

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.

Exception: Buildings and structures located within the high-velocity hurricane zone shall comply with the provision of Sections 2214 through 2224.

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. Identification of structural steel members shall comply with the requirements contained in AISC 360. Identification of cold-formed steel members shall comply with the requirements contained in AISI S100. Identification of cold-formed steel light-frame construction shall also comply with the requirements contained in AISI S200. Other 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 members shall comply with the requirements contained in AISC 360. Painting of open-web steel joists and joist girders shall comply with the requirements of SJI CJ-1.0, SJI JG-1.1, SJI K-1.1 and SJI LH/DLH-1.1. Individual structural members and assembled panels of cold-formed steel construction shall be protected against corrosion in accordance with the requirements con-

tained in AISI S100. Protection of cold-formed steel light-frame construction shall also comply with the requirements contained in AISI S200.

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.

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.

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.

2205.2 Seismic requirements for steel structures. Reserved.

2205.3 Seismic requirements for composite construction. Reserved.

2205.3.1 Seismic Design Categories D, E and F. Reserved.

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 CJ-1.0
2. SJI K-1.1
3. SJI LH/DLH-1.1
4. SJI JG-1.1

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 bear-

ing 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 manufacture, the steel joist manufacturer shall submit a *certificate of compliance* 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. Reserved.

SECTION 2208 STEEL STORAGE RACKS

2208.1 Storage racks. The design, testing and utilization of industrial steel storage racks made of cold-formed or hot-rolled steel structural members, shall be in accordance with the RMI/ANSI MH 16.1.

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 S100. The design of cold-formed stainless-steel structural members shall be in accordance with ASCE 8. Cold-formed steel light-frame construction shall also comply with Section 2210.

2209.2 Steel decks. The design and construction of cold-formed steel decks shall be in accordance with this section.

2209.2.1 Composite slabs on steel decks. Composite slabs of concrete and steel deck shall be designed and constructed in accordance with ASCE 3.

2209.2.2 Noncomposite steel floor decks. Noncomposite steel floor decks shall be permitted to be designed and constructed in accordance with ANSI/SDI-NC1.0, as modified in Section 2209.2.2.1.

2209.2.2.1 ANSI/SDI-NC1.0 Section 2.4B1. Replace Section 2.4B1 of ANSI/SDI-NC1.0 with the following:

1. General: The design of the concrete slabs shall be done in accordance with the *ACI Building Code Requirements for Reinforced Concrete*. The minimum concrete thickness above the top of the deck shall be 1½ inches (38 mm).

2209.2.3 Steel roof deck. Steel roof decks shall be permitted to be designed and constructed in accordance with ANSI/SDI-RD1.0.

SECTION 2210 COLD-FORMED STEEL LIGHT-FRAME CONSTRUCTION

2210.1 General. The design and installation of structural members and nonstructural members utilized in cold-formed steel light-frame construction where the specified minimum base steel thickness is between 0.0179 inches (0.455 mm) and 0.1180 inches (2.997 mm) shall be in accordance with AISI S200 and Sections 2210.2 through 2210.7, as applicable.

2210.2 Header design. Headers, including box and back-to-back headers, and double and single L-headers shall be designed in accordance with AISI S212 or AISI S100.

2210.3 Trusses.

2210.3.1 Design. Cold-formed steel trusses shall be designed in accordance with AISI S214, Sections 2210.3.1 through 2210.3.5 and accepted engineering practice.

2210.3.2 Truss design drawings. The truss design drawings shall conform to the requirements of Section B2.3 of AISI S214 and shall be provided with the shipment of trusses delivered to the job site. The truss design drawings shall include the details of permanent individual truss member restraint/bracing in accordance with Section B6(a) or B6(c) of AISI S214 where these methods are utilized to provide restraint/bracing.

2210.3.3 Deferred submittals. AISI S214 Section B4.2 shall be deleted.

2210.3.4 Trusses spanning 60 feet or greater. The owner shall contract with a *registered design professional* for the design of the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing for trusses with clear spans 60 feet (18 288 mm) or greater.

2210.3.5 Truss quality assurance. Trusses not part of a manufacturing process that provides requirements for quality control done under the supervision of a third-party quality control agency, shall be manufactured in compliance with Sections 1704.2 and 1704.3, as applicable.

2210.4 Wall stud design. Wall studs shall be designed in accordance with either AISI S211 or AISI S100.

2210.5 Floor and roof system design. Framing for floor and roof systems in buildings shall be designed in accordance with either AISI S210 or AISI S100.

2210.6 Lateral design. Light-frame shear walls, diagonal strap bracing that is part of a structural wall and diaphragms used to resist wind and other in-plane lateral loads shall be designed in accordance with AISI S213.

2210.7 Prescriptive framing. Detached one- and two-family dwellings and townhouses, less than or equal to three stories above grade plane, shall be permitted to be constructed in accordance with AISI S230 subject to the limitations therein.

SECTION 2211 GABLE END WALLS

2211.1 Gable end walls. Gable endwalls shall be structurally continuous between points of lateral support.

2211.2 Cathedral end walls. Gable endwalls adjacent to cathedral ceilings shall be continuous from the uppermost floor to ceilings shall be continuous from the uppermost floor to ceiling diaphragm or to the roof diaphragm.

SECTIONS 2212-2213 RESERVED

SECTION 2214 HIGH-VELOCITY HURRICANE ZONES— GENERAL—STEEL CONSTRUCTION

2214.1 Design. Steel and iron members shall be designed by methods admitting of rational analysis according to established principles or methods.

2214.2 The design, fabrication and erection of iron and steel for buildings and other structures shall be as set forth in this Chapter. The requirements set forth in Sections 2215 through 2221 herein, inclusive, apply to structural steel for buildings and other structures. Sections 2222 and 2223, apply to cold-formed members of sheet or strip steel and light-gauge steel construction.

2214.3 The following standards, as set forth in Chapter 35 of this code, are hereby adopted.

1. American Institute of Steel Construction, AISC:
 - a. *Manual of Steel Construction*, 2005, Thirteenth Edition, AISC, including *Specification for Structural Steel Buildings* 360-05.
 - b. *Serviceability Design Considerations for Low-Rise Buildings*, AISC.
 - c. *Engineering for Steel Construction*, AISC.
 - d. *Detailing for Steel Construction*, AISC.
 - e. *Iron and Steel Beams - 1873 to 1952*, AISC.
 - f. *Torsional Analysis of Steel Members*, AISC.
2. American Iron and Steel Institute, AISI:
 - a. *Specification for the Design of Cold-Formed Steel Structural Members*, AISI.
 - b. *Fire-Resistant Steel-Frame Construction*, AISI.
 - c. *Fire-Safe Structural Steel & #150; A Design Guide*, AISI.
 - d. *Designing Fire Protection for Steel Trusses*, AISI.
 - e. *Cold-Formed Steel Design Manual*, AISI

- f. *Specifications for the Design of Light-Gage Cold-Formed Stainless Structural Members*, AISI.
 - g. *Specification for the Criteria for Structural Application of Steel Cables for Buildings*, AISI.
 - h. *Designing Fire Protection for Steel Columns*, AISI.
 - i. *Design Manual for Structural Tubing*, AISI.
3. American National Standards Institute/American Society of Civil Engineers, ANSI/ASCE.
 - a. *Specifications for the Design and Construction of Composite Slabs and Commentary on Specifications for the Design and Construction of Composite Slabs*, ANSI/ASCE 3.
 - b. *Specifications for the Design of Cold-Formed Stainless Steel Structural Members*, ANSI/ASCE 8.
 - c. *Guideline for Structural Condition Assessment of Existing Buildings*, ANSI/ASCE 11.
 4. American National Standards Institute/American Welding Society, ANSI/AWS.
 - a. *Standard Welding Procedure and Performance Qualification*, AWS B2.1.
 - b. *Recommended Practice for Stud Welding*, AWS C5.4.
 - c. *Structural Welding Code—Steel*, ANSI/AWS D1.1.
 - d. *Structural Welding Code—Sheet Metal*, AWS D1.3.
 - e. *Structural Welding Code—Reinforcing Steel*, ANSI/AWS D1.4
 - f. *Specification for Welding of Sheet Metal*, AWS D9.1.
 - g. *Standard for Qualification of Welding Procedures and Welders for Piping and Tubing*, AWS D10.9.
 5. American Society for Testing and materials, ASTM.
 - a. *Standard Specification for General Requirements for Rolled Steel Plates, Shapes, b. Sheet Piling and Bars for Structural Use*, ASTM A 6.
 - b. *Standard Specifications for High-Strength Bolts for Structural Steel Joints*, ASTM A 325.
 - c. *Standard Specification for Heat-Treated Steel Structural Bolts. 150 KSI Minimum Tensile Strength*, ASTM A 490.
 - d. *Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot Dip Process*, ASTM A 525.
 6. National Association of Architectural Metal Manufacturers, NAAMM.
 - a. *Metal Grating Manual*, NAAMM.
 7. Rack Manufacturers Institute/American National Standards Institute, RMI/ANSI.
 - a. *Industrial Steel Storage Racks Manual*, RMI.
 - b. *Manual of Safety Practices - A code of Practices for the Use of Industrial and Commercial Steel Storage Racks*, RMI/ANSI MH16.2.
 8. Research Council on Structural Connections of the Engineering Foundation, RCSCEF.
 - a. *Specification for Structural Joints Using ASTM A 325 or A 490 Bolts*, RCSCEF.
 9. Shelving Manufacturers Association, a Products Section of the Material Handling Institute/American National Standards Institute, SMA/ANSI.
 - a. *Specification for the Design, Testing, Utilization and Application of Industrial Grade Steel Shelving*, SMA/ANSI MH281.
 10. Steel Deck Institute, Inc., SDI.
 - a. *Standard Practice Details*, SDI.
 - b. *SDI Manual of Construction with Steel Deck*, SDI.
 - c. *Deck Damage and Penetrations*, SDI.
 - d. *Steel Deck Institute Design Manual*.
 - e. *LRFD Design Manual for Composite Beams and Girders with Steel Deck*, SDI.
 - f. *Diaphragm Design Manual*, SDI.
 11. Steel Joist Institute, SJI.
 - a. *Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders*, SJI.
 - b. *Structural Design of Steel Joist Roofs to Resist Ponding Loads, Technical Digest No. 3*, SJI.
 - c. *Vibration of Steel Joist-Concrete Slab Floors, Technical Digest No. 5*, SJI.
 - d. *Structural Design of Steel Joist Roofs to Resist Uplift Loads, Technical Digest No. 6*, SJI.
 - e. *Welding of Open Web Steel, Technical Digest No. 8*, SJI.
 - f. *Handling and Erection of Steel Joists and Joist Girders, Technical Digest No. 9*, SJI.
 - g. *60-Year Steel Joist Manual*, SJI.
 12. Steel Structures Painting Council, SSPC.
 - a. *Steel Joist Shop Paint*, SSPC - Paint 15.
 - b. *A Guide to the Shop Painting of Structural Steel*, SSPC/AISC.
 13. Underwriters Laboratories, Inc., UL.
 - a. *Test for Uplift Resistance of Roof Assemblies*, UL 580.
 14. Welded Steel Tube Institute, Inc., WSTI.
 - a. *Manual of Cold Formed Welded Structural Steel Tube*.
- 2214.4 Workmanship.** Steel construction shall be in conformance with the tolerances, quality and methods of construction as set forth in Section 2214.3.
- 2214.5** Statements of the structural responsibilities of architects and professional engineers on the design of structural steel systems.
- 2214.5.1** The structural engineer of record and/or the architect of record shall be responsible for all aspects of the struc-

tural design including the design of components and connections. The structural construction documents may assign to the fabricator the responsibility for implementing the design as specified and for maintaining fabrication and erection tolerances and for ensuring the fit and erectability of the structure.

2214.5.2 The structural engineer of record and/or the architect of record may elect to detail all connections on the structural construction documents and require fabrication in accordance with those details.

2214.5.3 Alternately the structural engineer of record and/or the architect of record may permit the fabricator to select or modify connections subject to review and approval by the structural engineer of record and/or the architect of record. In that case, the structural construction documents shall specify criteria for the design of connections and shall identify the nature, magnitude and location of all design loads.

2214.5.4 The structural engineer of record and/or the architect of record shall require the submission of fabrication and erection drawings for review as an indication that his or her intent has been understood and the specified criteria have been used.

2214.5.5 Structural submittals requiring engineering input, such as dealing with substitute connections, shall be accompanied by design calculations and shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

SECTION 2215

HIGH-VELOCITY HURRICANE ZONES—MATERIAL

2215.1 Steel. Steel shall conform to the physical requirements set forth in the applicable standard in Section 2214.3.

2215.2 High-strength steel bolts. High-strength steel bolts shall conform to the requirements set forth in the applicable standards of Section 2214.3.

2215.3 Used and damaged material. All steel shall be straight and true, and any section damaged to be out of shape shall not be used. Steel previously used or fabricated for use or fabricated in error shall not be used except with the approval of the building official. Filled holes or welds shall not be concealed. Straightened or retempered fire-burned steel shall not be used except with the approval of the building official.

2215.4 Tests. The building official may require tests and/or mill records to determine the quality of materials.

2215.5 Ribbed bolts. Ribbed bolts shall be made from carbon manganese steel with a minimum tensile strength of 70,000 per square inch (482.7 MPa).

SECTION 2216

HIGH-VELOCITY HURRICANE ZONES— DESIGN LOADS

2216.1 Design shall be based on the dead, live, wind and other loads set forth in Chapter 16 (High-Velocity Hurricane Zones)

and the additional stress considerations set forth in this Chapter.

SECTION 2217

HIGH-VELOCITY HURRICANE ZONES— MINIMUM THICKNESS OF MATERIAL

2217.1 The minimum thickness of material shall not be less than as set forth in the applicable standards listed in Section 2214.3 except as otherwise set forth herein.

SECTION 2218

HIGH-VELOCITY HURRICANE ZONES— CONNECTIONS

2218.1 Connections shall conform to the requirements of the applicable standards set forth in Section 2214.3.

2218.2 A Florida-registered architect or professional engineer shall inspect the welding and high-strength bolting of structural steel framing and welding, bolting and fastening of light-weight material systems and metal sidings of buildings with areas exceeding 1,000 square feet (93 m²).

2218.3 Welding in the shop or field shall be performed by welders who have been qualified under the applicable AWS code.

SECTION 2219

HIGH-VELOCITY HURRICANE ZONES— TUBULAR COLUMNS

2219.1 Tubular columns and other primary compression members, excluding secondary posts and struts not subject to bending and whose design load does not exceed 2,000 pounds (8900 N), shall have a minimum least dimension of 2½ inches (64 mm) and a minimum wall thickness of 3/16 inch (4.8 mm).

2219.2 Tubular members when filled with concrete shall have ¼-inch diameter (6.4 mm) pressure relief holes drilled through the shell, within 6 inches (152 mm) of the top and bottom of the exposed length of the member and one hole at midheight.

2219.3 Concrete fill in tubular members shall not be assumed to carry any of the load except in compression members having a least dimension of 8 inches (203 mm) or greater and having a 1 inch (25 mm) inspection hole in the plate at each end.

SECTION 2220

HIGH-VELOCITY HURRICANE ZONES— PROTECTION OF METAL

2220.1 All field rivets, bolts, welds and abrasions to the shop coat shall be spot painted or treated with the material used for the shop coat, or an equivalent comparable to the shop coat, after removal of all objectionable deleterious materials.

2220.2 Primary structural steel members, except where intended to be encased in concrete, shall have one shop coat of paint and, if exposed to the atmosphere or elements in the completed building or structure shall receive a second shop coat of paint or be field painted in addition to the initial shop coat with

lead, graphite or asphalt paint or other approved coating compatible with the shop coat, except as herein provided. Surfaces of members in contact with, but not encased in, concrete or masonry shall be asphalt coated or otherwise effectively coated where the thickness of the metal is $\frac{3}{16}$ inch (4.8 mm) or less.

2220.3 Members having a corrosion-resistive metallic coating of zinc of not less than G90 Coating Designation (1.25 ounces; 35 grams) or other equivalent approved coating are not required to have the shop and field coating.

2220.4 Where structural members are exposed to industrial fumes, fresh and/or salt water, salt water spray, and other corrosive agents, such members shall be effectively protected with a corrosion-resistive metallic or other equivalent approved coating.

2220.5 Corrosion-resistant steels with or without painting or coating may be approved where sufficient test or other factual data establishing the satisfactory performance under the particular exposure conditions or usage is submitted to and approved by the building official.

SECTION 2221 HIGH-VELOCITY HURRICANE ZONES— GENERAL—OPEN WEB STEEL JOISTS

2221.1 Standards. Open web steel joists shall comply with the standards set forth in Section 2214.3.

2221.2 Statements of responsibilities of architects and professional engineers on the design of structural systems using open web steel joists.

2221.2.1 The structural construction documents shall designate the standards for joist design and shall indicate layout, end supports, anchorage, bridging requirements, etc., including connections to walls. The structural construction documents shall indicate special requirements for concentrated loads, openings, extended ends and resistance to uplift.

2221.2.2 The structural engineer of record and/or the architect of record shall require structural submittals for the structural engineer of record's review and/or the architect of record's review as an indication that his or her intent has been understood and that the specified criteria have been used. The structural submittals, unless catalog submittals, shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

2221.2.3 The structural submittals shall identify the specific project, shall list the design criteria and shall show all joist location information and details necessary for proper installation.

2221.3 Design.

2221.3.1 Open web steel joist systems shall be designed to accommodate the loads and forces set forth in Chapter 16 (High-Velocity Hurricane Zones).

2221.3.2 Net uplift forces for all zones, applied to the joist systems, shall be clearly indicated on the structural construction documents.

2221.3.3 Where the net uplift force is equal to or greater than the gravity load of construction, all web and bottom chord members shall comply with slenderness ratio requirements for top chord and for compression members other than top chord as provided for in the standards set forth in Section 2214.3(11).

2221.3.4 The slenderness ratio about the horizontal axis can be used in determining the capacity of the top chord provided the top chord is stayed laterally by the deck system. The top chord for superimposed dead and live loads shall be considered to be stayed laterally if:

1. A poured-in-place concrete slab is in direct contact with the top chord.
2. A light gauge steel deck complying with Section 2222 is fastened to the top chord.
3. Any other approved deck system such that attachments of the top chord to the deck are capable of resisting a lateral force specified in the standard set forth in Section 2214.3 and the spacing of the fasteners does not exceed 24 inches (610 mm) along the chord.

2221.3.5 When the bottom chord under net uplift loads is in compression, the bottom chord shall be stayed laterally by a bracing system adequately anchored at each end.

2221.3.6 Fastenings shall be bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per foot (5838 N/m).

2221.4 Connections. The joints and connections of members of steel joists shall be made by welding or bolting.

2221.5 Bridging.

2221.5.1 All bridging and anchors shall be completely installed before application of any construction loads. Bridging shall secure the chords against lateral movement and shall position and hold the joists vertical and in a straight line.

2221.5.2 Bridging members shall be of material having a thickness not less than:

1. $\frac{1}{8}$ inch (3.2 mm) for hot-rolled sections.
2. 16 gauge for cold-formed sections.
3. $\frac{1}{2}$ inch (12.7 mm) diameter for round members.

2221.5.3 Bridging shall be connected to the chords of the joists by welding, bolting or other positive mechanical means. Each attachment shall be capable of resisting a horizontal force specified in the standard set forth in Section 2214.3.

2221.5.4 Bridging shall be connected to the chords of the joists by bolting or welding at all points of contact and shall be capable of transmitting the forces required of the bridging members. The ends of all bridging lines shall terminate at walls or beams and shall be anchored thereto and where anchorage is not possible, stability shall be provided by additional bracing.

2221.5.5 Where uplift forces are a design requirement, a single line of continuous bottom chord bridging shall be provided near the first panel points.

2221.6 End supports and anchorage.

2221.6.1 Joists shall not bear directly on unit masonry unless masonry is designed as engineered unit masonry with properly reinforced, grout-filled continuous bond beam.

2221.6.2 The ends of every joist shall be bolted, welded or encased in concrete at each point of bearing to provide not less resistance in any direction than 50 percent of the Steel Joist Institute (SJI) rated end reaction horizontally and 100 percent of the net uplift reaction specified in the structural construction documents.

2221.6.3 The ends of joists shall have a minimum bearing, on reinforced concrete and steel supports as specified in the standard set forth in Section 2214.3(11).

2221.7 Fabrication. Steel joists shall be manufactured by plants having a certificate of competency issued by the authority having jurisdiction.

2221.8 Shop standards. The applicant for building permit will not be required to submit shop drawings for steel joists except as set forth in Sections 2221.8.1 and 2221.8.2.

2221.8.1 The master permit drawings required by this code shall describe all steel to be used in the proposed building or structure, including open-web frames and trusses, and shall detail member sizes, spacing, attachment and welding including provision for unusual loading such as concentrated loads, unusual cantilevering, soffit framing and continuity except that such prime drawings may designate standard open-web steel joists by Steel Joist Institute (SJI) number and symbol.

2221.8.2 Where standard open-web steel joists are designated on the prime drawings by customary SJI numbers or symbols, the manufacturer, fabricator or supplier may be required to submit design computations, stress diagrams, sizes of members and sizes of welds to the building official for approval before installation to demonstrate that the units to be provided do, in fact, comply with the specifications and performance standards set forth by SJI. Only design computations prepared by a professional engineer will be accepted. Resubmission of any fabricator designs so submitted and approved will not be required for each subsequent job. Proof of the characteristics of the material may be required for any steel for which a minimum yield strength in excess of 36,000 per square inch (248.2 MPa) is used as the basis of design.

**SECTION 2222
HIGH-VELOCITY HURRICANE ZONES—
COLD-FORMED STEEL CONSTRUCTION**

2222.1 Cold-formed steel construction shall include individual structural members, structural decks or wall panels, and nonstructural roofing, siding and other construction elements formed from sheet or strip steel and as set forth in Section 2214.3(2).

2222.2 Standards. Cold-formed steel used in structural applications shall conform to the Standards set forth in Section 2214.3(2).

2222.2.1 Galvanizing as referred to herein is to be zinc coating conforming to the standard set forth in Section 2214.3(5)(d).

2222.3 Individual structural members. Design, fabrication and erection of individual cold-formed steel structural members shall be as set forth herein.

2222.3.1 All structural members shall be positively connected to resist the loads set forth in Chapter 16 (High-Velocity Hurricane Zones).

2222.3.2 All connections shall be by welding, riveting, bolting or other approved fastening devices or methods providing positive attachment and resistance to loosening. Fasteners shall be of compatible material.

2222.3.3 Cables and rods shall not be used as lateral bracing in habitable structures. Lateral bracing, when used, shall have a slenderness ratio of 300 or less, unless restricted by any other section of this code.

2222.3.4 All doors shall be anchored as part of the frame in the closed position.

2222.3.5 No increase in strength shall be allowed for the effect of cold work.

2222.4 Structural sheets. Decks and panels with or without an approved fill material may be designed as diaphragms in accordance with *Diaphragm Design Manual of the Steel Deck Institute*, provided other limitations in this code are complied with.

2222.4.1 Poured fill on roof and floor decks shall not be assumed to have any structural value to support or resist vertical or lateral loads or to provide stability or diaphragm action unless so designed, and poured fill and/or applied materials do not degrade when subjected to moisture.

2222.4.2 Positive attachment of sheets shall be provided to resist uplift forces. Attachment shall be as set forth in Section 2222.3.1 and as required by rational analysis, and/or tests, but not less frequently than the following maximum spacing:

1. One fastener shall be placed near the corner of each sheet or at overlapping corners of sheets.
2. Along each supporting member, the spacing of fasteners shall not exceed 8 inches (203 mm) on centers at ends of sheets or 12 inches (305 mm) on centers.
3. The spacing of edge fasteners between panels, and between panels and supporting members, parallel to the direction of span, where continuous interlock is not otherwise provided shall be not more than 12 inches (305 mm) on centers.
4. Fastening shall be by bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per lineal foot (5838 N/m).

5. Poured lightweight concrete fill will be acceptable as continuous interlock.
6. Attachment to the supporting structure shall be provided at all perimeters and discontinuities by fasteners spaced at no more than 8 inches (203 mm) on center.
7. Wall panels shall be attached as set forth in Section 2222.4.2(1),(2) and (3).

2222.4.3 Metal siding and roof panels shall be not less than 24 gauge.

Exception: Roof panels having an approved fill material designed to act as a diaphragm may use a lighter deck gauge provided that the product approval for the fill material allows its use over the same deck gauge, but in no case shall the deck be less than 26 gauge. The permit applicant shall provide the building official with signed and sealed structural calculations for the diaphragm design prepared by a licensed architect or engineer proficient in structural design. The diaphragm design shall comply with the applicable requirements of Chapter 16 and Chapter 22 (High-Velocity Hurricane Zones).

2222.4.4 Deflection of metal siding and roof panels shall not exceed $L/240$.

2222.4.5 The bending stress of metal siding and roof panels shall be designed using a safety factor of not less than 2.5.

2222.4.6 Minimum roof decking uplift loads shall comply with the design requirements of Chapter 16 (High-Velocity Hurricane Zones) utilizing rational analysis, but not less than UL 580 Class 90.

2222.4.7 Reserved.

2222.4.8 Metal siding and roof panels shall be designed, where possible, to be continuous over two or more spans.

2222.5 Nonstructural sheets. Steel sheet sections not suitable by rational analysis for self-supporting structural sheets shall be termed roofing and siding. Roofing and siding shall be used only over solid wood sheathing or equivalent backing.

2222.5.1 Attachment of sheets shall be as set forth in Section 2222.4.2

2222.6 Protection of metal. All members shall be treated with protective paint coatings or equivalent protection except as permitted in Sections 2222.6.1 or 2222.6.2.

2222.6.1 All steel sheets having a thickness of less than 20 gauge, i.e., materials of higher gauge, shall be galvanized in accordance with the standards of Section 2214.3(5)(d) herein to provide a minimum coating designation of G90.

2222.6.2 Abrasions or damages to the protective coating shall be spot-treated with a material and in a manner compatible to the shop protective coating.

2222.7 Welding shall conform to the requirements of Sections 2214.3, 2218.2 and 2218.3.

SECTION 2223 HIGH-VELOCITY HURRICANE ZONES— PRE-ENGINEERED, PREFABRICATED METAL BUILDING SYSTEMS AND COMPONENTS (PRE-ENGINEERED STRUCTURES)

2223.1 Scope. Metal buildings (preengineered structures) shall include, but not be limited to, tapered or straight web structural steel frames and predominantly cold formed steel secondary components, including, but not limited to, girts, purlins, roof sheets, wall sheets, etc.

2223.2 Standards. Frames and components shall comply with the standards set forth in Section 2214.3.

2223.3 Structural construction documents for pre-engineered structures shall indicate the necessary measures for adapting the structures to the specific site. The structural construction documents shall indicate all openings, concentrated loads and other special requirements. Foundation conditions assumed in the design shall be indicated as well as the location and magnitude of building reactions on that foundation under all design conditions.

2223.4 Structural submittals.

2223.4.1 The structural engineer of record and/or the architect of record shall require structural submittals for review as an indication that his or her intent has been understood and that the specified criteria have been used. The structural submittals shall bear the impressed seal, signature and date of the specialty engineer who prepared them.

2223.4.2 The structural submittals shall identify the project and list loading and other design criteria. The fabrication and erection drawings shall indicate in detail the construction of the standard structure used or as modified to comply with the requirements of the particular project. The fabrication and erection drawings shall indicate all connection details, openings and other special details. The fabrication and erection drawings shall show the magnitude and location of building reactions on the foundation under all design conditions. Calculations supporting the design shall be submitted not only for the standard structure, but also for modifications and for related components requiring structural design.

2223.5 Design. A building or component system in this section shall have a structural engineer of record and/or architect of record responsible for the overall design and performance of the entire building including the foundation and the anchorage of the preengineered metal systems buildings thereto. The structural engineer of record and/or the architect of record shall provide the structural construction documents necessary for permitting.

2223.5.1 Calculations for drift and deflection of the metal system building shall be by the specialty engineer.

2223.5.2 Calculations for deflection shall be done using only the bare frame method. Reductions based on engineering judgment using the assumed composite stiffness of the building envelope shall not be allowed. Drift shall follow AISC serviceability design considerations for low-rise buildings. The use of composite stiffness for deflection calculations shall be permitted only when actual calculations

for the stiffness are included with the design for the specific project. When maximum deflections are specified by the structural construction documents, calculations shall be included in the design data.

2223.5.3 The manufacturer shall design the metal system building and/or component system in accordance with the provisions of Chapter 16 (High-Velocity Hurricane Zones), and the design shall be signed, dated and sealed by the specialty engineer and reviewed by the structural engineer of record and/or the architect of record. The manufacturer of the metal system building and/or component system shall be responsible to provide all reactions to the structural engineer of record and/or the architect of record.

2223.5.4 Fastenings shall be by bolting, welding or other approved fastening device that provides a resistance to lateral movement as required by rational analysis or by test, but not less than 400 pounds per lineal foot (5838 N/m).

2223.6 Permitting.

2223.6.1 The applicant for a building permit will be required to submit structural construction documents indicating the overall building dimensions, haunch and eave heights, roof slopes, bay spacing, column locations, approximate frame and component profiles, foundation details and fire rating details and the magnitude and location of building reactions on the foundation under all design conditions prior to the issuance of the permit.

2223.6.2 Prior to the commencement of erection of the structure, the structural submittal and calculations, including, but not limited to, fabrication and erection drawings signed, dated and sealed by the specialty engineer and reviewed by the architect of record and/or the structural engineer of record, shall be submitted and approved by the building department.

2223.6.3 Where the roofing and siding are structural sheets consisting of clip-mounted standing seam or other direct screw attached panel system and are in themselves the finished product, a separate roofing permit shall not be required.

2223.7 Fabrication and erection.

2223.7.1 Fabrication shall be done in accordance with the standards mentioned above. The manufacturer shall provide a letter certifying that the building has been designed and fabricated in accordance with the above referenced standards.

2223.7.2 Temporary bracing shall be provided during erection and shall remain in place until all structural frames, purlins, girts, flange braces, cable or rod bracing and sheets used as diaphragms have been installed.

2223.8 Roof sheets, wall sheets, roof panels and wall panels.

2223.8.1 All building envelope components shall have Product Approval.

2223.8.2 The fusion welding of structural members and structural sheets defined in Section 2222.4 and less than 22 gauge (0.0299 inch nominal) in thickness shall have minimum of $\frac{5}{8}$ inch (17 mm) diameter welds through weld

washers not less than 14-gauge in thickness and 1 inch (25 mm) in diameter, contoured if necessary to provide continuous contact, or an equivalent device.

2223.8.3 Clip-mounted standing-seam roof sheets shall not be used as diaphragms nor shall they be considered as adequate lateral bracing of the flange of the secondary member to which they are attached unless one or both of these features are designed into the sheathing system and the manufacturer can certify by testing and/or analysis that such capabilities exist and are appropriately defined.

2223.8.4 Structural standing-seam roof sheets shall be a minimum of 24 gauge [0.0239 inch (.6 mm) nominal] in thickness.

2223.8.5 Direct screw attached roof and wall sheets may be used as diaphragms provided the sheets are a minimum of 24 gauge [0.0239 inch (.6 mm) nominal] in thickness. Additionally, these sheets shall be considered to laterally brace the flange of the secondary member to which they are attached.

2223.8.6 See Section 2222 for additional requirements for roof sheets, wall sheets, roof panels and wall panels.

2223.9 Roof purlins and wall girts.

2223.9.1 Adequate bracing shall be provided to the compression flanges of secondary members with special attention to those members subject to uplift or outward pressures where no roof or wall sheets are attached to provide such bracing. Sag rods shall not be considered bracing when located in the neutral axis of the web of the secondary members.

2223.9.2 Roof purlins and wall girts shall be laterally braced in addition to relying on deck and panel diaphragm action.

2223.9.3 The ends and bearing points of secondary members shall be designed to carry 100 percent of dead, live and collateral loads superimposed on them by wind.

2223.9.4 Upward or outward forces of wind are to be calculated without live and collateral loads. When downward or inward forces caused by wind are involved, the dead forces plus collateral load forces must be combined but the roof live load may be omitted.

2223.10 Individual structural members.

2223.10.1 Cables and rods shall not be used as lateral bracing in habitable structures. Lateral bracing, when used, shall have a slenderness ratio of 300 or less, unless restricted by any other section of this code.

2223.10.2 Doors and windows in metal building systems shall have Product Approval.

2223.10.3 All doors shall be anchored as part of the frame in the closed position.

2223.10.4 See Section 2222 for additional requirements for metal building systems and components.

2223.11 Inspection.

2223.11.1 Metal system buildings shall be inspected by a Florida-registered architect or professional engineer.

2223.11.2 Metal building system manufacturers shall be accredited under an independent third-party inspection program that requires a minimum of two audits per year and is approved by the authority having jurisdiction.

2223.11.3 Letter of certification. The metal systems building manufacturer shall submit a written certification prepared, signed, dated and sealed by the specialty engineer registered to practice in the State of Florida verifying that the building system design and metal wall and roof system design including, but not limited to, panels, clips, support system components, etc., meet the indicated loading requirements and codes of the authorities having jurisdiction. The certification shall reference specific dead loads, live loads, wind loads/speeds, tributary area load reductions (if applicable), collateral loads, end use categories, crane loads, accessory loads, load combinations, governing code bodies including year and load applications. The letter of certification shall be provided to the structural engineer of record and/or the architect of record, the special inspector and the building department prior to the issuance of the certificate of occupancy.

2223.11.4 Structural construction documents demonstrating compliance with this code shall be reviewed and approved by the special inspector prior to the issuance of a certificate of occupancy.

**SECTION 2224
HIGH-VELOCITY HURRICANE ZONES—
CHAIN LINK FENCES**

2224.1 Chain link fences in excess of 12 feet (3.7 m) in height shall be designed according to the loads specified in Chapter 16 (High-Velocity Hurricane Zones).

2224.2 Chain link fences less than 12 feet (3.7 m) in height shall be designed according to the loads specified in Chapter 16 (High-Velocity Hurricane Zones) or may be constructed to meet the minimum requirements specified in Table 2224.

**TABLE 2224
CHAIN LINK FENCE MINIMUM REQUIREMENTS**

Fence Height (ft)	Terminal Post Dimensions (in inches) (o.d. x wall thickness)	Line Post Dimensions (o.d. x wall thickness) (in inches)	Terminal Post Concrete Foundation Size (diameter x depth) (in inches)	Line Post Concrete Foundation Size (diameter x depth) (in inches)
Up to 4	2 ³ / ₈ × 0.042	1 ⁵ / ₈ × 0.047	10 × 24	8 × 24
Over 4 to 5	2 ³ / ₈ × 0.042	1 ⁷ / ₈ × 0.055	10 × 24	8 × 24
Over 5 to 6	2 ³ / ₈ × 0.042	1 ⁷ / ₈ × 0.065	10 × 24	8 × 24
Over 6 to 8	2 ³ / ₈ × 0.110	2 ³ / ₈ × 0.095	10 × 36	10 × 36
Over 8 to 10	2 ⁷ / ₈ × 0.110	2 ³ / ₈ × 0.130	12 × 40	10 × 40
Over 10 to 12	2 ⁷ / ₈ × 0.160	2 ⁷ / ₈ × 0.120	12 × 42	12 × 42

For SI: 1 inch = 25.4 mm.

NOTES:

1. This table is applicable only to fences with unrestricted airflow.
2. Fabric: 12¹/₂ gauge minimum.
3. Tension bands: Use one less than the height of the fence in feet evenly spaced.
4. Fabric ties: Must be minimum the same gauge of the fabric.
5. Fabric tie spacing on the top rail: Five ties between posts, evenly spaced.
6. Fabric tie spacing on line posts: One less than height of the fence in feet, evenly spaced.
7. Either top rail or top tension wire shall be used.
8. Braces must be used at terminal posts if top tension wire is used instead of top rail.
9. Post spacing: 10 foot (3 m) on center maximum.
10. Posts shall be embedded to within 6 inches (152 mm) from the bottom of the foundation.
11. In order to follow the contour of the land, the bottom of the fence may clear the contour of the ground by up to 5 inches (127 mm) without increasing table values to the next higher limit.