

AISC's Code of Standard Practice for Steel Buildings and Bridges

**National Council of Structural
Engineers Associations**

WEBINAR

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AISC's Code of Standard Practice

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AISC's Code of Standard Practice

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AISC's Code of Standard Practice

The trade practices established and set forth in this Code define custom and usage for the fabricated structural steel industry in the United States for steel buildings, bridges, and other structures. The provisions of this Code govern the fabrication and erection of structural steel, in the absence of individual provisions in the contract documents superseding corresponding, individual provisions of this Code.

Paraphrased from COSP Section 1.1

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The Code of Standard Practice is referenced in the *AISC Specification for Steel Buildings*:

Chapter A

- A1 – Structural Steel is as defined in COSP
Section 2.1
- A2 - COSP is a referenced standard
- A4 - Structural design drawings and specifications shall meet requirements of COSP

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Chapter M

M2.7 – Dimensional Tolerances per COSP
Section 6

M3.1 – Shop painting and Surface preparation
per COSP Section 6

M4.1 – Erection

Column Bases per COSP Section 7

M4.2 – Stability and Connections

Carried up true and plumb per COSP Section 7

Secured and stabilized per COSP Section 7

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Chapter N

N2 – Fabricator and Erector Quality Program

Material Identification procedure per COSP 6.1

Fabricator's QCI inspects per COSP Section 6

Erector's QCI inspects per COSP Section 7.13

N3.1 – Fabricator and Erector Documents submitted per COSP Section 4 or 4.4

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SECTION TITLES in 1924

Section 1 Design

Section 2 Classification

Section 3 Invoicing

Section 4 Drawings and Specifications

Section 5 Good workmanship and Standard Practice

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SECTION TITLES in 1924, cont.

Section 6 Inspection and Delivery

Section 7 Erection

Section 8 Delays in Prosecution of Work

Section 9 Extra Work

Section 10 Proposals and Contracts

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CURRENT SECTION TITLES

Glossary

Section 1 General Provisions

Section 2 Classification of Materials

Section 3 Design Drawings and Specifications

Section 4 Shop and erection Drawings

Section 5 Materials

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CURRENT SECTION TITLES, cont.

Section 6 Shop Fabrication and Delivery

Section 7 Erection

Section 8 Quality Control

Section 9 Contracts

Section 10 Architecturally Exposed Structural
Steel

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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 job site.

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Owner's Designated Representative for Design(ODRC).

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.

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Contract Documents.

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

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Column Line.

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

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Erection Bracing Drawings.

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.

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Erection Drawings.

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

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Established Column Line.

The actual field line that is most representative of the erected column centers along a line of columns placed using the dimensions shown in the structural design drawings and the lines and bench marks established by the owner's designated representative for construction, to be used in applying the erection tolerances given in this Code for column shipping pieces.

1 General Provisions

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Means, Methods and Safety of Erection

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Erection

App. A

Digital Building Product Models

Note: This section will be substantially revised due to advances in the industry such as BIM.

1.8 Responsibility stability of the frame

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

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

2 Classification of Materials

2.2 Other Steel, Iron or Metal Devices, some examples:

Catwalks.

Cold-formed steel products

Handrail.

Lintels, if not attached to the structural steel frame.

Stairs

Steel deck.

Steel (open-web) joists.

Steel joist girders.

3.1 Completeness of Construction Documents

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

- (a) The size, section, material grade and location of all members;
- (b) All geometry and working points necessary for layout;

3.1 Completeness of Construction Documents

- (c) Floor elevations;
- (d) Column centers and offsets;
- (e) The camber requirements for members;
- (f) Joining requirements between elements of built-up members; and,
- (g) The information that is required in Sections 3.1.1 through 3.1.6.

An extensive list is provided in the commentary. See also Part 2 of the *Steel Construction Manual*.

3.1 Connections

3.1.2. The owner's designated representative for design shall indicate one of the following options for each connection:

(1) The complete connection design shall be shown in the structural design drawings;

(2) In the structural design drawings or specifications, the connection shall be designated to be selected or completed by an experienced steel detailer; or,

(3) In the structural design drawings or specifications, the connection shall be designated to be designed by a licensed professional engineer working for the fabricator.

3.1 Connections – Option One

The intent of this approach is that complete design information necessary for detailing the connection is shown in the structural design drawings. The steel detailer will then be able to transfer this information to the shop and erection drawings

3.1 Connections – Option One

Per the Commentary the following information is included:

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

3.1 Connections – Option Two

The connection(s) shall be designated to be selected or completed by an experienced steel detailer

The SER provides the schematics and the steel detailer completes the details

It is **not** the intent that this approach be used when the practice of engineering is required

3.1 Connections – Option Three

The SER provides design criteria and a licensed professional engineer working for the fabricator designs the connections.

3.1 Connections

One of these three options must be specified for each connection

Acceptable to use more than one method on same project

3.1 Connections – Options Two & Three

Communication is required in Options 2 and 3.

Any restrictions on types of connections

The connection design loads and associated criteria must be defined. Forces, moments, whether the loads provided are ASD or LRFD loads, and similar information is key here

What *substantiating connection information*, if any, is required

3.1 Connections – Option Three

Substantiating Connection Information

It is the information submitted by the fabricator, if requested by the SER, when option (2) or option (3) is designated for connections

Early in the process, the fabricator and SER need to discuss and agree on representative samples of the required substantiating connection information

3.1 Connections – Option Three

Review and Approval

The *connection design engineer* must review and confirm in writing, as part of the substantiating connection information, that the shop and erection drawings properly incorporate the connection designs.

This review does not replace the approval process of the shop and erection drawings by the SER. It is in addition to it.

3.1 Connections – Option Three

Final Authority

The SER is identified as the final authority in the case of a dispute between the SER and the licensed professional engineer in responsible charge of the connection design when option (3) is specified. This is simple and straightforward, and it is how it must be because only the SER has the full knowledge of the structure.

3.1 Connections

Summary of Options 1, 2 and 3

Simple and straightforward approaches to practices that already exist, are in wide use, but currently widely varying in how they are used.

Has appropriate limits for all three options.

Provisions allow all parties to manage their own risks, and no party is asked to assume the responsibility for the negligence of another party.

3.1 Connections

See also

Discussion in Part Two of the *Steel Construction Manual*

Connection Design Responsibility, Michael A. West, STRUCTURE magazine, November, 2011

3.2 Use of Architectural and M-E-P Drawings

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

4.4 Approvals

Except as provided in Section 4.5, the *shop and erection drawings* shall be submitted to the *owner's designated representatives for design and construction* for review and approval. The *shop and erection drawings* shall be returned to the *fabricator* within 14 calendar days..

4.4 Approvals, cont.

Final *substantiating connection information*, if any, shall also be submitted with the *shop and erection drawings*. The *owner's designated representative for design* is the final authority in the event of a disagreement between parties regarding *connection design*.

4.4 Approvals, cont.

Approved *shop* and *erection drawings* shall be individually annotated by the *owner's designated representatives for design and construction* as either approved or approved subject to corrections noted. When so required, the *fabricator* shall subsequently make the corrections noted and furnish corrected *shop* and *erection drawings* to the *owner's designated representatives for design and construction*.

4.4 Approvals – 4.4.1

4.4.1 Approval of the *shop* and *erection drawings*, approval subject to corrections noted and similar approvals shall constitute the following:

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

4.4 Approvals – 4.4.1, cont.

4.4.1, cont.

(b) Confirmation that the *owner's designated representative for design* has reviewed and approved the *connection* details shown on the *shop and erection drawings* and submitted in accordance with Section 3.1.2, if applicable; and,

(c) Release by the *owner's designated representatives for design and construction* for the *fabricator* to begin fabrication using the approved submittals.

4.4.2 Revisions (also Section 9.3)

Unless otherwise noted, any additions, deletions or *revisions* that are indicated in responses to RFIs or on the approved *shop and erection drawings* 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 *owner's designated representative for construction* when any direction or notation in responses to RFIs or on the *shop or erection drawings* or other information will result in an additional cost and/or a delay. See Sections 3.5 and 9.3.

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 *design drawings*. When RFIs involve discrepancies or *revisions*, see Sections 3.3, 3.5, and 4.4.2.

6.1 Identification of Material

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, either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

6.1 Identification of Material, cont.

(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 owner's designated representative for design, either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

6.1 Identification of Material, cont.

(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 owner's designated representative for design, either in the contract documents or in separate written instructions given to the fabricator prior to ordering mill materials.

6.4 Fabrication Tolerances

6.4.1 - Both ends finished $\pm 1/32$ " on length

6.4.1(a) - Other $L \leq 30'$, $\pm 1/16$ " on length

6.4.1(b) - Other $L > 30'$, $\pm 1/8$ " on length

6.4.4 – Camber Tolerance

Beam $L \leq 50$ -feet - zero, plus $1/2$ "

Beam $L > 50$ -feet, - zero, $+1/2$ -inch plus $1/8$ -inch per 10-feet

Measured in Fabricator's Shop in unstressed condition (QC Program)

7.5 Installation of Anchor Rods

- 7.5.1 Anchor rods are to be set by the ODRC per the approved embedment drawings per the tolerances provided (a-f). Tolerances are measured with respect to the column lines.
- 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 Installation of Anchor Rods

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 owner's designated representative for construction 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 7.13 for the erection of the structural steel.

7.5 Installation of Anchor Rods

7.5.4 ...The owner's designated representative for construction 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...

7.5 Installation of Anchor Rods

NOTE: The tolerances for anchor rods and other embedded material differ between the COSP and ACI 117 *Specification for Tolerances for Concrete Construction and Materials (ACI 117-10) and Commentary*.

These differences need to be resolved in the Project Specification.

7.7 Grouting

Grouting shall be the responsibility of the owner's designated representative for construction. 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.

7.7 Grouting - 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; and,
- (c) Leveling nuts and washers on the anchor rods beneath the column base.

7.10 Temporary Support of Structural Steel – 7.10.1

The owner's designated representative for design shall identify the following in the contract documents:

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

(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.

7.10 Temporary Support of Structural Steel – 7.10.2

The owner's designated representative for construction shall indicate to the erector prior to bidding, the installation schedule for non-structural steel elements of the lateral-load-resisting system and connecting diaphragm elements identified by the owner's designated representative for design in the contract documents.

7.10 Temporary Support of Structural Steel – 7.10.3

Based upon the information provided in accordance with Sections 7.10.1 and 7.10.2, the erector shall determine, furnish and install all temporary supports, such as temporary guys, beams, falsework, cribbing or other elements required for the erection operation. These temporary supports shall be sufficient to secure 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.

7.10 Temporary Support of Structural Steel – 7.10.3, cont.

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 owner's designated representatives for design and construction, nor those that are unpredictable, such as loads due to hurricane, tornado, earthquake, explosion or collision.

7.10 Temporary Support of Structural Steel – 7.10.3, cont.

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.

7.10 Temporary Support of Structural Steel

See also:

AISC Design Guide 10 *Erection Bracing of Low-Rise Structural Steel Frames*, Fisher and West, 1997

ASCE Standard *Design Loads on Structures during Construction (37-02)*

7.13 Erection Tolerances

Working points and working lines:

For members other than horizontal member, the member work point shall be the actual center of the member at each end...

For horizontal members, the working point shall be the centerline of the top flange or the top surface.

The member working line shall be the straight line that connects the member working points.

7.13 Erection Tolerances, cont.

7.13.1.1 - For an individual column shipping piece, the angular variation of the working line from a plumb line shall be equal to or less than 1/500 of the distance between working points.

$$(12 \times 26) / 500 = 0.624''$$

$$(12 \times 13) / 500 = 0.312''$$

7.13 Erection Tolerances, cont.

7.13.1.1(a) - ...adjacent to an elevator, the displacement of member working points shall be equal to or less than 1 in. from the Established Column Line in the first 20 stories.

7.13.1.1(b) - For an exterior ... column shipping piece, the displacement of member working points from the Established Column Line in the first 20 stories shall be ≤ 1 in. toward and 2 in. away from the building line.

7.13 Erection Tolerances, cont.

7.13.1.1(c) - For an exterior ... column shipping piece, the member working points at any splice level for multi-Tier buildings...shall fall within a horizontal envelop, parallel to the building line that is $\leq 1 \frac{1}{2}$ in. wide for buildings up to 300 ft in length.

7.13 Erection Tolerances, cont.

7.13.1.1(d) - For an exterior column shipping piece, the displacement of member working points from the Established Column Line, parallel to the building line, shall be equal to or less than 2 in. in the first 20 stories.

$$(5 \times 12 \times 13) / 500 = 1.56''$$

7.13 Erection Tolerances, cont.

Members other than columns:

7.13.1.2(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...caused solely by variations in column alignment and/or primary supporting member alignment that are within permissible variation for...such members.

7.13 Erection Tolerances, cont.

Members other than columns:

7.13.1.2(b) - For a member that consists of an individual, straight shipping piece that connects to a column, the variation in the distance of the member working point to the upper finished splice line of the column shall be equal to or less than plus $3/16$ " and minus $5/16$ ".

7.13 Erection Tolerances, cont.

Members other than columns:

7.13.1.2(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 solely caused by the variations in the elevations of the supporting members within the permissible variations for...those members.

7.13 Erection Tolerances, cont.

Adjustable items:

7.13.1.3 For members that are identified as Adjustable Items...in the Contract Documents...

(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 Drawings shall be equal to or less than plus or minus $3/8$ in.

7.13 Erection Tolerances, cont.

Adjustable items, cont.

(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 $3/8$ in.

(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 $3/8$ in.

NOTE: See discussion in Part 2 of the *Manual*

7.13 Erection Tolerances, cont.

7.13.2 - In the design of steel structures, the Owner's Designated Representative for Design 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.

8 Quality Control

8.5.4. Rejection of material or workmanship that is not in conformance with the contract documents shall be 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.

9 Contracts

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

10 AEISS - 10.1

When members are specifically designated as architecturally exposed structural steel or AEISS in the contract documents, the requirements in Sections 1 through 9 shall apply as modified in Section 10. AEISS members or components shall be fabricated and erected with the care and dimensional tolerances that are stipulated in Sections 10.2 through 10.4. The following additional information shall be provided in the contract documents when AEISS is specified:

10 AESS -10.1, cont.

10.1, cont.

- (a) Specific identification of members or components that are AESS;
- (b) Fabrication and/or erection tolerances that are to be more restrictive than provided for in this Section, if any; and,
- (c) Requirements, if any, of a mock-up panel or components for inspection and acceptance standards prior to the start of fabrication.

10 AEISS - 10.4.2

Unless otherwise specified in the contract documents, AEISS members and components shall be plumbed, leveled and aligned to a tolerance that is one-half that permitted for non-AEISS members. To accommodate these erection tolerances for AEISS, the owner's designated representative for design shall specify connections between AEISS members and non-AEISS members, masonry, concrete and other supports as adjustable items, in order to provide the erector with means for adjustment.

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Thank You

