract documents.

The ODRD reviews the approval documents 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 documents 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 documents and specifications will help to avoid repeated changes to the approval documents due to the selection of a connection that is not acceptable to the ODRD, thereby avoiding additional cost and/or delay for revising the approval documents.

For Option 2 and Option 3, the structural design documents must indicate the design loads for connections including transfer forces. Transfer forces can be determined using the connection geometry and statics for an individual load combination. However, transfer forces must be explicitly provided by the engineer of record when connection design loads are provided as maximum/minimum member forces resulting from more than one load combination or resulting from prescriptive rules provided in the contract documents.

The structural design documents must indicate the method of design used as LRFD or ASD. In order to conform to the spirit of ANSI/AISC 360, the connections must be selected using the same method and the corresponding references.

Substantiating connection information can take many forms. When Option 2 is designated, the approval documents may suffice unless additional information is requested by the engineer of record. When Option 3 is designated, the substantiating connection information is required and may take the form of hand calculations and/or software output, and any additional information as requested by the ODRD.

When substantiating connection information is required, it is required that representative samples of that information be agreed upon prior to preparation of the approval documents, in order to avoid additional cost and/or delay for the connection redesign and/or revising that might otherwise result.

The ODRD may require that the substantiating connection information be signed and sealed for Option 3. The signing and sealing of the cover letter transmitting the approval documents and substantiating connection information may suffice. This signing and sealing indicates that a licensed 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 ODRD and the licensed engineer’s work in performing the connection design. Such a requirement may not be possible when submitting fabrication and erection models.

### 3.2.4. Requirements for Member Reinforcement

(1) At locations away from connections: stiffeners, web doubler plates, bearing stiffeners, and all other member reinforcement, where required, shall be designed by the ODRD and shown in sufficient detail in the structural design documents so that the quantity, detailing, and fabrication requirements for these items can be readily understood.
(2) At locations of connections, the following requirements shall apply to column stiffeners, web doubler plates, beam bearing stiffeners, and all other member reinforcement required to satisfy strength and equilibrium of forces through the connection:

(a) These items, if required, shall be designed by the ODRD and shown in the structural design documents so that the quantity, detailing, and fabrication requirements can be readily understood, or

(b) Where connections and member reinforcement are specified to be designed by a licensed engineer working for the fabricator, the ODRD shall provide project-specific schematic details for member reinforcement with sufficient information for a fabricator to obtain an accurate bidding quantity and any limitations regarding the type and connection of member reinforcement. If no quantities or conceptual configurations are shown, member reinforcement at connections will not be included in the bid.

Commentary:
When considering member reinforcement, Option 3 is most useful when the ODRD delegates the connection design, but has selected members to eliminate or minimize the need for member reinforcement at connections. Alternatively, the design documents should specify that the determination and design of member reinforcement at connections is delegated to the licensed engineer working for the fabricator. In such cases, the ODRD is required to provide schematic details for member reinforcement with sufficient information for bidding.

When no quantities and details are shown for column stiffeners, web doubler plates, beam bearing stiffeners, and/or other member reinforcement required to satisfy strength and equilibrium of forces through connections, the fabricator’s bid reflects no allowance for these items. Should it subsequently be determined that member reinforcement at connections is required, the provisions of Sections 9.4 and 9.5 then apply.

3.3. Architectural, Electrical, and Mechanical
Design Documents and Specifications

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

When the referenced information is not available at the time of structural design, bidding, detailing, or fabrication, subsequent revisions shall be the responsibility of the owner and shall be made in accordance with Sections 3.6 and 9.3.

3.4. Discrepancies

When discrepancies exist between the design documents and specifications, the design documents shall govern. When discrepancies exist between scale dimensions in the design documents and the figures written in them, the figures shall
govern. When discrepancies exist between the structural design documents and the architectural, electrical, or mechanical design documents, or the design documents for other trades, the structural design documents shall govern. When discrepancies exist between the design drawings and the design model, the governing document shall be as identified per Section 1.4.

When a discrepancy is discovered in the contract documents in the course of the fabricator’s work, the fabricator shall promptly notify the ODRC so that the discrepancy can be resolved. Such resolution shall be timely so as not to delay the fabricator’s work. See Sections 3.6 and 9.3.

It is not the fabricator’s responsibility to discover discrepancies, including those that are associated with the coordination of the various design disciplines.

3.5. 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 drawings has been ½ 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 approval documents. 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.

3.6. Revisions to the Design Documents and Specifications

Revisions to the design documents and specifications shall be made either by issuing new design documents and specifications or by reissuing the existing design documents and specifications. In either case, all revisions, including revisions that are communicated through responses to RFIs or the annotation of the approval documents (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. When the design documents are communicated using design drawings, each design drawing shall be identified by the same drawing number throughout the duration of the project, regardless of the revision. See also Section 9.3.

When revisions are communicated using design models, revisions shall be made evident in the revised design model submitted by identifying within the design model which items are changed. Alternatively, the changes shall be submitted with a written document describing in explicit detail the items that are changed. A historic tracking of changes must either be present in the revised design model or maintained in the written record of changes.

The party or entity that is contractually assigned responsibility for managing the design model shall maintain accurate accounting and tracking records of the most current design model, as well as previously superseded design models, and shall
facilitate a tracking mechanism so that all contracted parties are aware of, and have access to, the most current design model.

**Commentary:**

*Revisions* to the *design documents* and *specifications* can be made by issuing sketches and supplemental information separate from the *design documents* and *specifications*. These sketches and supplemental information become amendments to the *design documents* 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 reissuing the existing structural *design documents* 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. When the *design documents* are communicated using *design drawings*, the same unique drawing number must identify each *design drawing* throughout the duration of the project so that *revisions* can be properly tracked, thus avoiding confusion and miscommunication among the various entities involved in the project.

When *revisions* are communicated through the annotation of the *approval documents* or contractor submissions, such changes must be confirmed in writing by one of the aforementioned methods. This written confirmation is imperative to maintain control of the cost and schedule of a project and to avoid potential errors in fabrication.

When *design models* are used, a similar unique method of identifying each *revision* must be used. This method can vary in various digital modeling software, but the same level of notation of changes must be present in the revised *design model* as would be used on *design drawings*.

### 3.7 Intellectual Property

Any copyright or other property or proprietary rights owned by the *ODRD* in any content included within the *contract documents*, whether created specifically for an individual project or otherwise made available for use on an individual project, shall remain the exclusive property of the *ODRD*.
SECTION 4. APPROVAL DOCUMENTS

4.1. Owner Responsibility

The owner shall furnish, in a timely manner and in accordance with the contract documents, the complete structural design documents and specifications that have been released for construction. Unless otherwise noted, design documents and specifications that are provided as part of the contract bid documents shall constitute authorization by the owner that the design documents and specifications are released for construction.

Commentary:
When the owner issues design documents and specifications that are released for construction, the fabricator and the erector rely on the fact that these are the owner’s requirements for the project. This release is required by the fabricator prior to the ordering of material and the preparation and completion of the approval documents.

To ensure the orderly flow of material procurement, detailing, fabrication, and erection activities on phased construction projects, it is essential that designs are not continuously revised after they have been released for construction. In essence, once a portion of a design is released for construction, the essential elements of that design should be “frozen” to ensure adherence to the contract price and construction schedule. Alternatively, all parties should reach a common understanding of the effects of future changes, if any, as they affect scheduled deliveries and added costs.

A pre-detailing conference, held after the structural steel fabrication contract is awarded, can benefit the project. Typical attendees may include the owner’s designated representative for construction, the owner’s designated representative for design, the fabricator, the steel detailer, and the erector. Topics of the meeting should relate to the specifics of the project and might include the following:

• Contract document review and general project overview, including clarifications of scope of work, tolerances, layouts and sequences, and special considerations.
• Detailing and coordination needs, such as bolting, welding, and connection considerations, constructability considerations, OSHA requirements, coordination with other trades, and the advanced bill of materials.
• The project communication system, including distribution of contact information for relevant parties to the contract, identification of the primary and alternate contacts in the general contractor’s office, and the RFI system to be used on the project.
• The submittal schedule, including the method of submitting (electronic or hard copy); for hard copy, how many copies of documents are required; connection submittals; and identification of schedule-critical areas of the project, if any.
• If digital models will be used as part of the delivery method for the design documents, the parties should determine and convey the levels of development, the digital model types that will be furnished, the authorized uses of such digital models, the transmission of digital models to prevent the loss or alteration of data, interoperability, and methods of review and approval. The
term “levels of development” refers to the level of completeness of elements within the digital model (see the BIMFORUM Level of Development Specification). The term “authorized uses” refers to the permitted uses of the digital model(s) and the digital data associated with the digital model(s). Such authorized uses may include the right to (1) store and view the digital model(s) for informational purposes only; (2) rely upon, store and view the digital model(s) to carry out the work on the project; (3) reproduce and distribute the digital model(s) for informational purposes only; (4) rely upon, reproduce and distribute the digital model(s) to carry out the work; (5) incorporate additional digital data into the digital model(s) without modifying the data received to carry out the work on the project; (6) modify the digital model(s) as required to carry out the work on the project; (7) produce the digital model(s) in an archival format for the owner to use as a reference for as-built construction data and/or for the operation of the project after completion; and/or (8) other authorized uses specified in the contract documents.

- Review of quality and inspection requirements, including the approvals process for corrective work.

Record of the meeting should be written and distributed to all parties. Subsequent meetings to discuss progress and issues that arise during construction also can be helpful, particularly when they are held on a regular schedule.

4.2. Fabricator Responsibility

4.2.1. Except as provided in Section 4.5, the fabricator shall produce the approval documents for the fabrication and erection of the structural steel and is responsible for the following:

(a) The transfer of information from the contract documents into accurate and complete approval documents

(b) The development of accurate, detailed dimensional information to provide for the fit-up of parts in the field

Commentary:
The fabricator may use the services of independent steel detailers to produce approval documents and to perform other support services, such as producing advanced bills of material and bolt summaries.

As the fabricator develops the detailed dimensional information for production of the approval documents, there may be discrepancies, missing information, or conflicts discovered in the contract documents. See Section 3.4.

4.2.2. Any copyright or other property or proprietary rights owned by the fabricator in any content included within the approval documents, whether created specifically for an individual project or otherwise made available for use on an individual project, shall remain the exclusive property of the fabricator.

4.2.3. When the approval documents are shop and erection drawings, each shop and erection drawing shall be identified by the same drawing number throughout the
duration of the project and shall be identified by revision number and date, with each specific revision clearly identified. When the approval documents are fabrication and erection models, each submittal shall be uniquely identified.

When the fabricator submits a request to change connection details that are described in the contract documents, the fabricator shall notify the owner’s designated representatives for design (ODRD) and construction (ODRC) in writing in advance of the submission of the approval documents. The owner’s designated representative for design shall review and approve or reject the request in a timely manner.

When requested to do so by the ODRD, the fabricator shall provide to the ODRD and the ODRC its schedule for the submittal of approval documents so as to facilitate the timely flow of information between all parties.

Commentary:

When the fabricator intends to make a submission of alternative connection details to those shown in the contract documents, the fabricator must notify the ODRD and the ODRC in advance. This will allow the parties involved to plan for the increased effort that may be required to review the alternative connection details. In addition, the owner will be able to evaluate the potential for cost savings and/or schedule improvements against the additional design cost for review of the alternative connection details by the ODRD. This evaluation by the owner may result in the rejection of the alternative connection details or acceptance of the submission for review based upon cost savings, schedule improvements, and/or job efficiencies.

The ODRD may request the fabricator’s schedule for the submittal of the approval documents. This process is intended to allow the parties to plan for the staffing demands of the submission schedule. The contract documents may address this issue in more detail. In the absence of the requirement to provide this schedule, none need be provided.

When the fabricator provides a schedule for the submission of the approval documents, it must be recognized that this schedule may be affected by revisions and the response time to requests for missing information or the resolution of discrepancies.

4.3. Use of Digital Files or Copies of the Design Documents

The fabricator shall neither use nor reproduce any part of the design documents as part of the approval documents without the written permission of the ODRD. When digital files or copies of the design documents are made available for the fabricator’s use as part of the approval documents, the fabricator shall accept this information under the following conditions:

(a) All information contained in the digital files or copies of the design documents shall be considered instruments of service of the ODRD and shall not be used for other projects, additions to the project, or the completion of the project by others. Digital files or copies of the design documents shall remain the property of the ODRD and in no case shall the transfer of these copies of the design documents be considered a sale or unrestricted license.

(b) CAD files or copies of the design drawings shall not be considered to be contract documents. In the event of a conflict between the design drawings and the
CAD files or copies thereof, the design drawings shall govern.

(c) When a design model is made available for use by the fabricator, the ODRC shall designate whether the design model and/or other documents are to be considered the contract documents. See Section 1.4.

(d) Any party or entity that creates a copy of the design model does so at their own risk.

(e) The use of copies of the design documents shall not in any way obviate the fabricator’s responsibility for proper checking and coordination of dimensions, details, member sizes and fit-up, and quantities of materials as required to facilitate the preparation of approval documents that are complete and accurate as required in Section 4.2.

(f) If copies of design drawings are used by the fabricator, the fabricator shall remove information that is not required for the fabrication or erection of the structural steel from the copies of the design drawings.

Commentary:
Copies of the design documents often are readily available to the fabricator. As a result, the ODRD may have reduced control over the unauthorized use of the design documents. There are many copyright and other legal issues to be considered.

The ODRD may choose to make copies of the design documents available to the fabricator, and may charge a service or licensing fee for this convenience. In doing so, a carefully negotiated agreement should be established to set out the specific responsibilities of both parties in view of the liabilities involved for both parties. For sample contracts, see Consensus Docs 301 BIM Addendum, AIA Document E202 Building Information Modeling Protocol Exhibit, AIA Document E203 Building Information Modeling and Digital Data Exhibit, AIA Document G201 Project Digital Data Protocol Form, and AIA Document G202 Project Building Information Modeling Protocol Form.

Once the design model has been accessed and/or modified by any entity other than the owner’s designated representative for design, the resulting model is considered a copy of the design model and is no longer part of the contract documents.

The copies of the design documents are provided to the fabricator for convenience only. The information therein should be adapted for use only in reference to the placement of structural steel members during erection. The fabricator should treat this information as if it were fully produced by the fabricator and undertake the same level of checking and quality assurance. When amendments or revisions are made to the contract documents, the fabricator must update this reference material.

When copies of the design drawings are provided to the fabricator, they often contain other information, such as architectural backgrounds or references to other contract documents. This additional material should be removed when producing the approval documents to avoid the potential for confusion.

Just like the transmission of the design documents created by the owner’s designated representative for design does not convey ownership rights in the design documents, the transmission of the approval documents created by the fabricator does not convey ownership rights in the approval documents.
4.4. **Approval**

The *approval documents* shall be submitted to the **ODRD** and the **ODRC** for review and approval. The *approval documents* shall be returned to the **fabricator** within 14 calendar days.

Final *substantiating connection information* shall also be submitted with the *approval documents* when Option 3 is designated, and as required in the *contract documents* when Option 2 is designated. The **ODRD** is the final authority in the event of a disagreement between parties regarding the design of *connections* to be incorporated into the overall *structural steel* frame. The **fabricator** and licensed **engineer** in responsible charge of *connection* design are entitled to rely upon the *connection* design criteria provided in accordance with Section 3.2. *Revisions* to these criteria shall be addressed in accordance with Sections 9.3 and 9.4.

Approved *approval documents* shall be individually annotated by the **ODRD** and the **ODRC** as either approved or approved subject to corrections noted. When so required, the **fabricator** shall subsequently make the corrections noted and furnish corrected *fabrication* and *erection documents* to the **ODRD** and the **ODRC**.

**Commentary:**

As used in this *Code*, the 14-day allotment for the return of *approval documents* is intended to represent the **fabricator**’s portal-to-portal time. The intent in this *Code* is that, in the absence of information to the contrary in the *contract documents*, 14 days may be assumed for the purposes of bidding, contracting, and scheduling. When additional time is desired, such as when *substantiating connection information* is part of the submittals, the modified allotment should be specified in the *contract documents*. A submittal schedule is commonly used to facilitate the approval process.

If the *approval documents* are approved subject to corrections noted, the **ODRD** may or may not require that it be resubmitted for record purposes following correction. If the *approval documents* are not approved, *revisions* must be made and the documents resubmitted until approval is achieved.

4.4.1. Approval, approval subject to corrections noted, and similar approvals of the *approval documents* shall constitute the following:

(a) Confirmation that the **fabricator** has correctly interpreted the *contract documents* in the preparation of those submittals.

(b) Confirmation that the **ODRD** has reviewed and approved the *connection* details shown in the *approval documents* submitted in accordance with Section 3.2.3.

(c) Release by the **ODRD** and the **ODRC** for the **fabricator** to begin fabrication using the approved submittals.

Such approval shall not relieve the **fabricator** of the responsibility for either the accuracy of the detailed dimensions in the *approval documents* or the general fit-up of parts that are to be assembled in the field.

The **fabricator** shall determine the fabrication schedule that is necessary to meet the requirements of the contract.
Commentary:
When considering the current language in this Section, the Committee sought language that would parallel the practices of CASE. In CASE Document 962, CASE indicates that when the design of some element of the primary structural system is left to someone other than the structural engineer of record, “…such elements, including connections designed by others, should be reviewed by the structural engineer of record. He [or she] should review such designs and details, accept or reject them and be responsible for their effects on the primary structural system.” Historically, this Code has embraced this same concept.

From the inception of this Code, AISC and the industry in general have recognized that only the ODRD has all the information necessary to evaluate the total impact of connection details on the overall structural design of the project. This authority traditionally has been exercised during the approval process for the approval documents. The ODRD has thus retained responsibility for the adequacy and safety of the entire structure since at least the 1927 edition of this Code.

4.4.2. Unless otherwise noted, any additions, deletions or revisions that are indicated in responses to RFIs or on the approved approval documents shall constitute authorization by the owner that the additions, deletions, or revisions are released for construction. The fabricator and the erector shall promptly notify the ODRC when any direction or notation in responses to RFIs or on the approval documents or other information will result in an additional cost and/or a delay. See Sections 3.6 and 9.3.

Commentary:
When the fabricator notifies the ODRC that a direction or notation in responses to RFIs or on the approval documents will result in an additional cost or a delay, it is then normally the responsibility of the ODRC to subsequently notify the ODRD.

4.5. Fabrication and/or Erection Documents Not Furnished by the Fabricator

When the fabrication and erection documents are not prepared by the fabricator, but are furnished by others, they shall be reviewed and approved by the ODRD and final fabrication and erection documents shall be delivered to the fabricator in a timely manner. These fabrication and erection documents shall be prepared, insofar as is practical, in accordance with the shop fabrication and detailing standards of the fabricator. The fabricator shall not be responsible for the completeness, coordination, or accuracy of fabrication and erection documents so furnished, nor for the general fit-up of the members that are fabricated in accordance with the documents provided.

Commentary:
Preparation of fabrication and erection documents by parties other than the fabricator carries significant risks for the project team and should only be undertaken after careful consideration of these risks.
The preparation of the fabrication and erection documents is very specific to the needs of the fabricator performing the work, and an integral part of the constructability and coordination assurance of the project. If a party other than the fabricator prepares the fabrication and erection documents, the contract documents should be very clear as to the management of this process, including the manner in which the following issues will be addressed:

- Review and approval of the fabrication and erection documents by the ODRD.
- Standards, format and contents of the fabrication and erection documents, or representative documents that will be part of the contract documents, for the mill order, field bolts, and numerical control files for fabrication.
- Provisions for proper risk management (errors and omissions or product liability, as applicable).
- Licensing of proprietary products and technology, and any associated fees.
- Incorporation of normal “pre-detailing” sequencing, erection aids, other OSHA Sub Part R requirements, or other local or regional safety requirements.
- Specific shop standards including preferred marking system of members, standard material sizes, and field considerations such as erection issues related to site access and erection clearances.
- Timing and content of information necessary for material to be sourced, ordered, delivered, stored, fabricated, and shipped to accommodate the construction schedule.
- Schedule updates for documents and tracking of impact to overall project schedule and contract, as these dates are impacted.
- Revision and control of fabrication and erection documents in order to maintain the integrity of all parts of the fabrication and erection process.
- Late released items that impact such items as, but not limited to, fabrication resource allocation, delivery dates and erection sequences, particularly if the late released items are on the project’s critical path or delay the release of critical path items. Late released items include items not completed due to lack of design information, items requiring additional information from the designer, or items affected by others, such as owner’s design changes or modifications to the construction sequence by the ODRC.
- Fabrication phase support, including issues that arise on night shift and weekends.
- Protocol for handling delays in the field, including responsibility for standby costs of labor or equipment.
- Coordination of joist, deck, and other manufactured items, including coordination and addressing of requests for information.
- Resolution of field issues and construction phase requests for information.

4.6. The RFI Process

When requests for information (RFIs) are issued, the process shall include the maintenance of a written record of inquiries and responses related to interpretation and implementation of the contract documents, including the clarifications and/or revisions to the contract documents that result, if any. RFIs shall not be used for the...
incremental *release for construction* of the *design documents*. When *RFIs* involve discrepancies or *revisions*, see Sections 3.4, 3.6, and 4.4.2.

When a *design model* is used as the *design documents*, the changes and/or *clarifications* made in response to *RFIs* shall be incorporated into the *design model*.

**Commentary:**

The *RFI* process is most commonly used during the detailing process, but can also be used to forward inquiries by the *erector* or to inform the *ODRD* in the event of a *fabricator* or *erector* error and to develop corrective measures to resolve such errors.

The *RFI* process is intended to provide a written record of inquiries and associated responses but not to replace all verbal communication between the parties on the project. *RFIs* should be prepared and responded to in a timely fashion so as not to delay the work of the *steel detailer*, *fabricator*, and *erector*. Discussion of the *RFI* issues and possible solutions between the *fabricator*, *erector*, and *ODRD* and the *ODRC* often can facilitate timely and practical resolution. Unlike submittals in Section 4.4, *RFI* response time can vary depending on the urgency of the issue, the amount of work required by the *ODRD* and the *ODRC* to develop a complete response, and other circumstances, such as building official approval.

*RFIs* should be prepared in a standardized format, including *RFI* number and date, identity of the author, reference to a specific location(s) in the *design documents* or *specification* section, the needed response date, a description of a suggested solution (graphic depictions are recommended for more complex issues), and an indication of possible schedule and cost impacts. *RFIs* should be limited to one question each (unless multiple questions are interrelated to the same issue) to facilitate the resolution and minimize response time. Questions and proposed solutions presented in *RFIs* should be clear and complete. *RFI* responses should be equally clear and complete in the depictions of the solutions, and signed and dated by the responding party.

Unless otherwise noted, the *fabricator* and *erector* can assume that a response to an *RFI* constitutes a *release for construction*. However, if the response will result in an increase in cost or a delay in schedule, Section 4.4.2 requires that the *fabricator* and/or *erector* promptly inform the *ODRD* and the *ODRC*.

### 4.7 Erection Documents

The *erection documents* shall be provided to the *erector* in a timely manner so as to allow the *erector* to properly plan and perform the work.

**Commentary:**

For planning purposes, this may include release of preliminary *erection documents*, if requested by the *erector*.
SECTION 5. MATERIALS

5.1. Mill Materials

Unless otherwise noted in the contract documents, the fabricator is permitted to order the materials that are necessary for fabrication when the fabricator receives contract documents that have been released for construction.

Commentary:
The fabricator may purchase materials in stock lengths, exact lengths, or multiples of exact lengths to suit the dimensions shown in the structural design documents. Such purchases will normally be job-specific in nature and may not be suitable for use on other projects or returned for full credit if subsequent design changes make these materials unsuitable for their originally intended use. The fabricator should be paid for these materials upon delivery from the mill, subject to appropriate additional payment or credit if subsequent unanticipated modification or reorder is required. Purchasing materials to exact lengths is not considered fabrication.

5.1.1. Unless otherwise specified by means of special testing requirements in the contract documents, mill testing shall be limited to those tests that are required for the material in the ASTM specifications indicated in the contract documents. Materials shall be marked by the supplier as specified in applicable ASTM standard specifications prior to delivery to the fabricator’s shop or other point of use. Such material not so marked by the supplier, shall not be used until

(a) Its identification is established by means of testing in accordance with the applicable ASTM specifications
(b) A fabricator’s identification mark, as described in Section 6.1 has been applied

5.1.2. When mill material does not satisfy applicable ASTM tolerances for camber, profile, flatness, or sweep, the fabricator is permitted to perform corrective procedures, including the use of controlled heating and/or mechanical straightening, subject to the limitations in ANSI/AISC 360.

Commentary:
Dimensional tolerances for rolled mill material are set forth in ASTM A6/A6M. Likewise, dimensional tolerances for HSS and pipe material are set forth in the applicable ASTM standard specifications. Normal variations in the cross-sectional geometry of standard structural shapes must be recognized by the designer, the fabricator, the steel detailer, and the erector (for example, see Figure C-5.1). Such tolerances are mandatory because roll wear—thermal distortions of the hot cross section immediately after leaving the forming rolls and differential cooling distortions that take place on the cooling beds—are all unavoidable. Geometric perfection of the cross section is not necessary for either structural or architectural reasons if the tolerances are recognized and provided for.
Fig. C-5.1. Mill tolerances on the cross section of a W-shape.
ASTM standard specifications also stipulate tolerances for straightness that are adequate for typical construction. However, these characteristics may be controlled or corrected to closer tolerances during the fabrication process when the added cost is justified by the special requirements for an atypical project.

5.1.3. When variations that exceed ASTM A6/A6M tolerances are discovered or occur after the receipt of mill material, the fabricator shall, at the fabricator’s option, be permitted to perform the ASTM A6/A6M corrective procedures for mill reconditioning of the surface of structural steel shapes and plates.

5.1.4. When special tolerances that are more restrictive than those in the applicable ASTM standard specifications are required for mill materials, such special tolerances shall be specified in the contract documents. The fabricator shall, at the fabricator’s option, be permitted to order material to the applicable ASTM standard specifications tolerances and subsequently perform the corrective procedures described in Sections 5.1.2 and 5.1.3.

5.2. Stock Materials

5.2.1. If used for structural purposes, materials that are taken from stock by the fabricator shall be of a quality that is at least equal to that required in the ASTM specifications indicated in the contract documents.

5.2.2. Material test reports shall be accepted as sufficient record of the quality of materials taken from stock by the fabricator. The fabricator shall review and retain the material test reports that cover such stock materials. However, the fabricator need not maintain records that identify individual pieces of stock material against individual material test reports, provided the fabricator purchases stock materials that meet the requirements for material grade and quality in the applicable ASTM specifications.

5.2.3. Stock materials that are purchased under no particular specification, under a specification that is less rigorous than the applicable ASTM specifications, or without material test reports or other recognized test reports shall not be used without the approval of the owner’s designated representative for design.
SECTION 6. SHOP FABRICATION AND DELIVERY

6.1. Identification of Material

6.1.1. The fabricator shall be able to demonstrate by written procedure and actual practice a method of material identification, visible up to the point of assembling members as follows:

(a) For shop-standard material, identification capability shall include shape designation. Representative material test reports shall be furnished by the fabricator if requested to do so by the owner’s designated representative for design (ODRD), either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

(b) For material of grade other than shop-standard material, identification capability shall include shape designation and material grade. Representative material test reports shall be furnished by the fabricator if requested to do so by the ODRD, either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

(c) For material ordered in accordance with an ASTM supplement or other special material requirements in the contract documents, identification capability shall include shape designation, material grade, and heat number. The corresponding material test reports shall be furnished by the fabricator if requested to do so by the ODRD, either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

Unless an alternative system is established in the fabricator’s written procedures, shop-standard material shall be as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Shop-Standard Material Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>W and WT</td>
<td>ASTM A992/A992M</td>
</tr>
<tr>
<td>M, S, MT, and ST</td>
<td>ASTM A572/A572M Grade 50</td>
</tr>
<tr>
<td>HP</td>
<td>ASTM A572/A572M Grade 50</td>
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<tr>
<td>L</td>
<td>ASTM A572/A572M Grade 50</td>
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<tr>
<td>C and MC</td>
<td>ASTM A992/A992M</td>
</tr>
<tr>
<td>HSS</td>
<td>ASTM A500/A500M Grade C</td>
</tr>
<tr>
<td>Steel Pipe</td>
<td>ASTM A53/A53M Grade B</td>
</tr>
<tr>
<td>Plates and Bars</td>
<td>ASTM A572/A572M Grade 50</td>
</tr>
</tbody>
</table>

Commentary:
The requirements in Section 6.1.1(a) will suffice for most projects. When material is of a strength level that differs from the shop-standard grade, the requirements in Section 6.1.1(b) apply. When special material requirements apply, such as ASTM A6/A6M Supplement S5 or S30 for Charpy V-notch impact testing or ASTM A6/A6M Supplement S8 for ultrasonic testing, the requirements in Section 6.1.1(c) are applicable.
6.1.2. During fabrication, up to the point of assembling members, each piece of material that is ordered to special material requirements shall carry a fabricator’s identification mark or an original supplier’s identification mark. The fabricator’s identification mark shall be in accordance with the fabricator’s established material identification system, which shall be on record and available prior to the start of fabrication for the information of the owner’s designated representative for construction (ODRC), the building code authority, and the inspector.

6.1.3. Members that are made of material that is ordered to special material requirements shall not be given the same assembling or erection mark as members made of other material, even if they are of identical dimensions and detail.

6.2. Preparation of Material

6.2.1. The thermal cutting of structural steel by hand-guided or mechanically guided means is permitted.

6.2.2. Surfaces that are specified as “finished” in the contract documents shall have a roughness height value measured in accordance with ASME B46.1 that is equal to or less than 500 μin. (12.5 μm). The use of any fabricating technique that produces such a finish is permitted.

**Commentary:**
Most cutting processes, including friction sawing and cold sawing, and milling processes meet a surface roughness limitation of 500 μin. (12.5 μm) per ASME B46.1.

6.3. Fitting and Fastening

6.3.1. Projecting elements of connection materials need not be straightened in the connecting plane, subject to the limitations in ANSI/AISC 360.

6.3.2. Backing and runoff tabs shall be used in accordance with AWS D1.1/D1.1M as required to produce sound welds. The fabricator or erector need not remove backing or runoff tabs unless such removal is specified in the contract documents. When the removal of backing is specified in the contract documents, such removal shall meet the requirements in AWS D1.1/D1.1M. When the removal of runoff tabs is specified in the contract documents, hand flame-cutting close to the edge of the finished member with no further finishing is permitted, unless other finishing is specified in the contract documents.

**Commentary:**
In most cases, the treatment of backing and runoff tabs is left to the discretion of the ODRD. In some cases, treatment beyond the basic cases described in this section may be required. As one example, special treatment is required for backing and runoff tabs in beam-to-column moment connections when the requirements in ANSI/AISC 341 must be met. In all cases, the ODRD should specify the required treatments in the contract documents.
6.3.3. Unless otherwise noted in the fabrication documents, high-strength bolts for shop-attached connection material shall be installed in the shop in accordance with the requirements in ANSI/AISC 360.

6.4. Shop Cleaning and Painting (see also Section 3.1)

Structural steel that does not require shop paint shall be cleaned of oil and grease with solvent cleaners, and of dirt and other foreign material, by sweeping with a fiber brush or other suitable means. For structural steel that is required to be shop painted, the requirements in Sections 6.4.1 through 6.4.4 shall apply.

Commentary:
Extended exposure of unpainted structural steel that has been cleaned for the subsequent application of fire protection materials can be detrimental to the fabricated product. Most levels of cleaning require the removal of all loose mill scale but permit some amount of tightly adhering mill scale. When a piece of structural steel that has been cleaned to an acceptable level is left exposed to a normal environment, moisture can penetrate behind the scale, and some "lifting" of the scale by the oxidation process is to be expected. Cleanup of "lifted" mill scale is not the responsibility of the fabricator, but is to be assigned by contract requirement to an appropriate contractor.

Section 6.4.3 of this Code is not applicable to weathering steel, for which special cleaning specifications are always required in the contract documents.

6.4.1. Unless otherwise specified in the contract documents, the fabricator shall, as a minimum, hand clean the structural steel of loose rust, loose mill scale, dirt, and other foreign matter prior to painting, by means of wire brushing or by other methods elected by the fabricator, to meet the requirements of SSPC-SP2. If the fabricator’s workmanship on surface preparation is to be inspected by the inspector, such inspection shall be performed in a timely manner prior to the application of the shop coat.

Commentary:
The selection of a paint system is a design decision involving many factors including the following:

(a) The owner’s preference
(b) The service life of the structure
(c) The severity of environmental exposure
(d) The cost of both initial application and future renewals
(e) The compatibility of the various components that comprise the paint system (surface preparation, shop coat, and subsequent coats)

Because the inspection of shop painting must be concerned with workmanship at each stage of the operation, the fabricator provides notice of the schedule of operations and affords the inspector access to the work site. Inspection must then be coordinated with that schedule so as to avoid delay of the scheduled operations.
Acceptance of the prepared surface must be made prior to the application of the required shop coat(s) because the degree of surface preparation cannot be readily verified after painting. Time delay between surface preparation and the application of the required shop coat(s) can result in unacceptable deterioration of a properly prepared surface, necessitating a repetition of surface preparation. This is especially true with blast-cleaned surfaces. The required shop coat(s) in any paint system is designed to maximize the wetting and adherence characteristics of the paint, usually at the expense of its weathering capabilities. Deterioration of the required shop coat(s) normally begins immediately after exposure to the elements and worsens as the duration of exposure is extended. Consequently, extended exposure of the required shop coat(s) will likely lead to its deterioration and may necessitate repair, possibly including the repetition of surface preparation and shop coat application in limited areas. With the introduction of high-performance paint systems, avoiding delay in the application of the shop coat has become more critical. High-performance paint systems generally require a greater degree of surface preparation, as well as early application of weathering protection for the required shop coat(s).

Because the fabricator does not control the selection of the paint system, the compatibility of the various components of the total paint system, or the length of exposure of the required shop coat(s), the fabricator cannot guarantee the performance of the required shop coat(s) or any other part of the system. Instead, the fabricator is responsible only for accomplishing the specified surface preparation and for applying the required shop coat(s) in accordance with the contract documents.

This Section stipulates that the structural steel is to be cleaned to meet the requirements in SSPC-SP2. This stipulation is not intended to represent an exclusive cleaning level, but rather the level of surface preparation that will be furnished unless otherwise specified in the contract documents if the structural steel is to be painted.

6.4.2. Unless otherwise specified in the contract documents, paint shall be applied by brushing, spraying, rolling, flow coating, dipping, or other suitable means, at the election of the fabricator. When the term “shop coat,” “shop paint,” or other equivalent term is used with no paint system specified, the fabricator’s standard shop paint shall be applied to a minimum dry-film thickness of one mil (0.025 mm). Unless specifically provided for in the contract documents, the properties of the optional shop coat are at the discretion of the fabricator.

6.4.3. Touch-up of abrasions caused by shipping and handling after painting shall be the responsibility of the contractor that performs touch-up in the field or field painting.

**Commentary:**
Touch-up in the field and field painting are not normally part of the fabricator’s or the erector’s contract.
6.4.4. The fabricator is not responsible for deterioration of the shop-applied paint when the paint is exposed to atmospheric conditions or corrosive conditions that are more severe than the intended use of the paint; or when painted members are stored for unanticipated durations due to project delays not caused by the fabricator. Handling damage or damage during transportation is not the responsibility of the fabricator unless the painted material is under the direct control of the fabricator or a subcontractor of the fabricator.

**Commentary:**
Paint systems are designed by the manufacturer to perform for a specific amount of time in specific environments. The appropriateness of a paint system and its required application is provided in the paint manufacturer’s technical data sheet. If the painted material is used or stored in conditions that are beyond the paint system’s design intent and the fabricator can show that they followed the directions of the paint data sheet, the fabricator is not responsible if the system fails to perform.

It is common practice that the fabricator temporarily stores the painted material at their plant or a third-party coating subcontractor until it is loaded for shipment. Once the painted material leaves the direct control of the fabricator or a subcontractor of the fabricator, the fabricator cannot be held responsible for damage.

6.5. Marking and Shipping of Materials

6.5.1. Unless otherwise specified in the contract documents, erection marks shall be applied to the structural steel members by painting or other suitable means.

6.5.2. Bolt assemblies and loose bolts, nuts, and washers shall be shipped in separate closed containers according to length and diameter, as applicable. Pins and other small parts and packages of bolts, nuts, and washers shall be shipped in boxes, crates, kegs, or barrels. A list and description of the material shall appear on the outside of each closed container.

**Commentary:**
In most cases, bolts, nuts, and other components in a fastener assembly can be shipped loose in separate containers. However, there are exceptions:

- ASTM F3125/F3125M Grades F1852 and F2280 twist-off-type tension-control bolt assemblies must be assembled and shipped in containers according to grade, length, and diameter.
- Galvanized ASTM F3125/F3125M Grade A325 and A325M bolts and their corresponding ASTM A563 or A563M nuts must be shipped in the same container according to length and diameter.

See these ASTM standards for the applicable requirements and the RCSC Specification for further explanation.
6.6. **Delivery of Materials**

6.6.1. Fabricated *structural steel* shall be delivered in a sequence that will permit efficient and economical fabrication and erection, and that is consistent with requirements in the *contract documents*. If the *owner* or *ODRC* wishes to prescribe or control the sequence of delivery of materials, that entity shall specify the required sequence in the *contract documents*. If the *ODRC* contracts separately for delivery and for erection, the *ODRC* shall coordinate planning between contractors.

6.6.2. *Anchor rods*, washers, nuts, and other anchorage or grillage materials that are to be built into concrete or masonry shall be shipped so that they will be available when needed. The *ODRC* shall allow the *fabricator* sufficient time to fabricate and ship such materials before they are needed.

6.6.3. If any shortage is claimed relative to the quantities of materials that are shown in the shipping statements, the *ODRC* or the *erector* shall promptly notify the *fabricator* so that the claim can be investigated.

**Commentary:**
The quantities of material that are shown in the shipping statement are customarily accepted as correct by the *ODRC*, the *fabricator*, and the *erector*.

6.6.4. Unless otherwise specified in the *contract documents*, and subject to the approved *approval documents*, the *fabricator* shall limit the number of field splices to that consistent with minimum project cost.

**Commentary:**
This section recognizes that the size and weight of *structural steel* assemblies may be limited by shop capabilities, the permissible weight, and clearance dimensions of available transportation or jobsite conditions.

6.6.5. If material arrives at its destination in damaged condition, the receiving entity shall promptly notify the *fabricator* and carrier prior to unloading the material or promptly upon discovery prior to erection.
SECTION 7. ERECTION

7.1. Method of Erection

Fabricated structural steel shall be erected using methods and a sequence that will permit efficient and economical performance of erection, and that is consistent with the requirements in the contract documents. If the owner or owner’s designated representative for construction (ODRC) wishes to prescribe or control the method and/or sequence of erection, or specifies that certain members cannot be erected in their normal sequence, that entity shall specify the required method and sequence in the contract documents. If the ODRC contracts separately for fabrication services and for erection services, the ODRC shall coordinate planning between contractors.

Commentary:
Design modifications and/or erection aids are sometimes requested by the erector to allow or facilitate the erection of the structural steel frame. When this is the case, the erector should notify the fabricator prior to the preparation of the approval documents so that the fabricator may refer the erector’s request to the owner’s designated representatives for design and construction for resolution.

7.2. Jobsite Conditions

The ODRC shall provide and maintain the following for the fabricator and the erector:

(a) Adequate access roads into and through the jobsite for the safe delivery and movement of the material to be erected and of derricks, cranes, trucks, and other necessary equipment under their own power
(b) A firm, properly graded, drained, convenient, and adequate space at the jobsite for the operation of the erector’s equipment, free from overhead obstructions, such as power lines, telephone lines, or similar conditions
(c) Adequate storage space, when the structure does not occupy the full available jobsite, to enable the fabricator and the erector to operate at maximum practical speed

Otherwise, the ODRC shall inform the fabricator and the erector of the actual jobsite conditions and/or special delivery requirements prior to bidding.

7.3. Foundations, Piers, and Abutments

The accurate location, strength, and suitability of, and access to, all foundations, piers, and abutments shall be the responsibility of the ODRC.

7.4. Lines and Benchmarks

The ODRC shall be responsible for the accurate location of lines and benchmarks at the jobsite and shall furnish the erector with a plan that contains all such information. The ODRC shall establish offset lines and reference elevations at each level for the erector’s use in the positioning of adjustable items (see Section 11.3.1.3), if any.
7.5. Installation of Anchor Rods, Foundation Bolts, and Other Embedded Items

7.5.1. Anchor rods, foundation bolts, and other embedded items shall be set by the ODRC in accordance with embedment drawings that have been approved by the owner's designated representatives for design (ODRD) and the ODRC. The variation in location of these items from the dimensions shown in the approved embedment drawings shall be as follows:

(a) The vertical variation in location from the specified top of anchor rod location shall be equal to or less than plus or minus ½ in. (13 mm).

(b) The horizontal variation in location from the specified position of each anchor rod centerline at any location along its projection above the concrete shall be equal to or less than the dimensions given for the anchor rod diameters listed as follows:

<table>
<thead>
<tr>
<th>Anchor rod diameter, in. (mm)</th>
<th>Horizontal Variation, in. (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>¾ and ⁷⁄₈ (19 and 22)</td>
<td>¼ (6)</td>
</tr>
<tr>
<td>1, 1¼, 1½ (25, 31, 38)</td>
<td>⁹⁄₁₆ (10)</td>
</tr>
<tr>
<td>1¾, 2, 2½ (44, 50, 63)</td>
<td>½ (13)</td>
</tr>
</tbody>
</table>

Commentary:
The tolerances established in this Section have been selected for compatibility with the holes sizes that are recommended for base plates in the AISC Steel Construction Manual. If special conditions require more restrictive tolerances, such as for smaller holes, the required tolerances should be stated in the contract documents. When the anchor rods are set in sleeves, the adjustment provided may be used to satisfy the required anchor-rod setting tolerances.

7.5.2. Unless otherwise specified in the contract documents, anchor rods shall be set with their longitudinal axis perpendicular to the theoretical bearing surface.

7.5.3. Embedded items and connection materials that are part of the work of other trades, but that will receive structural steel, shall be located and set by the ODRC in accordance with an approved embedment drawing. The variation in location of these items shall be limited to a magnitude that is consistent with the tolerances that are specified in Section 11.3 for the erection of the structural steel.

7.5.4. All work that is performed by the ODRC shall be completed so as not to delay or interfere with the work of the fabricator and the erector. The ODRC shall conduct a survey of the as-built locations of anchor rods, foundation bolts, and other embedded items, and shall verify that all items covered in Section 7.5 meet the corresponding tolerances. When corrective action is necessary, the ODRC shall obtain the guidance and approval of the ODRD.

Commentary:
Few fabricators or erectors have the capability to provide this survey. Under standard practice, it is the responsibility of others.
7.6. **Installation of Bearing Devices**

7.6.1. All leveling plates, leveling nuts, and washers, and loose base and bearing plates that can be handled without a derrick or crane are set to line and grade by the ODRC.

7.6.2. Loose base and bearing plates that require handling with a derrick or crane shall be set by the erector to lines and grades established by the ODRC. The fabricator shall clearly scribe loose base and bearing plates with lines or other suitable marks to facilitate proper alignment.

7.6.3. Base and bearing plates that are shop attached to shipping pieces shall be set with the shipping pieces by the erector to lines and grades established by the ODRC. See Section 11.3.

7.6.4. Promptly after the setting of all bearing devices, the ODRC shall check them for line and grade, as required in Section 7.6.4(a) and 7.6.4(b). The permissible variation in elevation relative to the specified grade for all bearing devices shall be equal to or less than plus or minus \( \frac{1}{8} \) in. (3 mm). The final location of bearing devices shall be the responsibility of the ODRC.

(a) For base and bearing plates shop attached to shipping pieces, the variation shall be measured at the top of the base or bearing plate.

(b) For loose base and bearing plates and other leveling devices, the variation shall be measured at the top of the base or bearing plate, or devices.

**Commentary:**
The \( \frac{1}{8} \) in. (3 mm) tolerance on elevation of bearing devices relative to established grades is provided to permit some variation in setting bearing devices, and to account for the accuracy that is attainable with standard surveying instruments. The use of leveling plates larger than 22 in. by 22 in. (550 mm by 550 mm) is discouraged and grouting is recommended with larger sizes. For the purposes of erection stability, the use of leveling nuts and washers is discouraged when base plates have less than four anchor rods.

7.7. **Grouting**

Grouting shall be the responsibility of the ODRC. Leveling plates and loose base and bearing plates shall be promptly grouted after they are set and checked for line and grade. Columns with attached base plates, beams with attached bearing plates, and other similar members with attached bearing devices that are temporarily supported on leveling nuts and washers, shims, or other similar leveling devices, shall be promptly grouted after the structural steel frame, or portion thereof, has been plumbed.

**Commentary:**
In the majority of structures, the vertical load from the column bases is transmitted to the foundations through structural grout. In general, there are three methods by which support is provided for column bases during erection:
(a) Pre-grouted leveling plates or loose base plates
(b) Shims
(c) Leveling nuts and washers on the anchor rods beneath the column base

Standard practice provides that loose base plates and leveling plates are to be grouted as they are set. Bearing devices that are set on shims or leveling nuts are grouted after plumbing, which means that the weight of the erected structural steel frame is supported on the shims or washers, nuts, and anchor rods. The erector must take care to ensure that the load that is transmitted in this temporary condition does not exceed the strength of the shims or washers, nuts, and anchor rods. These considerations are presented in greater detail in AISC Design Guide 1, Base Plate and Anchor Rod Design, and AISC Design Guide 10, Erection Bracing of Low-Rise Structural Steel Frames.

7.8. Field Connection Material

7.8.1. The fabricator shall provide field connection details that are consistent with the requirements in the contract documents and that will, in the fabricator’s opinion, result in economical fabrication and erection.

7.8.2. When the fabricator is responsible for erecting the structural steel, the fabricator shall furnish all materials that are required for both temporary and permanent connection of the component parts of the structural steel frame.

7.8.3. When the erection of the structural steel is not performed by the fabricator, the fabricator shall furnish the following field connection material:

(a) Bolts, nuts, and washers in sufficient quantity for all structural steel-to-structural steel field connections that are to be permanently bolted. The fabricator shall include an extra 2% plus three bolts, subject to a minimum of five extra bolts of each grade, type, diameter, length, and production lot number.
(b) Shims that are shown as necessary for make-up of permanent structural steel-to-structural steel field connections.
(c) Steel backing and runoff tabs that are required for field welding.

7.8.4. The erector shall furnish all welding electrodes, fit-up bolts, and drift pins used for the erection of the structural steel. Non-steel backing, if used, shall be furnished by the erector.

Commentary:
See the Commentary for Section 2.2.

7.9. Loose Material

Unless otherwise specified in the contract documents, loose structural steel items that are not connected to the structural steel frame shall be set by the ODRC without assistance from the erector.
7.10. **Temporary Support of Structural Steel Frames**

7.10.1. The *ODRD* shall identify the following in the *contract documents*:

(a) The lateral force-resisting system and connecting diaphragm elements that provide for lateral strength and stability in the completed structure

(b) Any special erection conditions or other considerations that are required by the design concept, such as the use of shores, jacks, or loads that must be adjusted as erection progresses to set or maintain *camber*, position within specified tolerances, or prestress

**Commentary:**

The intent of Section 7.10.1 of the *Code* is to alert the *ODRC* and the *erector* of the means for lateral force resistance in the completed structure so that appropriate planning can occur for construction of the building. Examples of a description of the lateral force-resisting system as required in Section 7.10.1(a) are shown in the following.

Example 1 is an all-steel building with a composite metal deck and concrete floor system. All lateral force resistance is provided by welded moment frames in each orthogonal building direction. One suitable description of this lateral force-resisting system is as follows:

*All lateral force resistance and stability of the building in the completed structure is provided by moment frames with welded beam-to-column connections framed in each orthogonal direction (see plan sheets for locations). The composite metal deck and concrete floors serve as horizontal diaphragms that distribute the lateral wind and seismic forces horizontally to the vertical moment frames. The vertical moment frames carry the applied lateral loads to the building foundation.*

Example 2 is a steel-framed building with a composite metal deck and concrete floor system. All beam-to-column *connections* are simple *connections* and all lateral force resistance is provided by reinforced concrete shear walls in the building core and in the stairwells. One suitable description of this lateral force-resisting system is as follows:

*All lateral force resistance and stability of the building in the completed structure is provided exclusively by cast-in-place reinforced concrete shear walls in the building core and stairwells (see plan sheets for locations). These walls provide all lateral force resistance in each orthogonal building direction. The composite metal deck and concrete floors serve as horizontal diaphragms that distribute the lateral wind and seismic forces horizontally to the concrete shear walls. The concrete shear walls carry the applied lateral loads to the building foundation.*

See also Commentary Section 7.10.3.

Section 7.10.1(b) is intended to apply to special requirements inherent in the design concept that could not otherwise be known by the *erector*. Such conditions might include designs that require the use of shores or jacks to impart a
load or to obtain a specific elevation or position in a subsequent step of the erection process in a sequentially erected structure or member. These requirements would not be apparent to an erector and must be identified so the erector can properly bid, plan, and perform the erection.

The erector is responsible for installation of all members (including cantilevered members) to the specified plumbness, elevation, and alignment within the erection tolerances specified in this Code. The erector must provide all temporary supports and devices to maintain elevation or position within these tolerances. This work is part of the means and methods of the erector and the ODRD need not specify these methods or related equipment.

See also the preset elevation requirements for cantilevered members in Section A4 of ANSI/AISC 360.

7.10.2. The ODRC shall indicate to the erector prior to bidding, the installation schedule for non-structural steel elements of the lateral force-resisting system and connecting diaphragm elements identified by the ODRD in the contract documents.

Commentary:
See Commentary Section 7.10.3.

7.10.3. Based upon the information provided in accordance with Sections 7.10.1 and 7.10.2, the erector shall determine the need for, furnish, and install all temporary supports, such as temporary guys, cables, beams, falsework, cribbing, erection aids, or other elements required for the erection operation. If the selection or design of such temporary supports is necessary, this shall be the responsibility of the erector. These temporary supports shall be sufficient to secure and maintain the stability of the bare structural steel framing, or any portion thereof, against loads that are likely to be encountered during erection, including those due to wind and those that result from erection operations.

The erector need not consider loads during erection that result from the performance of work by, or the acts of, others, except as specifically identified by the ODRD or the ODRC. Further, the erector need not consider those loads that are unpredictable, such as loads due to hurricane, tornado, earthquake, explosion, or collision.

Temporary supports that are required during or after the erection of the structural steel frame for the support of loads caused by non-structural steel elements, including cladding, interior partitions, and other such elements that will induce or transmit loads to the structural steel frame during or after erection, shall be the responsibility of others.

Commentary:
Many structural steel frames have lateral force-resisting systems that are activated during the erection process. Such lateral force-resisting systems may consist of welded moment frames, braced frames, or, in some instances, columns that cantilever from fixed-base foundations. Such frames are normally braced with temporary guys that, together with the steel deck floor and roof
diaphragms or other diaphragm bracing that may be included as part of the
design, provide stability during the erection process. The guy cables are also
commonly used to plumb the structural steel frame. The erector normally
furnishes and installs the required temporary supports and bracing to secure
the bare structural steel frame, or portion thereof, during the erection process.
When erection bracing drawings are required in the contract documents, those
drawings show this information. The need for and selection or design of tempo-
rary supports should be based on industry standards such as AISC Design Guide
10, Erection Bracing of Low-Rise Structural Steel Frames.

If the ODRC determines that steel decking is not installed by the erector,
temporary diaphragm bracing may be required if a horizontal diaphragm is not
available to distribute loads to the vertical and lateral force-resisting system. If the
steel deck will not be available as a diaphragm during structural steel erection, the
ODRC must communicate this condition to the erector prior to bidding. If such
diaphragm bracing is required, it must be furnished and installed by the erector.

Sometimes structural systems that are employed by the ODRD rely upon
other elements besides the structural steel frame for lateral force resistance. For instance, concrete or masonry shear walls or precast spandrels may be used
to provide resistance to vertical and lateral forces in the completed structure. Because these situations may not be obvious to the contractor or the erector,
it is required in this Code that the ODRD must identify such situations in the
contract documents. Similarly, if a structure is designed so that special erection
techniques are required, such as jacking to impose certain loads or position dur-
ing erection, it is required in this Code that such requirements be specifically
identified in the contract documents.

In some instances, the ODRD may elect to show erection bracing in the struc-
tural design documents. When this is the case, the ODRD should then confirm
that the bracing requirements were understood by review and approval of the
erection documents during the submittal process.

Sometimes during construction of a building, collateral building elements,
such as exterior cladding, may be required to be installed on the bare structural
steel frame prior to completion of the lateral force-resisting system. These ele-
ments may increase the potential for lateral loads on the temporary supports.
Such temporary supports may also be required to be left in place after the struc-
tural steel frame has been erected. Special provisions should be made by the
ODRC for these conditions.

7.10.4. All temporary supports that are required for the erection operation and furnished
and installed by the erector shall remain the property of the erector and shall not
be modified, moved, or removed without the consent of the erector. Temporary
supports provided by the erector shall remain in place until the portion of the
structural steel frame that they brace is complete and the lateral force-resisting
system and connecting diaphragm elements identified by the ODRD in accordance
with Section 7.10.1 are installed. Temporary supports that are required to be left
in place after the completion of structural steel erection shall be removed when no
longer needed by the ODRC and returned to the erector in good condition.

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7.11. Safety Protection

7.11.1. The *erector* shall provide floor coverings, handrails, walkways, and other safety protection for the *erector’s* personnel as required by law and the applicable safety regulations. Unless otherwise specified in the contract documents, the *erector* is permitted to remove such safety protection from areas where the erection operations are completed.

7.11.2. When safety protection provided by the *erector* is left in an area for the use of other trades after the *structural steel* erection activity is completed, the *ODRC* shall

(a) Accept responsibility for and maintain this protection
(b) Indemnify the *fabricator* and the *erector* from damages that may be incurred from the use of this protection by other trades
(c) Ensure that this protection is adequate for use by other affected trades
(d) Ensure that this protection complies with applicable safety regulations when being used by other trades
(e) Remove this protection when it is no longer required and return it to the *erector* in the same condition as it was received

7.11.3. Safety protection for other trades that are not under the direct employment of the *erector* shall be the responsibility of the *ODRC*.

7.11.4. When permanent steel decking is used for protective flooring and is installed by the *ODRC*, all such work shall be scheduled and performed in a timely manner so as not to interfere with or delay the work of the *fabricator* or the *erector*. The sequence of installation that is used shall meet all safety regulations.

7.11.5. Unless the interaction and safety of activities of others, such as construction by others or the storage of materials that belong to others, are coordinated with the work of the *erector* by the *ODRC*, such activities are prohibited until the erection of the *structural steel* frame, or portion thereof, is completed by the *erector* and accepted by the *ODRC*.

7.12. Accumulation of Mill and Fabrication Tolerances

The accumulation of mill tolerances and fabrication tolerances shall not cause the erection tolerances to be exceeded.

**Commentary:**

In editions of this *Code* previous to the 2005 edition, it was stated that “...variations are deemed to be within the limits of good practice when they do not exceed the cumulative effect of rolling tolerances, fabricating tolerances and erection tolerances.” It is recognized in the current provision in this Section that accumulations of mill tolerances and fabrication tolerances generally occur between the locations at which erection tolerances are applied, and not at the same locations.
7.13 **Owner’s Acceptance**

Prior to placing or applying any other materials, the ODRC shall determine that the location of the structural steel is acceptable for plumbness, elevation, and alignment and is in accordance with applicable requirements of this Code, ANSI/AISC 360 Chapters M and N, and any project specific requirements. The erector shall be given either timely notice of acceptance by the ODRC or a listing of specific items that are to be corrected in order to obtain acceptance. Such notice shall be rendered promptly upon completion of any part of the work and prior to the start of work by other trades that may be supported, attached, or applied to the structural steel frame.

7.14 **Correction of Errors**

The correction of minor misfits by moderate amounts of reaming, grinding, welding, or cutting, and the drawing of elements into line with drift pins shall be considered to be normal erection operations. Errors that cannot be corrected using the foregoing means, or that require major changes in member or connection configuration, shall be promptly reported to the ODRD, the ODRC, and the fabricator, by the erector, to enable the responsible entity to either correct the error or approve the most efficient and economical method of correction to be used by others.

**Commentary:**
As used in this Section, the term “moderate” refers to the amount of reaming, grinding, welding, or cutting that must be done on the project as a whole, not the amount that is required at an individual location. It is not intended to address limitations on the amount of material that is removed by reaming at an individual bolt hole, for example, which is limited by the bolt-hole size and tolerance requirements in ANSI/AISC 360 and the RCSC Specification.

7.15 **Cuts, Alterations, and Holes for Other Trades**

Neither the fabricator nor the erector shall cut, drill, or otherwise alter their work, nor the work of other trades, to accommodate other trades, unless such work is clearly specified in the contract documents. When such work is so specified, the ODRD and the ODRC shall furnish complete information as to materials, size, location, and number of alterations in a timely manner so as not to delay the preparation of the approval documents.

7.16 **Handling and Storage**

The erector shall take reasonable care in the proper handling and storage of the structural steel during erection operations to avoid the accumulation of excess dirt and foreign matter. The erector shall not be responsible for the removal from the structural steel of dust, dirt, or other foreign matter that may accumulate during erection as the result of jobsite conditions or exposure to the elements. The erector shall handle and store all bolts, nuts, washers, and related fastening products in accordance with the requirements of the RCSC Specification.

*Code of Standard Practice for Steel Buildings and Bridges, May 9, 2022*

AMERICAN INSTITUTE OF STEEL CONSTRUCTION
Commentary:
During storage, loading, transport, unloading, and erection, blemish marks caused by slings, chains, blocking, tie-downs, etc., occur in varying degrees. Abrasions caused by handling or cartage after painting are to be expected. It must be recognized that any shop-applied coating, no matter how carefully protected, will require touching up in the field. Touching up these blemished areas is the responsibility of the contractor performing the field touch-up or field painting.

The erector is responsible for the proper storage and handling of fabricated structural steel at the jobsite during erection. Shop-painted structural steel that is stored in the field pending erection should be kept free of the ground and positioned so as to minimize the potential for water retention. The owner or ODRC is responsible for providing suitable jobsite conditions and proper access so that the fabricator and the erector may perform their work.

Jobsite conditions are frequently muddy, sandy, dusty, or a combination thereof during the erection period. Under such conditions, it may be impossible to store and handle the structural steel in such a way as to completely avoid any accumulation of mud, dirt, or sand on the surface of the structural steel, even though the fabricator and the erector manages to proceed with their work.

Repairs of damage to painted surfaces and/or removal of foreign materials due to adverse jobsite conditions are outside the scope of responsibility of the fabricator and the erector when reasonable attempts at proper handling and storage have been made.

7.17. Field Painting (see also Section 3.1)
Neither the fabricator nor the erector is responsible to paint field bolt heads and nuts or field welds, nor to touch up abrasions of the shop coat, nor to perform any other field painting.

7.18. Final Cleaning Up
Upon the completion of erection and before final acceptance, the erector shall remove all of the erector’s falsework, rubbish, and temporary buildings.
SECTION 8. QUALITY CONTROL

8.1. General

8.1.1. The fabricator shall maintain a quality control program to ensure that the work is performed in accordance with the requirements in this Code, ANSI/AISC 360, and the contract documents. The fabricator shall have the option to use the AISC Quality Certification Program to establish and administer the quality control program.

Commentary:
The AISC Quality Certification Program confirms to the construction industry that a certified structural steel fabrication shop has the capability by reason of commitment, personnel, organization, experience, procedures, knowledge, and equipment to produce fabricated structural steel of the required quality for a given category of work. The AISC Quality Certification Program is not intended to involve inspection and/or judgment of product quality on individual projects; neither is it intended to guarantee the quality of specific fabricated structural steel products.

8.1.2. The erector shall maintain a quality control program to ensure that the work is performed in accordance with the requirements in this Code, ANSI/AISC 360, and the contract documents. The erector shall be capable of performing the erection of the structural steel and shall provide the equipment, personnel, and management for the scope, magnitude, and required quality of each project. The erector shall have the option to use the AISC Erector Certification Program to establish and administer the quality control program.

Commentary:
The AISC Erector Certification Program confirms to the construction industry that a certified structural steel erector has the capability by reason of commitment, personnel, organization, experience, procedures, knowledge, and equipment to erect fabricated structural steel to the required quality for a given category of work. The AISC Erector Certification Program is not intended to involve inspection and/or judgment of product quality on individual projects; neither is it intended to guarantee the quality of specific erected structural steel products.

8.1.3. When the owner requires more extensive quality control procedures or independent inspection by qualified personnel, or requires that the fabricator must be certified under the AISC Quality Certification Program and/or requires that the erector must be certified under the AISC Erector Certification Program, this shall be clearly stated in the contract documents, including a definition of the scope of such inspection.

8.2. Inspection of Mill Material

Material test reports shall constitute sufficient evidence that the mill product satisfies material order requirements. The fabricator shall make a visual inspection of material
that is received from the mill, but need not perform any material tests unless the owner’s designated representative for design (ODRD) specifies in the contract documents that additional testing is to be performed at the owner’s expense.

8.3. **Nondestructive Testing**

When nondestructive testing is required, the process, extent, technique, and standards of acceptance shall be clearly specified in the contract documents.

8.4. **Surface Preparation and Shop Painting Inspection**

Inspection of surface preparation and shop painting shall be planned for the acceptance of each operation as the fabricator completes it. Inspection of the paint system, including material and thickness, shall be made promptly upon completion of the paint application. When wet-film thickness is to be inspected, it shall be measured during the application.

8.5. **Independent Inspection**

When inspection by personnel other than those of the fabricator and/or erector is specified in the contract documents, the requirements in Sections 8.5.1 through 8.5.6 shall be met.

8.5.1. The fabricator and the erector shall provide the inspector with access to all places where the work is being performed. A minimum of 24 hours notification shall be given prior to the commencement of work.

8.5.2. Inspection of shop work by the inspector shall be performed in the fabricator’s shop to the fullest extent possible. Such inspections shall be timely, in-sequence, and performed in such a manner as will not disrupt fabrication operations and will permit the repair of nonconforming work prior to any required painting while the material is still in-process in the fabrication shop.

8.5.3. Inspection of field work shall be promptly completed without delaying the progress or correction of the work.

8.5.4. Rejection of material or workmanship that is not in conformance with the contract documents is permitted at any time during the progress of the work. However, this provision shall not relieve the owner or the inspector of the obligation for timely, in-sequence inspections.

8.5.5. The fabricator, erector, and ODRD and the owner’s designated representatives for construction (ODRC) shall be informed of deficiencies that are noted by the inspector promptly after the inspection. Copies of all reports prepared by the inspector shall be promptly given to the fabricator, erector, ODRD, and ODRC. The necessary corrective work shall be performed in a timely manner.

8.5.6. The inspector shall not suggest, direct, or approve the fabricator or erector to deviate from the contract documents or the approved approval documents, or approve such deviation, without the written approval of the ODRD and the ODRC.
SECTION 9. CONTRACTS

9.1. Contracts and Payment

9.1.1. For contracts that stipulate a lump sum price, the work that is required to be performed by the fabricator and the erector shall be completely defined in the contract documents.

9.1.2. For contracts that stipulate a price per pound, the scope of work that is required to be performed by the fabricator and the erector, the type of materials, the character of fabrication, and the conditions of erection shall be based upon the contract documents, which shall be representative of the work to be performed.

9.1.3. For contracts that stipulate a price per item, the work that is required to be performed by the fabricator and the erector shall be based upon the quantity and the character of the items that are described in the contract documents.

9.1.4. For contracts that stipulate unit prices for various categories of structural steel, the scope of work that is required to be performed by the fabricator and the erector shall be based upon the quantity, character, and complexity of the items in each category as described in the contract documents, and shall also be representative of the work to be performed in each category.

9.1.5. When an allowance for work is called for in the contract documents and the associated work is subsequently defined as to the quantity, complexity, and timing of that work after the contract is executed, the contract price for this work shall be adjusted by change order.

Commentary:
Allowances, if used, are not a true definition of the cost of work to be performed. By nature, an allowance is only an estimate and placeholder in the bid. Once the actual work is defined, the actual cost can be provided. It must be recognized that the actual cost can be higher or lower than the allowance. See Section 9.4.

Allowances required by the contract documents or proposed by the bidder should be as thoroughly defined as practicable as to the distinct nature of the work covered by the allowance, including whether the allowance is to include materials only, fabrication costs, and/or erection costs.

9.2. Calculation of Weights

Unless otherwise specified in the contract, for contracts stipulating a price per pound for fabricated structural steel that is delivered and/or erected, the quantities of materials for payment shall be determined by the calculation of the gross weight of materials as shown in the fabrication documents.

Commentary:
The standard procedure for calculation of weights that is described in this Code meets the need for a universally acceptable system for defining “pay weights” in contracts based upon the weight of delivered and/or erected materials. These
procedures permit the owner to easily and accurately evaluate price-per-pound proposals from potential suppliers and enables all parties to a contract to have a clear and common understanding of the basis for payment.

The procedure in *this Code* affords a simple, readily understood method of calculation that will produce pay weights that are consistent throughout the industry and that may be easily verified by the owner. While this procedure does not produce actual weights, it can be used by purchasers and suppliers to define a widely accepted basis for bidding and contracting for *structural steel*. However, any other system, rather than the current system based on gross weight as described in Sections 9.2.1 through 9.2.5, can be used as the basis for a contractual agreement. These systems could include net weight, as calculated on the shop drawings, or actual weight, as determined from shipping weight masters, or others, for those products delivered to the site. When other systems are used, both the supplier and the purchaser should clearly understand how the alternative procedure is handled.

9.2.1. The unit weight of steel shall be taken as 490 lb/ft³ (7 800 kg/m³). The unit weight of other materials shall be in accordance with the manufacturer’s published data for the specific product.

9.2.2. The weights of *standard structural shapes*, plates, and bars shall be calculated on the basis of *fabrication documents* that show the actual quantities and dimensions of material to be fabricated, as follows:

(a) The weights of all *standard structural shapes* shall be calculated using the nominal weight per ft (mass per m) and the detailed overall length.

(b) The weights of plates and bars shall be calculated using the detailed overall rectangular dimensions.

(c) When parts can be economically cut in multiples from material of larger dimensions, the weight shall be calculated on the basis of the theoretical rectangular dimensions of the material from which the parts are cut.

(d) When parts are cut from *standard structural shapes*, leaving a nonstandard section that is not useable on the same contract, the weight shall be calculated using the nominal weight per ft (mass per m) and the overall length of the *standard structural shapes* from which the parts are cut.

(e) Deductions shall not be made for material that is removed for cuts, copes, clips, blocks, drilling, punching, boring, slot milling, planing, or weld joint preparation.

9.2.3. The items for which weights are shown in tables in the AISC *Steel Construction Manual* shall be calculated on the basis of the tabulated weights shown therein.

9.2.4. The weights of items that are not shown in tables in the AISC *Steel Construction Manual* shall be taken from the manufacturer’s catalog and the manufacturer’s shipping weight shall be used.
Commentary:
Many items that are weighed for payment purposes are not tabulated with weights in the AISC Steel Construction Manual. These include, but are not limited to, anchor rods, clevises, turnbuckles, sleeve nuts, recessed-pin nuts, cotter pins, and similar devices.

9.2.5. The weights of shop or field weld metal and protective coatings shall not be included in the calculated weight for the purposes of payment.

9.3. Revisions to the Contract Documents
Revisions to the contract documents shall be confirmed by change order or extra work order. Unless otherwise noted, the issuance of a revision to the contract documents shall constitute authorization by the owner that the revision is released for construction. The contract price and schedule shall be adjusted in accordance with Sections 9.4 and 9.5.

9.4. Contract Price Adjustment
9.4.1. When the scope of work and responsibilities of the fabricator and the erector are changed from those previously established in the contract documents, an appropriate modification of the contract price shall be made. In computing the contract price adjustment, the fabricator and the erector shall consider the quantity of work that is added or deleted, the modifications in the character of the work, and the timeliness of the change with respect to the status of material ordering, detailing, fabrication, and erection operations.

Commentary:
The fabrication and erection of structural steel is a dynamic process. Typically, material is being acquired at the same time that the approval documents are being prepared. Additionally, the fabrication shop will normally fabricate pieces in the order that the structural steel is being shipped and erected.

Items that are revised or placed on hold generally upset these relationships and can be very disruptive to the digital modeling/detailing, fabricating, and erecting processes. The provisions in Sections 3.6, 4.4.2, and 9.3 are intended to minimize these disruptions so as to allow work to continue. Accordingly, it is required in this Code that the reviewer of requests for contract price adjustments recognize this and allow compensation to the fabricator and the erector for these inefficiencies and for the materials that are purchased and the detailing, fabrication, and erection that has been performed, when affected by the change.

9.4.2. Requests for contract price adjustments shall be presented by the fabricator and/or the erector in a timely manner and shall be accompanied by a description of the change that is sufficient to permit evaluation and timely approval by the owner.
9.4.3. Price-per-pound and price-per-item contracts shall provide for additions or deletions to the quantity, type, and character of work that are made prior to the time the contract documents are released for construction. When changes are made that affect the quantity, type, or character of work after the contract documents are released for construction, the contract price shall be equitably adjusted.

9.5. Scheduling

9.5.1. The contract schedule shall state when the design documents will be released for construction, if the design documents are not available at the time of bidding, and when the jobsite, foundations, piers, and abutments will be ready, free from obstructions, and accessible to the erector, so that erection can start at the designated time and continue without interference or delay caused by the owner’s designated representative for construction (ODRC) or other trades.

9.5.2. The fabricator and the erector shall advise the owner’s designated representatives for design (ODRD) and ODRC, in a timely manner, of the effect any revision has on the contract schedule.

9.5.3. If the fabrication or erection is significantly delayed due to revisions to the requirements of the contract, or for other reasons that are the responsibility of others, the fabricator and/or erector shall be compensated for the additional costs incurred.

9.6. Terms of Payment

The fabricator shall be paid for mill materials and fabricated product that is stored off the jobsite. Other terms of payment for the contract shall be outlined in the contract documents.

Commentary:

These terms include such items as progress payments for material, fabrication, erection, retainage, performance and payment bonds, and final payment. If a performance or payment bond, paid for by the owner, is required by contract, no retainage shall be required.
SECTION 10. ARCHITECTURALLY EXPOSED STRUCTURAL STEEL (AESS)

10.1. General Requirements

When members are specifically designated as architecturally exposed structural steel or AESS in the contract documents, the requirements in Sections 1 through 9 shall apply as modified in Section 10. Surfaces exposed to view of AESS members and components shall be fabricated and erected with the care and dimensional tolerances that are stipulated in Sections 10.2 through 10.6.

Commentary:
The designation of steel as AESS adds cost, and that cost is higher as the level of the AESS designation increases. However, not all exposed steel must be designated as AESS. There are many applications in which the as-produced appearance of fabricated and erected structural steel may be deemed sufficient without any special additional work.

10.1.1. The following categories shall be used when referring to AESS:

AESS 1: Basic elements
AESS 2: Feature elements viewed at a distance greater than 20 ft (6 m)
AESS 3: Feature elements viewed at a distance less than 20 ft (6 m)
AESS 4: Showcase elements with special surface and edge treatment beyond fabrication
AESS C: Custom elements with characteristics described in the contract documents

Commentary:
The categories are listed in the AESS matrix shown in Table 10.1. Each category describes characteristics with successively more detailed—and costly—requirements.

• Basic elements in AESS 1 are those that have workmanship requirements that exceed what would be done in non-AESS construction.
• Feature elements in AESS 2 and 3 exceed the basic requirements, but the intent is to allow the viewer to see the art of metalworking. AESS 2 is achieved primarily through geometry without finish work and treats things that can be seen at a larger viewing distance, like enhanced treatment of bolts, welds, connection and fabrication details, and tolerances for gaps, copes, and similar details. AESS 3 is achieved through geometry and basic finish work and treats things that can be seen at a closer viewing distance or are subject to touch by the viewer, with welds that are generally smooth but visible. AESS 3 involves the use of a mock-up and acceptance is based upon the approved conditions of the mock-up.
• Showcase elements in AESS 4 are those for which the designer intends that the form is the only feature showing in an element. All welds are ground and filled, edges are ground square and true. All surfaces are filled and sanded.
to a smoothness that doesn’t catch on a cloth or glove. Tolerances of fabricated forms are more stringent—generally half of standard tolerance. AESS 4 involves the use of a mock-up and acceptance is based upon the approved conditions of the mock-up.

- Custom elements in AESS C are those with other requirements defined in the contract documents, which may be more or less stringent than the other categories because individual desired characteristics may be required at the discretion of the specifier.

10.1.2. A mock-up shall be required for AESS 3 and 4. If a mock-up is to be used in other AESS categories, it shall be specified in the contract documents. When required, the nature and extent of the mock-up shall be specified in the contract documents. Alternatively, when a mock-up is not practical, the first piece of an element or connection can be used to determine acceptability.

**Commentary:**
Generally, a mock-up is produced and approved in the shop and subsequently placed in the field. The acceptability of the mock-up can be affected by many factors, including distance of view, lighting, and finishing. The expectations for the location and conditions of the mock-up at time of approval should be defined in the contract documents.

10.2. **Contract Documents**

The following additional information shall be provided in the contract documents when AESS is specified:

(a) Specific identification of members or components that are AESS using the AESS Categories listed in Section 10.1.1 and Table 10.1.

(b) Fabrication and/or erection tolerances that are to be more restrictive than provided for in this section, if any.

(c) For Category AESS C, the AESS matrix included in Table 10.1 shall be used to specify the required treatment of the element.

(d) Any variations from the AESS characteristics of Table 10.1.

(e) Any other special requirements for AESS members and components, such as the orientation of HSS weld seams and bolt heads.

10.3. **Approval Documents**

All members designated as AESS shall be clearly identified to a Category, either AESS 1, 2, 3, 4, or C, in the approval documents. Tack welds, temporary braces, backing, and fixtures used in fabrication of AESS shall be shown in the fabrication documents. Architecturally sensitive connection details shall be submitted for approval by the owner’s designated representative for design prior to completion of the approval documents.
## TABLE 10.1
AESS Category Matrix

<table>
<thead>
<tr>
<th>ID</th>
<th>Characteristics</th>
<th>Reference Section</th>
<th>AESS 4</th>
<th>AESS 3</th>
<th>AESS 2</th>
<th>AESS 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Showcase Elements</td>
<td>Feature Elements in Close View</td>
<td>Feature Elements not in Close View</td>
<td>Basic Elements</td>
</tr>
<tr>
<td>1.1</td>
<td>Butt and plug weld reinforcement limited to $\frac{1}{16}$ in. (2 mm)</td>
<td>10.4.9</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>1.2</td>
<td>Surface preparation to meet paint specification</td>
<td>10.4.11</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>1.3</td>
<td>Sharp edges eased</td>
<td>10.4.7</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>1.4</td>
<td>Continuous weld appearance</td>
<td>10.4.8</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>1.5</td>
<td>Consistent bolt appearance</td>
<td>10.4.1(g)</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>1.6</td>
<td>Weld spatters removed</td>
<td>10.4.8</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
</tbody>
</table>

2.1 Mock-ups                                                                 | 10.1.2            | •      | •      | Optional |
2.2 The fabricated product shall have one-half the applicable ASTM or AWS straightness tolerance | 10.4.3(b) & 10.4.5 | •      | •      | •      |
2.3 Fabrication, and erection marks not visible                            | 10.4.2            | •      | •      | •      |

3.1 Mill marks not visible                                                  | 10.4.2            | •      | •      |
3.2 Butt and plug welds ground smooth and filled                           | 10.4.9            | •      |
3.3 HSS weld seam oriented for reduced visibility                          | 10.4.12           | •      |
3.4 Cross-sectional abutting surfaces aligned                              | 10.4.3(a)         | •      |
3.5 Joint gap tolerances minimized                                         | 10.4.6            | •      |

4.1 HSS seam treated to comply with mock-up                                 | 10.4.12           | •      |
4.2 Welds contoured and blended                                             | 10.4.8            | •      |
4.3 Surfaces filled and sanded                                              | 10.4.7            | •      |
4.4 Weld show-through to meet acceptance criteria established by mock-up   | 10.4.10           | •      |

Notes:
1. AESS C are custom elements with characteristics described in the contract documents.
2. Standard structural steel contains no AESS characteristics.
Commentary:
Variations, if any, from the AESS Categories listed must be clearly noted. These variations could include machined surfaces, locally abraded surfaces, and forgings. In addition, if distinction is to be made between different surfaces or parts of members, the transition line/plane must be clearly identified/defined on the approval documents.

10.4. Fabrication

10.4.1. The following applies to the fabricator with respect to AESS:

(a) The fabricator shall fabricate and handle the steel with care to avoid marking or distorting the steel members.
(b) Slings shall be nylon-type or chains or wire rope with softeners.
(c) Care shall be taken to minimize damage to any shop paint or coating.
(d) When temporary braces or fixtures are required during fabrication or shipment, or to facilitate erection, care shall be taken to avoid blemishes or unsightly surfaces resulting from the use or removal of such temporary elements.
(e) Tack welds not incorporated into final welds shall be treated consistently with requirements for final welds.
(f) All weld backing and weld runoff tabs shall be removed, and the welds finished in accordance with Section 10.4.8. Removal, weld finishing, and grinding shall comply with the requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M, and ANSI/AISC 341, as applicable.
(g) Bolted connections shall have all bolt heads on the same side of the connection and shall be consistent from one connection to another as specified by the contract documents.

Commentary:
The requirements in Sections 10.4.1(f) and 10.6(f) call for the weld backing to be removed in accordance with AWS D1.1/D1.1M, and where the weld joint is part of the designated seismic force-resisting system, to also comply with ANSI/AISC 341 and AWS D1.8/D1.8M.

The requirements in Sections 10.4.1(g) and 10.6(g) do not extend to the “clocking” orientation of the bolt head (or nut).

10.4.2. Fabrication and erection marks shall not be visible for Categories AESS 2, 3, and 4, and mill marks shall not be visible for categories AESS 3 and 4. However, where members are fabricated of unfinished, reused, galvanized, or weathering steel, fabrication, erection, and mill marks may remain visible for all categories of AESS. Special requirements, if any, shall be specified as Category AESS C.

10.4.3. The permissible tolerances for member depth, width, out-of-square, and camber and sweep shall be as specified in ASTM A6/A6M and ASTM A500/A500M. The following exceptions apply:
(a) For Categories AESS 3 and 4, spliced cross sections shall be matched to meet the acceptance criteria established with mock-up required in Section 10.1.2.
(b) For Categories AESS 2, 3, and 4, the as-fabricated straightness tolerance shall be one-half of that specified in ASTM A6/A6M and ASTM A500/A500M.

**Commentary:**
The ability to match individual cross sections at a member splice depends on material thickness, mill tolerances for cross-section variation, joint configuration, and the process applied to the member(s) prior to splicing, such as cambering, curving, etc. Members with thinner cross-sectional elements that vary within tolerance may be drawn together more readily than those with thicker elements, and other elements may be so thick they cannot be drawn together to match at the splice. Users are cautioned to explore fabrication costs and capabilities for joining specific member cross sections and to use a mock-up to document expectations. AISC Design Guide 33, *Curved Member Design*, also provides guidance on cross-section distortion for curved members.

10.4.4. For curved structural members, whether composed of a single *standard structural shape* or built-up, the as-fabricated variation from the theoretical curvature shall be equal to or less than the standard *camber* and sweep tolerances permitted for straight members in the applicable ASTM standard.

**Commentary:**
The curvature tolerance for curved AESS members is not reduced from that used for curved non-AESS members because curved members have no straight line to sight and the resulting deviations are therefore indistinguishable. See also the Commentary to Section 11.2.2.

10.4.5. For Categories AESS 2, 3, and 4, the as-fabricated straightness tolerance for a built-up member as a whole shall be one-half of that specified in AWS D1.1/D1.1M.

10.4.6. For Categories AESS 3 and 4, copes, miters, and cuts in surfaces exposed to view shall have a gap that is uniform within \( \frac{1}{8} \) in. (3 mm), if shown to be an open joint. If instead the joint is shown to be in contact, the contact shall be uniform within \( \frac{1}{16} \) in. (2 mm).

10.4.7. For all categories of AESS, slivers and other similar discontinuities shall be removed and sharp corners resulting from shearing, flame cutting, or grinding shall be eased. For Categories AESS 1, 2, and 3, the surface condition of steel given in ASTM A6/A6M shall be acceptable. For Category AESS 4, local non-typical surface imperfections shall be filled and sanded to meet the acceptance criteria established with the mock-up required in Section 10.1.2.

10.4.8. For Categories AESS 1, 2, 3, and 4, welds shall be continuous in appearance, and weld spatter shall be removed. For Category AESS 4, welds shall be contoured and blended. Where contoured, blended, or seal welds are to be provided for Categories AESS 1, 2, and 3, those welds shall be defined in the *contract documents*.
Commentary:
Intermittent welds are made continuous in appearance, either with additional welding, caulking, or body filler. For corrosive environments, all joints should be seal welded.

10.4.9. For Categories AESS 1 and 2, weld projection up to $\frac{1}{16}$ in. (2 mm) is acceptable for butt and plug welded joints. For Categories AESS 3 and 4, welds shall be ground smooth/filled. In no case shall the requirements of ANSI/AISC 341 or AWS D1.8/D1.8M be violated.

10.4.10. For Categories AESS 1, 2, and 3, weld show-through shall be acceptable as produced. For Category AESS 4, the weld show-through shall meet the acceptance criteria established with the mock-up required in Section 10.1.2.

Commentary:
Weld show-through is a visual indication of the presence of a weld or welds on the opposite surface from the viewer. It is a function of weld size and material thickness and can’t be eliminated in thin material with thick welds. When weld show-through is a concern, this should be addressed in the mock-up.

10.4.11. AESS surfaces shall be prepared to meet the requirements of the contract documents and the specified paint or coating system (see Section 3.1).

10.4.12. For Categories AESS 1 and 2, seams of hollow structural sections shall be acceptable as produced. For Category AESS 3, seams shall be oriented as specified in the contract documents. For Category AESS 4, seams shall be ground, filled, and sanded to meet the acceptance criteria established with the mock-up required in Section 10.1.2.

10.5. Delivery of Materials
The fabricator shall use special care to avoid bending, twisting, or otherwise distorting AESS. All tie-downs on loads shall be nylon straps or chains with softeners to avoid damage to edges and surfaces of members. The standard for acceptance of delivered and erected members shall be equivalent to the standard employed at fabrication.

10.6. Erection
The following applies to the erector with respect to AESS:
(a) The erector shall use special care in unloading, handling, and erecting AESS to avoid marking or distorting the AESS. The erector shall plan and execute all operations in such a manner that allows the architectural appearance of the structure to be maintained.
(b) Slings shall be nylon-type or chains or wire rope with softeners.
(c) Care shall be taken to minimize damage to any shop paint or coating.
(d) When temporary braces or fixtures are required to facilitate erection, care shall be taken to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of such temporary elements.

(e) Tack welds not incorporated into final welds shall be ground smooth.

(f) All weld backing and weld runoff tabs shall be removed, and the welds finished in accordance with Section 10.4.8. Removal, weld finishing, and grinding shall comply with the requirements of AWS D1.1/D1.1M, AWS D1.8/D1.8M, and ANSI/AISC 341, as applicable.

(g) Bolted connections shall have all bolt heads on the same side of the connection and shall be consistent from one connection to another, as specified by the contract documents.

(h) For Category AESS 4, open holes shall be filled with weld metal or body filler and smoothed by grinding or filling to the standards applicable to the shop fabrication of the materials.

**Commentary:**
Weld access holes, as defined by ANSI/AISC 360, should be filled with body filler or other mutually agreed upon nonweldable material. Filling weld access holes with weld metal is discouraged for reasons cited in the commentary to AWS D1.1/D1.1M.
SECTION 11. FABRICATION AND ERECTION TOLERANCES

11.1. General Requirements

*Structural Steel* shall be fabricated and erected in conformance with the tolerances in this Section and as required in the *contract documents*.

11.2. Fabrication Tolerances

The tolerances on *structural steel* fabrication shall be in conformance with the requirements in Section 11.2.1 through 11.2.8.

**Commentary:**

Fabrication tolerances are stipulated in several specifications and codes, each applicable to a specialized area of construction. Basic fabrication tolerances are stipulated in this Section. For *architecturally exposed structural steel*, see Section 10. Other specifications and codes are also commonly incorporated by reference in the *contract documents*, such as ANSI/AISC 360, the RCSC Specification, AWS D1.1/D1.1M, AWS D1.5/D1.5M, AIST Technical Report 13, and the AASHTO Specification.

If the *engineer of record* determines that additional tolerances are required by the design concept, the tolerances should be identified in the *contract documents*, as required by Section 1.11 and ANSI/AISC 360, Section A4.1. The tolerances should be expressed in terms consistent with those found in Section 11, i.e., a description of the parameter to be measured and a tolerance (acceptable deviation from the required parameter).

11.2.1. For members that have both ends finished (see Section 6.2.2) for contact bearing, the variation in the overall length shall be equal to or less than \(\frac{3}{2}\) in. (1 mm). For other members that frame to other structural steel elements, the variation in the detailed length shall be as follows:

(a) For members that are equal to or less than 30 ft (9.1 m) in length, the variation shall be equal to or less than \(\frac{z}{6}\) in. (2 mm).

(b) For members that are greater than 30 ft (9.1 m) in length, the variation shall be equal to or less than \(\frac{8}{6}\) in. (3 mm).

11.2.2. For straight and curved structural members, whether of a single *standard structural shape* or built-up, the permitted variation in specified straightness or curvature shall be as listed in the following. In all cases, completed members shall be free of twists (except as allowed by ASTM standards), bends, and open joints. Sharp kinks or sharp bends shall be cause for rejection.

11.2.2.1. For straight structural members, the variation in straightness shall be equal to or less than that specified for structural shapes in the applicable ASTM standards except when a smaller variation is specified in the *contract documents*.

11.2.2.2. For curved structural members, the variation in the chord length shall be as defined in Section 11.2.1. The variation in curvature measured at the middle ordinate shall be equal to or less than the permissible variations in straightness as specified in

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applicable ASTM standards for *camber* in the strong direction and sweep in the weak direction, inside or outside of the theoretical arc, except when a smaller variation is specified in the *contract documents*. Should no applicable ASTM standard exist, the maximum variation in curvature measured at the middle ordinate shall be plus or minus $\frac{1}{6}$ in. (3 mm) times one-fifth the total arc length in ft (times two-thirds the total arc length in m) for members 10 ft (3 m) or greater in length. For members less than 10 ft (3 m) in length, the permissible variation in curvature measured at the middle ordinate shall be plus or minus $\frac{1}{6}$ in. (3 mm). The middle ordinate is located between work points (W.P.) as shown in Figure C-11.1.

For curved members, the work points shall be defined as follows:

(a) For members other than horizontal members, the member work point shall be the actual center of the member at each end of the shipping piece.

(b) For horizontal members, the work point shall be the actual centerline of the top flange or top surface at each end.

**Commentary:**
Curved structural members, as referred to in this section, are defined as those members intended to maintain a specified curvature while in use. This section does not apply to members specified for *camber*. The location of the arc length is defined by the contract drawings and may be either at the member’s inside radius, the outside radius, or the radius between work points.

11.2.3. For beams that are detailed without specified *camber*, the member shall be fabricated so that, after erection, any incidental *camber* due to rolling or shop fabrication is upward. For trusses that are detailed without specified *camber*, the components shall be fabricated so that, after erection, any incidental *camber* in the truss due to rolling or shop fabrication is upward.

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**Fig. C-11.1. Illustration of the tolerance on curved structural steel member.**
11.2.4. Beams specified in the *contract documents* as cambered, which are ordered as straight as defined by the applicable ASTM Specification and received by the *fabricator* with 75% of the specified *camber*, shall require no further cambering.

For beams specified in the *contract documents* as cambered, which are ordered as cambered or cambered by the fabricator, the variation in *camber* shall be as follows:

(a) For beams that are detailed equal to or less than 50 ft (15 m) in length, the variation shall be equal to or less than minus zero/plus ½ in. (13 mm).

(b) For beams that are detailed greater than 50 ft (15 m) in length, the variation shall be equal to or less than minus zero/plus ½ in. plus ⅛ in. for each 10 ft or fraction thereof (13 mm plus 3 mm for each 3 m or fraction thereof) in excess of 50 ft (15 m) in length.

For the purpose of inspection, *camber* shall be measured in the *fabricator’s* shop in the unstressed condition.

**Commentary:**
*Camber* can only be properly specified and inspected in the unstressed condition. Inspection is best performed in the shop using established quality control procedures where remedial work, if required, can easily be performed.

*Camber* cannot be inspected after erection because the effect of dead load and connection restraint cannot be accurately determined. See AISC Design Guide 36, *Design Considerations for Camber*, Appendix B.

The *camber* tolerance in this section applies to *camber* induced in the fabrication process, which is done in response to *camber* requirements in the *contract documents*.

In *structural steel* members there are two kinds of *camber*: (1) incidental *camber*, i.e., deviation from straightness, which is controlled by ASTM A6/A6M; and (2) induced *camber* which is specified by the *engineer of record* and is created by the *fabricator* or a supplier. Induced *camber* is controlled by the tolerances in Section 11.2.4. Straight members are subject to the straightness tolerances for sweep and *camber* in ASTM A6/A6M. AISC has recommended that designers not specify *cambers* that are less than ⅛ in. (19 mm) to 1 in. (25 mm).

11.2.5. For fabricated trusses that are specified in the *contract documents* with *camber*, the variation in *camber* at each specified *camber* point shall be equal to or less than plus or minus ⅛ of the distance to that point from the nearest point of support. For the purpose of inspection, *camber* shall be measured in the unstressed condition. For fabricated trusses that are specified in the *contract documents* without indication of *camber*, the foregoing requirements shall be applied at each panel point of the truss with a zero *camber* ordinate.
Commentary:
There is no known way to inspect truss camber in other than its “unstressed condition” because of factors that include the following:

(a) The effects of the dead weight of the member
(b) The restraint caused by the truss connections in the erected state
(c) The effects of additional dead load that may ultimately be intended to be applied, if any

Therefore, for shop fabricated trusses, inspection of the fabricator’s work on truss camber should be done in the fabrication shop in the unstressed condition. See Figure C-11.2. However, it is common practice for field assembled trusses to be ground assembled either in the laydown or shored position and the camber should be checked before raising the truss.

11.2.6. When permissible variations in the depths of beams and girders result in abrupt changes in depth at splices, such deviations shall be accounted for as follows:

(a) For splices with bolted joints, the variations in depth shall be taken up with filler plates.
(b) For splices with welded joints, the weld profile shall be adjusted to conform to the variations in depth, the required cross section of weld shall be provided, and the slope of the weld surface shall meet the requirements in AWS D1.1/D1.1M.

11.2.7. For holes in base and bearing plates, the allowable variation from the detailed location with respect to the column shaft centerlines shall be plus or minus 3 mm.

Taking \( L \) as the distance from the point at which truss camber is specified to the closer point of support, in. (mm), the tolerance on truss camber at that point is calculated as \( L/800 \). \( L \) must be equal to or less than one-half the span.

Fig. C-11.2. Illustration of the tolerance on camber for fabricated trusses with specified camber.
11.2.8. The tolerance on overall profile dimensions of welded built-up members shall meet the requirements in AWS D1.1/D1.1M and AWS D1.8/D1.8M for buildings, and AWS D1.5M/D1.5 for bridges.

11.3. Erection Tolerances

Erection tolerances shall be defined relative to member working points and working lines, which shall be defined as follows:

(a) For members other than horizontal members, the member work point shall be the actual center of the member at each end of the shipping piece.
(b) For horizontal members, the working point shall be the actual centerline of the top flange or top surface at each end.
(c) The member working line shall be the straight line that connects the member working points.

Commentary:
The provision (b) applies at the “top flange” or “top surface” of a horizontal member. It should be noted that this may not be the uppermost point of members, such as trusses with W-shape chords with webs horizontal or trusses with chords skewed from square. The contract documents may specify alternative working points.

The substitution of other working points is permitted for ease of use.

The tolerances on structural steel erection shall be in conformance with the requirements in Sections 11.3.1.

Commentary:
The erection tolerances defined in this section have been developed through long standing usage as practical criteria for the erection of structural steel. Erection tolerances were first defined in the 1924 edition of this Code in Section 7(f), “Plumbing Up.” With the changes that took place in the types and use of materials in building construction after World War II, and the increasing demand by architects and owners for more specific tolerances, AISC adopted new standards for erection tolerances in Section 7(h) of the March 15, 1959, edition of this Code. Experience has proven that those tolerances can be economically obtained.

Differential column shortening may be a consideration in design and construction. In some cases, it may occur due to variability in the accumulation of dead load among different columns (see Figure C-11.3). In other cases, it may be characteristic of the structural system that is employed in the design. Consideration of the effects of differential column shortening may be very important, such as when the slab thickness is reduced, when electrical and other similar fittings mounted on the structural steel are intended to be flush with the finished floor, and when there is little clearance between bottoms of beams and the tops of door frames or ductwork.
The effects of the deflection of transfer girders and trusses on the position of columns and hangers supported from them may be a consideration in design and construction. As in the case of differential column shortening, the deflection of these supporting members during and after construction will affect the position and alignment of the framing tributary to these transfer members.

Expansion and contraction in a structural steel frame may be a consideration in design and construction. Steel will expand or contract approximately ⅛ in. per 100 ft for each change of 15°F (3 mm per 30 m for each change of 8.3°C).

Fig. C-11.3. Effects of differential column shortening.

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in temperature. This change in length can be assumed to act about the center of rigidity. When anchored to their foundations, end columns will be plumb only when the steel is at normal temperature (see Figure C-11.4). It is therefore necessary to correct field measurements of offsets to the structure from established baselines for the expansion or contraction of the exposed structural steel frame. For example, a 200-ft-long (61-m-long) building that is plumbed up at 100°F (38°C) should have working points at the tops of the end columns positioned 1/2 in. (13 mm) further apart than the working points at the corresponding bases in order for the columns to be plumb at 70°F (21°C). Differential temperature effects on column length should also be taken into account in plumbing surveys when tall structural steel frames are subjected to sun exposure on one side.

The Code does not provide explicit tolerances for the vertical position of the top of column shipping pieces at the tier splices in a multi-story frame. The design and construction teams need to establish requirements for monitoring the vertical position of the tier splices. Performance requirements should be addressed in the contract documents. The means of making adjustments should be addressed by pre-planning and mutual agreement among the affected parties prior to the commencement of fabrication and erection.

The alignment of lintels, spandrels, wall supports, and similar members that are used to connect other building construction units to the structural steel frame should have an adjustment of sufficient magnitude to allow for the accumulation of mill tolerances and fabrication tolerances, as well as the erection tolerances. See Figure C-11.5.

If the engineer of record determines that additional tolerances are required by the design concept, the tolerances should be identified in the contract documents, as required by Section 1.11 and ANSI/AISC 360, Section A4.1. The tolerances should be expressed in terms consistent with those found in Section 11, i.e., a description of the parameter to be measured and a tolerance (acceptable deviation from the required parameter).

![Diagram](image-url)  
**Fig. C-11.4.** Tolerances in plan location of column.
Tolerances for Complex Structures. During successive stages of erection, certain complex steel framed structures may require significant temporary support, bracing, and/or means to maintain geometry and stability during erection to mitigate substantial displacement or indeterminate load paths. These conditions may arise due to the planned sequential application of dead loads, including nonstructural steel elements, during or after completion of the erection of the steel frame. Some examples include, but are not limited to, structures that have nonstructural steel elements in their lateral force-resisting system, structures incorporating cable elements, long span and cantilevered structures, two-way girder or truss-framed structures, and inclined steel frames.

In order to achieve the specified plumb condition, elevation, and alignment of the structure at the completion of the erecter’s work, and to determine the necessary fabrication geometry and preset geometry (camber or super-elevation) during erection of these structures, an analytical three-dimensional model should be used by the fabricator/erector to perform a staged construction analysis and erection bracing drawings.

The determination of the fabrication geometry, any preset geometry, and the unstressed and stressed conditions of the steel frame is best achieved through a cooperative approach between the fabricator/erector and the owner’s designated representative for design. The fabricator/erector should be provided with the same loads and the sequence of application of those loads used by the erecter.

If facia joints are set from nearest column finish line, allow ±5 in. (16 mm) for vertical adjustment. The entity responsible for the facia details must allow for progressive shortening of steel columns.

\[ D = \text{Tolerance required by manufacturer of wall unit plus survey tolerances.} \]

*Fig. C-11.5. Clearance required to accommodate fascia.*
The owner’s designated representative for design. The owner’s designated representative for construction should also provide a schedule for the application of the loads cited above for use in the creation of the erection bracing drawings.

Before commencing the work, the fabricator/erector and the owner’s designated representative for construction must mutually agree as to how and when the requirements of Section 11.3 will be applied.

11.3.1. The tolerances on position and alignment of member working points and working lines shall be as described in Sections 11.3.1.1 through 11.3.1.3.

11.3.1.1. For an individual column shipping piece intended to be vertical, the angular variation of the working line from a plumb line shall be equal to or less than $\frac{1}{500}$ of the distance between working points, subject to the following additional limitations:

(a) For an individual column, the allowed horizontal variation in location from the specified position at the base shall be equal to or less than $\frac{1}{4}$ in. (6 mm) in any direction.

(b) At column splices the variation between the upper column centerline relative to each principal axis and the lower column centerline relative to each principal axis shall be plus or minus $\frac{1}{4}$ in. (6 mm).

(c) For an individual column shipping piece that is adjacent to an elevator shaft, the displacement of member working points shall be equal to or less than 1 in. (25 mm) from the building column line in the first 20 stories. Above this level, an increase in the displacement of $\frac{1}{2}$ in. (1 mm) is permitted for each additional story up to a maximum displacement of 2 in. (50 mm) from the building column line.

(d) For an exterior individual column shipping piece, the displacement of member working points from the building column line in the first 20 stories shall be equal to or less than 1 in. (25 mm) toward and 2 in. (50 mm) away from the building exterior. Above this level, an increase in the displacement of $\frac{1}{50}$ in. (2 mm) is permitted for each additional story up to a maximum displacement of 2 in. (50 mm) toward and 3 in. (75 mm) away from the building exterior.

Commentary:
The limitations that are described in this section and illustrated in Figures C-11.6 and C-11.7 make it possible to maintain built-in-place or prefabricated facades in a true vertical plane up to the 20th story, if connections that provide for 3 in. (75 mm) of adjustment are used. Above the 20th story, the facade may be maintained within $\frac{1}{50}$ in. (2 mm) per story with a maximum total deviation of 1 in. (25 mm) from a true vertical plane, if connections that provide for 3 in. (75 mm) of adjustment are used. Connections that permit adjustments of plus 2 in. (50 mm) to minus 3 in. (75 mm)—a total of 5 in. (125 mm)—will be necessary in cases where it is desired to construct the facade to a true vertical plane above the 20th story.
For Enclosures or Attachments That May Follow Column Alignment

For Enclosures or Attachments That Must Be Held to Plan Location

\[ L = \text{Actual center-to-center of columns} = \text{plan dimensions} \pm \text{column cross-section} \]
\[ T_a = \text{Plumbness tolerance away from building exterior (varies, see Figure C-11.7)} \]
\[ T_t = \text{Plumbness tolerance toward building exterior (varies, see Figure C-11.7)} \]
\[ T_p = \text{Plumbness tolerance parallel to building exterior} (= T_a) \]

Notes:
1. \( b_{t,\text{max}} \) and \( d_{\text{max}} \) per ASTM A6/A6M. See Figure C-5.1.
2. The maximum clearance envelope does not include permissible sweep and camber in the column material.

*Fig. C-11.6. Clearance required to accommodate accumulated column tolerance.*
Note: The plumb line through the base working point for an individual column is not necessarily the precise plan location because Section 11.3.1.1 deals only with plumbness tolerances and does not include inaccuracies in location of the building column line, foundations, and anchor rods beyond the erector’s model.

Fig. C-11.7. Exterior column plumbness tolerances normal to building line.
(e) For an exterior individual column shipping piece, the member working points at any splice level for multi-tier buildings and at the tops of columns for single-tier buildings shall fall within a horizontal envelope, parallel to the exterior building column line, that is equal to or less than 1½ in. (38 mm) wide for buildings up to 300 ft (91 m) in length. An increase in the width of this horizontal envelope of ½ in. (13 mm) is permitted for each additional 100 ft (30 m) in length up to a maximum width of 3 in. (75 mm).

**Commentary:**
This section limits the position of exterior column working points at any given splice elevation to a narrow horizontal envelope parallel to the exterior building column line (see Figure C-11.8). This envelope is limited to a width of 1½ in. (38 mm), normal to the exterior building column line, in up to 300 ft (90 000 mm) of building length. The horizontal location of this envelope is not necessarily directly above or below the corresponding envelope at the adjacent splice elevations but should be within the limitation of the 1 in 500 plumbness tolerance specified for the controlling columns (see Figure C-11.7).

(f) For an exterior column shipping piece, the displacement of member working points from the building column line that is nominally parallel to the building exterior shall be equal to or less than 2 in. (50 mm) in the first 20 stories. Above this level, an increase in the displacement of ⅛ in. (2 mm) is permitted for each additional story up to a maximum displacement of 3 in. (75 mm) in the direction nominally parallel to the building exterior.

(g) For columns bearing on transfer members such as transfer girders and trusses the reference line for column plumbness and position is located at the intersection of the conforming, as-erected center of the transfer member, and the orthogonal building column line.

**Commentary:**
As illustrated in Figure C-11.8, the position tolerance for a column bearing on a transfer member is measured at the column location from the transfer member centerline along its longitudinal axis and from the perpendicular building column line.

11.3.1.2. For members other than column shipping pieces, the following limitations shall apply:

(a) For a member that consists of an individual, straight shipping piece without field splices, other than a cantilevered member, the variation in alignment shall be acceptable if it is caused solely by variations in column alignment and/or primary supporting member alignment that are within the permissible variations for the fabrication and erection of such members.
(b) For a member that consists of an individual, straight shipping piece that connects to a column, the variation in the distance from the member working point to the upper finished splice line of the column shall be equal to or less than plus \( \frac{\gamma}{6} \) in. (5 mm) and minus \( \frac{\gamma}{6} \) in. (8 mm). These tolerances also apply at the top of a column, either the top column in a multi-tier building or a column in a single-tier building.

(c) For a member that consists of an individual shipping piece that does not connect to a column, the variation in elevation shall be acceptable if it is caused solely by the variations in the elevations of the supporting members within the permissible variations for the fabrication and erection of those members.

(d) For a member that consists of an individual, straight shipping piece and that is a segment of a field assembled unit containing field splices between points of support, the plumbness, elevation, and alignment shall be acceptable if the angular variation, vertically and horizontally, of the working line from a straight line between points of support is equal to or less than \( \frac{5^0}{500} \) of the distance between working points.

Maximum envelope for working points of all columns at any given elevation \( E = 1\frac{1}{2} \) in. (38 mm) for up to 300 ft (91 m) of length; add \( \frac{1}{2} \) in. (13 mm) for each 100 ft (30 m) of length with 3 in. (75 mm) max. total.

For column plumbness tolerance, see Figures C-11.6 and C-11.7.

† Indicates column working points

At any splice elevation, envelope "E" is located within the limits \( T_a \) and \( T_t \).

At any splice elevation, envelope "E" may be located offset from the corresponding envelope at the adjacent splice elevations, above and below, by an amount not greater than \( \frac{1}{500} \) of the column length.

Fig. C-11.8. Tolerances in plan at any splice elevation of exterior columns.
Commentary:
The angular misalignment of the working line of all fabricated shipping pieces relative to the line between support points of the member as a whole in erected position must not exceed 1 in 500. Note that the tolerance is not stated in terms of a linear displacement at any point and is not to be taken as the overall length between supports divided by 500. Typical examples are shown in Figure C-11.9. Numerous conditions within tolerance for these and other cases are possible. The condition described in (d) applies to both plan and elevation tolerances.

(e) For a cantilevered member that consists of an individual, straight shipping piece, the plumbness, elevation, and alignment shall be acceptable if the angular variation of the working line from a straight line that is extended in the plan direction from the working point at its supported end is equal to or less than \( \frac{1}{500} \) of the distance from the working point at the free end.

Commentary:
This tolerance is evaluated after the fixed end condition is sufficient to stabilize the cantilever and before the temporary support is removed. The preset specified in the contract documents should be calculated accordingly. The temporary support cannot be used to induce artificial deflection into the cantilever to meet this tolerance after the fixed end is restrained.

(f) For a member of irregular shape, the plumbness, elevation, and alignment shall be acceptable if the fabricated member is within its tolerances and the members that support it are within the tolerances specified in this Code.

Fig. C-11.9. Alignment tolerances for members with field splices.
(g) For a member that is fully assembled in the field in an unstressed condition, the same tolerances shall apply as if fully assembled in the shop.

(h) For a member that is field-assembled, element-by-element, in place, temporary support shall be used or an alternative erection plan shall be submitted to the owner’s designated representatives for design (ODRD) and construction (ODRC). The tolerance in Section 11.3.1.2(d) shall be met in the supported condition with working points taken at the point(s) of temporary support.

Commentary:
Trusses fabricated and erected as a unit or as an assembly of truss segments normally have excellent controls on vertical position regardless of fabrication and erection techniques. However, a truss fabricated and erected by assembling individual components in place in the field is potentially more sensitive to deflections of the individual truss components and the partially completed work during erection, particularly the chord members. In such a case, the erection process should follow an erection plan that addresses this issue.

11.3.1.3. For members that are identified as adjustable items by the ODRD in the contract documents, the fabricator shall provide adjustable connections for these members to the supporting structural steel frame. Otherwise, the fabricator is permitted to provide nonadjustable connections. When adjustable items are specified, the ODRD shall indicate the total adjustability that is required for the proper alignment of these supports for other trades. The variation in the position and alignment of adjustable items shall be as follows:

(a) The variation in the vertical distance from the upper finished splice line of the nearest column to the support location specified in the structural design documents shall be equal to or less than plus or minus 3/32 in. (10 mm).

(b) The variation in the horizontal distance from the established finish line at the particular floor shall be equal to or less than plus or minus 3/32 in. (10 mm).

(c) The variation in vertical and horizontal alignment at the abutting ends of adjustable items shall be equal to or less than plus or minus 1/32 in. (5 mm).

Commentary:
When the alignment of lintels, wall supports, curb angles, mullions, and similar supporting members for the use of other trades is required to be closer than that permitted by the foregoing tolerances for structural steel, the ODRD must identify such items in the contract documents as adjustable items.

11.3.1.4. For inclined columns, the tolerances of 11.3.1.1(a), (c), (d), and (e) shall also apply at the working points of these columns.

11.3.2. In the design of steel structures, the ODRD shall provide for the necessary clearances and adjustments for material furnished by other trades to accommodate the mill tolerances, fabrication tolerances, and erection tolerances in this Code for the structural steel frame.
Commentary:
In spite of all efforts to minimize inaccuracies, deviations will still exist; therefore, in addition, the designs of prefabricated wall panels, partition panels, fenestrations, floor-to-ceiling door frames, and similar elements must provide for clearance and details for adjustment as described in Section 11.3.2. Designs must provide for adjustment in the vertical dimension of prefabricated facade panels that are supported by the structural steel frame because the accumulation of shortening of loaded steel columns will result in the unstressed facade supported at each floor level being higher than the structural steel framing to which it must be attached. Observations in the field have shown that where a heavy facade is erected to a greater height on one side of a multistory building than on the other, the structural steel framing will be pulled out of alignment. Facades should be erected at a relatively uniform rate around the perimeter of the structure.
Metric Conversion Factors for Common Steel Design Units in AISC Specifications

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<td>stress</td>
<td>ksi</td>
<td>6.895 megapascals (MPa), N/mm²</td>
</tr>
<tr>
<td>moment</td>
<td>kip-in.</td>
<td>113 000 N-mm</td>
</tr>
<tr>
<td>energy</td>
<td>ft-lbf*</td>
<td>1.356 joule (J)</td>
</tr>
<tr>
<td>force</td>
<td>kip (1 000 lbf)*</td>
<td>4 448 newton (N)</td>
</tr>
<tr>
<td>force</td>
<td>psf</td>
<td>47.88 pascal (Pa), N/m²</td>
</tr>
<tr>
<td>force</td>
<td>plf</td>
<td>14.59 N/m</td>
</tr>
<tr>
<td>force</td>
<td>kip/in.</td>
<td>175.1 N/mm</td>
</tr>
<tr>
<td>temperature</td>
<td>To convert °F to °C: ( t_c = \frac{(t_f - 32)}{1.8} )</td>
<td></td>
</tr>
</tbody>
</table>

*Force in lbf or N = mass × g, where g, acceleration due to gravity = 32.2 ft/sec² = 9.81 m/sec²