

## CHAPTER 22

# STEEL

### SECTION 2201 GENERAL

**2201.1 Scope.** The provisions of this chapter govern the quality, design, fabrication and erection of steel used structurally in buildings or structures.

### SECTION 2202 DEFINITIONS

**2202.1 Definitions.** The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meaning shown herein.

**STEEL CONSTRUCTION, COLD-FORMED.** That type of construction made up entirely or in part of steel structural members cold formed to shape from sheet or strip steel such as roof deck, floor and wall panels, studs, floor joists, roof joists and other structural elements.

**STEEL JOIST.** Any steel structural member of a building or structure made of hot-rolled or cold-formed solid or open-web sections, or riveted or welded bars, strip or sheet steel members, or slotted and expanded, or otherwise deformed rolled sections.

**STEEL MEMBER, STRUCTURAL.** Any steel structural member of a building or structure consisting of a rolled steel structural shape other than cold-formed steel, or steel joist members.

### SECTION 2203 IDENTIFICATION AND PROTECTION OF STEEL FOR STRUCTURAL PURPOSES

**2203.1 Identification.** Steel furnished for structural load-carrying purposes shall be properly identified for conformity to the ordered grade in accordance with the specified ASTM standard or other specification and the provisions of this chapter. Steel that is not readily identifiable as to grade from marking and test records shall be tested to determine conformity to such standards.

**2203.2 Protection.** Painting of structural steel shall comply with the requirements contained in AISC 360. Individual structural members and assembled panels of cold-formed steel construction, except where fabricated of approved corrosion-resistant steel or of steel having a corrosion-resistant or other approved coating, shall be protected against corrosion with an approved coat of paint, enamel or other approved protection.

### SECTION 2204 CONNECTIONS

**2204.1 Welding.** The details of design, workmanship and technique for welding, inspection of welding and qualification of welding operators shall conform to the requirements of the

specifications listed in Sections 2205, 2206, 2207, 2209 and 2210. Special inspection of welding shall be provided where required by Section 1704.

**2204.2 Bolting.** The design, installation and inspection of bolts shall be in accordance with the requirements of the specifications listed in Sections 2205, 2206, 2209 and 2210. Special inspection of the installation of high-strength bolts shall be provided where required by Section 1704.

**2204.2.1 Anchor rods.** Anchor rods shall be set accurately to the pattern and dimensions called for on the plans. The protrusion of the threaded ends through the connected material shall be sufficient to fully engage the threads of the nuts, but shall not be greater than the length of the threads on the bolts.

### SECTION 2205 STRUCTURAL STEEL

**2205.1 General.** The design, fabrication and erection of structural steel for buildings and structures shall be in accordance with AISC 360. Where required, the seismic design of steel structures shall be in accordance with the additional provisions of Section 2205.2.

**2205.2 Seismic requirements for steel structures.** The design of structural steel structures to resist seismic forces shall be in accordance with the provisions of Section 2205.2.1 or 2205.2.2 for the appropriate seismic design category.

**2205.2.1 Seismic Design Category A, B or C.** Structural steel structures assigned to Seismic Design Category A, B or C shall be of any construction permitted in Section 2205. An *R* factor as set forth in Section 12.2.1 of ASCE 7 for the appropriate steel system is permitted where the structure is designed and detailed in accordance with the provisions of AISC 341, Part I. Systems not detailed in accordance with the above shall use the *R* factor in Section 12.2.1 of ASCE 7 designated for "structural steel systems not specifically detailed for seismic resistance."

**2205.2.2 Seismic Design Category D, E or F.** Structural steel structures assigned to Seismic Design Category D, E or F shall be designed and detailed in accordance with AISC 341, Part I.

**2205.3 Seismic requirements for composite construction.** The design, construction and quality of composite steel and concrete components that resist seismic forces shall conform to the requirements of the AISC 360 and ACI 318. An *R* factor as set forth in Section 12.2.1 of ASCE 7 for the appropriate composite steel and concrete system is permitted where the structure is designed and detailed in accordance with the provisions of AISC 341, Part II. In Seismic Design Category B or above, the design of such systems shall conform to the requirements of AISC 341, Part II.

**2205.3.1 Seismic Design Categories D, E and F.** Composite structures are permitted in Seismic Design Categories D, E and F, subject to the limitations in Section 12.2.1 of ASCE 7, where substantiating evidence is provided to demonstrate that the proposed system will perform as intended by AISC 341, Part II. The substantiating evidence shall be subject to building official approval. Where composite elements or connections are required to sustain inelastic deformations, the substantiating evidence shall be based on cyclic testing.

## SECTION 2206 STEEL JOISTS

**2206.1 General.** The design, manufacture and use of open web steel joists and joist girders shall be in accordance with one of the following Steel Joist Institute (SJI) specifications:

1. SJI K-1.1
2. SJI LH/DLH-1.1
3. SJI JG-1.1

Where required, the seismic design of buildings shall be in accordance with the additional provisions of Section 2205.2 or 2210.5.

**2206.2 Design.** The registered design professional shall indicate on the construction documents the steel joist and/or steel joist girder designations from the specifications listed in Section 2206.1 and shall indicate the requirements for joist and joist girder design, layout, end supports, anchorage, non-SJI standard bridging, bridging termination connections and bearing connection design to resist uplift and lateral loads. These documents shall indicate special requirements as follows:

1. Special loads including:
  - 1.1. Concentrated loads;
  - 1.2. Nonuniform loads;
  - 1.3. Net uplift loads;
  - 1.4. Axial loads;
  - 1.5. End moments; and
  - 1.6. Connection forces.
2. Special considerations including:
  - 2.1. Profiles for nonstandard joist and joist girder configurations (standard joist and joist girder configurations are as indicated in the SJI catalog);
  - 2.2. Oversized or other nonstandard web openings; and
  - 2.3. Extended ends.
3. Deflection criteria for live and total loads for non-SJI standard joists.

**2206.3 Calculations.** The steel joist and joist girder manufacturer shall design the steel joists and/or steel joist girders in accordance with the current SJI specifications and load tables to support the load requirements of Section 2206.2. The registered design professional may require submission of the steel

joist and joist girder calculations as prepared by a registered design professional responsible for the product design. If requested by the registered design professional, the steel joist manufacturer shall submit design calculations with a cover letter bearing the seal and signature of the joist manufacturer's registered design professional. In addition to standard calculations under this seal and signature, submittal of the following shall be included:

1. Non-SJI standard bridging details (e.g. for cantilevered conditions, net uplift, etc.).
2. Connection details for:
  - 2.1. Non-SJI standard connections (e.g. flush-framed or framed connections);
  - 2.2. Field splices; and
  - 2.3. Joist headers.

**2206.4 Steel joist drawings.** Steel joist placement plans shall be provided to show the steel joist products as specified on the construction documents and are to be utilized for field installation in accordance with specific project requirements as stated in Section 2206.2. Steel placement plans shall include, at a minimum, the following:

1. Listing of all applicable loads as stated in Section 2206.2 and used in the design of the steel joists and joist girders as specified in the construction documents.
2. Profiles for nonstandard joist and joist girder configurations (standard joist and joist girder configurations are as indicated in the SJI catalog).
3. Connection requirements for:
  - 3.1. Joist supports;
  - 3.2. Joist girder supports;
  - 3.3. Field splices; and
  - 3.4. Bridging attachments.
4. Deflection criteria for live and total loads for non-SJI standard joists.
5. Size, location and connections for all bridging.
6. Joist headers.

Steel joist placement plans do not require the seal and signature of the joist manufacturer's registered design professional.

**2206.5 Certification.** At completion of fabrication, the steel joist manufacturer shall submit a certificate of compliance in accordance with Section 1704.2.2 stating that work was performed in accordance with approved construction documents and with SJI standard specifications.

## SECTION 2207 STEEL CABLE STRUCTURES

**2207.1 General.** The design, fabrication and erection including related connections, and protective coatings of steel cables for buildings shall be in accordance with ASCE 19.

**2207.2 Seismic requirements for steel cable.** The design strength of steel cables shall be determined by the provisions of ASCE 19 except as modified by these provisions.

1. A load factor of 1.1 shall be applied to the prestress force included in  $T_3$  and  $T_4$  as defined in Section 3.12.
2. In Section 3.2.1, Item (c) shall be replaced with “1.5  $T_3$ ” and Item (d) shall be replaced with “1.5  $T_4$ .”

**2210.6 Prescriptive framing.** Detached one- and two-family dwellings and townhouses, up to two stories in height, shall be permitted to be constructed in accordance with AISI-PM, subject to the limitations therein.

## SECTION 2208 STEEL STORAGE RACKS

**2208.1 Storage racks.** The design, testing and utilization of industrial steel storage racks shall be in accordance with the *RMI Specification for the Design, Testing and Utilization of Industrial Steel Storage Racks*. Racks in the scope of this specification include industrial pallet racks, movable shelf racks and stacker racks and does not apply to other types of racks, such as drive-in and drive-through racks, cantilever racks, portable racks or rack buildings. Where required, the seismic design of storage racks shall be in accordance with the provisions of Section 15.5.3 of ASCE 7.

## SECTION 2209 COLD-FORMED STEEL

**2209.1 General.** The design of cold-formed carbon and low-alloy steel structural members shall be in accordance with AISI-NAS. The design of cold-formed stainless-steel structural members shall be in accordance with ASCE 8. Cold-formed steel light-framed construction shall comply with Section 2210.

**2209.2 Composite slabs on steel decks.** Composite slabs of concrete and steel deck shall be designed and constructed in accordance with ASCE 3.

## SECTION 2210 COLD-FORMED STEEL LIGHT-FRAMED CONSTRUCTION

**2210.1 General.** The design, installation and construction of cold-formed carbon or low-alloy steel, structural and nonstructural steel framing shall be in accordance with AISI-General and AISI-NAS.

**2210.2 Headers.** The design and installation of cold-formed steel box headers, back-to-back headers and single and double L-headers used in single-span conditions for load-carrying purposes shall be in accordance with AISI-Header, subject to the limitations therein.

**2210.3 Trusses.** The design, quality assurance, installation and testing of cold-formed steel trusses shall be in accordance with AISI-Truss, subject to the limitations therein.

**2210.4 Wall stud design.** The design and installation of cold-formed steel studs for structural and nonstructural walls shall be in accordance with AISI-WSD.

**2210.5 Lateral design.** The design of light-framed cold-formed steel walls and diaphragms to resist wind and seismic loads shall be in accordance with AISI-Lateral.