FINAL EXPRESS TERMS
OF PROPOSED BUILDING STANDARDS
OF THE DIVISION OF THE STATE ARCHITECT - STRUCTURAL SAFETY

REGARDING THE 2001 CALIFORNIA BUILDING CODE
CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 2

Chapters 16A, 18A, 19A, 21A, 22A, and 23A

LEGEND FOR EXPRESS TERMS

1. Existing California amendments or code language being modified: All such language appears in *italics*, modified language is underlined.
2. New California amendments: All such language appears *underlined and in italics*.
3. Repealed text: All such language appears in ~~strikeout~~.

Chapter 16*A [For DSA-SS, OSHPD 1 & 4]*
STRUCTURAL DESIGN REQUIREMENTS

SECTION 1605A - DESIGN

1605A.2.2 Stability against overturning. Every structure shall be designed to resist the overturning effects caused by the lateral forces specified in this chapter. See Section 1611A.6 for retaining walls, Section ~~1615A~~ 1621A for wind and Section ~~1626A~~ 1630A.8 for seismic.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1611A - OTHER MINIMUM LOADS

1611A.7 Water Accumulation. All roofs shall be designed with sufficient slope or camber to ensure adequate drainage after the long-term deflection from dead load or shall be designed to resist ponding load, *P,* combined in accordance with Section 1612A.2 or 1612A.3. Ponding load shall include water accumulation from any source, including snow, due to deflection. See Section 1506 and Table 16A-C, Footnote 3, for drainage slope. See Section ~~1615A~~ 1613A for deflection criteria.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1629A - CRITERIA SELECTION (EARTHQUAKE DESIGN)

1629A.1 Basis for Design. The procedures and the limitations for the design of structures shall be determined considering seismic zoning, site characteristics, occupancy, configuration, structural system and height in accordance with this section. Structures shall be designed with adequate strength to withstand the lateral displacements induced by the Design Basis Ground Motion, considering the inelastic response of the structure and the inherent redundancy, overstrength and ductility of the lateral-force-resisting system. The minimum design strength shall be based on the Design Seismic Forces determined in accordance with the static lateral force procedure of Section 1630A, except as modified by Section 1631A.5.4. Where strength design is used, the load combinations of Section 1612A.2 shall apply. Where Allowable Stress Design is used, the load combinations of Section 1612A.3 shall apply. Allowable Stress Design may be used to evaluate sliding or overturning at the soil-structure interface regardless of the design approach used in the design of the structure, provided load combinations of Section 1612A.3 are utilized *and the foundation conforms with the requirements of Section 1633A.2.12*. ~~One- and two-family dwellings in Seismic Zone 1 need not conform to the provisions of this section.~~

1629A.9 System Limitations.

1629A.9.2 Undefined structural systems. For undefined structural systems not listed in Table 16A-N, the coefficient R shall be substantiated by approved cyclic test data and analyses. The following items shall be addressed when establishing R:

1. Dynamic response characteristics,
2. Lateral force resistance,
3. Overstrength and strain hardening or softening,
4. Strength and stiffness degradation,
5. Energy dissipation characteristics,
6. System ductility, and
7. Redundancy.

Undefined systems shall comply with Section 1631A.2.2.

1629A.10 Alternative Procedures

1629A.10.2 Seismic isolation. Seismic isolation, energy dissipation and damping systems may be used in the design of structures when approved by the *enforcement agency* and when special detailing is used to provide results equivalent to those obtained by the use of conventional structural systems.

[For OSHPD 1 & 4] [For DSA/SS] For alternate design procedures on seismic isolation systems, refer to Appendix Chapter 16A, Division ~~IV~~ VII, Earthquake Regulations for Seismic-Isolated Structures.

~~[For DSA/SS] For alternative design procedures on seismic isolation systems, refer to Chapter 16B, Division IV, Earthquake Regulations for Seismic-Isolated Structures, 1998, California Building Code, Volume 2B.~~

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1630A - MINIMUM DESIGN LATERAL FORCES AND RELATED EFFECTS

1630A.1 Earthquake Loads and Modeling Requirements.

1630A.1.1 Earthquake loads. *Any structure which does not have a highly irregular shape, large differences in lateral resistance or stiffness between adjacent stories, or other unusual structural features which could significantly affect the dynamic response, may be designed and constructed to resist the minimum lateral seismic forces set forth in the provisions of this section. The equivalent static lateral seismic forces assumed to act on parts or portions of structures and their anchorage shall be as set forth in Section 1632A. The equivalent static lateral seismic forces assumed to act on nonstructural components and their anchorage shall be as set forth in Section 1632A.* Structures shall be designed for ground motion producing structural response and seismic forces in any horizontal direction. The following earthquake loads shall be used in the load combinations set forth in Section 1612A:

$$E = \rho E_h \pm E_v \qquad \text{(30A-1)}$$

$$E_m = \Omega_0 E_h \qquad \text{(30A-2)}$$

WHERE:

E = the earthquake load on an element of the structure resulting from the combination of the horizontal component, E_h, and the vertical component, E_v.

E_h = the earthquake load due to the base shear, *V,* as set forth in Section 1630A.2 or the design lateral force, *Fp,* as set forth in Section 1632A.

E_m = the estimated maximum earthquake force that can be developed in the structure as set forth in Section 1630A.1.1.

E_v = the load effect resulting from the vertical component of the earthquake ground motion and is equal to * * * $0.5C_aID$ *applied* to the dead load effect, *D,* for Strength Design, and may be taken as zero for Allowable Stress Design.
<u>*Exception: See Section 1632A.2 for the definition of E_v for nonstructural components.*</u>

…(Section unchanged except as noted above)

1630A.8 Overturning

1630A.8.3 At foundation. See Sections 1629A.1<u>, 1633A.2.12</u> and 1809A.4 for overturning moments to be resisted at the foundation soil interface.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1631A - DYNAMIC ANALYSIS PROCEDURES

1631A.2 Ground Motion. *The dynamic analysis shall be based on the maximum probable ground motions prescribed in the Supplemental Ground-response Reports described in Section 1637A.2. The maximum probable* ground motion representation shall, as a minimum, be one having a 10-percent probability of being exceeded in 50 years, shall not be reduced by the quantity R and may be one of the following:

1. An elastic design response spectrum constructed in accordance with Figure 16A-3, using the values of C_a and C_v consistent with the specific site. The design acceleration ordinates shall be multiplied by the acceleration of gravity, 386.4 in./sec.2 (9.815 m/sec.2). *This spectrum may be used for regular structures only.*
2. A site-specific elastic design response spectrum based on the geologic, tectonic, seismologic and soil characteristics associated with the specific site. The spectrum shall be developed for a damping ratio of 0.05, unless a different value is shown to be consistent with the anticipated structural behavior at the intensity of shaking established for the site. *The site-specific response spectra shall be used for irregular structures and for all structures located on Soil Profile Type S_F.*
3. Ground motion time histories developed for the specific site shall be representative of actual earthquake motions. Response spectra from time histories, either individually or in combination, shall approximate the site design spectrum conforming to Section 1631A.2, Item 2.
4. For structures on Soil Profile Type S_F, the following requirements shall apply when required by Section 1629A.8.4, Item 4:

   4.1 The ground motion representation shall be developed in accordance with Items 2 and 3.

   4.2 Possible amplification of building response due to the effects of soil-structure interaction and lengthening of building period caused by inelastic behavior shall be considered.

1631A.2.1 Vertical Ground Motion ~~5.~~ The vertical component of ground motion may be defined by scaling corresponding horizontal accelerations by a factor of two-thirds. Alternative factors may be used when substantiated by site-specific data. Where the Near Source Factor, N_a, is greater than 1.0, site-specific vertical response spectra shall be used in lieu of the factor of two-thirds.

1631A.2.2 Upper Bound Earthquake ~~6.~~ *The "upper bound earthquake" ground motion is defined as the motion having a 10 percent probability of being exceeded in a 100-year period or maximum level of motion which may ever be expected at the building site within the known geological framework. Where required by other sections of this code, structures shall be designed to sustain the upper bound earthquake motion, including the PΔ effects, without forming a story collapse mechanism along any frameline. Such structures shall have sufficient ductility and strength to undergo the displacement caused by the upper bound earthquake motion without collapse. For irregular or unusual structures located in an area having large site-specific ground motion, criteria as determined by the project architect or structural engineer and approved by the enforcement agency will be required to demonstrate safety against collapse from the upper bound earthquake motion.*

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1632A - LATERAL FORCE ON ELEMENTS OF STRUCTURES, NONSTRUCTURAL COMPONENTS AND EQUIPMENT SUPPORTED BY STRUCTURES

1632A.1 General. Elements of structures and their attachments, permanent nonstructural components and their attachments, and the attachments for permanent equipment supported by a structure shall be designed to resist the total design seismic forces prescribed in Section 1632A.2.

Attachments shall include anchorages and required bracing *of components, including legs, platforms, frames, skids, or other elements providing gravity or lateral support to the equipment or component*. *Welded, bolted or other intermittent connections, such as inserts for anchorage of nonstructural components, shall not be allowed the one-third increase in allowable stresses permitted in Section 1612A.3.2.* Friction resulting from gravity loads shall not be considered to provide resistance to seismic forces.

When the structural failure of the lateral-force-resisting systems of nonrigid equipment would cause a life hazard, such systems shall be designed to resist the seismic forces prescribed in Section 1632A.2.

When permissible design strengths and other acceptance criteria are not contained in or referenced by this code, such criteria shall be obtained from approved national standards subject to the approval of the *enforcement agency.*

1632*A*.2 Design for Total Lateral Force. The total design lateral seismic force, F_p, shall be determined from the following formula:

$$F_p = 4.0 C_a I_p W_p \qquad (32A\text{-}1)$$

Alternatively, F_p may be calculated using the following formula:

~~$$F_p = \frac{a_p C_a I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right)W_p$$~~

$$F_p = \frac{a_p C_a I_p}{R_p}\left(1 + 2\frac{h_x}{h_r}\right)W_p \qquad (32A\text{-}2)$$

Except that: F_p shall not be less than $0.7 C_a I_p W_p$ and need not be more than $4 C_a I_p W_p$ (32*A*-3)

WHERE:

h_x is the element or component attachment elevation with respect to grade. h_x shall not be taken less than 0.0. *The value of h_x/h_r need not exceed 1.0.*

h_r is the structure roof elevation with respect to grade.

a_p is the in-structure Component Amplification Factor that varies from 1.0 to 2.5.

A value for a_p shall be selected from Table 16*A*-O. Alternatively, this factor may be determined based on the dynamic properties or empirical data of the component and the structure that supports it. The value shall not be taken less than 1.0. *For elevator-related equipment, see Part 7, Title 24, California Code of Regulations in addition to Table 16A-O.*

R_p is the Component Response Modification Factor that shall be taken from Table 16*A*-O, except that R_p for anchorages shall equal 1.5 for shallow expansion anchor bolts, shallow chemical anchors or shallow cast-in-place anchors. Shallow anchors are those with an embedment length-to-diameter ratio of less than 8. When anchorage is constructed of nonductile materials, or by use of adhesive, R_p shall equal 1.0.

The design lateral forces determined using Formula (32*A*-1) or (32*A*-2) shall be distributed in proportion to the mass distribution of the element or component. *To determine the out-of-plane loading for elements such as walls or wall panels that have points of attachment at two or more different elevations, the following procedure may be used. For the vertical span of the element having a unit weight w_p between two successive attachment elevations h_x and h_{x+i} evaluate the force coefficients F_p and W_p at each of the two points, observing the minimum and maximum limits, and compute the average of the two values. The resulting average coefficient times the unit weight w_p provides the distributed seismic load for the span between the attachment points, and this load may be extended to the top of any wall parapet above the roof attachment point at h_r.*

Forces determined using Formulas (32*A*-1) or (32*A*-2) shall be used to design members and connections that transfer these forces to the seismic-resisting systems. Members and connection design shall use the load combinations and factors specified in Section 1612*A*.2 or 1612*A*.3. *The vertical earthquake effect E_v, shall be applied simultaneously with the horizontal earthquake effect E_h. E_v shall be taken as $0.5C_aIW_p$ for Strength Design and $0.35C_aIW_p$ for Allowable Stress Design. E_v shall be applied to the dead load effect D, in a manner that produces the most severe member and connection demands* The Reliability/Redundancy Factor, ρ, may be taken equal to 1.0 *A continuous load path of sufficient strength and stiffness between the component and the supporting structure shall be verified. Local elements of the supporting structure shall be verified for the component loads where they control the design of the elements or their connections. The component loads shall be those determined using Formula (32A-1) or (32A-2), except that modifications to R_p due to anchorage conditions need not be considered.*

…(Section unchanged except as noted above)

1632A.6 HVAC Ductwork, Plumbing/Piping and Conduit Systems. *All pipes, ducts and conduit shall be braced to resist the forces prescribed in Section 1632A.2. Ductwork shall be constructed in accordance with provisions contained in Part 4, Title 24, California Mechanical Code. Pipes and their connections constructed of ductile materials (copper, ductile iron, steel or aluminum with brazed or welded connections) shall have brace spacing not exceeding that specified in Section 1632A.5 or other standards approved by the enforcement agency. Pipes and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), or with screwed connections shall have the brace spacing reduced to one-half of the spacing allowed for ductile material in accordance with Section 1632A.5 or other standards approved by the enforcement agency.*

Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components or equipment and the associated ductwork, piping and conduit:

1. Fuel, medical gas, and vacuum piping less than 1 inch (25 mm) inside diameter, or

2. All other piping less than 2.5 inches (64 mm) diameter, or

3. All piping suspended by individual hangers 12 inches (305 mm) or less in length from the top of the pipe to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections, or

4. All electrical conduit less than 2.5 inches (64 mm) trade size. , or

3.5. All rectangular air-handling ducts less than 6 square feet (0.56 m^2) in cross-sectional

area, or

6. All round air-handling ducts less than 28 inches (711 mm) in diameter, or

7. All ducts suspended by hangers 12 inches (305 mm) or less in length from the top of the duct to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.

Where lateral restraints are omitted, the piping, ducts or conduit shall be installed such that lateral motion of the piping or duct will not cause damaging impact with other systems or structural members, or loss of vertical support.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1633A - DETAILED SYSTEMS DESIGN REQUIREMENTS

1633A.2 Structural Framing Systems.

1633A.2.6 Collector elements. Collector elements shall be provided that are capable of transferring the seismic forces originating in other portions of the structure to the element providing the resistance to those forces.

Collector elements, splices and their connections to resisting elements shall resist the forces determined in accordance with Formula (33A-1). In addition, collector elements, splices, and their connections to resisting elements shall have the design strength to resist the combined loads resulting from the special seismic load of Section 1612A.4.

> **EXCEPTION:** In structures, or portions thereof, braced entirely by light-frame wood shear walls or light-frame steel and wood structural panel shear wall systems, collector elements, splices and connections to resisting elements need only be designed to resist forces in accordance with Formula (33A-1).

The quantity ~~E_M~~ E_m need not exceed the maximum force that can be transferred to the collector by the diaphragm and other elements of the lateral-force-resisting system. For Allowable Stress Design, the design strength may be determined using an allowable stress increase of 1.7 and *for LRFD* a resistance factor, ϕ, of 1.0. This increase shall not be combined with the one-third stress increase permitted by Section 1612A.3, but may be combined with the duration of load increase permitted in Division III of Chapter 23A.

1633A.2.12 Foundations and superstructure-to-foundation connections. *The foundation shall be capable of transmitting the design base shear and the overturning forces from the structure into the supporting soil.*

~~The~~ In addition, the foundation and the connection of the superstructure elements to the foundation shall have the strength to resist, in addition to gravity loads, the lesser of the following seismic loads:

1. The strength of the superstructure elements.

2. The maximum forces that would occur in the fully yielded structural system.

3. Ω_o times the forces in the superstructure elements due to the seismic forces as prescribed in this chapter.

> ***EXCEPTIONS:*** *1. Where structures are designed using R ≤ 2.2 such as for inverted pendulum-type structures.*
> *2. When it can be demonstrated that inelastic deformation of the foundation and superstructure-to-foundation connection will not result in a weak story or cause collapse of the structure.*
> *3. Where the basic structural system as described in Table 16A-N consists of light-framed walls with shear panels.*

Where moment resistance is assumed at the base of the superstructure elements, the rotation and flexural deformation of the foundation as well as deformation of the superstructure-to-foundation connection shall be considered in the drift and deformation compatibility analyses.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

TABLE 16A-M

Amend Table 16A-M as follows:

TABLE 16*A*-M—PLAN STRUCTURAL IRREGULARITIES

IRREGULARITY TYPE AND DEFINITION	REFERENCE SECTION
1a. **Torsional irregularity-to be considered when diaphragms are not flexible** Torsional irregularity shall be considered to exist when the maximum story drift, computed including accidental torsion, at one end of the structure transverse to an axis is more than 1.2 times the average of the story drifts of the two ends of the structure.	1633A.1 1633A.2.9, Item 6
*1b. **Severe Torsional irregularity-to be considered when diaphragms are not flexible*** *Severe torsional irregularity shall be considered to exist when the maximum story drift, computed including accidental torsion, at one end of the structure transverse to an axis is more than 1.4 times the average of the story drifts of the two ends of the structure.*	*1629A.9.5* *~~1631B.2.9~~ 1633A.2.9, Item 6*
2. **Reentrant corners** Plan configurations of a structure and its lateral force-resisting system contain reentrant corners, where both projections of the structure beyond a reentrant corner are greater than 15 percent of the plan dimension of the structure in the given direction.	1633A.2.9, Items 6 and 7
3. **Diaphragm discontinuity** Diaphragms with abrupt discontinuities or variations in stiffness, including those having cutout or open areas greater than 50 percent of the gross enclosed area of the diaphragm, or changes in effective diaphragm stiffness of more than 50 percent from one story to the next.	1633A.2.9, Item 6
4. **Out-of-plane offsets** Discontinuities in a lateral force path, such as out-of-plane offsets of the vertical elements.	1630A.8.2; 1633A.2.9, Item 6; 2213A.9.1
5. **Nonparallel systems** The vertical lateral load-resisting elements are not parallel to or symmetric about the major orthogonal axes of the lateral force-resisting system.	1633A.1

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

TABLE 16A-O

Amend Table 16A-O as follows:

TABLE 16A-O—HORIZONTAL FORCE FACTORS, a_P AND R_p

ELEMENTS OF STRUCTURES AND NONSTRUCTURAL COMPONENTS AND EQUIPMENT[1]	a_p	R_p	FOOTNOTE
1. Elements of Structures A. Walls including the following: (1) Unbraced (cantilevered) parapets.	2.5	3.0	
(2) Exterior walls at or above the ground floor and parapets braced above their centers of gravity.	1.0	3.0	2
(3) All interior-bearing and nonbearing walls.	1.0	3.0	2, 11 ~~8~~
B. Penthouse (except when framed by an extension of the structural frame).	2.5	4.0	
C. Connections for prefabricated structural elements other than walls. See also Section 1632*A*.2.	1.0	3.0	3~~, 20~~
2. Nonstructural Components A. Exterior and interior ornamentations and appendages.	2.5	3.0	~~20~~
B. Chimneys, stacks and trussed towers supported on or projecting above the roof: (1) Laterally braced or anchored to the structural frame at a point below their centers of mass.	2.5	3.0	
(2) Laterally braced or anchored to the structural frame at or above their centers of mass.	1.0	3.0	
C. Signs and billboards.	2.5	3.0	
D. Storage racks (include contents) *with upper storage level more than 5 feet (1524 mm) in height*	2.5	4.0	4, *23*
E. Permanent floor-supported cabinets and book stacks more than 6 feet (1829 mm) in height (include contents).	1.0	3.0	5, ~~20,~~ *23, 24*
F. Anchorage and lateral bracing for suspended ceilings and light fixtures.	1.0	3.0	3, 6, 7, 8, *25, 26*
G. Access floor systems.	1.0	3.0	9,*14* ~~20~~
H. Masonry or concrete fences over 6 feet (1829 mm) high.	1.0	3.0	
I. Partitions.	1.0	3.0	~~8~~ *11*
J. Wall hung cabinets and storage shelving (plus contents)	*1.0*	*3.0*	
3. Equipment A. Tanks and vessels (include contents), including support systems.	1.0	3.0	~~20~~
B. Electrical, mechanical and plumbing equipment and associated conduit and ductwork and piping*, and machinery. In hospitals and essential services buildings, this includes all piping, electrical conduits, cable trays and air-handling ducting necessary to the continuing operation of the facility.*	1.0	3.0	5, 10, ~~11~~, 12, 13, 14, 15, 16, ~~20~~
C. Any flexible equipment laterally braced or anchored to the structural frame at a point below their center of mass.	2.5	3.0	5, 10, 14, 15, 16, ~~20~~
D. Anchorage of emergency power supply systems	~~1.3~~ *1.0*	~~3.0~~ *2.5*	*14,* 17, 18,

and essential communications equipment. Anchorage and support systems for battery racks and fuel tanks necessary for operation of emergency equipment. See also Section 1632*A*.2.			*~~20,~~ 21*
E. Temporary containers with flammable or hazardous materials.	1.0	3.0	19
F. Power cable-driven elevators or hydraulic elevators with lifts over 5 feet (1524 mm): *(1) Hoistway structural framing providing the support for guide rail brackets*			*~~25~~ 27*
(2) Guide rails and guide rail brackets			
(3) Car and counterweight auxiliary guiding members or retainer plates			
(4) Driving machinery, pump unit tanks operating devices and control equipment cabinets			
4. Other Components			
A. Rigid components with ductile material and attachments.	1.0	3.0	1*, 14, ~~20~~*
B. Rigid components with nonductile material or attachments.	1.0	1.5	1*, 14, ~~20~~*
C. Flexible components with ductile material and attachments.	2.5	3.0	1*, 14, ~~20~~*
D. Flexible components with nonductile material or attachments.	2.5	1.5	1*, 14, ~~20~~*

[1]See Section 1627A for definitions of flexible components and rigid components. *See Section 1632A for formula using a_p. Horizontal forces are to be applied in any horizontal direction. The value of a_p shall not be reduced for all walls. Welded, bolted or other intermittent connections such as inserts for anchorage of nonstructural components shall not be allowed the one-third increase in allowable stress permitted in Section 1612A.3.2.*

[2]See Sections 1633A.2.4 and 1633A.2.8 for concrete and masonry walls and Section 1632A.2 for connections for ~~panel connectors for~~ *wall* panels.

[3]Applies to Seismic Zones 2, 3 and 4 only.

[4]Ground supported steel storage racks may be designed using the provisions of Section 1634A. Chapter 22A, Division ~~VI~~ X, may be used for design, provided seismic design forces are equal to or greater than those specified in Section 1632A.5 or 1634A.5, as appropriate.

[5]Only attachments, anchorage or restraints need be designed. *See Section 1632A.1.*

[6]Ceiling weight shall include all light fixtures and other equipment or partitions that are laterally supported by the ceiling. For purposes of determining the seismic force, a ceiling weight of not less than 4 psf (0.19 kN/m2) shall be used.

[7]Ceilings constructed of lath and plaster or gypsum board screw or nail attached to suspended members that support a ceiling at one level extending from wall to wall need not be analyzed, provided the walls are not over 50 feet (15 240 mm) apart.

[8]Light fixtures and mechanical services installed in metal suspension systems for acoustical tile and lay-in panel ceilings shall be independently supported from the structure above as specified in UBC Standard 25-2, Part III. *~~See also Section 1611A.5 for minimum load and deflection criteria for interior partitions.~~*

[9]*Wp* for access floor systems shall be the dead load of the access floor system plus 25 percent of the floor live load plus a 10-psf (0.48 kN/m2) partition load allowance.

[10]Equipment includes, but is not limited to, boilers, chillers, heat exchangers, pumps, air-handling units, cooling towers, control panels, motors, switchgear, transformers and life-safety equipment. It shall include major conduit, ducting and piping, which services such machinery and equipment and fire sprinkler systems. See Section 1632A.2 for additional requirements for determining a_p for nonrigid or flexibly mounted equipment.

[11]~~*Deleted*~~ *See also Section 1611A.5 for minimum load and deflection criteria for interior partitions.*

[12]Seismic restraints may be omitted from electrical raceways, such as cable trays, conduit and bus ducts, if all the following conditions are satisfied:

[12.1] Lateral motion of the raceway will not cause damaging impact with other systems.

[12.2] Lateral motion of the raceway does not cause loss of system vertical support.

[12.3] Rod-hung supports of less than 12 inches (305 mm) in length ~~have top connections that cannot develop moments~~ *where the hangers are detailed to avoid bending of the hangers and their connections*.

[12.4] Support members cantilevered up from the floor are checked for stability.

[13]Piping, ducts and electrical raceways, which must be functional following an earthquake, spanning between different buildings or structural systems shall be sufficiently flexible to withstand relative motion of support points assuming out-of-phase motions.

[14]Vibration isolators supporting *nonstructural components and* equipment shall be designed for lateral loads or restrained from displacing laterally by other means. Restraint shall also be provided, which limits vertical displacement, such that lateral restraints do not become disengaged. a_p and R_p for equipment supported on vibration isolators shall be taken as 2.5 and 1.5, respectively~~,~~. ~~except that if~~ *If* the isolation mounting frame is supported by shallow or expansion anchors, the design forces for the anchors calculated by Formula (32A-1), (32A-2) or (32A-3) shall be ~~additionally~~ multiplied by a factor of *1.3*.

[15]Equipment anchorage shall not be designed such that lateral loads are resisted by ~~gravity~~ friction induced solely by the effects of gravity (e.g., friction clips).

[16]Expansion anchors, which are required to resist seismic loads in tension, shall not be used where operational vibrating loads are present.

[17]Movement of components within electrical cabinets, rack- and skid-mounted equipment and portions of skid-mounted electromechanical equipment that may cause damage to other components by displacing, shall be restricted by attachment to anchored equipment or support frames.

[18]Batteries on racks shall be restrained against movement in all directions due to earthquake forces.

[19]Seismic restraints may include straps, chains, bolts, barriers or other mechanisms that prevent sliding, falling and breach of containment of flammable and toxic materials. Friction forces may not be used to resist lateral loads in these restraints unless positive uplift restraint is provided which ensures that the friction forces act continuously.

[20] *Not used.* ~~*The component anchorage shall be designed for the horizontal force, Fp,*~~

~~*acting simultaneously with a vertical seismic force equal to one third of the horizontal force, Fp.*~~

[21]Emergency equipment should be located where there is the least likelihood of damage due to earthquake. Such equipment should be located at ground level, and where it can be easily maintained to assure its operation during an emergency.

[22]Not used.

[23]Floor-supported storage racks, cabinets or book stacks not more than 5 feet (1524 mm) in height need not be anchored if the width of the supporting base or width between the exterior legs is equal to or greater than two thirds the height. In addition to gravity loads, storage racks or cabinets shall be designed and constructed to resist the horizontal force, F_p, with the base assumed to be anchored.

[24]Mobile storage racks or cabinets mounted on wheels and not restrained by fixed tracks are not subject to approval by the enforcement agency when the rack or cabinet is not more than 5 feet (1524 mm) in height and the width of the supporting base or width between the exterior legs/wheels is equal to or greater than two thirds the height. All such racks or cabinets shall be restrained to prevent movement when not in use. Movable storage racks or cabinets mounted on wheels or glides restrained by fixed tracks shall be designed and constructed to resist the horizontal force, Fp, with the base of the rack or cabinet assumed to be anchored. Provisions shall be made to resist translation perpendicular to the track and overturning both perpendicular and parallel to the track.

[25]Suspension systems for light fixtures which have passed shaking table tests approved by the enforcement agency, or which, as installed, are free to swing a minimum of 45 degrees from the vertical in all directions without contacting obstructions, shall be assumed to comply with the lateral-force requirements of Section 1632A.2. Unless the cable-type, free-swinging suspension systems shall have a safety wire or cable attached to the fixture and structure at each support capable of supporting four times the supported load.

[26]For suspended and surface-mounted light fixtures, the product of I a_p need not exceed 1.5 for any value of I.

[27]See Section 1633A.2.13.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1637A – SITE DATA FOR HOSPITALS, PUBLIC ELEMENTARY AND SECONDARY SCHOOLS, AND STATE-OWNED OR STATE-LEASED ESSENTIAL SERVICES BUILDINGS

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Division VI-R - EARTHQUAKE EVALUATION AND DESIGN FOR RETROFIT OF [FOR BSC, DSA] EXISTING STATE-OWNED BUILDINGS [FOR OSHPD] EXISTING HOSPITALS [FOR DSA-SS] EARTHQUAKE EVALUATION AND DESIGN FOR REHABILITATION OF EXISTING BUILDINGS FOR USE AS PUBLIC SCHOOL BUILDINGS

SECTION 1641A - DEFINITIONS

…

LATERAL LOAD CAPACITY *is the capacity as determined either by Method A or Method B of the subject element. ~~A [For DSA-SS: The capacity of]~~ The capacity of a system is the sum of all element capacities acting individually reduced by the β factor for the element and meeting the requirements of Section 1646A.2.4. All forms of loading are to consider both displacements in orthogonal directions and torsion.*

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1642A - SYMBOLS AND NOTATIONS

1642A.1 *The following symbols and notations apply to this division in addition to those of Section 1628A:*

~~*[For DSA-SS] Cn represents the nominal strength of a material for a given state of stress.*~~

ϕC_n = Usable strength or capacity of an element as determined in the materials chapters where ϕ is the strength reduction factor and C_n is the nominal strength.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1644A - METHOD A

1644A.9.2.3.3 [For DSA/SS] *In order to qualify for a β value equal to 1.0, such columns shall meet the following detailing and member limitations:*

1. Chapter 19A, Section 1921A.4, for concrete, and Chapter 22A, Section 2210A, ~~2211.4,~~ 2211A and 2213A.5, for steel in structures in Seismic Zones 3 and 4, except for welded steel moment connections where the current SAC Interim Guidelines for the evaluation, repair, modification, and design of welded steel moment frame buildings, FEMA 350, 351, 352, July 2000, provisions for columns apply.

1644A.13.1.2.1 [For DSA/SS] *Nonstructural components and systems shall meet the requirements for new buildings, Section 1632A, or comply with provisions of Section 1645A.8 and this section.*

The total design lateral force, F_p, shall be determined from the following formula:

~~$F_p = \beta H C_a I_p W_p$~~ $F_p = 4.0 H C_a I_p W_p$ *(44A-14)*

Alternatively, Fp may be calculated using the following formula:

~~$F_p = \beta \frac{a_p H C_a I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right) w_p$~~ $F_p = \frac{a_p H C_a I_p}{R_p}\left(1 + 2\frac{h_x}{h_r}\right) W_p$ *(44A-15)*

Except that:

F_p shall not be less than ~~$0.7\beta H C_a I_p W_p$~~ $0.7 H C_a I_p W_p$ *and need not be more than* ~~$4\beta H C_a I_p W_p$~~ $4 H C_a I_p W_p$. *(44A-16)*

Where:

~~β = is the value for the connection, not the element to which it is attached. The values of β for connections, bracing and materials shall be as prescribed in Section 1645A.7.2.~~

I_p = the value used for the structure selected from Table 16A-K.

h_x = the element or component attachment elevation with respect to grade. h_x shall not be taken less than 0.0.

h_r = the structure roof elevation with respect to grade. The value of h_x/h_r need not exceed 1.0.

a_p = the in-structure Component Amplification Factor that varies from 1.0 to 2.5. A value for a_p shall be selected from Table 16A-O.

R_p = the Component Response Modification Factor that shall be taken from Table 16A-0, except that R_p for anchorages shall equal 1.5 for shallow expansion bolts, shallow chemical anchors or shallow cast-in-place anchors. Shallow anchors are those with an embedment length-to-diameter ratio of less than 8. Where anchorage is constructed of nonductile materials, or has nonductile behavior, or the component is attached with an adhesive surface joint, R_p shall equal 1.0.

The design lateral forces determined using Formula (44A-14) or (44A-15) shall be distributed in proportion to the mass distribution of the element or component.

Forces determined using Formula (44A-14) or (44A-15) shall be used to design members and connections that transfer these forces to the seismic-resisting systems. Members and connections shall use the load combinations and factors specified in Section 1644A.4.1.1 or 1644A.4.1.2. The member or connection actions due to F_p are the earthquake load E to be used in the load combinations. The vertical earthquake effect E_v shall be applied

simultaneously with the horizontal earthquake effect E_h. E_v shall be taken as $0.5HC_aIW_p$ for Strength Design and $0.35HC_aIW_p$ for Allowable Stress Design. E_v shall be applied to the dead load effect D, in a manner that produces the most severe member and connection demands.

To determine the out-of-plane loading for elements such as walls or wall panels that have points of attachment at two or more different elevations, the following procedure may be used. For the vertical span of the element having a unit weight w_p between two successive attachment elevations h_x and h_{x+i} evaluate the force coefficients F_p/W_p at each of the two points, observing the minimum and maximum limits, and compute the average of the two values. The resulting average coefficient times the unit weight w_p provides the distributed seismic load for the span between the attachment points, and this load may be extended to the top of any wall parapet above the roof attachment point at h_r.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1648A - METHOD B

1648A.2.4 *The ground motion characterization used for Method B shall be consistent with this ~~those required by~~ Section ~~1643A.8~~.*

1648A.2.4.1.1 [For DSA/SS] *The ground motion characterization used for Method B shall be based on ground shaking having a 10 percent probability of exceedance in 50 years at a performance level for the protection of life and property and the maximum considered earthquake at the performance level for collapse prevention.*

Ground shaking having a 10 percent probability of exceedance in 50 years need not exceed 2/3 of the maximum considered earthquake. Ground shaking response spectra for use in Method B shall be determined in accordance with either the General Procedure of Section ~~1648A.2.2.2.1~~ 1648A.2.4.2.1 or the Site-Specific Procedure of Section ~~1648A.2.2.3.1~~ 1648A.2.4.3.1.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1649A - PEER REVIEW REQUIREMENTS

1649A.5.1 [For DSA/SS] Reports. *The reviewer(s) shall prepare a written report to the owner and ~~responsible~~ DSA that covers all aspects of the review performed, including conclusions reached by the reviewer, in accordance with Section 1640A.8.3. Such reports shall address the following.*

1. Scope of engineering design peer review performed during phase of work.

2. The status of the project documents and/or analyses at each review stage.

3. Ability of structural and nonstructural materials and framing systems to meet the performance objective.

4. Basic constructability of the retrofit or repair system.

5. Recommendations that would be appropriate to the specific project.

6. Presentation of the conclusions of the reviewer identifying any areas that need further review, investigation and/or clarification.

7. Compliance with the evaluation and retrofit report criteria per Section 1640A.8.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Appendix Chapter 16A

DIVISION *VII* - EARTHQUAKE REGULATIONS FOR SEISMIC-ISOLATED STRUCTURES

SECTION 1657A - CRITERIA SELECTION

1657A.3 Occupancy Categories. The importance factor, *I*, for a seismic-isolated building shall be taken as 1.0 regardless of occupancy category. *[For OSHPD 1] [For DSA-SS] The importance factor, Ip, for parts and portions of a seismic-isolated building shall be the same as that required for a fixed-base building of the same occupancy category.*

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1665A - REQUIRED TESTS OF ISOLATION SYSTEM

1665A.2.3 Sequence and cycles. The following sequence of tests shall be performed for the prescribed number of cycles at a vertical load equal to the average $D+0.5L$ on all isolator units of a common type and size:

1. Twenty fully reversed cycles of loading at a lateral force corresponding to the wind design force.

2. Three fully reversed cycles of loading at each of the following increments of displacement: $0.2\ D_D$, $0.5\ D_D$ and $1.0\ D_D$, $1.0D_M$.

3. Three fully reversed cycles at the total maximum displacement, $1.0D_{TM}$.

4. ~~$(15C_{VD}/C_{VA}B_D)$~~ $(15C_{VD}/C_{AD}B_D)$, but not less than 10, fully reversed cycles of loading at 1.0 times the total design displacement, $1.0D_{TD}$.

…(Section unchanged except as noted above)

1665A.4 System Adequacy. The performance of the test specimens shall be assessed as

adequate if the following conditions are satisfied:

1. The force-deflection plots of all tests specified in Section 1665A.2 have a positive incremental force-carrying capacity.

2. For each increment of test displacement specified in Section 1665A.2.3, Item 2, and for each vertical load case specified in Section 1665A.2.3:

2.1 There is no greater than a plus or minus 10 percent difference between the effective stiffness at each of the three cycles of test and the average value of effective stiffness for each test specimen.

2.2 There is no greater than a 10 percent difference in the average value of effective stiffness of the two test specimens of a common type and size of the isolator unit over the required three cycles of test.

3. For each specimen there is no greater than a plus or minus 20 percent change in the initial effective stiffness of each test specimen over the ~~($15C_{VD}/C_{VA}B_D$)~~ ($15C_{VD}/C_{AD}B_D$), but not less than 10, cycles of the test specified in Section 1665A.2.3, Item 4.

4. For each specimen there is no greater than a 20 percent decrease in the initial effective damping over for the ~~($15C_{VD}/C_{VA}B_D$)~~ ($15C_{VD}/C_{AD}B_D$), but not less than 10, cycles of the test specified in Section 1665A.2.3, Item 4.

5. All specimens of vertical load-carrying elements of the isolation system remain stable at the total maximum displacement for static load as prescribed in Section 1665A.2.6.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Chapter 18*A* *[For DSA-SS]*
FOUNDATIONS AND RETAINING WALLS

SECTION 1804A - FOUNDATION INVESTIGATION

1804A.1 General. *Soil investigation reports which include foundation or pile capacity recommendations, recommendations regarding installation, and, in the case of engineered fills, directions as to materials and construction procedures shall be prepared by a geotechnical engineer qualified to undertake investigations for foundation and earthwork design. Investigations involving test borings, exploration shafts or load tests shall be made under the engineering control of such a geotechnical engineer.*

Site investigations and reports pertaining to geologic hazards shall be made where required by Sections 17212 and 17212.5 of the Education Code for public school buildings, Sections ~~15044~~ 129775 and ~~15045~~ 129780 of the Health and Safety Code for hospital buildings, and Section 16014 of the Health and Safety Code for essential services buildings. See also Sections 1629A.3 and 1637A.

… Remainder unchanged of section unchanged

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1806A - FOOTINGS

1806A.2 Footing Design. (2nd paragraph)

The enforcing agency may require… drift values in Chapter 16A.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1809A - FOUNDATION CONSTRUCTION - SEISMIC ZONES 3 AND 4

1809A.5 Special Requirements for Piles and Caissons.

1809A.5.1 General. Piles, caissons and caps shall be designed according to the provisions of Section ~~1603A~~ 1605A, including the effects of lateral displacements. *Whenever such members are founded in Type S_D, S_E, or S_F soils,* special detailing requirements as described in Section 1809A.5.2 shall apply for a length of *such members* equal to 120 percent of the flexural length. Flexural length shall be considered as a length of pile from the first point of zero lateral deflection to the underside of the pile cap or grade beam.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Chapter 19*A [For DSA/SS & OSHPD 1 & 4*]
CONCRETE

SECTION 1903A - SPECIFICATIONS FOR TESTS AND MATERIALS

1903A.3.2.1 [For DSA/SS] The nominal maximum size of coarse aggregate shall not be larger than:

1. One fifth the narrowest dimension between sides of forms, or 2. One third the depth of slabs, or

3. Three fourths the minimum clear spacing between individual reinforcing bars or wires, bundles of bars, or prestressing tendons or ducts.

These limitations may be waived if, in the judgment of the *structural engineer and the enforcement agency,* workability and methods of consolidation are such that concrete can be placed without honeycomb or voids *and the mixes are designed and tested in accordance with Method B or C of Section 1905A.*

Evidence that the aggregate used is not reactive in the presence of cement alkalies may be required by the enforcement agency. If new aggregate sources are to be used or if past experience indicates problems with existing aggregate sources, test the aggregate for potential reactivity according to ASTM C 289. If a result other than innocuous is obtained, test the cement-aggregate combination according to ASTM C 227 using the cement corresponding to that on which the selection of concrete proportions was based (see Section 1905A.2). If the results of this test indicate an expansion greater than 0.10 percent at six months, the aggregate shall be deemed to contain reactive substances in amounts deleterious to concrete, and shall be used with a cementitious material system suitable for preventing alkali-aggregate reaction as follows:

1. Low-alkali portland cement containing not more than 0.6 percent total alkali when calculated as sodium oxide, as determined by the method given in Methods of Chemical Analysis of Hydraulic Cement, ASTM ~~C 144~~ C 114.

2. Blended hydraulic cement, Type 1S or 1P, conforming to UBC Standard 19-1, Part III, except that Type 1S cement shall not contain less than 40 percent slag constituent.

3. Replacement of not less than 15 percent by weight of the portland cement used by a mineral admixture conforming to ASTM C 618.

4. Replacement of not less than 40 percent by weight of the portland cement used by a ground granulated blast-furnace slag conforming to ASTM C 989.

1903A.11 Glass Fiber Reinforced Concrete. Recommended Practice for Glass Fiber Reinforced Concrete Panels, PCI Manual 128.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1905A - CONCRETE QUALITY, MIXING AND PLACING

1905A.2.3 *Concrete specified by compressive strength shall be proportioned by one of the following methods:*

Method A. *As an alternate to Methods B and C, below, the compressive strength of 2,500 psi (17.2 MPa) and 3,000 psi (20.7 MPa) concrete shall be permitted to be used for structural concrete in accordance with Table ~~19A-A-7~~ 19A-A-8.*

…(Section unchanged except as noted above)

~~**1905A.5.1 [For DSA/SS]** Average Strength Reduction. As data become available during construction, *** the amount by which f.cr must exceed the specified value of f.c, provided:~~
~~1. Thirty or more test results are available and average of test results exceeds that required by Section 1905A.3.2.1, using a standard deviation calculated in accordance with Section 1905A.3.1.1, or~~
~~2. Fifteen to 29 test results are available and average of test results exceeds that required by Section 1905A.3.2.1, using a standard deviation calculated in accordance with Section 1905A.3.1.2, and~~
~~3. Special exposure requirements of Section 1904A are met.~~

~~**1905A.5.2**~~ **1905A.5.1** ***[For OSHPD 1&4 and DSA/SS]*** As data becomes available during construction, *it shall be permitted to reduce* the amount by which f'_{cr} must exceed the specified value of f'_c, provided:

1. Thirty or more test results are available and average of test results exceeds that required by Section 1905A.3.2.1, using a standard deviation calculated in accordance with Section 1905A.3.1.1, or

2. Fifteen to 29 test results are available and average of test results exceeds that required by Section 1905A.3.2.1, using a standard deviation calculated in accordance with Section

1905A.3.1.2, and

3. Special exposure requirements of Section 1904A are met.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022
Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 1921A - REINFORCED CONCRETE STRUCTURES RESISTING FORCES INDUCED BY EARTHQUAKE MOTIONS

1921A.0 Notations.

…

~~Δ_m~~ $\Delta_M = 0.7R\Delta_s$.

…

…(Section unchanged except as noted above)

1921A.3.2 Longitudinal reinforcement.

1921A.3.2.1 At any section of a flexural member, except as provided in Section 1910A.5.3, for top as well as for bottom reinforcement, the amount of reinforcement shall not be less than that given by Formula (~~20A-3~~ 10A-3) but not less than 200 $b_w d/f_y$, (For **SI:** 1.38 $b_w d/f_y$) and the reinforcement ratio, ρ, shall not exceed 0.025. At least two bars shall be provided continuously, both top and bottom.

…(Section unchanged except as noted above)

1921A.5.3 Shear strength.

1921A.5.3.1 The nominal shear strength of the joint shall not be taken greater than the forces specified below for normal-weight aggregate concrete.

For joints confined on all four faces $20\sqrt{f'_c}A_j$

(For **SI:** $1.66\sqrt{f'_c}A_j$)

For joints confined on three faces or on two opposite faces $15\sqrt{f'_c}A_j$

(For **SI:** 1.25 $\sqrt{f'_c}A_j$)

For others 12 $\sqrt{f'_c}A_j$

(For **SI:** 1.00 $\sqrt{f'_c}A_j$)

A member that frames into a face is considered to provide confinement to the joint if at least three fourths of the face of the joint is covered by the framing member. A joint is considered to be confined ~~is~~ if such confining members frame into all faces of the joint.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Chapter 21A *[DSA-SS & OSHPD]*
MASONRY

SECTION 2108A - STRENGTH DESIGN OF MASONRY

2108A.2.2.6 Development. The calculated tension or compression reinforcement shall be developed in accordance with the following provisions:
The embedment length of reinforcement shall be determined by Formula (8A-12).

$$l_d = l_{de} / \phi \qquad \text{(8A-12)}$$

WHERE:

$$l_{de} = \frac{0.15 d_b^2 f_y}{K\sqrt{f'_m}} \leq 52 d_b \qquad \text{(8A-13)}$$

For SI: $$l_{de} = \frac{1.8 d_b^2 f_y}{K\sqrt{f'_m}} \leq 52 d_b$$

K shall not exceed $3d_b$.

2108A.2.6.2.6 Members subjected to axial force and flexure.
The requirements set forth in this subsection apply to piers proportioned to resist flexure in conjunction with axial loads.

1. **Longitudinal reinforcement.** A minimum of four longitudinal bars shall be provided at all sections of every pier.

Flexural reinforcement shall be distributed across the member depth. Variation in reinforcement area between reinforced cells shall not exceed 50 percent.

Minimum reinforcement ratio calculated over the gross cross section shall be 0.002.

Maximum reinforcement ratio calculated over the gross cross section shall be 0.15*f.m / fy*.

Maximum bar diameter shall be one eighth nominal width of the pier.

2. **Transverse reinforcement.** Transverse reinforcement shall be hooked around the extreme longitudinal bars with standard 180-degree hook as defined in Section 2108A.2.2.4.

Within an end region extending one pier depth from the end of the beam, and at any region at which flexural yielding may occur during seismic or wind loading, the maximum spacing of transverse reinforcement shall not exceed one fourth the nominal depth of the pier.

The maximum spacing of transverse reinforcement shall not exceed one half the nominal depth of the pier. The minimum transverse reinforcement ratio shall be 0.0015.

3. **Lateral reinforcement.** Lateral reinforcement shall be provided to confine the grouted core when compressive strains due to axial and bending forces exceed 0.0015, corresponding to factored forces with ~~R_w~~ *R* equal to ~~1.5~~ *1.1*. The unconfined portion of the cross section with strain exceeding 0.0015 shall be neglected in computing the nominal strength of the section.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Chapter 22A *[DSA/SS & OSHPD]*
STEEL

Division V - SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS FOR USE WITH ALLOWABLE STRESS DESIGN

SECTION 2213A - SEISMIC PROVISIONS FOR STRUCTURAL STEEL BUILDINGS IN SEISMIC ZONES 3 AND 4

2213A.7 Special Moment-Resisting Frame (SMRF) Requirements.

2213A.7.3 Width-thickness ratio. Girders shall comply with Division III, except that the flange width-thickness ratio, $b_f / 2t_f$, shall not exceed $52 / \sqrt{F_y}$ (For **SI:** $0.31 / \sqrt{E / F_y}$).

The width-thickness ratio of column sections shall meet the requirements of Division III, Section ~~2251 N7~~ 2208 N7. The outside wall width-thickness ratio of rectangular tubes used for columns shall not exceed $110 / \sqrt{F_y}$ (For **SI:** $0.65 / \sqrt{E / F_y}$), unless otherwise stiffened.

…(Section unchanged except as noted above)

2213A.9 Requirements for Special Concentrically Braced Frames.

2213A.9.1 General. The provisions of this section apply to special concentrically braced frame structures as defined in Section ~~1625A~~ 1627A. All members and connections in special braced frames shall be designed and detailed to resist shear and flexure caused by eccentricities in the geometry of the members comprising the frame in accordance with

Section 2213A.9. Any member intersected by a brace shall be continuous through the connection. Horizontal bracing that transfers forces between horizontally offset bracing in the vertical plane shall be subject to the requirements of Section 2213A.9, except Sections 2213A.9.2.3; 2213A.9.4.1, Item 3; and 2213A.9.4.2. Horizontal bracing other than the above is not subjected to the requirements of Section 2213A.9.

…(Section unchanged except as noted above)

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Division VIII - LATERAL RESISTANCE FOR STEEL STUD WALL SYSTEMS

SECTION 2219A - GENERAL

Steel stud wall systems in which shear panels are used to resist lateral loads produced by wind or earthquake shall comply with the requirements of this section. The nominal shear value used to establish the allowable shear value or design shear value shall not exceed the values set forth in Table 22A-VIII-A * * * for wind loads or Table 22A-VIII-C for seismic loads. The allowable shear value (ASD) or design *shear* value (LRFD) shall be determined using the ~~*f*~~ *Φ* or ~~*W*~~ *Ω* factors as set forth in Section 2219A.3.

…(Section unchanged except as noted above)

2219A.3 Design. Where allowable stress design is used, the allowable shear value shall be determined by dividing the nominal shear value, shown in Table 22A-VIII-A, * * * by a factor of safety (~~*W*~~ *Ω*) which shall be taken as 3.0. The factor of safety (~~*W*~~ *Ω*) for the nominal loads shown in Table 22A-VIII-C shall be taken as *3.0*.

Where Load and Resistance Factor Design is used, the design shear value shall be determined by multiplying the nominal shear value, shown in Table~~s~~ 22A-VIII-A ~~and 22A-VIIIB~~, by a resistance factor *(~~f~~ Φ)* which shall be taken as 0.45. The resistance factor *(~~f~~ Φ)* for the nominal loads shown in Table 22A-VIII-C shall be taken as 0.55.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 2220A - SPECIAL REQUIREMENTS IN SEISMIC ZONES 3 AND 4

2220A.2 Boundary Members and Anchorage. Boundary members and the uplift anchorage thereto shall have the strength to resist the forces determined by the *following* load ~~*modifications*~~ *combinations*:

1. Axial compression $1.0P_{DL} + 0.7P_{LL} + \Omega_O P_E$

2. Axial tension $0.85P_{DL} \pm \Omega_O P_E$

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

Chapter 23A *[For DSA/SS and OSHPD]*
WOOD

Division III - DESIGN SPECIFICATIONS FOR ALLOWABLE STRESS DESIGN OF WOOD BUILDINGS

Part I - ALLOWABLE STRESS DESIGN OF WOOD

This standard, with certain exceptions, is the ~~ANSI/NfoPA NDS-91~~ ANSI/AF&PA NDS-2001 National Design Specification for Wood Construction of the American Forest and Paper Association, ~~Revised 1991 Edition,~~ and the Supplement to the ~~1991~~ 2001 Edition, National Design Specification, adopted by reference.

The National Design Specification for Wood Construction, ~~Revised 1991~~ 2001 Edition, and 2001 Supplement are available from the American Forest and Paper Association, 1111 19th Street, NW, Eighth Floor, Washington, DC, 20036.

SECTION 2316A - DESIGN SPECIFICATIONS

2316A.1 Adoption and Scope. The National Design Specification for Wood Construction, ~~Revised 1991~~ 2001 Edition (NDS), which is hereby adopted as a part of this code, shall apply to the allowable stress design and construction of wood structures using visually graded lumber, mechanically graded lumber, structural glued laminated timber, and timber piles. ~~National Design Specification Appendix Section F, Design for Creep and Critical Deflection Applications, Appendix Section G, Effective Column Length, and Appendix Section J, Solution of Hankinson Formula are specifically adopted and made a part of this standard. The Supplement to the 1991Edition National Design Specification, Tables 2A, 4A except for the Repetitive Member Factor, Cr, 4B except for the Repetitive Member Factor,Cr, 4C except for the Repetitive Member Factor Cr, 4D, 4E except for the Repetitive Member Factor, Cr, 5A, 5B and 5C are specifically adopted and made a part of this standard.~~

~~Other codes, standards or specifications referred to in this standard are to be considered as only an indication of an acceptable method or material that can be used with the approval of the enforcement agency, except where such other codes, standards or specifications are specifically adopted by this code as primary standards.~~ *Where a standard or specification referred to in this code conflicts with a standard or specification referenced in the 2001 NDS for wood construction, the 2001 NDS shall prevail.*

2316A.2 Amendments.

~~**1. Sec. 1.1. Delete and substitute the following:**~~

~~The design of elements of structures using visually graded lumber, mechanically graded lumber, structural glued laminated timber, timber piles, and design of their connections shall be in accordance with Chapter 23A, Division III, Part 1.~~

~~**2. Secs. 1.2 through 1.5. Delete.**~~

~~**3. Sec. 2.2. Delete first sentence and substitute the following:**~~

~~Allowable stress design values for visually graded structural lumber, mechanically graded structural lumber and structural glued laminated timber shall be in accordance with NDS Supplement Tables 2A, 4A except for the Repetitive Member Factor, Cr, 4B except for the Repetitive Member Factor Cr, 4C except for the Repetitive Member Factor, Cr, 4D, 5A, 5B and 5C. The Repetitive Member Factor, Cr, shall not be used to adjust the allowable stresses set forth in Tables 4A, 4B, 4C and 4E. Values for species and grades not tabulated shall be submitted to the enforcement agency for approval.~~

~~4.~~ *1.* Sec. 2.3.2.1. In fourth sentence, delete "or Figure B1 (see Appendix B)."

~~5.~~ *2.* Sec. 2.3.2.3. Delete and substitute the following:

2.3.2.3 When using Section 1612A.3.1 basic load combinations, the Load Duration Factor, C_D *except for dead load,* noted in Table 2.3.2 shall NOT be permitted to be used. When using Section 1612A.3.2 alternate load combinations, the one-third increase shall not be used concurrently with the Load Duration Factor, C_D.

~~6.~~ *3.* Table 2.3.2. Delete and substitute as follows:

TABLE 2.3.2—LOAD DURATION FACTORS, C_D

DESIGN LOAD	LOAD DURATION	C_D
Dead Load	Permanent	0.9
Floor, Occupancy Live Load	Ten Years	1.0
Snow Load	Two Months	1.15
Roof Live Load[3]	Seven Days	1.25
Earthquake Load[1]	—	1.33
Wind Load[2]	—	1.33
Impact	—	2.0

C A

[1] 1.60 may be used for nailed and bolted connections exhibiting Mode III or IV behavior, except that the increases for earthquake are not combined with the increase allowed in Section 1612A.3. The 60-percent increase for nailed and bolted connections exhibiting Mode III or IV behavior for earthquake shall not be applicable to joist hangers, framing anchors, and other mechanical fastenings, including straps and hold-down anchors. The 60-percent increase shall not apply to the allowable shear values in Tables 23A-II-H, 23A-II-I-1, 23A-II-I-2, 23A-II-J or in Section 2315A.3.

[2] 1.60 may be used for members and nailed and bolted connections exhibiting Mode III or IV behavior, except that the increases for wind are not combined with the increase allowed in Section 1612A.3. The 60-percent increase shall not apply to the allowable shear values in Tables 23A-II-H, 23A-II-I-1, 23A-II-I-2, 23A-II-J or in Section 2315A.3.

[3] *Provided the dead load includes the weight of at least one reroofing.*

~~7.~~ *4.* Sec. ~~2.3.4.~~ 2.3.3. Add a second paragraph following Table ~~2.3.4~~ 2.3.3 :

The allowable unit stresses for fire-retardant-treated solid-sawn lumber and plywood, including fastener values, subject to prolonged elevated temperatures from manufacturing or equipment processes, but not exceeding 150˚ F (66˚ C), shall be developed from approved test methods that properly consider potential strength-reduction characteristics, including effects of heat and moisture.

~~8.~~ *5.* Sec. ~~2.3.6.~~ 2.3.4. Add second, third and fourth paragraphs as follows:

The values for lumber and plywood impregnatedwith approved fire-retardant chemicals, including fastener values, shall be submitted to the enforcement agency for approval. Submittal to the enforcement agency shall include all substantiating data. Such values shall be developed from approved test methods and procedures that consider potential strength-reduction characteristics, including the effects of elevated temperatures and moisture. Other adjustments are applicable, except that the impact load-duration factor shall not apply.

The values for fasteners specified in Division III shall be reduced to 90 percent, except that values for light metal plate connectors shall be recommended by each truss plate manufacturer and approved by the enforcement agency. Values for glued-laminated timber, including fastener design values, shall be recommended by the treater and submitted to the enforcement agency for approval. Submittal to the enforcement agency shall include all substantiating data.

In addition to the requirements specified in Section 207, fire retardant lumber having structural applications shall be tested and identified by an approved inspection agency in accordance with UBC Standard 23-5.

~~9. Sec. 2.3.8. Add new second and third paragraphs following Table 2.3.8:~~

~~For lumber I beams and box beams, the form factor, Cf, shall be calculated as:~~

$$C_f = \left[1 + \left(\frac{d^2 + 143}{d^2 + 88} - 1\right) C_g\right]$$

For **SI:**

$$C_f = \left[1 + \left(\frac{\left(\frac{d}{25.4}\right)^2 + 143}{\left(\frac{d}{25.4}\right)^2 + 88} - 1\right) C_g\right]$$

~~WHERE:~~
~~*Cf* = form factor.~~
~~*Cg* = support factor = *p*2(6 - 8*p* + 3*p*2)(1 - *q*) + *q*.~~
~~*d* = depth of I or box beam.~~
~~*p* = ratio of depth of compression flange to full depth of beam.~~
~~*q* = ratio of thickness of web or webs to full width of beam.~~

~~10. Sec. 2.3.10. Add a paragraph at end of section as follows:~~

In joists supported on a ribbon or ledger board and spiked to the studding, the allowable stress in compression perpendicular to grain may be increased 50 percent.

11. Sec. 3.2.1. Add a second sentence as follows:

For continuous beams, the span shall be taken as the distance between centers of bearings on supports over which the beam is continuous.

12. Sec. 3.2.3.2. *Delete and substitute* as follows:

Notches in sawn lumber bending members shall not exceed one tenth the depth of the member and shall not be located in the middle third of the span. Where members are notched at the ends, the notch depth shall not exceed one fourth the beam depth. The tension side of sawn lumber bending members of 4 inches (102 mm) or greater nominal thickness shall not be notched except at ends of members. Cantilevered portions of beams less than 4 inches (102 mm) in nominal thickness shall not be notched unless the reduced section properties and lumber defects are considered in the design. For effects of notch on shear strength, see Section 3.4.4.

13. Sec. 3.2.3.3. Delete and substitute as follows:

Notched glued-laminated members shall be designed as required for sawn lumber using the allowable stress of a combination, with the outer lamination being the grade of laminations exposed by the notch. Where a notch is located on the tension face of a member, at least one fully threaded lag bolt, or equal, shall be provided on each side of the notch to prevent splitting.

14. Sec. 3.3.2. Add a last paragraph as follows:

A beam of circular cross section may be assumed to have the same strength as a square beam having the same cross-sectional area. If a circular beam is tapered, it shall be considered a beam of variable cross section.

15. Sec. 3.4.4. Add a section as follows:

3.4.4.5 When girders, beams or joists are notched at points of support on the compression side, they shall meet design requirements for the net section in bending and in shear. The actual shear stress at such point shall be calculated as follows:

$$f_v = \frac{3V}{2b\left[d - \left(\frac{d - d'}{d'}\right) e\right]}$$

WHERE:
d = total depth of beam.
di = actual depth of beam at notch.
e = distance notch extends inside the inner edge of support.
V = shear force.

Where *e* exceeds *d* , the actual shear stress for the notch on the compression side shall be calculated as follows:

~~$$f_v = \frac{3V}{2bd'}$$~~

~~16. Sec. 3.7.1.4. Delete and substitute as follows:~~

~~The slenderness ratio for solid columns, *le/d* shall not exceed 50.~~

~~17. Sec. 3.8.2. Delete and substitute as follows:~~

~~Where designs that induce tension stresses perpendicular to grain cannot be avoided, mechanical reinforcement sufficient to resist such forces shall be provided.~~

~~18. Sec. 4.2.5.5. Delete.~~

~~19. Sec. 4.3.4. Delete and substitute as follows:~~
~~The provisions of Item (b) above apply.~~

~~20. Sec. 4.4.1.1. Delete and substitute as follows:~~

~~Rectangular sawn lumber beams, rafters, joists or other bending members shall be supported laterally to prevent rotation or lateral displacement in accordance with Section 4.4.1.2, or shall be designed in accordance with the lateral stability provisions in Section 3.3.3.~~

~~21. Sec. 4.4.1.2. Delete first sentence.~~

~~(c) Add: The provisions of Item (b) above apply.~~

~~(d) Delete and substitute as follows:~~

~~Six to 1; bridging, full-depth solid blocking or cross bracing shall be installed at intervals not exceeding 8 feet (2438 mm) and the provisions of Item (b) above shall apply unless:~~

~~Both edges of the member are held in line or,~~

~~The compression edge of the member is supported throughout its length to prevent lateral displacement, as by adequate sheathing or subflooring, and the ends and all points of bearing have lateral support to prevent rotation.~~

~~22.~~ 6. Sec. 4.4.1. Add a section as follows:

4.4.1.4 Bridging for Floor Joists and Roof Joists or Rafters.

Roof joists or rafters of more than 8-inch (203 mm) depth and floor joists of more than 4-inch (102 mm) depth which are spaced 32 inches (813 mm) on center or less shall be provided with bridging to distribute superimposed loads. Floor joists shall be bridged every 8 feet (2438 mm) and roof joists or rafters every 10 feet (3048 mm) by solid blocking 2 inches (51 mm) thick and the full depth of the joist or rafter, or by wood cross bridging of not less than 1 inch by 3 inches (25 mm by 76 mm) or nailed metal cross bridging of equal strength. Where cross bridging is used, the lower ends of such cross bridging shall be driven up and nailed after the floor, subfloor or roof has been nailed.

23. Sec. 5.2.2. Delete and substitute as follows:

[For DSA/SS] Reinforcement of radial tension. *Where mechanical reinforcement is required to resist radial tension, reinforcement shall be as described in the 3rd Edition (1985) of the Timber ConstructionManual or as otherwise approved. The maximum spacing of mechanical reinforcement shall not exceed one half the effective embedded thread length of the member at the location of the reinforcement. The effective embedded thread length is the embedded thread length in the tension zone from the neutral axis of the member to the end of the reinforcement.*

24. Sec. 5.4.1. Delete second paragraph and substitute as follows:

For curved bending members having a varying cross section, the maximum actual radial stress induced, *fr*, is given by:

$$f_r = K_r \frac{6M}{bd^2}$$

WHERE:
b = width of cross section, inches (mm).
d = depth of cross section at the apex in inches (mm).
Kr = radial stress factor determined from the following relationship:

$$K_r = A + B\left(\frac{d}{Rm}\right) + C\left(\frac{d}{Rm}\right)^2$$

M = bending moment at midspan in inch-pounds (N·mm).

WHERE:
Rm = radius of curvature at the center line of the member at midspan in inches (mm).
A, B and *C* = constants as follows:

β (1)	A (2)	B (3)	C (4)
(0.0)	(0.0)	(0.2500)	(0.0)
2.5°	0.0079	0.1747	0.1284
5.0°	0.0174	0.1251	0.1939
7.5°	0.0279	0.0937	0.2162
10.0°	0.0391	0.0754	0.2119
15.0°	0.0629	0.0619	0.1722
20.0°	0.0893	0.0608	0.1393
25.0°	0.1214	0.0605	0.1238
30.0°	0.1649	0.0603	0.1115

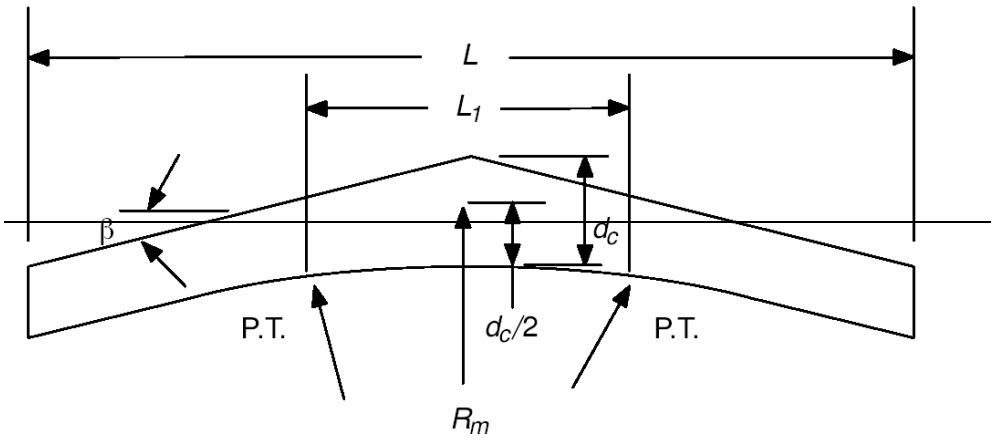
and β = angle between the upper edge of the member and the horizontal in degrees.Values of *Kr* for intermediate values of â may be interpolated linearly.
When the beam is loaded with a uniform load, *Kr* may be modified by multiplying by the reduction factor *Cr* as calculated by the following formula:

$$C_r = A + B\left(\frac{L}{L_t}\right) + C\left(\frac{d_c}{R_m}\right) + D\left(\frac{L}{L_t}\right)^2$$
$$+ E\left(\frac{d_c}{R_m}\right)^2 + F\left(\frac{d_c}{R_m}\right)\left(\frac{L}{L_t}\right)$$
$$+ G\left(\frac{L}{L_t}\right)^3 + H\left(\frac{d_c}{R_m}\right)^3$$

WHERE:
Cr = reduction factor.
L = span of beam.
Lt = length of beam between tangent points.
A, B
. . . H = constants for a given â as follows:

β	A	B	C	D	E	F	G	H
2.3°	-0.142	0.418	-2.358	-0.053	—	—	0.002	—
9.7°	0.143	0.376	-0.541	-0.060	—	—	0.003	—
14.9°	0.406	0.293	-0.927	-0.041	—	—	0.002	—
20.0°	0.423	0.364	-1.022	-0.067	—	0.146	—	—
25.2°	0.540	0.360	-1.061	-0.070	—	0.156	—	—
29.8°	0.502	0.372	—	-0.076	-3.712	0.138	0.004	4.336

and β = angle between the upper edge of the member and the horizontal in degrees. Values of *Cr* for intermediate values may be interpolated linearly.



PITCHED AND TAPERED CURVED BEAM

25. Sec. 5.4.1.2. Delete and substitute as follows:

When M is in the direction tending to decrease the curvature (increase the radius), mechanical reinforcing sufficient to resist all radial tension stresses is required, but in no

~~*case shall the calculated radial tension stress exceed one third the allowable unit stress in horizontal shear. When mechanical reinforcing is used, the maximum moisture content of the laminations at time of manufacture shall not exceed 12 percent for dry conditions of use.*~~

~~26.~~ *~~7.~~* Sec. ~~5.4.4.~~ 5.4. Add a new section as follows:

~~5.4.4~~ 5.4.5 Ponding. Roof-framing members shall be designed for the deflection and drainage or ponding requirements specified in Section 1506 and Chapter 16A. In glued-laminated timbers, the minimum slope for roof drainage required by Section 1506 shall be in addition to a camber of one and one-half times the calculated dead load deflection. The calculation of the required slope shall not include any vertical displacement created by short taper cuts. In no case shall the deflection of glued-laminated timber roof members exceed 1/2-inch (13 mm) for a 5 pound-per-square-foot (239 Pa) uniform load.

~~27.~~ *~~8.~~* Sec. ~~5.4.5.~~ 5.4. Add a new section as follows:

~~5.4.5~~ 5.4.6 Tapered Faces. Sawn tapered cuts shall not be permitted on the tension face of any beam. Pitched or curved beams shall be so fabricated that the laminations are parallel to the tension face. Straight, pitched or curved beams may have sawn tapered cuts on the compression face.

For other members subject to bending, the slope of tapered faces, measured from the tangent to the lamination of the section under consideration, shall not be steeper than 1 unit vertical in 24 units horizontal (4% slope) on the tension side.

EXCEPTIONS:
1. This requirement does not apply to arches.
2. Taper may be steeper at sections increased in size beyond design requirements for architectural projections.

~~28.~~ 9. Sec. ~~5.4.6.~~ 5.4. Add a new section as follows:

5.4.7 Manufacture and Fabrication. *The manufacture and fabrication of structural glued-laminated timber shall be in accordance with ANSI/AITC A 190.1 and the following requirements:*

1. ***Joints.*** *All portions of end joints in adjacent laminations shall be separated in accordance with ANSI/AITC A 190.1 and ASTMD3737. The areas requiring 6-inch (152 mm) spacing shall be shown on the approved drawings or described in the specifications.*

Joints in adjacent laminations of arched members shall be separated as required for bending members.

2. ***Adhesives.*** *Dry-use adhesives shall not be used.*

3. ***Moisture content at the time of gluing.*** *The maximum moisture content of the ~~wood~~ laminating lumber at the time of gluing shall not exceed 16 percent for projects located in coastal areas, 12 percent for projects located in interior valleys or ~~10 percent for projects located in~~ desert areas, with the geographical areas as determined by the enforcement agency. The moisture content of the wood for members that will be exposed to direct sunlight in the finished structure shall not exceed ~~the following limits~~ 12 percent at time of gluing~~:~~ .*

~~1. 12 percent for Alaskan Yellow Cedar~~

~~*2. 10 percent for all other species*~~

~~*The minimum moisture content shall not be less than 7 percent.*~~ *The range of moisture content of laminations assembled into a single member shall not exceed 5 percent at the time of gluing.*

When mechanical reinforcing is used, such as radial tension reinforcement, the maximum moisture content of the laminations at time of manufacture shall not exceed 12 percent for dry conditions of use.

~~*3.* ***Reinforcement for radial tension.*** *Where mechanical reinforcement is required to resist radial tension, reinforcement shall be as described in 3rd Edition (1985) of the Timber Construction Manual or as otherwise approved. The maximum spacing of mechanical reinforcement shall not exceed one half the effective embedded thread length of the member at the location of reinforcement. The effective embedded thread length is the embedded thread length in the tension zone from the neutral axis of the member to the end of the reinforcement.*~~

4. ***Inspection.*** *See Section 2337A for inspection requirements.*

~~29.~~ 10. Sec. ~~5.4.7.~~ 5.4. Add a new section as follows:

5.4.8 Specifications. *For structural glued-laminated timber, the following shall be shown on the plans and in the specifications:*

Whether for dry or wet conditions of use

Species and applicable standard

Stress requirements and combination symbol

If the temperature of the timber exceeds 150°F (66°C) in service

Tension zones for purposes of determining grades of laminations and location of spaced end joints for all members except simple beams supporting uniform loads.

Those portions of glued-laminated timbers which form the structural supports of a building or other structure and are exposed to weather and not properly protected by a roof, eave overhangs or similar covering shall be pressure treated with an approved preservative or be manufactured from wood of natural resistance to decay.

All weather-exposed surfaces of members shall be protected in an approved manner to prevent decay where they are located in a high-humidity environment such as in direct contact with soil or water and where portions extend beyond the walls and roof coverage in buildings. When the member is protected with an approved pressure treatment, the treatment process shall not impair the structural integrity of the member. When the member is protected by flashing or is encased, care must be taken to provide ventilation and prevent moisture entrapment on the member.

All members shall have appropriate weather protection during transit, storage and erection.

~~**30. Sec. *8.2. Delete and substitute as follows:***~~

~~***8.2.3*** Allowable shear values for bolts used to connect a wood member to concrete or masonry are permitted to be determined as one half the tabulated double shear value for a wood member twice the thickness of the member attached to the concrete or~~

~~masonry.~~

~~31.~~ 11. Sec. ~~12.2.3.~~ 11.5.4. Delete.

~~32. Sec. 12.3.7. Delete.~~

~~33.~~ *12.* Sec. ~~12.4.1.~~ 11.1.5.6. Delete and substitute as follows:

~~12.4.1~~ **11.1.5.6** For wood-to-wood joints, the spacing center to center of nails in the direction of stress shall not be less than the required penetration. Edge or end distances in the direction of stress shall not be less than one-half of the required penetration. All spacing and edge and end distances shall be such as to avoid splitting of the wood.

~~34. Sec. 13.2.1. Delete and substitute as follows:~~

~~13.2.1 Test for design values.~~ ~~Tests to determine design values for metal plate connectors in lateral withdrawal, net section shear and net section tension shall be conducted in accordance with the test and evaluation procedures in ANSI/TPI 1-1995. Design values determined in accordance with these test procedures shall be multiplied by all applicable adjustment factors (see Table 7.3.1) to obtain allowable design values.~~

~~35. NDS Supplement Table 5A. Add combinations and design values as follows:~~

COMBINATION SYMBOL[4]	SPECIES OUTER LAMINATIONS/CORE LAMINATIONS[5]	DESIGN VALUES IN POUNDS PER SQUARE INCH (psi)													
		BENDING ABOUT X-X AXIS (Loaded Perpendicular to Wide Faces of Laminations)						BENDING ABOUT Y-Y AXIS (Loaded Parallel to Wide Faces of Laminations)					AXIALLY LOADED		
		Bending		Compression Perpendicualr to Grain											
		Tension Zone Stressed in Tension F_{bxx}	Compression Zone Stressed in Tension[6] F_{bxx}	Tension Face[9,10] $F_{c\perp xx}$	Compression Face[9,10] $F_{c\perp xx}$	Shear Parallel to Grain[10] F_{vxx}	Modulus of Elasticity E_{xx}	Bending F_{byy}	Compression Perpendicular to Grain (Side Faces) $F_{c\perp yy}$	Shear Parallel to Grain F_{vyy}	Shear Parallel to Grain (For Members With Mulitple Piece Laminations Which are not Edge glued)[13] F_{vyy}	Modulus of Elasticity E_{yy}	Tension Parallel to Grain F_t	Compression Parallel to Grain F_c	Modulus of Elasticity E
VISUALLY GRADED SOUTHERN PINE															
26F-V1	SP/SP	2600	1300	650	650	200	1,800,000	1900	560	175	90	1,600,000	1150	1600	1,600,000
26F-V2	SP/SP	2600	1300	650	650	200	1,900,000	2200	650	175	90	1,800,000	1200	1650	1,800,000
26F-V3	SP/SP	2600	1300	650	650	200	1,900,000	2100	560	175	90	1,800,000	1150	1600	1,800,000
26F-V4[8]	SP/SP	2600	2600	650	650	200	1,900,000	2100	560	175	90	1,800,000	1150	1600	1,800,000
E-RATED SOUTHERN PINE															
28F-E1	SP/SP	2800	1400	650	650	200	2,000,000	1600	560	175	90	1,700,000	1300	1850	1,700,000
28F-E2[8]	SP/SP	2800	2800	650	650	200	2,000,000	1600	560	175	90	1,700,000	1300	1850	1,700,000
30F-E1[15]	SP/SP	3000	1500	650	650	200	2,000,000	1750	560	175	90	1,700,000	1250	1750	1,700,000
30F-E2[8,15]	SP/SP	3000	3000	650	650	200	2,000,000	1750	560	175	90	1,700,000	1250	1750	1,700,000

[15]These combinations are only for nominal widths 6 inches and less, in accordance with AITC 117-93.

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 2318A - TIMBER CONNECTORS AND FASTENERS

2318A.3.3 Spacing and penetration. Common wire nails shall have penetration into the piece receiving the point as set forth in Tables 23A-III-C-1 and 23A-III-C-2.Nails or spikes forwhich the gages or lengths are not set forth in Tables 23A-III-C-1 and 23A-III-C-2 shall have a required penetration of not less than 11 diameters, and allowable loadsmay be interpolated. Allowable loads shall not be increased when the penetration of nails into the member holding the point is larger than required by this section. *Spacing shall be in accordance with Section 2316A.2, Item ~~33~~ 12.*

Common wire 10d, 12d and 16 d nails may be used to join two members of 2-inch (51 mm) nominal thickness at the tabulated values indicated for these nails.

Nails in plywood shall not be overdriven such that the nail heads penetrate the face ply by more than the thickness of the nail head or break the face-ply wood fibers.

2318A.3.4 Corrosion resistance. *Nails and spikes used in wet or exterior locations, such as exterior wall coverings of hospitals, public elementary and secondary schools, community college buildings, and state-owned or state-leased essential services buildings, shall be corrosion resistant and shall have a hot-dipped or tumbled galvanized coating of not less than ~~1.5~~ 1.0 ounces of zinc per square foot (~~458~~ 305 gm/m^2) or be fabricated of copper, stainless steel or brass.*

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023

SECTION 2320A - CONVENTIONAL LIGHT-FRAME CONSTRUCTION DESIGN PROVISIONS

2320A.8.3 Framing details. Joists shall be supported laterally at the ends and at each support by solid blocking except where the ends of joists are nailed to a header, band or rim joist or to an adjoining stud or by other approved means. Solid blocking shall not be less than 2 inches (51 mm) in thickness and the full depth of joist.

Notches on the ends of joists shall not exceed one fourth the joist depth. Holes bored in joists shall not be within 2 inches (51 mm) of the top or bottom of the joist, and the diameter of any such hole shall not exceed one third the depth of the joist. Notches in the top or bottom of joists shall not exceed one ~~*tenth*~~ sixth the depth and shall not be located in the middle third of the span. *Notches or holes shall not be placed in joists unless fully detailed in the approved plans.*

Joist framing from opposite sides of a beam, girder or partition shall be lapped at least 3 inches (76 mm) or the opposing joists shall be tied together in an approved manner.

Ledger strips applied to the sides of girders for support of joists shall not be less than 2 inches by 4 inches (51 mm by 102 mm).

2320A.8.7 Bridging. *Floor joists more than 4 inches (102 mm) in depth shall be provided with bridging in accordance with the provisions of Section 2316A.2, Item ~~22~~ 6 ~~, 4.4.1.4~~.*

2320A.12.8 Blocking. Roof rafters and ceiling joists shall be supported laterally to prevent rotation and lateral displacement when required by Division III, Part I, Section 4.4.1.2. *In addition, rafters of more than 8 inches (203 mm) in depth shall be provided with bridging in accordance with the provisions of Section 2316A.2, Item ~~22~~ 6.*

Notation

Authority: Education Code Sections 17310, 81142; Health & Safety Code Section 16022

Reference(s): Education Code Sections 17280 - 17317, and 811130 - 81149; Health & Safety Code Sections 16000 - 16023