

**Chapter 22 - Steel**

Adopt and/or codify entire chapter as amended below:

2001 CBC	PROPOSED ADOPTION	DSA-SS	PURPOSE
	Adopt entire chapter without amendments		
	Adopt entire chapter with amendments listed below	X	
	Adopt only those sections listed below		
2205A.10.2 2205A.13	2204.1.1 CA	X	Item 1 - Continues requirement for DSA approval of welded splices in structural steel elements, fulfilling statutory requirement to ensure safe construction.  Item 2 - Continues design requirement for welded stud shear connectors used in a common application not addressed in referenced standard.
2205A.12	2204.2.2 CA	X	Amendment continues requirements for design of steel baseplates and anchor bolts, considering potential adverse effects of oversized holes to seismic load transfer, and as recognized by the referenced standard.
-	2205.4 CA	x	Amendment provides reference for code-user to chapter 16 provision for seismic design category assignment, which significantly affects design requirements for steel seismic load-resisting systems.
2205A.7 2231A.5 2231A.7	2206.6 CA	X	Amendment specifies requirements for joist design approval by DSA, and for special inspection during fabrication.
2205A.4.1	2209.3 CA	X	Item 1 - Amendment specifies, by reference to a recognized national guideline, acceptable design criteria for steel deck diaphragms.  Item 2 - Amendment prescribes minimum metal deck gage when post-installed anchors are to be installed, as required by all current anchor listings.
-	2210.3.1 CA	X	Amendment specifies requirements for truss design approval by DSA, and for special inspection during fabrication.
2219A 2220A	2210.5.1 CA	X	Amendment continues current requirement per 2001 CBC and maintains statewide consistency for stock or reuse plans and modular/relocatable construction. Otherwise, the requirements vary significantly depending on the project site (via seismic design category).
-	2211 CA	X	Amendment addresses a specific type of steel frame in current use and unique to CA school construction, and which is not addressed in the 2006 IBC or referenced standards.

**Legend for Express Terms:**

1. 2006 IBC model code language appears in Times Roman font.
2. DSA-SS amendments appear in *Arial font, italicized and underlined.*

<b>Express Terms</b>	<b>Commentary</b>
<p><b>SECTION 2201 GENERAL</b></p> <p><b>2201.1 Scope.</b> The provisions of this chapter govern the quality, design, fabrication and erection of steel used structurally in buildings or structures.</p> <p><b>SECTION 2202 DEFINITIONS</b></p> <p><b>2202.1 Definitions.</b> The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meaning shown herein.</p> <p><b>STEEL CONSTRUCTION, COLD-FORMED.</b> 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.</p> <p><b>STEEL JOIST.</b> 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.</p> <p><b>STEEL MEMBER, STRUCTURAL.</b> 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.</p> <p><b>SECTION 2203 IDENTIFICATION AND PROTECTION OF STEEL FOR STRUCTURAL PURPOSES</b></p> <p><b>2203.1 Identification.</b> 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.</p> <p><b>2203.2 Protection.</b> 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.</p> <p><b>SECTION 2204 CONNECTIONS</b></p> <p><b>2204.1 Welding.</b> 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.</p> <p><u><i><b>2204.1.1 Additional Requirements. For public elementary and secondary schools, community colleges, and state essential services</b></i></u></p>	<p><b>2204.1.1:</b> Revision of existing amendments.</p>

buildings, the following requirements also apply:

1. No welded splices shall be made except those shown on the approved plans, or otherwise approved by the enforcement agency.
2. When welded stud shear connectors are used for transfer of distributed shear forces for applications other than composite member design, such as diaphragm shear transfer to collector or diaphragm chord elements, the nominal strength of stud shear connectors are permitted to be determined in accordance with Section 2d. (3), Chapter I of AISC 360.

**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.

**2204.2.2 Additional Requirements. For public elementary and secondary schools, community colleges, and state essential services buildings, the following provisions apply:**

1. When shear or tensile forces are intended to be transferred between a column base plate and anchor bolts, with oversized base plate holes larger than the anchor bolts by more than 1/8 inch (3.2 mm) as permitted by Table C-J9.1 of AISC 360, the design shall include special detailing for transfer of shear or tensile forces (e.g. the use of shear lugs or welded structural plate washers).
2. When the shear forces are transferred through anchor bolts, the anchor bolts shall be checked for tensile stresses, including the net tensile component of any bending moment, in combination with shear stresses in accordance with Section J3.7 of AISC 360.

**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

Item 1 - Continues requirement for DSA approval of welded splices in structural steel elements, fulfilling statutory requirement to ensure safe construction. AWS D1.1 requires that the design engineer approve any welded splices, but does not address enforcement agency oversight.

Item 2 - Clarifies design criteria for welded stud shear connectors used in a common application that is not addressed in the referenced standard. This amendment has been revised to allow full value prescribed by the standard for composite construction connectors, whereas at this time the existing amendment allows 1/3 of that value. This revision is based on (1) lack of technical justification for the 1/3 factor, and (2) input from Virginia Polytechnic Institute, which has performed much of the research for the standard.

**2204.2.2:**

Revision of existing amendments.

Item 1 - continues requirements for design of steel baseplates and anchor bolts, considering potential adverse effects of oversized holes to seismic load transfer, and as recognized by the referenced standard.

Item 2 - continues requirement to check seismic load transfer through anchor bolts with induced flexural stresses, typically resulting from eccentricity (e.g. baseplate grout/drypack space).

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.

**2205.4 Additional Requirements. For public elementary and secondary schools, community colleges and state essential services buildings, the following requirements also apply:**

- 1. Refer to Sections 1613.5.6 and 1614.1, which require any structure to be assigned to seismic design category "D", unless otherwise required by this code or ASCE 7 to be assigned to seismic design category E or F.**
- 2. Refer to Section 1614.1 for limitations on the use of seismic force-resisting systems per items A.14 and B.24 in Table 12.2-1 of ASCE 7.**

**2205.4:**

This new amendment provides reference for code-users to chapter 16 provisions for seismic design category assignment and permitted seismic-load resisting systems. The seismic design category assignment significantly affects design requirements for steel seismic load-resisting systems.

**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. Non uniform 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 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;

- 3.4. Bridging attachments; and
- 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.

**2206.6 Additional Requirements. For public elementary and secondary schools, community colleges, and state essential services buildings, the following requirements also apply:**

**1. Requirements for approval of open-web steel joist and joist girder design.**

**Joist and joist girder design drawings, joist placement plans, and engineering analysis shall be provided to the enforcement agency and approved prior to joist fabrication, in accordance with Title 24, Part 1, Section 4-317 (g). Each joist or joist girder design drawing or sheet shall bear the signature and stamp or seal of the registered engineer or licensed architect responsible for the joist design. Alterations to the approved joist design drawings or fabricated joists are subject to the approval of the enforcement agency.**

**2. Special inspection is required for the fabrication and welding of steel joists or joist girders, except as noted below. The special inspector shall verify that proper quality control procedures and tests have been employed for all materials and the fabrication process, and shall perform visual inspection of the finished product. Each inspected joist or joist girder shall be stamped by the special inspector with an identification mark.**

**Exception: Special inspection is not required for steel joists designed and fabricated per SJI Specifications SJI K-1.1 or SJI LH/DLH-1.1, provided the steel joist manufacturer is a current member of SJI in good standing and is qualified by SJI to manufacture the types or series of steel joists specified. The steel joist manufacturer shall file a certificate of compliance per Section 2206.5 of this code with the design professional in general responsible charge and with the enforcement agency.**

**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  $T_4$

**2206.6:**

Proposed DSA amendments specify requirements for DSA approval of joist design drawings, and also specify requirements for special inspection during fabrication of non-exempted joists.

Substantial revision of existing DSA amendments regarding steel joists are proposed. The 2006 IBC model code contains significant new provisions for steel joists, addressing permit plans and specs, and joist design drawings and calculations.

Section 2206.2 of the IBC prescribes requirements for project-specific joist design criteria that must be shown on the construction documents (i.e. permit / contract plans and specs). The model code also specifies requirements for joist design drawings and calculations (i.e. shop drawings).

Proposed DSA amendments clarify requirements for deferred submittal of joist design drawings and calculations by referencing Sec. 4-317 (g) of Part 1, Title 24. The deferred approval process allows for enforcement agency review & approval of the selected joist manufacturer's design.

If a deferred approval process is not employed, a specific manufacturer's joist design must be included in the construction documents (permit or contract plans and specs). This may be problematic if the selected manufacturer, based on award of contract, is not the manufacturer whose joists were detailed on the contract plans. DSA has determined that the code cannot be

as defined in Section 3.12.

2. In Section 3.2.1, Item (c) shall be replaced with "1.5 T<sub>3</sub>" and Item (d) shall be replaced with "1.5 T<sub>4</sub>."

**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.

**2209.3 Additional Requirements. For public elementary and secondary schools, community colleges, and state essential services buildings, the following requirements also apply:**

- 1. Steel deck diaphragms. Diaphragm shear strength and stiffness of steel deck and concrete-filled steel deck diaphragms shall be determined in accordance with approved analytical procedures or with approved tests. Steel deck and concrete-filled steel deck diaphragms that conform with ICC-ES AC 43, latest edition (International Code Council Evaluation Service, Inc. Acceptance Criteria for Steel Decks) shall be considered to meet the requirements of this section.**
- 2. The base material thickness of concrete-filled steel decking shall not be less than 0.0359 inch (0.9 mm) (20 gage) if post-installed anchors or power-driven fasteners will be specified for installation in the composite assembly.**

**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.

amended to require the construction documents (e.g. permit / contract plans) to include one manufacturer's joist design, due to potential conflict with Public Contract Code laws that apply to public schools.

Current DSA amendment 2231A.7 requiring load testing of joists that are "not susceptible to rational analysis" is proposed for repeal, as the SJI certification program requires load testing of these (K series) joists.

**2209.3:**

Item 1 - Amendment specifies, by reference, DSA acceptance of the current nationally recognized acceptance criteria for steel deck diaphragms. This provides specific design criteria for design professionals and enforcement staff.

Item 2 - Amendment prescribes minimum metal deck gage when post-installed anchors are to be installed, as 20 gage minimum is required by all current anchor listings.

**2210.3.1 Additional Requirements.** *For public elementary and secondary schools, community colleges, and state essential services buildings, complete engineering analysis and truss design drawings shall accompany the construction documents submitted to the enforcement agency for approval. When load testing is required per Section G of AISI-Truss, the test report shall be submitted with the truss design drawings and engineering analysis to the enforcement agency.*

*The fabrication of trusses shall be continuously inspected by a qualified special inspector approved by the enforcement agency. The special inspector shall verify conformance of materials and fabrication with approved plans and specifications. Each inspected truss shall be stamped by the special inspector with an identification mark.*

**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.

**2210.5.1 Additional Requirements.** *For public elementary and secondary schools, community colleges, and state essential services buildings, shear wall assemblies per Section C2.2.3 of AISI-Lateral are not permitted within the seismic force-resisting system of buildings or structures assigned to Occupancy Category III or IV, or buildings designed to be relocatable. Refer to Section 1614.1.*

**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 2211 LIGHT MODULAR STEEL MOMENT FRAMES FOR PUBLIC ELEMENTARY AND SECONDARY SCHOOLS, AND COMMUNITY COLLEGES**

**2211.1 General**

**2211.1.1 Configuration.** *Light Modular Steel Moment Frame buildings shall be constructed of factory-assembled modules comprising a single story moment-resisting space frame supporting a floor and roof. Individual modules shall not exceed a width of 14 feet (4.25 meters) nor a length of 72 feet (22 meters). All connections of beams to corner columns shall be designed as moment-resisting in accordance with the criteria of Section 2211.2.3. Modules may be stacked to form multi-story structures not exceeding 35 feet or two stories in height. When stacked modules are evaluated separately, seismic forces on each module*

**2210.3.1:**

Amendment specifies requirements for truss design approval by DSA, and for special inspection during fabrication.

**2210.5.1:**

Amendment continues current restrictions per 2001 CBC for gypsum board/plaster shear resistive assemblies (for specified occupancies) and maintains statewide consistency for stock or reuse plans and modular/relocatable construction. Without this amendment, shear wall assemblies per Sec. C2.2.3 of AISI Lateral (gypsum board, plaster) could be used in seismic design category D (if building is less than 35' in height), but not in seismic design categories E or F.

This amendment would maintain the current requirement for ductile shear wall systems, which are expected to endure moderate or larger seismic forces with minimal damage, facilitating continued use or minimal post-disaster disruption of occupancy. This requirement would apply to any state essential facility or school building with an occupant load of more than 250.

**2211:**

Amendment addresses a specific type of steel frame in current use and unique to CA school construction, and which is not addressed in the 2006 IBC or referenced standards.

Light modular steel moment frame buildings have been in use

shall be distributed in accordance with Section 12.8.3 of ASCE 7, considering the modules in the stacked condition. See 2211.2.5 of this code.

**2211.1.2. Design, fabrication and erection.** The design, fabrication and erection of Light Modular Steel Moment Frame buildings shall be in accordance with the AISC Specification for Structural Steel Buildings (ANSI/AISC 360) and the AISI North American Specification for the Design of Cold Formed Structural Members (AISI/COC/NASPEC) as applicable, and the requirements of this section. The maximum dead load of the roof and elevated floor shall not exceed 25 psf and 50 psf respectively. The maximum dead load of the exterior walls shall not exceed 45 psf of wall surface.

**2211.2 Seismic requirements.** In addition to the other requirements of this code, the design, materials and workmanship of Light Modular Steel Moment Frames shall comply with the requirements of this section. The response modification coefficient, R, shall be equal to 3½. C<sub>d</sub> and Ω<sub>0</sub> shall be equal to 3.0. Refer to Section 1614.

**2211.2.1 Base Materials.** Beams, columns, and connection materials shall be limited to those materials permitted under the AISC Specification for Structural members (ANSI/AISC 360) and the AISI North American Specification for the Design of Cold Formed Structural members (AISI/COC/NASPEC).

**2211.2.2 Beam to Column Strength Ratio.** At each moment-resisting connection the following shall apply:

$$\frac{\sum S_{bi} F_{ybi}}{\sum S_{cj} F_{ycj}} \geq 1.4$$

where:

F<sub>ybi</sub> is the specified yield stress of beam “i”

F<sub>ycj</sub> is the specified yield stress of column “j”

S<sub>bi</sub> is the flexural section modulus of each beam “i” that is moment connected to the column “j” at the connection

S<sub>cj</sub> is the flexural section modulus of each column “j” that is moment connected to the beam “i” at the connection

**Exceptions:**

1. Beam-column connections at the floor level beams of first or second-story modules need not comply with this requirement.

2. Beam-to-column strength ratios less than 1.4 are allowed

in California in a variety of occupancies for many years. Thousands of these buildings have been in service for many years in public schools, office occupancies and other uses. These units, which due to their geometry have very high strength to weight ratio are inherently rugged. Hundreds of these modular buildings on public school campuses have been subjected to strong earthquake ground shaking in the 1971 San Fernando, 1987 Whittier, 1989 Loma Prieta, 1993 Landers, and 1994 Northridge earthquakes. No structural damage to any of these buildings has ever been reported, despite rigorous post-earthquake inspections.

Under the International Building Code, these buildings which have previously been classified as Ordinary Moment Frame systems can not be constructed in Seismic Design Categories D, E, or F. This will prohibit the continued use of these buildings throughout much of the State of California. This will impose an unnecessary economic burden on public school districts and others, without justification, given the satisfactory past performance of these buildings.

This proposal permits the continued use of these structures in California by establishing a new structural system that preserves the fabrication and erection procedures that have been successfully applied in the past. Design procedures are identical to those for other structural systems, except as needed to ensure that the systems meet the limitations necessary to ensure proper behavior.

if proven to be acceptable by analysis or testing.

**2211.2.3 Welding.** Weld filler metals shall be be capable of producing weld metal with a minimum Charpy V-Notch toughness of 20 ft-lbs at 0°F. Where beam bottom flanges attach to columns with complete joint penetration groove welds and weld backing is used at the bottom surface of the beam flange, such backing shall be removed and the root pass back-gouged, repaired and reinforced with a minimum 3/16" (5mm) fillet weld.

**2211.2.4 Connection Design.** Connections of beams to columns shall have the design strength to resist the maximum seismic load effect.  $E_m$ , calculated in accordance with Section 12.4.3 of ASCE 7.

**2211.2.5 Multi-story assemblies.** Analysis of multi-story assemblies shall be permitted to consider the stacked modules as a single assembly, with restraint conditions between the stacked units that represent the actual method of attachment. Alternatively, it shall be permitted to analyze the individual modules of stacked assemblies independently, with lateral and vertical reactions from modules above applied as concentrated loads at the top of the supporting module.