REVISION RECORD FOR THE STATE OF CALIFORNIA

ERRATA

January 1, 2014

2013 Title 24, Part 2, Vol. 2 California Code of Regulations

General Information:

1. The date of this erratum is for identification purposes only. See the History Note Appendix on the back side or accompanying page.
2. This erratum is issued by the California Building Standards Commission in order to correct nonsubstantive printing errors or omissions in California Code of Regulations, Title 24, Part 2, Vol. 2, of the 2013 *California Building Code*. Instructions are provided below.
3. Health and Safety Code Section 18938.5 establishes that only building standards in effect at the time of the application for a building permit may be applied to the project plans and construction. This rule applies to both adoptions of building standards for Title 24 by the California Building Standards Commission, and local adoptions and ordinances imposing building standards. An erratum to Title 24 is a nonregulatory correction because of a printing error or omission that does not differ substantively from the official adoption by the California Building Standards Commission. Accordingly, the corrected code text provided by this erratum may be applied on and after the stated effective date.
4. You may wish to retain the superseded material with this revision record so that the prior wording of any section can be easily ascertained.

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PREFACE

This document is Part 2 of 12 parts of the official triennial compilation and publication of the adoptions, amendments and repeal of administrative regulations to *California Code of Regulations, Title 24*, also referred to as the *California Building Standards Code*. This part is known as the *California Building Code.*

The *California Building Standards Code* is published in its entirety every three years by order of the California legislature, with supplements published in intervening years. The California legislature delegated authority to various state agencies, boards, commissions and departments to create building regulations to implement the state's statutes. These building regulations, or standards, have the same force of law, and take effect 180 days after their publication unless otherwise stipulated. The *California Building Standards Code* applies to occupancies in the State of California as annotated.

A city, county, or city and county may establish more restrictive building standards reasonably necessary because of local climatic, geological or topographical conditions. Findings of the local condition(s) and the adopted local building standard(s) must be filed with the California Building Standards Commission to become effective and may not be effective sooner than the effective date of this edition of the *California Building Standards Code.* Local building standards that were adopted and applicable to previous editions of the *California Building Standards Code* do not apply to this edition without appropriate adoption and the required filing.

Should you find publication (e.g., typographical) errors or inconsistencies in this code or wish to offer comments toward improving its format, please address your comments to:

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ACKNOWLEDGEMENTS

The 2013 *California Building Standards Code* (Code) was developed through the outstanding collaborative efforts of the Department of Housing and Community Development, the Division of State Architect, the Office of the State Fire Marshal, the Office of Statewide Health Planning and Development, the California Energy Commission, the California Department of Public Health, the California State Lands Commission, the Board of State and Community Corrections, and the California Building Standards Commission (Commission).

This collaborative effort included the assistance of the Commission's Code Advisory Committees and many other volunteers who worked tirelessly to assist the Commission in the production of this Code.

Governor Edmund G. Brown Jr.

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For questions on California state agency amendments, please refer to the contact list on the following page.

CALIFORNIA CODE OF REGULATIONS, TITLE 24

California Agency Information Contact List

Board of State and Community Corrections

www.bscc.ca.gov . . . . . (916) 445-5073
Local Adult Jail Standards
Local Juvenile Facility Standards

California Building Standards Commission

www.bsc.ca.gov . . . . . (916) 263-0916

California Energy Commission

*www.energy.ca.gov . . . . . **Energy Hotline** (800) 772-3300*
Building Efficiency Standards
Appliance Efficiency Standards
Compliance Manual/Forms

California State Lands Commission

www.slc.ca.gov . . . . . (562) 499-6312
Marine Oil Terminals

California State Library

www.library.ca.gov . . . . . (916) 654-0266

Department of Consumer Affairs:

Acupuncture Board
www.acupuncture.ca.gov . . . . . (916) 515-5200
Office Standards

Board of Pharmacy
www.pharmacy.ca.gov . . . . . (916) 574-7900
Pharmacy Standards

Bureau of Barbering and Cosmetology
www.barbercosmo.ca.gov . . . . . (916) 952-5210
Barber and Beauty Shop, and College Standards

Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation
www.bearhfti.ca.gov . . . . . (916) 999-2041
Insulation Testing Standards

Structural Pest Control Board
www.pestboard.ca.gov . . . . . (800) 737-8188
Structural Standards

Veterinary Medical Board
www.vmb.ca.gov . . . . . (916) 263-2610
Veterinary Hospital Standards

Department of Food and Agriculture

www.cdfa.ca.gov
Meat & Poultry Packing Plant Standards (916) 654-0509
Dairy Standards (916) 654-0773

Department of Housing and Community Development

www.hcd.ca.gov . . . . . (916) 445-9471

Residential- Hotels, Motels, Apartments, Single-Family Dwellings; and Permanent Structures in Mobilehome & Special Occupancy Parks

(916) 445-3338
Factory-Built Housing, Manufactured Housing & Commercial Modular

Mobilehome- Permits & Inspections
Northern Region–(916) 255-2501
Southern Region–(951) 782-4420

(916) 445-9471
Employee Housing Standards

Department of Public Health

www.dph.ca.gov . . . . . (916) 449-5661

Organized Camps Standards
Public Swimming Pools Standards

Division of the State Architect

www.dgs.ca.gov/dsa . . . . . (916) 445-8100

Access Compliance

Structural Safety

Public Schools Standards
Essential Services Building Standards
Community College Standards

State Historical Building Safety Board

Alternative Building Standards

Office of Statewide Health Planning and Development

www.oshpd.ca.gov . . . . . (916) 440-8356

Hospital Standards
Skilled Nursing Facility Standards & Clinic Standards
Permits

Office of the State Fire Marshal

osfm.fire.ca.gov . . . . . (916) 445-8200

Code Development and Analysis
Fire Safety Standards

CHAPTER 16
STRUCTURAL DESIGN

SECTION 1601
GENERAL

1601.1 Scope. The provisions of this chapter shall govern the structural design of buildings, structures and portions thereof regulated by this code.

1601.1.1 Application. [DSA-SS/CC] *The scope of application of Chapter 16 is as follows:*

Community college buildings regulated by the Division of the State Architect-Structural Safety/Community Colleges (DSA-SS/CC), as listed in Section 1.9.2.2.

1601.1.2 Identification of amendments. [DSA-SS/CC] *Division of the State Architect-Structural Safety/Community Colleges (DSA-SS/CC) amendments appear in this chapter preceded with the appropriate acronym, as follows:*

Division of the State Architect - Structural Safety/ Community Colleges: ***[DSA-SS/CC]*** *- For community college buildings listed in Section 1.9.2.2*

1601.1.3 Reference to other chapters. [DSA-SS/CC] *Where reference within this chapter is made to sections in Chapters 17 and 18, the provisions in Chapters 17A and 18A respectively shall apply instead.*

1601.1.4 Amendments. [DSA-SS/CC] *See Section 1616 for additional requirements.*

1601.2 Enforcement agency approval. [DSA-SS/CC, OSHPD 2] *In addition to requirements of the California Administrative Code and the California Building Code, any aspect of project design, construction, quality assurance or quality control programs for which this code requires approval by the design professional, are also subject to approval by the enforcement agency.*

SECTION 1602
DEFINITIONS AND NOTATIONS

1602.1 Definitions. The following terms are defined in Chapter 2:

ALLOWABLE STRESS DESIGN.

DEAD LOADS.

DESIGN STRENGTH.

DIAPHRAGM.

Diaphragm, blocked.

Diaphragm boundary.

Diaphragm chord.

Diaphragm flexible.

Diaphragm, rigid.

DURATION OF LOAD.

ENFORCEMENT AGENT. [OSHPD 2] *That individual within the agency or organization charged with responsibility for agency or organization compliance with the requirements of this code. Used interchangeably with "Building Official" or "Code Official."*

ESSENTIAL FACILITIES.

FABRIC PARTITION.

FACTORED LOAD.

HELIPAD.

ICE-SENSITIVE STRUCTURE.

IMPACT LOAD.

LIMIT STATE.

LIVE LOAD.

LIVE LOAD (ROOF).

LOAD AND RESISTANCE FACTOR DESIGN (LRFD).

LOAD EFFECTS.

LOAD FACTOR.

LOADS.

NOMINAL LOADS.

OTHER STRUCTURES.

PANEL (PART OF A STRUCTURE).

RESISTANCE FACTOR.

RISK CATEGORY.

STRENGTH, NOMINAL.

STRENGTH, REQUIRED.

STRENGTH DESIGN.

SUSCEPTIBLE BAY.

VEHICLE BARRIER.

NOTATIONS.

D = Dead load.

D_i = Weight of ice in accordance with Chapter 10 of ASCE 7.

E = Combined effect of horizontal and vertical earthquake induced forces as defined in Section 12.4.2 of ASCE 7.

F = Load due to fluids with well-defined pressures and maximum heights.

F_a = Flood load in accordance with Chapter 5 of ASCE 7.

H = Load due to lateral earth pressures, ground water pressure or pressure of bulk materials.

L = Roof live load greater than 20 psf (0.96 kN/m^2) and floor live load.

L_r = Roof live load of 20 psf (0.96 kN/m^2) or less.

R = Rain load.

S = Snow load.

T = Self-straining load.

V_{asd} = Nominal design wind speed (3-second gust), miles per hour (mph) (km/hr) where applicable.

V_{ult} = Ultimate design wind speeds (3-second gust), miles per hour (mph) (km/hr) determined from Figures 1609A, 1609B, or 1609C or ASCE 7.

W = Load due to wind pressure.

W_i = Wind-on-ice in accordance with Chapter 10 of ASCE 7.

SECTION 1603
CONSTRUCTION DOCUMENTS

1603.1 General. Construction documents shall show the size, section and relative locations of structural members with floor levels, column centers and offsets dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.9 shall be indicated on the construction documents.

Exception: Construction documents for buildings constructed in accordance with the conventional light-frame construction provisions of Section 2308 shall indicate the following structural design information:

1. Floor and roof live loads.
2. Ground snow load, P_g.
3. Ultimate design wind speed, V_{ult}, (3-second gust), miles per hour (mph) (km/hr) and nominal design wind speed, V_{asd}, as determined in accordance with Section 1609.3.1 and wind exposure.
4. Seismic design category and site class.
5. Flood design data, if located in flood hazard areas established in Section 1612.3.
6. Design load-bearing values of soils.

[OSHPD 2] *Additional requirements are included in Sections 7-115 and 7-125 of the California Administrative Code (Part 1, Title 24, C.C.R).*

1603.1.1 Floor live load. The uniformly distributed, concentrated and impact floor live load used in the design shall be indicated for floor areas. Use of live load reduction in accordance with Section 1607.10 shall be indicated for each type of live load used in the design.

1603.1.2 Roof live load. The roof live load used in the design shall be indicated for roof areas (Section 1607.12).

1603.1.3 Roof snow load data. The ground snow load, P_g, shall be indicated. In areas where the ground snow load, P_g, exceeds 10 pounds per square foot (psf) (0.479 kN/m^2), the following additional information shall also be provided, regardless of whether snow loads govern the design of the roof:

1. Flat-roof snow load, P_f.
2. Snow exposure factor, C_e.
3. Snow load importance factor, I.
4. Thermal factor, C_t.

1603.1.4 Wind design data. The following information related to wind loads shall be shown, regardless of whether wind loads govern the design of the lateral force-resisting system of the structure:

1. Ultimate design wind speed, V_{ult}, (3-second gust), miles per hour (km/hr) and nominal design wind speed, V_{asd}, as determined in accordance with Section 1609.3.1.
2. Risk category.
3. Wind exposure.Where more than one wind exposure is utilized, the wind exposure and applicable wind direction shall be indicated.
4. The applicable internal pressure coefficient.
5. Components and cladding. The design wind pressures in terms of psf (kN/m^2) to be used for the design of exterior component and cladding materials not specifically designed by the registered design professional.

1603.1.5 Earthquake design data. The following information related to seismic loads shall be shown, regardless of whether seismic loads govern the design of the lateral force-resisting system of the structure:

1. Risk category.
2. Seismic importance factor, I_e.
3. Mapped spectral response acceleration parameters, S_S and S_1.
4. Site class.
5. Design spectral response acceleration parameters, S_{DS} and S_{D1}.
6. Seismic design category.
7. Basic seismic force-resisting system(s).
8. Design base shear(s).
9. Seismic response coefficient(s), C_S.
10. Response modification coefficient(s), R.
11. Analysis procedure used.

1603.1.6 Geotechnical information. The design load-bearing values of soils shall be shown on the construction documents.

1603.1.7 Flood design data. For buildings located in whole or in part in flood hazard areas as established in Section 1612.3, the documentation pertaining to design, if required in Section 1612.5, shall be included and the following information, referenced to the datum on the community's Flood Insurance Rate Map (FIRM), shall be shown, regardless of whether flood loads govern the design of the building:

1. In flood hazard areas not subject to high-velocity wave action, the elevation of the proposed lowest floor, including the basement.
2. In flood hazard areas not subject to high-velocity wave action, the elevation to which any nonresidential building will be dry flood proofed.

TABLE 1607.1—continued
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[g]

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
32. Stores		
Retail		
First floor	100	1,000
Upper floors	75	1,000
Wholesale, all floors	125[m]	1,000
33. Vehicle barriers	See Section 1607.8.3	
34. Walkways and elevated platforms (other than exitways)	60	—
35. Yards and terraces, pedestrians	100[m]	—
36. [OSHPD 2] Storage racks and wall-hung cabinets.	*Total loads[n]*	—

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kN/m^2, 1 pound = 0.004448 kN, 1 pound per cubic foot = 16 kg/m^3.

a. Floors in garages or portions of buildings used for the storage of motor vehicles shall be designed for the uniformly distributed live loads of Table 1607.1 or the following concentrated loads: (1) for garages restricted to passenger vehicles accommodating not more than nine passengers, 3,000 pounds acting on an area of 4.5 inches by 4.5 inches; (2) for mechanical parking structures without slab or deck that are used for storing passenger vehicles only, 2,250 pounds per wheel.

b. The loading applies to stack room floors that support nonmobile, double-faced library book stacks, subject to the following limitations:
   1. The nominal bookstack unit height shall not exceed 90 inches;
   2. The nominal shelf depth shall not exceed 12 inches for each face; and
   3. Parallel rows of double-faced book stacks shall be separated by aisles not less than 36 inches wide.

c. Design in accordance with ICC 300.

d. Other uniform loads in accordance with an approved method containing provisions for truck loadings shall also be considered where appropriate.

e. The concentrated wheel load shall be applied on an area of 4.5 inches by 4.5 inches.

f. The minimum concentrated load on stair treads shall be applied on an area of 2 inches by 2 inches. This load need not be assumed to act concurrently with the uniform load.

g. Where snow loads occur that are in excess of the design conditions, the structure shall be designed to support the loads due to the increased loads caused by drift buildup or a greater snow design determined by the building official (see Section 1608).

h. See Section 1604.8.3 for decks attached to exterior walls.

i. Uninhabitable attics without storage are those where the maximum clear height between the joists and rafters is less than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

j. Uninhabitable attics with storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.

   The live load need only be applied to those portions of the joists or truss bottom chords where both of the following conditions are met:
   i. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches; and
   ii. The slopes of the joists or truss bottom chords are no greater than two units vertical in 12 units horizontal.

   The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb./ft^2.

k. Attic spaces served by stairways other than the pull-down type shall be designed to support the minimum live load specified for habitable attics and sleeping rooms.

TABLE 1607.1—continued
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[g]

l. Areas of occupiable roofs, other than roof gardens and assembly areas, shall be designed for appropriate loads as approved by the building official. Unoccupied landscaped areas of roofs shall be designed in accordance with Section 1607.12.3.

m. Live load reduction is not permitted unless specific exceptions of Section 1607.10 apply.

n. [OSHPD] The minimum vertical design live load shall be as follows:

Paper media:

12-inch-deep (305 mm) shelf 33 pounds per lineal foot (482 N/m)

15-inch-deep (381 mm) shelf 41 pounds per lineal foot (598 N/m), or 33 pounds per cubic foot (5183 N/m^3) per total volume of the rack or cabinet, whichever is less.

Film media:

18-inch-deep (457 mm) shelf 100 pounds per lineal foot (1459 N/m), or 50 pounds per cubic foot (7853 N/m3) per total volume of the rack or cabinet, whichever is less.

Other media:

20 pounds per cubic foot (311 N/m^3) or 20 pounds per square foot (958 Pa), whichever is less, but not less than actual loads.

1607.5 Partition loads. In office buildings and in other buildings where partition locations are subject to change, provisions for partition weight shall be made, whether or not partitions are shown on the construction documents, unless the specified live load exceeds 80 psf (3.83 kN/m^2). The partition load shall not be less than a uniformly distributed live load of 15 psf (0.72 kN/m^2).

1607.6 Helipads. Helipads shall be designed for the following live loads:

1. A uniform live load, L, as specified below. This load shall not be reduced.
   1.1. 40 psf (1.92 kN/m^2) where the design basis helicopter has a maximum take-off weight of 3,000 pounds (13.35 kN) or less.
   1.2. 60 psf (2.87 kN/m^2) where the design basis helicopter has a maximum take-off weight greater than 3,000 pounds (13.35 kN).
2. A single concentrated live load, L, of 3,000 pounds (13.35 kN) applied over an area of 4.5 inches by 4.5 inches (114 mm by 114 mm) and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated load is not required to act concurrently with other uniform or concentrated live loads.
3. Two single concentrated live loads, L, 8 feet (2438 mm) apart applied on the landing pad (representing the helicopter's two main landing gear, whether skid type or wheeled type), each having a magnitude of 0.75 times the maximum take-off weight of the helicopter, and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated loads shall be applied over an area of 8 inches by 8 inches (203 mm by 203 mm) and are not required to act concurrently with other uniform or concentrated live loads.

Landing areas designed for a design basis helicopter with maximum take-off weight of 3,000 pounds (13.35 kN) shall be identified with a 3,000 pound (13.34 kN) weight limita-

tion. The landing area weight limitation shall be indicated by the numeral "3" (kips) located in the bottom right corner of the landing area as viewed from the primary approach path. The indication for the landing area weight limitation shall be a minimum 5 feet (1524 mm) in height.

1607.7 Heavy vehicle loads. Floors and other surfaces that are intended to support vehicle loads greater than a 10,000 pound (4536 kg) gross vehicle weight rating shall comply with Sections 1607.7.1 through 1607.7.5.

1607.7.1 Loads. Where any structure does not restrict access for vehicles that exceed a 10,000-pound (4536 kg) gross vehicle weight rating, those portions of the structure subject to such loads shall be designed using the vehicular live loads, including consideration of impact and fatigue, in accordance with the codes and specifications required by the jurisdiction having authority for the design and construction of the roadways and bridges in the same location of the structure.

1607.7.2 Fire truck and emergency vehicles. Where a structure or portions of a structure are accessed and loaded by fire department access vehicles and other similar emergency vehicles, the structure shall be designed for the greater of the following loads:

1. The actual operational loads, including outrigger reactions and contact areas of the vehicles as stipulated and approved by the building official; or
2. The live loading specified in Section 1607.7.1.

1607.7.3 Heavy vehicle garages. Garages designed to accommodate vehicles that exceed a 10,000 pound (4536 kg) gross vehicle weight rating, shall be designed using the live loading specified by Section 1607.7.1. For garages the design for impact and fatigue is not required.

Exception: The vehicular live loads and load placement are allowed to be determined using the actual vehicle weights for the vehicles allowed onto the garage floors, provided such loads and placement are based on rational engineering principles and are approved by the building official, but shall not be less than 50 psf (2.9 kN/m^2). This live load shall not be reduced.

1607.7.4 Forklifts and movable equipment. Where a structure is intended to have forklifts or other movable equipment present, the structure shall be designed for the total vehicle or equipment load and the individual wheel loads for the anticipated vehicles as specified by the owner of the facility. These loads shall be posted per Section 1607.7.5.

1607.7.4.1 Impact and fatigue. Impact loads and fatigue loading shall be considered in the design of the supporting structure. For the purposes of design, the vehicle and wheel loads shall be increased by 30 percent to account for impact.

1607.7.5 Posting. The maximum weight of the vehicles allowed into or on a garage or other structure shall be posted by the owner in accordance with Section 106.1.

1607.8 Loads on handrails, guards, grab bars, *shower* seats, *dressing room bench seats* and vehicle barriers. Handrails, guards, grab bars, accessible seats, accessible benches and vehicle barriers shall be designed and constructed to the structural loading conditions set forth in this section.

1607.8.1 Handrails and guards. Handrails and guards shall be designed to resist a linear load of 50 pounds per linear foot (plf) (0.73 kN/m) in accordance with Section 4.5.1 of ASCE 7. Glass handrail assemblies and guards shall also comply with Section 2407.

Exceptions:

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.8.1.1 shall be applied.
2. In Group I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load less than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

1607.8.1.1 Concentrated load. Handrails and guards shall also be designed to resist a concentrated load of 200 pounds (0.89 kN) in accordance with Section 4.5.1 of ASCE 7.

1607.8.1.2 Intermediate rails. Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to resist a concentrated load of 50 pounds (0.22 kN) in accordance with Section 4.5.1 of ASCE 7.

1607.8.2 Grab bars, shower seats and dressing room bench seats. Grab bars, shower seats and dressing room bench seat systems shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point on the grab bar or seat so as to produce the maximum load effects. ***(DSA-AC & HCD 1-AC)*** *See Chapter 11A, Section 1127A.4, Chapter 11B, Sections 11B-609.8, 11B-610.4 and 11B-903.6 for grab bars, shower seats and dressing room bench seats, as applicable.*

1607.8.3 Vehicle barriers. Vehicle barriers for passenger vehicles shall be designed to resist a concentrated load of 6,000 pounds (26.70 kN) in accordance with Section 4.5.3 of ASCE 7. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provisions for traffic railings.

1607.9 Impact loads. The live loads specified in Sections 1607.3 through 1607.8 shall be assumed to include adequate allowance for ordinary impact conditions. Provisions shall be made in the structural design for uses and loads that involve unusual vibration and impact forces.

1607.9.1 Elevators. Members, elements and components subject to dynamic loads from elevators shall be designed for impact loads and deflection limits prescribed by ASME A17.1.

1607.9.2 Machinery. For the purpose of design, the weight of machinery and moving loads shall be increased as follows to allow for impact: (1) light machinery, shaft- or motor-driven, 20 percent; and (2) reciprocating machinery or power-driven units, 50 percent. Percentages shall be increased where specified by the manufacturer.

to Seismic Design Category A and to Section 12.11 of ASCE 7 for walls of structures assigned to all other seismic design categories. *For anchorage of concrete or masonry walls to roof and floor diaphragms, the out-of-plane strength design force shall not be less than 280 lb/linear ft (4.09 kN/m) of wall.* Required anchors in masonry walls of hollow units or cavity walls shall be embedded in a reinforced grouted structural element of the wall. See Sections 1609*A* for wind design requirements and 1613*A* for earthquake design requirements.

1604*A*.8.3 Decks. Where supported by attachment to an exterior wall, decks shall be positively anchored to the primary structure and designed for both vertical and lateral loads as applicable. Such attachment shall not be accomplished by the use of toenails or nails subject to withdrawal. Where positive connection to the primary building structure cannot be verified during inspection, decks shall be self-supporting. Connections of decks with cantilevered framing members to exterior walls or other framing members shall be designed for both of the following:

1. The reactions resulting from the dead load and live load specified in Table 1607*A*.1, or the snow load specified in Section 1608A, in accordance with Section 1605A, acting on all portions of the deck.
2. The reactions resulting from the dead load and live load specified in Table 1607*A*.1, or the snow load specified in Section 1608*A*, in accordance with Section 1605*A*, acting on the cantilevered portion of the deck, and no live load or snow load on the remaining portion of the deck.

1604*A*.9 Counteracting structural actions. Structural members, systems, components and cladding shall be designed to resist forces due to earthquake and wind, with consideration of overturning, sliding and uplift. Continuous load paths shall be provided for transmitting these forces to the foundation. Where sliding is used to isolate the elements, the effects of friction between sliding elements shall be included as a force.

1604*A*.10 Wind and seismic detailing. Lateral-force-resisting systems shall meet seismic detailing requirements and limitations prescribed in this code and ASCE 7, excluding Chapter 14 and Appendix 11A, even when wind load effects are greater than seismic load effects.

SECTION 1605*A*
LOAD COMBINATIONS

1605*A*.1 General. Buildings and other structures and portions thereof shall be designed to resist:

1. The load combinations specified in Section 1605*A*.2, 1605*A*.3.1 or 1605*A*.3.2,
2. The load combinations specified in Chapters 18 through 23, and
3. The seismic load effects including overstrength factor in accordance with Section 12.4.3 of ASCE 7 where required by Section 12.2.5.2, 12.3.3.3 or 12.10.2.1 of ASCE 7. With the simplified procedure of ASCE 7 Section 12.14, the seismic load effects including overstrength factor in accordance with Section 12.14.3.2 of ASCE 7 shall be used.

Applicable loads shall be considered, including both earthquake and wind, in accordance with the specified load combinations. Each load combination shall also be investigated with one or more of the variable loads set to zero.

Where the load combinations with overstrength factor in Section 12.4.3.2 of ASCE 7 apply, they shall be used as follows:

1. The basic combinations for strength design with overstrength factor in lieu of Equations 16-5 and 16-7 in Section 1605*A*.2.
2. The basic combinations for allowable stress design with overstrength factor in lieu of Equations 16-12, 16-14 and 16-16 in Section 1605*A*.3.1.
3. The basic combinations for allowable stress design with overstrength factor in lieu of Equations 16-21 and 16-22 in Section 1605*A*.3.2.

1605*A*.1.1 Stability. Regardless of which load combinations are used to design for strength, where overall structure stability (such as stability against overturning, sliding, or buoyancy) is being verified, use of the load combinations specified in Section 1605*A*.2 or 1605*A*.3 shall be permitted. Where the load combinations specified in Section 1605*A*.2 are used, strength reduction factors applicable to soil resistance shall be provided by a registered design professional. The stability of retaining walls shall be verified in accordance with Section 1807*A*.2.3. *When using allowable stress design, factor of safety for soil bearing values shall not be less than the overstrength factor of the structures supported.*

1605A.2 Load combinations using strength design or load and resistance factor design. Where strength design or load and resistance factor design is used, buildings and other structures, and portions thereof, shall be designed to resist the most critical effects resulting from the following combinations of factored loads:

$1.4(D + F)$ **(Equation 16*A*-1)**

$1.2(D + F) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-2)**

$1.2(D + F) + 1.6(L_r \text{ or } S \text{ or } R) + 1.6H + (f_1 L \text{ or } 0.5W)$ **(Equation 16*A*-3)**

$1.2(D + F) + 1.0W + f_1 L + 1.6H + 0.5(L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-4)**

$1.2(D + F) + 1.0E + f_1 L + 1.6H + f_2 S$ **(Equation 16*A*-5)**

$0.9D + 1.0W + 1.6H$ **(Equation 16*A*-6)**

$0.9(D + F) + 1.0E + 1.6H$ **(Equation 16*A*-7)**

where:

f_1 = 1 for places of public assembly live loads in excess of 100 pounds per square foot (4.79 kN/m^2), and parking garages; and 0.5 for other live loads.

f_2 = 0.7 for roof configurations (such as saw tooth) that do not shed snow off the structure, and 0.2 for other roof configurations.

Exceptions:

1. Where other factored load combinations are specifically required by other provisions of this code, such combinations shall take precedence.
2. Where the effect of H resists the primary variable load effect, a load factor of 0.9 shall be included with H where H is permanent and H shall be set to zero for all other conditions.

1605*A*.2.1 Other loads. Where flood loads, F_a, are to be considered in the design, the load combinations of Section 2.3.3 of ASCE 7 shall be used. Where self-straining loads, T, are considered in design, their structural effects in combination with other loads shall be determined in accordance with Section 2.3.5 of ASCE 7. Where an ice-sensitive structure is subjected to loads due to atmospheric icing, the load combinations of Section 2.3.4 of ASCE 7 shall be considered.

1605*A*.3 Load combinations using allowable stress design.

1605*A*.3.1 Basic load combinations. Where allowable stress design (working stress design), as permitted by this code, is used, structures and portions thereof shall resist the most critical effects resulting from the following combinations of loads:

$D + F$ **(Equation 16*A*-8)**

$D + H + F + L$ **(Equation 16*A*-9)**

$D + H + F + (L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-10)**

$D + H + F + 0.75(L) + 0.75(L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-11)**

$D + H + F + (0.6W \text{ or } 0.7E)$ **(Equation 16*A*-12)**

$D + H + F + 0.75(0.6W) + 0.75L + 0.75(L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-13)**

$D + H + F + 0.75\,(0.7\,E) + 0.75\,L + 0.75\,S$ **(Equation 16*A*-14)**

$0.6D + 0.6W + H$ **(Equation 16*A*-15)**

$0.6(D + F) + 0.7E + H$ **(Equation 16*A*-16)**

Exceptions:

1. Crane hook loads need not be combined with roof live load or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 psf (1.44 kN/m^2) or less and roof live loads of 30 psf or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 psf (1.44 kN/m^2), 20 percent shall be combined with seismic loads.
3. Where the effect of H resists the primary variable load effect, a load factor of 0.6 shall be included with H where H is permanent and H shall be set to zero for all other conditions.
4. In Equation 16-15, the wind load, W, is permitted to be reduced in accordance with Exception 2 of Section 2.4.1 of ASCE 7.
5. In Equation 16-16, 0.6 D is permitted to be increased to 0.9 D for the design of special reinforced masonry shear walls complying with Chapter 21.

1605*A*.3.1.1 Stress increases. Increases in allowable stresses specified in the appropriate material chapter or the referenced standards shall not be used with the load combinations of Section 1605*A*.3.1, except that increases shall be permitted in accordance with Chapter 23.

1605*A*.3.1.2 Other loads. Where flood loads, F_a, are to be considered in design, the load combinations of Section 2.4.2 of ASCE 7 shall be used. Where self-straining loads, T, are considered in design, their structural effects in combination with other loads shall be determined in accordance with Section 2.4.4 of ASCE 7. Where an ice-sensitive structure is subjected to loads due to atmospheric icing, the load combinations of Section 2.4.3 of ASCE 7 shall be considered.

1605*A*.3.2 Alternative basic load combinations. In lieu of the basic load combinations specified in Section 1605.3.1, structures and portions thereof shall be permitted to be designed for the most critical effects resulting from the following combinations. When using these alternative basic load combinations that include wind or seismic loads, allowable stresses are permitted to be increased or load combinations reduced where permitted by the material chapter of this code or the referenced standards. For load combinations that include the counteracting effects of dead and wind loads, only two-thirds of the minimum dead load likely to be in place during a design wind event shall be used. When using allowable stresses which have been increased or load combinations which have been reduced as permitted by the material chapter of this code or the referenced standards, where wind loads are calculated in accordance with Chapters 26 through 31 of ASCE 7, the coefficient (ω) in the following equations shall be taken as 1.3. For other wind loads, (ω) shall be taken as 1. When allowable stresses have not been increased or load combinations have not been reduced as permitted by the material chapter of this code or the referenced standards, (ω) shall be taken as 1. When using these alternative load combinations to evaluate sliding, overturning and soil bearing at the soil-structure interface, the reduction of foundation overturning from Section 12.13.4 in ASCE 7 shall not be used. When using these alternative basic load combinations for proportioning foundations for loadings, which include seismic loads, the vertical seismic load effect, E_v, in Equation 12.4-4 of ASCE 7 is permitted to be taken equal to zero.

$D + L + (L_r \text{ or } S \text{ or } R)$ **(Equation 16*A*-17)**

$D + L + 0.6\,\omega W$ **(Equation 16*A*-18**

$D + L + 0.6\,\omega W + S/2$ **(Equation 16*A*-19)**

$D + L + S + 0.6\,\omega W/2$ **(Equation 16*A*-20)**

$D + L + S + E/1.4$ **(Equation 16*A*-21)**

$0.9D + E/1.4$ **(Equation 16*A*-22)**

Exceptions:

1. Crane hook loads need not be combined with roof live loads or with more than three-fourths of the snow load or one-half of the wind load.
2. Flat roof snow loads of 30 psf (1.44 kN/m^2) or less and roof live loads of 30 psf or less need not be combined with seismic loads. Where flat roof snow loads exceed 30 psf (1.44 kN/m^2), 20 percent shall be combined with seismic loads.

1605*A*.3.2.1 Other loads. Where *F*, *H* or *T* are to be considered in the design, each applicable load shall be added to the combinations specified in Section 1605*A*.3.2. Where self-straining loads, *T*, are considered in design, their structural effects in combination with other loads shall be determined in accordance with Section 2.4.4 of ASCE 7..

SECTION 1606*A*
DEAD LOADS

1606*A*.1 General. Dead loads are those loads defined in Section 1602*A*.1. Dead loads shall be considered permanent loads.

1606*A*.2 Design dead load. For purposes of design, the actual weights of materials of construction and fixed service equipment shall be used. In the absence of definite information, values used shall be subject to the approval of the building official.

1606A.3 Roof dead loads. *The design dead load shall provide for the weight of at least one additional roof covering in addition to other applicable loadings if the new roof covering is permitted to be applied over the original roofing without its removal, in accordance with Section 1510.*

SECTION 1607*A*
LIVE LOADS

1607*A*.1 General. Live loads are those loads defined in Section 1602*A*.1.

1607*A*.2 Loads not specified. For occupancies or uses not designated in Table 1607*A*.1, the live load shall be determined in accordance with a method approved by the building official.

1607*A*.3 Uniform live loads. The live loads used in the design of buildings and other structures shall be the maximum loads expected by the intended use or occupancy but shall in no case be less than the minimum uniformly distributed live loads given in Table 1607*A*.1.

1607*A*.4 Concentrated live loads. Floors and other similar surfaces shall be designed to support the uniformly distributed live loads prescribed in Section 1607*A*.3 or the concentrated live loads, in pounds (kiloNewtons), given in Table 1607*A*.1, whichever produces the greater load effects. Unless otherwise specified, the indicated concentration shall be assumed to be uniformly distributed over an area of $2^1/_2$ feet by $2^1/_2$ feet (762 mm by 762 mm) and shall be located so as to produce the maximum load effects in the structural members.

1607*A*.5 Partition loads. In office buildings and in other buildings where partition locations are subject to change, provisions for partition weight shall be made, whether or not partitions are shown on the construction documents, unless the specified live load exceeds 80 psf (3.83 kN/m^2). The partition load shall not be less than a uniformly distributed live load of 15 psf (0.74 kN/m^2).

1607*A*.6 Helipads. Helipads shall be designed for the following live loads:

1. A uniform live load, *L*, as specified below. This load shall not be reduced.
   1.1. 40 psf (1.92 kN/m^2) where the design basis helicopter has a maximum take-off weight of 3,000 pounds (13.35 kN) or less.
   1.2. 60 psf (2.87 kN/m^2) where the design basis helicopter has a maximum take-off weight greater than 3,000 pounds (13.35 kN).
2. A single concentrated live load, *L*, of 3,000 pounds (13.35 kN) applied over an area of 4.5 inches by 4.5 inches (114 mm by 114 mm) and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated load is not required to act concurrently with other uniform or concentrated live loads.
3. Two single concentrated live loads, *L*, 8 feet (2438 mm) apart applied on the landing pad (representing the helicopter's two main landing gear, whether skid type or wheeled type), each having a magnitude of 0.75 times the maximum take-off weight of the helicopter, and located so as to produce the maximum load effects on the structural elements under consideration. The concentrated loads shall be applied over an area of 8 inches by 8 inches (203 mm by 203 mm) and are not required to act concurrently with other uniform or concentrated live loads.

Landing areas designed for a design basis helicopter with maximum take-off weight of 3,000 pounds (13.35 kN) shall be identified with a 3,000 pound (13.34 kN) weight limitation. The landing area weight limitation shall be indicated by the numeral "3" (kips) located in the bottom right corner of the landing area as viewed from the primary approach path. The indication for the landing area weight limitation shall be a minimum 5 feet (1524 mm) in height.

1607*A*.7 Heavy vehicle loads. Floors and other surfaces that are intended to support vehicle loads greater than a 10,000 pound (4536 kg) gross vehicle weight rating shall comply with Sections 1607*A*.7.1 through 1607*A*.7.5.

1607*A*.7.1 Loads. Where any structure does not restrict access for vehicles that exceed a 10,000-pound (4536 kg) gross vehicle weight rating, those portions of the structure subject to such loads shall be designed using the vehicular live loads, including consideration of impact and fatigue,

in accordance with the codes and specifications required by the jurisdiction having authority for the design and construction of the roadways and bridges in the same location of the structure.

1607*A*.7.2 Fire truck and emergency vehicles. Where a structure or portions of a structure are accessed and loaded by fire department access vehicles and other similar emergency vehicles, the structure shall be designed for the greater of the following loads:

1. The actual operational loads, including outrigger reactions and contact areas of the vehicles as stipulated and approved by the building official; or
2. The live loading specified in Section 1607*A*.7.1.

1607*A*.7.3 Heavy vehicle garages. Garages designed to accommodate vehicles that exceed a 10,000 pound (4536 kg) gross vehicle weight rating, shall be designed using the live loading specified by Section 1607*A*.7.1. For garages the design for impact and fatigue is not required.

Exception: The vehicular live loads and load placement are allowed to be determined using the actual vehicle weights for the vehicles allowed onto the garage floors, provided such loads and placement are based on rational engineering principles and are approved by the building official, but shall not be less than 50 psf (2.9 kN/m^2). This live load shall not be reduced.

1607*A*.7.4 Forklifts and movable equipment. Where a structure is intended to have forklifts or other movable equipment present, the structure shall be designed for the total vehicle or equipment load and the individual wheel loads for the anticipated vehicles as specified by the owner of the facility. These loads shall be posted per Section 1607*A*.7.5.

1607*A*.7.4.1 Impact and fatigue. Impact loads and fatigue loading shall be considered in the design of the supporting structure. For the purposes of design, the vehicle and wheel loads shall be increased by 30 percent to account for impact.

1607*A*.7.5 Posting. The maximum weight of the vehicles allowed into or on a garage or other structure shall be posted by the owner in accordance with Section 106*A*.1.

1607*A*.8 Loads on handrails, guards, grab bars, seats and vehicle barriers. Handrails, guards, grab bars, accessible seats, accessible benches and vehicle barriers shall be designed and constructed to the structural loading conditions set forth in this section.

1607*A*.8.1 Handrails and guards. Handrails and guards shall be designed to resist a linear load of 50 pounds per linear foot (plf) (0.73 kN/m) in accordance with Section 4.5.1 of ASCE 7. Glass handrail assemblies and guards shall also comply with Section 2407*A*.

Exceptions:

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607*A*.8.1.1 shall be applied.
2. In Group I-3, F, H and S occupancies, for areas that are not accessible to the general public and that have an occupant load less than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).

1607*A*.8.1.1 Concentrated load. Handrails and guards shall also be designed to resist a concentrated load of 200 pounds (0.89 kN) in accordance with Section 4.5.1 of ASCE 7.

1607*A*.8.1.2 Intermediate rails. Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to resist a concentrated load of 50 pounds (0.22 kN) in accordance with Section 4.5.1 of ASCE 7.

1607*A*.8.2 Grab bars, shower seats and dressing room bench seats. Grab bars, shower seats and dressing room bench seat systems shall be designed to resist a single concentrated load of 250 pounds (1.11 kN) applied in any direction at any point on the grab bar or seat so as to produce the maximum load effects. *[DSA-AC] See Chapter 11A, Section 1127A.4, and Chapter 11B, Sections 11B-609.8, 11B-610.4 and 11B-903.6 for grab bars, shower seats and dressing room bench seats, as applicable.*

1607*A*.8.3 Vehicle barriers. Vehicle barriers for passenger vehicles shall be designed to resist a concentrated load of 6,000 pounds (26.70 kN) in accordance with Section 4.5.3 of ASCE 7. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provisions for traffic railings.

1607*A*.9 Impact loads. The live loads specified in Sections 1607*A*.3 through 1607*A*.8 shall be assumed to include adequate allowance for ordinary impact conditions. Provisions shall be made in the structural design for uses and loads that involve unusual vibration and impact forces.

1607*A*.9.1 Elevators. Members, elements and components subject to dynamic loads from elevators shall be designed for impact loads and deflection limits prescribed by ASME A17.1.

1607*A*.9.2 Machinery. For the purpose of design, the weight of machinery and moving loads shall be increased as follows to allow for impact: (1) light machinery, shaft- or motor-driven, 20 percent; and (2) reciprocating machinery or power-driven units, 50 percent. Percentages shall be increased where specified by the manufacturer.

TABLE 1607*A*.1
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[g]

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
1. Apartments (see residential)	—	—
2. Access floor systems		
Office use	50	2,000
Computer use	100	2,000
3. Armories and drill rooms	150 [m]	—
4. Assembly areas [o, q]		
Fixed seats (fastened to floor)	60 [m]	
Follow spot, projections and control rooms	50	
Lobbies	100 [m]	—
Movable seats	100 [m]	
Stage floors	150 [m]	
Platforms (assembly)	100 [m]	
Other assembly areas	100 [m]	
5. Balconies and decks[h]	Same as occupancy served	—
6. Catwalks	40	300
7. Cornices	60	—
8. Corridors		
First floor	100	
Other floors	Same as occupancy served except as indicated	—
9. Dining rooms and restaurants	100 [m]	—
10. Dwellings (see residential)	—	—
11. Elevator machine room grating (on area of 2 inches by 2 inches)	—	300
12. Finish light floor plate construction (on area of 1 inch by 1 inch)	—	200
13. Fire escapes	100	—
On single-family dwellings only	40	
14. Garages (passenger vehicles only)	40 [m]	Note a
Trucks and buses	See Section 1607.7	
15. Handrails, guards and grab bars	See Section 1607.8	
16. Helipads	See Section 1607.6	
17. Hospitals *[OSHPD 1 & 4]*		
Corridors above first floor	100	1,000
Operating rooms, laboratories	60	1,000
Patient rooms	40	1,000
Mechanical and electrical equipment areas including open areas around equipment	50	
Storage		
Light	*125*	
Heavy	*250*	
Dining Area (not used for assembly)	*100*	*1,000*
Kitchen and serving areas	*50*	*1,000*
18. Hotels (see residential)	—	—
19. Libraries[n]		
Corridors above first floor	80	1,000
Reading rooms	60	1,000
Stack rooms	150[b, m]	1,000
20. Manufacturing		
Heavy	250 [m]	3,000
Light	125 [m]	2,000
21. Marquees	75	—

(continued)

TABLE 1607*A*.1—continued
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[g]

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
22. Office buildings[n]		
Corridors above first floor	80	2,000
File and computer rooms shall be designed for heavier loads based on anticipated occupancy	—	—
Lobbies and first-floor corridors	100	2,000
Offices	50	2,000
23. Penal institutions		
Cell blocks	40	—
Corridors	100	
24. Recreational uses:		
Bowling alleys, poolrooms and similar uses	75[m]	
Dance halls and ballrooms	100[m]	
Gymnasiums	100[m]	—
Reviewing stands, grandstands and bleachers[q]	100[c, m]	
Stadiums and arenas with fixed seats (fastened to floor)	60[c, m]	
25. Residential		
One- and two-family dwellings		
Uninhabitable attics without storage[i]	10	
Uninhabitable attics with storage [i, j, k]	20	
Habitable attics and sleeping areas[k]	30	
All other areas	40	—
Hotels and multifamily dwellings		
Private rooms and corridors serving them	40	
Public rooms[m] and corridors serving them	100	
26. Roofs		
All roof surfaces subject to maintenance workers		300
Awnings and canopies:		
Fabric construction supported by a skeleton structure	5 nonreducible	
All other construction	20	
Ordinary flat, pitched, and curved roofs (that are not occupiable)	20	
Where primary roof members are exposed to a work floor, at single panel point of lower chord of roof trusses or any point along primary structural members supporting roofs:		
Over manufacturing, storage warehouses, and repair garages		2,000
All other primary roof members		300
Occupiable roofs:		
Roof gardens	100	
Assembly areas	100[m]	
All other similar areas	Note 1	Note 1
27. Schools[n]		
Classrooms	40[p]	1,000
Corridors above first floor	80	1,000
First-floor corridors	100	1,000
28. Scuttles, skylight ribs and accessible ceilings	—	200
29. Sidewalks, vehicular drive ways and yards, subject to trucking	250[d, m]	8,000[e]

(continued)

TABLE 1607*A*.1—continued
MINIMUM UNIFORMLY DISTRIBUTED LIVE LOADS, L_o, AND MINIMUM CONCENTRATED LIVE LOADS[g]

OCCUPANCY OR USE	UNIFORM (psf)	CONCENTRATED (lbs.)
30. Stairs and exits		
One- and two-family dwellings	40	300 [f]
All other	100	300 [f]
31. Storage warehouses (shall be designed for heavier loads if required for anticipated storage)		—
Heavy	250[m]	
Light	125[m]	
32. Stores		
Retail		
First floor	100	1,000
Upper floors	75	1,000
Wholesale, all floors	125[m]	1,000
33. Vehicle barriers	See Section 1607.8.3	
34. Walkways and elevated platforms (other than exitways)	60	—
35. Yards and terraces, pedestrians[r]	100[m]	—
36. Storage racks and wall-hung cabinets.	*Total loads*[n]	

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 square foot = 0.0929 m^2, 1 pound per square foot = 0.0479 kN/m^2, 1 pound = 0.004448 kN, 1 pound per cubic foot = 16 kg/m^3.

a. Floors in garages or portions of buildings used for the storage of motor vehicles shall be designed for the uniformly distributed live loads of Table 1607.1 or the following concentrated loads: (1) for garages restricted to passenger vehicles accommodating not more than nine passengers, 3,000 pounds acting on an area of 4.5 inches by 4.5 inches; (2) for mechanical parking structures without slab or deck that are used for storing passenger vehicles only, 2,250 pounds per wheel.

b. The loading applies to stack room floors that support nonmobile, double-faced library bookstacks, subject to the following limitations:
   1. The nominal bookstack unit height shall not exceed 90 inches;
   2. The nominal shelf depth shall not exceed 12 inches for each face; and
   3. Parallel rows of double-faced book stacks shall be separated by aisles not less than 36 inches wide.

c. Design in accordance with ICC 300.

d. Other uniform loads in accordance with an approved method containing provisions for truck loadings shall also be considered where appropriate.

e. The concentrated wheel load shall be applied on an area of 4.5 inches by 4.5 inches.

f. The minimum concentrated load on stair treads shall be applied on an area of 2 inches by 2 inches. This load need not be assumed to act concurrently with the uniform load.

g. Where snow loads occur that are in excess of the design conditions, the structure shall be designed to support the loads due to the increased loads caused by drift buildup or a greater snow design determined by the building official (see Section 1608A). For special-purpose roofs, see Section 1607A.11.2.2.

h. See Section 1604A.8.3 for decks attached to exterior walls.

i. Uninhabitable attics without storage are those where the maximum clear height between the joists and rafters is less than 42 inches, or where there are not two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses. This live load need not be assumed to act concurrently with any other live load requirements.

j. Uninhabitable attics with storage are those where the maximum clear height between the joists and rafters is 42 inches or greater, or where there are two or more adjacent trusses with web configurations capable of accommodating an assumed rectangle 42 inches in height by 24 inches in width, or greater, within the plane of the trusses.
   The live load need only be applied to those portions of the joists or truss bottom chords where both of the following conditions are met:
   i. The attic area is accessible from an opening not less than 20 inches in width by 30 inches in length that is located where the clear height in the attic is a minimum of 30 inches; and
   ii. The slopes of the joists or truss bottom chords are no greater than two units vertical in 12 units horizontal.
   The remaining portions of the joists or truss bottom chords shall be designed for a uniformly distributed concurrent live load of not less than 10 lb./ft^2.

k. Attic spaces served by stairways other than the pull-down type shall be designed to support the minimum live load specified for habitable attics and sleeping rooms.

l. Areas of occupiable roofs, other than roof gardens and assembly areas, shall be designed for appropriate loads as approved by the building official. Unoccupied landscaped areas of roofs shall be designed in accordance with Section 1607*A*.12.3.

m. Live load reduction is not permitted unless specific exceptions of Section 1607*A*.10 apply.

Table Notes TABLE 1607*A*.1—continued

n. The minimum vertical design live load shall be as follows:
Paper media:
12-inch-deep shelf 33 pounds per lineal foot
15-inch-deep shelf 41 pounds per lineal foot, or
33 pounds per cubic foot per total volume of the rack or cabinet, whichever is less.
Film media:
18-inch-deep shelf 100 pounds per lineal foot, or
50 pounds per cubic foot per total volume of the rack or cabinet, whichever is less.
Other media:
20 pounds per cubic foot or 20 pounds per square foot, whichever is less, but not less than actual loads.

*o. **[DSA-SS]** The following minimum loads for stage accessories apply:*
1. Gridirons and fly galleries: 75 pounds per square foot uniform live load.
2. Loft block wells: 250 pounds per lineal foot vertical load and lateral load.
3. Head block wells and sheave beams: 250 pounds per lineal foot vertical load and lateral load. Head block wells and sheave beams shall be designed for all tributary loft block well loads. Sheave blocks shall be designed with a safety factor of five.
4. Scenery beams where there is no gridiron: 300 pounds per lineal foot vertical load and lateral load.
5. Ceiling framing over stages shall be designed for a uniform live load of 20 pounds per square foot. For members supporting a tributary area of 200 square feet or more, this additional load may be reduced to 15 pounds per square foot.

*p. **[DSA-SS]** The minimum uniform live load for classroom occupancies is 50 psf. Live load reduction is not permitted for classrooms classified as Group A occupancies unless specific exception of Section 1607A.10 apply.*

*q. **[DSA-SS]** The minimum uniform live load for a press box floor or accessible roof with railing is 100 psf.*

*r. **[DSA-SS]** Item 35 applies to pedestrian bridges and walkways that are not subjected to uncontrolled vehicle access.*

1607*A*.10 Reduction in uniform live loads. Except for uniform live loads at roofs, all other minimum uniformly distributed live loads, L_o, in Table 1607*A*.1 are permitted to be reduced in accordance with Section 1607*A*.10.1 or 1607*A*.10.2. Uniform live loads at roofs are permitted to be reduced in accordance with Section 1607*A*.12.2.

1607*A*.10.1 Basic uniform live load reduction. Subject to the limitations of Sections 1607*A*.10.1.1 through 1607*A*.10.1.3 and Table 1607*A*.1, members for which a value of $K_{LL}A_T$ is 400 square feet (37.16 m^2) or more are permitted to be designed for a reduced uniformly distributed live load, L, in accordance with the following equation:

(Equation 16*A*-22)

$$L = L_o\left(0.25 + \frac{15}{\sqrt{K_{LL}A_T}}\right)$$

For SI: $L = L_o\left(0.25 + \frac{4.57}{\sqrt{K_{LL}A_T}}\right)$

where:

L= Reduced design live load per square foot (m^2) of area supported by the member.

L_o= Unreduced design live load per square foot (m^2) of area supported by the member (see Table 1607A.1).

K_{LL}= Live load element factor (see Table 1607A.10.1).

A_T= Tributary area, in square feet (square meters).

L shall not be less than $0.50L_o$ for members supporting one floor and L shall not be less than $0.40L_o$ for members supporting two or more floors.

TABLE 1607*A*.10.1
LIVE LOAD ELEMENT FACTOR, K_{LL}

ELEMENT	K_{LL}
Interior columns	4
Exterior columns without cantilever slabs	4
Edge columns with cantilever slabs	3
Corner columns with cantilever slabs	2
Edge beams without cantilever slabs	2
Interior beams	2
All other members not identified above including: Edge beams with cantilever slabs Cantilever beams One-way slabs Two-way slabs Members without provisions for continuous shear transfer normal to their span	1

1607*A*.10.1.1 One-way slabs. The tributary area, A_T, for use in Equation 16*A*-23 for one-way slabs shall not exceed an area defined by the slab span times a width normal to the span of 1.5 times the slab span.

1607*A*.10.1.2 Heavy live loads. Live loads that exceed 100 psf (4.79 kN/m^2) shall not be reduced.

Exceptions:

1. The live loads for members supporting two or more floors are permitted to be reduced by a maximum of 20 percent, but the live load shall not be less than L as calculated in Section 1607*A*.10.1.
2. For uses other than storage, where approved, additional live load reductions shall be permitted where shown by the registered design professional that a rational approach has been used and that such reductions are warranted.

1607*A*.10.1.3 Passenger vehicle garages. The live loads shall not be reduced in passenger vehicle garages.

Exception: The live loads for members supporting two or more floors are permitted to be reduced by a maximum of 20 percent, but the live load shall not be less than L as calculated in Section 1607*A*.10.1.

1607*A*.10.2 Alternative uniform live load reduction. As an alternative to Section 1607*A*.10.1 and subject to the limitations of Table 1607*A*.1, uniformly distributed live loads are permitted to be reduced in accordance with the following provisions. Such reductions shall apply to slab systems, beams, girders, columns, piers, walls and foundations.

1. A reduction shall not be permitted where the live load exceeds 100 psf (4.79 kN/m^2) except that the design live load for members supporting two or more floors is permitted to be reduced by a maximum of 20 percent.

   Exception: For uses other than storage, where approved, additional live load reductions shall be permitted where shown by the registered design professional that a rational approach has been used and that such reductions are warranted.

2. A reduction shall not be permitted in passenger vehicle parking garages except that the live loads for members supporting two or more floors are permitted to be reduced by a maximum of 20 percent.
3. For live loads not exceeding 100 psf (4.79 kN/m^2), the design live load for any structural member supporting 150 square feet (13.94 m^2) or more is permitted to be reduced in accordance with Equation 16*A*-24.
4. For one-way slabs, the area, A, for use in Equation 16*A*-24 shall not exceed the product of the slab span and a width normal to the span of 0.5 times the slab span.

   $R = 0.08(A - 150)$ **(Equation 16*A*-24)**

   For SI: $R = 0.861(A - 13.94)$

   Such reduction shall not exceed the smallest of:

   1. 40 percent for horizontal members;
   2. 60 percent for vertical members; or
   3. R as determined by the following equation.

   $R = 23.1(1 + D/L_o)$ **(Equation 16*A*-25)**

   where:

   A = Area of floor supported by the member, square feet (m^2).

   D = Dead load per square foot (m^2) of area supported.

   L_o = Unreduced live load per square foot (m^2) of area supported.

   R = Reduction in percent.

1607*A*.11 Distribution of floor loads. Where uniform floor live loads are involved in the design of structural members arranged so as to create continuity, the minimum applied loads shall be the full dead loads on all spans in combination with the floor live loads on spans selected to produce the greatest load effect at each location under consideration. It shall be permitted to reduce floor live loads in accordance with Section 1607*A*.10.

1607*A*.12 Roof loads. The structural supports of roofs and marquees shall be designed to resist wind and, where applicable, snow and earthquake loads, in addition to the dead load of construction and the appropriate live loads as prescribed in this section, or as set forth in Table 1607*A*.1. The live loads acting on a sloping surface shall be assumed to act vertically on the horizontal projection of that surface.

1607*A*.12.1 Distribution of roof loads. Where uniform roof live loads are reduced to less than 20 psf (0.96 kN/m^2) in accordance with Section 1607*A*.12.2.1 and are applied to the design of structural members arranged so as to create continuity, the reduced roof live load shall be applied to adjacent spans or to alternate spans, whichever produces the most unfavorable load effect. See Section 1607*A*.12.2 for reductions in minimum roof live loads and Section 7.5 of ASCE 7 for partial snow loading.

1607*A*.12.2 General. The minimum uniformly distributed live loads of roofs and marquees, L_o, in Table 1607*A*.1 are

permitted to be reduced in accordance with Section 1607*A*.12.2.1.

1607*A*.12.2.1 Ordinary roofs, awnings and canopies. Ordinary flat, pitched and curved roofs, and awnings and canopies other than of fabric construction supported by a skeleton structure, are permitted to be designed for a reduced uniformly distributed roof live load, L_r, as specified in the following equations or other controlling combinations of loads as specified in Section 1605*A*, whichever produces the greater load effect.

In structures such as greenhouses, where special scaffolding is used as a work surface for workers and materials during maintenance and repair operations, a lower roof load than specified in the following equations shall not be used unless approved by the building official. Such structures shall be designed for a minimum roof live load of 12 psf (0.58 kN/m^2).

$L_r = L_o R_1 R_2$ **(Equation 16*A*-26)**

where: $12 \le L_r \le 20$

For SI: $L_r = L_o R_1 R_2$

where: $0.58 \le L_r \le 0.96$

L_o = Unreduced roof live load per square foot (m^2) of horizontal projection supported by the member (see Table 1607*A*.1).

L_r = Reduced roof live load per square foot (m^2) of horizontal projection supported by the member.

The reduction factors R_1 and R_2 shall be determined as follows:

$R_1 = 1$ for $A_t \le 200$ square feet (18.58 m^2) **(Equation 16*A*-27)**

$R_1 = 1.2 - 0.001A_t$ for 200 square feet $< A_t <$ 600 square feet **(Equation 16*A*-28)**

For SI: $1.2 - 0.011A_t$ for 18.58 square meters $< A_t <$ 55.74 square meters

$R_1 = 0.6$ for $A_t \ge 600$ square feet (55.74 m^2) **(Equation 16*A*-29)**

where:

A_t = Tributary area (span length multiplied by effective width) in square feet (m^2) supported by the member, and

$R_2 = 1$ for $F \le 4$ **(Equation 16*A*-30)**

$R_2 = 1.2 - 0.05F$ for $4 < F < 12$ **(Equation 16*A*-31)**

$R_2 = 0.6$ for $F \ge 12$ **(Equation 16*A*-32)**

where:

F = For a sloped roof, the number of inches of rise per foot (for SI: $F = 0.12 \times$ slope, with slope expressed as a percentage), or for an arch or dome, the rise-to-span ratio multiplied by 32.

1607*A*.12.3 Occupiable roofs. Areas of roofs that are occupiable, such as roof gardens, or for assembly or other similar purposes, and marquees are permitted to have their uniformly distributed live loads reduced in accordance with Section 1607.10.

1607*A*.12.3.1 Landscaped roofs. The uniform design live load in unoccupied landscaped areas on roofs shall be 20 psf (0.958 kN/m^2). The weight of all landscaping materials shall be considered as dead load and shall be computed on the basis of saturation of the soil.

1607*A*.12.4 Awnings and canopies. Awnings and canopies shall be designed for uniform live loads as required in Table 1607*A*.1 as well as for snow loads and wind loads as specified in Sections 1608*A* and 1609*A*.

1607A.12.5 Uncovered open-frame roof structures. *Uncovered open-frame roof structures shall be designed for a vertical live load of not less than 10 pounds per square foot (0.48 kN/m^2) of the total area encompassed by the framework.*

1607*A*.13 Crane loads. The crane live load shall be the rated capacity of the crane. Design loads for the runway beams, including connections and support brackets, of moving bridge cranes and monorail cranes shall include the maximum wheel loads of the crane and the vertical impact, lateral and longitudinal forces induced by the moving crane.

1607*A*.13.1 Maximum wheel load. The maximum wheel loads shall be the wheel loads produced by the weight of the bridge, as applicable, plus the sum of the rated capacity and the weight of the trolley with the trolley positioned on its runway at the location where the resulting load effect is maximum.

1607*A*.13.2 Vertical impact force. The maximum wheel loads of the crane shall be increased by the percentages shown below to determine the induced vertical impact or vibration force:

Monorail cranes (powered) . . . . . 25 percent

Cab-operated or remotely operated bridge cranes (powered) . . . . . 25 percent

Pendant-operated bridge cranes (powered) . . . . . 10 percent

Bridge cranes or monorail cranes with hand-geared bridge, trolley and hoist . . . . . 0 percent

1607*A*.13.3 Lateral force. The lateral force on crane runway beams with electrically powered trolleys shall be calculated as 20 percent of the sum of the rated capacity of the crane and the weight of the hoist and trolley. The lateral force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction perpendicular to the beam, and shall be distributed with due regard to the lateral stiffness of the runway beam and supporting structure.

1607*A*.13.4 Longitudinal force. The longitudinal force on crane runway beams, except for bridge cranes with hand-geared bridges, shall be calculated as 10 percent of the maximum wheel loads of the crane. The longitudinal force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction parallel to the beam.

strength equal to the required vertical shear strength for allowable stress design (ASD) or two-thirds of the required shear strength for load and resistance factor design (LRFD) but not less than 10 kips (45 kN). For the purpose of this section, the shear force and the axial tensile force need not be considered to act simultaneously.

Exception: Where beams, girders, open web joist and joist girders support a concrete slab or concrete slab on metal deck that is attached to the beam or girder with not less than $^3/_8$-inch-diameter (9.5 mm) headed shear studs, at a spacing of not more than 12 inches (305 mm) on center, averaged over the length of the member, or other attachment having equivalent shear strength, and the slab contains continuous distributed reinforcement in each of two orthogonal directions with an area not less than 0.0015 times the concrete area, the nominal axial tension strength of the end connection shall be permitted to be taken as half the required vertical shear strength for ASD or one-third of the required shear strength for LRFD, but not less than 10 kips (45 kN).

1615*A*.4 Bearing wall structures. Bearing wall structures shall have vertical ties in all load-bearing walls and longitudinal ties, transverse ties and perimeter ties at each floor level in accordance with this section and as shown in Figure 1615*A*.4.

1615*A*.4.1 Concrete wall structures. Precast bearing wall structures constructed solely of reinforced or prestressed concrete, or combinations of these shall conform to the requirements of Sections 7.13, 13.3.8.5 and 16.5 of ACI 318.

1615*A*.4.2 Other bearing wall structures. Ties in bearing wall structures other than those covered in Section 1615*A*.4.1 shall conform to this section.

1615*A*.4.2.1 Longitudinal ties. Longitudinal ties shall consist of continuous reinforcement in slabs; continuous or spliced decks or sheathing; continuous or spliced members framing to, within or across walls; or connections of continuous framing members to walls. Longitudinal ties shall extend across interior load-bearing walls and shall connect to exterior load-bearing walls and shall be spaced at not greater than 10 feet (3038 mm) on center. Ties shall have a minimum nominal tensile strength, T_T, given by Equation 16*A*-41. For ASD the minimum nominal tensile strength shall be permitted to be taken as 1.5 times the allowable tensile stress times the area of the tie.

$$T_T = wL_S \le \alpha_T S \qquad \textbf{(Equation 16}\textit{A}\textbf{-41)}$$

where:

L = The span of the horizontal element in the direction of the tie, between bearing walls, feet (m).

w = The weight per unit area of the floor or roof in the span being tied to or across the wall, psf (N/m^2).

S = The spacing between ties, feet (m).

α_T = A coefficient with a value of 1,500 pounds per foot (2.25 kN/m) for masonry bearing wall structures and a value of 375 pounds per foot (0.6 kN/m) for structures with bearing walls of cold-formed steel light-frame construction.

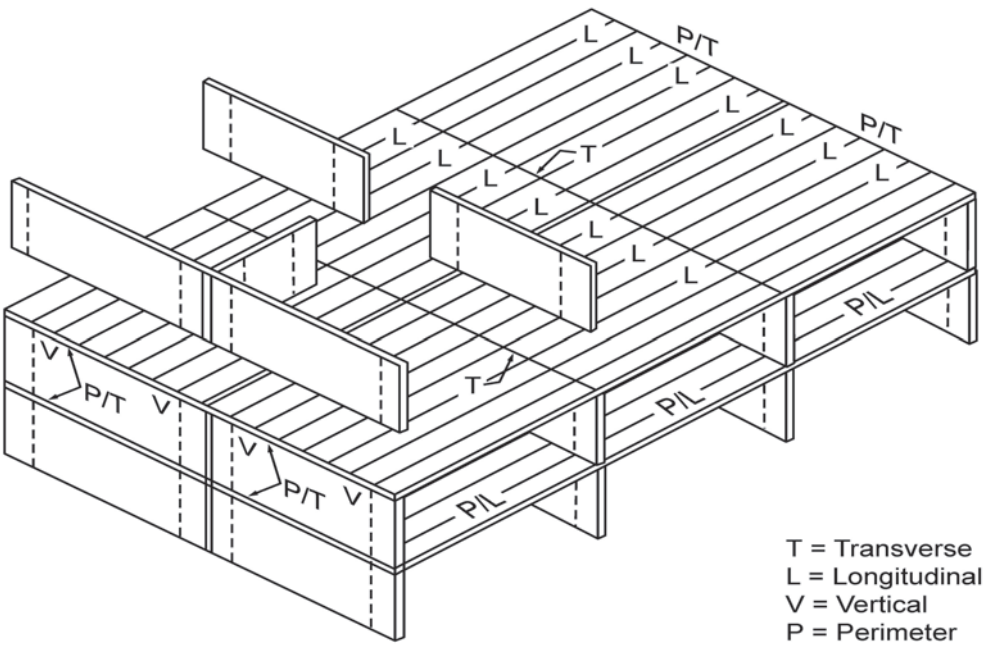

FIGURE 1614*A*.4
LONGITUDINAL, PERIMETER, TRANSVERSE AND VERTICAL TIES

1615*A*.4.2.2 Transverse ties. Transverse ties shall consist of continuous reinforcement in slabs; continuous or spliced decks or sheathing; continuous or spliced members framing to, within or across walls; or connections of continuous framing members to walls. Transverse ties shall be placed no farther apart than the spacing of load- bearing walls. Transverse ties shall have minimum nominal tensile strength T_T, given by Equation 16*A*-46. For ASD the minimum nominal tensile strength shall be permitted to be taken as 1.5 times the allowable tensile stress times the area of the tie.

1615*A*.4.2.3 Perimeter ties. Perimeter ties shall consist of continuous reinforcement in slabs; continuous or spliced decks or sheathing; continuous or spliced members framing to, within or across walls; or connections of continuous framing members to walls. Ties around the perimeter of each floor and roof shall be located within 4 feet (1219 mm) of the edge and shall provide a nominal strength in tension not less than T_p, given by Equation 16*A*-42. For ASD the minimum nominal tensile strength shall be permitted to be taken as 1.5 times the allowable tensile stress times the area of the tie.

$$T_p = 200w \le \beta_T \qquad \textbf{(Equation 16A-42)}$$

For SI:

$$T_p = 90.7w \le \beta_T$$

where:

w = As defined in Section 1614*A*.4.2.1.

β_T = A coefficient with a value of 16,000 pounds (7200 kN) for structures with masonry bearing walls and a value of 4,000 pounds (1300 kN) for structures with bearing walls of cold-formed steel light-frame construction.

1615*A*.4.2.4 Vertical ties. Vertical ties shall consist of continuous or spliced reinforcing, continuous or spliced members, wall sheathing or other engineered systems. Vertical tension ties shall be provided in bearing walls and shall be continuous over the height of the building. The minimum nominal tensile strength for vertical ties within a bearing wall shall be equal to the weight of the wall within that story plus the weight of the diaphragm tributary to the wall in the story below. No fewer than two ties shall be provided for each wall. The strength of each tie need not exceed 3,000 pounds per foot (450 kN/m) of wall tributary to the tie for walls of masonry construction or 750 pounds per foot (140 kN/m) of wall tributary to the tie for walls of cold-formed steel light-frame construction.

SECTION *1616A* MODIFICATIONS TO ASCE 7

1616A.1 General. *The text of ASCE 7 shall be modified as indicated in Sections 1616A.1.1 through 1616A.1.42.*

1616A.1.1 ASCE 7, Section 1.3. *Modify ASCE 7 Section 1.3 by the adding Section 1.3.6 as follows:*

1.3.6 ***Structural design criteria.*** *Where design is based on ASCE 7, Chapters 16, 17, 18, or 31, the ground motion, wind tunnel design recommendations, analysis, and design methods, material assumptions, testing requirements, and acceptance criteria proposed by the engineer shall be submitted to the enforcement agency in the form of structural design criteria for approval.*

[DSA-SS, OSHPD 1 & 4] *Peer review requirements in Section 3414A of this code shall apply to design reviews required by ASCE 7 Chapters 17 and 18.*

1616A.1.2 ASCE 7, Section 11.1.3. *Replace last paragraph of ASCE 7, Section 11.1.3, by the following:*

Buildings shall be designed and detailed in accordance with Chapter 12.

1616A.1.3 ASCE 7, Section 11.4.7. *Modify ASCE 7 Section 11.4.7 by adding the following:*

For buildings assigned to Seismic Design Category E or F, or when required by the building official, a ground motion hazard analysis shall be performed in accordance with ASCE 7 Chapter 21 as modified by Section 1803A.6 of this code.

1616A.1.4 ASCE 7, Table 12.2-1. *Modify ASCE 7 Table 12.2-1 as follows:*

A. *BEARING WALL SYSTEMS*

5. *Intermediate Precast Shear Walls—Not permitted by OSHPD.*

17. *Light-framed walls with shear panels of all other materials—Not permitted by OSHPD and DSA-SS.*

B. BUILDING FRAME SYSTEMS

3. *Ordinary steel concentrically braced frames—Not permitted by OSHPD.*

8. *Intermediate Precast Shear Walls—Not permitted by OSHPD.*

24. *Light-framed walls with shear panels of all other materials—Not permitted by OSHPD and DSA-SS.*

26. *Special steel plate shear wall—Not permitted by OSHPD.*

C. ***MOMENT-RESISTING FRAME SYSTEMS***

2. *Special steel truss moment frames—Not permitted by OSHPD.*

3. *Intermediate steel moment frames—Not permitted by OSHPD.*

4. *Ordinary steel moment frames—Not permitted by OSHPD.*

5. *Cold-formed steel–special bolted moment frame - Not permitted by DSA-SS and OSHPD.*

Exceptions:

1. *Systems listed in this section can be used as an alternative system when preapproved by the enforcement agency.*

2. *Rooftop or other supported structures not exceeding two stories in height and 10 percent of the total structure weight can use the systems in*

this section when designed as components per ASCE 7 Chapter 13.

3. *Systems listed in this section can be used for seismically isolated buildings when permitted by Section 1613A.4.1.*

1616A.1.5 ASCE 7, Section 12.2.3.1. *Replace ASCE 7, Section 12.2.3.1, Items 1 and 2, by the following:*

The value of the response modification coefficient, R, used for design at any story shall not exceed the lowest value of R that is used in the same direction at any story above that story. Likewise, the deflection amplification factor, C_d, and the system over strength factor, Ω_0, used for the design at any story shall not be less than the largest value of these factors that are used in the same direction at any story above that story.

1616A.1.6 ASCE 7, Section 12.2.3.2. *Modify ASCE 7, Section 12.2.3.2, by adding the following additional requirements:*

f. Where design of elements of the upper portion is governed by special seismic load combinations, the special loads shall be considered in the design of the lower portion.

1616A.1.7 ASCE 7, Section 12.2.5.6.1 [DSA-SS] *The exception after the first paragraph is not permitted by DSA-SS.*

1616A.1.8 ASCE 7, Section 12.2.5.7.1 [DSA-SS] *The exception after the first paragraph is not permitted by DSA-SS.*

1616A.1.9 ASCE 7, Section 12.2.5.7.2 [DSA-SS] *The exception after the first paragraph is not permitted by DSA-SS.*

1616A.1.10 ASCE 7, Section 12.3.3. *Modify first sentence of ASCE 7, Section 12.3.3.1, as follows:*

12.3.3.1 Prohibited horizontal and vertical irregularities for Seismic Design Categories D through F. *Structures assigned to Seismic Design Category D, E or F having horizontal structural irregularity Type 1b of Table 12.3-1 or vertical structural irregularities Type 1b, 5a or 5b of Table 12.3-2 shall not be permitted.*

1616A.1.11 ASCE 7, Section 12.7.2. *Modify ASCE 7, Section 12.7.2, by adding Item 6 to read as follows:*

6. *Where buildings provide lateral support for walls retaining earth, and the exterior grades on opposite sides of the building differ by more than 6 feet (1829 mm), the load combination of the seismic increment of earth pressure due to earthquake acting on the higher side, as determined by a geotechnical engineer qualified in soils engineering plus the difference in earth pressures shall be added to the lateral forces provided in this section.*

1616A.1.12 ASCE 7, Section 12.8.1.3. *Replace ASCE 7, Section 12.8.1.3, by the following:*

12.8.1.3 Maximum S_s value in determination of C_s. *For regular structures five stories or less above the base, as defined in Section 11.2, and with a period, T, of 0.5 s or less, C_s is permitted to be calculated using the larger of either S_s =1.5 or 80 percent of the value of S_s determined per Sections 11.4.1 or 11.4.7.*

1616A.1.13 ASCE 7, Section 12.9.4. *Replace ASCE 7 Section 12.9.4 as follows:*

12.9.4 Scaling design values of combined response. *Modal base shears used to determine forces and drifts shall not be less than the base shear calculated using the equivalent lateral force procedure of Section 12.8.*

1616A.1.14 ASCE 7, Section 12.10.2.1. *Replace ASCE 7, Exception 1 of Section 12.10.2.1, by adding the following:*

Exception:

1. *The forces calculated above need not exceed those calculated using the load combinations of Section 12.4.3.2 with seismic forces determined by Equation 12.10-3 and transfer forces, where applicable.*

1616A.1.15 ASCE 7, Section 12.12.3. [OSHPD 1 & 4] *Replace ASCE 7 Equation 12.12-1 by the following:*

$$\delta_M = C_d \delta_{max} \qquad \textbf{(Equation 12.12-1)}$$

1616A.1.16 ASCE 7, Section 12.13.1. *Modify ASCE 7 Section 12.13.1 by adding Section 12.13.1.1 as follows:*

12.13.1.1 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. Stability against overturning and sliding shall be in accordance with Section 1605A.1.1.*

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. *Forces from the load combinations with overstrength factor in accordance with ASCE 7, Section 12.4.3.2.*

Exceptions:

1. *Where referenced standards specify the use of higher design loads.*
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 basic structural system consists of light framed walls with shear panels, unless the reference standard specifies the use of higher design loads.*

Where the computation of the seismic overturning moment is by the equivalent lateral-force method or the modal analysis method, reduction in overturning

moment permitted by section 12.13.4 of ASCE 7 may be used.

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.

1616A.1.17 ASCE 7, Section 13.1.3. [OSHPD 1 & 4] *Modify ASCE 7 Section 13.1.3 by the following:*

The design of supports and attachments for all nonstructural components shall have a component importance factor, I_p, equal to 1.5.

1616A.1.18 ASCE 7, Section 13.1.4. *Replace ASCE 7, Section 13.1.4, with the following:*

13.1.4 Exemptions. *The following nonstructural components are exempt from the requirements of this section:*

1. *Furniture (except storage cabinets as noted in Table 13.5-1).*
2. *Temporary or moveable (mobile) equipment.*

   Exceptions:

   a) *Equipment shall be anchored if it is permanently attached to the building utility services such as electricity, gas or water. For the purposes of this requirement, "permanently attached" shall include all electrical connections except plugs for duplex receptacles.*

   b) *The enforcement agency shall be permitted to require temporary attachments for movable equipment which is usually stationed in one place and heavier than 400 pounds, when they are not in use for a period longer than 8 hours at a time.*

3. *Architectural, mechanical and electrical components in Seismic Design Categories D, E or F where all of the following apply:*

   a. *The component is positively attached to the structure;*

   b. *Flexible connections are provided at seismic separation joints and between the component and associated ductwork, piping and conduit; and either:*

      i. *The component weighs 400 pounds (1780 N) or less and has a center of mass located 4 feet (1.22 m) or less above the adjacent floor or roof level that directly support the component;*

         Exception: *Special Seismic Certification requirements of this code in accordance with Section 1705A.12.4 shall be applicable.*

      or

      ii. *The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 lb/ft (73 N/m) or less.*

   Exception: *The enforcement agency shall be permitted to require attachments for equipment with hazardous contents to be shown on construction documents irrespective of weight.*

1616A.1.19 ASCE 7, Section 13.4 *Replace ASCE 7, Sections 13.4.2.3, with the following:*

13.4.2.3 Post-installed anchors in concrete and masonry.

Post-installed anchors in concrete used for component anchorage shall be pre-qualified for seismic applications in accordance with ACI 355.2, ICC-ES AC193 or ICC-ES AC308. Post-installed anchors in masonry used for component anchorage shall be pre-qualified for seismic applications in accordance with ICC-ES AC01, AC58 or AC106.

Use of screw anchors shall be limited to dry interior conditions. Re-use of screw anchors or screw anchor holes shall not be permitted.

1616A.1.20 ASCE 7, Section 13.5.6. *Replace ASCE 7, Section 13.5.6 with the following:*

13.5.6 Suspended ceilings. *Suspended ceilings shall be in accordance with this section.*

13.5.6.1 Seismic forces. *The weight of the ceiling, W_p, shall include the ceiling grid; ceiling tiles or panels; light fixtures if attached to, clipped to, or laterally supported by the ceiling grid; and other components that are laterally supported by the ceiling. W_p shall be taken as not less than 4 psf (19 N/m^2).*

The seismic force, F_p, shall be transmitted through the ceiling attachments to the building structural elements or the ceiling-structure boundary.

13.5.6.2 Seismic design requirements. *Suspended acoustical tile or lay-in panel ceilings shall be designed in accordance with ASTM E 580, Section 5.2.8, and the requirements of Sections 13.5.6.2.1 and 13.5.6.2.2, or be designed in accordance with Section 13.2.1.(1), or be seismically qualified in accordance with Sections 13.2.5 or 13.2.6.*

13.5.6.2.1 Industry standard construction for acoustical tile or lay-in panel ceilings. *Acoustical tile or lay-in panel ceilings in Seismic Design Categories D, E, and F shall be designed and installed in accordance with ASTM C 635, ASTM C 636, and ASTM E 580, Section 5 - Seismic Design Categories D, E, and F as modified by Section 13.5.6.2.2.*

13.5.6.2.2 Modification to ASTM E 580. *Modify ASTM E 580 by the following:*

1. ***Exitways.*** *Lay-in ceiling assemblies in exitways of hospitals and essential services build-*

6. *Cab stabilizers and counterweight frames shall be designed to withstand computed lateral load with a minimum horizontal acceleration of 0.5g.*

1616A.1.29 ASCE 7, Section 16.1.4. *Remove ASCE 7, Sections 16.1.4.1 and 16.1.4.2, and modify Section 16.1.4, by the following:*

Maximum scaled base shears used to determine forces and drifts shall not be less than the base shear calculated using the equivalent lateral force procedure of Section 12.8.

1616A.1.30 ASCE 7, Section 16.2.2. *Modify ASCE 7, Section 16.2.2, by adding the following:*

Requirements of this section shall be deemed to be satisfied for new buildings, using acceptance criteria, in Section 16.2.4.2, by the nonlinear modeling parameters in ASCE 41.

1616A.1.31 ASCE 7, Section 16.2.3. *Modify ASCE 7, Section 16.2.3, by adding the following:*

Requirements of this section shall be deemed to be satisfied by using load combinations in Sections 12.4.2.3 and 12.4.3.2 with 25 percent of the required live loads.

1616A.1.32 ASCE 7, Section 16.2.4. *Modify ASCE 7, Section 16.2.4, by the following:*

a) Where site is located within 3.1 miles (5 km) of an active fault at least seven ground motions shall be analyzed and response parameters shall be based on larger of the average of the maximum response with ground motions applied as follows:

1. *Each of the ground motions shall have their maximum component at the fundamental period aligned in one direction.*
2. *Each of the ground motion's maximum component shall be rotated orthogonal to the previous analysis direction.*

b) Where site is located more than 3.1 miles (5 km) from an active fault at least 10 ground motions shall be analyzed. The ground motions shall be applied such that one-half shall have their maximum component aligned in one direction and the other half aligned in the orthogonal direction. The average of the maximum response of all the analyses shall be used for design.

1616A.1.33 [OSHPD 1 & 4] ASCE 7, Section 16.2.4.1. *Replace ASCE 7 exception to Section 16.2.3 by the following:*

Where this standard requires the consideration of the load combinations with overstrength factor of Section 12.4.3.2, average demand from MCE analysis obtained from suite of analysis in accordance with Section 16.2.4 shall be used with Immediate Occupancy (IO) acceptance criteria in Section 16.2.4.2.

1616A.1.34 ASCE 7, Section 16.2.4.2 [OSHPD 1 & 4] *Modify ASCE 7, Section 16.2.4.2, by the following:*

Acceptance criteria for elements subjected to deformation beyond their linear range of response shall be based on ASCE 41 for Immediate Occupancy (IO) at Design Earthquake (DE) and Life Safety (LS) at Maximum Considered Earthquake (MCE). For LS acceptance criteria at MCE, primary components shall be within the acceptance criteria for primary components and secondary components shall be within the acceptance criteria for secondary components.

1616A.1.35 ASCE 7, Section 17.2.1. *Modify ASCE 7, Section 17.2.1, by adding the following:*

The importance factor, I_p , for parts and portions of a seismically isolated building shall be the same as that required for a fixed-base building of the same risk category.

1616A.1.36 ASCE 7, Section 17.2.4.7. *Modify ASCE 7, Section 17.2.4.7, by adding the following:*

The effects of uplift and/or rocking shall be explicitly accounted for in the analysis and in the testing of the isolator units.

1616A.1.37 ASCE 7, Section 17.2.5.2. *Modify ASCE 7, Section 17.2.5.2, by adding the following:*

The separation requirements for the building above the isolation system and adjacent buildings shall be the sum of the factored displacements for each building. The factors to be used in determining separations shall be:

1. *For seismically isolated buildings, the deformation resulting from the analyses using the maximum considered earthquake unmodified by R_I.*
2. *For fixed based buildings, C_d times the elastic deformations resulting from an equivalent static analysis using the seismic base shear computed via ASCE 7, Section 12.8.*

1616A.1.38 ASCE 7, Section 17.4. *Modify ASCE 7, Section 17.4.2, by adding the following:*

17.4.2.3 Linear procedures. *Linear procedures shall be limited to structures located at sites with S_1 less than 0.6g.*

1616A.1.39 ASCE 7, Section 17.6 *Modify ASCE 7, Section 17.6, by the following:*

17.6.1.1 Minimum seismic force. *For the response spectrum and linear response history procedures, V_b and V_s shall not be taken less than those calculated in accordance with Equations 17.5-7 and 17.5-8.*

1616A.1.40 ASCE 7, Section 18.3.1. *Modify ASCE 7, Section 18.3.1, by replacing the third paragraph with the following:*

If the calculated force in an element of the seismic force resisting system does not exceed 1.5 times its nominal strength for the Risk-Targeted Maximum Considered Earthquake (MCE_R) nor its nominal strength for the design earthquake (DE), the element is permitted to be modeled as linear. For this section, the MCE_R and DE response shall be based on largest response due to a sin-

gle ground motion and not the average response of suite of ground motions.

1616A.1.41 Earthquake motion measuring instrumentation and monitoring. [OSHPD 1 & 4] *Modify ASCE 7 by the following:*

Scope: *For buildings with a seismic isolation system, a damping system or a lateral force resisting system (LFRS) not listed in ASCE 7 Table 12.2-1, earthquake motion measuring instrumentation and monitoring shall be required. Monitoring requirements shall also apply to welded steel moment frame buildings constructed under a permit issued prior to October 25, 1994.*

Instrumentation: *There shall be a sufficient number of instruments to characterize the response of the building during an earthquake and shall include at least one triaxial free field instrument or equivalent. A proposal for instrumentation and equipment specifications shall be forwarded to the enforcement agency for review and approval. The owner of the building shall be responsible for the implementation of the instrumentation program. Maintenance of the instrumentation and removal/ processing of the records shall be the responsibility of the enforcement agency.*

The instruments shall be interconnected for common start and common timing. Each instrument shall be located so that access is maintained at all times and is unobstructed by room contents. A sign stating "MAINTAIN CLEAR ACCESS TO THIS INSTRUMENT" shall be posted in a conspicuous location.

Monitoring: *After every significant seismic events, where the ground shaking acceleration at the site exceeds 0.3g, or the acceleration at any monitored building level exceeds 0.8g, as measured by the seismic monitoring system in the building, the owner shall retain a structural engineer to make an inspection of the structural system. The inspection shall include viewing the performance of the building, reviewing the strong motion records, and a visual examination of the isolators, dampers and connections for deterioration, offset or physical damage. A report for each inspection, including conclusions on the continuing adequacy of the structural system, shall be submitted to the enforcement agency.*

1616A.1.42 Operational nonstructural performance level requirements. [OSHPD 1 & 4] *New general acute care hospitals and new building(s) required for general acute care services shall satisfy Operational Nonstructural Performance Level (NPC-5) requirements.*

Exception: *A new building which is required for general acute care services that is added to an existing general acute care hospital and which has a building area of 4,000 square feet (371 m^2) or less, need not satisfy the NPC-5 requirements until the deadline specified in California Administrative Code (Part 1, Title 24 CCR), Chapter 6.*

Hospitals and buildings designed and constructed to the provisions of this code for new construction shall be deemed to satisfy Operational Nonstructural Performance Level (NPC-5) requirements when:

1. *The facility has on-site supplies of water and holding tanks for sewage and liquid waste, sufficient to support 72 hours of emergency operations for the hospital or building, which are integrated into the building plumbing systems in accordance with the California Plumbing Code.*
2. *An on-site emergency system as defined in the California Electrical Code is incorporated into the building electrical system for critical care areas. Additionally, the system shall provide for radiological service and an onsite fuel supply for 72 hours of acute care operation.*

Emergency and standby generators shall not be located below the higher of the Design Flood Elevation (DFE) or Base Flood Elevation (BFE) plus two feet (BFE + 2 ft.) and shall be located at an elevation close to grade for easy accessibility from outside for maintenance.

CHAPTER 17

STRUCTURAL TESTS AND SPECIAL INSPECTIONS

SECTION 1701
GENERAL

1701.1 Scope. The provisions of this chapter shall govern the quality, workmanship and requirements for materials covered. Materials of construction and tests shall conform to the applicable standards listed in this code.

1701.2 New materials. New building materials, equipment, appliances, systems or methods of construction not provided for in this code, and any material of questioned suitability proposed for use in the construction of a building or structure, shall be subjected to the tests prescribed in this chapter and in the approved rules to determine character, quality and limitations of use.

1701.3 Used materials. The use of second-hand materials that meet the minimum requirements of this code for new materials shall be permitted.

SECTION 1702
DEFINITIONS

1702.1 Definitions. The following terms are defined in Chapter 2:

> **APPROVED AGENCY.**

APPROVED FABRICATOR.

CERTIFICATE OF COMPLIANCE.

DESIGNATED SEISMIC SYSTEM.

FABRICATED ITEM.

INSPECTION CERTIFICATE.

INTUMESCENT FIRE-RESISTANT COATINGS.

MAIN WINDFORCE-RESISTING SYSTEM.

MASTIC FIRE-RESISTANT COATINGS.

SPECIAL INSPECTION.

Continuous special inspection.

Periodic special inspection.

SPECIAL INSPECTOR.

SPRAYED FIRE-RESISTANT MATERIALS.

STRUCTURAL OBSERVATION.

SECTION 1703
APPROVALS

1703.1 Approved agency. An approved agency shall provide all information as necessary for the building official to determine that the agency meets the applicable requirements.

1703.1.1 Independence. An approved agency shall be objective, competent and independent from the contractor responsible for the work being inspected. The agency shall also disclose possible conflicts of interest so that objectivity can be confirmed.

1703.1.2 Equipment. An approved agency shall have adequate equipment to perform required tests. The equipment shall be periodically calibrated.

1703.1.3 Personnel. An approved agency shall employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.

1703.2 Written approval. Any material, appliance, equipment, system or method of construction meeting the requirements of this code shall be approved in writing after satisfactory completion of the required tests and submission of required test reports.

1703.3 Approved record. For any material, appliance, equipment, system or method of construction that has been approved, a record of such approval, including the conditions and limitations of the approval, shall be kept on file in the building official's office and shall be open to public inspection at appropriate times.

1703.4 Performance. Specific information consisting of test reports conducted by an approved testing agency in accordance with the appropriate referenced standards, or other such information as necessary, shall be provided for the building official to determine that the material meets the applicable code requirements.

1703.4.1 Research and investigation. Sufficient technical data shall be submitted to the building official to substantiate the proposed use of any material or assembly. If it is determined that the evidence submitted is satisfactory proof of performance for the use intended, the building official shall approve the use of the material or assembly subject to the requirements of this code. The costs, reports and investigations required under these provisions shall be paid by the applicant.

1703.4.2 Research reports. Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from approved sources.

1703.5 Labeling. Where materials or assemblies are required by this code to be labeled, such materials and assemblies shall be labeled by an approved agency in accordance with Section 1703. Products and materials required to be labeled shall be labeled in accordance with the procedures set forth in Sections 1703.5.1 through 1703.5.4.

1703.5.1 Testing. An approved agency shall test a representative sample of the product or material being labeled to the relevant standard or standards. The approved agency shall maintain a record of the tests performed. The record

shall provide sufficient detail to verify compliance with the test standard.

1703.5.2 Inspection and identification. The approved agency shall periodically perform an inspection, which shall be in-plant if necessary, of the product or material that is to be labeled. The inspection shall verify that the labeled product or material is representative of the product or material tested.

1703.5.3 Label information. The label shall contain the manufacturer's or distributor's identification, model number, serial number or definitive information describing the product or material's performance characteristics and approved agency's identification.

1703.5.4 Method of labeling. Information required to be permanently identified on the product shall be acid etched, sand blasted, ceramic fired, laser etched, embossed or of a type that, once applied, cannot be removed without being destroyed.

1703.6 Evaluation and follow-up inspection services. Where structural components or other items regulated by this code are not visible for inspection after completion of a prefabricated assembly, the applicant shall submit a report of each prefabricated assembly. The report shall indicate the complete details of the assembly, including a description of the assembly and its components, the basis upon which the assembly is being evaluated, test results and similar information and other data as necessary for the building official to determine conformance to this code. Such a report shall be approved by the building official.

1703.6.1 Follow-up inspection. The applicant shall provide for special inspections of fabricated items in accordance with Section 1704.2.5.

1703.6.2 Test and inspection records. Copies of necessary test and inspection records shall be filed with the building official.

SECTION 1704
SPECIAL INSPECTIONS, CONTRACTOR RESPONSIBILITY AND STRUCTURAL OBSERVATIONS

1704.1 General. This section provides minimum requirements for special inspections, the statement of special inspections, contractor responsibility and structural observations.

1704.2 Special inspections. Where application is made for construction as described in this section, the owner or the registered design professional in responsible charge acting as the owner's agent shall employ one or more approved agencies to perform inspections during construction on the types of work listed under Section 1705. These inspections are in addition to the inspections identified in Section 110.

Exceptions:

1. Special inspections are not required for construction of a minor nature or as warranted by conditions in the jurisdiction as approved by the building official.
2. Unless otherwise required by the building official, special inspections are not required for Group U occupancies that are accessory to a residential occupancy including, but not limited to, those listed in Section 312.1.
3. Special inspections are not required for portions of structures designed and constructed in accordance with the cold-formed steel light-frame construction provisions of Section 2211.7 or the conventional light-frame construction provisions of Section 2308. *[OSHPD 2] Not permitted by OSHPD.*
4. ***[HCD 1]*** *The provisions of Health and Safety Code Division 13, Part 6 and the California Code of Regulations, Title 25, Division 1, Chapter 3, commencing with Section 3000, shall apply to the construction and inspection of factory-built housing as defined in Health and Safety Code Section 19971.*

1704.2.1 Special inspector qualifications. The special inspector shall provide written documentation to the building official demonstrating his or her competence and relevant experience or training. Experience or training shall be considered relevant when the documented experience or training is related in complexity to the same type of special inspection activities for projects of similar complexity and material qualities. These qualifications are in addition to qualifications specified in other sections of this code.

The registered design professional in responsible charge and engineers of record involved in the design of the project are permitted to act as the approved agency and their personnel are permitted to act as the special inspector for the work designed by them, provided they qualify as special inspectors.

1704.2.2 Access for special inspection. The construction or work for which special inspection is required shall remain accessible and exposed for special inspection purposes until completion of the required special inspections.

1704.2.3 Statement of special inspections. The applicant shall submit a statement of special inspections in accordance with Section 107.1 *Chapter 1, Division II,* as a condition for permit issuance. This statement shall be in accordance with Section 1704.3.

Exception: A statement of special inspections is not required for portions of structures designed and constructed in accordance with the cold-formed steel light-frame construction provisions of Section 2211.7 or the conventional light-frame construction provisions of Section 2308.

1704.2.4 Report requirement. Special inspectors shall keep records of inspections. The special inspector shall furnish inspection reports to the building official, and to the registered design professional in responsible charge. Reports shall indicate that work inspected was or was not completed in conformance to approved construction documents. Discrepancies shall be brought to the immediate attention of the contractor for correction. If they are not corrected, the discrepancies shall be brought to the attention of the building official and to the registered design

TABLE 1705A.2.1
REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD[a]	CBC REFERENCE
1. Material verification of high-strength bolts, nuts and washers:				
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	—	X	AISC 360, Section A3.3 and applicable ASTM material standards	—
b. Manufacturer's certificate of compliance required.	—	X	—	—
2. Inspection of high-strength bolting:				
a. Snug-tight joints.	—	X	AISC 360, Section M2.5	—
b. Pretensioned and slip-critical joints using turn-of-nut with matchmarking, twist-off bolt or direct tension indicator methods of installation	—	X		—
c. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation.	X	—		—
3. Material verification of structural steel and cold-formed steel deck:				
a. For structural steel, identification markings to conform to AISC 360.	—	X	AISC 360, Section A3.1	2203A.1
b. For other steel, identification markings to conform to ASTM standards specified in the approved construction documents.	—	X	Applicable ASTM material standards	
c. Manufacturer's certified test reports.	—	X	—	—
4. Material verification of weld filler materials:				
a. Identification markings to conform to AWS specification in the approved construction documents.	—	X	AISC 360, Section A3.5 and applicable AWS A5 documents	—
b. Manufacturer's certificate of compliance required.	—	X	—	—
5. Inspection of welding:				
a. Structural steel and cold-formed steel deck:				
1. Complete and partial joint penetration groove welds	X	—	AWS D1.1	1705A.2.2
2. Multipass fillet welds.	X	—		
3. Single-pass fillet welds > 5/16"	X	—		
4.Plug and slot welds.	X	—		
5. Single-pass fillet welds ≤ 5/16"	—	X		
6. Floor and roof deck welds.	—	X	AWS D1.3	—
b. Reinforcing steel:				
1. Verification of weldability of reinforcing steel other than ASTM A 706.	—	X	AWS D1.4. ACI 318: Section 3.5.2	—
2. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special structural walls of concrete and shear reinforcement.	X	—		—
3. Shear reinforcement.	X			—
4. Other reinforcing steel.	—	X		—
6. Inspection of steel frame joint details for compliance:				
a. Details such as bracing and stiffening.	—	X	—	1705A.2.2
b. Member locations.	—	X	—	
c. Application of joint details at each connection.	—	X	—	

For SI: 1 inch = 25.4 mm.

a. Where applicable, see also Section 1705A.11, Special inspections for seismic resistance.

inspector shall verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

1705A.2.2.3 Steel joist and joist girder inspection. *Special inspection is required during the manufacture and welding of steel joists or joist girders. The special inspector shall verify that proper quality control procedures and tests have been employed for all materials and the manufacturing process, and shall perform visual inspection of the finished product. The special inspector shall place a distinguishing mark, and/or tag with this distinguishing mark, on each inspected joist or joist girder. This mark or tag shall remain on the joist or joist girder throughout the job site receiving and erection process.*

1705A.2.2.4 Light-framed steel truss inspection. *The manufacture of cold-formed light framed steel trusses shall be continuously inspected by a qualified special inspector approved by the enforcement agency. The special inspector shall verify conformance of materials and manufacture with approved plans and specifications. The special inspector shall place a distinguishing mark, and/or tag with this distinguishing mark, on each inspected truss. This mark or tag shall remain on the truss throughout the job site receiving and erection process.*

1705A.2.2.5 Inspection of structural welding. *Inspection of all shop and field welding operations shall be made by a qualified welding inspector approved by the enforcement agency. The minimum requirements for a qualified welding inspector shall be as those for an AWS certified welding inspector (CWI), as defined in the provisions of the AWS QC1. All welding inspectors shall be as approved by the enforcement agency.*

The welding inspector shall make a systematic daily record of all welds. In addition to other required records, this record shall include:

1. *Identification marks of welders.*
2. *List of defective welds.*
3. *Manner of correction of defects.*

The welding inspector shall check the material, details of construction and procedure, as well as workmanship of the welds. The inspector shall verify that the installation of end-welded stud shear connectors is in accordance with the requirements of AWS D1.1 and the approved plans and specifications. The inspector shall furnish the architect, structural engineer, and the enforcement agency with a verified report that the welding is proper and has been done in conformity with AWS D1.1, D1.8, and the approved construction documents.

1705*A*.3 Concrete construction. The special inspections and verifications for concrete construction shall be as required by this section and Table 1705*A*.3.

Exception: Special inspections shall not be required for concrete patios, driveways and sidewalks, on grade.

1705*A*.3.1 Materials. In the absence of sufficient data or documentation providing evidence of conformance to quality standards for materials in Chapter 3 of ACI 318, the building official shall require testing of materials in accordance with the appropriate standards and criteria for the material in Chapter 3 of ACI 318. Weldability of reinforcement, except that which conforms to ASTM A 706, shall be determined in accordance with the requirements of Section 3.5.2 of ACI 318.

1705A.3.2 Batch plant inspection. *Except as provided under Section 1705A.3.3, the quality and quantity of materials used in transit-mixed concrete and in batched aggregates shall be continuously inspected by an approved special inspector at the location where materials are measured.*

1705A.3.3 Waiver of continuous batch plant inspection. *Continuous batch plant inspection may be waived by the registered design professional, subject to approval by the enforcement agency under either of the following conditions:*

1. *The concrete plant complies fully with the requirements of ASTM C 94, Sections 8 and 9, and has a current certificate from the National Ready Mixed Concrete Association or another agency acceptable to the enforcement agency. The certification shall indicate that the plant has automatic batching and recording capabilities.*
2. *For single -story light-framed - buildings and isolated foundations supporting equipment only, where the specified compressive strength f'_c of the concrete delivered to the jobsite is 3,500 psi (24.13 MPa) and where the f'_c used in design is not greater than 3,000 psi (20.68 MPa).*

When continuous batch plant inspection is waived, the following periodic inspection requirements shall apply and shall be described in the construction documents:

1. *Qualified technician of the testing laboratory shall check the first batch at the start of the day.*
2. *Licensed weighmaster to positively identify materials as to quantity and certify to each load by a batch ticket.*
3. *Batch tickets, including material quantities and weights shall accompany the load, shall be transmitted to the inspector of record by a truck driver with load identified thereon. The load shall not be placed without a batch ticket identifying the mix. The inspector will keep a*

1705*A*.11 Special inspections for seismic resistance. Special inspections itemized in Sections 1705*A*.11.1 through 1705*A*.11.8, unless exempted by the exceptions of Section 1704*A*.2, are required for the following:

1. The seismic force-resisting systems in structures assigned to Seismic Design Category D, E or F in accordance with Sections 1705*A*.11.1 through 1705*A*.11.3, as applicable.
2. *Equipment/components requiring special seismic certification* assigned to Seismic Design Category D, E or F in accordance with Section 1705*A*.11.4.
3. Architectural, mechanical and electrical components in accordance with Sections 1705*A*.11.5 and 1705*A*.11.6.
4. Storage racks in structures assigned to Seismic Design Category D, E or F in accordance with Section 1705*A*.11.7.
5. Seismic isolation *and damping* systems in accordance with Section 1705*A*.11.8.

1705*A*.11.1 Structural steel. Special inspection for structural steel shall be in accordance with the quality assurance requirements of AISC 341 a*s modified by Section 1705A.2.1 of this code.*

1705*A*.11.2 Structural wood. Continuous special inspection is required during field gluing operations of elements of the seismic force-resisting system. Periodic special inspection is required for nailing, bolting, anchoring and other fastening of components within the seismic force-resisting system, including wood shear walls, wood diaphragms, drag struts, braces, shear panels and hold-downs.

1705*A*.11.3 Cold-formed steel light-frame construction. Periodic special inspection is required during welding operations of elements of the seismic force-resisting system. Periodic special inspection is required for screw attachment, bolting, anchoring and other fastening of components within the seismic force-resisting system, including shear walls, braces, diaphragms, collectors (drag struts) and hold-downs.

1705*A*.11.4 *Special inspection for special seismic certification.* The special inspector shall examine *equipment and components* requiring *special* seismic *certification* in accordance with Section *1705A.12.4* and verify that the label, anchorage or mounting conforms to the certificate of compliance.

1705*A*.11.5 Architectural components. Periodic special inspection is required during the erection and fastening of exterior cladding, interior and exterior nonbearing walls, *ceilings*, and interior and exterior veneer in structures assigned to Seismic Design Category D, E or F.

1705*A*.11.5.1 Access floors. Periodic special inspection is required for the anchorage of access floors in structures assigned to Seismic Design Category D, E or F.

1705*A*.11.6 Mechanical and electrical components. Special inspection for mechanical and electrical components shall be as follows:

1. Periodic special inspection is required during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Category D, E or F;
2. Periodic special inspection is required during the anchorage of other electrical equipment in structures assigned to Seismic Design Category *D*, E or F;
3. Periodic special inspection is required during the installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units in structures assigned to Seismic Design Category D, E or F;
4. Periodic special inspection is required during the installation and anchorage of ductwork designed to carry hazardous materials in structures assigned to Seismic Design Category D, E or F; and
5. Periodic special inspection is required during the installation and anchorage of vibration isolation systems in structures assigned to Seismic Design Category D, E or F where the construction documents require a nominal clearance of $^1/_4$ inch (6.4 mm) or less between the equipment support frame and restraint.

1705*A*.11.7 Storage racks. Periodic special inspection is required during the anchorage of storage racks 8 feet (2438 mm) or greater in height in structures assigned to Seismic Design Category D, E or F.

1705*A*.11.8 Seismic isolation *and damping systems.* Periodic special inspection shall be provided for seismic isolation systems during the fabrication and installation of isolator units and energy dissipation devices. *Continuous special inspection is required for prototype and production testing of isolator units and damping devices.*

1705*A*.12 Testing and *certification* for seismic resistance. The testing and *certification* specified in Sections 1705*A*.12.1 through 1705*A*.12.4, unless exempted from special inspections by the exceptions of Section 1704*A*.2 are required as follows:

1. The seismic force-resisting systems in structures assigned to Seismic Design Category D, E or F shall meet the requirements of Sections 1705*A*.12.1 and 1705*A*.12.2, as applicable.
2. *Equipment and components* in structures assigned to Seismic Design Category D, E or F *shall comply with* the *special seismic* certification requirements of Section *1705A.12.4*.
3. Architectural, mechanical and electrical components in structures assigned to Seismic Design Category D, E or F and where the requirements of ASCE 7 Section 13.2.1, *Item 2*, are met by submittal of manufacturer's certification, shall comply with Section 1705*A*.12.3.
4. The seismic isolation system in seismically isolated structures *and damping devices*, shall meet the testing requirements of Section *1705A.12.5.*

1705*A*.12.1 Concrete reinforcement. Where reinforcement complying with ASTM A 615 is used to resist earth-

quake-induced flexural and axial forces in special moment frames, special structural walls and coupling beams connecting special structural walls, in structures assigned to Seismic Design Category B, C, D, E or F, the reinforcement shall comply with Section 21.1.5.2 of ACI 318. Certified mill test reports shall be provided for each shipment of such reinforcement. Where reinforcement complying with ASTM A 615 is to be welded, chemical tests shall be performed to determine weldability in accordance with Section 3.5.2 of ACI 318.

1705*A*.12.2 Structural steel. Testing for structural steel shall be in accordance with the quality assurance requirements of AISC 341.

Exception: Testing for structural steel in structures assigned to Seismic Design Category C that are not specifically detailed for seismic resistance, with a response modification coefficient, *R*, of 3 or less, excluding cantilever column systems.

1705*A*.12.3 *Manufacturer's* certification of nonstructural components. The registered design professional shall specify on the construction documents the requirements for *manufacturer's* certification by analysis, testing or experience data for nonstructural components**,** in accordance with Section *13.2.1, Item 2* of ASCE 7, where such certification is required by Section 1705*A*.12.

Seismic sway braces satisfying requirements of FM 1950 shall be deemed to satisfy the requirements of this Section.

1705A.12.4 Special seismic certification. [OSHPD 1 & 4] The registered design professional shall specify on the construction documents the requirements for special seismic certification by analysis, testing or experience data for equipment and components listed in Section *1705A.12.4.1*.

Active or energized equipment and components shall be certified exclusively on the basis of approved shake table testing in accordance with ICC-ES AC 156.

Minimum of two equipment/components shall be tested for a product line with similar structural configuration. Where a range of products are tested, the two equipment/components shall be either the largest and smallest, or approved alternative representative equipment/components.

***Exception:** When a single product (and not a product line with more than one product with variations) is certified and manufacturing process is ISO 9001 certified, one test shall be permitted.*

All tests shall be performed by an independent laboratory having accreditation to the International Standards Organization (ISO) accreditation standard 17025 or shall be under the responsible charge of an independent California licensed engineer. Test reports shall be reviewed and accepted by an independent California licensed structural engineer.

For a multicomponent system, where active or energized components are certified by tests, connecting elements, attachments, and supports can be justified by supporting analysis.

***1705A.12.4.1** Special seismic certification shall be required for the following systems, equipment, and components:*

1. *Emergency and standby power systems.*
2. *Elevator equipment (excluding elevator cabs).*
3. *Components with hazardous contents.*
4. *Exhaust and smoke control fans.*
5. *Switchgear and switchboards.*
6. *Motor control centers.*
7. *Radiography and fluoroscopy systems in fluoroscopy rooms.*
8. *CT (Computerized Tomography) systems.*
9. *Air conditioning units.*
10. *Air handling units.*
11. *Chillers, evaporators, and condensers.*
12. *Cooling towers.*
13. *Transformers.*
14. *Electrical substations.*
15. *UPS and batteries.*
16. *Distribution panels.*
17. *Control panels.*
18. *Power isolation and correction systems.*
19. *Motorized surgical lighting systems.*
20. *Motorized operating table systems.*

Exceptions: <

1. *Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with this code.*
2. *Movable (mobile) and temporary equipment/components that are not anchored to structure or permanently attached to the building utility services such as electricity, gas or water. For the purposes of this requirement, "permanently attached" shall include all electrical connections except plugs for duplex receptacles.*
3. *Pipes, ducts, conduits and cable trays, excluding in-line equipment and components.*
4. *Underground tanks.*
5. *Electric motors and pumps not more than 10 hp rigidly supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with this code.*

4. Maximum allowable thickness of each lift of compacted fill material.
5. Field test method for determining the in-place dry density of the compacted fill.
6. Minimum acceptable in-place dry density expressed as a percentage of the maximum dry density determined in accordance with Item 3.
7. Number and frequency of field tests required to determine compliance with Item 6.

1803*A*.5.9 Controlled low-strength material (CLSM). Where shallow foundations will bear on controlled low-strength material (CLSM), a geotechnical investigation shall be conducted and shall include all of the following:

1. Specifications for the preparation of the site prior to placement of the CLSM.
2. Specifications for the CLSM.
3. Laboratory or field test method(s) to be used to determine the compressive strength or bearing capacity of the CLSM.
4. Test methods for determining the acceptance of the CLSM in the field.
5. Number and frequency of field tests required to determine compliance with Item 4.

1803*A*.5.10 Alternate setback and clearance. Where setbacks or clearances other than those required in Section 1808*A*.7 are desired, the building official shall be permitted to require a geotechnical investigation by a registered design professional to demonstrate that the intent of Section 1808*A*.7 would be satisfied. Such an investigation shall include consideration of material, height of slope, slope gradient, load intensity and erosion characteristics of slope material.

1803*A*.5.11 Seismic Design Categories C through F. For structures assigned to Seismic Design Category C, D, E or F, the geotechnical investigation shall be conducted, and shall include an evaluation of all of the following potential geologic and seismic hazards:

1. Slope instability.
2. Liquefaction.
3. Total and differential settlement.
4. Surface displacement due to faulting or seismically induced lateral spreading or lateral flow.

1803*A*.5.12 Seismic Design Categories D through F. For structures assigned to Seismic Design Category D, E or F, the geotechnical investigation required by Section 1803.5.11 shall also include all of the following as applicable:

1. The determination of dynamic seismic lateral earth pressures on foundation walls and retaining walls supporting more than 6 feet (1.83 m) of backfill height due to design earthquake ground motions.
2. The potential for liquefaction and soil strength loss evaluated for site peak ground acceleration, earthquake magnitude, and source characteristics consistent with the maximum considered earthquake ground motions. Peak ground acceleration shall be determined based on:
   2.1 A site-specific study in accordance with Section 21.5 of ASCE 7; or
   2.2 In accordance with Section 11.8.3 of ASCE 7.
3. An assessment of potential consequences of liquefaction and soil strength loss, including, but not limited to:
   3.1. Estimation of total and differential settlement;
   3.2. Lateral soil movement;
   3.3. Lateral soil loads on foundations;
   3.4. Reduction in foundation soil-bearing capacity and lateral soil reaction;
   3.5. Soil downdrag and reduction in axial and lateral soil reaction for pile foundations;
   3.6. Increases in soil lateral pressures on retaining walls; and
   3.7. Flotation of buried structures.
4. Discussion of mitigation measures such as, but not limited to:
   4.1. Selection of appropriate foundation type and depths;
   4.2. Selection of appropriate structural systems to accommodate anticipated displacements and forces;
   4.3. Ground stabilization; or
   4.4. Any combination of these measures and how they shall be considered in the design of the structure.

1803A.6 Geohazard reports. *Geohazard reports shall be required for all proposed construction.*

Exceptions:

1. *Reports are not required for one-story, wood-frame and light-steel-frame buildings of Type II or Type V construction and 4,000 square feet (371 m^2) or less in floor area, not located within Earthquake Fault Zones or Seismic Hazard Zones as shown in the most recently published maps from the California Geological Survey (CGS) or in seismic hazard zones as defined in the Safety Element of the local General Plan; nonstructural, associated structural or voluntary structural alterations, and incidental structural additions or alterations, and structural repairs for other than earthquake damage.*
2. *A previous report for a specific site may be resubmitted, provided that a reevaluation is made and the report is found to be currently appropriate.*

The purpose of the geohazard report shall be to identify geologic and seismic conditions that may require project mitigations. The reports shall contain data which provide an

assessment of the nature of the site and potential for earthquake damage based on appropriate investigations of the regional and site geology, project foundation conditions and the potential seismic shaking at the site. The report shall be prepared by a California-certified engineering geologist in consultation with a California-registered geotechnical engineer.

The preparation of the geohazard report shall consider the most recent CGS Note 48: Checklist for the Review of Engineering Geology and Seismology Reports for California Public School, Hospitals, and Essential Services Buildings. In addition, the most recent version of CGS Special Publication 42, Fault Rupture Hazard Zones in California, shall be considered for project sites proposed within an Alquist-Priolo Earthquake Fault Zone. The most recent version of CGS Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California, shall be considered for project sites proposed within a Seismic Hazard Zone. All conclusions shall be fully supported by satisfactory data and analysis.

In addition to requirements in Sections 1803A.5.11 and 1803A.5.12, the report shall include, but shall not be limited to, the following:

1. *Site geology.*
2. *Evaluation of the known active and potentially active faults, both regional and local.*
3. *Ground-motion parameters, as required by Sections 1613A and 1616A, and ASCE 7.*

The three Next Generation Attenuation (NGA) relations used for the 2008 USGS seismic hazards maps for Western United States (WUS) shall be utilized to determine the site-specific ground motion. When supported by data and analysis, other NGA relations, that were not used for the 2008 USGS maps, shall be permitted as additions or substitutions. No fewer than three NGA relations shall be utilized.

***1803A.7 Geotechnical* reporting.** Where geotechnical investigations are required, a written report of the investigations shall be submitted to the building official by the owner or authorized agent at the time of permit application. *The geotechnical report shall provide completed evaluations of the foundation conditions of the site and the potential geologic/seismic hazards affecting the site. The geotechnical report shall include, but shall not be limited to, site-specific evaluations of design criteria related to the nature and extent of foundation materials, groundwater conditions, liquefaction potential, settlement potential and slope stability. The report shall contain the results of the analyses of problem areas identified in the geohazard report. The geotechnical report shall incorporate estimates of the characteristics of site ground motion provided in the geohazard report.* This geotechnical report shall include, but need not be limited to, the following information:

1. A plot showing the location of the soil investigations.
2. A complete record of the soil boring and penetration test logs and soil samples.
3. A record of the soil profile.
4. Elevation of the water table, if encountered. *Historic high ground water elevations shall be addressed in the report to adequately evaluate liquefaction and settlement potential.*
5. Recommendations for foundation type and design criteria, including but not limited to: bearing capacity of natural or compacted soil; provisions to mitigate the effects of expansive soils; mitigation of the effects of liquefaction, differential settlement and varying soil strength; and the effects of adjacent loads.
6. Expected total and differential settlement.
7. Deep foundation information in accordance with Section 1803*A*.5.5.
8. Special design and construction provisions for foundations of structures founded on expansive soils, as necessary.
9. Compacted fill material properties and testing in accordance with Section 1803*A*.5.8.
10. Controlled low-strength material properties and testing in accordance with Section 1803*A*.5.9.
11. *The report shall consider the effects of stepped footings addressed in Section 1809A.3.*
12. *The report shall consider the effects of seismic hazards in accordance with Section 1803A.6 and shall incorporate the associated geohazard report.*

1803A.8 Geotechnical peer review. [DSA-SS and DSA-SS/CC] *When alternate foundations designs or ground improvements are employed or where slope stabilization is required, a qualified peer review by a California-licensed geotechnical engineer, in accordance with Section 3422, may be required by the enforcement agency. In Section 3422, where reference is made to structural or seismic-resisting system, it shall be replaced with geotechnical, foundation, or ground improvement, as appropriate.*

SECTION 1804*A*
EXCAVATION, GRADING AND FILL

1804*A*.1 Excavation near foundations. Excavation for any purpose shall not remove lateral support from any foundation without first underpinning or protecting the foundation against settlement or lateral translation.

1804*A*.2 Placement of backfill. The excavation outside the foundation shall be backfilled with soil that is free of organic material, construction debris, cobbles and boulders or with a controlled low-strength material (CLSM). The backfill shall be placed in lifts and compacted in a manner that does not damage the foundation or the waterproofing or dampproofing material.

Exception: CLSM need not be compacted.

1804*A*.3 Site grading. The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than one unit vertical in 20 units horizontal (5-percent slope) for a minimum distance of 10 feet (3048 mm) measured perpendicular to the face of the wall. If physical obstructions or lot lines prohibit 10 feet (3048 mm) of

ments, respectively. Special inspections in accordance with Section 1704*A*.10 shall be provided for helical piles.

SECTION 1811A
PRESTRESSED ROCK AND SOIL FOUNDATION ANCHORS

1811A.1 General. *The requirements of this section address the use of vertical rock and soil anchors in resisting seismic or wind overturning forces resulting in tension on shallow foundations.*

1811A.2 Adoption. *Except for the modifications as set forth in Sections 1811A.3 and 1811A.4, all prestressed rock and soil foundation anchors shall be designed in accordance with PTI Recommendations for Prestressed Rock and Soil Anchors.*

1811A.3 Geotechnical requirements. *Geotechnical report for the prestressed rock and soil foundation anchors shall address the following:*

1. *Minimum diameter and minimum spacing for the anchors including consideration of group effects.*
2. *Maximum unbonded length and minimum bonded length of the tendon.*
3. *Maximum recommended anchor tension capacity based upon the soil or rock strength/grout bond and anchor depth/spacing.*
4. *Allowable bond stress at the ground/grout interface and applicable factor of safety for ultimate bond stress.*
5. *Anchor axial tension stiffness recommendations at the anticipated anchor axial tension displacements, when required for structural analysis.*
6. *Minimum grout pressure for installation and post-grout pressure.*
7. *Class I Corrosion Protection is required for all permanent anchors. Geotechnical report shall specify the corrosion protection recommendations for temporary anchors.*
8. *Performance test shall be at a minimum of 1.6 times the design loads. There shall be a minimum of two preproduction test anchors. Preproduction test anchors shall be tested to ultimate load or 0.80 times the specified minimum tensile strength of the tendon. A creep test is required for all prestressed anchors with greater than 10 kips of lock-off prestressing load.*
9. *Lock-off prestressing load requirements.*
10. *Acceptable drilling methods.*
11. *Geotechnical observation and monitoring requirements.*

1811A.4 Structural Requirements.

1. *Tendons shall be thread-bar anchors conforming to ASTM A 722.*
2. *The anchors shall be placed vertical.*
3. *Design loads shall be based upon the load combinations in Section 1605A.3.1 and shall not exceed 60 percent of the specified minimum tensile strength of the tendons.*
4. *Ultimate load shall be based upon Section 1615A.1.10 and shall not exceed 80 percent of the specified minimum tensile strength of the tendons.*
5. *The anchor shall be designed to fail in grout bond to the soil or rock before pullout of the soil wedge by group effect.*
6. *Foundation design shall incorporate the effect of lock-off loads.*
7. *Design shall account for as-built locations of soil anchors considering all the acceptable construction tolerances.*
8. *Design shall account for both short and long term deformation.*
9. *Enforcement agency may require consideration of anchor deformation in evaluating deformation compatibility or building drift where it may be significant.*

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 19 – CONCRETE

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the user.
See Chapter 1 for state agency authority and building applications.)

Adopting agency	BSC	SFM	HCD			DSA			OSHPD				BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4								
Adopt entire chapter											X									
Adopt entire chapter as amended (amended sections listed below)	X		X	X				X		X										
Adopt only those sections that are listed below																				
Chapter / Section																				
1901.1.1								X												
1901.1.2								X												
1901.1.3								X												
1901.1.4								X												
1905.1.2	*X*																			
1905.1.3	*X*																			
1905.1.9	*X*		*X*	*X*																
1907.1.1			*X*	*X*																
1908.1.1										X										
1909.1.1										X										
1909.1.2										X										
1909.2 & subsections										X										
1913.1.1								X												
1913.2								*X*												
1913.2.1								*X*												
1913.2.2								X												
1913.2.3								X												
1913.2.4								X												
1913.2.5								X												
1913.2.6								X												
1913.2.7								X												
1913.2.8								X												
1913.2.9								X												
1913.2.10								X												
1913.2.11								X												
1913.2.11.1								X												
1913.2.11.2								X												
1913.2.11.3								X												
1913.2.11.4								X												
1913.2.11.5								X												
1913.3.1								*X*												
1913.3.2								X												
1913.3.3								X												
1913.3.4								X												
1913.3.5								X												
1913.3.6								X												
1913.3.7								X												
1913.3.8								X												

(continued)

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 19 – CONCRETE — continued

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the user.
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Adopting agency	BSC	SFM	HCD			DSA			OSHPD				CSA	DPH	AGR	DWR	CEC	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4								
Adopt entire chapter																				
Adopt entire chapter as amended (amended sections listed below)																				
Adopt only those sections that are listed below																				
Chapter / Section																				
1913.4.1								X												
1913.4.2								X												
1913.4.3								X												
1913.4.4								X												
1913.4.5								X												
1913.5								X												

thickness, a minimum of one bar shall be provided at the top and bottom of the footing. Continuity of reinforcement shall be provided at corners and intersections.

Exceptions:

1. *In Seismic Design Categories A, B and C, detached one- and two-family dwellings three stories or less in height constructed with stud-bearing walls, are permitted to have plain concrete footings without longitudinal reinforcement.*

2. *For foundation systems consisting of a plain concrete footing and a plain concrete stemwall, a minimum of one bar shall be provided at the top of the stemwall and at the bottom of the footing.*

3. *Where a slab on ground is cast monolithically with the footing, one No. 5 bar is permitted to be located at either the top of the slab or bottom of the footing.*

1905.1.9 ACI 318, Section D.3.3. *Modify ACI 318, Sections D.3.3.4.2, D.3.3.4.3(d) and D.3.3.5.2 to read as follows:*

D.3.3.4.2 - Where the tensile component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor tensile force associated with the same load combination, anchors and their attachments shall be designed in accordance with Section D.3.3.4.3. The anchor design tensile strength shall be determined in accordance with Section D.3.3.4.4.

Exception: *Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 and Section 1604.8.2 of this code shall be deemed to satisfy Section D.3.3.4.3(d).*

D.3.3.4.3(d) - The anchor or group of anchors shall be designed for the maximum tension obtained from design load combinations that include E, with E increased by Ω_0. The anchor design tensile strength shall be calculated from Section D.3.3.4.4

D.3.3.5.2 – Where the shear component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor shear force associated with the same load combination, anchors and their attachments shall be designed in accordance with Section D.3.3.5.3. The anchor design shear strength for resisting earthquake forces shall be determined in accordance with Section D.6.

Exceptions:

1. *For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or nonbearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane design shear strength in accordance with Sections D.6.2 and D.6.3 need not be computed and Section D.3.3.5.3 shall be deemed to be satisfied provided all of the following are met:*

   1.1. *The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.*

   1.2. *The maximum anchor nominal diameter is $^5/_8$ inches (16 mm).*

   1.3. *Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).*

   1.4. *Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.*

   1.5. *Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.*

   1.6. *The sill plate is 2-inch or 3-inch nominal thickness.*

2. *For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or nonbearing walls of anchor bolts attaching cold-formed steel track of bearing or nonbearing walls of light-frame construction to foundations or foundation stem walls the in-plane design shear strength in accordance with Sections D.6.2 and D.6.3 need not be computed and Section D.3.3.5.3 shall be deemed to be satisfied provided all of the following are met:*

   2.1. *The maximum anchor nominal diameter is $^5/_8$ inches (16 mm).*

   2.2. *Anchors are embedded into concrete a minimum of 7 inches (178 mm).*

   2.3. *Anchors are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.*

   2.4. *Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.*

   2.5. *The track is 33 to 68 mil designation thickness.*

   Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

3. *In light-frame construction, bearing or nonbearing walls, shear strength of concrete*

anchors less than or equal to $^5/_8$ inch (16 mm) in diameter of sill plate or track to foundation or foundation stem wall need not satisfy Section D.3.3.5.3 (a) through (c) when the design strength of the anchors is determined in accordance with Section D.6.2.1(c).

SECTION 1906
STRUCTURAL PLAIN CONCRETE

1906.1 Scope. The design and construction of structural plain concrete, both cast-in-place and precast, shall comply with the minimum requirements of ACI 318, as modified in Section 1905.

Exception: For Group R-3 occupancies and buildings of other occupancies less than two stories above grade plane of light-frame construction, the required footing thickness of ACI 318 is permitted to be reduced to 6 inches (152 mm), provided that the footing does not extend more than 4 inches (102 mm) on either side of the supported wall.

SECTION 1907
MINIMUM SLAB PROVISIONS

1907.1 General. The thickness of concrete floor slabs supported directly on the ground shall not be less than $3^1/_2$ inches (89 mm). A 6-mil (0.006 inch; 0.15 mm) polyethylene vapor retarder with joints lapped not less than 6 inches (152 mm) shall be placed between the base course or subgrade and the concrete floor slab, or other approved equivalent methods or materials shall be used to retard vapor transmission through the floor slab.

Exception: A vapor retarder is not required:

1. For detached structures accessory to occupancies in Group R-3, such as garages, utility buildings or other unheated facilities.
2. For unheated storage rooms having an area of less than 70 square feet (6.5 m^2) and carports attached to occupancies in Group R-3.
3. For buildings of other occupancies where migration of moisture through the slab from below will not be detrimental to the intended occupancy of the building.
4. For driveways, walks, patios and other flatwork which will not be enclosed at a later date.
5. Where approved based on local site conditions.

1907.1.1 [HCD 1] Capillary break. *When a vapor retarder is required, a capillary break shall be installed in accordance with the California Green Building Standards Code (CALGreen), Chapter 4, Division 4.5.*

SECTION 1908
ANCHORAGE TO CONCRETE—ALLOWABLE STRESS DESIGN

1908.1 Scope. The provisions of this section shall govern the allowable stress design of headed bolts and headed stud anchors cast in normal-weight concrete for purposes of transmitting structural loads from one connected element to the other. These provisions do not apply to anchors installed in hardened concrete or where load combinations include earthquake loads or effects. The bearing area of headed anchors shall be not less than one and one-half times the shank area. Where strength design is used, or where load combinations include earthquake loads or effects, the design strength of anchors shall be determined in accordance with Section 1909. Bolts shall conform to ASTM A 307 or an approved equivalent.

1908.1.1 Power Actuated Fasteners. [OSHPD 2] *Power actuated fasteners qualified in accordance with ICC-ES AC 70 shall be deemed to satisfy the requirements of this section.*

Power actuated fasteners shall be permitted in seismic shear for components exempt from construction documents review by ASCE 7 Section 13.1.4 and for interior nonbearing nonshear wall partitions. Power actuated fastener shall not be used to anchor exterior cladding or curtain wall systems.

1908.2 Allowable service load. The allowable service load for headed anchors in shear or tension shall be as indicated in Table 1908.2. Where anchors are subject to combined shear and tension, the following relationship shall be satisfied:

$$(P_s / P_t)^{5/3} + (V_s / V_t)^{5/3} \le 1 \qquad \textbf{(Equation 19-1)}$$

where:

P_s = Applied tension service load, pounds (N).

P_t = Allowable tension service load from Table 1908.2, pounds (N).

V_s = Applied shear service load, pounds (N).

V_t = Allowable shear service load from Table 1908.2, pounds (N).

1908.3 Required edge distance and spacing. The allowable service loads in tension and shear specified in Table 1908.2 are for the edge distance and spacing specified. The edge distance and spacing are permitted to be reduced to 50 percent of the values specified with an equal reduction in allowable service load. Where edge distance and spacing are reduced less than 50 percent, the allowable service load shall be determined by linear interpolation.

1908.4 Increase in allowable load. Increase of the values in Table 1908.2 by one-third is permitted where the provisions of Section 1605.3.2 permit an increase in allowable stress for wind loading.

1908.5 Increase for special inspection. Where special inspection is provided for the installation of anchors, a 100-percent increase in the allowable tension values of Table 1908.2 is permitted. No increase in shear value is permitted.

inches (457 mm), the wall above and below the floor line shall meet the requirements of ACI 318 Section 14.3.

1913.3.3 ACI 318, Section 21.9.2.2. *Modify ACI 318, Section 21.9.2.2 by adding the following:*

Where boundary members are not required by ACI 318 Section 21.9.6, minimum reinforcement parallel to the edges of all structural walls and the boundaries of all openings shall consist of twice the cross-sectional area of the minimum shear reinforcement required per lineal foot of wall. Horizontal extent of boundary element shall be per ACI 318 Section 21.9.6.4 (a) and (b).

1913.3.4 ACI 318, Section 21.9.4*. Modify ACI 318 by adding Section 21.9.4.6 as follows:*

21.9.4.6 - Walls and portions of walls with $P_u > 0.35P_o$ shall not be considered to contribute to the calculated strength of the structure for resisting earthquake-induced forces. Such walls shall conform to the requirements of ACI 318 Section 21.13.

1913.3.5 ACI 318, Section 21.11.4. *Modify ACI 318 Section 21.11.4 by adding the following:*

Collector and boundary elements in topping slabs placed over precast floor and roof elements shall not be less than 3 inches (76 mm) or 6 d_b thick, where d_b is the diameter of the largest reinforcement in the topping slab.

1913.3.6 ACI 318, Section 21.11.7. *Modify ACI 318 Section 21.11.7 by adding Section 21.11.7.7 as follows:*

21.11.7.7 - Where boundary members are not required by ACI 318 Section 21.11.7.5, minimum reinforcement parallel to the edges of all diaphragms and the boundaries of all openings shall consist of twice the cross-sectional area of the minimum shear reinforcement required per linear foot of diaphragm.

1913.3.7 ACI 318, Chapter 22. *Plain concrete is not permitted.*

1913.3.8 ACI 318, Section D.3.3. *Replace the requirements of Section 1905.1.9 with the following. Modify ACI 318, Sections D.3.3.4.2, D.3.3.4.3(d), and D.3.3.5.2 to read as follows:*

D.3.3.4.2 - Where the tensile component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor tensile force associated with the same load combination, anchors and their attachments shall be designed in accordance with Section D.3.3.4.3. The anchor design tensile strength shall be determined in accordance with Section D.3.3.4.4.

Exception:

Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 and Section 1604.8.2 of this code shall be deemed to satisfy Section D.3.3.4.3(d).

D.3.3.4.3(d) - The anchor or group of anchors shall be designed for the maximum tension obtained from design load combinations that include E, with E increased by Ω_0. The anchor design tensile strength shall be calculated from Section D.3.3.4.4.

D.3.3.5.2 - Where the shear component of the strength-level earthquake force applied to anchors exceeds 20 percent of the total factored anchor shear force associated with the same load combination, anchors and their attachments shall be designed in accordance with Section D.3.3.5.3. The anchor design shear strength for resisting earthquake forces shall be determined in accordance with Section D.6.

Exceptions:

1. *For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or nonbearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane design shear strength in accordance with Sections D.6.2 and D.6.3 need not be computed and Section D.3.3.5.3 shall be deemed to be satisfied, provided all of the following are met:*
   1.1. *The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.*
   1.2. *The maximum anchor nominal diameter is $^5/_8$ inches (16 mm).*
   1.3. *Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).*
   1.4. *Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.*
   1.5. *Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.*
   1.6. *The sill plate is 2-inch or 3-inch nominal thickness.*
2. *For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or nonbearing walls of anchor bolts attaching cold-formed steel track of bearing or nonbearing walls of light-frame construction to foundations or foundation stem walls the in-plane design shear strength in accordance with Sections D.6.2 and D.6.3 need not be computed and Section D.3.3.5.3 shall be deemed to be satisfied provided all of the following are met:*
   2.1. *The maximum anchor nominal diameter is $^5/_8$ inches (16 mm).*
   2.2. *Anchors are embedded into concrete a minimum of 7 inches (178 mm).*

2.3. *Anchors are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.*

2.4. *Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.*

2.5. *The track is 33 to 68 mil designation thickness.*

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100, Section E3.3.1.

3. *In light-frame construction, bearing or nonbearing walls, shear strength of concrete anchors less than or equal to $^5/_8$ inch (16 mm) in diameter of sill plate or track to foundation or foundation stem wall need not satisfy Section D.3.3.5.3 (a) through (c) when the design strength of the anchors is determined in accordance with Section D.6.2.1(c).*

1913.4 Shotcrete.

1913.4.1 Preconstruction tests. *A test panel prepared in accordance with Section 1913.5 is required. Approval from the enforcement agency must be obtained prior to performing test panels.*

1913.4.2 Surface preparation. *Concrete or masonry to receive shotcrete shall have the entire surface thoroughly cleaned and roughened by sand blasting, and just prior to receiving shotcrete, shall be thoroughly cleaned of all debris, dirt and dust. Concrete and masonry shall be wetted before shotcrete is deposited, but not so wet as to overcome suction.*

1913.4.3 Joints. *The film of laitance which forms on the surface of the shotcrete shall be removed within approximately two hours after application by brushing with a stiff broom. If this film is not removed within two hours, it shall be removed by thorough wire brushing or sand blasting. Construction joints over eight hours old shall be thoroughly cleaned with air and water prior to receiving shotcrete.*

1913.4.4 Forms and ground wires for shotcrete. *Forms for shotcrete shall be substantial and rigid. Forms shall be built and placed so as to permit the escape of air and rebound.*

Adequate ground wires, which are to be used as screeds, shall be placed to establish the thickness, surface planes and form of the shotcrete work. All surfaces shall be rodded to these wires.

1913.4.5 Placing. *Shotcrete shall be placed in accordance with ACI 506.*

1913.5 Existing concrete structures. *The structural use of existing concrete with a core strength less than 1,500 psi (10.3MPa) is not permitted in rehabilitation work.*

For existing concrete structures, sufficient cores shall be taken at representative locations throughout the structure, as designated by the architect or structural engineer, so that knowledge will be had of the in-place strength of the concrete. At least three cores shall be taken from each building for each 4,000 square feet (372 m^2) of floor area, or fraction thereof. Cores shall be at least 4 inches (102 mm) in diameter. Cores as small as 2.75 inches (70 mm) in diameter may be allowed by the enforcement agency when reinforcement is closely spaced and the coarse aggregate does not exceed $^3/_4$ inch (19 mm).

1904*A*.2 Concrete properties. Concrete mixtures shall conform to the most restrictive maximum water-cementitious materials ratios, maximum cementitious admixtures, minimum air-entrainment and minimum specified concrete compressive strength requirements of ACI 318 based on the exposure classes assigned in Section 1904*A*.1.

Exception: *For occupancies and appurtenances thereto in Group R occupancies that are in buildings less than four stories above grade plane, normal-weight aggregate concrete is permitted to comply with the requirements of Table 1904A.2 based on the weathering classification (freezing and thawing) determined from Figure 1904A.2 in lieu of the durability requirements of ACI 318.*

TABLE 1904*A*.2
MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'_c)

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'_c at 28 days, psi)		
	Negligible exposure	Moderate exposure	Severe exposure
Basement walls[c] and foundations not exposed to the weather	2,500	2,500	2,500[a]
Basement slabs and interior slabs on grade, except garage floor slabs	2,500	2,500	2,500[a]
Basement walls[c], foundation walls, exterior walls and other vertical concrete surfaces exposed to the weather	2,500	3,000[b]	3,000[b]
Driveways, curbs, walks, patios, porches, carport slabs, steps and other flatwork exposed to the weather, and garage floor slabs	2,500	3,000[b, d]	3,500[b, d]

For SI: 1 pound per square inch = 0.00689 MPa.

a. Concrete in these locations that can be subjected to freezing and thawing during construction shall be of air-entrained concrete in accordance with Section 1904*A*.2.

b. Concrete shall be air entrained in accordance with ACI 318.

c. Structural plain concrete basement walls are exempt from the requirements for exposure conditions of Section 1904*A*.2.

d. For garage floor slabs where a steel trowel finish is used, the total air content required by ACI 318 is permitted to be reduced to not less than 3 percent, provided the minimum specified compressive strength of the concrete is increased to 4,000 psi.

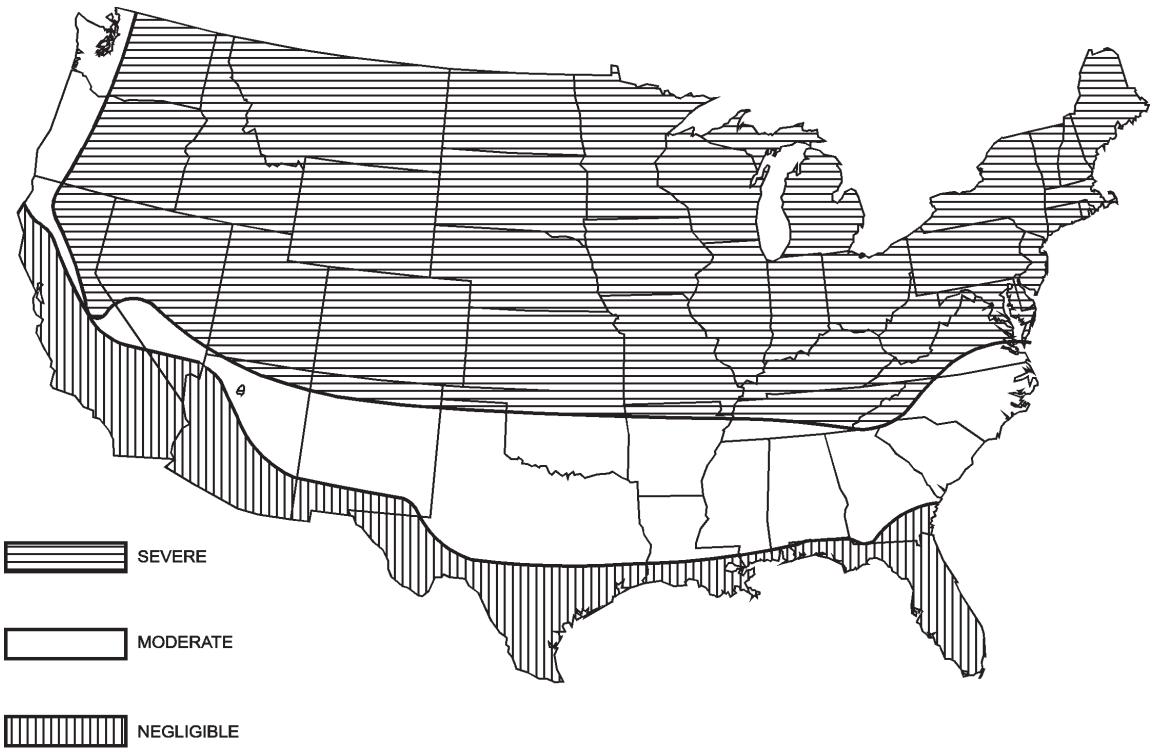

FIGURE 1904*A*.2
WEATHERING PROBABILITY MAP FOR CONCRETE[a, b, c]

a. Lines defining areas are approximate only. Local areas can be more or less severe than indicated by the region classification.

b. A "severe" classification is where weather conditions encourage or require the use of deicing chemicals or where there is potential for a continuous presence of moisture during frequent cycles of freezing and thawing. A "moderate" classification is where weather conditions occasionally expose concrete in the presence of moisture to freezing and thawing, but where deicing chemicals are not generally used. A "negligible" classification is where weather conditions rarely expose concrete in the presence of moisture to freezing and thawing.

c. Alaska and Hawaii are classified as severe and negligible, respectively.

SECTION 1905*A*
MODIFICATIONS TO ACI 318

1905*A*.1 General. The text of ACI 318 shall be modified as indicated in Sections 1905*A.1.1* through 1905*A.1.21*.

1905A.1.1 ACI 318, Section 5.1.1. *Modify ACI 318, Section 5.1.1, as follows:*

For concrete designed and constructed in accordance with this chapter, f'_c, shall not be less than 3,000 psi (20.7 MPa). Reinforced concrete with specified compressive strength higher than 8,000 psi (55 MPa) shall require prior approval of structural design method and acceptance criteria by the enforcement agency.

1905A.1.2 ACI 318, Section 5.6.2.1*. Replace ACI 318, Section 5.6.2.1, by the following:*

5.6.2.1 Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, or not less than once for each 50 cubic yards (38.2 m^3) of concrete, or not less than once for each 2,000 square feet (186 m^2) of surface area for slabs or walls. Additional samples for seven-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.

1905A.1.3 ACI 318, Section 8.13.5. *Replace ACI 318, Section 8.13.5, as follows:*

8.13.5 – Permanent burned clay or concrete tile fillers shall be considered only as forms and shall not be included in the calculations involving shear or bending moments.

The thickness of the concrete slab on the permanent fillers shall be designed as described in ACI 318, Section 8.13.6, as modified in Section 1905A.1.4.

1905A.1.4 ACI 318, Section 8.13.6. *Replace ACI 318, Section 8.13.6, as follows:*

8.13.6 – Where removable forms or fillers are used, the thickness of the concrete slab shall not be less than $1/12$ of the clear distance between joists and in no case less than $2\frac{1}{2}$ inches (64 mm). Such slab shall be reinforced at right angles to the joists with at least the amount of reinforcement required for flexure, considering load concentrations, if any, but in no case shall the reinforcement be less than that required by ACI 318, Section 7.12.

1905A.1.5 ACI 318, Section 8.13. *Add Section 8.13.9 to ACI 318 as follows:*

8.13.9 Concrete bridging. Concrete bridging shall be provided as follows: one near the center of spans for 20 to 30 feet (6096 mm to 9144 mm) spans and two near the third points of spans over 30 feet (9144 mm). Such bridging shall be either:

(a) A continuous concrete web having a depth equal to the joist and a width not less than $3\frac{1}{2}$ inches (89 mm) reinforced with a minimum of one No. 4 bar in the top and bottom; or

(b) Any other concrete element capable of transferring a concentrated load of 1,000 pounds (4.5 kN) from any joist to the two adjacent joists.

Such bridging shall not be required in roof framing if an individual member is capable of carrying dead load plus a concentrated load of 1,500 pounds (6.7 kN) at any point.

1905A.1.6 ACI 318, Section 10.5.3. *Modify ACI 318, Section 10.5.3, by adding the following:*

This section shall not be used for members that resist seismic loads, except that reinforcement provided for foundation elements for one-story wood-frame or one-story light steel buildings need not be more than one-third greater than that required by analysis for all loading conditions.

1905A.1.7 ACI 318, Section 12.14.3. *Add Section 12.14.3.6 to ACI 318 as follows:*

12.14.3.6 – Welded splices and mechanical connections shall maintain the clearance and coverage requirements of ACI 318, Sections 7.6 and 7.7.

1905A.1.8 ACI 318, Section 14.2.6. *Replace ACI 318, Section 14.2.6, as follows:*

14.2.6 – Walls shall be anchored to intersecting elements such as floors or roofs; or to columns, pilasters, buttresses, of intersecting walls and footings with reinforcement at least equivalent to No. 4 bars at 12 inches (305 mm) on center for each layer of reinforcement.

1905A.1.9 ACI 318, Section 14.5 – Empirical design method. *Not permitted by DSA-SS and OSHPD.*

1905A.1.10 ACI 318, Section 14.9. *Modify ACI 318 by adding Section 14.9 as follows:*

14.9 – Foundation walls. Horizontal reinforcing of concrete foundation walls for wood-frame or light-steel buildings shall consist of the equivalent of not less than one No. 5 bar located at the top and bottom of the wall. Where such walls exceed 3 feet (914 mm) in height, intermediate horizontal reinforcing shall be provided at spacing not to exceed 2 feet (610 mm) on center. Minimum vertical reinforcing shall consist of No. 3 bars at 24 inches (610 mm) on center.

Where concrete foundation walls or curbs extend above the floor line and support wood-frame or light-steel exterior, bearing or shear walls, they shall be doweled to the foundation wall below with a minimum of No. 3 bars at 24 inches (610 mm) on center. Where the height of the wall above the floor line exceeds 18 inches (457 mm), the wall above and below the floor line shall meet the requirements of ACI 318, Section 14.3.

1905A.1.11 ACI 318 Section 16. *Add Section 16.11 to ACI 318.1, as follows:*

16.11 – Reinforcement. Perimeters of precast walls shall be reinforced continuously with a minimum of one No. 5 bar extending the full height and width of the wall panel. Bars shall be continuous around corners. Where wall panels do not abut columns or other wall panels,

CHAPTER 21*A*

MASONRY

SECTION 2101*A*
GENERAL

2101*A*.1 Scope. This chapter shall govern the materials, design, construction and quality of masonry.

2101A.1.1 Application. *The scope of application of Chapter 21A is as follows:*

1. *Applications listed in Section 1.9.2.1 regulated by the Division of the State Architect-Structural Safety (DSA-SS). These applications include public elementary and secondary schools, community colleges and state-owned or state-leased essential services buildings.*
2. *Applications listed in Sections 1.10.1, and 1.10.4 regulated by the Office of Statewide Health Planning and Development (OSHPD).These applications include hospitals, skilled nursing facilities, intermediate care facilities and correctional treatment centers.*

   Exception: [OSHPD 2] *Single-story Type V skilled nursing or intermediate care facilities utilizing wood-frame or light-steel-frame construction as defined in Health and Safety Code Section 129725, which shall comply with Chapter 21 and any applicable amendments therein.*

2101A.1.2 Amendments in this chapter. *DSA-SS and OSHPD 1 & 4 adopt this chapter and all amendments.*

Exception: *Amendments adopted by only one agency appear in this chapter preceded with the appropriate acronym of the adopting agency, as follows:*

1. *Division of the State Architect-Structural Safety:*

   [DSA-SS] *For applications listed in Section 1.9.2.1.*

2. *Office of Statewide Health Planning and Development:*

   [OSHPD 1] - *For applications listed in Section 1.10.1.*

   [OSHPD 4] - *For applications listed in Section 1.10.4.*

2101A.1.3 Prohibition: *The following design, systems, and materials are not permitted by DSA-SS and OSHPD:*

1. *Unreinforced masonry*
2. *Autoclaved aerated concrete (AAC) masonry*
3. *Empirical design of masonry*
4. *Adobe construction*
5. *Ordinary reinforced masonry shear walls*
6. *Intermediate reinforced masonry shear walls*
7. *Prestressed masonry shear walls*
8. *Direct design of masonry*

2101A.2 Design methods. Masonry shall comply with the provisions of one of the following design methods in this chapter as well as the requirements of Sections 2101*A* through 2104*A*. Masonry designed by the allowable stress design provisions of Section 2101*A*.2.1, *or* the strength design provisions of Section 2101*A*.2.2, shall comply with Section 2105*A*.

2101*A*.2.1 Allowable stress design. Masonry designed by the allowable stress design method shall comply with the provisions of Sections 2106*A* and 2107*A*.

2101*A*.2.2 Strength design. Masonry designed by the strength design method shall comply with the provisions of Sections 2106*A* and 2108*A*.

2101*A*.2.3 Prestressed masonry. *Not permitted by DSA and OSHPD.*

2101*A*.2.4 Empirical design. *Not permitted by DSA and OSHPD.*

2101*A*.2.5 Glass unit masonry. Glass unit masonry shall comply with the provisions of Section 2110*A*.

2101*A*.2.6 Masonry veneer. Masonry veneer shall comply with the provisions of Chapter 14.

2101*A*.2.7 Direct design. *Not permitted by DSA and OSHPD.*

2101*A*.3 Construction documents. The construction documents shall show all of the items required by this code including the following:

1. Specified size, grade, type and location of reinforcement, anchors and wall ties.
2. Reinforcing bars to be welded and welding procedure.
3. Size and location of structural elements.
4. Provisions for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture.
5. Loads used in the design of masonry.
6. Specified compressive strength of masonry at stated ages or stages of construction for which masonry is designed, except where specifically exempted by this code.
7. Details of anchorage of masonry to structural members, frames and other construction, including the type, size and location of connectors.
8. Size and permitted location of conduits, pipes and sleeves.
9. The minimum level of testing and inspection as defined in Chapter 17*A*, or an itemized testing and inspection program that meets or exceeds the requirements of Chapter 17*A*.

2101*A*.3.1 Fireplace drawings. The construction documents shall describe in sufficient detail the location, size and construction of masonry fireplaces. The thickness and characteristics of materials and the clearances from walls, partitions and ceilings shall be indicated.

SECTION 2102*A*
DEFINITIONS AND NOTATIONS

2102*A*.1 General. The following terms are defined *in Chapter 2, except those defined below which shall, for the purposes of this chapter, have the meanings shown herein:*

AAC MASONRY.

ADOBE CONSTRUCTION.

Adobe, stabilized.

Adobe, unstabilized.

ANCHOR.

ARCHITECTURAL TERRA COTTA.

AREA.

Gross cross-sectional.

Net cross-sectional.

AUTOCLAVED AERATED CONCRETE (AAC).

BED JOINT.

BOND BEAM.

BRICK.

Calcium silicate (sand lime brick).

Clay or shale.

Concrete.

CAST STONE.

CELL.

CHIMNEY.

CHIMNEY TYPES.

High-heat appliance type.

Low-heat appliance type.

Masonry type.

Medium-heat appliance type.

CLEANOUT.

COLLAR JOINT.

COMPRESSIVE STRENGTH OF MASONRY.

DIMENSIONS.

Nominal.

Specified.

FIREPLACE.

FIREPLACE THROAT.

FOUNDATION PIER.

HEAD JOINT.

MASONRY.

Ashlar masonry.

Coursed ashlar.

Glass unit masonry.

Plain masonry.

Random ashlar.

Reinforced masonry.

Solid masonry.

Unreinforced (plain) masonry.

MASONRY UNIT.

Hollow.

Solid.

MORTAR.

MORTAR, SURFACE-BONDING.

PRESTRESSED MASONRY.

PRISM.

RUBBLE MASONRY.

Coursed rubble.

Random rubble.

Rough or ordinary rubble.

RUNNING BOND.

SHEAR WALL.

Detailed plain masonry shear wall.

Intermediate prestressed masonry shear wall.

Intermediate reinforced masonry shear wall.

Ordinary plain masonry shear wall.

Ordinary plain prestressed masonry shear wall.

Ordinary reinforced masonry shear wall.

Special prestressed masonry shear wall.

Special reinforced masonry shear wall.

SPECIFIED.

SPECIFIED COMPRESSIVE STRENGTH OF MASONRY, f'_m.

STACK BOND.

STONE MASONRY.

Ashlar stone masonry.

Rubble stone masonry.

STRENGTH.

Design strength.

Nominal strength.

Required strength.

THIN-BED MORTAR.

TIE, WALL.

TILE, STRUCTURAL CLAY.

2104*A*.1.4 Chases and recesses. Chases and recesses shall be constructed as masonry units are laid. Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels.

2104*A*.1.5 Lintels. The design for lintels shall be in accordance with the masonry design provisions of either Section 2107*A* or 2108*A*.

2104*A*.1.6 Support on wood. Masonry shall not be supported on wood girders or other forms of wood construction except as permitted in Section 2304.12.

2104*A*.2 Corbeled masonry. Corbeled masonry shall comply with the requirements of Section 1.12 of TMS 402/ACI 530/ASCE 5.

2104*A*.2.1 Molded cornices. Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of projecting masonry or molded cornices shall lie within the middle one-third of the supporting wall. Terra cotta and metal cornices shall be provided with a structural frame of approved noncombustible material anchored in an approved manner.

2104*A*.3 Cold weather construction. The cold weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 C, shall be implemented when the ambient temperature falls below 40°F (4°C).

2104*A*.4 Hot weather construction. The hot weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 D, shall be implemented when the ambient air temperature exceeds 100°F (37.8°C), or 90°F (32.2°C) with a wind velocity greater than 8 mph (12.9 km/hr).

2104A.5 Grouted masonry.

2104A.5.1 General conditions.*Grouted masonry shall be constructed in such a manner that all elements of the masonry act together as a structural element. At the time of laying, all masonry units shall be free of dust and dirt. Prior to grouting, the grout space shall be clean so that all spaces to be filled with grout do not contain mortar projections greater than $^1/_4$ inch (6.4 mm), mortar droppings and other foreign material. Grout shall be placed so that all spaces to be grouted do not contain voids.*

Grout materials and water content shall be controlled to provide adequate fluidity for placement without segregation of the constituents, and shall be mixed thoroughly. Segregation of the grout materials and damage to the masonry shall be avoided during the grouting process.

Reinforcement and embedded items shall be clean, properly positioned and securely anchored against movement prior to grouting. Bolts shall be accurately set with templates or by approved equivalent means and held in place to prevent dislocation during grouting. Reinforcement, embedded items and bolts shall be solidly embedded in grout. Anchor bolts in the face shells of hollow masonry units shall be positioned to maintain a minimum of $^1/_2$ in. of grout between the bolt and the face shell.

The grouting of any section of wall shall be completed in one day with no interruptions greater than one hour.

Grout pours greater than 12 inches (300 mm) in height shall be consolidated by mechanical vibration during placement to fill the grout space before loss of plasticity, and reconsolidated by mechanical vibration to minimize voids due to water loss. Grout pours less than 12 inches in height may be puddled.

Between grout pours, or where grouting has been stopped more than an hour, a horizontal construction joint shall be formed by stopping all wythes at the same elevation and with the grout stopping a minimum of $1^1/_2$ inches (38 mm) below a mortar joint, except at the top of the wall. Where bond beams occur, the grout pour shall be stopped a minimum of $^1/_2$ inch (12.7 mm) below the top of the masonry.

Grout shall not be handled nor pumped utilizing aluminum equipment unless it can be demonstrated with the materials and equipment to be used that there will be no deleterious effect on the strength of the grout.

2104A.5.1.1 Reinforced grouted masonry.

2104A.5.1.1.1 General. *Reinforced grouted masonry is that form of construction made with clay or shale brick or made with solid concrete building brick in which interior joints of masonry are filled by pouring grout around reinforcement therein as the work progresses.*

2104A.5.1.1.1.1 Low-lift grouted construction. *Requirements for construction shall be as follows:*

1. *All units in the two outer wythes shall be laid with full-shoved head joint and bed mortar joints. Masonry headers shall not project into the grout space.*
2. *The minimum grout space for low-lift grout masonry shall be $2^1/_2$ inches (64 mm). All reinforcement and wire ties shall be embedded in the grout. The thickness of the grout between masonry units and reinforcment shall be a minimum of one bar diameter.*
3. *One tier of a grouted reinforced masonry wall may be carried up 12 inches (305 mm) before grouting, but the other tier shall be laid up and grouted in lifts not to exceed one masonry unit in height. All grout shall be puddled with a mechanical vibrator or wood stick immediately after placing so as to completely fill all voids and to consolidate the grout. All vertical and horizontal steel shall be held firmly in place by a frame or suitable devices.*
4. *Toothing of masonry walls is prohibited. Racking is to be held to a minimum.*

2104A.5.1.1.1.2 High-lift grouted construction. *Where high-lift grouting is used, the method shall*

be subject to the approval of the enforcement agency. Requirements for construction shall be as follows:

1. *All units in the two wythes shall be laid with full head and bed mortar joints.*
2. *The two wythes shall be bonded together with wall ties. Ties shall not be less than No. 9 wire in the form of rectangles 4 inches (102 mm) wide and 2 inches (51 mm) in length less than the overall wall thickness. Kinks, water drips, or deformations shall not be permitted in the ties. One tier of the wall shall be built up not more than 16 inches (406 mm) ahead of the other tier. Ties shall be laid not to exceed 24 inches (610 mm) on center horizontally and 16 inches (406 mm) on center vertically for running bond, and not more than 24 inches (610 mm) on center horizontally and 12 inches (305 mm) on center vertically for stack bond.*
3. *Cleanouts shall be provided for each pour by leaving out every other unit in the bottom tier of the section being poured or by cleanout openings in the foundation. The foundation or other horizontal construction joints shall be cleaned of all loose material and mortar droppings before each pour. The cleanouts shall be sealed after inspection and before grouting.*
4. *The grout space in high-lift grouted masonry shall be a minimum of $3^1/_2$ inches (89 mm). All reinforcent and wire ties shall be embedded in the grout. The thickness of the grout between masonry units and reinforcent shall be a minimum of one bar diameter.*
5. *Vertical grout barriers or dams of solid masonry shall be built across the grout space the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall be spaced not more than 30 feet (9144 mm) apart.*
6. *An approved admixture of a type that reduces early water loss and produces an expansive action shall be used in high-lift grout.*
7. *Grouting shall be done in a continuous pour in lifts not exceeding 4 feet (1219 mm). Grout shall be consolidated by mechanical vibration only, and shall be reconsolidated after excess moisture has been absorbed, but before plasticity is lost. The grouting of any section of a wall between control barriers shall be completed in one day, with no interruptions greater than one hour.*

2104A.5.1.2 Reinforced hollow-unit masonry.

2104A.5.1.2.1 General. *Reinforced hollow-unit masonry is that type of construction made with hollow-masonry units in which cells are continuously filled with grout, and in which reinforcement is embedded. All cells shall be solidly filled with grout in reinforced hollow-unit masonry, except as provided in Section 2114A.1. Construction shall be one of the two following methods: The low-lift method where the maximum height of construction laid before grouting is 4 feet (1220 mm), or the high-lift method where the full height of construction between horizontal cold joints is grouted in one operation. General requirements for construction shall be as follows:*

1. *Bond shall be provided by lapping units in successive vertical courses. Where stack bond is used in reinforced hollow-unit masonry, the open-end type of unit shall be used with vertical reinforcement spaced a maximum of 16 inches (406 mm) on center.*
2. *Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear unobstructed, continuous vertical cell measuring not less than 2 inches by 3 inches (51 mm by 76 mm), except the minimum cell dimension for high-lift grout shall be 3 inches (76 mm).*
3. *Grout shall be a workable mix suitable for placing without segregation and shall be thoroughly mixed. Grout shall be placed by pumping or an approved alternate method and shall be placed before initial set or hardening occurs. Grout shall be consolidated by mechanical vibration during placing and reconsolidated after excess moisture has been absorbed, but before workability is lost.*
4. *All reinforcement and wire ties shall be embedded in the grout. The space between masonry unit surfaces and reinforcement shall be a minimum of one bar diameter.*
5. *Horizontal reinforcement shall be placed in bond beam units with a minimum grout cover of 1 inch (25 mm) above steel for each grout pour. The depth of the bond beam channel below the top of the unit shall be a minimum of $1^1/_2$ inches (38 mm) and the width shall be 3 inches (76 mm) minimum.*

2104A.5.1.2.2 Low-lift grouted construction. *Units shall be laid a maximum of 4 feet (1220 mm) before grouting. Grouting shall follow each 4 feet (1220 mm) of construction laid and shall be consolidated so as to completely fill all voids and embed all reinforcing steel. Horizontal reinforcement shall be fully embedded in grout in an uninterrupted pour.*

2104A.5.1.2.3 High-lift grouted construction. *Where high-lift grouting is used, the method shall*

2105*A*.3.3 Compliance. Compliance with the requirement for the specified compressive strength of masonry, f'_m, shall be considered satisfied provided the modified compressive strength equals or exceeds the specified f'_m. Additional testing of specimens cut from locations in question shall be permitted.

2105A.4 Masonry core testing. [OSHPD 1 & 4] *Not less than two cores shall be taken from each building for each 5,000 square feet (465 m^2) of the greater of the masonry wall area or the floor area or fraction thereof. The architect or structural engineer in responsible charge of the project or his or her representative or the inspector of record shall select the areas for sampling. Cores shall be a minimum of $3^3/_4$ inches (76 mm) in diameter and shall be taken in such a manner as to exclude masonry unit webs and reinforcing steel. The inspector of record or testing agency shall inspect the coring of the masonry walls.*

Visual examination of all cores shall be made by a laboratory acceptable to the building official and the condition of the cores reported as required by the California Administrative Code. One half of the number of cores taken shall be tested in shear. The shear test shall test both joints between the grout core and the outside wythes or face shells of the masonry. Shear testing apparatus shall be of a design approved by the enforcement agency. Core samples shall not be soaked before testing. The unit shear on the cross section of the core shall not be less than 2.5 $\sqrt{f'_m}$ psi.

All cores shall be submitted to the laboratory, acceptable to the building official, for examination regardless of whether the core specimens failed during the cutting operation. The laboratory shall report the location where each core was taken, the findings of their visual examination of each core, identify which cores were selected for shear testing and the results of the shear tests.

> ***2105A.5 [DSA-SS] Masonry core testing.*** *Not less than two cores shall be taken from each building for each 5,000 square feet (465 m^2) of the greater of the masonry wall area or the floor area or fraction thereof. The architect or structural engineer in responsible charge of the project or his/her representative or the inspector of record shall select the areas for sampling. Cores shall be a minimum of $3^3/_4$ inches (76 mm) in diameter and shall be taken in such a manner as to exclude masonry unit webs and reinforcing steel. If vertical reinforcing steel is placed such that cores will include reinforcing steel, core testing may be waived by the design professional in responsible charge, as approved by the enforcement agency. The inspector of record shall observe the coring of the masonry walls.*

Visual examination of all cores shall be made by a laboratory acceptable to the building official and the condition of the cores reported as required by the California Administrative Code. All cores taken shall be tested in shear. The shear test shall test both joints between the grout core and the outside wythes or face shell of the masonry. Shear testing apparatus shall be of a design approved by the enforcement agency. Core samples shall not be soaked before testing. The average unit shear on the cross section of all the cores shall not be less than 2.5 $\sqrt{f'_m}$ psi.

All cores shall be submitted to the laboratory, acceptable to the building official, for examination, regardless of whether the outside wythe or face shells separated during the cutting operation. The laboratory shall report the location where each core was taken, the findings of their visual examination of each core, and the results of the shear tests.

SECTION 2106*A*
SEISMIC DESIGN

2106*A*.1 Seismic design requirements for masonry. Masonry structures and components shall comply with the requirements in Section 1.18 of TMS 402/ACI 530/ASCE 5 depending on the structure's seismic design category.

2106A.1.1 Modifications to TMS 402/ACI 530/ASCE 5.

Modify TMS 402/ACI 530/ASCE 5/Section 1.18 as follows:

1. ***Minimum reinforcement requirements for masonry walls.*** *The total area of reinforcement in reinforced masonry walls shall not be less than 0.003 times the sectional area of the wall. Neither the horizontal nor the vertical reinforcement shall be less than one third of the total. Horizontal and vertical reinforcement shall be spaced at not more than 24 inches (610 mm) center to center. The minimum reinforcing shall be No. 4, except that No. 3 bars may be used for ties and stirrups. Vertical wall reinforcement shall have dowels of equal size and equal matched spacing in all footings. Reinforcement shall be continuous around wall corners and through intersections. Only reinforcement which is continuous in the wall shall be considered in computing the minimum area of reinforcement. Reinforcement with splices conforming to TMS 402/ACI 530/ASCE 5 as modified by Section 2107A and 2108A shall be considered as continuous reinforcement.*

   Horizontal reinforcement shall be provided in the top of footings, at the top of wall openings, at roof and floor levels, and at the top of parapet walls. For walls 12 inches (nominal) (305 mm) or more in thickness, horizontal and vertical reinforcement shall be equally divided into two layers, except where designed as retaining walls. Where reinforcement is added above the minimum requirements, such additional reinforcement need not be so divided.

   In bearing walls of every type of reinforced masonry, there shall be trim reinforcement of not less than one No. 5 bar or two No. 4 bars on all sides of, and adjacent to, every opening which exceeds 16 inches (406 mm) in either direction, and such bars shall extend not less than 48 diameters, but in no case less than 24 inches (610 mm) beyond the corners of the opening. The bars required by this paragraph shall be in addition to the minimum reinforcement elsewhere required.

When the reinforcement in bearing walls is designed, placed and anchored in position as for columns, the allowable stresses shall be as for columns.

Joint reinforcement shall not be used as principal reinforcement in masonry designed by the strength design method.

2. ***Minimum reinforcement for masonry columns.*** *The spacing of column ties shall be as follows: not greater than 8 bar diameters, 24 tie diameters, or one half the least dimension of the column for the full column height. Ties shall be at least $^3/_8$-inch (10 mm) diameter and shall be embedded in grout. Top tie shall be within 2 inches (51 mm) of the top of the column or of the bottom of the horizontal bar in the supported beam.*

3. ***Lateral support.*** *Lateral support of masonry may be provided by cross walls, columns, pilasters, counterforts or buttresses where spanning horizontally or by floors, beams, girts or roofs where spanning vertically. Where walls are supported laterally by vertical elements, the stiffness of each vertical element shall exceed that of the tributary area of the wall.*

4. ***Anchor bolts.*** *Bent bar anchor bolts shall not be allowed. The maximum size anchor shall be $^1/_2$-inch (13 mm) diameter for 6-inch (152 mm) nominal masonry, $^3/_4$-inch (19 mm) diameter for 8-inch (203 mm) nominal masonry, $^7/_8$-inch (22 mm) diameter for 10-inch (254 mm) nominal masonry, and 1-inch (25mm) diameter for 12-inch (304.8 mm) nominal masonry.*

SECTION 2107*A*
ALLOWABLE STRESS DESIGN

2107*A*.1 General. The design of masonry structures using allowable stress design shall comply with Section 2106*A* and the requirements of Chapters 1 and 2 of TMS 402/ACI 530/ ASCE 5 except as modified by Sections 2107*A*.2 through *2107A.6*.

2107*A*.2 TMS 402/ACI 530/ASCE 5, Section *2.1.7.7.1.1*, lap splices. In lieu of Section *2.1.7.7.1.1*, it shall be permitted to design lap splices in accordance with Section 2107A.*2.1*.

2107*A*.2.1 Lap splices. The minimum length of lap splices for reinforcing bars in tension or compression, l_d, shall be

$$l_d = 0.002 d_b f_s \qquad \textbf{(Equation 21A-1)}$$

For SI: $l_d = 0.29 d_b f_s$

but not less than 12 inches (305 mm). In no case shall the length of the lapped splice be less than 40 bar diameters, *and need not be greater than 72 bar diameters.*

where:

d_b = Diameter of reinforcement, inches (mm).

f_s = Computed stress in reinforcement due to design loads, psi (MPa).

In regions of moment where the design tensile stresses in the reinforcement are greater than 80 percent of the allowable steel tension stress, F_s, the lap length of splices shall be increased not less than 50 percent of the minimum required length. Other equivalent means of stress transfer to accomplish the same 50 percent increase shall be permitted. Where epoxy coated bars are used, lap length shall be increased by 50 percent.

2107*A*.3 TMS 402/ACI 530/ASCE 5, Section *2.1.7.7*, splices of reinforcement. Modify Section *2.1.7.7* as follows:

2.1.7.7 Splices of reinforcement. Lap splices, welded splices or mechanical splices are permitted in accordance with the provisions of this section. All welding shall conform to AWS D1.4. Welded splices shall be of ASTM A 706 steel reinforcement. Reinforcement larger than No. 9 (M #29) shall be spliced using mechanical connections in accordance with Section *2.1.7.7.3*.

2107*A*.4 TMS 402/ACI 530/ASCE 5, Section 2.3.7, maximum bar size. Add the following to Chapter 2:

2.3.7 Maximum bar size. The bar diameter shall not exceed one-eighth of the nominal wall thickness and shall not exceed one-quarter of the least dimension of the cell, course or collar joint in which it is placed.

2107A.5 TMS 402/ACI 530/ASCE 5. *Modify by adding Section 2.1.8, as follows:*

2.1.8 - Walls and Piers.

Thickness of Walls. *For thickness limitations of walls as specified in this chapter, nominal thickness shall be used. Stresses shall be determined on the basis of the net thickness of the masonry, with consideration for reduction, such as raked joints.*

The thickness of masonry walls shall be designed so that allowable maximum stresses specified in this chapter are not exceeded. Also, no masonry wall shall exceed the height or length-to-thickness ratio or the minimum thickness as specified in this chapter and as set forth in Table 2107A.5, below.

Piers. *Every pier or wall section which width is less than three times its thickness shall be designed and constructed as required for columns if such pier is a structural member. Every pier or wall section which width is between three and five times its thickness or less than one half the height of adjacent openings shall have all horizontal steel in the form of ties except that in walls 12 inches (305 mm) or less in thickness such steel may be in the form of hairpins.*

2107A.6 [OSHPD 1 & 4] Modify TMS402/ACI 530/ASCE 5, Section 2.3.4.4 by the following:

All reinforced masonry components that are subjected to in-plane forces shall have a maximum reinforcement ratio, ρ_{max}, not greater than that computed by Equation 2-23.

CHAPTER 22*A*

STEEL

SECTION 2201*A* GENERAL

2201*A*.1 Scope. The provisions of this chapter govern the quality, design, fabrication and erection of steel used structurally in buildings or structures.

2201A.1.1 Application. *The scope of application of Chapter 22A is as follows:*

1. *Structures regulated by the Division of the State Architect-Structural Safety (DSA-SS), which include those applications listed in Section 1.9.2.1. These applications include public elementary and secondary schools, community colleges and state- owned or state-leased essential services buildings.*
2. *Structures regulated by the Office of Statewide Health Planning and Development (OSHPD), which include those applications listed in Sections 1.10.1, and 1.10.4. These applications include hospitals, skilled nursing facilities, intermediate care facilities and correctional treatment centers.*

   Exception: [OSHPD 2] *Single-story Type V skilled nursing or intermediate care facilities utilizing wood-frame or light-steel-frame construction as defined in Health and Safety Code Section 129725, which shall comply with Chapter 22 and any applicable amendments therein.*

2201A.1.2 Identification of amendments. *DSA-SS and OSHPD adopt this chapter and all amendments.*

Exception: *Amendments adopted by only one agency appear in this chapter preceded with the appropriate acronym of the adopting agency, as follows:*

1. *Division of the State Architect-Structural Safety:* ***[DSA-SS]*** *For applications listed in Section 1.9.2.1.*
2. *Office of Statewide Health Planning and Development:*

   [OSHPD 1] *- For applications listed in Section 1.10.1.*

   [OSHPD 4] *- For applications listed in Section 1.10.4*

SECTION 2202*A* DEFINITIONS

2202*A*.1 Definitions. The following terms *are defined in Chapter 2.*

STEEL CONSTRUCTION, COLD-FORMED.

STEEL JOIST.

STEEL MEMBER, STRUCTURAL.

SECTION 2203*A* IDENTIFICATION AND PROTECTION OF STEEL FOR STRUCTURAL PURPOSES

2203*A*.1 Identification. Identification of structural steel members shall comply with the requirements contained in AISC 360. Identification of cold-formed steel members shall comply with the requirements contained in AISI S100. Identification of cold-formed steel light-frame construction shall also comply with the requirements contained in AISI S200. Other steel furnished for structural load-carrying purposes shall be properly identified for conformity to the ordered grade in accordance with the specified ASTM standard or other specification and the provisions of this chapter. Steel that is not readily identifiable as to grade from marking and test records shall be tested to determine conformity to such standards.

2203*A*.2 Protection. Painting of structural steel members shall comply with the requirements contained in AISC 360. Painting of open-web steel joists and joist girders shall comply with the requirements of SJI CJ-1.0, SJI JG-1.1, SJI K-1.1 and SJI LH/DLH-1.1. Individual structural members and assembled panels of cold-formed steel construction shall be protected against corrosion in accordance with the requirements contained in AISI S100. Protection of cold-formed steel light- frame construction shall also comply with the requirements contained in AISI S200.

SECTION 2204*A* CONNECTIONS

2204*A*.1 Welding. The details of design, workmanship and technique for welding, inspection of welding and qualification of welding operators shall conform to the requirements of the specifications listed in Sections 2205*A*, 2206*A*, 2207*A*, 2208*A*, 2210*A* and 2211*A*. Special inspection of welding shall be provided where required by Section 1705*A*.

2204*A*.2 Bolting. The design, installation and inspection of bolts shall be in accordance with the requirements of the specifications listed in Sections 2205*A*, 2206*A*, 2207*A*, 2210*A* and 2211*A*. Special inspection of the installation of high-strength bolts shall be provided where required by Section 1705*A*.

2204*A*.2.1 Anchor rods. Anchor rods shall be set in accordance with the construction documents. The protrusion of the threaded ends through the connected material shall fully engage the threads of the nuts, but shall not be greater than the length of the threads on the bolts.

2204A.2.2 Column base plate. *When shear and/or tensile forces are intended to be transferred between column base plates and anchor bolts, provisions shall be made in the design to eliminate the effects of oversized holes permitted in base plates by AISC 360 by use of shear lugs and/or welded shear transfer plates or other means acceptable to*

the enforcement agency, when the oversized holes are larger than the anchor bolt by more than $^1/_8$ inch (3.2 mm). When welded shear transfer plates and shear lugs or other means acceptable to the enforcement agency are not used, the anchor bolts shall be checked for the induced bending stresses in combination with the shear stresses.

SECTION 2205*A*
STRUCTURAL STEEL

2205*A*.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 structural steel structures shall be in accordance with the additional provisions of Section 2205A.2.

2205*A*.2 Seismic requirements for structural steel structures. The design of structural steel structures to resist seismic forces shall be in accordance with the provisions of Section 2205*A*.2.2, as applicable.

> **2205*A*.2.1 Seismic Design Category B or C.** *Not permitted by DSA-SS and OSHPD.*

2205*A*.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.

2205A.3 Modifications to AISC 341. [DSA-SS]

2205A.3.1 Section D1. *Add Section D1.6 as follows:*

6. Diaphragm bracing systems. *The required strength of diagonal bracing members used as the diaphragm shall be determined from either of the following:*

(1) The load effect resulting from the diaphragm analysis per the applicable building code provided the members satisfy all of the following requirements:

1. Diagonal bracing members comply with Section D1.1 for moderately ductile members.

2. Each diagonal bracing member resists no more than 30 percent of the diaphragm shear at each line of resistance.

3. Diagonal bracing members shall not support gravity loads other than self-weight.

(2) The load effect required for collectors using the load combinations stipulated in the applicable building code.

2205A.3.2 Section D2. *Modify Section D2.6c(b)(ii) as follows:*

(ii) the moment calculated using the load combinations of the applicable building code, including the amplified seismic load, provided the connection or other mechanism within the column base is designed to have the ductility necessary to accommodate the column base rotation resulting from the design story drift.

2205A.3.3 Section D2. *Add Section D2.9 as follows:*

9. Diaphragm bracing systems. *The required strength of the connections of diagonal bracing members used as the diaphragm shall be the load effect required for collectors using the load combinations stipulated in the applicable building code.*

2205A.3.4 Section F2. *Modify Section F2.3 Exception (2)(a) as follows:*

(a) The *maximum of the* forces determined using load combination stipulated by the applicable building code including the amplified seismic load, applied to the building frame model in which all compression braces have been removed *and those determined with no compression braces removed per D1.4a(2).*

2205A.3.5 Section F2. *Modify Section F2.4a by adding the following:*

Where each framing bay on a line of resistance does not have opposing diagonal braces within the same column bay, then the collector forces along that line shall be designed considering the redistribution of seismic forces to other bays as a result of the post-buckled redistribution of loads using the analysis requirements of Section F2.3. The collector shall not be designed for a load less than that stipulated by the applicable building code.

2205A.4 Modifications to AISC 341. [OSHPD 1 and 4]

2205A.4.1 Glossary. *Modify glossary by adding the following:*

Inelastic Rotation: *The permanent or plastic portion of the rotation angle between a beam and the column, or between a link and the column of the test specimen, measured in radians. The inelastic rotation shall be computed based upon an analysis of the test specimen deformations. Sources of inelastic rotation include yielding of members and connectors, yielding of connection elements and slip between members and connection elements. For beam-to-column moment connections in special moment frames, the inelastic rotation is represented by the plastic chord rotation angle calculated as the plastic deflection of the beam or girder, at the center of its span divided by the distance between the center of the beam span and the centerline of the panel zone of the beam-column connection. For link-to-column connections in eccentrically braced frames, inelastic rotation shall be computed based upon the assumption that inelastic action is concentrated at a single point located at the intersection of the centerline of the link with the face of the column.*

2205A.4.2 Section E3. *Replace Section E3.6b Item 1 by the following:*

(1) The connection shall be capable of sustaining an interstory drift angle of at least 0.04 radians and an inelastic rotation of 0.03 radians.

2205A.4.3 Section E3*. Replace Section E3.6c Item # a by the following:*

(a) Use of SMF connections designed in accordance with ANSI /AISC 358 shall be as modified in Section 2205A.4.

2205A.4.4 Section F2. *Special concentrically braced frames (SCBF) modifications*

5b. Diagonal braces, Add a new section as follows.

(4) The use of rectangular or square HSS are not permitted for bracing members, unless filled solid with cement grout having a minimum compressive strength of 3000 psi at 28 days. The effects of composite action in the filled composite brace shall be considered in the sectional properties of the system where it results in the more severe loading condition or detailing.

2205A.4.5 Section F3*. Modify Section F3.6e Item 2 as follows:*

Exception is not permitted.

2205A.4.6 Section K2. *Replace Section K2.3b as follows:*

The size of the beam or link used in the test specimen shall be within the following limits:

1. *At least one of the test beams or links shall be no less than 100 percent of the depth of the prototype beam or link. For the remaining specimens, the depth of the test beam or link shall be no less than 90 percent of the depth of the prototype beam or link.*
2. *At least one of the test beams or links shall be no less than 100 percent of the weight per foot of the prototype beam or link. For the remaining specimens, the weight per foot of the test beam or link shall be no less than 75 percent of the weight per foot of the prototype beam or link.*

The size of the column used in the test specimen shall properly represent the inelastic action in the column, as per the requirements in Section K2.3a. In addition, the depth of the test column shall be no less than 90 percent of the depth of the prototype column.

Extrapolation beyond the limitations stated in this section shall be permitted subject to peer review and approval by the enforcement agency.

2205A.4.7 Section K2. *Modify Section K2.8 by the following:*

The test specimen must sustain the required interstory drift angle, or link rotation angle, and inelastic rotation for at least two complete loading cycles.

2205A.5 Modifications to AISC 358. [OSHPD 1 and 4]

2205A.5.1.2. *Design Requirements, 2.1 Special and Intermediate Moment Frame Connection Types, Table 2-1 Prequalified Moment Connections modifications.*

The prequalified bolted moment connections are not permitted in buildings.

Exceptions:

1. *Erection bolts are permitted.*
2. *The approved moment connection in accordance with AISC 358 Chapter 10 as permitted by the exception to Section 2206A.2.*

SECTION 2206*A*
COMPOSITE STRUCTURAL STEEL AND CONCRETE STRUCTURES

2206*A*.1 General. Systems of structural steel acting compositely with reinforced concrete shall be designed in accordance with AISC 360 and ACI 318, excluding ACI 318 Chapter 22. Where required, the seismic design of composite steel and concrete systems shall be in accordance with the additional provisions of Section 2206*A*.2.

2206*A*.2 Seismic requirements for composite structural steel and concrete construction. Where a response modification coefficient, *R*, in accordance with ASCE 7, Table 12.2-1 is used for the design of systems of structural steel acting compositely with reinforced concrete, the structures shall be designed and detailed in accordance with the requirements of AISC 341 *and shall be considered as an alternative system.*

Exception: *Steel and concrete composite special moment frame with the approved moment connections in accordance with AISC 358 Chapter 10 shall be permitted, provided:*

1. *Beams are provided with reduced beam sections (RBS),*
2. *Columns shall be hollow structural sections (HSS) and completely filled with structural concrete having unit weight not less than 110 pounds per cubic foot (17 kN/m^3). Concrete shall have 28-day compressive strength not less than 4,000 psi (28 MPa).*
3. *Web extension to beam web two sided fillet weld welds are sized to develop expected strength of the beam web and shall not be less than a $^1/_4$ inch fillet weld,*
4. *The high-strength bolt design shall consider interaction between shear and tension as required by AISC 360, and*
5. *The HSS shall not be less than $^1/_2$ inch.*

SECTION 2207*A*
STEEL JOISTS

2207*A*.1 General. The design, manufacture and use of open web steel joists and joist girders shall be in accordance with one of the following Steel Joist Institute (SJI) specifications:

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

Where required, the seismic design of buildings shall be in accordance with the additional provisions of Section 2205*A*.2 or 2210*A*.5.

2207*A*.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 2207*A*.1 and shall indicate the requirements for joist and joist girder design, layout, end supports, anchorage, non-SJI standard bridging, bridging termination connections and bearing connection design to resist uplift and lateral loads. These documents shall indicate special requirements as follows:

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

2207*A*.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 2207*A*.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.

2207*A*.4 Steel joist drawings. Steel joist placement plans shall be provided to show the steel joist products as specified on the construction documents and are to be utilized for field installation in accordance with specific project requirements as stated in Section 2207*A*.2. Steel placement plans shall include, at a minimum, the following:

1. Listing of all applicable loads as stated in Section 2207*A*.2 and used in the design of the steel joists and joist girders as specified in the construction documents.
2. Profiles for nonstandard joist and joist girder configurations (standard joist and joist girder configurations are as indicated in the SJI catalog).
3. Connection requirements for:
    3.1. Joist supports;
    3.2. Joist girder supports;
    3.3. Field splices; and
    3.4. Bridging attachments.
4. Deflection criteria for live and total loads for non-SJI standard joists.
5. Size, location and connections for all bridging.
6. Joist headers.

2207A.4.1 Design approval. [DSA-SS] *Joist and joist girder design calculations and profiles with member sizes and connection details, and joist placement plans shall be provided to the enforcement agency and approved prior to joist fabrication, in accordance with the California Administrative Code (Title 24, Part 1). Joist and joist girder design calculations and profiles with member sizes and connection details 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 and joist girder design calculations and profiles with member sizes and connection details, or to fabricated joists are subject to the approval of the enforcement agency.*

2207A.5 **Certification.** At completion of manufacture, the steel joist manufacturer shall submit a certificate of compliance in accordance with Section 1704*A*.2.2 stating that work was performed in accordance with approved construction documents and with SJI standard specifications.

2207A.6 Joist chord bracing. *The chords of all joists shall be laterally supported at all points where the chords change direction.*

SECTION 2208*A*
STEEL CABLE STRUCTURES

2208*A*.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.

SECTION 2209*A*
STEEL STORAGE RACKS

2209*A*.1 Storage racks. The design, testing and utilization of industrial steel storage racks made of cold-formed or hot-rolled steel structural members, shall be in accordance with RMI/ANSI MH 16.1. Where required by ASCE 7, the seismic design of storage racks shall be in accordance with the provisions of Section 15.5.3 of ASCE 7, except that the mapped acceleration parameters, S_s and S_1, shall be determined in accordance with Section 1613*A*.3.1.

adjoining slabs or 4-inch (102 mm) concrete barrier seat off installed.

2304.11.3 Laminated timbers. The portions of glued-laminated timbers that form the structural supports of a building or other structure and are exposed to weather and not fully protected from moisture by a roof, eave or similar covering shall be pressure treated with preservative or be manufactured from naturally durable or preservative-treated wood.

2304.11.4 Wood in contact with the ground or fresh water. Wood used in contact with the ground (exposed earth) in the locations specified in Sections 2304.11.4.1 and 2304.11.4.2 shall be naturally durable (species for both decay and termite resistance) or preservative treated using water-borne preservatives in accordance with AWPA U1 (Commodity Specifications A or F) for soil or fresh water use.

Exception: Untreated wood is permitted where such wood is continuously and entirely below the ground-water level or submerged in fresh water.

2304.11.4.1 Posts or columns. Posts and columns supporting permanent structures that are embedded in concrete that is in direct contact with the earth, embedded in concrete that is exposed to the weather or in direct contact with the earth shall be of preservative-treated wood.

2304.11.4.2 Wood structural members. Wood structural members that support moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, shall be of naturally durable or preservative-treated wood unless separated from such floors or roofs by an impervious moisture barrier.

2304.11.5 Supporting member for permanent appurtenances. Naturally durable or preservative-treated wood shall be utilized for those portions of wood members that form the structural supports of buildings, balconies, porches or similar permanent building appurtenances where such members are exposed to the weather without adequate protection from a roof, eave, overhang or other covering to prevent moisture or water accumulation on the surface or at joints between members.

Exception: When a building is located in a geographical region where experience has demonstrated that climatic conditions preclude the need to use durable materials where the structure is exposed to the weather.

2304.11.6 Termite protection. In geographical areas where hazard of termite damage is known to be very heavy, wood floor framing in the locations specified in Section 2304.11.2.1 and exposed framing of exterior decks or balconies shall be of naturally durable species (termite resistant) or preservative treated in accordance with AWPA U1 for the species, product preservative and end use or provided with approved methods of termite protection.

2304.11.7 Wood used in retaining walls and cribs. Wood installed in retaining or crib walls shall be preservative treated in accordance with AWPA U1 (Commodity Specifications A or F) for soil and fresh water use.

2304.11.8 Attic ventilation. For attic ventilation, see Section 1203.2.

2304.11.9 Under-floor ventilation (crawl space). For under-floor ventilation (crawl space), see Section 1203.3.

2304.11.10 Earth fills. [SPCB] *Separate the earth fills such as under porches or paving from all woodwork by concrete, masonry, good quality cement plaster or other material approved by local building codes. Chemical treatment of earth fills is considered adequate if the foundation adjoining the fill meets standards of the current building codes.*

2304.12 Long-term loading. Wood members supporting concrete, masonry or similar materials shall be checked for the effects of long-term loading using the provisions of the AF&PA NDS. The total deflection, including the effects of long-term loading, shall be limited in accordance with Section 1604.3.1 for these supported materials.

Exception: Horizontal wood members supporting masonry or concrete nonstructural floor or roof surfacing not more than 4 inches (102 mm) thick need not be checked for long-term loading.

SECTION 2305
GENERAL DESIGN REQUIREMENTS FOR LATERAL FORCE-RESISTING SYSTEMS

2305.1 General. Structures using wood-frame shear walls or wood-frame diaphragms to resist wind, seismic or other lateral loads shall be designed and constructed in accordance with AF&PA SDPWS and the applicable provisions of Sections 2305, 2306 and 2307.

2305.1.1 Openings in shear panels. Openings in shear panels that materially affect their strength shall be detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

2305.1.2 Additional requirements. [DSA-SS, DSA-SS/CC and OSHPD 1, 2 & 4] *The following limitations shall apply:*

1. *Straight-sheathed horizontal lumber diaphragms are not permitted.*
2. *Gypsum-based sheathing shear walls and portland cement plaster shear walls are not permitted.*
3. *Shear wall foundation anchor bolt washers shall be provided in accordance with AF&PA SDPWS Section 4.3.6.4.3. The exception to AF&PA SDPWS Section 4.3.6.4.3 shall not apply.*
4. *Wood structural panel shear walls and diaphragms using staples as fasteners are not permitted.*

5. *Unblocked shear walls are not permitted.*
6. *Any wood structural panel sheathing used for shear walls that are part of the seismic force-resisting system shall be applied directly to framing members.*
7. *Single and double diagonally sheathed lumber walls shall not be used to resist seismic forces.*

2305.2 Diaphragm deflection. The deflection of wood-frame diaphragms shall be determined in accordance with AF&PA SDPWS. The deflection (Δ) of a blocked wood structural panel diaphragm uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-1. If not uniformly fastened, the constant 0.188 (For SI: 1/1627) in the third term shall be modified by an approved method.

Exception: [DSA-SS, DSA-SS/CC and OSHPD 1, 2 & 4] *Section 2305.2 is not permitted by DSA and OSHPD.*

$$\Delta = \frac{5vL^3}{8EAb} + \frac{vL}{4Gt} + 0.188Le_n + \frac{\Sigma(\Delta_c X)}{2b} \qquad \textbf{(Equation 23-1)}$$

For SI: $\Delta = \frac{0.052vL^3}{EAb} + \frac{vL}{4Gt} + \frac{Le_n}{1627} + \frac{\Sigma(\Delta_c X)}{2b}$

where:

A = Area of chord cross section, in square inches (mm^2).

b = Diaphragm width, in feet (mm).

E = Elastic modulus of chords, in pounds per square inch (N/mm^2).

e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].

Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].

L = Diaphragm length, in feet (mm).

v = Maximum shear due to design loads in the direction under consideration, in pounds per linear foot (plf) (N/mm).

Δ = The calculated deflection, in inches (mm).

$\Sigma(\Delta_c X)$ = Sum of individual chord-splice slip values on both sides of the diaphragm, each multiplied by its distance to the nearest support.

TABLE 2305.2(1)
e_n VALUES (inches) FOR USE IN CALCULATING DIAPHRAGM AND SHEAR WALL DEFLECTION DUE TO FASTENER SLIP (Structural I)[a, c]

LOAD PER FASTENER[b] (pounds)	FASTENER DESIGNATIONS
	14-Ga staple x 2 inches long
60	0.011
80	0.018
100	0.028
120	0.04
140	0.053
160	0.068

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound = 4.448 N.

a. Increase e_n values 20 percent for plywood grades other than Structural I.

b. Load per fastener = maximum shear per foot divided by the number of fasteners per foot at interior panel edges.

c. Decrease e_n values 50 percent for seasoned lumber (moisture content < 19 percent).

2305.3 Shear wall deflection. The deflection of wood-frame shear walls shall be determined in accordance with AF&PA SDPWS. The deflection (Δ) of a blocked wood structural panel shear wall uniformly fastened throughout with staples is permitted to be calculated in accordance with Equation 23-2.

Exception: [DSA-SS, DSA-SS/CC and OSHPD 1, 2 & 4] *Section 2305.3 is not permitted by DSA and OSHPD.*

$$\Delta = \frac{8vh^3}{EAb} + \frac{vh}{Gt} + 0.75he_n + d_a\frac{h}{b} \qquad \textbf{(Equation 23-2)}$$

For SI: $\Delta = \frac{vh^3}{3EAb} + \frac{vh}{Gt} + \frac{he_n}{407.6} + d_a\frac{h}{b}$

where:

A = Area of boundary element cross section in square inches (mm^2) (vertical member at shear wall boundary).

b = Wall width, in feet (mm).

d_a = Vertical elongation of overturning anchorage (including fastener slip, device elongation, anchor rod elongation, etc.) at the design shear load (v).

E = Elastic modulus of boundary element (vertical member at shear wall boundary), in pounds per square inch (N/mm^2).

e_n = Staple deformation, in inches (mm) [see Table 2305.2(1)].

Gt = Panel rigidity through the thickness, in pounds per inch (N/mm) of panel width or depth [see Table 2305.2(2)].

h = Wall height, in feet (mm).

v = Maximum shear due to design loads at the top of the wall, in pounds per linear foot (N/mm).

Δ = The calculated deflection, in inches (mm).

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 24 – GLASS AND GLAZING

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the user.
See Chapter 1 for state agency authority and building applications.)

Adopting agency	BSC	SFM	HCD			DSA			OSHPD				BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4								
Adopt entire chapter	X		X	X						X										
Adopt entire chapter as amended (amended sections listed below)							X	X	X			X								
Adopt only those sections that are listed below																				
Chapter / Section																				
2403.2.1							X	X	X			X								
Table 2403.2.1							X	X	X			X								
2410 & Subsections							*X*	*X*	*X*			*X*								

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 25 – GYPSUM BOARD AND PLASTER

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the user.
See Chapter 1 for state agency authority and building applications.)

Adopting agency	BSC	SFM	HCD			DSA			OSHPD				BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4								
Adopt entire chapter	X		X	X						X										
Adopt entire chapter as amended (amended sections listed below)									X			X								
Adopt only those sections that are listed below																				
Chapter / Section																				
2501.2							X	X	X			X								
2503.2							X	X	X			X								
2504.2							X	X	X			X								
2504.2.1							X	X	X			X								
2505.3							X	X	X			X								
2507.3							X	X	X			X								
2508.5.6							X	X	X			X								

The Office of the State Fire Marshal's adoption of this chapter or individual sections is applicable to structures regulated by other state agencies pursuant to Section 1.11.

CHAPTER 31B [DPH]
PUBLIC POOLS

Division I—GENERAL

SECTION 3101B
SCOPE

The provisions of this chapter shall apply to the construction, installation, renovation, alteration, addition, relocation, replacement or use of any public pool and to its ancillary facilities, mechanical equipment and related piping. Public pools include those located in or designated as the following: commercial building, hotel, motel, resort, recreational vehicle or mobile home park, campground, apartment house, condominium, townhouse, homeowner association, club, community building or area, public or private school, health club or establishment, water park, swim school, medical facility, bed and breakfast, licensed day-care facility, recreation and park district and municipal pools.

[DSA-AC] *Refer to Chapter 11B for accessibility provisions applicable to public accommodations, commercial buildings and public housing.*

SECTION 3102B
DEFINITIONS

ANCILLARY FACILITY *is any area used in conjunction with or for the operation of a pool such as public dressing rooms, lockers, shower or bathroom areas, drinking fountains, equipment room, pool deck area, pool enclosure or building space that is intended to be used by pool users.*

BACKWASH *is the process of reversing the flow of water through the filter to thoroughly clean the filter media and/or elements and remove the debris from the contents of the filter vessel.*

CANTILEVERED DECKING *is the part of the deck which extends over a top edge of a pool or spa.*

CLEAN POOL WATER *is pool water that is free of dirt, oils, scum, algae, floating materials or visible organic and inorganic materials that would pollute the water.*

CLEAR POOL WATER *is pool water that is free from cloudiness and is transparent.*

COPING *is a slip-resistant cap installed on the top edge of a pool or spa.*

CORROSION RESISTANT *is capable of maintaining original surface characteristics under the prolonged influence of the use environment.*

DECK *is an area surrounding a pool which is specifically constructed or installed for use by pool users.*

DIATOMACEOUS EARTH *is a filtering media consisting of microscopic fossilized skeletons of diatoms.*

EASILY CLEANABLE *is a characteristic of a surface or material that allows removal of dirt, stains or residue by normal cleaning methods.*

EFFECTIVE PARTICLE SIZE *is the theoretical size of a sieve in mm that will pass 10 percent by weight of sand.*

ENFORCING AGENT *is the health officer, director of environmental health, registered environmental health specialist or environmental health specialist trainee.*

EQUIPMENT AREA *is an area where the recirculation system and all related appurtenances are located.*

HANDHOLD *is a structure located at or above the water line around the perimeter of the pool wall that allows a pool user to hold onto the poolside for support.*

INLET *is a fitting or fixture through which recirculated water enters the pool.*

LADDER *is a series of vertically separate treads or rungs either connected by vertical rail members or independently fastened to an adjacent vertical pool wall.*

LIVING UNIT *is any building or portion thereof that contains living facilities including provisions for sleeping.*

MAIN DRAIN *is a submerged suction outlet typically located at the bottom of a pool that conducts water to a recirculating pump.*

MEDICAL POOL *is a special-purpose pool used by a State-recognized medical institution engaged in the healing arts under the direct supervision of licensed medical personnel for treatment of the infirm.*

OUTLET *is a fitting or fixture through which recirculated water is removed from the pool which may or may not be connected to the pump.*

PERFORMANCE STANDARD *is a standard that is accredited and published. Products compliant with a standard may be listed by any authorized nationally recognized testing laboratory.*

PERIMETER OVERFLOW SYSTEM *is a system which includes perimeter-type overflow gutters, surge basin or similar surface water collective system components and their interconnecting piping.*

PERMISSIBLE EXPOSURE LIMIT *is the maximum amount or concentration of a chemical that a worker may be exposed to under United States Occupational Safety and Health Administration regulations.*

POOL OR PUBLIC POOL *is an artificial basin, chamber or tank constructed or prefabricated with impermeable surfaces that is used, or intended to be used, for public swimming, diving or recreational activities but does not include individual therapeutic tubs or baths where the main purpose is the cleaning of the body. Any manmade lake or swimming lagoon with a sand beach or sand bottom is not a public pool.*

POOL OPERATOR or OPERATOR *is a person who is responsible for maintaining compliance with all requirements relating to pool operation, maintenance and safety of pool users.*

POOL USER *is a person using a pool and ancillary facilities for the purpose of water activities such as diving, swimming or wading.*

RADIUS OF CURVATURE *is the radius arc which denotes the curved surface from the point of departure from the springline of the pool to the pool bottom.*

READILY ACCESSIBLE *is capable of being reached easily for cleaning, repair, replacement or inspection without the necessity of removing a panel, door or similar obstruction and without requiring a person to climb over or remove obstacles or to use devices such as portable ladders.*

READILY DISASSEMBLED *means capable of being taken apart by hand or by using only simple tools such as a screwdriver, pliers or open-end wrench.*

RECESSED STEPS *are a series of vertically spaced cavities in the pool wall creating riser and tread areas for pool ingress and egress.*

RECIRCULATION SYSTEM *is the system of hydraulic components designed to remove, filter, disinfect and return water to the pool.*

RIM FLOW GUTTER *is a perimeter overflow system in which the overflow rim is at the same elevation with the deck.*

SKIMMER EQUALIZER LINE *is a submerged suction outlet located below the waterline and connected to the body of a skimmer that prevents air from being drawn into the pump if the water level drops below the skimmer weir or the skimmer is blocked by debris. A skimmer equalizer line is not a main drain.*

SLIP RESISTANT *is a rough finish that is not abrasive to the bare foot.*

SPA POOL OR SPA *is a pool that incorporates a water jet system, an aeration system or a combination of the two systems used in conjunction with heated water.*

SPECIAL PURPOSE POOL *is a pool constructed exclusively for a specific purpose, such as instruction, diving, competition or medical treatment.*

SPLASH ZONE *is the maximum distance the water from a spray ground can project horizontally.*

SPRAY GROUND *is a pool with no standing water in the splash zone and consists of a surge basin with a recirculation system from which water is directed through water features for contact with pool users.*

SPRINGLINE *is the point from which the pool wall breaks from vertical and begins its arc in the radius of curvature.*

STAIRS *are a series of two or more steps.*

STEP *is a riser and tread.*

SUCTION OUTLET *is any outlet that is connected to the pump through which water is removed from the pool.*

SURGE BASIN *is a reservoir or surge trench open to the atmosphere that receives water via gravity flow from the main drain, spray ground or perimeter overflow system and from which the recirculation system operates.*

TEMPERED WATER *is water between 100°F and 110°F.*

TURNOVER TIME *is the maximum time allowed to circulate one complete volume of the pool water through the recirculation system.*

UNIFORMITY COEFFICIENT *is the ratio of the theoretical size of a sieve in mm that will pass 60 percent of the sand to the theoretical size of a sieve in mm that will pass 10 percent of the sand.*

WADING POOL *is a pool intended to be used for wading by small children and having a maximum water depth of 18 inches (457 mm) at the deepest point.*

WATER FEATURE *means an interactive device or structure through which water is directed to the pool user such as a water fountain, water spray, dancing water jet, waterfall, dumping bucket or shooting water cannon.*

WATERLINE *shall be defined as one of the following:*

1. ***Skimmer system.*** *The waterline shall be the midpoint of the operating range of the skimmers.*
2. ***Overflow system.*** *The waterline shall be the top edge of the overflow rim.*

PLAN REVIEW, PERMITS, CONSTRUCTION AND FIELD INSPECTIONS

SECTION 3103B PLAN REVIEW

3103B.1 *A person proposing to construct, renovate or alter a pool, ancillary facilities or equipment and appurtenances shall submit plans and specifications detailing compliance with this chapter to the enforcing agent for review and written approval prior to commencing construction and shall first be cleared by the enforcing agent before substitution if not an exact duplicate of the units being changed or replaced. A local building department shall not issue a permit for a public pool or ancillary facility until the plans have been approved by the enforcing agent.*

3103B.2 *Plans submitted for approval pursuant to this section shall be drawn to a scale of $^1/_4$ inch (6.4 mm) equals 1 foot (305 mm), except that plans for spa pools shall be drawn to a scale of 1 inch (25 mm) equals 1 foot (305 mm), unless otherwise approved by the enforcing agent.*

3103B.3 *The enforcing agent shall notify the person submitting the plans and specifications of approval or disapproval.*

3103B.4 *The enforcing agent shall retain one copy of the approved plans and specifications and any subsequent changes or modifications. The approved plans shall be valid for a period of two years from the date of approval or as extended by the enforcing agent.*

SECTION 3110B
PERMANENT MARKINGS

3110B.1 General. *No markings, designs or lettering shall be permitted on the pool shell except for slip resistant lane markings, depth marking lines and safety markings.*

3110B.2 Lane markings. *Slip resistant lane lines at the bottom of the pool shall not exceed 12 inches (305 mm) in width.*

3110B.3 Depth marking line. *There shall be installed a straight line of slip resistant tile a minimum of 4 inches (102 mm) and not greater than 6 inches (152 mm) wide of a color contrasting with the background of the pool shell across the bottom of the pool where the water depth is $4^1/_2$ feet (1372 mm).*

Exception: *Pools having a maximum water depth of 5 feet (1524 mm) or less shall not be required to have a depth marking line.*

3110B.4 Water depth markers.

3110B.4.1 Location. *The water depth shall be clearly marked at the following locations:*

1. *Maximum depth; and*
2. *Minimum depth; and*
3. *Each end; and*
4. *Both sides at each end; and*
5. *At the break in the bottom slope between the shallow and deep portions of the pool (see also Section 3109B.3); and*
6. *Along the perimeter of the pool at distances not to exceed 25 feet (7620 mm).*

Exception: *A spa or wading pool shall have a minimum of two depth markers indicating the maximum depth.*

3110B.4.2 Position. *Where required by Section 3110B.4.1, depth markers shall be located in the following positions:*

1. *On the coping or on the deck, the depth markers shall be placed as close as possible but no more than 3 feet (914 mm) from the pool water; and*
2. *For pools with skimmer systems the depth markers shall be high at the waterline which typically will result in the depth markers being submerged approximately 50 percent; or*
3. *For pools with perimeter overflow systems where coping cantilevers over the gutter depth markers may be positioned at the face of the cantilevered coping, the back wall above the gutter or immediately below the waterline which will result in the depth markers being completely submerged; or*
4. *For pools with rim flow gutters, depth markers shall be positioned immediately below the waterline which will result in the depth markers being completely submerged.*

3110B.4.3 Tolerance. *Depth markers shall be positioned to indicate the water depth accurate to the nearest 6 inches (152 mm) as measured at the waterline.*

3110B.4.4 Size of markers. *Depth markers shall:*

1. *Have numerals a minimum of 4 inches (102 mm) in height and of a color contrasting with the background and be marked in units of feet and inches. Abbreviations of FT and IN may be used in lieu of feet and inches; and*
2. *Be made of a durable material that is resistant to weathering; and*
3. *Be slip resistant when they are located on the pool deck.*

3110B.5 No diving markers. *For pool water depths 6 feet (1830 mm) and shallower no diving markers with the universal symbol of no diving, which is a red circle with a slash through it superimposed over the image of a diver, shall be installed on the deck directly adjacent to the depth markers required by Section 3110B.4.1. No diving markers shall comply with Section 3110B.4.4(2-3).*

SECTION 3111B
STEPS, RECESSED STEPS, LADDERS AND STAIRS

3111B.1 Construction. *A means of entry and exit to and from the pool shall consist of steps, recessed steps, ladders, stairs, ramps or a combination of these. One means of entry and exit shall be provided in the shallowest portion of a pool if the vertical distance from the bottom of the pool to the deck is over 1 foot (305 mm). A second means of entry and exit shall be provided in the deep portion of a pool having a depth greater than $4^1/_2$ feet (1372 mm). Where the width of the pool exceeds 30 feet (9144 mm), such means of entry and exit shall be provided at each side, not more than 100 feet (30,480 mm) apart.*

Note: *For illustrated diagrams pertaining to this section see Figures 31B-6 and 31B-7.*

3111B.2 Ladders. *Ladders shall be corrosion resistant and shall be equipped with slip resistant tread surfaces. Ladders shall be rigidly installed and shall provide a clearance of not less than 3 inches (76 mm) or more than 5 inches (127 mm) between any part of the ladder and the pool wall.*

3111B.3 Stairs. *Stairs shall be provided in the shallowest portion of a pool. In pools with more than one shallow end stairs shall be provided at each shallow end. Each step of a stair shall have a tread in accordance with Figure 31B-7. Risers shall conform to Figure 31B-7. At least one hand rail shall be provided extending from the deck to not less than a point above the top of the lowest step installed in accordance with Figure 31B-7.*

3111B.4 Recessed steps and step risers. *Ladder treads and recessed steps shall have a minimum tread of 5 inches (127 mm) and a width of 14 inches (356 mm) and shall be designed to be readily cleaned. Step risers shall be uniform and shall not exceed 12 inches (305 mm) in height. The first riser shall be measured from the deck.*

3111B.5 Hand rails. *Hand rails shall be provided at the top of both sides of each ladder and recessed steps and shall extend over the coping or edge of the deck.*

3111B.6 Stairs for a spa pool. *Each step of a spa pool stair shall have a tread dimension in accordance with Figure 31B-7. Risers shall not exceed 12 inches (305 mm) in height. Two hand rails shall be provided extending from the deck to not less than a point above the top of the lowest step in accordance with Figure 31B-7. The steps shall be located where the deck is at least 4 feet (1219 mm) wide.*

SECTION 3112B HANDHOLDS

3112B.1 General. *Every pool shall be provided with handholds (perimeter overflow system, bull-nosed coping or cantilevered decking) around the entire perimeter installed not greater than 9 inches (229 mm) above the waterline.*

Exception: *Handholds are not required for wading pools.*

3112B.2 *For special purpose pools used for instruction or competitive swimming, a handhold at water level similar to the rim of a perimeter overflow system is required.*

3112B.3 *Where perimeter overflow systems are not provided, a bull-nosed coping or cantilevered decking of reinforced concrete, or material equivalent in strength and durability, with rounded slip resistant edges shall be provided. The overhang for either bull-nosed coping or cantilevered decking shall not exceed 2 inches (51 mm) or be less than 1 inch (25 mm) and shall not exceed $2^1/_2$ inches (64 mm) in thickness.*

Exception: *The enforcing agent may accept other handholds for spa pools.*

SECTION 3113B DIVING BOARDS AND PLATFORMS

3113B.1 General. *Diving boards and platforms shall be anchored to the pool deck, constructed of corrosion resistant material, designed and constructed to be easily cleanable and finished with a durable slip resistant material.*

3113B.2 Rails and steps. *Diving boards or platforms greater than 18 inches (456 mm) in height above the deck shall be provided with a ladder or stairs for access. Hand rails shall be provided at all ladders and stairs leading to diving boards or platforms more than 1 meter above the water. Diving boards and platforms that are over 1 meter above the water shall have guard rails on both sides of the diving board or platform that extend to a point on the platform directly above the water's edge. Guard rails shall be 36 inches (914 mm) above the diving board or platform.*

3113B.3 Dimensions. *Dimensions and clearances for the use of diving boards or platforms shall conform to those shown in Figures 31B-1 and 31B-2. Platforms and diving boards shall conform to the USA Diving Rules and Codes, Part 1, Subpart A and Appendix B, effective January 1, 2010.*

SECTION 3114B POOL DECKS

3114B.1 General. *A minimum continuous and unobstructed 4-foot wide (1219 mm) slip resistant, cleanable, nonabrasive deck area of concrete or like material shall be provided flush with the top of the pool coping extending completely around the pool, and the deck area shall further extend 4 feet (1219 mm) on both sides and rear of any diving board, fixed disabled access assistance device or slide and their appurtenances. The deck width shall be measured from the poolside edge of the coping lip.*

Exception: *A deck at least 4 feet (1219 mm) in width shall extend around a continuous 50 percent or more of the perimeter of a spa pool. For spa pools that have their walls extending above the ground or floor level, the deck area requirement shall apply at the ground or floor level unless otherwise approved in writing by the enforcing agent.*

3114B.2 Deck between pools and/or spas. *Where multiple pools and/or spas are built adjacent to each other, the deck width separating them shall be a minimum of 6 feet (1830 mm).*

3114B.3 Deck slope. *The pool's deck surface shall have a slope of no less than 1 percent ($^1/_8$ inch per foot) but no more than 2 percent ($^1/_4$ inch per foot) away from the pool to a deck drainage system and shall be constructed and finished to prevent standing water.*

3114B.4 Deck covering. *Deck coverings or other materials that are not equivalent to concrete in strength, durability and slip resistance and are not able to withstand repeated brushing, scrubbing or cleaning procedures shall not be installed or used within 4 feet (1219 mm) of the pool.*

3114B.5 Unpaved areas. *Landscape plants, flower beds or similar unpaved areas shall not be located within 4 feet (1219 mm) of a spa pool.*

SECTION 3115B POOL LIGHTING

3115B.1 General. *Pools shall have underwater and deck lighting such that lifeguards or other persons may observe, without interference from direct and reflected glare from the lighting sources, every part of the underwater area and pool surface, all diving boards or other pool appurtenances. If underwater or deck surface lighting is not operational, the operator of the pool shall secure the pool area and not permit any use of the pool after dark and shall post the same sign as required in Section 3120B.9.*

Note: *See Part 3, Article 3-680, Title 24, California Code of Regulations for electrical installation requirements.*

3115B.2 Nighttime use. *Pools used at night shall be equipped with underwater lighting fixtures that will provide complete illumination to all underwater areas of the pool with no blind*

spots. Illumination shall enable a lifeguard or other persons to determine whether:

1. *A pool user is lying on the bottom of the pool; and*
2. *The pool water conforms to the definition of "clear pool water."*

***Exception:** Pools provided with a system of overhead lighting fixtures where it can be demonstrated to the enforcing agent that the system is equivalent to the underwater lighting fixture system.*

***3115B.3 Deck area lighting.** When the pool is to be used at night, pool deck areas and emergency egress areas shall be provided with lighting so that persons walking on the deck can identify hazards. Lighting fixtures shall be aimed towards the deck area and away from the pool surface insofar as practical.*

ANCILLARY FACILITIES

SECTION 3116B
BATHHOUSE, DRESSING, SHOWER AND TOILET FACILITIES

***3116B.1** Shower and dressing facilities shall be provided for users of a pool.*

Exceptions:

1. *Shower and dressing facilities may not be required when pool users have access to such facilities in adjacent living quarters.*
2. *Public toilet facilities may be omitted when pool users have access to toilet facilities either in living quarters located not more than 300 feet (91,440 mm) in travel distance from the pool or in an adjacent building such as a recreational facility, clubhouse or cabana.*

***3116B.2 Number of sanitary facilities.** For the purpose of this subsection, one pool user shall be considered for every 15 square feet (1.39 m^2) of pool water surface area.*

***3116B.2.1 Showers.** One shower shall be provided for every 50 pool users.*

***3116B.2.2 Toilets.** Separate toilet facilities shall be provided for each sex. One toilet shall be provided for every 60 women or less and one toilet plus one urinal for every 75 men or less.*

***3116B.2.3 Lavatories.** One lavatory shall be provided for every 80 pool users.*

3116B.3 Construction.

***3116B.3.1 Floors.** Floors shall have a hard, nonabsorbent surface, such as portland cement concrete, ceramic tile or other approved material, which extends upwards onto the wall at least 5 inches (127 mm) with a coved base. Floors which may be walked on by a wet pool user shall be slip resistant. Floors shall be sloped not less than $^1/_4$ inch (6.4mm) per foot to floor drains or other approved surface water disposal areas. Carpeting and other similar artificial floor covering shall not be permitted on shower and toilet room floors.*

***3116B.3.2 Interior surfaces.** The materials used in the walls, except for structural elements, shall be of a type which is not adversely affected by moisture.*

***3116B.3.3 Privacy.** All doors and windows shall be arranged to prevent viewing of the interior from any portion of the building used by the opposite sex and from view from the outdoors. View screens shall be permitted for this purpose.*

3116B.4 Water supply.

***3116.B.4.1** Showers and lavatories shall be provided with hot and cold water faucets.*

***3116B.4.2** Tempered water shall be permitted in lieu of individual hot and cold water faucets.*

***3116B.4.3** A means to limit the hot water to 110°F (43°C) maximum shall be provided to prevent scalding. This temperature limit control shall not be adjustable by the pool user.*

SECTION 3117B
DRINKING FOUNTAINS

One guarded jet drinking fountain shall be provided for the first 250 pool users and an additional fountain shall be provided for each additional 200 pool users or fraction thereof. The number of pool users shall be determined according to Section 3116B.2.

***Exception:** Drinking fountains shall not be required when drinking water is available at adjacent living quarters, or in an adjacent building such as a bathhouse, cabana, clubhouse or recreational facility.*

SECTION 3118B
HOSE BIBBS

Potable water outlets with hose attachments shall be protected by a nonremovable hose bibb backflow preventer, a nonremovable hose bibb vacuum breaker or by an atmospheric vacuum breaker installed not less than 6 inches (152 mm) above the highest point of usage located on the discharge side of the last valve as required by the California Plumbing Code. In climates where freezing temperatures occur, a listed self-draining frost-proof hose bibb with an integral backflow preventer or vacuum breaker shall be used. Hose bibbs shall be provided so that all portions of the pool deck area may be reached with a 75 foot length of hose attached to the hose bibb. A hose bibb shall be provided in the equipment area. Hose bibbs shall be located so that they do not constitute a hazard.

SECTION 3119B
POOL ENCLOSURE

***3119B.1 Enclosure.** The pool shall be enclosed by one or a combination of the following: a fence, portion of a building, wall, or other approved durable enclosure. Doors, windows,*

gates of living units or associated private premises shall not be permitted as part of the pool enclosure. The enclosure, doors and gates shall meet all of the following specifications:

1. *The enclosure shall have a minimum effective perpendicular height of 5 feet (1524 mm) as measured from the outside as depicted in Figure 31B-4; and*
2. *Openings, holes or gaps in the enclosure, doors and/or gates shall not allow the passage of a 4-inch (102 mm) diameter sphere. The enclosure shall be constructed over a hard and permanent material equivalent to concrete; and*
3. *The enclosure shall be designed and constructed so that it cannot be readily climbed by small children. Horizontal and diagonal member designs which might serve as a ladder for small children are prohibited. Horizontal members shall be spaced at least 48 inches (1219 mm) apart. No planters or other structures that can be climbed shall be permitted within 5 feet (1524 mm) of the outside of the pool enclosure or within a 5 foot (1524 mm) arc as depicted in Figure 31B-5. The area 5 feet (1524 mm) outside of the pool enclosure shall be a common area open to the public; and*
4. *Chain link may be used, provided that the openings are not greater than $1^{3}/_{4}$ inches (44 mm) measured horizontally.*

3119B.2 Gates. *Gates and doors opening into the pool enclosure also shall meet the following specifications:*

1. *Gates and doors shall be equipped with self-closing and self-latching devices. The self-latching device shall keep the gate or door securely closed. Gates and doors shall open outwardly away from the pool except where otherwise prohibited by law. Hand activated door or gate opening hardware shall be located at a height no lower than 42 inches (1067 mm) but no higher than 44 inches (1179 mm) above the deck or walkway; and*
2. *Gates and doors shall be capable of being locked during times when the pool is closed. Exit doors which comply with Chapter 10, Title 24, California Code of Regulations shall be considered as meeting these requirements; and*
3. *The pool enclosure shall have at least one means of egress without a key for emergency purposes. Unless all gates or doors are so equipped, those gates and/or doors which will allow egress without a key shall have a sign in letters at least 4 inches (102 mm) high stating EMERGENCY EXIT; and*
4. *The enclosure shall be constructed so that all persons will be required to pass through common pool enclosure gates or doors in order to gain access to the pool area. All gates and doors exiting the pool area shall open into a public area or a walkway accessible by all patrons of the pool.*

3119B.3 Retroactivity. *Sections 3119B.1 and 3119B.2 shall apply only to public pool enclosures constructed on or after July 1, 1994. Notwithstanding the foregoing effective date, no fence enclosure shall be less than 4 feet (1219 mm) in height.*

3119B.4 Enclosure of pools constructed prior to July 1, 1994. *The enforcing agent may allow the installation of an enclosure which reduces the pool deck to less than 4 feet (1219 mm) in width when the physical characteristics of a site preclude providing a 4-foot (1219 mm) wide deck around the perimeter of an existing pool.*

SECTION 3120B
REQUIRED SIGNS

3120B.1 General. *All signs shall have clearly legible letters or numbers not less than 4 inches (102 mm) high, unless otherwise required in this section, affixed to a wall, pole, gate or similar permanent structure in a location visible to all pool users.*

3120B.2 Pool user capacity sign. *A sign shall indicate the maximum number of pool users permitted for each pool.*

3120B.2.1 Spa pool. *The pool user capacity of a spa pool shall be based on one pool user for every 10 square feet (0.929 m^2) of pool water surface area.*

3120B.2.2 Other pools. *The pool user capacity for all other pools shall be based on one pool user for every 20 square feet (1.858 m^2) of pool water surface area.*

Exception: *Pool user capacity requirements do not apply to wading pools or spray grounds.*

3120B.3 No diving sign. *Signs shall be posted in conspicuous places and shall state, "NO DIVING" at pools with a maximum water depth of 6 feet or less.*

3120B.4 No lifeguard sign. *Where no lifeguard service is provided, a sign shall be posted stating, "NO LIFEGUARD ON DUTY." The sign also shall state in letters at least 1 inch (25 mm) high, "Children under the age of 14 shall not use pool without a parent or adult guardian in attendance."*

3120B.5 Artificial respiration and cardiopulmonary resuscitation sign. *An illustrated diagram with text at least $^{1}/_{4}$ inch (6 mm) high of artificial respiration and cardiopulmonary resuscitation procedures shall be posted.*

3120B.6 Emergency sign. *The emergency telephone number 911, the number of the nearest emergency services and the name and street address of the pool facility shall be posted.*

3120B.7 Warning sign for a spa pool. *A warning sign for spa pools shall be posted stating, "CAUTION" and shall include the following language in letters at least 1 inch (25 mm) high:*

1. *Elderly persons, pregnant women, infants and those with health conditions requiring medical care should consult with a physician before entering the spa.*
2. *Unsupervised use by children under the age of 14 is prohibited.*
3. *Hot water immersion while under the influence of alcohol, narcotics, drugs or medicines may lead to serious consequences and is not recommended.*
4. *Do not use alone.*
5. *Long exposure may result in hyperthermia, nausea, dizziness or fainting.*

9. *Commencing January 1, 1998, whenever a construction permit is issued for alteration of an existing public wading pool, it shall be retrofitted so as to be in compliance with this section.*
10. *By January 1, 2000, every public wading pool, regardless of the date of original construction, shall be retrofitted to comply with this section.*

Authority: Health and Safety Code Section 116064 (e) Reference: Health and Safety Code Section 116064 AB 2114, (Statues 1995, c. 415).

SECTION 3162B
ANTI-ENTRAPMENT DEVICES AND SYSTEMS

1. *The Legislature finds and declares that the public health interest requires that there be uniform statewide health and safety standards for public swimming pools to prevent physical entrapment and serious injury to children and adults. It is the intent of the Legislature to occupy the whole field of health and safety standards for public swimming pools and the requirements established in this article and the regulations adopted pursuant to this article shall be exclusive of all local health and safety standards relating to public swimming pools.*
2. *As used in this section, the following words have the following meanings:*
   - *(a) "ANSI/APSP performance standard" means a standard that is accredited by the American National Standards Institute (ANSI) and published by the Association of Pool and Spa Professionals (APSP).*
   - *(b) "ASME/ANSI performance standard" means a standard that is accredited by the American National Standards Institute and published by the American Society of Mechanical Engineers.*
   - *(c) "ASTM performance standard" means a standard that is developed and published by ASTM International..*
   - *(d) "Public swimming pool" means an outdoor or indoor structure, whether in-ground or aboveground, intended for swimming or recreational bathing, including a swimming pool, hot tub, spa, or nonportable wading pool, that is any of the following:*
     - *(i) Open to the public generally, whether for a fee or free of charge.*
     - *(ii) Open exclusively to members of an organization and their guests, residents of a multiunit apartment building, apartment complex, residential real estate development, or other multifamily residential area, or patrons of a hotel or other public accommodations facility.*
     - *(iii) Located on the premises of an athletic club, or public or private school.*
   - *(e) "Qualified individual" means a contractor who holds a current valid license issued by the State of California or a professional engineer licensed in the State of California who has experience working on public swimming pools.*
   - *(f) "Safety vacuum release system" means a vacuum release system that ceases operation of the pump, reverses the circulation flow, or otherwise provides a vacuum release at a suction outlet when a blockage is detected.*
   - *(g) "Skimmer equalizer line" means a suction outlet located below the waterline, typically on the side of the pool, and connected to the body of a skimmer that prevents air from being drawn into the pump if the water level drops below the skimmer weir. However, a skimmer equalizer line is not a suction outlet for purposes of Subdivisions (4) and (6).*
   - *(h) "Suction outlet" means a fitting or fixture of a swimming pool that conducts water to a recirculating pump.*
   - *(i) "Unblockable suction outlet" means a suction outlet, including the sump, that has a perforated (open) area that cannot be shadowed by the area of the 18-inch by 23-inch body blocking element of the ANSI/APSP-16 performance standard, and that the rated flow through any portion of the remaining open area cannot create a suction force in excess of the removal force values in Table 1 of that standard.*
3. *Subject to Subdivision (6), every public swimming pool shall be equipped with anti-entrapment devices or systems that comply with ANSI/APSP-16 performance standard or successor standard designated by the Federal Consumer Product Safety Commission.*
   - *a. A public swimming pool that has a suction outlet in any location other than on the bottom of the pool shall be designed so that the recirculation system shall have the capacity to provide a complete turnover of pool water within the following time:*
     - *(i) One-half hour or less for a spa pool.*
     - *(ii) One-half hour or less for a spray ground.*
     - *(iii) One hour or less for a wading pool.*
     - *(iv) Two hours or less for a medical pool.*
     - *(v) Six hours or less for all other types of public pools.*
4. *Subject to Subdivisions (5) and (6), every public swimming pool with a single suction outlet that is not an unblockable suction outlet shall be equipped with at least one or more of the following devices or systems that are designed to prevent physical entrapment by pool drains:*
   - *(a) A safety vacuum release system that has been tested by a nationally recognized testing laboratory and found to conform to ASME/ANSI Performance Standard A112.19.17, as in effect on December 31, 2009, or ASTM Performance Standard F2387, as in effect on December 31, 2009.*

(b) *A suction-limiting vent system with a tamper-resistant atmospheric opening, provided that it conforms to any applicable ASME/ANSI or ASTM performance standard.*

(c) *A gravity drainage system that utilizes a collector tank, provided that it conforms to any applicable ASME/ANSI or ASTM performance standard.*

(d) *An automatic pump shut-off system tested by a department-approved independent third party and found to conform to any applicable ASME/ANSI or ASTM performance standard.*

(e) *Any other system that is deemed, in accordance with federal law, to be equally effective as, or more effective than, the systems described in paragraph (a) at preventing or eliminating the risk of injury or death associated with the circulation system of the pool and suction outlets.*

5. *Every public swimming pool constructed on or after January 1, 2010, shall have at least two suction outlets per pump that are hydraulically balanced and symmetrically plumbed through one or more "T" fittings, and that are separated by a distance of at least three feet in any dimension between the suction outlets. A public swimming pool constructed on or after January 1, 2010, that meets the requirements of this subdivision, shall be exempt from the requirements of Subdivision (4).*

6. *A public swimming pool constructed prior to January 1, 2010, shall be retrofitted to comply with Subdivisions (3) and (4) by no later than July 1, 2010, except that no further retrofitting is required for a public swimming pool that completed a retrofit between December 19, 2007, and January 1, 2010, that complied with the Virginia Graeme Baker Pool and Spa Safety Act (15 U.S.C. Sec. 8001 et seq.) as in effect on the date of issue of the construction permit, or for a nonportable wading pool that completed a retrofit prior to January 1, 2010, that complied with state law on the date of issue of the construction permit. A public swimming pool owner who meets the exception described in this subdivision shall do one of the following prior to September 30, 2010:*

   a. *File the form issued by the department pursuant to subdivision (g), as otherwise provided in subdivision (h).*

   b. *File a signed statement attesting that the required work has been completed.*

   c. *Provide a document containing the name and license number of the qualified individual who completed the required work.*

   d. *Provide either a copy of the final building permit, if required by the local agency, or a copy of one of the following documents if no permit was required:*

      (i) *A document that describes the modification in a manner that provides sufficient information to document the work that was done to comply with federal law.*

      (ii) *A copy of the final paid invoice. The amount paid for the services may be omitted or redacted from the final invoice prior to submission.*

7. *Prior to March 31, 2010, the department shall issue a form for use by an owner of a public swimming pool to indicate compliance with this section. The department shall consult with county health officers and directors of departments of environmental health in developing the form and shall post the form on the department's Internet Web site. The form shall be completed by the owner of a public swimming pool prior to filing the form with the appropriate city, county, or city and county department of environmental health. The form shall include, but not be limited to, the following information:*

   a. *A statement of whether the pool operates with a single suction outlet or multiple suction outlets that comply with Subdivision (5).*

   b. *Identification of the type of anti-entrapment devices or systems that have been installed pursuant to Subdivision (4) and the date or dates of installation.*

   c. *Identification of the type of devices or systems designed to prevent physical entrapment that have been installed pursuant to Subdivision (4) in a public swimming pool with a single suction outlet that is not an unblockable suction outlet and the date or dates of installation or the reason why the requirement is not applicable.*

   d. *A signature and license number of a qualified individual who certifies that the factual information provided on the form in response to paragraphs (a) to (c), inclusive, is true to the best of his or her knowledge.*

8. *A qualified individual who improperly certifies information pursuant to Paragraph (d) of Subdivision (7) shall be subject to potential disciplinary action at the discretion of the licensing authority.*

9. *Except as provided in Subdivision (6), each public swimming pool owner shall file a completed copy of the form issued by the department pursuant to this section with the city, county, or city and county department of environmental health in the city, county, or city and county in which the swimming pool is located. The form shall be filed within 30 days following the completion of the swimming pool construction or installation required pursuant to this section or, if the construction or installation is completed prior to the date that the department issues the form pursuant to this section, within 30 days of the date that the department issues the form. The public swimming pool owner or operator shall not make a false statement, representation, certification, record, report, or otherwise falsify information that he or she is required to file or maintain pursuant to this section.*

10. *In enforcing this section, health officers and directors of city, county, or city and county departments of environmental health shall consider documentation filed on or with the form issued pursuant to this section by the owner of a public swimming pool as evidence of compliance with this section. A city, county, or city and county department*

CHAPTER 31F [SLC]
MARINE OIL TERMINALS
Division I

SECTION 3101F [SLC]
INTRODUCTION

3101F.1 General. *The Lempert-Keene-Seastrand oil spill prevention and response act of 1990 (act), as amended, authorized the California State Lands Commission (SLC) to regulate marine oil terminals (MOTs) in order to protect public health, safety and the environment. The authority for this regulation is contained in Sections 8755 and 8756 of the California Public Resources Code. This act defines "oil" as any kind of petroleum, liquid hydrocarbons, or petroleum products or any fraction or residues thereof, including but not limited to, crude oil, bunker fuel, gasoline, diesel fuel, aviation fuel, oil sludge, oil refuse, oil mixed with waste, and liquid distillates from unprocessed natural gas. The provisions of this chapter regulate marine oil terminals as defined under this act.*

3101F.2 Purpose. *The purpose of this code is to establish minimum engineering, inspection and maintenance criteria for MOTs in order to prevent oil spills and to protect public health, safety and the environment. This code does not, in general, address operational requirements. Relevant provisions from existing codes, industry standards, recommended practices, regulations and guidelines have been incorporated directly or through reference, as part of this code.*

Where there are differing requirements between this code and/or references cited herein, the choice of application shall be subject to approval of the Marine Facilities Division (Division) of the SLC.

3101F.3 Applicability. *The provisions of this chapter are applicable to the evaluation of existing MOTs and design of new MOTs in California. Each provision is classified as New (N), Existing (E), or Both (N/E) and shall be applied accordingly. If no classification is indicated, the classification shall be considered to be (N/E).*

Existing (E) requirements apply to MOTs that are in operation on the date this code is adopted. For these MOTs, equivalent or in-kind replacement of existing equipment, short pipeline sections, or minor modification of existing components shall also be subject to the existing (E) requirements.

New (N) requirements apply to:

1. *A MOT or berthing system (Subsection 3102F.1.3) that commences or recommences operation with a new or modified operations manual after adoption of this code.*
2. *Addition of new structural components or systems at an existing MOT that are structurally independent of existing components or systems.*
3. *Addition of new (nonreplacement) equipment, piping, pipelines, components or systems to an existing MOT.*
4. *Major repairs or substantially modified in-place systems.*
5. *Any associated major installations or modifications.*

3101F.4 Overview. *This Code ensures that a MOT can be safely operated within its inherent structural and equipment-related constraints.*

Section 3102F defines minimum requirements for audit, inspection and evaluation of the structural, electrical and mechanical systems on a prescribed periodic basis, or following a significant, potentially damage-causing event.

Section 3103F , 3104F and 3107F provide criteria for structural loading, deformation and performance-based evaluation considering earthquake, wind, wave, current, seiche and tsunami effects.

Section 3105F provides requirements for the safe mooring and berthing of tank vessels and barges.

Section 3106F describes requirements for geotechnical hazards and foundation analyses, including consideration of slope stability and soil failure.

Section 3108F provides requirements for fire prevention, detection and suppression including appropriate water and foam volumes.

Sections 3109F through 3111F provide requirements for piping/pipelines, mechanical and electrical equipment and electrical systems.

English units are prescribed herein; however, many of the units in the references are in System International (SI).

3101F.5 Risk reduction strategies. *Risk reduction strategies, such as pipeline segmentation devices, system flexibility and spill containment devices may be used to reduce the size of a potential oil spill. Such strategies may reduce the MOT risk classification as determined from Table 31F-4-1.*

3101F.6 Review requirements.

3101F.6.1 Quality assurance. *All audits, inspections, engineering analyses or design shall be reviewed by a professional having similar or higher qualifications as the person who performed the work, to ensure quality assurance. This review may be performed in-house.*

Peer review is required for nonlinear dynamic structural analyses and alternative lateral force procedures not prescribed herein. The peer review may be from an independent internal or external source. The peer reviewer shall be a California registered civil or structural engineer.

3101F.6.2 Division review. *The following will be subject to review for compliance with this code by the Division or its authorized representative(s):*

1. *Any audit, inspection, analysis or evaluation of MOTs.*
2. *Any significant change, modification or re-design of a structural, mooring, fire, piping/pipelines, mechanical or electrical system at an MOT, prior to use or reuse.*
3. *Engineering analysis and design for any new MOT prior to construction. Also see Section 3102F.3.3.1.*
4. *Construction inspection team and the construction inspection report(s).*

3101F.7 Alternatives. *In special circumstances where certain requirements of these standards cannot be met, alternatives that provide an equal or better protection of the public health, safety and the environment shall be subject to Division Chief approval with concurrence of the Division's lead engineer in responsible charge.*

Authority: Sections 8755 and 8757, Public Resources Code.
Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

Division 2

SECTION 3102F
AUDIT AND INSPECTION

3102F.1 General.

3102F.1.1 Purpose. *Section 3102F defines minimum requirements for audit, inspection, and evaluation of the structural, mechanical and electrical components and systems.*

3102F.1.2 Audit and inspections types. *The audit and inspections described in this Chapter (31F) and 2 CCR 2320 (a) and (b) [2.1] are:*

1. *Annual inspection*
2. *Audit*
3. *Post-event inspection*

Each has a distinct purpose and is conducted either at a defined interval (see Table 31F-2-1 and Section 3102F.3.3.2), as a result of a significant, potentially damage-causing event or a significant change in operations. In the time between audits and inspections, operators are expected to conduct periodic walk-down examinations of the MOT to detect potentially unsafe conditions.

3102F.1.3 Berthing systems. *For the purpose of assigning structural ratings and documenting the condition of mechanical and electrical systems, an MOT shall be divided into independent "berthing systems." A berthing system consists of the wharf and supporting structure, mechanical and electrical components that serve the berth and pipeline systems as defined in Title 2 CCR §2560 and 2561(n).*

For example, a MOT consisting of wharves with three berths adjacent to the shoreline could contain three independent "berthing systems" if the piping does not route through adjacent berths. Therefore, a significant defect that would restrict the operation of one berth would have no impact on the other two berths. Conversely, if a T-head Pier, with multiple berths sharing a trestle that supports all piping to the shoreline, had a significant deficiency on the common trestle, the operation of all berths could be adversely impacted. This configuration is classified as a single berthing system.

The physical boundaries of a berthing system may exclude unused sections of a structure. Excluded sections must be physically isolated from the berthing system. Expansion joints may provide this isolation.

3102F.1.4 Records. *All MOTs shall have records reflecting current, as-built conditions for all berthing systems. Records shall include, but not be limited to modifications and/or replacement of structural components, electrical or mechanical equipment or relevant operational changes, new construction including design drawings, calculations, engineering analyses, soil borings, equipment manuals, specifications, shop drawings, technical and maintenance manuals and documents.*

Chronological records and reports of annual inspections, audits and post-event inspections and documentation of equipment or structural changes shall be maintained.

Records shall be indexed and be readily accessible to the Division (see 2 CCR Section 2320 (c) (2)) [2.1].

3102F.1.5 Baseline inspection. *If "as-built" or subsequent modification drawings are not available, incomplete or inaccurate, a baseline inspection is required to gather data in sufficient detail for adequate evaluaton.*

The level of detail required shall be such that structural member sizes, connection and reinforcing details are documented, if required in the structural analysis. In addition, the strength and/or ductility characteristics of construction materials shall be determined, as appropriate. Nondestructive testing, partially destructive testing and/or laboratory testing methods may be used.

All fire, piping, mechanical and electrical systems shall be documented as to location, capacity, operating limits and physical conditions.

3102F.2 Annual inspection. *The annual inspection required by 2 CCR 2320 (a)(1) [2.1], may include an engineering examination of the topside and underside areas of the dock, including the splash zone. The Division shall perform the inspection, with cooperation from the owner/operator. Observations will be recorded and a report of violations and deficiencies shall be provided to the operator.*

Subject to operating procedures, a boat shall be provided to facilitate the inspection of the dock undersides and piles down to the splash zone. If a boat is not available or the under dock inspection cannot be performed by the Division during the annual inspection, the MOT operator shall carry out or cause to be carried out, such an inspection. The operator will then provide the Division with a report detailing the examination results including photographs, videos and sketches as necessary to accurately depict the state of the underside of the dock.

3102F.3 Audits.

3102F.3.1 Objective. *The objective of the audit is to review structural, mechanical and electrical systems on a prescribed periodic basis to verify that each berthing system is fit for its specific defined purpose. <u>The audit includes above water and underwater inspections, engineering evaluation, documentation and recommended follow-up actions.</u>*

3102F.3.2 Overview. *The audit shall include above water and underwater inspections, and structural, electrical and mechanical systems evaluations, with supporting documentation, drawings and follow-up actions. Structural systems shall include seismic, operational, mooring, berthing and geotechnical considerations. Mechanical systems shall include fire, piping/pipelines and mechanical equipment considerations. The audit is performed by a multi-disciplinary team of engineers, qualified inspectors and may include Division representatives.*

The above water inspection involves an examination of all structural, mechanical and electrical components above the waterline. Structural defects and their severity shall be documented, but the exact size and location of each deficiency is typically not required.

The underwater inspection involves an examination of all structural, mechanical and electrical components below the waterline. A rational and representative underwater sampling of piles may be acceptable with Division approval, for cases of limited visibility, heavy marine growth, restricted inspection times because of environmental factors (currents, water temperatures, etc.) or a very large number of piles.

Global operational structural assessment rating(s) (OSAR), global seismic structural assessment rating(s) (SSAR) and global inspection condition assessment rating(s) (ICAR) shall be assigned to each structure and overall berthing system, where appropriate (Table 31F-2-4).

Remedial action priorities (RAP) shall be assigned for component deficiencies (Table 31F-2-5). Recommendations for remediation and/or upgrading shall be prescribed as necessary.

An audit is not considered complete until the audit report is received by the Division.

3102F.3.3 Schedule.

3102F.3.3.1 Initial audit. *For a new MOT or new berthing system(s), the initial audit of the "as-built" systems(s) shall be performed prior to commencement of operations.*

3102F.3.3.2 Subsequent audits. *A subsequent audit report of each terminal shall be completed at a maximum interval of 4 years, and includes documentation of inspections. This interval may be reduced, based on the recommendation of the audit team leader, and with the approval of the Division, depending on the extent and rate of deterioration or other factors.*

The maximum interval for above water inspections shall be 4 years. The maximum interval for underwater inspections is dependent upon the condition of the facility, the construction material type and/or the environment at the mudline, as shown in Table 31F-2-1.

If there are no changes in the defined purpose (see Section 3102F.3.6.1) of the berthing system(s), then analyses from previous audits may be referenced. However, if there is a significant change in a berthing system(s), or when deterioration or damage must be considered, a new analysis may be required.

The Division may require an audit, inspection or supplemental evaluations to justify changes in the use of the berthing system(s).

3102F.3.4 Audit team.

3102F.3.4.1 Project manager. *The audit shall be conducted by a multidisciplinary team under the direction of a project manager representing the MOT. The project manager shall have specific knowledge of the MOT and may serve other roles on the audit team.*

3102F.3.4.2 Audit team leader. *The audit team leader shall lead the on-site audit team and shall be responsible for directing field activities, including the inspection of all structural, mechanical and electrical systems. The team leader shall be a California registered civil or structural engineer and may serve other roles on the audit team.*

3102F.3.4.3 Structural inspection team. *The structural inspection shall be conducted under the direction of a registered civil or structural engineer.*

All members of the structural inspection team shall be graduates of a 4-year civil/structural engineering, or closely related (ocean/coastal) engineering curriculum, and shall have been certified as an Engineer-in-Training; or shall be technicians who have completed a course of study in structural inspections. The minimum acceptable course in structural inspections shall include 80 hours of instruction specifically related to structural inspection, followed by successful completion of a comprehensive examination. An example of an acceptable course is the U.S. Department of Transportation's "Safety Inspection of In- Service Bridges." Certification as a Level IV Bridge Inspector by the National Institute of Certification in Engineering Technologies (NICET) shall also be acceptable [2.2].

For underwater inspections, the registered civil or structural engineer directing the underwater structural inspection shall also be a commercially trained diver or equivalent and shall actively participate in the inspection, by personally conducting a minimum of 25 percent of the underwater examination [2.2].

Each underwater team member shall also be a commercially trained diver, or equivalent. Divers performing manual tasks such as cleaning or supporting the diving operation, but not conducting or reporting on inspections, may have lesser technical qualifications [2.2].

3102F.3.4.4 Structural analyst. *A California registered civil or structural engineer shall be in responsible charge of the structural evaluations.*

3102F.3.4.5 Electrical inspection team. *A registered electrical engineer shall direct the on-site team performing the inspection and evaluation of electrical components and systems.*

3102F.3.4.6 Mechanical inspection team. *A registered engineer shall direct the on-site team performing the inspection and evaluation of piping/pipeline, mechanical and fire components and systems, except the Fire Protection Assessment in accordance with Section 3108F.2.2.*

3102F.3.4.7 Divisional representation. *The Division representative(s) may participate in any audit or inspection as observer(s) and may provide guidance.*

3102F.3.4.8 Geotechnical analyst. *A California registered civil engineer with a California authorization as a geotechnical engineer shall perform the geotechnical evaluation required for the audit and all other geotechnical evaluations.*

3102F.3.5 Scope of inspections.

3102F.3.5.1 Above water structural inspection. *The above water inspection shall include all accessible components above +3 ft MLLW. Accessible components shall*

be defined as those components above and below deck that are reachable without the need for excavation or extensive removal of materials that may impair visual inspection. The above water inspection shall include, but not be limited to, the following:

1. *Piles*
2. *Pile caps*
3. *Beams*
4. *Deck soffit*
5. *Bracing*
6. *Retaining walls and bulkheads*
7. *Connections*
8. *Seawalls*
9. *Slope protection*
10. *Deck topsides and curbing*
11. *Expansion joints*
12. *Fender system components*
13. *Dolphins and deadmen*
14. *Mooring points and hardware*
15. *Navigation aids*
16. *Platforms, ladders, stairs, handrails and gangways*
17. *Backfill (sinkholes/differential settlement)*

3102F.3.5.2 Underwater structural inspection. *The underwater inspection shall include all accessible components from +3 ft MLLW to the mudline, including the slope and slope protection, in areas immediately surrounding the MOT. The water depth at the berth(s) shall be evaluated, verifying the maximum or loaded draft specified in the MOT's Operations Manual (2 CCR 2385 (d)) [2.1].*

The underwater structural inspection shall include the Level I, II and III inspection efforts, as shown in Tables 31F-2-2 and 31F-2-3. The underwater inspection levels of effort are described below, per [2.2]:

Level I—Includes a close visual examination, or a tactile examination using large sweeping motions of the hands where visibility is limited. Although the Level I effort is often referred to as a "swim-by" inspection, it must be detailed enough to detect obvious major damage or deterioration due to overstress or other severe deterioration. It should confirm the continuity of the full length of all members and detect undermining or exposure of normally buried elements. A Level I effort may also include limited probing of the substructure and adjacent channel bottom.

Level II—A detailed inspection which requires marine growth removal from a representative sampling of components within the structure. For piles, a 12-inch high band should be cleaned at designated locations, generally near the low waterline, at the mud-line, and midway between the low waterline and the mudline. On a rectangular pile, the marine growth removal should include at least three sides; on an octagon pile, at least six sides; on a round pile, at least three-fourths of the perimeter. On large diameter piles, 3 ft or greater, marine growth removal should be effected on 1 ft by 1 ft areas at four locations approximately equally spaced around the perimeter, at each elevation. On large solid faced elements such as retaining structures, marine growth removal should be effected on 1 ft by 1 ft areas at the three specified elevations. The inspection should also focus on typical areas of weakness, such as attachment points and welds. The Level II effort is

TABLE 31F-2-1
MAXIMUM INTERVAL BETWEEN UNDERWATER INSPECTIONS (YEARS)[1]

INSPECTION CONDITION ASSESSMENT RATING (ICAR)[6]	CONSTRUCTION MATERIAL				CHANNEL BOTTOM OR MUDLINE—SCOUR[4]	
	Unwrapped Timber or Unprotected Steel (no coating or cathodic protection)[4]		Concrete, Wrapped Timber, Protected Steel or Composite Materials (FRP, plastic, etc.)[4]			
	Benign[2] Environment	Aggressive[3] Environment	Benign[2] Environment	Aggressive[3] Environment	Benign[2] Environment	Aggressive[3] Environment
6 (Good)	6	4	6	5	6	5
5 (Satisfactory)	6	4	6	5	6	5
4 (Fair)	5	3	5	4	6	5
3 (Poor)	4	3	5	4	6	5
2 (Serious)	2	1	2	2	2	2
1 (Critical)	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]	N/A[5]

1. *The maximum interval between Underwater Inspections shall be changed as appropriate, with the approval of the Division, based on the extent of deterioration observed on a structure, the rate of further anticipated deterioration or other factors.*
2. *Benign environments include fresh water and maximum current velocities less than 1.5 knots for the majority of the days in a calendar year.*
3. *Aggressive environments include brackish or salt water, polluted water, or waters with current velocities greater than 1.5 knots for the majority of the days in the calendar year.*
4. *For most structures, two maximum intervals will be shown in this table, one for the assessment of construction material (timber, concrete, steel, etc.) and one for scour (last 2 columns). The shorter interval of the two should dictate the maximum interval used.*
5. *MOTs rated "Critical" will not be operational; and Emergency Action shall be required in accordance with Table 31F-2-6.*
6. *ICARs shall be assigned in accordance with Table 31F-2-4.*

TABLE 31F-2-2
UNDERWATER INSPECTION LEVELS OF EFFORT [2.2]

LEVEL	PURPOSE	DETECTABLE DEFECTS			
		Steel	Concrete	Timber	Composite
I	General visual/tactile inspection to confirm as-built condition and detect severe damage	Extensive corrosion, holes Severe mechanical damage	Major spalling and cracking Severe reinforcement corrosion Broken piles	Major loss of section Broken piles and bracings Severe abrasion or marine borer attack	Permanent deformation Broken piles Major cracking or mechanical damage
II	To detect surface defects normally obscured by marine growth	Moderate mechanical damage Corrosion pitting and loss of section	Surface cracking and spalling Rust staining Exposed reinforcing steel and/or prestressing strands	External pile damage due to marine borers Splintered piles Loss of bolts and fasteners Rot or insect infestation	Cracking Delamination Material degradation
III	To detect hidden or interior damage, evaluate loss of cross-sectional area, or evaluate material homogeneity	Thickness of material Electrical potentials for cathodic protection	Location of reinforcing steel Beginning of corrosion of reinforcing steel Internal voids Change in material strength	Internal damage due to marine borers (internal voids) Decrease in material strength	N/A

TABLE 31F-2-3
SCOPE OF UNDERWATER INSPECTIONS [2.2]

LEVEL		SAMPLE SIZE AND METHODOLOGY[1]							
		Steel		Concrete		Timber		Composite	Slope Protection, Channel Bottom or Mudline-Scour
		Piles	Bulkheads/ Retaining Walls	Piles	Bulkheads/ Retaining Walls	Piles	Bulkheads/ Retaining Walls	Piles	
I	Sample Size: Method:	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile	100% Visual/Tactile
II	Sample Size: Method:	10% Visual: Removal of marine growth in 3 bands	Every 100 LF Visual: Removal of marine growth in 1 SF areas	10% Visual: Removal of marine growth in 3 bands	Every 100 LF Visual: Removal of marine growth in 1 SF areas	10% Visual: Removal of marine growth on 3 bands Measurement: Remaining diameter	Every 50 LF Visual: Removal of marine growth in 1 SF areas	10% Visual: Removal of marine growth in 3 bands	0%
III	Sample Size: Method:	5% Remaining thickness measurement; electrical potential measurement; corrosion profiling as necessary	Every 200 LF Remaining thickness measurement; electrical potential measurement; corrosion profiling as necessary	0% N/A	0% N/A	5% Internal marine borer infestation evaluation	Every 100 LF Internal marine borer infestation evaluation	0%	0%

1. The minimum inspection sampling size for small structures shall include at least two components.
LF = Linear Feet; SF = Square Feet; N/A = Not Applicable

intended to detect and identify damaged and deteriorated areas that may be hidden by surface biofouling. The thoroughness of marine growth removal should be governed by what is necessary to discern the condition of the underlying structural material. Removal of all biofouling staining is generally not required.

Level III—A detailed inspection typically involving nondestructive or partially-destructive testing, conducted to detect hidden or interior damage, or to evaluate material homogeneity. Level III testing is generally limited to key structural areas, areas which are suspect or areas which may be representative of the underwater structure.

3102F.3.5.3 Special inspection considerations.

3102F.3.5.3.1 Coated components. *For coated steel components, Level I and Level II efforts should focus on the evaluation of the integrity and effectiveness of the coating. The piles should be inspected without damaging the coating. Level III efforts should include ultrasonic thickness measurements without removal of the coating, where feasible.*

3102F.3.5.3.2 Encased components. *For steel, concrete or timber components that have been encased, the Level I and II efforts should focus on the evaluation of the integrity of the encasement. If evidence of signifi-*

cant damage to the encasement is present, or if evidence of significant deterioration of the underlying component is present, then the damage evaluation should consider whether the encasement was provided for protection and/or structural capacity. Encasements should not typically be removed for an audit.

For encasements on which the formwork has been left in place, the inspection should focus on the integrity of the encasement, not the formwork. Level I and Level II efforts in such cases should concentrate on the top and bottom of the encasement. For concrete components, if deterioration, loss of bonding, or other significant problems with the encasement are suspected, it may be necessary to conduct a special inspection, including coring of the encasement and laboratory evaluation of the materials.

3102F.3.5.3.3 Wrapped components. *For steel, concrete or timber components that have been wrapped, the Level I and II efforts should focus on the evaluation of the integrity of the wrap. Since the effectiveness of a wrap may be compromised by removal, and since the removal and re-installation of wraps is time-consuming, it should not be routinely done. However, if evidence of significant damage exists, or if the effectiveness of the wraps is in question, then samples should be removed to facilitate the inspection and evaluation. The samples may be limited to particular zones or portions of members if damage is suspected, based on the physical evidence of potential problems. A minimum sample size of three members should be used. A five-percent sample size, up to 30 total members, may be adequate as an upper limit.*

For wrapped timber components, Level III efforts should consist of removal of the wraps from a representative sample of components in order to evaluate the condition of the timber beneath the wrap. The sample may be limited to particular zones or portions of the members if damage is suspected (e.g., at the mudline/bottom of wrap or in the tidal zone). The sample size should be determined based on the physical evidence of potential problems and the aggressiveness of the environment. A minimum sample size of three members should be used. A five-percent sample size, up to 30 total members, may be adequate as an upper limit.

3102F.3.5.4 Mechanical and electrical inspections. *The mechanical and electrical inspections shall include but not be limited to the following:*

1. *Loading arms*
2. *Cranes and lifting equipment, including cables*
3. *Piping/manifolds and supports*
4. *Oil transfer hoses*
5. *Fire detection and suppression systems*
6. *Vapor control system*
7. *Sumps/sump tanks*
8. *Vent systems*
9. *Pumps and pump systems*
10. *Lighting*
11. *Communications equipment*
12. *Gangways*
13. *Electrical switches and junction boxes*
14. *Emergency power equipment*
15. *Air compressors*
16. *Meters*
17. *Cathodic protection systems*
18. *Winches*
19. *ESD and other control systems*
20. *Ladders*

All alarms, limit switches, load cells, current meters, anemometers, leak detection equipment, etc., shall be operated and/or tested to the extent feasible, to ensure proper function.

3102F.3.6 Evaluation and assessment.

3102F.3.6.1 Terminal operating limits. *The physical boundaries of the facility shall be defined by the berthing system operating limits, along with the vessel size limits and environmental conditions.*

The audit shall include a "Statement of Terminal Operating Limits," which must provide a concise statement of the purpose of each berthing system in terms of operating limits. This description must at least include, the minimum and maximum vessel sizes, including Length Overall (LOA), beam, and maximum draft with associated displacement (see Fig. 31F-2-1).

In establishing limits for both the minimum and maximum vessel sizes, due consideration shall be given to water depths, dolphin spacing, fender system limitations, manifold height and hose/loading arm reach, with allowances for tidal fluctuations, surge and drift.

Maximum wind, current or wave conditions, or combinations thereof, shall be clearly defined as limiting conditions for vessels at each berth, both with and without active product transfer.

3102F.3.6.2 Mooring and berthing. *Mooring and berthing analyses shall be performed in accordance with Section 3105F. The analyses shall be consistent with the terminal operating limits and the structural configuration of the wharf and/or dolphins and associated hardware.*

Based on inspection results, analyses and engineering judgment, mooring and berthing OSARs shall be assigned on a global basis, independently for each structure and overall berthing system. The OSARs defined in Table 31F-2-4 shall be used for this purpose. The mooring and berthing OSARs document the berthing system(s) fitness-for-purpose.

3102F.3.6.3 Structure. *A structural evaluation, including a seismic analysis, shall be performed in accordance with Sections 3103F through 3107F. Such evaluation*

shall consider local or global reduction in capacity, as determined from the inspection.

Based on inspection results, structural analyses and engineering judgment, OSARs (for operational loading) and SSARs shall be assigned on a global basis, independently for each structure, structural system(s) and berthing system(s), as appropriate. The OSARs and SSARs defined in Table 31F-2-4 shall be used for this purpose and document the structural and/or berthing system(s) fitness-for-purpose.

Based on inspection results and engineering judgment, ICARs shall be assigned on a global basis, independently for each above and underwater structure, structural system and berthing system, as appropriate. The ICARs defined in Table 31F-2-4 shall be used for this purpose.

Structural component deficiencies assigned RAPs as per Table 31F-2-5 shall be considered in the OSARs, SSARs and ICARs. The assigned ratings shall remain in effect until all the significant corrective action has been completed to the satisfaction of the Division, or until completion of the next audit.

3102F.3.6.4 Mechanical and electrical systems. *An evaluation of all mechanical and electrical systems and components shall be performed in accordance with Sections 3108F through 3111F of these standards. If a pipeline stress analysis is required (see Section 3109F.3), forces and imposed seismic displacements resulting from the structural analysis shall be considered. Mechanical and electrical component deficiencies shall be assigned ratings from Table 31F-2-5.*

3102F.3.7 Follow-up actions. *Follow-up actions as described in Table 31F-2-6 shall be prescribed. Multiple follow-up actions may be assigned; however, guidance shall be provided as to the order in which the follow-up actions should be carried out.*

If an assessment rating of "1", "2" or "3" (Table 31F-2-4) or a RAP of "P1" or "P2" (Table 31F-2-5) or "Emergency Action" using Table 31F-2-6, is assigned to a structure, berthing system or critical component, the Division shall be notified immediately. The Executive Summary Table ES-2 (see Example Table 31F-2-8) shall include implementation schedules for all follow-up and remedial actions. Follow-up and remedial actions and implementation schedules are subject to Division approval. Executive Summary Tables shall be maintained and updated by the MOT, and shall be submitted in the audit and/or upon Division request. For action plan implementation, see Section 3102F.3.9.

3102F.3.8 Documentation and reporting. *The audit reports shall be signed and stamped by the audit team leader. The inspection and other reports and drawings shall be signed and stamped by the engineers in responsible charge.*

Each audit and inspection, whether partial or complete, shall be adequately documented. Partial inspections cover only specific systems or equipment examined. The resulting reports shall summarize and reference relevant previous ratings and deficiencies. Inspection reports shall be included in subsequent audits.

The contents of the audit and inspection reports for each berthing system shall, at a minimum, include the following as appropriate:

Executive summary—*a concise narrative of the audit or inspection results and analyses conclusions. It shall include summary information for each berthing system, including an overview of the assigned follow-up actions. The Executive Summary Tables shall also be included (see Example Tables 31F-2-7A through 31F-2-7C and 31F-2-8).*

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Introduction—*a brief description of the purpose and scope of the audit or inspection, as well as a description of the inspection/evaluation methodology used.*

Existing conditions—*a description, along with a summary, of the observed conditions. Subsections shall be used to describe the above water structure, underwater structure, fire, piping/pipeline, mechanical and electrical systems, to the extent each are included in the scope of the audit. Photos, plan views and sketches shall be utilized as appropriate to describe the structure and the observed conditions. Details of the inspection results such as test data, measurements data, etc., shall be documented in an appendix.*

Evaluation and assessment—*assessment ratings shall be assigned to all structures and/or berthing systems. Also, see Section 3102F.3.6. All supporting calculations, as-built drawings and documentation shall be included in appendices as appropriate to substantiate the ratings. However, the results and recommendations of the engineering analyses shall be included in this section. Component deficiencies shall be described and a corresponding RAP assigned.*

Follow-up actions—*Specific follow-up actions (Table 31F-2-6) shall be documented (Table 31F-2-8), and remedial schedules included, for each audited system. Audit team leaders shall specify which follow-up actions require a California registered engineer to certify that the completion is acceptable.*

Appendices—*When appropriate, the following appendices shall be included:*

1. *Background data on the terminal - description of the service environment (wind/waves/currents), extent and type of marine growth, unusual environmental conditions, etc.*
2. *Inspection/testing data*
3. *Mooring and berthing analyses*
4. *Structural and seismic analyses and calculations*
5. *Geotechnical report*
6. *MOT Fire Protection Assessment*
7. *Pipeline stress and displacement analyses*

8. *Mechanical and electrical system documentation*
9. *Corrosion assessment*
10. *Photographs, sketches and supporting data shall be included to document typical conditions and referenced deficiencies, and to justify the assessment ratings and the remedial action priorities RAPs assigned.*

3102F.3.9 Action plan implementation report. *After implementation of remedial measures, a report shall be submitted to the Division and shall include:*

1. *A description of each action taken*
2. *Updated Executive Summary Tables*
3. *Supporting documentation with calculations and/or relevant data*

3102F.4 Post-event inspection. *A post-event inspection is a focused inspection following a significant, potentially damage-causing event such as an earthquake, storm, vessel impact, fire, explosion or tsunami. The primary purpose is to assess the integrity of structural, mechanical and electrical systems. This assessment will determine the operational status and/or any remedial measures required.*

TABLE 31F-2-4
ASSESSMENT RATINGS

RATING		DESCRIPTION OF STRUCTURE(S) AND/OR SYSTEMS[4]	
		OSAR[1] and SSAR[2]	ICAR[3]
6	Good	The capacity of the structure or system meets the requirements of this standard. The structure or system should be considered fit-for-purpose. No repairs or upgrades are required.	No problems or only minor problems noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs or upgrades are required.
5	Satisfactory	The capacity of the structure or system meets the requirements of this standard. The structure or system should be considered fit-for-purpose. No repairs or upgrades are required.	Limited minor to moderate defects or deterioration observed, but no overstressing observed. No repairs or upgrades are required.
4	Fair	The capacity of the structure or system is no more than 15 percent below the requirements of this standard, as determined from an engineering evaluation. The structure or system should be considered as marginal. Repair and/or upgrade measures may be required to remain operational. Facility may remain operational, provided a plan and schedule for remedial action is presented to and accepted by the Division.	All primary structural elements are sound, but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present, but do not significantly reduce the load bearing capacity of the structure. Repair and/or upgrade measures may be required to remain operational. Facility may remain operational, provided a plan and schedule for remedial action is presented to and accepted by the Division.
3	Poor	The capacity of the structure or system is no more than 25 percent below the requirements of this standard, as determined from an engineering evaluation. The structure or system is not fit-for-purpose. Repair and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted or contingency basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.	Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load bearing capacity of the structure. Repair and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted or contingency basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.
2	Serious	The capacity of the structure or system is more than 25 percent below the requirements of this standard, as determined from an engineering evaluation. The structure or system is not fit-for-purpose. Repairs and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.	Advanced deterioration, overstressing or breakage may have significantly affected the load bearing capacity of primary structural components. Local failures are possible and loading restrictions may be necessary. Repairs and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.
1	Critical	The capacity of the structure or system is critically deficient relative to the requirements of this standard. The structure or system is not fit-for-purpose. The facility shall cease operations until deficiencies are corrected and accepted by the Division.	Very advanced deterioration, overstressing or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur and load restrictions should be implemented as necessary. The facility shall cease operations until deficiencies are corrected and accepted by the Division.

1. *OSAR = Operational Structural Assessment Ratings*
2. *SSAR = Seismic Structural Assessment Ratings*
3. *ICAR = Inspection Condition Assessment Ratings [2.2]; Ratings shall be assigned comparing the observed condition to the original condition.*
4. *Structural, mooring or berthing systems*

3102F.4.1 Notification and action plan. *Notification as per 2 CCR 2325(e) [2.1] shall be provided to the local area Division field office. The notification shall include, as a minimum:*

1. *Brief description of the event*
2. *Brief description of the nature, extent and significance of any damage observed as a result of the event*
3. *Operational status and any required restrictions*
4. *Statement as to whether a Post-Event inspection will be carried out*

The Division may carry out or cause to be carried out, a post-event inspection. In the interim, the Division may direct a change in the operations manual, per 2 CCR 2385 (f)(3) [2.1].

If a post-event inspection is required, an action plan shall be submitted to the Division within five (5) days after the event. This deadline may be extended in special circumstances. The action plan shall include the scope of the inspection (above water, underwater, electrical, mechanical systems, physical limits, applicable berthing systems, etc.) and submission date of the final report. The action plan is subject to Division approval.

3102F.4.2 Inspection team. *The qualifications of the inspection team shall be the same as those prescribed in Section 3102F.3.4. Division representatives may participate in any post-event inspection, as observers, and may provide guidance.*

3102F.4.3 Scope. *The post-event inspection shall focus on the possible damage caused by the event. General observations of long-term or preexisting deterioration such as significant corrosion-related damage or other deterioration should be made as appropriate, but should not be the focus of the inspection. The inspection shall always include an above-water assessment of structural, mechanical and electrical components.*

The inspection team leader shall determine the need for, and methodology of, an underwater structural assessment, in consultation with the Division. Above water observations, such as shifting or differential settlement, misalignments, significant cracking or spalling, bulging, etc., shall be used to determine whether or not an underwater assessment is required. Similarly, the inspection team leader shall determine, in consultation with the Division, the need for,

TABLE 31F-2-5
COMPONENT DEFICIENCY REMEDIAL ACTION PRIORITIES (RAP)

REMEDIAL PRIORITIES	DESCRIPTION AND REMEDIAL ACTIONS
P1	Specified whenever a condition that poses an immediate threat to public health, safety or the environment is observed. Emergency Actions may consist of barricading or closing all or portions of the berthing system, evacuating product lines and ceasing transfer operations. The berthing system is not fit-for-purpose. Immediate remedial actions are required prior to the continuance of normal operations.
P2	Specified whenever defects or deficiencies pose a potential threat to public health, safety and the environment. Actions may consist of limiting or restricting operations until remedial measures have been completed. The berthing system is not fit-for-purpose. This priority requires investigation, evaluation and urgent action.
P3	Specified whenever systems require upgrading in order to comply with the requirement of these standards or current applicable codes. These deficiencies do not require emergency or urgent actions. The MOT may have limitations placed on its operational status.
P4	Specified whenever damage or defects requiring repair are observed. The berthing system is fit-for-purpose. Repair can be performed during normal maintenance cycles, but not to exceed one year.
R	Recommended action is a good engineering/maintenance practice, but not required by these standards. The berthing system is fit-for-purpose.

TABLE 31F-2-6
FOLLOW-UP ACTIONS [2.2]

FOLLOW-UP ACTION	DESCRIPTION
Emergency Action	Specified whenever a condition which poses an immediate threat to public health, safety or the environment is observed. Emergency Actions may consist of barricading or closing all or portions of the berthing system, limiting vessel size, placing load restrictions, evacuating product lines, ceasing transfer operations, etc.
Engineering Evaluation	Specified whenever damage or deficiencies are observed which require further investigation or evaluation to determine appropriate follow-up actions.
Repair Design Inspection	Specified whenever damage or defects requiring repair are observed. The repair design inspection is performed to the level of detail necessary to prepare appropriate repair plans, specifications and estimates.
Upgrade Design and Implementation	Specified whenever the system requires upgrading in order to comply with the requirements of these standards and current applicable codes.
Special Inspection	Typically specified to determine the cause or significance of nontypical deterioration, usually prior to designing repairs. Special testing, laboratory analysis, monitoring or investigation using nonstandard equipment or techniques are typically required.
Develop and Implement Repair Plans	Specified when the Repair Design Inspection and required Special Inspections have been completed. Indicates that the structure is ready to have repair plans prepared and implemented.
No Action	Specified when no further action is necessary until the next scheduled audit or inspection.

and methodology of any supplemental inspections (e.g., special inspections (see Section 3102F.3.5.3).

The following information may be important in determining the need for, and methodology of, the post-event inspection:

1. *Earthquakes or vessel or debris impact typically cause damage both above and below the waterline. Following a major earthquake, the inspection should focus on components likely to attract highest lateral loads (batter or shorter piles in the rear of the structure, etc.). In case of vessel or debris impact, the inspection effort should focus on components in the path of the impact mass.*
2. *Major floods or tsunamis may cause undermining of the structure, and/or scouring at the mudline.*
3. *Fire damage varies significantly with the type of construction materials but all types may be adversely affected. Special inspections (sampling and laboratory testing) shall be conducted, as determined by the inspection team leader, in order to determine the nature and extent of damage.*
4. *High wind or wave events often cause damage both above and below the waterline. An underwater inspection may be required if damage is visible above the waterline. Structural damage may be potentially increased if a vessel was at the berth during the event. The effects of high wind may be most prevalent on equipment and connections of such equipment to the structure.*

The methodology of conducting an underwater post- event inspection should be established with due consideration of the structure type and type of damage anticipated. Whereas slope failures or scour may be readily apparent in waters of adequate visibility, overstressing cracks on piles covered with marine growth will not be readily apparent. Where such hidden damage is suspected, marine growth removal should be performed on a representative sampling of components in accordance with the Level II effort requirements described in Section 3102F.3.5.2. The cause of the event will determine the appropriate sample size and locations.

3102F.4.4 Post-event ratings. *A post-event rating [2.2] shall be assigned to each berthing system upon completion of the inspection (see Table 31F-2-9). All observations of the above and under water structure, mechanical and electrical components and systems shall be considered in assigning a post-event rating.*

Ratings should consider only damage that was likely caused by the event. Pre-existing deterioration such as corrosion damage should not be considered unless the structural integrity is immediately threatened or safety systems or protection of the environment may be compromised.

Assignment of ratings should reflect an overall characterization of the berthing system being rated. The rating shall consider both the severity of the deterioration and the extent to which it is widespread throughout the facility. The fact that the facility was designed for loads that are lower than the current standards for design should have no influence upon the ratings.

3102F.4.5 Follow-up actions. *Follow-up actions shall be assigned upon completion of the post-event inspection of each berthing system. Table 31F-2-5 specifies remedial action priorities for deficiencies. Table 31F-2-6 specifies various follow-up actions. Multiple follow-up actions may be assigned; however, guidance should be provided as to the order in which the follow-up actions should be carried-out. Follow-up actions shall be subject to Division approval.*

3102F.4.6 Documentation and reporting. *Documentation of the specific attributes of each defect shall not be required during a post-event inspection. However, a narrative description of significant damage shall be used. The description shall be consistent with and shall justify the post-event rating assigned.*

A report shall be prepared and submitted to the Division upon completion of the post-event inspection and shall, at a minimum, include:

1. *Brief description of the facility including the physical limits of the structure, type of construction material(s), and the mechanical and electrical systems present*
2. *Brief description of the event triggering the inspection*
3. *Scope of the inspection (above water, underwater, electrical or mechanical)*
4. *Date of the inspection*
5. *Names and affiliations of inspection team*
6. *Description of the nature, extent and significance of any observed damage resulting from the event*
7. *Photographs should be provided to substantiate the descriptions and justify the condition rating*
8. *Assignment of a post-event rating*
9. *Statement regarding whether the facility is fit to resume operations and, if so, under what conditions*
10. *Assignment of follow-up action(s)*
11. *Inspection data, drawings, calculations and other relevant engineering materials*
12. *Signature and stamp of team leader(s)*

3102F.4.7 Action Plan Report. *Upon completion of all actions delineated in the action plan, a final report shall be submitted to the Division to document the work completed. Supporting documentation such as calculations or other relevant data shall be provided in appendices.*

3102F.5 References.

[2.1] California Code of Regulations (CCR), Title 2, Division 3, Chapter 1, Article 5, Marine Terminals Inspection and Monitoring, Sections 2315, 2320, 2325 and 2385 (short form example: 2 CCR 2315 (Title 2 of California Code of Regulations, Section 2315).

[2.2] Childs, K.M., editor, 2001, "Underwater Investigations - Standard Practice Manual," American Society of Civil Engineers, Reston, VA.

Authority: Sections 8755 and 8757, Public Resources Code

Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

TABLE 31F-2-7A

EXAMPLE	EXECUTIVE SUMMARY TABLE (ES-1A) GLOBAL OPERATIONAL STRUCTURAL ASSESSMENT RATINGS (OSAR)									REV. # MM/YYYY
Berthing system	Berth(s)[1]	Structure(s)[1]	Type of analysis[2]	OSAR rating[4]	Last audit date (MM/YYYY)	Next audit due date (MM/YYYY)	Last analysis date (MM/YYYY)[5]	Repair/replacement due date (MM/YYYY)[6]	Fit-for-purpose (Y/N)	Description or comments[7]
North Wharf	Berth 1	Wharfhead	O	5	08/2008	08/2011	02/2008	N/A	Y	None
North Wharf	Berth 1	Mooring Dolphin	M	2	08/2008	08/2011	05/2008	12/2008	N	Hook capacity inadequate
North Wharf	Berth 1	Breasting Dolphin	B	3	08/2008	08/2011	06/2008	02/2010	Y	Berthing velocity restrictions required. Velocity monitoring system operational. Fender system to be upgraded. See Terminal Operating Limits.
North Wharf	Berth 1	Overall	O	4	08/2008	08/2011	02/2008	N/A	Y	None
North Wharf	Berth 1	Dolphins, Trestles, Catwalks, Bulkhead walls, etc.			08/2008	08/2011				
South Wharf	Berth 2				08/2008	08/2011				

TABLE 31F-2-7B

EXAMPLE	EXECUTIVE SUMMARY TABLE (ES-1B) GLOBAL SEISMIC STRUCTURAL ASSESSMENT RATINGS (SSAR)								REV. # MM/YYYY
Berthing system	Berth(s)[1]	Structure(s)[1]	SSAR rating[4]	Last audit date (MM/YYYY)	Next audit due date (MM/YYYY)	Last analysis date (MM/YYYY)[5]	Repair/replacement due date (MM/YYYY)[6]	Fit-for-purpose (Y/N)	Description or comments[7]
North Wharf	Berth 1	Wharfhead	2	08/2008	08/2011	05/2008	02/2010	N	Level 1 – OK; SAP2000 Pushover Analysis Level 2 – NG; SAP2000 Pushover Analysis displacements too large and liquefation
North Wharf	Berth 1	Trestle	5	08/2008	08/2011	05/2008	N/A	Y	Level 1 – OK; SAP2000 Linear Analysis Level 2 – OK; SAP2000 Linear Analysis
North Wharf	Berth 1	30" Crude line	5	08/2008	08/2011	05/2008	N/A	Y	Level 1 – N/A Level 2 – OK; CAESAR Analysis
North Wharf	Overall	Overall							
North Wharf	Berth 1	Dolphins, Pipeline Trestle, Bulkhead walls, etc.							
South Wharf	Berth 2								

TABLE 31F-2-7C

EXAMPLE	EXECUTIVE SUMMARY TABLE (ES-1C) GLOBAL INSPECTION CONDITION ASSESSMENT RATINGS (ICAR)[9]							REV. # MM/YYYY
Berthing system	Berth(s)[1]	Structure(s)[1]	Type of inspection[3]	ICAR rating [4, 9]	Last inspection date (MM/YYYY)[10]	Inspection interval (YRS.)	Next inspection due date (MM/YYYY)[10]	Description or comments[7]
North Wharf	Berth 1	Wharfhead	AW	5	02/2008	3	02/2011	General satisfactory condition. See RAPs in Table ES-2 for details.
North Wharf	Berth 1	Wharfhead	UW	4	02/2008	5	02/2013	Pile damage; 10 serve, 15 minor See RAPs in Table ES-2 for details.
North Wharf	Berth 1	Breasting Dolphin BD-1	AW	6	02/2008	3	02/2011	See RAPs in Table ES-2
North Wharf	Berth 1	Breasting Dolphin BD-1	UW	5	02/2008	5	02/2013	See RAPs in Table ES-2
North Wharf	Berth 1	Dolphins, Trestle, Catwalks, Bulkhead walls, etc.						
South Wharf	Berth 2							

These notes apply to Tables 31F-2-7A through 7C:

1. *The term "Overall" shall be input in this field when the assessment ratings are summarized for a berth.*
2. *"Types of Analyses": "O" = Operational Loading Analysis, "M" = Mooring Analysis, "B" = Berthing Analysis*
3. *"Types of Inspections": "AW" = Above Water Inspection, "UW" = Underwater Inspection*
4. *All assessment ratings shall be assigned in accordance with Table 31F-2-4.*
5. *The "Analysis Dates" are defined by the month and year in which the final design package is submitted to the Division.*
6. *The "Repair/Replacement Dates" are defined by the month and year in which the repair/replacement is to be completed and operational.*
7. *The "Description or Comments" shall reference all MOT operating limits. For OSARs, this includes berthing velocity restrictions, load limits, etc. For SSARs, this includes a brief list of the findings for each Seismic Performance Level.*
8. *Inspection findings may trigger a structural reassessment (see Tables 31F-2-7A and 31F-2-7B).*
9. *Ratings shall be assigned comparing the observed condition to the original condition.*
10. *The "Inspection Dates" are defined by the month and year in which the last day of formal field inspection is conducted.*

TABLE 31F-2-9
POST-EVENT RATINGS AND REMEDIAL ACTIONS [2.2]

RATING	SUMMARY OF DAMAGE	REMEDIAL ACTIONS
A	*No significant event-induced damage observed.*	*No further action required. The berthing system may continue operations.*
B	*Minor to moderate event-induced damage observed but all primary structural elements and electrical/mechanical systems are sound.*	*Repairs or mitigation may be required to remain operational. The berthing system may continue operations.*
C	*Moderate to major event-induced damage observed which may have significantly affected the load bearing capacity of primary structural elements or the functionality of key electrical/mechanical systems.*	*Repairs or mitigation may be necessary to resume or remain operational. The berthing system may be allowed to resume limited operations.*
D	*Major event-induced damage has resulted in localized or widespread failure of primary structural components; or the functionality of key electrical/ mechanical systems has been significantly affected. Additional failures are possible or likely to occur.*	*The berthing system may not resume operations until the deficiencies are corrected.*

Division 3

SECTION 3103F
STRUCTURAL LOADING CRITERIA

3103F.1 General. *Section 3103F establishes the environmental and operating loads acting on the marine oil terminal (MOT) structures and on moored vessel(s). The analysis procedures are presented in Sections 3104F – 3107F.*

3103F.2 Dead loads.

3103F.2.1 General. *Dead loads shall include the weight of the entire structure, including permanent attachments such as loading arms, pipelines, deck crane, fire monitor tower, gangway structure, vapor control equipment and mooring hardware. Unit weights specified in Section 3103F.2.2 may be used for MOT structures if actual weights are not available.*

3103F.2.2 Unit weights. *The unit weights in Table 31F-3-1 may be used for both existing and new MOTs.*

TABLE 31F-3-1
UNIT WEIGHTS

MATERIAL	UNIT WEIGHT (pcf)*
Steel or cast steel	490
Cast iron	450
Aluminum alloys	175
Timber (untreated)	40-50
Timber (treated)	45-60
Concrete, reinforced (normal weight)	145-160
Concrete, reinforced (lightweight)	90-120
Asphalt paving	150

* pounds per cubic foot

3103F.2.3 Equipment and piping area loads. *The equipment and piping area loads in Table 31F-3-2 may be used, as a minimum, in lieu of detailed as-built data.*

TABLE 31F-3-2
EQUIPMENT AND PIPING AREA LOADS

LOCATION	AREA LOADS (psf)***
Open areas	20*
Areas containing equipment and piping	35**
Trestle roadway	20*

* Allowance for incidental items such as railings, lighting, miscellaneous equipment, etc.

** 35 psf is for miscellaneous general items such as walkways, pipe supports, lighting and instrumentation. Major equipment weight shall be established and added into this weight for piping manifold, valves, deck crane, fire monitor tower, gangway structure and similar ma/or equipment.

*** pounds per square foot

3103F.3 Live loads and buoyancy. *The following vertical live loading shall be considered, where appropriate: uniform loading, truck loading, crane loading and buoyancy. Additionally, MOT specific, nonpermanent equipment shall be identified and used in loading computations.*

3103F.4 Earthquake loads.

3103F.4.1 General. *Earthquake loads are described in terms of Peak Ground Acceleration (PGA), spectral acceleration and earthquake magnitude. The required seismic analysis procedures (Tables 31F-4-2 and 31F-4-3) are dependent on the risk classification obtained from Table 31F-4-1.*

3103F.4.2 Design earthquake motion parameters. *The earthquake ground motion parameters of peak ground acceleration, spectral acceleration and earthquake magnitude are modified for site amplification and near fault directivity effects. The resulting values are the design peak ground acceleration (DPGA), design spectral acceleration (DSA) and design earthquake magnitude (DEM).*

The peak ground and spectral acceleration may be evaluated using:

1. *U.S. Geological Survey (USGS) or California Geological Survey [CGS, formerly the California Division of Mines and Geology (CDMG)] maps as discussed in Section 3103F.4.2.2,*
2. *A site-specific probabilistic seismic hazard analysis (PSHA) as discussed in Section 3103F.4.2.3.*
3. *For the Ports of Los Angeles, Long Beach and Port Hueneme, PSHA results are provided in Section 3103F.4.2.3.*

Unless stated otherwise, the DSA values are for 5 percent damping; values at other levels may be obtained as per Section 3103F.4.2.9.

The appropriate probability levels associated with DPGA and DSA for different seismic performance levels are provided in Table 31F-4 -2. Deterministic earthquake motions, which are used only for comparison to the probabilistic results, are addressed in Section 3103F.4.2. 7.

The evaluation of Design Earthquake Magnitude (DEM), is discussed in Section 3103F.4.2.8. This parameter is required when acceleration time histories (Section 3103F.4.2.10) are addressed or if liquefaction potential (Section 3106F.3) is being evaluated.

3103F.4.2.1 Site classes. *The following site classes, defined in Section 3106F.2, shall be used in developing values of DSA and DPGA:*

S_A, S_B, S_C, S_D, S_E and S_F.

For S_F, a site-specific response analysis is required per Section 3103F.4.2.5.

3103F.4.2.2 Earthquake motions from USGS maps. *Earthquake ground motion parameters can be obtained from the Maps 29-32 in the National Earthquake Hazard Reduction Program (NEHRP) design map set discussed in subsection 1.6.1 of [3.1], or the USGS website: (http://earthquake.usgs.gov/research/hazmaps/). These are available as peak ground acceleration and spectral acceleration values at 5 percent damping for 10 and 2 percent probability of exceedance in 50 years, which correspond to Average Return Periods (ARPs) of 475 and 2,475 years, respectively. The spectral acceleration values are available for 0.2, and 1.0 second spectral periods. In obtaining peak ground acceleration and spectral acceleration values from the USGS web site, the site location can be specified in terms of site longitude and latitude or the zip code when appropriate. The*

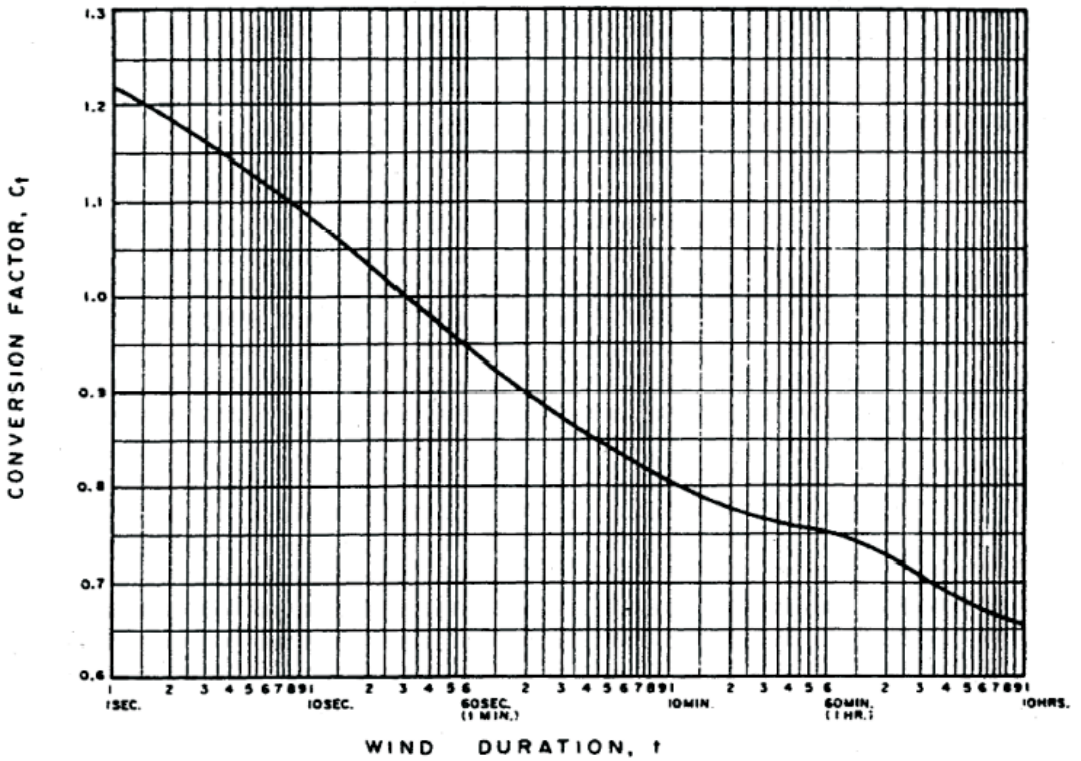

FIGURE 31F-3-3 WIND SPEED CONVERSION FACTOR [3.12]

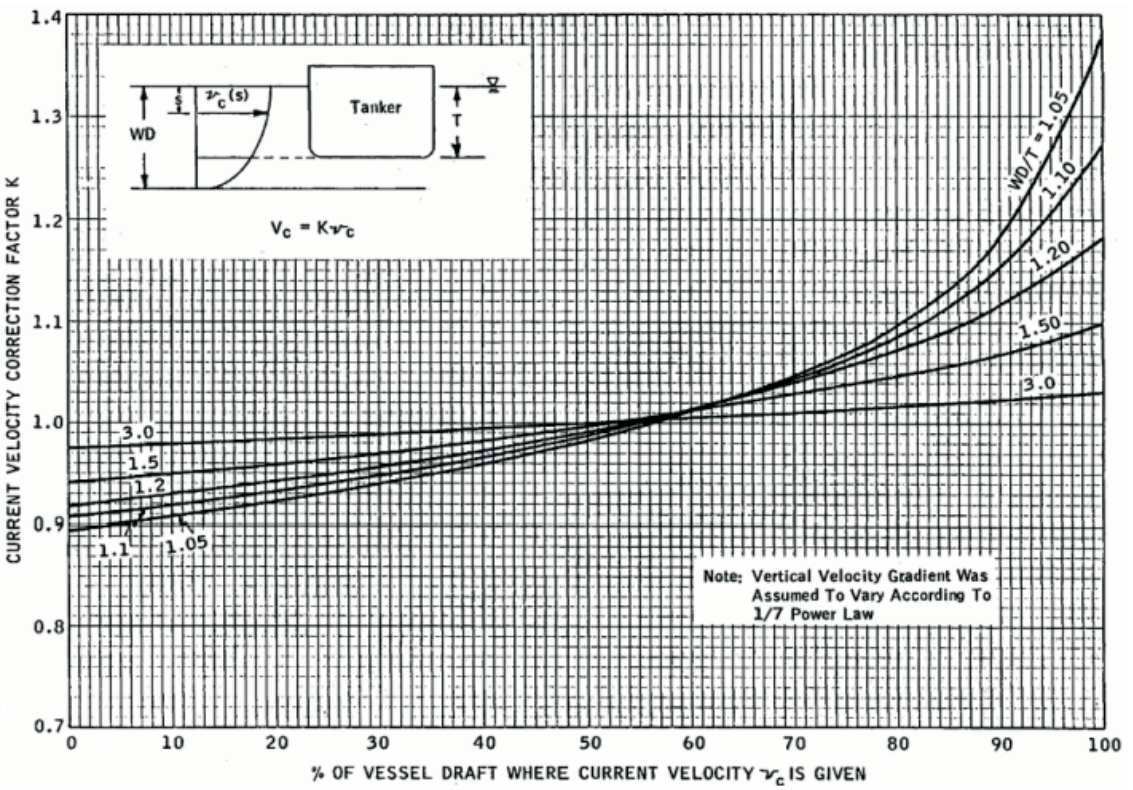

FIGURE 31F-3-4 CURRENT VELOCITY CORRECTION FACTOR (p. 23, OCIMF , 1997 [3.13])

3103F.5.5 Passing vessels. *When required in Section 3105F.3, the sway and surge forces, as well as yaw moment, on a moored vessel, due to passing vessels, shall be established considering the following:*

1. *Ratio of length of moored vessel to length of passing vessel.*
2. *Distance from moored vessel to passing vessel.*
3. *Ratio of midship section areas of the moored and passing vessels.*
4. *Underkeel clearances of the moored and passing vessels.*
5. *Draft and trim of the moored vessel and draft of the passing vessel.*
6. *Mooring line tensions.*

The passing vessel's speed should take into consideration the ebb or flood current. Normal operating wind and current conditions can be assumed when calculating forces due to a passing vessel. Either method of Krieble [3.19] or Wang [3.20] may be used to determine forces on a moored vessel. Kriebel's recent wave tank study improves on an earlier work of Seelig [3.21].

3103F.5.6 Seiche. *The penetration of long period low amplitude waves into a harbor can result in resonant standing wave systems, when the wave forcing frequency coincides with a natural frequency of the harbor. The resonant standing waves can result in large surge motions if this frequency is close to the natural frequency of the mooring system. Section 3105F.3.3 prescribes the procedure for the evaluation of these effects.*

3103F.5.7 Tsunamis. *A tsunami may be generated by an earthquake or a subsea or coastal landslide, which may induce large wave heights and excessive currents. The large wave or surge and the excessive currents are potentially damaging, especially if there is a tank vessel moored alongside the MOT wharf.*

Tsunamis can be generated either by a distant or near source. A tsunami generated by a distant source (far field event) may allow operators to have an adequate warning for mitigating the risk by depart the MOT and go into deep water. For near-field events, with sources less than 500 miles away, the vessel may not have adequate time to depart. Each MOT shall have a "tsunami plan" describing what actions will be performed, in the event of a distant tsunami.

Recent tsunami studies have been completed for both Southern and Northern California. For the Ports of Los Angeles and Long Beach, one of those recent studies focused on near field tsunamis with predicted return periods of 5,000 to 10,000 years [3.22]. These maximum water levels (run-up) would not normally be used for MOT design. However, because the study also provides actual tidal records from recent distant tsunamis, it should be used for design.

The run-up value for Port Hueneme was obtained from an earlier study by Synolakis et al. [3.23].

Run up-values: Port of Los Angeles and Long Beach = 8 ft.

Port Hueneme = 11 ft.

For the San Francisco Bay, a recent study provides the maximum credible tsunami water levels and current speeds. These results are deterministic and are based on the most severe seismic sources that could reasonably impact MOTs in the San Francisco Bay [3.24]. Table 31F-3-8 provides values for the marine oil terminal locations within San Francisco Bay. Water levels could be positive or negative and current velocities may vary in direction. In order to determine the maximum run-up at a MOT, the largest values should be added to the mean high tide. Further details are available in [3.24].

Loads from tsunami-induced waves can be calculated for various structural configurations [3.25]. Tsunami wave heights in shallow water and particle kinematics can also be obtained. Other structural considerations include uplift and debris impact.

TABLE 31F-3-8
TSUNAMI RUN-UP VALUES (ft) AND CURRENT SPEEDS (ft/sec) IN THE SAN FRANCISCO BAY AREA [AFTER 3.24]

S.F. Bay Locale	Maximum Water Levels (ft.)	Current Velocity (ft/sec)
Richmond, outer	7.5	4.9
Richmond, inner	7.9	8.9
Martinez	2.3	1.3
Selby	2.6	1.6
Rodeo	2.6	2.0
Benicia	2.0	1.0

3103F.6 Berthing Loads.

3103F.6.1 General. *Berthing loads are quantified in terms of transfer of kinetic energy of the vessel into potential energy dissipated by the fender(s). The terms and equations below are based on those in UFC 4-152-01, "Piers and Wharves" [3.26] and PIANC [3.27].*

Kinetic energy shall be calculated from the following equation:

$$E_{vessel} = \frac{1}{2} \cdot \frac{W}{g} \cdot V_n^2 \qquad (3\text{-}15)$$

where:

E_{vessel} = *Berthing energy of vessel [ft-lbs]*

W = *Total weight of vessel and cargo in pounds [long tons × 2240]*

g = *Acceleration due to gravity [32.2 ft/sec^2]*

V_n = *Berthing velocity normal to the berth [ft/sec]*

TABLE 31F-3-12
LRFD LOAD FACTORS FOR LOAD COMBINATIONS [3.26]

LOAD TYPE	VACANT CONDITION		MOORING & BREASTING CONDITION	BERTHING CONDITION	EARTHQUAKE CONDITION[3]	
Dead Load (D)	1.2	0.9	1.2	1.2	1.2 + k^1	0.9-k^1
Live Load (L)	1.6	—	1.6[2]	1.0	1.0	—
Buoyancy (B)	1.2	0.9	1.2	1.2	1.2[1]	0.9[1]
Wind on Structure (W)	1.6	1.6	1.6	1.6	—	—
Current on Structure (C)	1.2	0.9	1.2	1.2	1.2	0.9
Earth Pressure on the Structure (H)	1.6	1.6	1.6	1.6	1.6[4]	1.6[4]
Mooring/Breasting Load (M)	—	—	1.6	—	—	—
Berthing Load (B_e)	—	—	—	1.6	—	—
Earthquake Load (E)	—	—	—	—	1.0	1.0

1. k = 0.50 (PGA) The k factor (k=0.5(PGA)) and buoyancy (B) shall be applied to the vertical dead load (D) only, and not to the inertial mass of the structure.
2. The load factor for live load (L) may be reduced to 1.3 for the maximum outrigger float load from a truck crane.
3. For Level 1 and 2 earthquake conditions with strain levels defined in Division 7, the current on structure (C) may not be required.
4. An earth pressure on the Structure factor (H) of 1.0 may be used for pile or bulkhead structures.

TABLE 31F-3-13
SERVICE OR ASD LOAD FACTORS FOR LOAD COMBINATIONS [3.26]

LOAD TYPE	VACANT CONDITION	MOORING & BREASTING CONDITION	BERTHING CONDITION	EARTHQUAKE CONDITION	
Dead Load (D)	1.0	1.0	1.0	1 + 0.7k^1	1 - 0.7k^1
Live Load (L)	1.0	1.0	0.75	—	—
Buoyancy (B)	1.0	1.0	1.0	1.0	0.6
Wind on Structure (W)	1.0	1.0	0.75	—	—
Current on Structure (C)	1.0	1.0	1.0	—	—
Earth Pressure on the structure (H)	1.0	1.0	1.0	1.0	1.0
Mooring/Breasting Load (M)	—	1.0	—	—	—
Berthing Load (Be)	—	—	1.0	—	—
Earthquake Load (E)	—	—	—	0.7	0.7
% Allowable Stress	100	100	100	100[2]	

1. k = 0.5 (PGA)
2. Increase in allowable stress shall not be used with these load combinations unless it can be demonstrated that such increase is justified by structural behavior caused by rate or duration of load. See ASCE 7 [3.11]

breasting condition. The wind and current loads acting on the structure are therefore additional loads that can act simultaneously with the mooring, breasting and/or berthing loads.

3103F.8.5 Earth pressure on the structure (H). *The soil pressure on end walls, typically concrete cut-off walls, steel sheet pile walls on wharf type structures and/or piles shall be considered.*

3103F.8.6 Mooring line/breasting loads (M). *Mooring line and breasting loads can occur simultaneously or individually, depending on the combination of wind and current. Multiple load cases for operating and survival conditions may be required (see Sections 3103F.5.2 and 3105F.2). In addition, loads caused by passing vessels shall be considered for the "mooring and breasting condition." Refer to Sections 3105F.2 and 3105F.3 for the determination of mooring line and breasting loads.*

3103F.8.7 Berthing load (B_e). *Berthing is a frequent occurrence, and shall be considered as a normal operating load. No increase in allowable stresses shall be applied for ASD.*

3103F.8.8 Earthquake loads (E). *Performance based seismic analysis methodology requires that the actual displacement demand be limited to defined strains in concrete, steel and timber. For the deck and pile evaluation, two cases of dead load (upper and lower bound) shall be considered in combination with the seismic load.*

3103F.9 Safety factors for mooring lines. *Safety factors for different material types of mooring lines are given in Table 31F-3-14. The safety factors should be applied to the minimum number of lines specified by the mooring analysis, using the highest loads calculated for the environmental conditions. The minimum breaking load (MBL) of new ropes is obtained from the certificate issued by the manufacturer. If nylon tails are used in combination with steel wire ropes, the safety factor shall be based on the weaker of the two ropes.*

3103F.10 Mooring hardware (N/E). *Mooring hardware shall include but not be limited to bollards, quick release hooks, other mooring fittings and base bolts. All mooring fittings shall be clearly marked with their safe working loads [3.13] (N). The certificate issued by the manufacturer normally defines the safe working loads of this hardware.*

TABLE 31F-3-14
SAFETY FACTORS FOR ROPES*

Steel Wire Rope	1.82
Nylon	2.2
Synthetic	2.0
Polyester Tail	2.3
Nylon Tail	2.5

*From Mooring Equipment Guidelines', OCIMF[3.30]

3103F.10.1 Quick release hooks. *For new MOTs or berthing systems, a minimum of three quick-release hooks are required for each breasting line location for tankers greater than or equal to 50,000 DWT. At least two hooks at each location shall be provided for breasting lines for tankers less than 50,000 DWT. Remote release may be considered for emergency situations.*

All hooks and supporting structures shall withstand the minimum breaking load (MBL) of the strongest line with a safety factor of 1.2 or greater. Only one mooring line shall be placed on each quick release hook (N/E).

For multiple quick release hooks, the minimum horizontal load for the design of the tie-down shall be:

$$F_d = 1.2 \times MBL \times [1 + 0.75(n-1)] \qquad (3\text{-}21)$$

F_d = Minimum factored demand for assembly tie-down.

n = Number of hooks on the assembly.

The capacity of the supporting structures must be larger than F_d (See Section 3107F.5.3).

3103F.10.2 Other fittings. *Other fittings include cleats, bitts and bollards.*

If the allowable working loads for existing fittings are not available, the values listed in Table 31F-3-15 may be used for typical sizes, bolt patterns and layout. The allowable working loads are defined for mooring line angles up to 60 degrees from the horizontal. The combination of vertical and horizontal loads must be considered.

TABLE 31F-3-15
ALLOWABLE WORKING LOADS

TYPE OF FITTINGS	NO. OF BOLTS	BOLT SIZE (in)	WORKING LOAD (kips)
30 in. Cleat	4	$1\frac{1}{8}$	20
42 in. Cleat	6	$1\frac{1}{8}$	40
Low Bitt	10	$1\frac{5}{8}$	60 per column
High Bitt	10	$1\frac{3}{4}$	75 per column
44 $\frac{1}{2}$ in. Fit. Bollard	4	$1\frac{3}{4}$	70
44 $\frac{1}{2}$ in. Fit. Bollard	8	$2\frac{1}{4}$	200
48 in. Fit. Bollard	12	$2\frac{3}{4}$	450

Note: This table is modified from Table 6-11, UFC 4-159-03 [3.17]

3103F.10.3 Base bolts. *Base bolts are subjected to both shear and uplift. Forces on bolts shall be determined using the following factors:*

1. *Height of load application on bitts or bollards.*
2. *Actual vertical angles of mooring lines for the highest and lowest tide and vessel draft conditions, for all sizes of vessels at each particular berth.*
3. *Actual horizontal angles from the mooring line configurations, for all vessel sizes and positions at each particular berth.*
4. *Simultaneous loads from more than one vessel.*

For existing MOTs, the deteriorated condition of the base bolts and supporting members shall be considered in determining the capacity of the fitting.

3103F.11 Miscellaneous loads. *Handrails and guardrails shall be designed for 25 plf with a 200-pound minimum concentrated load in any location or direction.*

3103F.12 Symbols.

a = Distance between the vessel's center of gravity and the point of contact on the vessel's side, projected onto the vessel's longitudinal axis [ft]

B = Beam of vessel

B_1 = Coefficient used to adjust one-second period spectral response, for the effect of viscous damping

B_s = Coefficient used to adjust the short period spectral response, for the effect of visous damping.

C_b = Berthing Coefficient

C_c = Configuration Coefficient

C_g = Geometric Coefficient

C_d = Deformation Coefficient

C_e = Eccentricity Coefficient

C_m = Effective mass or virtual mass coefficient

C_t = Windspeed conversion factor

DSA = Design Spectral Acceleration

DSA_d = DSA values at damping other than 5 percent

DT = Displacement of vessel

DWT = Dead weight tons

d_{actual} = Arrival maximum draft of vessel at berth

d_{max} = Maximum vessel draft (in open seas)

E_{fender} = Energy to be absorbed by the fender system

E_{vessel} = Berthing energy of vessel [ft-lbs]

F_a, F_v = Site coefficients from Tables 31F-3-5 and 31F-3-6

F_A = Accidental factor accounting for abnormal conditions

g = Acceleration due to gravity [32.2 ft/sec^2]

h = Elevation above water surface [feet]

K = Current velocity correction factor (Fig 31F-3-4)

k = Radius of longitudinal gyration of the vessel [ft]

PGA_X = Peak ground acceleration corresponding to the Site Class under consideration.

s = Water depth measured from the surface

S_a = Spectral acceleration

S_1 = Spectral acceleration value (for the boundary of S_B and S_C) at 1.0 second

S_A-S_F = Site classes as defined in Table 31F-6-1

S_S = Spectral acceleration value (for the boundary of S_B and S_C) at 0.2

S_{X1} = Spectral acceleration value at 1.0 second corresponding to the Site Class under consideration

S_{XS} = Spectral acceleration value at 0.2 second corresponding to the period of S_S and the Site Class under consideration

T = Draft of vessel (see Fig 31F-3-4)

T = Period (Sec)

T_0 = Period at which the constant acceleration and constant velocity regions of the design spectrum intersect

V_c = Average current velocity [knots]

v_c = Current velocity as a function of depth [knots]

V_h = Wind speed (knots) at elevation h

V_L = Over land wind speed

V_n = Berthing velocity normal to the berth [ft/sec]

v_t = Velocity over a given time period

$V_{t=30sec}$ = Wind speed for a 30 second interval

V_w = Wind speed at 33ft. (10 m) elevation [knots]

W = Total weight of vessel and cargo inpounds[displacement tonnage × 2240]

WD = Water Depth (Fig 31F-3-4)

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Authority: Sections 8755 and 8757, Public Resources Code.

Reference: Sections 8750,8751,8755 and 8757, Public Resources Code.

Division 4

SECTION 3104F
SEISMIC ANALYSIS
AND STRUCTURAL PERFORMANCE

3104F.1 General.

3104F.1.1 Purpose. *The purpose of this section is to establish minimum standards for seismic analysis and structural performance. Seismic performance is evaluated at two criteria levels. Level 1 requirements define a performance criterion to ensure MOT functionality. Level 2 requirements safeguard against major structural damage or collapse.*

3104F.1.2 Applicability. *Section 3104F applies to all new and existing MOTs structures. Structures supporting loading arms, pipelines, oil transfer and storage equipment, critical nonstructural systems and vessel mooring structures, such as mooring and breasting dolphins are included. Catwalks and similar components that are not part of the lateral load carrying system and do not support oil transfer equipment may be excluded.*

3104F.1.3 Oil spill risk classification. *Each existing MOT shall be catagorized into one of three risk classifications (high, medium or low) as shown in Table 31F-4-1, based on the highest of the following:*

1. *Exposed total volume of oil during transfer ("total volume" as calculated in Section 3108F.2.3)*
2. *Number of oil transfer operations per berthing system per year*
3. *Maximum vessel size (DWT) that may call at the berthing system*

If risk reduction strategies (see Section 3101F.5) are adopted such that the maximum volume of exposed oil during transfer is less than 1,200 barrels, the classification level of the facility may be lowered. All new MOTs are classified as high risk.

3104F.1.4 Configuration classification. *Each MOT shall be designated as regular or irregular, in accordance with Figure 31F-4-1.*

Irregular configurations, such as the "T" layout, may be analyzed as regular if the presence of expansion joints divides the T-configuration into two or more regular segments. Expansion joints in this context are defined as joints that separate each structural segment in such a manner that each segment will move independently during an earthquake.

If an irregular MOT is divided into seismically isolated sections, an evaluation of the relative movement of pipelines and supports shall be considered, including phase differences (Section 3109F.3).

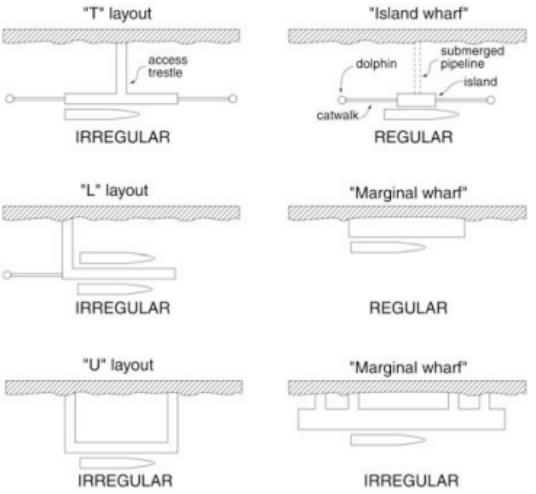

FIGURE 31F-4-1
PIER AND WHARF CONFIGURATIONS

3104F.2 Existing MOTs

3104F.2.1 Design earthquake motions. *Two levels of design seismic performance shall be considered. These levels are defined as follows:*

Level 1 Seismic performance:

- *Minor or no structural damage*
- *Temporary or no interruption in operations*

Level 2 Seismic performance:

- *Controlled inelastic structural behavior with repairable damage*
- *Prevention of structural collapse*
- *Temporary loss of operations, restorable within months*
- *Prevention of major spill (≥1200 bbls)*

3104F.2.2 Basis for evaluation. *Component capacities shall be based on existing conditions, calculated as "best estimates," taking into account the mean material strengths, strain hardening and degradation overtime. The capacity of components with little or no ductility, which may lead to brittle failure scenarios, shall be calculated based on lower bound material strengths. Methods to establish component strength and deformation capacities for typical structural*

TABLE 31F-4-1
MOT RISK CLASSIFICATION

RISK CLASSIFICATION	EXPOSED OIL (bbis)	TRANSFERS PER YEAR PER BERTHING SYSTEM	MAXIMUM VESSEL SIZE (DWTxl000)
High	*≥ 1200*	*N.A.*	*N.A.*
Medium	*< 1200*	*≥ 90*	*≥ 30*
Low	*< 1200*	*< 90*	*< 30*

materials and components are provided in Section 3107F. Geotechnical considerations are discussed in Section 3106F.

3104F.2.3 Analytical procedures. *The objective of the seismic analysis is to verify that the displacement capacity of the structure is greater than the displacement demand, for each performance level defined in Table 31F-4-2. The required analytical procedures are summarized in Table 31F-4-3.*

The displacement capacity of the structure shall be calculated using the nonlinear static (pushover) procedure. It is also acceptable to use a nonlinear dynamic procedure for capacity evaluation. Methods used to calculate the displacement demand are linear modal, nonlinear static and nonlinear dynamic.

Any rational method, subject to the Division's approval, can be used in lieu of the required analytical procedures shown in Table 31F-4-3.

3104F.2.3.1 Nonlinear static capacity procedure (pushover). *Two-dimensional nonlinear static (pushover) analyses shall be performed; three-dimensional analyses are optional. A model that incorporates the nonlinear load deformation characteristics of all components for the lateral force-resisting system shall be displaced to a target displacement to determine the internal deformations and forces. The target displacement depends on the seismic performance level under consideration. Modeling details are as follows:*

3104F.2.3.1.1 Modeling. *A series of nonlinear pushover analyses may be required depending on the complexity of the MOT structure. At a minimum, pushover analysis of a two-dimensional model shall be conducted in both the longitudinal and transverse directions. The piles shall be represented by nonlinear elements that capture the moment-curvature/rotation relationships for components with expected inelastic behavior in accordance with Section 3107F. A nonlinear element is not required to represent each pile location. Piles with similar lateral force-deflection behavior may be lumped in fewer larger springs, provided that the overall torsional effects are captured.*

Linear material component behavior is acceptable where nonlinear response will not occur. All components shall be based on effective moment of inertia calculated in accordance with Section 3107F. Specific requirements for timber pile structures are discussed in the next section.

3104F.2.3.1.2 Timber pile supported structures. *For all timber pile supported structures, linear elastic procedures may be used. Alternatively, the nonlinear static procedure may be used to estimate the target displacement demand, Δ_d.*

A simplified single pile model for a typical timber pile supported structure is shown in Figure 31F-4-2. The pile-deck connections may be assumed to be "pinned." The lateral bracing can often be ignored if it is in poor condition. These assumptions shall be used for the analysis, unless a detailed condition assessment and lateral analysis indicate that the existing bracing and connections may provide reliable lateral resistance.

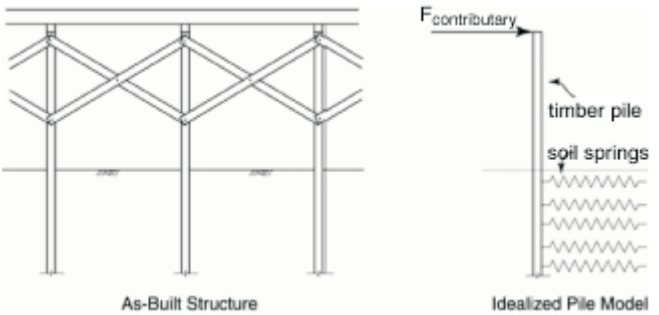

FIGURE 31F-4-2—SIMPLIFIED SINGLE PILE MODEL OF A TIMBER PILE SUPPORTED STRUCTURE

TABLE 31F-4-2
SEISMIC PERFORMANCE CRITERIA

RISK CLASSIFICATION	SEISMIC PERFORMANCE LEVEL	PROBABILITY OF EXCEEDANCE	RETURN PERIOD
High	*Level 1*	*50% in 50 years*	*72 years*
	Level 2	*10% in 50 years*	*475 years*
Medium	*Level 1*	*65% in 50 years*	*48 years*
	Level 2	*15% in 50 years*	*308 years*
Low	*Level 1*	*75% in 50 years*	*36 years*
	Level 2	*20% in 50 years*	*224 years*

TABLE 31F-4-3
MINIMUM REQUIRED ANALYTICAL PROCEDURES

RISK CLASSIFICATION	CONFIGURATION	SUBSTRUCTURE MATERIAL	DISPLACEMENT DEMAND PROCEDURE	DISPLACEMENT CAPACITY PROCEDURE
High/Medium	*Irregular*	*Concrete/Steel*	*Linear Modal*	*Nonlinear Static*
High/Medium	*Regular*	*Concrete/Steel*	*Nonlinear Static*	*Nonlinear Static*
Low	*Regular/Irregular*	*Concrete/Steel*	*Nonlinear Static*	*Nonlinear Static*
High/Medium/Low	*Regular/Irregular*	*Timber*	*Nonlinear Static*	*Nonlinear Static*

3104F.2.3.4 Nonlinear dynamic analysis. *Nonlinear dynamic time history analysis is optional, and if performed, a peer review is required (see Section 3101F.6.1). Multiple acceleration records shall be used, as explained in Section 3103F.4.2.10. The following assumptions may be made:*

1. *Equivalent "super piles" can represent groups of piles.*
2. *If the deck has sufficient rigidity (both in-plane and out-of plane) to justify its approximation as a rigid element, a 2-D plan simulation may be adequate.*

A time-history analysis should always be compared with a simplified approach to ensure that results are reasonable. Displacements calculated from the nonlinear time history analyses may be used directly in design, but shall not be less than 80 percent of the values obtained from Section 3104F.2.3.2.

3104F.2.3.5 Alternative procedures. *Alternative lateral-force procedures using rational analyses based on well-established principles of mechanics may be used in lieu of those prescribed in these provisions. As per Section 3101F.6.1, peer review is required.*

3104F.3 New MOTs. *The analysis and design requirements described in Section 3104F.2 shall also apply to new MOTs. Additional requirements are as follows:*

1. *Site-specific response spectra analysis (see Section 3103F.4.2.3).*
2. *Soil parameters based on site-specific and new borings (see Section 3106F.2.2).*

3104F.4 General analysis and design requirements.

3104F.4.1 Load combinations. *Earthquake loads shall be used in the load combinations described in Section 3103F.8.*

3104F.4.2 Combination of orthogonal effects. *The design displacement demand, Δ_d, shall be calculated by combining the longitudinal, Δ_x, and transverse, Δ_y, displacements in the horizontal plane (Figure 31F-4-7):*

$$\Delta_d = \sqrt{\Delta_x^2 + \Delta_y^2} \qquad (4\text{-}7)$$

where:

$$\Delta_x = \Delta_{xy} + 0.3\Delta_{xx} \qquad (4\text{-}8)$$

and $$\Delta_y = 0.3\Delta_{yx} + \Delta_{yy} \qquad (4\text{-}9)$$

or

and $$\Delta_y = \Delta_{yx} + 0.3\Delta_{yy} \qquad (4\text{-}10)$$

$$\Delta_x = 0.3\Delta_{xy} + \Delta_{xx} \qquad (4\text{-}11)$$

whichever results in the greater design displacement demand.

In lieu of combining the displacement demands as presented above, the design displacement demand for marginal wharf type MOTs may be calculated as:

$$\Delta_d = \Delta_y \sqrt{1 + \left(0.3\left(1 + 20e/L_l\right)\right)^2} \qquad (4\text{-}12)$$

where:

Δ_y = *transverse displacement demand*

e = *eccentricity between center of mass and center of rigidity*

L_l = *longitudinal length between wharf expansion*

This equation is only valid for wharf aspect ratios (length/breadth) greater than 3.

3104F.4.3 P-Δ Effects. *The P-Δ effect (i.e., the additional moment induced by the total vertical load multiplied by the lateral deck deflection) shall be considered unless the following relationship is satisfied (see Figure 31F-4-8):*

$$\frac{V}{W} \geq 4\frac{\Delta_d}{H} \qquad (4\text{-}13)$$

where:

V = *base shear strength of the structure obtained from a plastic analysis*

W = *dead load of the frame*

Δ_d = *displacement demand*

H = *distance from the location of maximum in-ground moment to center of gravity of the deck*

For wharf structures where the lateral displacement is limited by almost fully embedded piles, P-Δ effects may be ignored; however, the individual stability of the piles shall be checked in accordance with Section 3107F.2.5.2.

If the landside batter piles are allowed to fail in a Level 2 evaluation, the remaining portion of the wharf shall be checked for P-Δ effects.

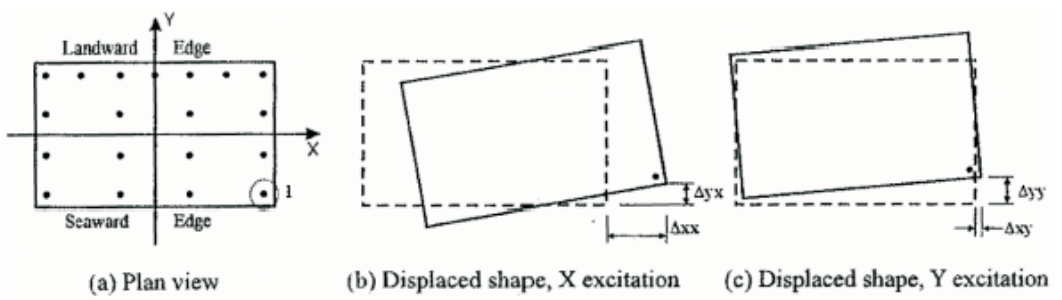

FIGURE 31F-4-7
PLAN VIEW OF WHARF SEGMENT UNDER X AND Y SEISMIC EXCITATIONS [4.3]

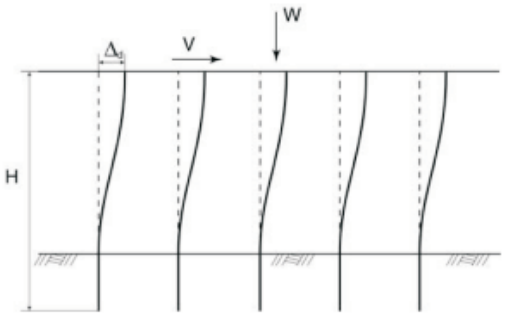

FIGURE 31F-4-8
P-Δ EFFECT

3104F.4.4 Expansion joints. *The effect of expansion joints shall be considered in the seismic analysis.*

3104F.4.5 Shear key forces. *Shear force across shear keys connecting adjacent wharf segments, V_{sk}, (approximate upper bound to the shear key force [4.4]) shall be calculated as follows:*

$$V_{sk} = 1.5\left(e/L_l\right)V_{\Delta T} \qquad (4\text{-}14)$$

where:

$V_{\Delta T}$ = *total segment lateral force found from a push-over analysis*

L_l = *segment length*

e = *eccentricity between the center of rigidity and the center of mass*

3104F.4.6 Connections. *For an existing wharf, the deteriorated conditions at the junction between the pile top and pile cap shall be considered in evaluating the moment capacity. Connection detail between the vertical pile and pile cap shall be evaluated to determine whether full or partial moment capacity can be developed under seismic action.*

For new MOTs, the connection details shall develop the full moment capacities.

The modeling shall simulate the actual moment capacity (full or partial) of the joint in accordance with Section 3107F.2. 7.

3104F.4.7 Batter piles. *Batter piles primarily respond to earthquakes by developing large axial compression or tension forces. Bending moments are generally of secondary importance. Failure in compression may be dictated by the deck-pile connection (most common type), material compression, buckling, or by excessive local shear in deck members adjacent to the batter pile. Failure in tension may be dictated by connection strength or by pile pull out. (p. 3-83 of [4.4]).*

When the controlling failure scenario is reached and the batter pile fails, the computer model shall be adjusted to consist of only the vertical pile acting either as a full or partial moment frame based on the connection details between the pile top and pile cap. The remaining displacement capacity, involving vertical piles, before the secondary failure stage develops, shall then be established (see Section 3107F.2.8).

Axial p-z curves shall be modeled. In compression, displacement capacity should consider the effect of the reduction in pile modulus of elasticity at high loads and the increase in effective length for friction piles. This procedure allows the pile to deform axially before reaching ultimate loads, thereby increasing the displacement ductility [4.4].

Horizontal nonlinear p-y springs are only applied to batter piles with significant embedment, such as for landside batter piles in a wharf structure. Moment fixity can be assumed for batter piles that extend well above the ground such as waterside batter piles in a wharf structure or batter piles in a pier type structure.

3104F.5 Nonstructural components. *This section covers nonstructural components having a significant mass and/or a critical importance to the operability and safety of the MOT. The weight of nonstructural components shall be included in the dead load of the structure, per Section 3103F.2.*

3104F.5.1 Contribution to global response. *Nonstructural components including, but not limited to pipelines, loading arms, raised platforms, control rooms and vapor control equipment, may affect the global structural response. In such cases, the seismic characteristics (mass and/or stiffness) of the nonstructural components shall be considered. If the seismic response of nonstructural components is out of phase with the global structural response, then the mass contribution can be neglected in the seismic structural analysis.*

3104F.5.2 Seismic loads. *In general, for nonstructural components, the evaluation procedures of Section 3110F.8 are adequate.*

For pipelines, the seismic analysis shall be performed in accordance with Section 3109F.3, in lieu of Section 3110F.8. If a pipeline analysis has been performed and support reactions are available, they may be used to determine the forces on the support structure.

A pipeline segment under consideration shall extend between two adjacent anchor points. A simplified pipeline analysis may be used when the relative displacement demands of anchor points are considered. As an option, a full nonlinear time-history analysis can be used to capture the nonlinear interaction between the structure and the pipeline.

3104F.5.3 Nonstructural critical systems assessment. *A seismic assessment of the survivability and continued operation during a Level 2 earthquake (see Table 31F-4-2) shall be performed for critical systems such as fire protection, emergency shutdown and electrical power systems. The assessment shall consider the adequacy and condition of anchorage, flexibility and seismically-induced interaction. For existing systems, seismic adequacy may be assessed per [4.5].*

3104F.6 Symbols.

e = *Eccentricity between center of mass and center of rigidity*

$E_{inertial}$ = *Inertial seismic load*

F_u = *Required strength at maximum response*

3. *Horizontal breast mooring line angles exceed 15 normal to the hull*
4. *Horizontal spring mooring line angles exceed 10 degrees from a line parallel to the hull*

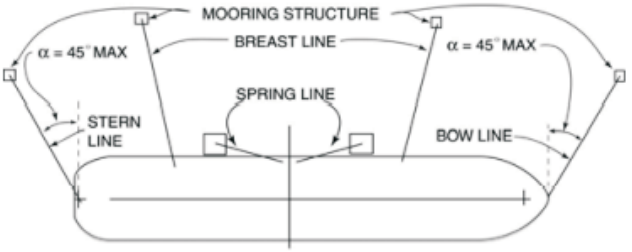

FIGURE 31F-5-2
HORIZONTAL LINE ANGLES [5.4]

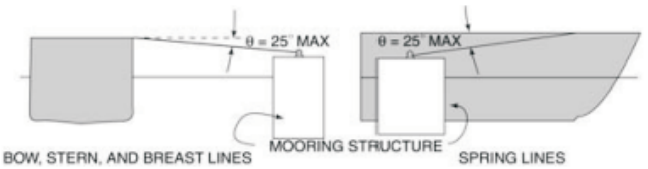

FIGURE 31F-5-3
VERTICAL LINE ANGLES [5.4]

5. *Vertical mooring line angles (θ) exceed 25 degrees*
6. *Mooring lines for lateral loads not grouped at bow and stern*

When the forces have been determined and the distance between the bow and stern mooring points is known, the yaw moment can be resolved into lateral loads at the bow and stern. The total environmental loads on a moored vessel are comprised of the lateral load at the vessel bow, the lateral load at the vessel stern and the longitudinal load. Line pretension loads must be added.

Four load cases shall be considered:

1. *Entire load is taken by mooring lines*
2. *Entire load is taken by breasting structures*
3. *Load is taken by combination of mooring lines and breasting structures*
4. *Longitudinal load is taken only by spring lines*

3105F.2.2 Numerical procedure. *A numerical procedure is required to obtain mooring forces for MOTs that cannot use manual procedure. Computer program(s) shall be based on mooring analysis procedures that consider the characteristics of the mooring system, calculate the environmental loads and provide resulting mooring line forces and vessel motions (surge and sway).*

3105F.3 Wave, passing vessel, seiche and tsunami.

3105F.3.1 Wind waves. *MOTs are generally located in sheltered waters such that typical wind waves can be assumed not to affect the moored vessel if the significant wave period, T_s, is less than 4 seconds. However, if the period is equal to or greater than 4 seconds, then a simplified dynamic analysis (See Section 3103F.5.4) is required. The wave period shall be established based on a 1-year significant wave height, H_s. For MOTs within a harbor basin, the wave period shall be based on the locally generated waves with relatively short fetch.*

3105F.3.2 Passing vessels. *These forces generated by passing vessels are due to pressure gradients associated with the flow pattern. These pressure gradients cause the moored vessel to sway, surge, and yaw, thus imposing forces on the mooring lines.*

Passing vessel analysis shall be conducted when all of the following conditions exist (See Figure 31F-5-4):

1. *Passing vessel size is greater than 25,000 DWT.*
2. *Distance L is 500 feet or less*
3. *Vessel speed V is greater than V_{crit}*

where:

$$V_{crit} = 1.5 + \frac{L - 2B}{500 - 2B} 4.5(knots) \qquad (5\text{-}1)$$

Exception: *If $L \leq 2B$, passing vessel loads shall be considered.*

L and B are shown in Figure 31F-5-4, in units of feet. V is defined as the speed of vessel over land minus the current velocity, when traveling with the current, or the speed of vessel over land plus the current velocity, when traveling against the current.

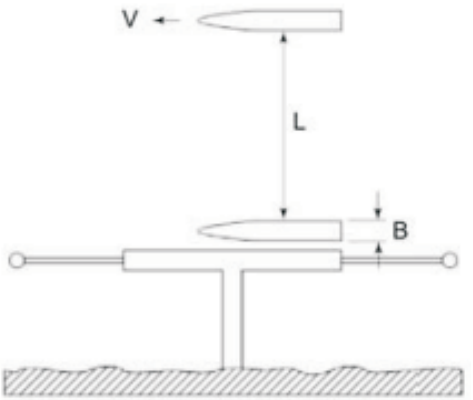

FIGURE 31F-5-4
PASSING VESSEL

When such conditions (1, 2 and 3 above) exist, the surge and sway forces and the yaw moment acting on the moored vessel shall, as a minimum, be established in accordance with Section 3103F.5.5 or by dynamic analysis.

For MOTs located in ports, the passing distance, L, may be established based on channel width and vessel traffic patterns. The guidelines established in the Department of Defense, UFC 4-150-06, Figure 5-17 [5.6] for interior channels may be used. The "vertical bank" in Figure 5-17 of [5.6] shall be replaced by the side of the moored vessel when establishing the distance, "L ."

For MOTs, not located within a port, the distance, "L," must be determined from observed traffic patterns.

The following passing vessel positions shall be investigated:

1. *Passing vessel is centered on the moored ship. This position produces maximum sway force.*
2. *The midship of the passing vessel is fore or aft of the centerline of the moored ship by a distance of 0.40 times the length of the moored ship. This position is assumed to produce maximum surge force and yaw moment at the same time.*

The mooring loads due to a passing vessel shall be added to the mooring loads due to wind and current.

3105F.3.3 Seiche. *A seiche analysis is required for existing MOTs located within a harbor basin and which have historically experienced seiche. A seiche analysis is required for new MOTs inside a harbor basin prone to penetration of ocean waves.*

The standing wave system or seiche is characterized by a series of "nodes" and "antinodes." Seiche typically has wave periods ranging from 20 seconds up to several hours, with wave heights in the range of 0.1 to 0.4 ft [5.6].

The following procedure may be used, as a minimum, in evaluating the effects of seiche within a harbor basin. In more complex cases where the assumptions below are not applicable, dynamic methods are required.

1. *Calculate the natural period of oscillation of the basin. The basin may be idealized as rectangular, closed or open at the seaward end. Use Chapter 2 of UFC 4-150-06 [5.6] to calculate the wave period and length for different modes. The first three modes shall be considered in the analysis.*
2. *Determine the location of the moored ship with respect to the antinode and node of the first three modes to determine the possibility of resonance.*
3. *Determine the natural period of the vessel and mooring system. The calculation shall be based on the total mass of the system and the stiffness of the mooring lines in surge. The surge motion of the moored vessel is estimated by analyzing the vessel motion as a harmonically forced linear single degree of freedom spring mass system. Methods outlined in a paper by F.A. Kilner [5.7] can be used to calculate the vessel motion.*
4. *Vessels are generally berthed parallel to the channel; therefore, only longitudinal (surge) motions shall be considered, with the associated mooring loads in the spring lines. The loads on the mooring lines (spring lines) are then determined from the computed vessel motion and the stiffness of those mooring lines.*

3105F.3.4 Tsunami. *Run-up and current velocity shall be considered in the tsunami assessment. Table 31F-3-8 provides run-up values for the San Francisco Bay area, Los Angeles/Long Beach Harbors and Port Hueneme.*

3105F.4 Berthing analysis and design. *The analysis and design of berthing components shall be based on the loading combinations and safety factors defined in Sections 3103F.8 and 3103F.9 and in accordance with ACI 318 [5.1], AISC [5.2], and ANSI/AF&PA NDS [5.3], as applicable.* <

3105F.4.1 Berthing energy demand. *The kinetic berthing energy demand shall be determined in accordance with Section 3103F.6.*

3105F.4.2 Berthing energy capacity. *For existing MOTs, the berthing energy capacity shall be calculated as the area under the force-deflection curve for the combined structure and fender system as indicated in Figure 31F-5-5. Fender piles may be included in the lateral analysis to establish the total force-deflection curve for the berthing system. Load-deflection curves for other fender types shall be obtained from manufacturer's data. The condition of fenders shall be taken into account when performing the analysis.*

When batter piles are present, the fender system typically absorbs most of the berthing energy. This can be established by comparing the force-deflection curves for the fender system and batter piles. In this case only the fender system energy absorption shall be considered.

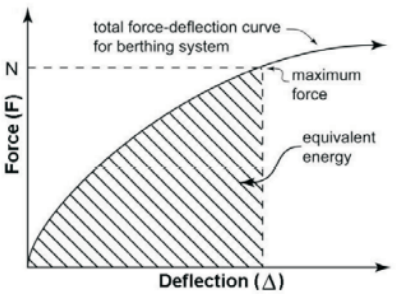

FIGURE 31F-5-5
BERTHING ENERGY CAPACITY

3105F.4.3 Tanker contact length.

3105F.4.3.1 Continuous fender system. *A continuous fender system consists of fender piles, chocks, wales, and rubber or spring fender units.*

The contact length of a ship during berthing depends on the spacing of the fender piles and fender units, and the connection details of the chocks and wales to the fender piles.

The contact length, L_c can be approximated by the chord formed by the curvature of the bow and the berthing angle as shown in Equation 5-2 below.

$$L_c = 2r \sin \alpha \qquad (5\text{-}2)$$

where:

L_c = *contact length*

r = *Bow radius*

α = *Berthing angle*

In lieu of detailed analysis to determine the contact length, Table 31F-5-1 may be used. The contact length

for a vessel within the range listed in the table can be obtained by interpolation.

TABLE 31F-5-1
CONTACT LENGTH

VESSEL SIZE (DWT)	CONTACT LENGTH
330	25 ft
1,000 to 2,500	35 ft
5,000 to 26,000	40 ft
35,000 to 50,000	50 ft
65,000	60 ft
100,000 to 125,000	70 ft

3105F.4.3.2 Discrete fender system. *For discrete fender systems (i.e., not continuous), one fender unit or breasting dolphin shall be able to absorb the entire berthing energy.*

3105F.4.4 Longitudinal and vertical berthing forces. *The longitudinal and vertical components of the horizontal berthing force shall be calculated using appropriate coefficients of friction between the vessel and the fender. In lieu of as-built data, the values in Table 31F-5-2 may be used for typical fender/vessel materials:*

TABLE 31F-5-2
COEFFICIENT OF FRICTION

CONTACT MATERIALS	FRICTION COEFFICIENT
Timber to Steel	0.4 to 0.6
Urethane to Steel	0.4 to 0.6
Steel to Steel	0.25
Rubber to Steel	0.6 to 0.7
UHMW* to Steel	0.1 to 0.2

**Ultra-high molecular weight plastic rubbing strips.*

Longitudinal and vertical forces shall be determined by:

$$F = \mu N \qquad (5\text{-}3)$$

where:

F = *longitudinal or vertical component of horizontal berthing force*

μ = *coefficient of friction of contact materials*

N = *maximum horizontal berthing force (normal to fender)*

3105F.4.5 Design and selection of new fender systems. *For guidelines on new fender designs, refer to the Department of Defense "Piers and Wharves" document (UFC 4-152-01) [5.8] and the PIANC Guidelines for the Design of Fenders Systems: 2002 [5.9]. Also see Section 3103F.6.*

3105F.5 Layout of new MOTs. *The number and spacing of independent mooring dolphins and breasting dolphins depends on the DWT and length overall (LOA) of vessels to be accommodated.*

Breasting dolphins shall be positioned adjacent to the parallel body of the vessel when berthed. A minimum of two breasting dolphins shall be provided. The spacing of breasting dolphins shall be adequate for all sizes of vessels that may berth at the MOT.

Mooring dolphins shall be set back from the berthing line (fender line) for a distance between 115 ft and 165 ft, so that longer bow, stern and breast lines can be deployed.

For a preliminary layout, the guidelines in the British Standards, Part 4, Section 2 [5.10], may be used in conjunction with the guidelines below.

1. *If four breasting dolphins are provided, the spacing between exterior breasting dolphins shall be between 0.3 and 0.4 LOA of the maximum sized vessel expected to call at the MOT. The spacing between interior breasting dolphins shall be approximately 0.3 to 0.4LOA of the minimum sized vessel expected to call at the MOT.*
2. *If only two breasting dolphins are provided, the spacing between the dolphins shall be the smaller (0.3LOA) of the guidelines specified above.*
3. *If bow and stern lines are used for mooring, the spacing between exterior mooring dolphins shall be 1.35 times the LOA of the maximum sized vessel expected to call at the MOT.*
4. *The spacing between interior mooring dolphins shall be 0.8 times the LOA of the maximum sized vessel expected to call at the MOT.*

The final layout of the mooring and breasting dolphins shall be determined based on the results of the mooring analysis that provides optimal mooring line and breasting forces for the range of vessels to be accommodated. The breasting force under the mooring condition shall not exceed the maximum fender reaction of the fender unit when it is being compressed at the manufacturers rated deflection.

3105F.6 Symbols.

α = *Berthing angle. It also indicates the angle of horizontal mooring lines, see Fig 5-2.*

Δ = *Deflection*

θ = *Vertical mooring line angles*

B = *Beam of vessel*

F = *Longitudinal or vertical component of horizontal normal berthing force*

L = *Distance between passing and moored vessels*

L_c = *Contact length*

N = *Maximum horizontal berthing force*

r = *Bow radius*

μ = *Coefficient of friction of contact materials*

V = *Ground speed (knots)*

V_c = *Maximum current (knots).*

V_{crit} = *Ground speed (knots) above which passing loads must be considered*

V_w = *Maximum wind speed (knots)*

3105F.7 References.

[5.1] American Concrete Institute,ACI 318-05, 2005, "Building Code Requirements for Structural Concrete (318-05) and Commentary (318R-05)," Farmington Hills, Michigan.

[5.2] American Institute of Steel Construction Inc. (AISC), 2005, "Steel Construction Manual," Thirteenth Edition, Chicago, IL.

[5.3] American Forest & Paper Association, 2005, "National Design Specification for Wood Construction," ANSI/AF&PA NDS-2005, Washington, D.C.

[5.4] Oil Companies International Marine Forum (OCIMF), 2008, "Mooring Equipment Guidelines (MEG3)," 3rd Ed., London, England.

[5.5] Department of Defense, 3 October 2005, "Moorings", Unified Facilities Criteria (UFC) 4-152-03, Washington D.C., USA.

[5.6] Department of Defense, 12 December 2001, "Military Harbors and Coastal Facilities", Unified Facilities Criteria (UFC) 4-150-06, Washington D.C., USA.

[5.7] Kilner F.A., 1961, "Model Tests on the Motion of Moored Ships Placed on Long Waves." Proceedings of 7th Conference on Coastal Engineering, August 1960, The Hague, Netherlands, published by the Council on Wave Research - The Engineering Foundation.

[5.8] Department of Defense, 28 July 2005, "Piers and Wharves," Unified Facilities Criteria (UFC), 4-152-01, Washington D.C., USA.

[5.9] Permanent International Association of Navigation Congresses (PIANC), 2002, "Guidelines for the Design of Fender Systems: 2002," Brussels.

[5.10] British Standards Institution, 1994, "British Standard Code of Practice for Maritime Structures - Part 4. Code of Practice for Design of Fendering and Mooring Systems," BS6349, London, England.

Authority: Sections 8755 and 8757, Public Resources Code.

Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

The knowledge factor, k, is 1.0 when comprehensive knowledge as specified above is utilized. Otherwise, the knowledge factor shall be 0.75 (see Table 2-1 of FEMA 356 [7.3]).

3107F.2.2 Component stiffness. *Stiffness that takes into account the stress and deformation levels experienced by the component shall be used. Nonlinear load-deformation relations shall be used to represent the component load-deformation response. However, in lieu of using nonlinear methods to establish the stiffness and moment curvature relation of structural components, the equations of Table 31F-7-3 may be used to approximate the effective elastic stiffness, EI_e, for lateral analyses (see Section 3107F.5 for definition of symbols).*

TABLE 31F-7-3
EFFECTIVE ELASTIC STIFFNESS

CONCRETE COMPONENT	EI_e / EI_g
Reinforced Pile	$0.3 + N/(f'_c A_g)$
Pile/Deck Dowel Connection[1]	$0.3 + N/(f'_c A_g)$
Prestressed Pile[1]	$0.6 < Ei_e/EI_g < 0.75$
Steel Pile	1.0
Concrete w/ Steel Casing	$\frac{E_S I_S + 0.25 E_C I_C}{(E_S I_S + E_C I_C)}$
Deck	0.5

1. *The pile/deck connection and prestressed pile may also be approximated as one member with an average stiffness of 0.42 Ei_e/EI_g (Ferritto et al, 1999 [7.2])*

N = is the axial load level.
E_S = Young's modulus for steel
I_S = Moment of inertia for steel section
E_C = Young's modulus for concrete
I_C = Moment of inertia for uncracked concrete section

3107F.2.3 Deformation capacity of flexural members. *Stress-strain models for confined and unconfined concrete, mild and prestressed steel presented in Section 3107F.2.4 shall be used to perform the moment-curvature analysis.*

The stress-strain characteristics of steel piles shall be based on the actual steel properties. If as-built information is not available, the stress-strain relationship may be obtained per Section 3107F.2.4.2.

For concrete in-filled steel piles, the stress-strain model for confined concrete shall be in accordance with Section 3107F.2.4.1.

Each structural component expected to undergo inelastic deformation shall be defined by its moment-curvature relation. The displacement demand and capacity shall be calculated per Sections 3104F.2 and 3104F.3, as appropriate.

The moment-rotation relationship for concrete components shall be derived from the moment-curvature analysis per Section 3107F.2.5.4 and shall be used to determine lateral displacement limitations of the design. Connection details shall be examined per Section 3107F.2.7.

3107F.2.4 Stress-Strain models.

3107F.2.4.1 Concrete. *The stress-strain model and terms for confined and unconfined concrete are shown in Figure 31F-7-1.*

3107F.2.4.2 Reinforcement steel and structural steel. *The stress-strain model and terms for reinforcing and structural steel are shown in Figure 31F-7-2.*

3107F.2.4.3 Prestressed steel. *The stress-strain model of Blakeley and Park [7.4] may be used for prestressed steel. The model and terms are illustrated in Figure 31F-7-3.*

3107F.2.4.4 Alternative stress-strain models. *Alternative stress-strain models are acceptable if adequately documented and supported by test results, subject to Division approval.*

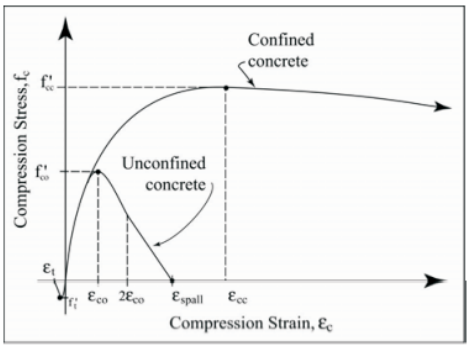

FIGURE 31F-7-1
STRESS-STRAIN CURVES FOR CONFINED AND UNCONFINED CONCRETE [7.1]

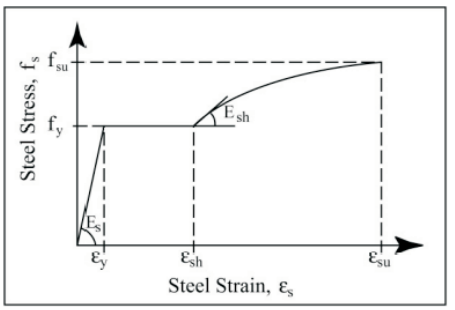

FIGURE 31F-7-2
STRESS-STRAIN CURVE FOR MILD REINFORCING STEEL OR STRUCTURAL STEEL [7.1]

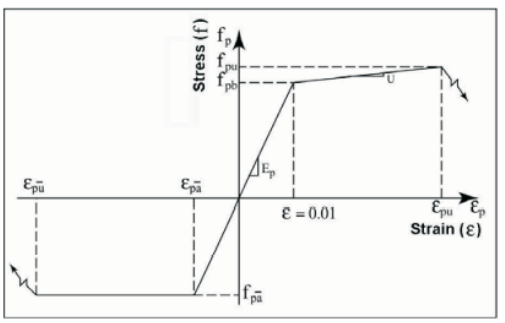

FIGURE 31F-7-3
STRESS-STRAIN CURVE FOR PRESTRESSED STEEL [7.4]

3107F.2.5 Concrete piles.

3107F.2.5.1 General. *The capacity of concrete piles is based on permissible concrete and steel strains corresponding to the desired performance criteria.*

Different values may apply for plastic hinges forming at in-ground andpile-top locations. These procedures are applicable to circular, octagonal, rectangular and square pile cross sections.

3107F.2.5.2 Stability. *Stability considerations are important to pier-type structures. The moment-axial load interaction shall consider effects of high slenderness ratios (kl/r). An additional bending moment due to axial load eccentricity shall be incorporated unless:*

$$e/h \le 0.10 \qquad (7\text{-}4)$$

where:

e = *eccentricity of axial load*

h = *width of pile in considered direction*

3107F.2.5.3 Plastic hinge length. *The plastic hinge length is required to convert the moment-curvature relationship into a moment-plastic rotation relationship for the nonlinear pushover analysis.*

The pile's plastic hinge length, L_p (above ground), when the plastic hinge forms against a supporting member is:

$$L_p = 0.08L + 0.15 f_{ye} d_{bl} \ge 0.3 f_{ye} d_{bl} \qquad (7\text{-}5)$$

where:

L = *the distance from the critical section of the plastic hinge to the point of contraflexure*

d_{bl} = *the diameter of the longitudinal reinforcement*

f_{ye} = *design yield strength of longitudinal reinforcement (ksi)*

If a large reduction in moment capacity occurs due to spalling, then the plastic hinge length shall be:

$$L_p = 0.3 f_{ye} d_{bl} \qquad (7\text{-}6)$$

When the plastic hinge forms in-ground, the plastic hinge length may be determined from Figure 31F-7-4 (see page 311 of [7.1]).

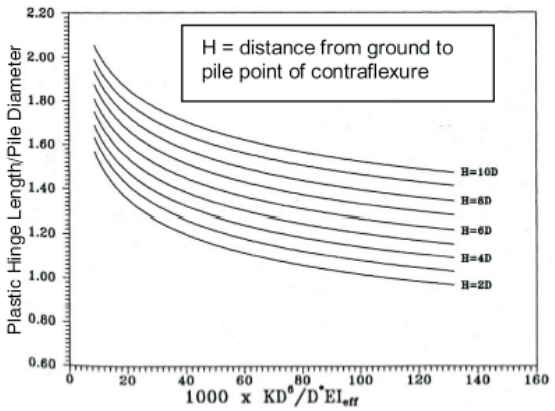

FIGURE 31F-7-4
INFLUENCE OF PILE/SOIL STIFFNESS RATIO ON PLASTIC HINGE LENGTH (after Fig. 5.30 of [7.1])

The stiffness parameter (x-axis) is:

$$\frac{KD^6}{[D^*]EI_e} \qquad (7\text{-}7)$$

where:

EI_e = *the effective stiffness*

K = *the subgrade modulus*

D = *pile diameter*

D^* = *reference diameter of 6 ft*

If site specific soil information is not available then the values for K in Table 31F-7-4 may be used.

TABLE 31F-7-4
SUBGRADE MODULUS K

SOIL TYPE	AVG UNDRAINED SHEAR STRENGTH [psf]	SUBGRADE MODULUS K [lb/in^3]
Soft Clay	*250-500*	*30*
Medium Clay	*500-1000*	*100*
Stiff Clay	*1000-2000*	*500*
Very Stiff Clay	*2000-4000*	*1000*
Hard Clay	*4000-8000*	*2000*
Loose Sand (above WT/submerged)	—	*25/20*
Medium Sand (above WT/submerged)	—	*90/60*
Sand (above WT/submerged)	—	*275/125*

3107F.2.5.4 Plastic rotation. *The plastic rotation, $_p$, can be determined from Equation 7-8, by using moment-curvature analysis and applicable strain limitations, as shown in Figure 31F-7-5.*

The plastic rotation is:

$$\theta_p = L_p \phi_p = L_p \left(\phi_m - \phi_y\right) \qquad (7\text{-}8)$$

where:

L_p = *plastic hinge length*

ϕ_p = *plastic curvature*

ϕ_m = *maximum curvature*

ϕ_y = *yield curvature*

The maximum curvature, ϕ_m shall be determined by the concrete or steel strain limit state at the prescribed performance level, whichever comes first.

Alternatively, the maximum curvature, ϕ_m may be calculated as:

$$\phi_m = \frac{\varepsilon_{cm}}{C_u} \qquad (7\text{-}9)$$

where:

ε_{cm} = *max limiting compression strain for the prescribed performance level (Table 31F-7-5)*

c_u = *neutral-axis depth, at ultimate strength of section*

The yield curvature, ϕ_y is the curvature at the intersection of the secant stiffness, EI_c, through first yield and the nominal strength, ($\varepsilon_c = 0.004$)

$$\phi_y = \frac{M_y}{EI_c} \qquad (7\text{-}10)$$

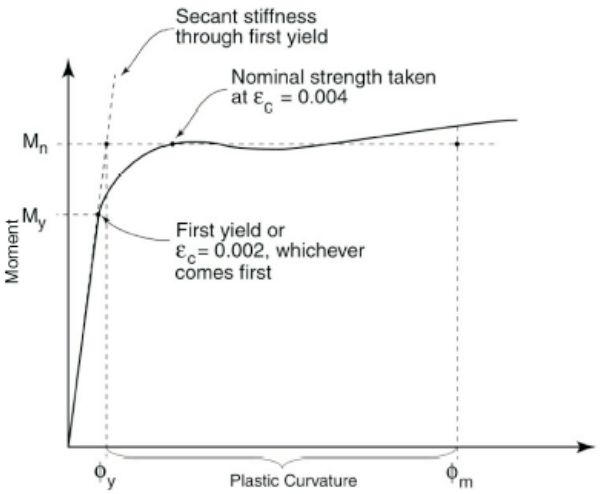

FIGURE 31F-7-5
MOMENT CURVATURE ANALYSIS

3107F.2.5.5 Ultimate concrete and steel flexural strains. *Strain values computed in the nonlinear push-over analysis shall be compared to the following limits.*

3107F.2.5.5.1 Unconfined concrete piles: *An unconfined concrete pile is defined as a pile having no confinement steel or one in which the spacing of the confinement steel exceeds 12 inches.*

Ultimate concrete compressive strain:

$$\varepsilon_{cu} = 0.005 \qquad (7\text{-}11)$$

3107F.2.5.5.2 Confined concrete piles:

Ultimate concrete compressive strain [7.1]:

$$\varepsilon_{cu} = 0.004 + (1.4\rho_s f_{yh}\varepsilon_{sm})/f'_{cc} \geq 0.005 \qquad (7\text{-}12)$$
$$\varepsilon_{cu} \leq 0.025$$

where:

ρ_s = *effective volume ratio of confining steel*

f_{yh} = *yield stress of confining steel*

ε_{sm} = *strain at peak stress of confining reinforcement, 0.15 for grade 40, 0.10 for grade 60*

f'_{cc} = *confined strength of concrete approximated by 1.5 f'_c*

3107F.2.5.6 Component acceptance/damage criteria. *The maximum allowable concrete strains may not exceed the ultimate values defined in Section 3107F.2.5.5. The following limiting values (Table 31F-7-5) apply for each performance level for both existing and new structures. The "Level 1 or 2" refer to the seismic performance criteria (see Section 3104F.2.1).*

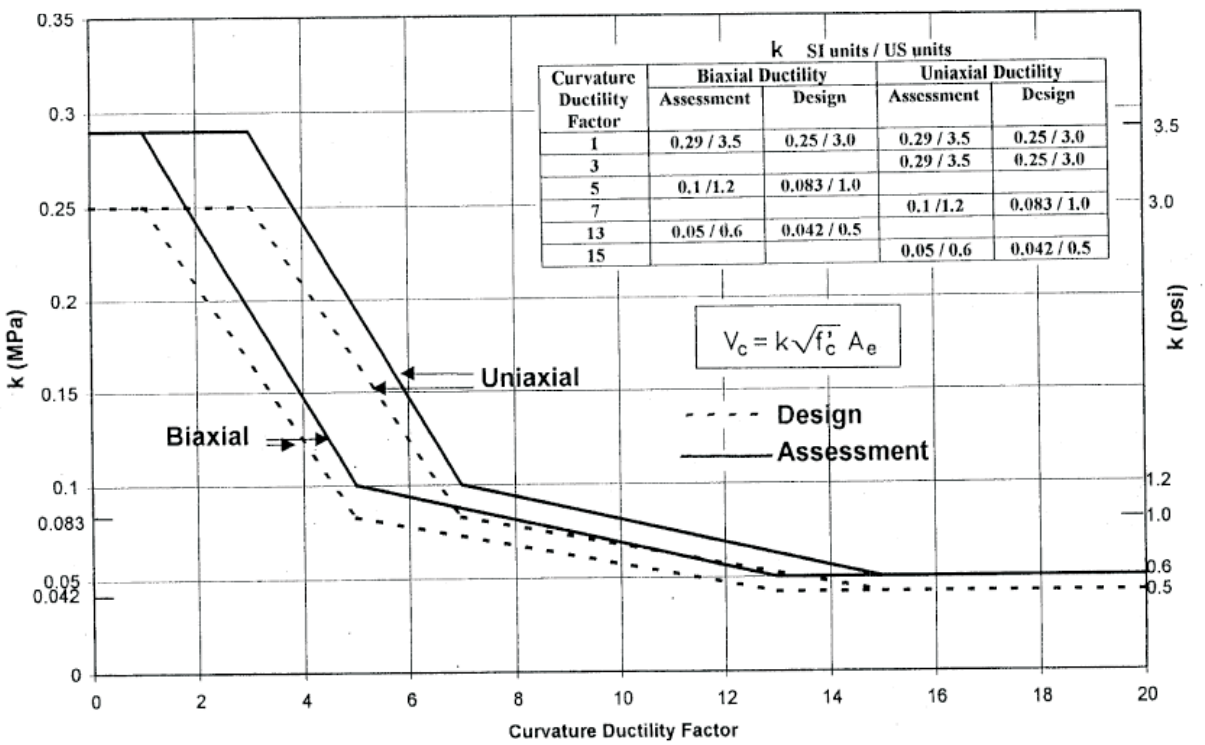

FIGURE 31F-7-6
CONCRETE SHEAR MECHANISM
(from Fig. 3-30 of [7.2])

For all nonseismic loading combinations, concrete components shall be designed in accordance with the ACI requirements [7.5].

Note that for existing facilities, the pile/deck hinge may be controlled by the capacity of dowel reinforcement in accordance with Section 317F.2. 7.

TABLE 31F-7-5
LIMITS OF STRAIN

COMPONENT STRAIN	LEVEL 1	LEVEL 2
MCCS Pile/deck hinge	$\varepsilon_c \le 0.004$	$\varepsilon_c \le 0.025$
MCCS In-ground hinge	$\varepsilon_c \le 0.004$	$\varepsilon_c \le 0.008$
MRSTS Pile/deck hinge	$\varepsilon_s \le 0.01$	$\varepsilon_s \le 0.05$
MRSTS In-ground hinge	$\varepsilon_s \le 0.01$	$\varepsilon_s \le 0.025$
MPSTS In-ground hinge	$\varepsilon_p \le 0.005$ (incremental)	$\varepsilon_p \le 0.025$ (total strain)

MCCS = Maximum Concrete Compression Strain, ε_c
MRSTS = Maximum Reinforcing Steel Tension Strain, ε_s
MPSTS = Maximum Prestressing Steel Tension Strain, ε_p

3107F.2.5.7 Shear design. *If expected lower bound of material strength Section 3107F.2.1.1 Equations (7-2a, 7-2b, 7-2c) are used in obtaining the nominal shear strength, a new nonlinear analysis utilizing the upper bound estimate of material strength Section 3107F.2.1.1 Equations (7-3a, 7-3b, 7-3c) shall be used to obtain the plastic hinge shear demand. An alternative conservative approach is to multiply the maximum shear demand, V_{max} from the original analysis by 1.4 (Section 8.16.4.4.2 of ATC-32 [7.6]):*

$$V_{design} = 1.4V_{max} \qquad (7\text{-}13)$$

If moment curvature analysis that takes into account strain-hardening, an uncertainty factor of 1.25 may be used:

$$V_{design} = 1.25V_{max} \qquad (7\text{-}14)$$

Shear capacity shall be based on nominal material strengths, and reduction factors according to ACI-318 [7.5].

As an alternative, the method of Kowalski and Priestley [7.7] may be used. Their method is based on a three-parameter model with separate contributions to shear strength from concrete (V_c), transverse reinforcement (V_s), and axial load (V_p) to obtain nominal shear strength (V_n):

$$V_n = V_c + V_s + V_p \qquad (7\text{-}15)$$

A shear strength reduction factor of 0.85 shall be applied to the nominal strength, V_n, to determine the design shear strength. Therefore:

$$V_{design} \le 0.85V_n \qquad (7\text{-}16)$$

The equations to determine V_c, V_s and V_p are:

$$V_c = k\sqrt{f'_c}A_c \qquad (7\text{-}17)$$

where:

k = *factor dependent on the curvature ductility*

$\mu_\phi = \dfrac{\phi}{\phi_y}$, *within the plastic hinge region, from Figure 31F-7-6. For regions greater than $2D_p$ (see Equation 7-18) from the plastic hinge location, the strength can be based on = 1.0 (see Ferritto et. al. [7.2]).*

f_c = *concrete compressive strength*

A_e = $0.8A_g$ *is the effective shear area*

Circular spirals or hoops [7.2]:

$$V_s = \frac{\frac{\pi}{2}A_{sp}f_{yh}\left(D_p - c - c_o\right)\cot(\theta)}{s} \qquad (7\text{-}18)$$

where:

A_{sp} = *spiral or hoop cross section area*

f_{yh} = *yield strength of transverse or hoop reinforcement*

D_p = *pile diameter or gross depth (in case of a rectangular pile with spiral confinement)*

c = *depth from extreme compression fiber to neutral axis (1V.A.) atflexural strength (see Fig. 31F-7-7)*

c_0 = *concrete cover to center of hoop or spiral (see Fig. 31F-7-7)*

θ = *angle of critical crack to the pile axis (see Fig. 31F-7-7) taken as 30° for existing structures, and 35° for new design*

s = *spacing of hoops or spiral along the pile axis*

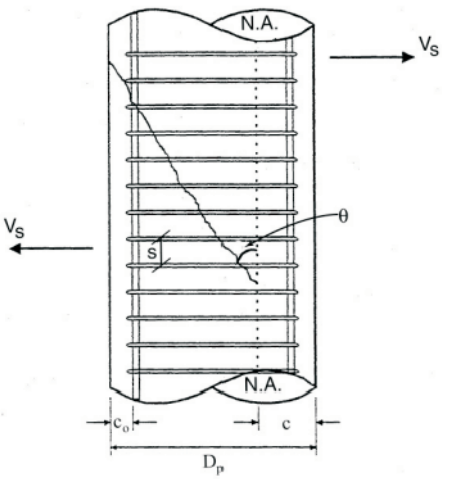

FIGURE 31F-7-7
TRANSVERSE SHEAR MECHANISM

Rectangular hoops or spirals [7.2]:

$$V_s = \frac{A_h f_{yh}\left(D_p - c - c_o\right)\cot(\theta)}{s} \qquad (7\text{-}19)$$

where:

A_h = *total area of transverse reinforcement, parallel to direction of applied shear cut by an inclined shear crack*

Shear strength from axial mechanism, V_p (see Fig. 31F-7-8):

$$V_p = \Phi\left(N_u + F_p\right)\tan\alpha \qquad (7\text{-}20)$$

where:

N_u = *external axial compression on pile including seismic load. Compression is taken as positive; tension as negative*

F_p = *prestress compressive force in pile*

α = *angle between line joining centers of flexural compression in the deck/pile and in-ground hinges, and the pile axis*

Φ *1.0 for existing structures, and 0.85 for new design*

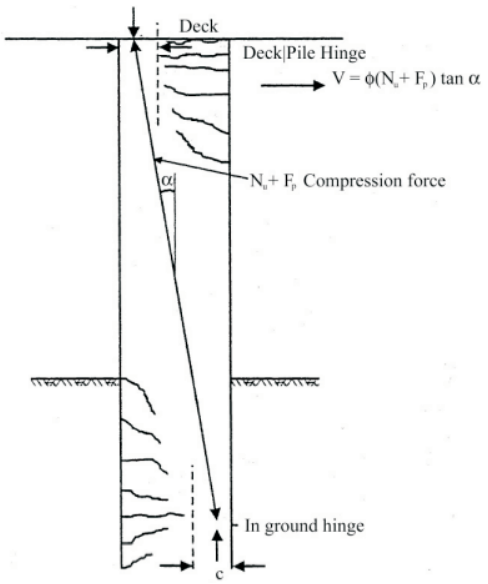

FIGURE 31F-7-8
AXIAL FORCE SHEAR MECHANISM

3107F.2.6 Steel piles.

3107F.2.6.1 General. *The capacity of steel piles is based on allowable strains corresponding to the desired performance criteria and design earthquake.*

3107F.2.6.2 Stability. *Section 3107F.2.5.2 applies to steel piles.*

3107F.2.6.3 Plastic hinge length. *The plastic hinge length depends on the section shape and the slope of the moment diagram in the vicinity of the plastic hinge.*

For plastic hinges forming in steel piles at the deck/pile interface and where the hinge forms in the steel section rather than in a special connection detail (such as a reinforced concrete dowel connection), allowance should be made for strain penetration into the pile cap. This increase may be taken as $0.25D_p$, where D_p is the pile diameter or pile depth in the direction of the applied shear force.

3107F.2.6.4 Ultimate flexural strain capacity. *The following limiting value applies:*

Strain at extreme-fiber, $\varepsilon_u \le 0.035$

3107F.2.6.5 Component acceptance/damage criteria. *The maximum allowable strain may not exceed the ultimate value defined in Section 3107F.2.6.4. Table 31F-7-6 provides limiting strain values for each performance level, for both new and existing structures.*

Steel components for noncompact hollow piles ($D_P/t < 0.07 \times E/f_y$) and for all nonseismic loading combinations shall be designed in accordance with AISC [7.8].

TABLE 31F-7-6
STRUCTURAL STEEL STRAIN LIMITS, ε_u

COMPONENTS	LEVEL I	LEVEL 2
Concrete Filled Pipe	0.008	0.030
Hollow Pipe	0.008	0.025

Level 1 or 2 refer to the seismic performance criteria (Section 3104F.2. 1)

3107F.2.6.6 Shear design. *The procedures of Section 3107F.2.5.7, which are used to establish V_{design} are applicable to steel piles.*

The shear capacity shall be established from the AISC [7.8]. For concrete filled pipe, equation (7-15) may be used to determine shear capacity; however, V_{pile} must be substituted for V_s.

$$V_{pile} = (\pi/2)\, t f_{y,pile}\left(D_p - c - c_o\right)\cot\theta \qquad (7\text{-}21)$$

where:

t = *steel pile wall thickness*

$f_{y,pile}$ = *yield strength of steel pile*

c_0 = *distance from outside of steel pipe to center of hoop or spiral*

[All other terms are as listed for Equation (7-18)].

3107F.2.7 Pile/deck connection strength.

3107F.2.7.1 Joint shear capacity. *The joint shear capacity shall be computed in accordance with ACI 318 [7.5]. For existing MOTs, the method [7.1, 7.2] given below may be used:*

1. *Determine the nominal shear stress in the joint region corresponding to the pile plastic moment capacity.*

$$v_j = \frac{0.9M_p}{\sqrt{2}l_{dv}D_p^2} \qquad (7\text{-}22)$$

where:

v_j = *Nominal shear stress*

M_p = *Over strength moment demand of the plastic hinge (the maximum possible moment in the*

pile) as determined from *the procedure of Section 3107F.2.5.7.*

l_{dv} = *Vertical development length, see Figure 31F-7-9*

D_p = *Diameter of pile*

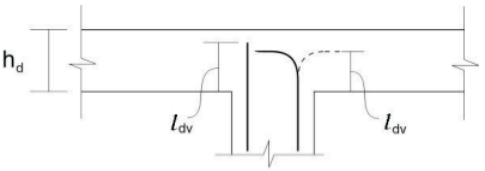

FIGURE 31F-7-9
DEVELOPMENT LENGTH

2. *Determine the nominal principal tension pt, stress in the joint region:*

$$p_t = \frac{-f_a}{2} + \sqrt{\left(\frac{f_a}{2}\right)^2 + v_j^2} \qquad (7\text{-}23)$$

where:

$$f_a = \frac{N}{\left(D_p + h_d\right)^2} \qquad (7\text{-}24)$$

is the average compressive stress at the joint center caused by the pile axial compressive force N and h_d is the deck depth. Note, if the pile is subjected to axial tension under seismic load, the value of N, and f_a will be negative.

If $p_t > 5.0\sqrt{f'_c}$, psi, joint failure will occur at a lower moment than the column plastic moment capacity M_p. In this case, the maximum moment that can be developed at the pile/deck interface will be limited by the joint principal tension stress capacity, which will continue to degrade as the joint rotation increases, as shown in Figure 31F-7-10. The moment capacity of the connection at which joint failure initiates can be established from Equations 7-26 and 7-27.

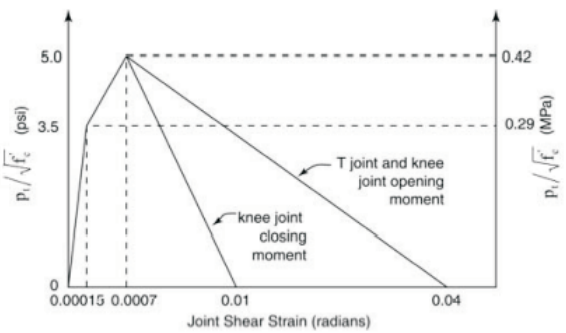

FIGURE 31F-7-10
DEGRADATION OF EFFECTIVE PRINCIPAL TENSION STRENGTH WITH JOINT SHEAR STRAIN (rotation) [7.1, pg. 564]

For $p_t = 5.0\sqrt{f'_c}$, determine the corresponding joint shear stress, v_j:

$$v_j = \sqrt{p_t\left(p_t - f_a\right)} \qquad (7\text{-}25)$$

3. *The moment capacity of the connection can be approximated as:*

$$M_c = \left(\frac{1}{.90}\right)\sqrt{2}v_j l_{dv} D_p^2 \le M_p \qquad (7\text{-}26)$$

This will result in a reduced strength and effective stiffness for the pile in a pushover analysis. The maximum displacement capacity of the pile should be based on a drift angle of 0.04 radians.

If no mechanisms are available to provide residual strength, the moment capacity will decrease to zero as the joint shear strain increases to 0.04 radians, as shown in Figure 31F-7-11.

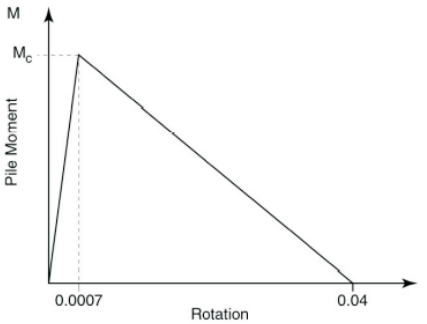

FIGURE 31F-7-11
REDUCED PILE MOMENT CAPACITY

If deck stirrups are present within $h_d/2$ of the face of the pile, the moment capacity, $M_{c,r}$, at the maximum plastic rotation of 0.04 radians may be increased from zero to the following (see Figure 31F-7-12):

$$M_{c,r} = 2A_s f_y\left(h_d - d_c\right) + N\left(\frac{D_p}{2} - d_c\right) \qquad (7\text{-}27)$$

A_s = *Area of slab stirrups on one side of joint*

h_d = *See Figure 31F-7-9 (deck thickness)*

d_c = *Depth from edge of concrete to center of main reinforcement*

In addition, the bottom deck steel (A_s, deckbottom) area within $h_d/2$ of the face of the pile shall satisfy:

$$A_{s,deckbottom} \ge 0.5 \cdot A_s \qquad (7\text{-}28)$$

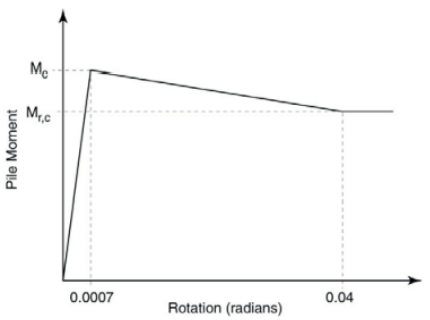

FIGURE 31F-7-12
JOINT ROTATION

3108F.5 Fire alarms. *Automatic and manual fire alarms shall be provided at strategic locations. The fire alarm system shall be arranged to provide a visual and audible alarm that can be readily discerned by all personnel at the MOT. Additionally, visual and audible alarms shall be displayed at the Facility's Control Center (N/E).*

If the fire alarm system is integrated with the ESD system, the operation shall be coordinated with the closure of SIVs, block valves and pumps to avoid adverse hydraulic conditions (N/E).

Fire alarms shall be tested and maintained in accordance with NFPA-72 [8.9] or the local enforcing agency requirements. Specifications shall be retained. The latest testing and maintenance records shall be readily accessible to the Division (N/E).

3108F.6 Fire suppression. *Table 31F-8-3 gives the minimum provisions for fire-water flow rates and fire extinguishers. The table includes consideration of the fire hazard classification (Low, Medium or High), the cargo liquid hazard class (Low or High) and the vessel or barge size. The minimum provisions may have to be augmented for multi-berth terminals or those conducting simultaneous transfers, in accordance with the risks identified in the Fire Protection Assessment.*

3108F.6.1 Coverage (N/E). *The fire suppression system shall provide coverage for:*

1. *Marine structures including the pier/wharf and approach trestle*
2. *Terminal cargo manifold*
3. *Cargo transfer system including loading arms, hoses and hose racks*
4. *Vessel manifold*
5. *Sumps*
6. *Pipelines*
7. *Control stations*

3108F.6.2 Fire hydrants. *Hydrants shall be located not greater than 150 ft apart, along the wharf and not more than 300 ft apart on the approach trestle [8.4] (N).*

Additional hose connections shall be provided at the base of fixed monitors and upstream of the water and foam isolation valves. Connections shall be accessible to fire trucks or mutual aid equipment as identified in the Fire Protection Assessment (N/E).

Hydrants and hoses shall be capable of applying two independent water streams covering the cargo manifold, transfer system, sumps and vessel manifold (N/E).

3108F.6.3 Fire water. *The source of fire water shall be reliable and provide sufficient capacity as determined in the Fire Protection Assessment. Water-based fire protection systems shall be tested and maintained per NFPA 25 [8.10], as adopted and amended by the State Fire Marshal, or the local enforcing agency requirements. Specifications shall be retained. The latest testing and maintenance records shall be readily accessible to the Division (N/E).*

1. *All wet systems shall be kept pressurized (jockey pump or other means) (N/E).*
2. *Wet system headers shall be equipped with a low-pressure alarm wired to the control room (N).*
3. *Fire pumps shall be installed at a distance of at least 100 ft from the nearest cargo manifold area (N).*
4. *Hose connections for fireboats or tugboats shall be provided on the MOT fire water line, and at least one connection shall be an international shore fire connection at each berth [8.4]. Connections shall be installed at a safe access distance from the high-risk*

TABLE 31F-8-3
MINIMUM FIRE SUPPRESSION PROVISIONS (N/E)

FIRE HAZARD CLASSIFICATION (From Table 31F-8-2)	VESSEL AND CARGO LIQUID HAZARD CLASS (From Table 31F-8-1)	MINIMUM PROVISIONS
LOW	Barge with L_C (including drums)	**500 gpm of water** 2 x 20 lb portable dry chemical and 2 x 110 lb wheeled dry chemical extinguishers or the equivalent.
	Barge with H_C (including drums) Tankers < 50 KDWT , handling L_C or H_C	**1,500 gpm of water** 2 x 20 lb portable dry chemical and 2 x 165 lb wheeled dry chemical extinguishers or the equivalent
MEDIUM	Tankers < 50 KDWT handling L_C	**1,500 gpm of water** 2 x 20 lb portable dry chemical and 2 x 165 lb wheeled dry chemical extinguishers or the equivalent.
	Tankers < 50 KDWT , handling H_C	**2,000 gpm of water** 4 x 20 lb portable dry chemical and 2 x 165 lb wheeled dry chemical extinguishers or the equivalent.
HIGH	Tankers < 50 KDWT , handling L_C or H_C	**3,000 gpm of water** 4 x 20 lb portable dry chemical and 2 x 165 lb wheeled dry chemical extinguishers or the equivalent.
LOW, MEDIUM, HIGH	Tankers > 50 KDWT , handling L_C or H_C	**3,000 gpm of water** 6 x 20 lb portable dry chemical and 4 x 165 lb wheeled dry chemical extinguishers or the equivalent.

Notes: L_C and H_C are defined in Table 31F-8-1. KDWT = Dead Weight Tons (Thousands)

areas such as sumps, manifolds and loading arms (N/E).

3108F.6.4 Foam supply (N/E). *Product flammability, foam type, water flow rates and application duration shall be considered in foam supply calculations.*

Fixed foam proportioning equipment shall be located at a distance of at least 100 ft from the high-risk areas such as sump, manifold and loading arms, except where hydraulic limits of the foam delivery system require closer proximity.

MOTs shall have a program to ensure that foam is replaced according to the manufacturer's recommendations.

3108F.6.5 Fire monitor systems. *Fire monitors shall be located to provide coverage of MOT cargo manifolds, loading arms, hoses, and vessel manifold areas. This coverage shall provide at least two independent streams of water/foam. Monitors shall be located to provide an unobstructed path between the monitor and the target area (N/E).*

If the vessel manifold is more than 30 ft above the wharf deck, the following factors shall be considered, in order to determine if monitors located on elevated masts or towers are required (N/E):

1. *Maximum tanker freeboard*
2. *Tidal variations*
3. *Pier/wharf/loading platform elevation*
4. *Winds*
5. *Fire water line pressure*

Sprinklers and/or remotely controlled water/foam monitors shall be installed to protect personnel, escape routes, shelter locations and the fire water system (N).

Isolation valves shall be installed in the fire water and the foam lines in order to segregate damaged sections without disabling the entire system. Readily accessible isolation valves shall be installed 100 –150 ft from the manifold and the loading arm/hose area (N).

3108F.6.6 Supplemental fire suppression systems (E). *A supplemental system is an external waterborne or land-based source providing suppressant and equipment. Supplemental systems may not provide more than one-quarter of the total water requirements specified in the Fire Protection Assessment.*

Additionally, supplementary systems shall not be considered in a Fire Protection Assessment, unless available within 20 minutes following the initiation of a fire alarm. Mutual aid may be considered as part of the supplemental system.

3108F.7 Critical systems seismic assessment (N/E). *Fire detection and protection systems, and emergency shutdown systems shall have a seismic assessment per Section 3104F.5.3. For equipment anchorages and supports, see Section 3110F.8.*

3108F.8 References.

[8.1] American Petroleum Institute, 1998, API Recommended Practice 2001 (API RP 2001), "Fire Protection in Refineries," 7th ed., Washington, D.C.

[8.2] Oil Companies International Marine Forum (OCIMF), 1987, "Guide on Marine Terminal Fire Protection and Emergency Evacuation," 1st ed., Witherby, London.

[8.3] 2 CCR 2300-2407 (Title 2, California Code of Regulations, Sections 2300-2407).

[8.4] International Chamber of Shipping (ICS), Oil Companies International Marine Forum (OCIMF), International Association of Ports and Harbors (IAPH), 2006, "International Safety Guide for Oil Tankers and Terminals (ISGOTT)," 5th ed., Witherby, London.

[8.5] American Petroleum Institute, 1998, API Recommended Practice 2003 (API RP 2003), "Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents," 6th ed., Washington, D.C.

[8.6] 33 CFR 154.550 (Title 33, Code of Federal Regulations, Section 154.550).

[8.7] National Fire Protection Association, 2008, NFPA 70 (Article 500), "National Electrical Code," Quincy, MA.

[8.8] American Petroleum Institute, 1999, API Publication 2218, "Fireproofing Practices in Petroleum and Petrochemical Processing Plants," 2nd ed., Washington, D.C.

[8.9] National Fire Protection Association, 2010, NFPA 72, "National Fire Alarm and Signaling Code," Quincy, MA.

[8.10] National Fire Protection Association, 2011, NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems," Quincy, MA.

Authority: Sections 8755 and 8757, Public Resources Code.

Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

Division 9

SECTION 3109F
PIPING AND PIPELINES

3109F.1 General. *This section provides minimum engineering standards for piping, pipelines, valves, supports and related appurtenances at MOTs. This section applies to piping and pipelines used for transferring:*

1. *Oil (see Section 3101F.1) to or from tank vessels or barges*
2. *Oil within the MOT*
3. *Vapors, including Volatile Organic Compounds (VOCs)*
4. *Inerting or enriching gases to vapor control systems*

Additionally, it also applies to piping or pipelines providing services, which includes stripping, sampling, venting, vapor control and fire water.

See Section 3101F.3 for definitions of "new" (N) and "existing" (E).

3109F.2 Oil piping and pipeline systems. *All pressure piping and pipelines for oil service shall conform to the provisions of API Standard 2610 [9.1], ASME B31.3 [9.2] or B31.4 [9.3] as appropriate, including the following:*

1. *All piping/pipelines shall be documented on current P&ID's (N/E).*
2. *Piping and pipeline systems shall be installed above deck (N).*
3. *The systems shall be arranged in a way not to obstruct access to and removal of other piping components and equipment (N).*
4. *Flexibility shall be achieved through adequate expansion loops or joints (N/E).*
5. *A guide or lateral restraint shall be provided just past the elbow where a pipe changes direction in order to minimize excessive axial stress (N).*
6. *Piping shall be routed to allow for movement due to thermal expansion and seismic displacement, without exceeding the allowable stresses in the supports, and anchor connections (see Section 3109F.3) (N/E).*
7. *Plastic piping shall not be used unless designated for oil service (N/E).*
8. *If a flanged connection exists within 20 pipe diameters from the end of any replaced section, the pipe shall be replaced up to and including the flange.*
9. *Pipelines shall be seamless, electric-resistance-welded or electric-fusion-welded (N).*
10. *Piping greater than 2 inches in diameter shall be butt-welded. Piping 2 inches and smaller shall be socket welded or threaded.*
11. *Pipeline connections directly over the water shall be welded (N). Flanged connections not over water shall have secondary containment (N).*
12. *Pipelines that do not have a valid and certified Static Liquid Pressure Test (SLPT) [9.4] shall be marked "OUT OF SERVICE." Out-of-service piping and pipelines shall be purged, gas-freed and physically isolated from sources of oil.*
13. *If a pipeline is "out-of-service" for 3 or more years, it will require Division approval prior to re-use.*

3109F.3 Pipeline stress analysis (N/E). *Pipeline stress analysis shall be performed for:*

1. *New piping and pipelines*
2. *Significant rerouting/relocation of existing piping*
3. *Any replacement of "not in-kind" piping*
4. *Any significant rearrangement or replacement of "not in-kind" anchors and/or supports*
5. *Significant seismic displacements calculated from the structural assessment*

Pipeline stress analysis shall be performed in accordance with ASME B31.4 [9.3], considering all relevant loads and corresponding displacements determined from the structural analysis described in Section 3104F. Seismic loading of above-grade pipelines may be analyzed in accordance with ASME B31.E [9.5].

Flexibility analysis for piping, considering supports, shall be performed in accordance with ASME B31.4 [9.3] by using the largest temperature differential imposed by normal operation, start-up, shutdown or abnormal conditions. Thermal loads shall be based upon maximum and minimum local temperatures; heat traced piping shall use the maximum attainable temperature of the heat tracing system.

To determine forces at sliding surfaces, the coefficients of static friction shown in Table 31F-9-1 shall be used.

TABLE 31F-9-1
COEFFICIENTS OF STATIC FRICTION

SLIDING SURFACE MATERIALS	COEFFICIENT OF STATIC FRICTION
Teflon on Teflon	0.10
Plastic on Steel	0.35
Steel on Steel	0.40
Steel on Concrete	0.45
Steel on Timber	0.49

3109F.4 Anchors and supports. *Anchors and supports shall conform to ASME B31.3 [9.2], ASME B31.4 [9.3], API Standard 2610 [9.1] and the ASCE Guidelines [9.6](N).*

A seismic assessment shall be performed for existing anchors and supports using recommendations in Section 7 of CalARP [9.7] or Chapter 11 of FEMA 356 [9.8], as appropriate (E).

3109F.5 Appurtenances.

3109F.5.1 Valves and fittings. *Valves and fittings shall meet the following requirements:*

1. *Conform to ASME B31.3 [9.2], ASME B31.4 [9.3], API Standard 609 [9.9] and ASME B16.34 [9.10], as appropriate, based on their service (N).*

2. *Conform to Section 8 of [9.1] (N/E).*
3. *Stems shall be oriented in a way not to pose a hazard in operation or maintenance (N/E).*
4. *Nonductile iron, cast iron, and low-melting temperature metals shall not be used in any hydrocarbon service, fire water or foam service (N/E).*
5. *Double-block and bleed valves shall be used for manifold valves. (N/E).*
6. *Isolation valves shall be fire-safe, in accordance with API Standard 607 [9.11] (N).*
7. *Swing check valves shall not be installed in vertical down-flow piping (N/E).*
8. *Pressure relief devices shall be used in any closed piping system that has the possibility of being over pressurized due to temperature increase (thermal relief valves) or surging (N/E).*
9. *Pressure relief devices shall be sized in accordance with API RP 520 [9.12] (N). Set pressures and accumulating pressures shall be in accordance with [9.12] (N/E).*
10. *Discharge from pressure relief valves shall be directed into lower pressure piping for recycling or proper disposal. Discharge shall never be directed into the open environment, unless secondary containment is provided (N/E).*
11. *Threaded, socket-welded, flanged and welded fittings shall conform to Section 8 of [9.1] (N/E).*

3109F.5.2 Valve actuators (N/E).

1. *Actuators shall have a readily accessible, manually operated overriding device to operate the valve during a power loss.*
2. *Torque switches shall be set to stop the motor closing operation at a specified torque setting.*
3. *Limit switches shall be set to stop the motor opening operation at a specified limit switch setting.*
4. *Critical valves shall be provided with thermal insulation. The insulation shall be inspected and maintained at periodic intervals. Records of thermal insulation inspections and condition shall be maintained for at least 6 years.*
5. *Electrical insulation for critical valves shall be measured for resistance following installation and retested periodically. These records shall be maintained for at least 6 years.*

3109F.6 Utility and auxiliary piping systems. *Utility and auxiliary piping includes service for:*

1. *Stripping and sampling*
2. *Vapor control*
3. *Fire water and foam*
4. *Natural gas*
5. *Compressed air, venting and nitrogen*

Stripping and sampling piping shall conform to Section 3109F.2 (N/E).

Vapor return lines and VOC vapor inerting and enriching (natural gas) piping shall conform to 33 CFR 154.808 [9.13] and API RP 1124 [9.14] (N/E).

Firewater and foam piping and fittings shall meet the following requirements:

1. *Conform to ASME B16.5 [9.15]*
2. *Fire mains shall be carbon steel pipe (N/E)*
3. *High density polyethylene (HDPE) piping may be used for buried pipelines (N/E)*
4. *Piping shall be color-coded (N/E)*

Compressed air, venting and nitrogen piping and fittings shall conform to ASME B 31.3 [9.2] (N). Utility and auxiliary piping shall have external visual inspections, similar to that defined in Section 10.1 of API 574 [9.16] (N/E).

3109F.7 References.

[9.1] American Petroleum Institute (API), 2005, API Standard 2610, "Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities," 2nd ed., Washington, D.C.

[9.2] American Society of Mechanical Engineers (ASME), 2010, ASME B31.3, "Process Piping," New York.

[9.3] American Society of Mechanical Engineers (ASME), 2009, ASME B31.4, "Pipeline Transportation Systems For Liquid Hydrocarbons And Other Liquids," New York.

[9.4] 2 CCR 2560 - 2571 (Title 2, California Code of Regulations (CCR), Sections 2560-2571).

[9.5] American Society of Mechanical Engineers (ASME), 2008, B31.E, "Standard for the Seismic Design and Retrofit of Above-Ground Piping Systems," New York.

[9.6] American Society of Civil Engineers, 2011, "Guidelines for Seismic Evaluation and Design of Petrochemical Facilities," 2nd ed., New York.

[9.7] CalARP Program Seismic Guidance Committee, September 2009, "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments," Sacramento, CA.

[9.8] Federal Emergency Management Agency, Nov. 2000, FEMA 356, "Prestandard and Commentary for the Seismic Rehabilitation of Buildings," Washington, D.C.

[9.9] American Petroleum Institute (API), 1997, API Standard 609, "Butterfly Valves: Double Flanged, Lug- and Wafer-Type," 5th ed., Washington, D.C.

[9.10] American Society of Mechanical Engineers (ASME), 1996, ASME B16.34, "Valves Flanged Threaded And Welding End," New York.

[9.11] American Petroleum Institute (API), 1996, API Standard 607, "Fire Test for Soft-Seated Quar-

ter-Turn Valves," 4th ed., 1993 (reaffirmed 4/1996), Washington, D.C.

[9.12] American Petroleum Institute (API), 2000, API RP 520, "Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries, Part I —Sizing and Selection," 7th ed., and Part II—Installation, 2003, 5th ed., Washington, D.C.

[9.13] 33 CFR 154.808 — Vapor Control Systems, General (Title 33, Code of Federal Regulations (CFR), Section 154.808).

[9.14] American Petroleum Institute (API), 1991, Recommended Practice 1124 (API RP 1124), "Ship, Barge, and Terminal Hydrocarbon Vapor Collection Manifolds," 1st ed., Washington, D.C.

[9.15] American Society of Mechanical Engineers (ASME), 1996, ASME B16.5, "Pipe Flanges and Flanged Fittings," New York.

[9.16] American Petroleum Institute (API), 2009, API RP 574, "Inspection Practices for Piping System Components," 3rd ed., Washington, D.C.

Authority: Sections 8755 and 8757, Public Resources Code.

Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

Division 10

SECTION 3110F
MECHANICAL AND ELECTRICAL EQUIPMENT

3110F.1 General. *This section provides the minimum standards for mechanical and electrical equipment at MOTs.*

See Section 3101F.3 for definitions of "new" (N) and "existing" (E).

3110F.2 Marine loading arms.

3110F.2.1 General criteria. *Marine loading arms and ancillary systems shall conform to 2 CCR 2380 (b) [10.1], 33 CFR 154.510 [10.2] and the "Design and Construction Specification for Marine Loading Arms," [10.3].*

The following shall be considered when determining the loading arm maximum allowable extension limits:

1. *Vessel sizes and manifold locations*
2. *Lowest-low water level (datum)*
3. *Highest-high water level*
4. *Maximum vessel surge and sway*
5. *Maximum width of fendering system*

3110F.2.2 Electrical and hydraulic power systems.

3110F.2.2.1 Pressure and control systems (N).

1. *Pressure gauges shall be mounted in accordance with ASME B40.100-1 998 [10.4].*
2. *The hydraulic drive cylinders shall be mounted and meet either the mounting requirements of ANSI/(NFPA) T3. 6.7 R2 -1 996 [10.5] or equivalent.*
3. *In high velocity current (>1.5 knots) areas, all new marine loading arms shall be fitted with quick disconnect couplers and emergency quick release systems in conformance with Sections 6.0 and 7.0 of [10.3]. In complying with this requirement, attention shall be paid to the commentary and guidelines in Part III of reference [10.3].*
4. *Out-of-limit, balance and the approach of out-of-limit alarms shall be located at or near the loading arm console.*

3110F.2.2.2 Electrical components (N). *The following criteria shall be implemented:*

1. *Equipment shall be provided with a safety disconnecting device to isolate the entire electrical system from the electrical mains in accordance with Article 430 of the National Electrical Code (NEC), [10.6].*
2. *Motor controllers and 3-pole motor overload protection shall be installed and sized in accordance with Article 430, NEC [10.6].*
3. *Control circuits shall be limited to 120 volts and shall comply with Articles 500 and 501 of the NEC [10.6]. Alternatively, intrinsically safe wiring and controls may be provided in accordance with Article 504, NEC [10.6] and ANSI/UL Std. No. 913 [10.7].*
4. *Grounding and bonding shall comply with the requirements of Article 430, NEC [10.6] and Section 3111F.*

Section 3111F includes requirements for electrical equipment, wiring, cables, controls and electrical auxiliaries located in hazardous areas.

3110F.2.2.3 Remote operation. *The remote control system, where provided, shall conform to the recommendations of the OCIMF [10.3]. The remote operation shall be facilitated by either a pendant control system or by a hand-held radio controller (N).*

The pendant control system shall be equipped with a plug-in capability to an active connector located either in the vicinity of the loading arms, or at the loading arm outboard end on the triple swivel, and hard-wired into the control console. The umbilical cord running from the triple swivel to the control console shall be attached to the loading arm. Other umbilical cords shall have sufficient length to reach the maximum operational limits (N).

The radio controller if installed shall comply with 2 CCR 2370(e) [10.8] and 47CFR Part 15 [10.9] requirements for transmitters operating in an industrial environment (N/E).

3110F.3 Oil transfer hoses (N/E). *Hoses for oil transfer service shall be in compliance with 2 CCR 2380 (a) [10.10] and 33 CFR 1 54.500 [10.11].*

Hoses with diameters of 6 inches or larger shall have flanges that meet ANSIB1 6.5 [10.12]. Hoses with diameters of 4 inches or less may have quick disconnect fittings provided that they meet ASTM F-1122 [10.13].

3110F.4 Lifting equipment: winches and cranes. *Lifting equipment shall conform to [10.14], [10.15], [10.16] and [10.1 7]. Electrical equipment shall conform to the provisions of Section 3111F.*

3110F.4.1 Winches.

1. *Winches and ancillary equipment shall be suitable for a marine environment (N/E).*
2. *Winches shall be provided with a fail-safe braking system, capable of holding the load under all conditions, including a power failure (N/E).*
3. *Winches shall be fully reversible (N).*
4. *Shock, transient and abnormal loads shall be considered when selecting winch systems (N).*
5. *Winches shall have limit switches and automatic trip devices to prevent over-travel of the drum in either direction. Limit switches shall be tested, and demonstrated to function correctly under operating condi-*

tions without inducing undue tensions or slack in the winch cables (N/E).

6. *Under all operating conditions, there shall be at least two full turns of cable on grooved drums, and at least three full turns on ungrooved drums (N/E).*
7. *Moving winch parts which present caught-in hazards to personnel shall be guarded (N/E).*
8. *Winches shall have clearly identifiable and readily accessible stop controls (N/E).*

3110F.4.2 Cranes (N/E).

1. *Cranes shall not be loaded in excess of the manufacturer's rating except during performance tests.*
2. *Drums on load-hoisting equipment shall be equipped with positive holding devices.*
3. *Under all operating conditions, there shall be at least two full turns of cable on grooved drums, and at least three full turns on ungrooved drums.*
4. *Braking equipment shall be capable of stopping, lowering, and holding a load of at least the full test load.*
5. *When not in use, crane booms shall be lowered to ground level or secured to a rest support against displacement by wind loads or other outside forces.*
6. *Safety systems including devices that affect the safe lifting and handling, such as interlocks, limit switches, load/moment and overload indicators with shutdown capability, emergency stop switches, radius and locking indicators, shall be provided [10.18].*

3110F.5 Shore-to-vessel access for personnel. *This section applies to shore-to-vessel means of access for personnel and equipment provided by the terminal. This includes ancillary structures and equipment, which support, supplement, deploy and maneuver such vessel access systems.*

Shore-to-vessel access for personnel shall conform to 29 CFR 1918.22 [10.19], Sections 19(b) and 21(b) of [10.20], Chapter 16.4 of [10.21] and the following:

1. *Shore-to-vessel access systems shall be designed to withstand the forces from dead, live, wind, vibration, impact loads and the appropriate combination of these loads. The design shall consider all the critical positions of the system in the stored, maintenance, maneuvering and deployed positions, where applicable (N).*
2. *The minimum live load shall be 50 psf on walkways and 25 plf with a 200 pounds minimum concentrated load in any location or direction on handrails (N).*
3. *The walkway shall be not less than 36 inches in width (N) and not less than 20 inches for existing walkways (E).*
4. *The shore-to-vessel access system shall be positioned so as to not interfere with the safe passage or evacuation of personnel (N/E).*
5. *Guardrails shall be provided on both sides of the access systems with a clearance between the inner most surfaces of the guardrails of not less than 36 inches and shall be maintained for the full length of the walkway (N).*
6. *Guardrails shall be at a height not less than 33 inches above the walkway surface and shall include an intermediate rail located midway between the walkway surface and the top rail (N/E).*
7. *The walkway surface, including self-leveling treads, if so equipped, shall be finished with a safe nonslip footing accommodating all operating gangway inclinations (N/E).*
8. *Under no circumstances shall the operating inclination of the walkway exceed 60 degrees from the horizontal or the maximum angle recommended by the manufacturer, whichever is less (N/E).*
9. *The undersides of aluminum gangways shall be protected with hard plastic or wooden strips to prevent being dragged or rubbed across any steel deck or component (N/E).*

3110F.6 Sumps, discharge containment and ancillary equipment. *Sumps, discharge containment and ancillary equipment shall conform to 2 CCR 2380(f) [10.22], 33 CFR 1 54.530 [10.23] and the following:*

1. *Sumps for oil drainage shall be equipped with pressure/vacuum vents, automatic draining pumps and shall be tightly covered (N/E).*
2. *Sumps which provide drainage for more than one berth should be equipped with liquid seals so that a fire on one berth does not spread via the sump (N/E).*
3. *Sumps shall be located at least 25ft from the manifolds, base of the loading arms or hose towers (N).*
4. *Conduct periodic integrity testing of the sump containers and periodic integrity and leak testing of the related valves and piping.*

3110F.7 Vapor control systems. *Vapor control systems shall conform to 33 CFR 154.800 through 154.850 [10.24] and API Standard 2610 [10.25]. The effects of seismic, wind, dead, live and other loads shall be considered in the analysis and design of individual tie-downs of components, such as of steel skirts, vessels, controls and detonation arresters. The analysis and design shall include the load transfer to supporting deck/pile structures or foundation elements.*

3110F.8 Equipment anchors and supports. *For new (N) electrical and mechanical equipment, the seismic lateral loads (demand) shall be calculated using the methods of Section 6.4 of FEMA 450 [10.26]. The design for load transfer to the wharf deck shall use the same procedures as for mooring and berthing components (see Section 3107F.5.3).*

For existing (E) equipment, the seismic assessment shall be performed in accordance with CalARP [10.27], FEMA 356 [10.28] or ASCE Guidelines [10.29].

3110F.9 Equipment and systems maintenance (N/E). *Mechanical and electrical equipment critical to oil spill prevention, such as, but not limited to: mooring line quick release and loading arm quick disconnect systems, shall be maintained and tested as per the manufacturer's recommendations (N/E).*

The latest records shall be readily accessible to the Division (N/E).

3110F.10 Pumps (N/E). *Specification information for all MOT pumps providing oil and fire water service to wharf pipeline systems shall be retained. Information shall include, but not be limited to, pump make and model, motor make and model, flow rate, pressure rating and pump performance curves.*

Hydrocarbon pumps that serve the oil transfer operations at the berthing system must be maintained per API 2610 [10.25]. Firewater pumps providing the wharf fire protection shall be maintained per NFPA 25 [10.30], as adopted and amended by the State Fire Marshal, or local enforcing agency requirements.

3110F.11 Critical systems seismic assessment (N/E). *Critical mechanical and electrical equipment related to personnel safety, oil spill prevention or response, shall have a seismic assessment per Section 3104F.5.3. For equipment anchorages and supports, see Section 3110F.8.*

3110F.12 References.

[10.1] 2 CCR 2380(b), Title 2, California Code of Regulations, Section 2380(b), Loading Arms.

[10.2] 33 CFR 154.510, Title 33 Code of Federal Regulations Section 154.510.

[10.3] Oil Companies International Marine Forum (OCIMF), 1999, "Design and Construction Specification for Marine Loading Arms," 3rd ed., Witherby, London.

[10.4] American Society of Mechanical Engineers (ASME), 2000, ASME B40.100-1998, "Pressure Gauges and Gauge Attachments," New York.

[10.5] National Fluid Power Association (NFPA), 1996, ANSI/(NFPA) T3. 6. 7R2-1996, "Fluid Power Systems and Products —Square Head Industrial Cylinders - Mounting Dimensions," Milwaukee, WI.

[10.6] National Fire Protection Association, 2002, NFPA 70, "National Electrical Code," Quincy, MA.

[10.7] Underwriters Laboratory, Inc., 1997, "Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations," ANSI/UL Standard No. 913, 5th ed., Northbrook, IL.

[10.8] 2 CCR 2370(e), Title 2 California Code of Regulations, Section 2370(e).

[10.9] 47 CFR Part 15 Private Land Mobile Radio Services, Title 47 Code of Federal Regulations (CFR).

[10.10] 2 CCR 2380(a), Title 2, California Code of Regulations, Section 2380(a).

[10.11] 33 CFR 154.500 Hose Assemblies, Title 33 Code of Federal Regulations Section 154.500.

[10.12] American Society of Mechanical Engineers, 1996, ASME/ANSI B16.5, "Pipe Flanges and Flanged Fittings," New York.

[10.13] American Society for Testing and Materials, 2001, ASTMF-1122-87 (1998), "Standard Specification for Quick Disconnect Couplings," West Conshohocken , PA.

[10.14] 29 CFR 1918, Subpart F, Title 29 Code of Federal Regulations Section 1918, Subpart F.

[10.15] American Society of Mechanical Engineers, 1996, ASME B30.4 - 1996, "Portal Tower and Pedestal Cranes," New York.

[10.16] American Society of Mechanical Engineers, 2002, ASME B30.7 - 2001, "Base Mounted Drum Hoists," New York.

[10.17] American Society of Mechanical Engineers, 1999, ASME HST-4, "Performance Standard for Overhead Electric Wire-Rope Hoists," New York.

[10.18] 29 CFR 1917.46, Title 29 Code of Federal Regulations Section 1917.46 Load Indicating Devices.

[10.19] 29 CFR 1918.22, Title 29 Code of Federal Regulations Section 1918.22, Gangways.

[10.20] US Army Corps of Engineers, 1996, "Safety and Health Requirements Manual, Sections 19(b) and 21(b)," EM 385-1 -1, Washington, D.C.

[10.21] Chapter 16.4, Ship/Shore Access, International Safety Guide for Oil Tankers and Terminals, 5th ed. 2006, Witherby, London.

[10.22] 2 CCR 2380(f), Title 2, California Code of Regulations, Section 2380(f), Small Discharge Containment.

[10.23] 33 CFR 154.530, Title 33, Code of Federal Regulations, Section 154.530 Small Discharge Containment.

[10.24] 33 CFR 154.800 through 154.850, Title 33 Code of Federal Regulations, Sections 154.800 through 154.850.

[10.25] American Petroleum Institute (API), 2005, API Standard 2610, "Design, Construction, Operation, Maintenance, and Inspection of Terminal and Tank Facilities," 2nd ed., Washington, D.C.

[10.26] Federal Emergency Management Agency, 2003, "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (FEMA 450)," Part 1 — Provisions, Washington D.C.

[10.27] CalARP Program Seismic Guidance Committee, September 2009, "Guidance for California Accidental Release Prevention (CalARP) Program Seismic Assessments," Sacramento, CA.

[10.28] Federal Emergency Management Agency, Nov. 2000, FEMA 356, "Prestandard and Commentary for the Seismic Rehabilitation of Buildings," Washington, D.C.

interfere with them in any way that would reduce their effectiveness.

3. *Bonding of vessels to the MOT structure is not permitted (2 CCR 2341 (f)) [11.5].*
4. *Whenever flanges of pipelines with cathodic protection are to be opened for repair or other work, the flanges shall be bonded prior to separation.*
5. *Direct wiring to ground shall be provided from all towers, loading arms or other high structures that are susceptible to lightning surges or strikes.*

3111F.7 Equipment specifications (N). *All electrical systems and components shall conform to National Electrical Manufacturers Association (NEMA) standards or be certified by a Nationally Recognized Testing Laboratory (NRTL).*

3111F.8 Illumination (N/E). *Lighting shall conform to 2 CCR 2365 [11.8] and 33 CFR 154.570 (d) [11.9].*

3111F.9 Communications, control and monitoring systems.

3111F.9.1 Communication systems (N/E). *Communications systems shall comply with 2 CCR 2370 [11.10], and conform to Section 6 of [11.11].*

3111F.9.2 Overfill monitoring and controls (N/E). *Overfill protection systems shall conform to Appendix C of API RP 2350 [11.12]. These systems shall be tested before each transfer operation or monthly, whichever is less frequent. Where vessel or barge overfill sensors and alarms are provided, they shall comply with 33 CFR 154.812 [11.13].*

All sumps shall be provided with level sensing devices to initiate an alarm to alert the operator at the approach of a high level condition. A second alarm shall be initiated at a high-high level to alert the operator. Unless gravity drainage is provided, sumps must have an automatic pump, programmed to start at a predetermined safe level.

3111F.9.3 Monitoring systems (N/E). *All monitoring systems and instrumentation such as, but not limited to: velocity monitoring systems, tension monitoring systems, anemometers, and current meters, shall be installed, maintained and calibrated per the manufacturer's recommendations. Specifications shall be retained. The latest records shall be readily accessible to the Division.*

3111F.10 Corrosion protection.

3111F.10.1 Corrosion assessment (N/E). *An assessment shall be performed to determine the existing and potential corrosion. This assessment shall include all steel or metallic components, including the structure, pipelines, supports or other ancillary equipment, with drawings and specifications for corrosion prevention/protection. The assessment shall be performed by a licensed professional engineer, using the methods and criteria prescribed in [11.14].*

3111F.10.2 Inspection, testing and records (N/E). *For sacrificial anode systems, periodic underwater inspections shall be performed and observations recorded. For impressed current systems, monthly rectifier readings and annual potential readings of the protected components shall be taken. If potential readings for steel structures are outside of acceptable limits (between -0.85 [11.15] and -1.10 Volts), corrective actions shall be taken. Voltage drops other than across the structure-to-electrolyte boundary must be considered for valid interpretations of potential measurement. Consideration is understood to mean the application of sound engineering practice in determining the significance of voltage drops by methods such as:*

1. *Measuring or calculating voltage drop(s)*
2. *Reviewing historical performance of the cathodic protection system (CPS)*
3. *Evaluating the physical and electrical characteristics of the structure and the environment*
4. *Determining whether or not there is physical evidence of corrosion*

All isolating sections shall be tested immediately after installation or replacement, and, at a minimum, annually. Test results shall be recorded and documented. Electrical tests on insulating flanges shall make use of specialized insulator testers. The test instrument shall make use of RF signals, capacitive measurements or other means to clearly determine whether an insulating flange is shorted or open circuited without being affected by pipe-to-soil potentials, cathodic protection voltages or whether it is buried or exposed.

The cathodic protection inspection for buried or submerged pipelines shall conform to API 570 [11.16].

Insulating and isolating arrangements for protection against static, stray and impressed currents shall be tested in accordance with 2 CCR 2341(d) and 2380 [11.17].

3111F.11 Critical systems seismic assessment (N/E). *Electrical power systems shall have a seismic assessment per Section 3104F.5.3. For equipment anchorages and supports, see Section 3110F.8.*

3111F.12 References.

[11.1] American Petroleum Institute, 1999, API Recommended Practice 540 (API RP 540), "Electrical Installations in Petroleum Processing Plants," 4th ed., Washington, D.C.

[11.2] National Fire Protection Association, 2002, NFPA 70, "National Electrical Code (NEC)," Quincy, MA.

[11.3] American Petroleum Institute, 1997, API Recommended Practice 500 (API RP 500), "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2," 2nd ed., Washington, D.C.

[11.4] National Fire Protection Association, 1998, NFPA 496, "Standard for Purged and Pressurized Enclosures for Electrical Equipment," Quincy, MA.

[11.5] 2 CCR 2341(f), Title 2, California Code of regulations, Section 2341(f).

[11.6] National Fire Protection Association, 2010, NFPA 110, "Standard for Emergency and Standby Power Systems," Quincy, MA.

[11.7] National Fire Protection Association, 2011, NFPA 111, "Standard on Stored Electrical Energy Emergency and Standby Power Systems," Quincy, MA.

[11.8] 2 CCR 2365, Title 2 California Code of Regulations, Section 2365.

[11.9] 33 CFR 154.570(d), Title 33 Code of Federal Regulations Section 154.570(d).

[11.10] 2 CCR 2370, Title 2 California Code of Regulations, Section 2370.

[11.11] Oil Companies International Marine Forum (OCIMF), 1987, "Guide on Marine Terminal Fire Protection and Emergency Evacuation," 1st ed., Witherby, London.

[11.12] American Petroleum Institute, 1996, API Recommended Practice 2350 (API RP 2350), "Overfill Protection for Storage Tanks," 2nd ed., Washington, D.C.

[11.13] 33 CFR 1 54.812, Title 33, Code of Federal Regulations, Section 154.812 - Facility Requirements for Vessel Liquid Overfill Protection.

[11.14] National Association of Corrosion Engineers (NACE), Standard Recommended Practice, 1994, RP01 76-1994 "Corrosion Control of Steel Fixed Offshore Platforms Associated with Petroleum Production," Houston, TX.

[11.15] Department of Defense, 31 January 1990, Military Handbook, "Electrical Engineering Cathodic Protection," MIL-HDBK-1004/10, Washington, D.C.

[11.16] American Petroleum Institute, 2002, API 570, "Piping Inspection Code," 2nd ed., October 1998 (February 2000 Addendum 1), Washington, D.C.

[11.17] 2 CCR 2341(d) and 2380, Title 2, California Code of Regulations, Sections 2341(d) and 2380.

Authority: Sections 8755 and 8757, Public Resources Code.

Reference: Sections 8750, 8751, 8755 and 8757, Public Resources Code.

CHAPTER 34
EXISTING STRUCTURES

SECTION 3401
GENERAL

3401.1 Scope. The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing structures, *including state-regulated structures in accordance with Sections 3401.1 and 3401.2.*

[DSA-AC] *For applications listed in Section 1.9.1 regulated by the Division of the State Architect-Access Compliance for accessibility requirements, see Chapter 11B.*

Exception: Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

[HCD 1] *In addition to the requirements in this chapter, maintenance, alteration, repair, addition, or change of occupancy to existing buildings and accessory structures under the authority of the Department of Housing and Community Development, as provided in Section 1.8.2.1.1, shall comply with California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1.*

Exceptions:

1. Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300-02.
2. ***[HCD 2]*** *For moved buildings and maintenance, alteration, repair, addition, or change of occupancy to existing buildings and accessory structures in mobilehome parks or special occupancy parks as provided in Section 1.8.2.1.3. See California Code of Regulations, Title 25, Division 1, Chapters 2 and 2.2.*
3. ***[HCD 1]*** *Limited-density owner-built rural dwellings.*

3401.1.1 Existing state-owned structures. *The provisions of Sections* 3417 *through* 3422 *establish minimum standards for earthquake evaluation and design for retrofit of existing state-owned structures, including buildings owned by the University of California and the California State University.*

The provisions of Sections 3417 *through* 3422 *may be adopted by a local jurisdiction for earthquake evaluation and design for retrofit of existing buildings.*

3401.1.2 Public school buildings. [DSA-SS] *The provisions of Sections* 3417 *through* 3423 *establish minimum standards for earthquake evaluation and design for the rehabilitation of existing buildings for use as public school buildings under the jurisdiction of the Division of the State Architect-Structural Safety (DSA-SS, refer to Section 1.9.2.1) where required by Sections 4-307 and 4-309(c) of the California Administrative Code.*

The provisions of Section 3417 *through* 3423 *also establish minimum standards for earthquake evaluation and design for rehabilitation of existing public school buildings currently under the jurisdiction of DSA-SS.*

3401.1.3 Community college buildings. [DSA-SS/CC] *The provisions of Sections* 3417 *through* 3423 *establish minimum standards for earthquake evaluation and design for the rehabilitation of existing buildings for use as community college buildings under the jurisdiction of the Division of the State Architect-Structural Safety/Community Colleges (DSA-SS/CC, refer to Section 1.9.2.2) where required by Sections 4-307 and 4-309(c) of the California Administrative Code.*

The provisions of Section 3417 *through* 3423 *also establish minimum standards for earthquake evaluation and design for rehabilitation of existing community college buildings currently under the jurisdiction of DSA-SS/CC.*

3401.2 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices or safeguards which are required by this code shall be maintained in conformance with the code edition under which installed. The owner or the owner's designated agent shall be responsible for the maintenance of buildings and structures. To determine compliance with this subsection, the building official shall have the authority to require a building or structure to be reinspected. The requirements of this chapter shall not provide the basis for removal or abrogation of fire protection and safety systems and devices in existing structures.

3401.3 Compliance. Alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall comply with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in the *California Fire Code*, *California Mechanical Code*, *California Plumbing Code*, *California Residential Code* and *California Electrical Code*. Where provisions of the other codes conflict with provisions of this chapter, the provisions of this chapter shall take precedence.

3401.4 Building materials and systems. Building materials and systems shall comply with the requirements of this section.

3401.4.1 Existing materials. Materials already in use in a building in compliance with requirements or approvals in effect at the time of their erection or installation shall be permitted to remain in use unless determined by the building code official to be unsafe per Section 116.

[HCD 1] *Local ordinances or regulations shall permit the replacement, retention and extension of original materials, and the use of original methods of construction, for any building or accessory structure, provided such building or structure complied with the building code provisions in effect at the time of original construction and the building or accessory structure does not become or continue to be a substandard building. For additional information, see Health and Safety Code Sec-*

tions 17912, 17920.3, 17922(d), 17922.3, 17958.8 and 17958.9.

3401.4.2 New and replacement materials. Except as otherwise required or permitted by this code, materials permitted by the applicable code for new construction shall be used. Like materials shall be permitted for repairs and alterations, provided no hazard to life, health or property is created. Hazardous materials shall not be used where the code for new construction would not permit their use in buildings of similar occupancy, purpose and location.

3401.4.3 Existing seismic force-resisting systems. Where the existing seismic force-resisting system is a type that can be designated ordinary, values of R, Ω_0, and C_d for the existing seismic force-resisting system shall be those specified by this code for an ordinary system unless it is demonstrated that the existing system will provide performance equivalent to that of a detailed, intermediate or special system.

3401.5 Dangerous conditions. The building official shall have the authority to require the elimination of conditions deemed dangerous.

3401.6 Alternative compliance. Work performed in accordance with the *International Existing Building Code* shall be deemed to comply with the provisions of this chapter.

Exception: [OSHPD 2] *Section 3401.6 not permitted by OSHPD.*

3401.7 Adoption of ASCE 41: [OSHPD 2 & 3] *All additions, alterations, repairs and seismic retrofit to the existing structures or portions thereof may be designed in accordance with the provisions of ASCE 41, as modified herein. For load combinations which do not include seismic forces, the new building code provisions of this code shall be applicable.*

3401.7.1 ASCE 41 Section 1.4 –Rehabilitation Objectives. *Target building performance level shall be Life Safety (LS) Building Performance Level (3-C) as defined in Section 1.5.3.3 at Basic Safety Earthquake 1 (BSE-1) Seismic Hazard Level as defined in section 1.6.1.2 for Risk Category II Structures and Basic Safety Objective (BSO) Level as defined in Section 1.4.1 for Risk Category III Structures.*

Risk Category IV structures shall satisfy Immediate Occupancy (IO) Building Performance Level of (1-B) as defined in Section 1.5.3.2 at Basic Safety Earthquake 1 (BSE-1) Seismic Hazard Level as defined in Section 1.6.1.2 and Collapse Prevention (CP) building performance level (5-E) per Section 1.5.3.4 at Basic Safety Earthquake 2 (BSE-2) Seismic Hazard Level as defined in Section 1.6.1.1.

3401.7.2 ASCE 41 Section 1.6 - Seismic Hazard. *Response spectra and acceleration time histories shall be constructed in accordance with ASCE 7. The Basic Safety Earthquake 2 (BSE-2) in ASCE 41 shall be same as Maximum Considered Earthquake (MCE_R) in ASCE 7. The Basic Safety Earthquake 1 (BSE-1) shall be two-thirds of BSE-2.*

3401.7.3 Analysis procedure. *The selection of a particular analysis procedure from ASCE 41 may be subject to the approval of the enforcement agent.*

3401.7.4 Structural design criteria. *Prior to implementation of ASCE 41 nonlinear dynamic procedures—the ground motion, analysis and design methods, material assumptions and acceptance criteria proposed by the engineer shall be reviewed by the enforcement agent.*

3401.7.5 Structural observation, testing and inspections. *Construction, testing, inspection and structural observation requirements shall be as required for new construction.*

3401.8 Existing Group R Occupancies. [SFM] *See the California Residential Code for existing Group R-3 occupancies or Chapter 46 of the California Fire Code for all other existing Group R occupancies.*

3401.9 Dangerous conditions. [BSC] *Regardless of the extent of structural or nonstructural damage, the building code official shall have the authority to require the elimination of conditions deemed dangerous.*

SECTION 3402
DEFINITIONS

3402.1 Definitions. The following terms are defined in Chapter 2:

DANGEROUS.

EXISTING STRUCTURE.

PRIMARY FUNCTION.

SUBSTANTIAL STRUCTURAL DAMAGE.

TECHNICALLY INFEASIBLE.

SECTION 3403
ADDITIONS

3403.1 General. Additions to any building or structure shall comply with the requirements of this code for new construction. Alterations to the existing building or structure shall be made to ensure that the existing building or structure together with the addition are no less conforming with the provisions of this code than the existing building or structure was prior to the addition. An existing building together with its additions shall comply with the height and area provisions of Chapter 5.

Exception: *For state-owned buildings, including those owned by the University of California and the California State University and the Judicial Council, the requirements of Sections 3403.3 and 3403.4 are replaced by the requirements of Sections 3417 through 3422.*

3403.2 Flood hazard areas. For buildings and structures in flood hazard areas established in Section 1612.3, any addition that constitutes substantial improvement of the existing structure, as defined in Section 1612.2, shall comply with the flood design requirements for new construction, and all aspects of the existing structure shall be brought into compliance with the requirements for new construction for flood design.

For buildings and structures in flood hazard areas established in Section 1612.3, any additions that do not constitute substantial improvement of the existing structure, as defined in Section 1612.2, are not required to comply with the flood design requirements for new construction.

3. *The modification to the structural components increases the seismic forces in or strength requirements of any structural component of the existing structure by more than 10 percent cumulative since the original construction, unless the component has the capacity to resist the increased forces determined in accordance with Section 3419. If the building's seismic base shear capacity has been increased since the original construction, the percent change in base shear may be calculated relative to the increased value.*

4. *Structural elements need repair where the damage has reduced the lateral-load-resisting capacity of the structural system by more than 10 percent.*

5. *Changes in live or dead load increase story shear by more than 10 percent.*

TABLE 3416.7(1)
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A PHYSICAL HAZARD BASIC QUANTITIES PER LABORATORY SUITE[1]
When two units are given, values within parentheses are in cubic feet (cu. ft) or pounds (lb)

CONDITION		STORAGE			USE CLOSED SYSTEMS			USE OPEN SYSTEMS		
MATERIAL	CLASS	Solid Pounds (cu. ft)	Liquid Gallons (lb)	Gas (cu. ft)	Solid Pounds (cu. ft)	Liquid Gallons (lb)	Gas (cu. ft)	Solid Pounds (cu. ft)	Liquid Gallons (lb)	Gas (cu. ft)
1.1 Combustible liquid	II	—	120[2]	—	—	120	—	—	30	—
	III-A	—	330[2]	—	—	330	—	—	80	—
	III-B	—	13,200[2]	—	—	13,200	—	—	3,300	—
1.2 Combustible dust lbs./1000 cu. ft.		1	—	—	1	—	—	1	—	—
1.3 Combustible fiber (loose) (baled)		(100) (1,000)	— —	— —	(100) (1,000)	— —	— —	(20) (200)	— —	— —
1.4 Cryogenic, flammable or oxidizing			45	—	—	45	—	—	10	—
2.1 Explosives		12	(1)[2]	—	1/4	(1/4)	—	1/4	(1/4)	—
3.1 Flammable solid		125[2]	—	—	25	—	—	25	—	—
3.2. Flammable gas (gaseous) (liquefied)		— —	— 15[2]	750[2] —	— —	— 15[2]	750[2] —	— —	— —	— —
3.3 Flammable liquid Combination I-A, I-B, I-C	I-A	—	30[2]	—	—	30	—	—	10	—
	I-B	—	60[2]	—	—	60	—	—	15	—
	I-C	—	90[2]	—	—	90	—	—	20	—
		—	120[2]	—	—	120	—	—	30	—
4.1 Organic peroxide, unclassified detonatable		1[2]	(1)[2]	—	1/4	(1/4)	—	1/4	(1/4)	—
4.2 Organic peroxide	I	5[2]	(5)[2]	—	(1)	(1)	—	1	1	—
	II	50[2]	(50)[2]	—	50	(50)	—	10	(10)	—
	III	125[2]	(125)[2]	—	125	(125)	—	25	(25)	—
	IV	500	(500)	—	500	(500)	—	100	(100)	—
	V	N.L.	N.L.	—	N.L.	N.L.	—	N.L.	N.L.	—
4.3 Oxidizer	4	1[2]	(1)[2]	—	1/4[2]	(1/4)	—	1/4	(1/4)	—
	3	10[2]	(10)[2]	—	2	(2)	—	2	(2)	—
	2	250[2]	(250)[2]	—	50	(250)	—	50	(50)	—
	1	1,000[2]	(1,000)[2]	—	1,000	(1,000)	—	200	(200)	—
4.4 Oxidizer.Gas (gaseous) (liquefied)		— —	— 15[2]	1,500[2] —	— —	— 15[2]	1,500[2] —	— —	— —	— —
5.1 Pyrophoric		4[2]	(4)[2]	50[2]	1	(1)	10[2]	0	0	0
6.1 Unstable (reactive)	4	1[2]	(1)[2]	10[2]	1/4	(1/4)	2[2]	1/4	(1/4)	0
	3	5[2]	(5)[2]	50[2]	1	(1)	10[2]	1	(1)	0
	2	50[2]	(50)[2]	250[2]	50	(50)	250[2]	10	(10)	0
	1	125[2]	(125)[2]	750[2]	125	(125)	750[2]	25	(25)	0
7.1 Water (reactive)	3	5[2]	(5)[2]	—	5	(5)	—	1	(1)	—
	2	50[2]	(50)[2]	—	50	(50)	—	10	(10)	—
	1	125[2]	(125)[2]	—	125	(125)[2]	—	25	(25)	—

1. *A laboratory suite is a space up to 10,000 square feet (929 m^2) bounded by not less than a one-hour fire-resistive occupancy separation within which the exempt amounts of hazardous materials may be stored, dispensed, handled or used. Up through the third floor and down through the first basement floor, the quantity in this table shall apply. Fourth, fifth and sixth floors and the second and third basement floor level quantity shall be reduced to 75 percent of this table. The seventh through 10th floor and below the third basement floor level quantity shall be reduced to 50 percent of this table.*
2. *Quantities may be increased 100 percent when stored in approved exhausted gas cabinets, exhausted enclosures or fume hoods.*

TABLE 3416.7(2)
EXEMPT AMOUNTS OF HAZARDOUS MATERIALS, LIQUIDS AND CHEMICALS PRESENTING A HEALTH HAZARD MAXIMUM QUANTITIES ER LABORATORY SUITE[1]
When two units are given, values within parentheses are in pounds (lbs.)

MATERIAL	STORAGE			USE CLOSED SYSTEMS			USE OPEN SYSTEMS	
	Solid lb	Liquid Gallons (lb)	Gas cu. ft	Solid lb	Liquid Gallons (lb)	Gas cu. ft	Solid lb	Liquid Gallons (lb)
1. Corrosives	5,000	500	650[2]	5,000	500	650	1,000	100
2a. Highly toxics[2]	40	10	65	5	1	65	2	1/4
2b. Toxics	500	50	650[2]	500	50	650	5	1/2
3. Irritants	5,000	500	650	5,000	500	650	1,000	100
4. Sensitizers	5,000	500	650	5,000	500	650	1,000	100
5. Other health hazards	5,000	500	650	5,000	500	650	1,000	100

1. *A laboratory suite is a space up to 10,000 square feet (929 m^2) bounded by not less than a one-hour fire-resistive occupancy separation within which the exempt amounts of hazardous materials may be stored, dispensed, handled or used. Up through the third floor and down through the first basement floor, the quantity in this table shall apply. Fourth, fifth and sixth floors and the second and third basement floor level quantity shall be reduced to 75 percent of this table. The seventh through 10th floor and below the third basement floor level quantity shall be reduced to 50 percent of this table.*
2. *Permitted only when stored or used in approved exhausted gas cabinets, exhausted enclosures or fume hoods. Quantities of high toxics in use in open systems need not be reduced above the third floor or below the first basement floor level. Individual container size shall be limited to 2 pounds (0.91 kg) for solids and 1/4 gallon (0.95 L) for liquids.*

3417.3.2 Public school buildings. *For public schools, the provisions of Section 3417 apply when required in accordance with Sections 4-307 and 4-309(c), Title 24, Part 1.*

3417.3.3 Community college buildings. *For community colleges, the provisions of Section 3417 apply when required in accordance with Sections 4-307 and 4-309(c), Title 24, Part 1.*

3417.4 Evaluation required. *If the criteria in Section 3417.3 apply to the project under consideration, the design professional of record shall provide an evaluation in accordance with Section 3417 to determine the seismic performance of the building in its current configuration and condition. If the structure's seismic performance as required by Section 3417.5 is evaluated as satisfactory and the peer reviewer(s), when Method B of Section 3421 is used, concur, then no structural retrofit is required.*

3417.5 Minimum seismic design performance levels for structural and nonstructural components. *Following the notations of ASCE 41, the seismic requirements for design and assessment are based upon a prescribed Earthquake Hazard Level (BSE-1, BSE-2, BSE-R or BSE-C), a specified structural performance level (S-1 through S-5) and a non-structural performance level (N-A through N-E). The minimum seismic performance criteria are given in Table 3417.5 according to the Building Regulatory Authority and the Risk Category as determined in Chapter 16 or by the regulatory authority. The building shall be evaluated at both the Level 1 and Level 2 performance levels, and the more restrictive requirements shall apply.*

Basic Safety Earthquake 2 (BSE-2) in ASCE 41 shall be same as Risk-Targeted Maximum Considered Earthquake (MCE_R) in ASCE 7. Probabilistic response spectra defining other Earthquake Hazard Levels shall be developed using site-specific ground motions in accordance with ASCE 7 Section 21.2 utilizing the Next Generation Attenuation (NGA) relations used for the 2008 USGS seismic hazards maps for Western United States (WUS). When supported by data and analysis, other NGA relations, that were not used for the 2008 USGS maps, shall be permitted as additions or substitutions. No fewer than three NGA relations shall be utilized. Response spectra shall incorporate the risk coefficient C_R per ASCE 7 Section 21.2.1.1

Ground-motion response history analysis shall be as set forth in ASCE 7 Chapter 16, Section 17.3 or Section 18.2.3.

Exception: *If the floor area of an addition is greater than the larger of 50 per cent of the floor area of the original building or 1,000 square feet (93 m^2), then the Table 3417.5 entries for BSE-R and BSE-C are replaced by BSE-1 and BSE-2, respectively.*

3417.6 Retrofit required. *Where the evaluation indicates the building does not meet the required performance objectives of this section, the owner shall take appropriate steps to ensure that the building's structural system is retrofitted in accordance with the provisions of Section 3417. Appropriate steps are either: 1) undertake the seismic retrofit as part of the additions, modifications and/or repairs of the structure; or 2) provide a plan, acceptable to the building official, to complete the seismic retrofit in a timely manner. The relocation or moving of an existing building is considered to be an alteration requiring filing of the plans and specifications approved by the building official.*

3417.7 *The additions, modification or repair to any existing building are permitted to be prepared in accordance with the requirements for a new building, Chapter 16, Part 2, Title 24, C.C.R., 2013 edition, applied to the entire building.*

3417.8 *The requirements of ASCE 41 Chapter 9 are to apply to the use of seismic isolation or passive energy systems for the repair, modification or retrofit of an existing structure. When seismic isolation or passive energy dissipation is used, the project must have project peer review as prescribed in Section 3422.*

TABLE 3417.5
SEISMIC PERFORMANCE REQUIREMENTS BY BUILDING REGULATORY AUTHORITY AND RISK CATEGORY. ALL BUILDINGS NOT REGULATED BY DSA ARE ASSIGNED AS "STATE-OWNED."

		PERFORMANCE CRITERIA	
Building Regulatory Authority	Risk Category	Level 1	Level 2
State-Owned	I, II, III	BSE-R, S-3, N-D	BSE-C, S-5, N-E
State-Owned	IV	BSE-R, S-2, N-B	BSE-C, S-4, N-C
Division of the State Architect - Public schools	I	BSE-1, S-3, N-C	BSE-2, S-5, N-E
Division of the State Architect - Public schools	II, III	BSE-1, S-2, N-C	BSE-2, S-4, N-D
Division of the State Architect - Public schools	IV	BSE-1, S-2, N-C	BSE-2, S-4, N-C
Division of the State Architect - Community college	I, II, III	BSE-R, S-3, N-D	BSE-2, S-5, N-E
Division of the State Architect - Community college	IV	BSE-R, S-2, N-B	BSE-2, S-4, N-C

1. ASCE 41 provides acceptance criteria (e.g. m, rotation) for Immediate Occupancy (S1), Life Safety (S3), and Collapse Prevention (S5), and specifies that values for S-2 and S-4 are to be determined by interpolation between the adjacent performance level values.
   The required method of interpolation is as follows:
   For level S-2, the acceptance value is $^1/_3$ of the sum of the tabulated value for Immediate Occupancy (IO level) and twice the tabulated value for the Life Safety (LS level).
   For level S-4, the acceptance value is one-half the sum of the value for the LS level and the value for the Collapse Prevention (CP) level.
   For nonstructural components, N-A corresponds to the IO level, N-C to the LS level, and N-D to the Hazards Reduced (HR level).
   For evaluation procedures, N-B shall be the same as for N-A. Where numerical values are used, the values for N-B are one half the sum of the appropriate IO and LS values. Where IO or CP values are not given by ASCE 41, then the LS values are permitted to be substituted.
2. Buildings evaluated and retrofitted to meet the requirements for a new building, Chapter 16, Part 2, Title 24, in accordance with the exception in Section 3419.1, are deemed to meet the seismic performance requirements of this section.

3417.9 *Any construction required by this chapter shall include structural observation by the registered design professional who is responsible for the structural design in accordance with Section 3419.10.*

3417.10 *Where Method B of Section 3421 is used or is required by Section 3419.7, the proposed method of building evaluation and design procedures must be accepted by the building official prior to the commencement of the work.*

3417.11 Voluntary lateral-force-resisting system modifications. *Where the exception of Section 3417.2 applies, modifications of existing structural components and additions of new structural components that are initiated for the purpose of improving the seismic performance of an existing structure and that are not required by other portions of this chapter are permitted under the requirements of Section 3419.12.*

SECTION 3418
DEFINITIONS

3418.1. *In addition to the definitions given in Section 3402, for the purposes of Sections 3417 through 3423, certain terms are defined as follows:*

ADDITION *means any work that increases the floor or roof area or the volume of enclosed space of an existing building, and is structurally attached to the existing building by connections that are required for transmitting vertical or horizontal loads between the addition and the existing structure.*

ALTERATION *means any change within or to an existing building, which does not increase and may decrease the floor or roof area or the volume of enclosed space.*

BSE-C RESPONSE ACCELERATION PARAMETERS *are the parameters (S_{XS} and S_{X1}) taken from 5-percent/50-year maximum direction spectral response acceleration curves or by a Site Specific Response Spectrum developed in accordance with Section 3417.5. Values for BSE-C need not be greater than those for BSE-2.*

BSE-R RESPONSE ACCELERATION PARAMETERS *are the parameters (S_{XS} and S_{X1}) taken from 20-percent /50-year maximum direction spectral response acceleration curves or by a Site Specific Response Spectrum developed in accordance with Section 3417.5. Values for BSE-R need not be greater than those for BSE-1.*

BUILDING OFFICIAL *is that individual within the agency or organization charged with responsibility for compliance with the requirements of this code. For some agencies this person is termed the "enforcement agent."*

DESIGN *is the procedure that includes both the evaluation and retrofit design of an existing component, element or structural system, and design of a new component, element or structural system.*

ENFORCEMENT AGENCY (Authority Having Jurisdiction in ASCE 41) *is the agency or organization charged with responsibility for agency or organization compliance with the requirements of this code.*

METHOD A *refers to the procedures prescribed in Section 3420.*

METHOD B *refers to the procedures allowed in Section 3421.*

MODIFICATIONS. *For this chapter, modification is taken to include repairs to structures that have been damaged.*

N-A, N-B, N-C, N-D, N-E *are seismic nonstructural component performance measures as defined in ASCE 41. N-A corresponds to the highest performance level, and N-D the lowest, while N-E is not considered.*

PEER REVIEW *refers to the procedures contained in Section 3422.*

REPAIR *as used in this chapter means the design and construction work undertaken to restore or enhance the structural and nonstructural load-resisting system participating in the lateral response and stability of a structure that has experienced damage from earthquakes or other destructive events.*

S-1, S-2, S-3, S-4, S-5, S-6 *are seismic structural performance measures as defined in ASCE 41. S-1 corresponds to the highest performance level, and S-5 the lowest, while S-6 is not considered.*

SPECIFIC PROCEDURES *are the procedures listed in Section 3419.1.1.*

STRUCTURAL REPAIRS *are any changes affecting existing or requiring new structural components primarily intended to correct the effects of damage, deterioration or impending or actual failure, regardless of cause.*

SECTION 3419
SEISMIC CRITERIA SELECTION FOR EXISTING BUILDINGS

3419.1 Basis for evaluation and design. *This section determines what technical approach is to be used for the seismic evaluation and design for existing buildings. For those buildings or portions of buildings for which Section 3417 requires action, the procedures and limitations for the evaluation of existing buildings and design of retrofit systems and/or repair thereof shall be implemented in accordance with this section.*

One of the following approaches must be used:

1. *Method A of Section 3420;*
2. *Method B of Section 3421, with independent review of a peer reviewer as required in Section 3422; or*
3. *For state-owned buildings only, the use of one of the specific procedures listed in Section 3419.1.1.*

When Method B is chosen it must be approved by the building official, and, where applicable, by the peer reviewer. All referenced standards in ASCE 41 shall be replaced by referenced standards listed in Chapter 35 of this code.

Exception: [DSA-SS & DSA-SS/CC] *For public schools and community colleges constructed to the requirements of California Building Code, 2007 or later edition, that code is permitted to be used in place of those specifiec in Section 3419.1 provided the building complies with Seismic Design Category D or higher.*

3419.1.1 Specific procedures. *For state-owned buildings, the following specific procedures taken from the International Existing Building Code (IEBC) Appendix A may be used, without peer review, for their respective types of construction to comply with the seismic performance requirements for Risk Category I, II or III buildings:*

1. *Seismic Strengthening Provisions for Unreinforced Masonry Bearing Wall Buildings (Chapter A1 of the IEBC).*
2. *Prescriptive Provisions for Seismic Strengthening of Cripple Walls and Sill Plate Anchorage of Light Wood-Frame, Residential Buildings (Chapter A3 of the IEBC).*
3. *Earthquake Hazard Reduction in Existing Reinforced Concrete and Reinforced Masonry Wall Buildings with Flexible Diaphragms (Chapter A2 of the IEBC).*

3419.1.2 *When a design project is begun under Method B the selection of the peer reviewer is subject to the approval of the building official. Following approval by the peer reviewer, the seismic criteria for the project and the planned evaluation provisions must be approved by the building official. The approved seismic criteria and evaluation provisions shall apply. Upon approval of the building official these are permitted to be modified.*

3419.1.3 *For state-owned and community college buildings, where unreinforced masonry is not bearing, it may be used only to resist applied lateral loads. Where unreinforced masonry walls are part of the structure they must be assessed for stability under the applicable nonstructural evaluation procedure.*

3419.1.4 Public schools. *For public schools, unreinforced masonry shall not be used to resist in-plane or out-of-plane seismic forces or superimposed gravity loads.*

3419.1.5 Public schools. *For public schools of light-frame construction, horizontal diaphragms and vertical shear walls shall consist of either diagonal lumber sheathing or structural panel sheathing. Braced horizontal diaphragms may be acceptable when approved by DSA. Straight lumber sheathing may be used in combination with diagonal or structural panel sheathing as diaphragms or shear walls. Let-in bracing, plaster (stucco), hollow claytile, gypsum wallboard and particleboard sheathing shall not be assumed to resist seismic forces.*

3419.2 Existing conditions. *The existing condition and properties of the entire structure must be determined and documented by thorough inspection of the structure and site, review of all available related construction documents, review of geotechnical and engineering geologic reports, and performance of necessary testing and investigation. Where samples from the existing structure are taken or in situ tests are performed, they shall be selected and interpreted in a statistically appropriate manner to ensure that the properties determined and used in the evaluation or design are representative of the conditions and structural circumstances likely to be encountered in the structure as a whole. Adjacent structures or site features that may affect the retrofit design shall be identified.*

The entire load path of the seismic-force-resisting system shall be determined, documented and evaluated. The load path includes all the horizontal and vertical elements participating in the structural response: such as diaphragms, diaphragm chords, diaphragm collectors, vertical elements such as walls frames, braces; foundations and the connections between the components and elements of the load path. Repaired or retrofitted elements and the standards under which the work was constructed shall be identified.

Data collection in accordance with ASCE 41 Section 2.2 shall meet the following minimum levels:

1. *For state-owned buildings, the requirements shall be met following the data collection requirements of ASCE 41, Section 2.2.*
2. *For public schools and community college buildings constructed in conformance with the Field Act, the "Usual" level as defined in ASCE 41, Section 2.2.6.2.*
3. *For public schools and community college buildings not constructed in conformance with the Field Act, the "Comprehensive" level as defined in ASCE 41, Section 2.2.6.3.*

Concrete material requirements and testing for public school and community college buildings shall also comply with Sections 1914A and 1913.5, respectively.

Qualified test data from the original construction may be accepted, in part or in whole, by the enforcement agency to fulfill the data collection requirements.

Exceptions:

1. *The number of samples for data collection may be adjusted with approval of the enforcement agency when it has been determined that adequate information has been obtained or additional information is required.*
2. *Welded steel moment frame connections of buildings that may have experienced potentially damaging ground motions shall be inspected in accordance with Chapters 3 and 4, FEMA 352, Recommended Post Earthquake Evaluation and Repair Criteria for Welded Moment-Frame Construction for Seismic Applications (July 2000).*

Where original building plans and specifications are not available, "as-built" plans shall be prepared that depict the existing vertical and lateral structural systems, exterior elements, foundations and nonstructural systems in sufficient detail to complete the design.

Data collection shall be directed and observed by the project structural engineer or design professional in charge of the design.

3419.3 Site geology and soil characteristics. *Soil profile shall be assigned in accordance with the requirements of Chapter 18.*

3419.4 Risk categories. *For purposes of earthquake-resistant design, each structure shall be placed in one of the risk categories in accordance with the requirements of this code.*

3419.5 Configuration requirements. *Each structure shall be designated structurally regular or irregular in accordance with the requirements of ASCE 41, Sections 2.4.1.1.1. to 2.4.1.1.4.*

3419.6 General selection of the design method. *The requirements of Method B (Section 3421) may be used for any existing building.*

3419.7 Prescriptive selection of the design method. *The requirements of Method A (Section 3420) or the specific procedures for applicable building types given in Section 3419.1.1 are permitted to be used except under the following conditions, where the requirements of Method B (Section 3421) must be used.*

3419.7.1 *When the building contains prestressed or post-tensioned structural components (beams, columns, walls or slabs) or contains precast structural components (beams, columns, walls or flooring systems).*

3419.7.2 *When the building is classified as irregular in vertical or horizontal plan by application of ASCE/SEI 7, Section 12.3 and/or ASCE 41, Sections 2.4.1.1.1 to 2.4.1.1.4, unless the irregularity is demonstrated not to affect the seismic performance of the building.*

Exception: *If the retrofit design removes the configurational attributes that caused the building to be classified as irregular, then Section 3419.7.2 does not apply and Method A may be used.*

3419.7.3 *For any building that is assigned to Risk Category IV.*

3419.7.4 *For any building using undefined or hybrid structural systems.*

3419.7.5 *When seismic isolation or energy dissipation systems are used in the retrofit or repair, either as part of the existing structure or as part of the modifications.*

3419.7.6 *When the height of the structure exceeds 240 feet (73 152 mm).*

3419.8 Strength requirements. *All components of the lateral-force-resisting system must have the strength to meet the acceptance criteria prescribed in ASCE 41, Chapter 3, or as prescribed in the applicable Appendix A chapter of the IEBC if a specific procedure in Section 3419.1.1 is used. Any component not having this strength shall have its capacity increased by modifying or supplementing its strength so that it exceeds the demand, or the demand is reduced to less than the existing strength by making other modifications to the structural system.*

Exception: *A component's strength is permitted to be less than that required by the specified seismic load combinations if it can be demonstrated that the associated reduction in seismic performance of the component or its removal due to the failure does not result in a structural system that does not comply with the required performance objectives of Section 3417. If this exception is taken for a component, then it cannot be considered part of the primary lateral-load-resisting system.*

3419.9 Nonstructural component requirements. *Where the nonstructural performance levels required by Section 3417, Table 3417.5 are N-D or higher, mechanical, electrical and plumbing components shall comply with the provisions of ASCE 41, Chapter 11, Section 11.2.*

Exception: *Modifications to the procedures and criteria may be made subject to approval by the building official, and concurrence of the peer reviewer if applicable. All reports and correspondence shall also be forwarded to the building official.*

3419.10 Structural observation, testing and inspection. *Structural, geotechnical and construction observation, testing and inspection as used in this section shall mean meeting the requirements of Chapter 17, with a minimum allowable level of investigation corresponding to seismic design category (SDC) D. At a minimum the project site will be visited by the responsible design professional to observe existing conditions and to review the construction work for general compliance with approved plans, specifications and applicable structural regulations. Such visits shall occur at significant construction stages and at the completion of the structural retrofit. Structural observation shall be provided for all structures. The plan for testing and inspection shall be submitted to the building official for review and approval with the application for permit.*

Additional requirements: *For public schools and community colleges, construction material testing, inspection and observation during construction shall also comply with Section 4-333, Part 1, Title 24.*

3419.10.1 *The registered design professional, or their designee, responsible for the structural design shall be retained to perform structural observation and independently report to the owner of observations and findings as they relate to adherence to the permitted plans and good workmanship.*

3419.10.2 *At the conclusion of construction, the structural observer shall submit to the enforcement agency and the owner a final written statement that the required site visits have been made, that the work, to the best of the structural observers knowledge and belief, is or is not in general conformity to the approved plans and that the observed structural deficiencies have been resolved and/or listing those that, to the best of the structural observers knowledge and belief, have not been satisfactorily corrected.*

3419.10.2.1 *The requirement for structural observation shall be noted and prominently displayed on the front sheet of the approved plans and incorporated into the general notes on the approved plans.*

3419.10.2.2 Preconstruction meeting. *A preconstruction meeting is mandatory for all projects which require structural observation. The meeting shall include, but is not limited to, the registered design professional, structural observer, general constructor, affected subcontractors, the project inspector and a representative of the enforcement agency (designated alternates may attend if approved by the structural observer). The structural observer shall schedule and coordinate this meeting. The purpose of the meeting is to identify and clarify all essential structural components and connections that affect the lateral and vertical load systems and to review scheduling of the required observations for the project's structural system retrofit.*

3419.11 Temporary actions. *When compatible with the building use, and the time phasing for both use and the retrofit program, temporary shoring or other structural support is permitted to be considered. Temporary bracing, shoring and prevention of falling hazards are permitted to be used to qualify for Exception 1 in Section 3419.12 that allows inadequate capability in some existing components, as long as the required performance levels given in Section 3417 can be provided by the permanent structure. The consideration for such temporary actions shall be noted in the design documents.*

3419.12 Voluntary modifications to the lateral-force resisting system. *Where modifications of existing structural components and additions of new structural components are initiated for the purpose of improving the lateral-force resisting strength or stiffness of an existing structure and they are not required by other sections of this code, then they are permitted to be designed to meet an approved seismic performance criteria provided that an engineering analysis is submitted that follows:*

1. *The capacity of existing structural components required to resist forces is not reduced, unless it can be demonstrated that reduced capacity meets the requirements of Section 3419.8.*
2. *The lateral loading to or strength requirement of existing structural components is not increased beyond their capacity.*
3. *New structural components are detailed and connected to the existing structural components as required by this code for new construction.*
4. *New or relocated nonstructural components are detailed and connected to existing or new structural components as required by this code for new construction.*
5. *A dangerous condition is not created.*

3419.12.1 State-owned buildings. *Voluntary modifications to lateral-force-resisting systems conducted in accordance with Appendix A of the IEBC and the referenced standards of this code shall be permitted.*

3419.12.1.1 Design documents. *When Section 3419.12 is the basis for structural modifications, the approved design documents must clearly state the scope of the seismic modifications and the accepted criteria for the design. The approved design documents must clearly have the phrase "The seismic requirements of Chapter 34 for existing buildings have not been checked to determine if these structural modifications meet CBC requirements: the modifications proposed are to a different seismic performance standard* than *would be required in Section 3419 if they were not voluntary as allowed in Section 3419.12."*

3419.12.2 Public schools and community colleges. *When Section 3419.12 is the basis for structural modifications, the approved design documents must clearly indicate the scope of modifications and the acceptance criteria for the design.*

SECTION *3420*
METHOD A

3420.1 General. *The retrofit design shall employ the Linear Static or Linear Dynamic Procedures of ASCE 41, Section 3.3.1 or 3.3.2, and comply with the applicable general requirements of ASCE 41, Chapters 2 and 3. The earthquake hazard level and performance level given specified in Section 3417.5 for the building's risk category shall be used. Structures shall*

of the existing structure shall be brought into compliance with the requirements for new construction for flood design.

For buildings and structures in flood hazard areas established in Section *1612A.3*, any alterations that do not constitute substantial improvement of the existing structure, as defined in Section *1612A.2*, are not required to comply with the flood design requirements for new construction.

3404*A*.3 Existing structural elements carrying gravity load. Any existing gravity load-carrying structural element for which an alteration causes an increase in design gravity load of more than 5 percent shall be strengthened, supplemented, replaced or otherwise altered as needed to carry the increased gravity load required by this code for new structures. Any existing gravity load-carrying structural element whose gravity load-carrying capacity is decreased as part of the alteration shall be shown to have the capacity to resist the applicable design gravity loads required by this code for new structures.

3404*A*.3.1 Design live load. Where the alteration does not result in increased design live load, existing gravity load-carrying structural elements shall be permitted to be evaluated and designed for live loads approved prior to the alteration. If the approved live load is less than that required by Section *1607A*, the area designed for the nonconforming live load shall be posted with placards of approved design indicating the approved live load. Where the alteration does result in increased design live load, the live load required by Section *1607A* shall be used.

3404*A*.4 Existing structural elements carrying lateral load. Except as permitted by Section *3404A.5*, where the alteration increases design lateral loads in accordance with Section *1609A* or *1613A*, or where the alteration results in a structural irregularity as defined in ASCE 7, or where the alteration decreases the capacity of any existing lateral load-carrying structural element, the structure of the altered building or structure shall be shown to meet the requirements of Sections *1609A* and *1613A*.

Exceptions:

1. Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is no more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered. For purposes of calculating demand-capacity ratios, the demand shall consider applicable load combinations with design lateral loads or forces per Sections *1609A* and *1613A*. For purposes of this exception, comparisons of demand-capacity ratios and calculation of design lateral loads, forces, and capacities shall account for the cumulative effects of additions and alterations since original construction.
2. *For incidental alterations, drift limits based on original design code shall be permitted to be used in lieu of the drift limits required by ASCE 7.*

3404*A*.5 Voluntary seismic improvements. Alterations to existing structural elements or additions of new structural elements that are not otherwise required by this chapter and are initiated for the purpose of improving the performance of the seismic force-resisting system of an existing structure or the performance of seismic bracing or anchorage of existing nonstructural elements shall be permitted, provided that an engineering analysis is submitted demonstrating the following:

1. The altered structure, and the altered structural and nonstructural elements are no less in compliance with the provisions of this code with respect to earthquake design than they were prior to the alteration.
2. New structural elements are designed, detailed and connected to the existing structural elements as required by Chapter 16*A*. *Alterations of existing structural elements shall be based on design demand required by Chapter 16A but need not exceed the maximum load effect that can be transferred to the elements by the system.*

   Exception: *Seismic design in accordance with Sections 3411A and 3412A shall be permitted.*
3. New, relocated *or altered* nonstructural elements are designed, detailed and connected to existing or new structural elements as required by Chapter *16A*.
4. The alterations do not create a structural irregularity as defined in ASCE 7 or make an existing structural irregularity more severe.

3404*A*.6 Smoke alarms. Individual sleeping units and individual dwelling units in Group R and I-1 occupancies shall be provided with smoke alarms in accordance with Section 1103*A*.8 of the *California Fire Code.*

SECTION 3405A
REPAIRS

3405*A*.1 General. Buildings and structures, and parts thereof, shall be repaired in compliance with Section 3405*A* and 3401*A*.2. Work on nondamaged components that is necessary for the required repair of damaged components shall be considered part of the repair and shall not be subject to the requirements for alterations in this chapter. Routine maintenance required by Section 3401*A*.2, ordinary repairs exempt from permit in accordance with Section 105.2, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.

3405*A*.2 Substantial structural damage to vertical elements of the lateral force-resisting system. A building that has sustained substantial structural damage to the vertical elements of its lateral force-resisting system shall be evaluated and repaired in accordance with the applicable provisions of Sections *3405A.2.1* through *3405A.2.3*.

3405*A*.2.1 Evaluation. The building shall be evaluated by a registered design professional, and the evaluation findings shall be submitted to the building official. The evaluation shall establish whether the damaged building, if repaired to its pre-damage state, would comply with the provisions of this code for wind and earthquake loads.

Wind loads for this evaluation shall be those prescribed in Section *1609A.* Earthquake loads for this evaluation, if required, shall be permitted to be 75 percent of those prescribed in Section *1613A.*

3405*A*.2.2 Extent of repair for compliant buildings. If the evaluation establishes compliance of the pre-damage building in accordance with Section 3405*A*.2.1, then repairs shall be permitted that restore the building to its pre-damage state, based on material properties and design strengths applicable at the time of original construction.

3405*A*.2.3 Extent of repair for noncompliant buildings. If the evaluation does not establish compliance of the predamage building in accordance with Section *3405A.2.1,* then the building shall be rehabilitated to comply with applicable provisions of this code for load combinations, including wind or seismic loads. The wind loads for the repair shall be as required by the building code in effect at the time of original construction, unless the damage was caused by wind, in which case the wind loads shall be as required by the code in effect at the time of original construction or as required by this code. Earthquake loads for this rehabilitation design shall be those required for the design of the predamage building, but not less than *ninety* percent of those prescribed in Section *1613A.* New structural members and connections required by this rehabilitation design shall comply with the detailing provisions of this code for new buildings of similar structure, purpose and location.

3405*A*.3 Substantial structural damage to gravity load-carrying components. Gravity load-carrying components that have sustained substantial structural damage shall be rehabilitated to comply with the applicable provisions of this code for dead and live loads. Snow loads shall be considered if the substantial structural damage was caused by or related to snow load effects. Existing gravity load-carrying structural elements shall be permitted to be designed for live loads approved prior to the damage. Nondamaged gravity load-carrying components that receive dead, live or snow loads from rehabilitated components shall also be rehabilitated or shown to have the capacity to carry the design loads of the rehabilitation design. New structural members and connections required by this rehabilitation design shall comply with the detailing provisions of this code for new buildings of similar structure, purpose and location.

3405*A*.3.1 Lateral force-resisting elements. Regardless of the level of damage to vertical elements of the lateral force-resisting system, if substantial structural damage to gravity load-carrying components was caused primarily by wind or earthquake effects, then the building shall be evaluated in accordance with Section 3405*A*.2.1 and, if noncompliant, rehabilitated in accordance with Section 3405*A*.2.3.

3405*A*.4 Less than substantial structural damage. For damage less than substantial structural damage, repairs shall be allowed that restore the building to its pre-damage state, based on material properties and design strengths applicable at the time of original construction. New structural members and connections used for this repair shall comply with the detailing provisions of this code for new buildings of similar structure, purpose and location.

3405*A*.5 Flood hazard areas. For buildings and structures in flood hazard areas established in Section 1612*A*.3, any repair that constitutes substantial improvement of the existing structure, as defined in Section 1612*A*.2, shall comply with the flood design requirements for new construction, and all aspects of the existing structure shall be brought into compliance with the requirements for new construction for flood design.

For buildings and structures in flood hazard areas established in Section 1612*A*.3, any repairs that do not constitute substantial improvement or repair of substantial damage of the existing structure, as defined in Section 1612*A*.2, are not required to comply with the flood design requirements for new construction.

SECTION 3406A
FIRE ESCAPES

3406*A*.1 Where permitted. Fire escapes shall be permitted only as provided for in Sections 3406*A*.1.1 through 3406*A*.1.4.

3406*A*.1.1 New buildings. Fire escapes shall not constitute any part of the required means of egress in new buildings.

3406*A*.1.2 Existing fire escapes. Existing fire escapes shall be continued to be accepted as a component in the means of egress in existing buildings only.

3406*A*.1.3 New fire escapes. New fire escapes for existing buildings shall be permitted only where exterior stairs cannot be utilized due to lot lines limiting stair size or due to the sidewalks, alleys or roads at grade level. New fire escapes shall not incorporate ladders or access by windows.

3406*A*.1.4 Limitations. Fire escapes shall comply with this section and shall not constitute more than 50 percent of the required number of exits nor more than 50 percent of the required *exit* capacity.

3406*A*.2 Location. Where located on the front of the building and where projecting beyond the building line, the lowest landing shall not be less than 7 feet (2134 mm) or more than 12 feet (3658 mm) above grade, and shall be equipped with a counterbalanced stairway to the street. In alleyways and thoroughfares less than 30 feet (9144 mm) wide, the clearance under the lowest landing shall not be less than 12 feet (3658 mm).

3406*A*.3 Construction. The fire escape shall be designed to support a live load of 100 pounds per square foot (4788 Pa) and shall be constructed of steel or other approved noncombustible materials. Fire escapes constructed of wood not less than nominal 2 inches (51 mm) thick are permitted on buildings of Type V construction. Walkways and railings located over or supported by combustible roofs in buildings of Type III and IV construction are permitted to be of wood not less than nominal 2 inches (51 mm) thick.

3406*A*.4 Dimensions. Stairs shall be at least 22 inches (559 mm) wide with risers not more than, and treads not less than, 8 inches (203 mm) and landings at the foot of stairs not less than 40 inches (1016 mm) wide by 36 inches (914 mm) long, located not more than 8 inches (203 mm) below the door.

3406*A*.5 Opening protectives. Doors and windows along the fire escape shall be protected with $^3/_4$-hour opening protectives.

SECTION 3407A
GLASS REPLACEMENT

3407*A*.1 Conformance. The installation or replacement of glass shall be as required for new installations.

SECTION 3408*A*
CHANGE OF OCCUPANCY

3408*A*.1 Conformance. No change shall be made in the use or occupancy of any building that would place the building in a different division of the same group of occupancies or in a different group of occupancies, unless such building is made to comply with the requirements of this code for such division or group of occupancies. Subject to the approval of the building official, the use or occupancy of existing buildings shall be permitted to be changed and the building is allowed to be occupied for purposes in other groups without conforming to all the requirements of this code for those groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.

3408*A*.2 Certificate of occupancy. A certificate of occupancy shall be issued where it has been determined that the requirements for the new occupancy classification have been met.

3408*A*.3 Stairways. An existing stairway shall not be required to comply with the requirements of Section 1009 where the existing space and construction does not allow a reduction in pitch or slope.

3408*A*.4 Seismic. When a change of occupancy results in a structure being reclassified to a higher risk category, the structure shall conform to the seismic requirements for a new structure of the higher risk category.

Exception: Specific seismic detailing requirements of Section 1613*A* for a new structure shall not be required to be met where the seismic performance is shown to be equivalent to that of a new structure. A demonstration of equivalence shall consider the regularity, overstrength, redundancy and ductility of the structure.

SECTION 3409*A*
HISTORIC BUILDINGS

3409*A*.1 Historic buildings. The provisions of this code relating to the construction, repair, alteration, addition, restoration and movement of structures, and change of occupancy shall not be mandatory for historic buildings where such buildings are judged by the building official to not constitute a distinct life safety hazard.

3409*A*.2 Flood hazard areas. Within flood hazard areas established in accordance with Section 1612*A*.3, where the work proposed constitutes substantial improvement as defined in Section 1612*A*.2, the building shall be brought into compliance with Section 1612*A*.

Exception: Historic buildings that are:

1. Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places;
2. Determined by the Secretary of the U.S. Department of Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined to qualify as an historic district; or
3. Designated as historic under a state or local historic preservation program that is approved by the Department of Interior.

SECTION 3410*A*
MOVED STRUCTURES

3410*A*.1 Conformance. Structures moved into or within the jurisdiction shall comply with the provisions of this code for new structures.

SECTION 3411A
ADDITIONS, ALTERATIONS, REPAIRS AND SEISMIC RETROFIT TO EXISTING BUILDINGS OR STRUCTURES DESIGNED IN ACCORDANCE WITH PRE-1973 BUILDING CODE

3411A.1 General. *Provisions of this section shall apply to hospital buildings which were originally designed to pre-1973 building code and not designated as SPC 3 or higher in accordance with Chapter 6 of the California Administrative Code.*

3411A.1.1 Incidental and minor structural alterations, additions or repairs. *Incidental and minor structural additions shall be permitted provided the additions meet this code for new construction using importance factor, I, equal to or greater than 1.0. Alterations or repairs to the existing affected lateral load-resisting systems shall be made to conform to the requirements of Sections 3404A or 3405A respectively using importance factor, I, equal to or greater than 1.0.*

3411A.1.2 Major structural alteration, additions or repairs. *Major structural alterations, additions or repairs shall be in accordance with Section 3403A, 3404A or 3405A respectively.*

SECTION 3412*A*
COMPLIANCE ALTERNATIVES *FOR ADDITIONS, ALTERATIONS, REPAIRS AND SEISMIC RETROFIT TO EXISTING STRUCTURES*

3412A.1 Adoption of ASCE 41. *Except for the modifications as set forth in Sections 3412A and 3413A all additions, alterations, repairs and seismic retrofit to existing structures or portions thereof shall be permitted to be designed in accordance with the provisions of ASCE 41. For load combinations which do not include seismic forces, the new building code provisions of this code shall be applicable.*

3412A.1.1 ASCE 41 Section 1.4 – Rehabilitation Objectives. *Target building performance level shall be as follows:*

a. For general acute care hospitals along with all structures required for their continuous operation or access/egress – *Immediate Occupancy (IO) Structural Performance Level (S-1) as defined in Section 1.5.1.1 at Basic Safety Earthquake 1 (BSE-1) Seismic Hazard Level as defined in Section 1.6.1.2 and Collapse Prevention (CP) Structural performance level (S-5) per Section 1.5.1.5 at Basic Safety Earthquake 2 (BSE-2) Seismic Hazard Level as defined in Section 1.6.1.1. The nonstructural performance level shall satisfy the requirements of this code for new hospital buildings.*

Exceptions: *Buildings satisfying requirements of Sections 3411A or 3412A.2.*

b. For pre-1973 buildings which will not be used for general acute care services after January 1, 2030 – *Basic Safety Objective (BSO) Level as defined in Section 1.4.1. BSO level includes Life Safety Building Performance (3-C) Level as defined in Section 1.5.3.3 at the Basic Safety Earthquake 1 (BSE-1) Seismic Hazard Level as defined in section 1.6.1.2 and Collapse Prevention (CP) building performance level (5-E) per Section 1.5.3.4 at the Basic Safety Earthquake 2 (BSE-2) Seismic Hazard Level as defined in Section 1.6.1.1.*

Exceptions: *Buildings satisfying requirements of Sections 3411A or 3412A.2.*

c. All others – *Immediate Occupancy (IO) Building Performance Level of (1-B) as defined in Section 1.5.3.2 at Basic Safety Earthquake 1 (BSE-1) Seismic Hazard Level as defined in Section 1.6.1.2 and Collapse Prevention (CP) building performance level (5-E) per Section 1.5.3.4 at Basic Safety Earthquake 2 (BSE-2) Seismic Hazard Level as defined in Section 1.6.1.1.*

3412A.1.2 Material testing required*. Use of material properties based on historical information as default values shall not be permitted.*

3412A.1.3 Analysis procedure. *The selection of a particular analysis procedure from ASCE 41 shall be subject to the approval of the enforcement agent.*

3412A.1.4 Structural design criteria. *Prior to implementation of ASCE 41 Nonlinear Dynamic Procedure, the ground motion, analysis and design methods, material assumptions and acceptance criteria proposed by the engineer shall be reviewed by the enforcement agent.*

3412A.1.5 Structural observation, testing and inspections. *Construction, testing, inspection and structural observation requirements shall be as required for new construction.*

3412A.2 Seismic evaluation and retrofit of general acute care hospitals. *Not withstanding any other requirements of this code, existing general acute care hospitals shall comply with the seismic evaluation requirements specified in Chapter 6, of the California Administrative Code, when applicable. Seismic retrofit to comply with requirements specified in Chapter 6 of the California Administrative Code shall be permitted to be in accordance with this section. For load combinations that do not include seismic forces, the new building provisions of this code shall be applicable.*

3412A.2.1 SPC 5 and NPC 4/NPC 5. *Structures and nonstructural components and systems satisfying the requirements of this code for new buildings for Risk Category IV shall be considered to satisfy the requirements of SPC 5 and NPC 4. NPC 4 buildings satisfying operational requirements for NPC 5 of Table 11.1, Chapter 6, of the California Administrative Code, shall be placed in nonstructural performance category NPC 5.*

New general acute care hospitals and new building(s), larger than 4000 sq ft, required for general acute care services designed to requirements of this code shall be considered to satisfy the requirements of SPC 5 and NPC 5.

3412A.2.2 SPC 5 using ASCE 41. *Structures satisfying the requirements of immediate occupancy structural performance level (S-1) in accordance with Section 1.5.1.1 of ASCE 41 at BSE-1, Collapse prevention performance level S-5 in accordance with Section 1.5.1.5 of ASCE 41 at BSE-2 and items identified in Chapter 6, Article 10 of the California Administrative Code, satisfying the requirements of Immediate Occupancy Nonstructural performance level (N-B) per Section 1.5.2.2 of ASCE 41 at BSE-1 shall be considered to comply with SPC 5 requirements of Table 2.5.3, Chapter 6, of the California Administrative Code.*

3412A.2.3 SPC 2 using ASCE 41. *Structures satisfying the requirements of life safety structural performance level (S-3) per Section 1.5.1.3 of ASCE 41 at BSE-1 and items identified in Chapter 6, Article 10, of the California Administrative Code satisfying the requirements of life safety nonstructural performance level (N-C) per Section 1.5.2.3 of ASCE 41 at BSE-1, shall be considered to comply with SPC 2 requirements of Table 2.5.3, Chapter 6, of the California Administrative Code.*

3412A.2.4 NPC. *Nonstructural components for immediate occupancy nonstructural performance level (N-B) in Section 1.5.2.2 shall meet the requirements of this code for new buildings. Nonstructural components for operational nonstructural performance level (NPC-5) in Section 1.5.2.1 shall meet performance level N-B and Section 3413A.1.30. Building satisfying the requirements of nonstructural performance level NPC and N-B as described in this section shall be considered to satisfy the requirements of NPC 5 & NPC 4 of Table 11.1, Chapter 6, of the California Administrative Code, respectively.*

Immediate occupancy nonstructural performance level (N-B) in Section 1.5.2.2 and life safety nonstructural performance level (N-C) in Section 1.5.2.3 of ASCE 41 at BSE-1 shall be considered equivalent to NPC 3/NPC 2 and NPC 3R requirements respectively of Table 11.1, Chapter 6, of the California Administrative Code. For NPC 3/NPC 3R/NPC 2, only components listed in Table 11.1, Chapter 6, of the California Administrative Code for NPC 3/NPC 3R/NPC 2 need to satisfy the requirements specified above.

Exceptions:

1) *Evaluation procedure in Article 11, Chapter 6, of the California Administrative Code shall be used for seismic evaluation of NPC 2, NPC 3/NPC 3R, NPC 4 and NPC 5, where specific procedure is not outlined in ASCE 41. Administrative and permitting provisions outlined in Article 11, Chapter 6, of the California Administrative Code shall apply.*
2) *Anchorage and bracing of nonstructural components in buildings in seismic performance categories SPC 1 and SPC 2 with a performance level of NPC 3R shall be permitted to comply with the provisions of Section 1630A of the 1995 California Building Code using an importance factor I_p =1.0. The capacity of welds, anchors and fasteners shall be determined in accordance with requirements of this code.*
3) *Anchorage and bracing of nonstructural components in buildings in seismic performance categories SPC 1 or SPC 2 with a performance level of NPC 3 or higher, and SPC 3 or SPC 4, shall be permitted to comply with the provisions of Section 1630B of the 1998 California Building Code using an importance factor I_p =1.5. The capacity of welds, anchors and fasteners shall be determined in accordance with requirements of this code.*

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. Increases in F_p due to anchorage conditions (for example shallow anchors) need not be considered. For NPC 3R, the adequacy of load path for nonstructural elements need only be verified when the total reaction at the point of support (including the application of F_p) exceeds the following limits:

1. *250 pounds for components or equipment attached to light frame walls. For the purposes of this requirement, the sum of the absolute value of all reactions due to component loads on a single stud shall not exceed 250 pounds.*
2. *1,000 pounds for components or equipment attached to roofs, or walls of reinforced concrete or masonry construction.*
3. *2,000 pounds for components or equipment attached to floors or slabs-on-grade.*

Exception: *If the anchorage or bracing is configured in a manner that results in significant torsion on a supporting structural element, the effects of the nonstructural reaction force on the structural element shall be considered in the anchorage design.*

SECTION 3413A
MODIFICATIONS TO ASCE 41

3413A.1 General. *The text of ASCE 41 shall be modified as indicated in Sections 3413A.1.1 through 3413A.1.32.*

3413A.1.1 ASCE 41 Section 1.1. *Modify ASCE 41 Section 1.1 with the following:*

Seismic evaluations shall be performed using procedure and criteria of ASCE 41 except for general acute care hospitals, which shall be evaluated per Chapter 6, of the California Administrative Code. when required per provisions of that chapter.

3413A.1.2 ASCE 41 Section 1.6 Seismic Hazard. *Modify ASCE 41 Section 1.6 with the following:*

Response spectra and acceleration time histories shall be constructed in accordance with Sections 1613A, 1616A, and 1803A.6. Basic Safety Earthquake 2 (BSE-2) in ASCE 41 shall be same as Maximum Considered Earthquake (MCE) in ASCE 7. Basic Safety Earthquake 1 (BSE-1) shall be two-thirds of BSE-2.

3413A.1.3 ASCE 41 Section 2.2.6. *Modify ASCE 41 Section 2.2.6 with the following:*

Data collection requirements. *The extent of data collection shall be at Comprehensive level for all structures except that data collection at Usual level shall be permitted for structures with BSO or lower target performance objective. Materials properties testing program shall be pre-approved by the enforcement agent.*

Tension testing of reinforcing bars shall be in accordance with ASTM A 370 Annex A9. All test specimens shall be the full section of the bar as rolled (8-in. gage length) and shall not be reduced.

Structural members, slabs and walls shall be repaired equivalent to their original condition at test sample locations.

For buildings, built under an OSHPD permit based on the 1976 or later edition of the CBC, where materials properties are shown on design drawings and original materials test data are available, no materials testing shall be required when approved by the enforcement agent.

3413A.1.4 ASCE 41 Section 2.4.1.1. *Modify ASCE 41 Section 2.4.1.1 with the following:*

1. *If one or more component DCRs exceed 1.5 for the Immediate Occupancy Structural Performance Level (S-1) or 2.0 for the Life Safety Structural Performance level (S-3) and any irregularity described in Section 2.4.1.1.1 through 2.4.1.1.4 is present, then linear procedures are not applicable and shall not be used.*
2. *Linear procedures are not applicable to moment resisting frames where plastic hinges do not form in either the beam at the face of column or in the column panel zone.*

3413A.1.5 ASCE 41 Section 2.4.2.1. *Modify ASCE 41 Section 2.4.2.1 with the following:*

Nonlinear static procedure. *If higher mode effects are significant and building is taller than 75 feet above the base, the Nonlinear Dynamic Procedure shall be used.*

3413A.1.6 ASCE 41 Section 2.4.4.5. *Modify ASCE 41 Section 2.4.4.5 by the following:*

Material properties. *Expected material properties are not permitted to be determined by multiplying lower bound values by the assumed factors specified in Chapters 5 through 8.*

3413A.1.7 ASCE 41 Section 3.2.10.1. *Modify ASCE 41 Section 3.2.10.1 with the following:*

Linear procedures. *Equation 3-5 is not permitted by OSHPD.*

3413A.1.8 ASCE 41 Section 3.3.1.3.5. *Replace ASCE 41 Section 3.3.1.3.5 as follows:*

Unreinforced masonry buildings. *Unreinforced Masonry not permitted by OSHPD.*

3413A.1.9 ASCE 41 Section 3.3.3.2.2. *Modify ASCE 41 Section 3.3.3.2.2 with the following:*

Simplified NSP Analysis. *Not permitted by OSHPD.*

3413A.1.10 ASCE 41 Section 3.4.2.2. *Modify ASCE 41 Section 3.4.2.2 with the following:*

Acceptance criteria for linear procedures – drift limitations. *The interstory drift ratio shall not exceed the drift limits for Risk Category IV buildings in ASCE 7 Table 12.12-1 due to forces corresponding to BSE-1, except that buildings designed to BSO or lower performance levels are permitted to meet the drift limits for Risk Category II buildings. For dual systems, the least interstory drift ratio shall control.*

Exception: *Larger interstory drift ratios shall be permitted where justified by rational analysis that both structural and nonstructural elements can tolerate such drift and approved by the enforcement agent.*

3413A.1.11 ASCE 41 Section 3.4.3.2.1. *Modify ASCE 41 Section 3.4.3.2.1 with the following:*

Deformation-controlled actions. *For any building required to meet the Operational Building Performance level, 1-A or Immediate Occupancy Building Performance Level, 1-B, primary components shall be within the acceptance criteria for primary components and secondary components shall be within the acceptance criteria for secondary components.*

3413A.1.12 ASCE 41 Section 4.4. *Modify ASCE 41 Section 4.4 with the followings:*

Foundation strength and stiffness. *Foundation and soil strength shall be used to evaluate potential overturning, uplift and sliding for fixed base assumptions, and stiffness for flexible base assumptions, including deformations associated with those actions.*

3413A.1.13 ASCE 41 Section 4.4.1.1. *Replace ASCE 41 Section 4.4.1.1 as follows:*

Presumptive capacities. *Not permitted by OSHPD.*

3413A.1.14 ASCE 41 Section 4.4.1.2. *Replace ASCE 41 Section 4.4.1.2 as follows:*

Prescriptive expected capacities. *Not permitted by OSHPD.*

3413A.1.15 ASCE 41 Section 4.4.3.2.2. *Modify ASCE 41 Section 4.4.3.2.2 with the following:*

Flexible base assumption. *The soil strength shall be evaluated.*

3413A.1.16 ASCE 41 Section 4.5. *Modify ASCE 41 Section 4.5 with the following:*

Seismic earth pressure. *Where the grade difference from one side of the building to another exceeds one-half story height, the seismic increment of earth pressure shall be added to the gravity lateral earth pressure to evaluate the building overturning and sliding stability and the lateral force resisting system below grade in combination with the building seismic forces.*

3413A.1.17 ASCE 41 Table 5.6. *Modify ASCE 41 Table 5.6 with the following:*

Acceptance criteria for nonlinear procedures—structural steel components. *For fully and partially restrained moment connections designed to 1989 or prior edition of the California Building Code shall be verified for the presence of welds using E70T-4 electrodes or other electrodes with equivalent aluminum content. Where E70T-4 or equivalent electrodes are present, the plastic rotation angles and residual strength ratios used shall be substantiated by the statistical analysis of three or more applicable cyclic test results subject to the approval of the enforcement agent.*

3413A.1.18 ASCE 41 Section 6.7.1.1. *Modify ASCE 41 Section 6.7.1.1 with the following:*

Monolithic reinforced concrete shear walls and wall segments. *For nonlinear procedures, shear walls or wall segments with axial loads greater than 0.35 P_o shall be included in the model as primary elements with appropriate strength and stiffness degrading properties assigned to those components subject to the approval of the enforcement agent. For linear procedures, the effects of deformation compatibility shall be investigated using moment-curvature section analyses and cyclic testing*

results of similar components to determine whether strengthening is necessary to maintain the gravity load carrying capacity of that component.

Horizontal wall segments or spandrels reinforced similar to vertical wall segments or piers shall be classified as wall segments, not shear wall coupling beams, in Tables 6-18 through 6-21.

3413A.1.19 ASCE 41 Section 7.3.2. *Replace ASCE 41 Section 7.3.2 as follows:*

Unreinforced masonry walls and piers in-plane. *Not permitted by OSHPD.*

3413A.1.20 ASCE 41 Section 7.3.3. *Replace ASCE 41 Section 7.3.3 as follows:*

Unreinforced masonry walls out-of-plane. *Not permitted by OSHPD.*

3413A.1.21 ASCE 41 7.3.4.2.2 Shear strength of walls and piers. *Modify ASCE 41 Section 7.3.4.2.2 with the following:*

The spacing of shear reinforcing, S, shall be less than or equal to the wall pier clear height divided by 2 or the story height divided by 2, whichever is smaller.

3413A.1.22 ASCE 41 Section 9.2.4. *Modify ASCE 41 Section 9.2.4 with the following:*

Linear procedures. *Verification of the interstory lateral displacements, isolator displacements, the strength adequacy of the seismic force resisting system and isolation system, and anchorage to the foundation shall be accomplished using the nonlinear dynamic procedure.*

3413A.1.23 ASCE 41 Section 9.2.5.1. *Modify ASCE 41 Section 9.2.5.1 with the following:*

Nonlinear static procedure. *Verification of the interstory lateral displacements, isolator displacements, the strength adequacy of the seismic force resisting system and isolation system, and anchorage to the foundation shall be accomplished using the nonlinear dynamic procedure.*

3413A.1.24 *Reserved.*

3413A.1.25 *Reserved.*

3413A.1.26 ASCE 41 Section 9.3.4. *Modify ASCE 41 Section 9.3.4 with the following:*

Linear Procedures. *Verification of the interstory lateral displacements, damper relative velocities and displacements, the strength adequacy of the seismic force resisting system and damping system, and anchorage to the foundation shall be accomplished using the nonlinear dynamic procedure.*

3413A.1.27 ASCE 41 Section 9.3.5.1. *Modify ASCE 41 Section 9.3.5.1 with the following:*

Nonlinear static procedure. *Verification of the interstory lateral displacements, damper relative velocities and displacements, the strength adequacy of the seismic force resisting system and damping system, and anchorage to the foundation shall be accomplished using the nonlinear dynamic procedure.*

3413A.1.28 *Reserved.*

3413A.1.29 ASCE 41 Chapter 10. *Replace ASCE 41 Chapter 10 as follows:*

Simplified rehabilitation. *Not permitted by OSHPD.*

3413A.1.30 ASCE 41 Section 11.3.2. *Modify ASCE 41 Section 11.3.2 with the following:*

Operational nonstructural performance level (NPC-5) requirements. *All Structures shall meet immediate occupancy nonstructural performance level (N-B) and facility shall have on-site supplies of water and holding tanks for sewage and liquid waste, sufficient to support 72 hours emergency operations, are integrated into the building plumbing systems in accordance with the California Plumbing Code. An on-site emergency system as defined in the California Electrical Code is incorporated into the building electrical system for critical care areas. Additionally, the system shall provide for radiological service and an onsite fuel supply for 72 hours of acute care operation.*

3413A.1.31 ASCE 41 Section 11.9.4.3.1. *Modify ASCE 41 Section 11.9.4.3.1 with the following:*

Ceilings in all categories shall satisfy requirements for ceilings in Category C specified in this section.

3413A.1.32 ASCE 41 Section 11.10.2.4. *Modify ASCE 41 Section 11.10.2.4 by the following:*

For general acute care hospital, nonstructural evaluation shall comply with requirements of Section 11.2, Chapter 6 of the California Administrative Code.

SECTION 3414A
PEER REVIEW REQUIREMENTS

3414A.1 General. *Independent peer review is an objective technical review by knowledgeable reviewer(s) experienced in structural design, analysis and performance issues involved. The reviewer(s) shall examine the available information on the condition of building, basic engineering concept employed and recommendations for action.*

3414A.2 Timing of independent review. *The independent reviewer (s) shall be selected prior to initiation of substantial portion of the design and analysis work that is to be reviewed, and review shall start as soon as practical and sufficient information defining the project is available.*

3414A.3 Qualifications and terms of employment. *The reviewer shall be independent from the design and construction team.*

3414A.3.1 *The reviewer(s) shall have no other involvement in the project before, during or after the review, except in a review capacity.*

3414A.3.2 *The reviewer shall be selected and paid by owner and shall have technical expertise in repair of buildings similar to the one being reviewed, as determined by enforcement agent.*

3414A.3.3 *The reviewer (in case of review team, the chair) shall be a California-licensed structural engineer who is*

familiar with technical issues and regulations governing the work to be reviewed.

3414A.3.4 *The reviewer shall serve through completion of the project and shall not be terminated except for failure to perform the duties specified herein. Such termination shall be in writing with copies to enforcement agent, owner, and the engineer of record. When a reviewer is terminated or resigns, a qualified replacement shall be appointed within 10 working days.*

3414A.4 Scope of review. *Review activities shall include, where appropriate, available construction documents, design criteria, observation of the condition of structure, all new and original inspection reports, including methods of sampling, analyses prepared by the engineer of record and consultants, and the retrofit or repair design. Review shall include consideration of the proposed design approach, method, materials and details.*

3414A.5 Reports. *The reviewer(s) shall prepare a written report to the owner and responsible enforcement agent that covers all aspect of the review performed including conclusions reached by the reviewer. Report shall be issued after the schematic phase, during design development, and at the completion of construction documents, but prior to their issuance of permit. Such report shall include, at the minimum, statement of the following.*

1. *Scope of engineering design peer review with limitations defined.*
2. *The status of the project documents at each review stage.*
3. *Ability of selected materials and framing systems to meet the performance criteria with given loads and configuration.*
4. *Degree of structural system redundancy and the deformation compatibility among structural and nonstructural elements.*
5. *Basic constructability of the retrofit or repair system.*
6. *Other recommendation that will be appropriate for the specific project.*
7. *Presentation of the conclusions of the reviewer identifying any areas that need further review, investigation and/or clarification.*
8. *Recommendations.*

3414A.6 Responses and corrective actions. *The engineer of record shall review the report from the reviewer(s) and shall develop corrective actions and other responses as appropriate. Changes observed during construction that affect the seismic-resisting system shall be reported to the reviewer in writing for review and recommendations. All reports, responses and corrective actions prepared pursuant to this section shall be submitted to the responsible enforcement agent and the owner along with other plans, specifications and calculations required. If the reviewer resigns or is terminated by the owner prior to completion of the project, then the reviewer shall submit copies of all reports, notes, and the correspondence to the responsible enforcement agent, the owner, and the engineer of record within 10 working days of such termination.*

SECTION 3415A
EARTHQUAKE MONITORING INSTRUMENTS FOR EXISTING BUILDINGS

3415A.1 Earthquake recording instrumentation of existing buildings. *All owners of existing structures, selected by the enforcement agency for the installation of earthquake-recording instruments, shall provide space for the installation and access to such instruments. Location of said instruments shall be determined by the enforcement agency. The enforcement agency shall make arrangements to provide, maintain, and service the instruments. Data shall be the property of the enforcement agency, but copies of individual records shall be made available to the public on request and the payment of an appropriate fee.*

SECTION 3416A
COMPLIANCE ALTERNATIVES FOR SERVICES/SYSTEMS AND UTILITIES

3416A.1 General. *The provisions of this section are intended to maintain or increase the current degree of public safety, health and general welfare in existing buildings while permitting repair, alteration, addition and change of occupancy without requiring full compliance with Chapters 2 through 33, or Sections 3401A.3, and 3403A through 3408A, except where compliance with other provisions of this code is specifically required in this section.*

Services/systems and utilities that originate in and pass through or under buildings and are necessary to the operation of an acute care hospital, skilled nursing facility, intermediate care facility or correctional treatment center shall meet the structural requirements of this section. Examples of services/systems and utilities include but are not limited to normal power; emergency power; nurse call; fire alarm; communication and data systems; space-heating systems; process load systems; cooling systems; domestic hot and cold water systems; means of egress systems; fire-suppression systems; building drain and sewer systems; and medical gas systems that support basic and supplemental services.

After January 1, 2030, services/systems and utilities for acute care hospital buildings shall not originate in or pass through or under a nonhospital or Hospital building unless it has approved performance categories of SPC-3 or higher and NPC-5.

3416A.1.1 Services/systems and utilities. *Services/systems and utilities that are necessary to the operation of an acute care hospital, skilled nursing facility, intermediate care facility, or correctional treatment center shall meet the structural requirements of this section, based upon the approved Structural Performance Category (SPC) of the building receiving the services/systems and utilities.*

Services from an acute care hospital, skilled nursing facility or a correctional treatment center shall be permitted to serve a nonconforming building with prior approval of the Office. The services/systems and utilities in the nonconforming building shall be equipped with fail safe valves, switches or other equivalent devices that allow the nonconforming building to be isolated from the acute care hospital buildings.

Exception: *Remodel projects that use available existing services/systems and utilities are exempted from the requirements of this section. The enforcing agency shall be permitted to exempt minor addition, minor alteration, and minor remodel projects and projects to upgrade existing services/systems and utilities from the requirements of this section.*

3416A.1.1.1 Services/systems and utilities for hospital buildings.

3416A.1.1.1.1 New buildings, additions, alterations, and remodels of conforming (SPC-3, -4, or -5) hospital buildings. *Services/systems and utilities for new buildings and additions, and alterations or remodels to existing conforming buildings shall originate in hospital buildings that have approved performance categories of SPC-3 or higher and NPC-4 or higher. The services/systems and utilities shall not pass through or under buildings that do not have approved performance categories of SPC-2 or higher and NPC-4 or higher.*

Exception: *Services/systems and utilities shall be permitted to pass through or under buildings that have approved nonstructural performance categories of NPC-3 or higher or NPC-2, provided that the building has an approved extension to the NPC-3 deadline. The services/systems and utilities feeding the new building addition, alteration, or remodel shall conform to the new building provisions of this code and shall be deemed by OSHPD to be free of adverse seismic interactions caused by potential failure of overhead or adjacent components.*

3416A.1.1.1.2 Additions, alterations, and remodels of SPC-2 hospital buildings. *Services/systems and utilities for additions, alterations, or remodels of SPC-2 hospital buildings shall be permitted to originate in and pass through or under SPC-2 or higher buildings that have an approved nonstructural performance category of NPC-3 or higher.*

Exception: *Services/systems and utilities shall be permitted to pass through or under buildings that have approved nonstructural performance categories of NPC-2, provided that the building has an approved extension to the NPC-3 deadline. Services/systems and utilities feeding the addition, alteration or remodel shall conform to the nonstructural bracing requirements for new buildings.*

3416A.1.1.1.3 Alterations and remodels of SPC-1 hospital buildings. *Services/systems and utilities for alterations or remodels of SPC-1 hospital buildings shall be permitted to originate in and pass through or under SPC-1 or higher buildings that have an approved nonstructural performance category of NPC-2 or higher.*

3416A.1.1.1.4 Buildings without SPC/NPC ratings. *When services/systems and utilities for new buildings, additions, alterations, or remodels pass through or under hospital buildings which would not otherwise require evaluation for an SPC rating, such buildings shall be evaluated in accordance with the requirements of Section 1.3, Chapter 6, California Administrative Code, to determine the appropriate ratings, or shall be shown to meet the structural requirements of these regulations for new hospital buildings. The services/systems and utilities feeding the new building addition, alteration, or remodel shall conform with new building provisions of this code and shall be deemed by OSHPD to be free of adverse seismic interactions caused by potential failure of overhead or adjacent components.*

3416A.1.1.1.5 Buildings removed from acute-care hospital service. *Services/systems and utilities for conforming acute care hospital buildings shall be permitted to pass through or under a building that has been removed from acute care hospital service until January 1, 2030 if the building removed from service meets the performance requirements of Section 3416A.1.1.1.1. Services/systems and utilities for nonconforming acute care hospital buildings shall be permitted to pass through or under a building that has been removed from acute care hospital service only if the building removed from service and meets the performance requirements of Section 3416A.1.1.1.2.*

3416A.1.1.2 Services/systems and utilities for skilled nursing facilities, intermediate care facilities, and correctional treatment centers.

3416A.1.1.2.1 New buildings and additions. *Services/systems and utilities for new buildings and additions shall not originate in or pass through or under nonconforming structures.*

Exception: *As an alternate to this section, skilled nursing and intermediate care facilities, and correctional treatment centers shall be permitted to meet the requirements in Section 3416A.1.1.1 for hospital buildings.*

3416A.1.1.2.2 Alterations and remodels. *Services/systems and utilities for alterations or remodels of existing buildings shall be permitted to pass through nonconforming structures, provided the new services/systems and utilities passing through the buildings are anchored and braced for seismic forces in accordance with these regulations for new buildings and are free of adverse seismic interactions caused by potential failure of overhead or adjacent components.*

3416A.1.2 Jurisdiction. *Services/systems and utilities for hospitals, skilled nursing facilities and intermediate-care facilities shall originate in and only pass through or under buildings that are under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD).*

SECTION 3417A
COMPLIANCE ALTERNATIVES FOR MEANS OF EGRESS

3417A.1 General. *Means of egress through existing buildings shall be in accordance with Chapter 10 except as modified in this section.*

3417A.1.1 Means of egress for hospitals, skilled nursing facilities, intermediate care facilities and correctional treatment centers. *Means of egress for acute care hospitals, skilled nursing facilities, intermediate care facilities and correctional treatment centers shall comply with the requirements of Sections 3417A.1.1.1 and 3417A.1.1.2.*

Exception: *The enforcing agency shall be permitted to exempt minor additions, minor alterations and minor remodel projects from these requirements.*

3417A.1.1.1 Means of egress for hospital buildings. *Means of egress for hospital buildings shall comply with the requirements of Sections 3417A.1.1.1.1 through 3417A.1.1.1.6.*

3417A.1.1.1.1 New and existing conforming hospital buildings. *Means of egress for new hospital buildings and additions to existing conforming hospital buildings shall only pass through buildings that comply with the requirements of SPC-3 or higher and NPC-4 or higher.*

Exception: *Existing means of egress that pass through hospital buildings that have approved nonstructural performance categories NPC-3, or NPC-2, if the building has an approved extension to the NPC-3 deadline, shall be permitted to remain for the duration of extension. The nonstructural components in the path of egress shall be braced in accordance with the new building provisions of this code.*

3417A.1.1.1.2 Existing SPC-2 hospital buildings. *Means of egress for additions to existing SPC-2 hospital buildings shall only pass through hospital buildings that have OSHPD-approved performance categories of SPC-2 or higher and NPC-4 or higher.*

Exception: *The means of egress shall be permitted to pass through hospital buildings that have approved nonstructural performance categories of NPC-3, or NPC-2 if the building has an approved extension to the NPC-3 deadline. Nonstructural components in the path of egress shall be braced in accordance with the new building provisions of this code.*

3417A.1.1.1.3 Existing SPC-3 or higher hospital buildings. *Means of egress for remodels of existing SPC-3 or higher hospital buildings shall only pass through hospital buildings that have approved performance categories of SPC-2 or higher and NPC-4 or higher.*

Exception: *The means of egress shall be permitted to pass through hospital buildings that have approved nonstructural performance categories of NPC-3, or NPC-2 if the building has an approved extension to the NPC-3 deadline. Nonstructural components in the path of egress shall be braced in accordance with the new building provisions of this code.*

3417A.1.1.1.4 Existing SPC-1 hospital buildings. *Means of egress for remodels of existing SPC-1 hospital buildings shall only pass through hospital buildings that have approved performance categories of SPC-1 or higher and NPC-2 or higher.*

Exception: *Means of egress for acute care service spaces for hospitals licensed pursuant to subdivision (a) of Section 1250 of the Health and Safety Code shall comply with the requirements of Section 3417A.1.1.1.2.*

3417A.1.1.1.5 Other nonconforming hospital buildings. *Hospital buildings that would not otherwise require evaluation for an SPC rating, which are used as a part of the means of egress for acute care hospitals, shall be evaluated in accordance with the requirements of Section 1.3, Chapter 6, of the California Administrative Code to determine the appropriate rating, or shall meet the structural requirements of these regulations for conforming hospital buildings. Means of egress shall be in accordance with the requirements of Sections 3417A.1.1.1.1 through 3417A.1.1.1.4.*

3417A.1.1.1.6 Buildings removed from hospital service. *The means of egress for acute care hospitals shall be permitted to pass through buildings that are removed from hospital service only if the buildings remain under the jurisdiction of OSHPD, and only until January 1, 2030, subject to the following:*

1. *Egress for conforming hospital buildings shall be permitted to pass through buildings that have been removed from acute care hospital service that comply with the requirements of Section 3417A.1.1.1.1 or 3417A.1.1.1.3.*
2. *Egress for nonconforming hospital buildings shall be permitted to pass through buildings that have been removed from acute care hospital service that comply with the requirements of Section 3417A.1.1.1.2 or 3417A.1.1.1.4.*

After January 1, 2030, the means of egress for acute care hospital buildings shall only pass through hospital buildings that have approved performance categories of SPC-3 or higher and NPC-5.

3417A.1.1.2 Means of egress for skilled nursing facilities, intermediate care facilities and correctional treatment centers. *Means of egress for skilled nursing facilities, intermediate-care facilities and correctional treatment centers shall comply with the requirements of Sections 3417.1.1.2.1 and 3417.1.1.2.2.*

3418A.4.3.1 Skilled nursing or acute psychiatric services. *When general acute care services are removed from an SPC building which is intended to be used for skilled nursing or acute psychiatric services, and the new services will be licensed under the existing license of the general acute care hospital these new services shall comply with Section 3416A.1.1.1.5 for a nonconforming hospital building.*

3418A.4.3.2 Outpatient clinical services. *When general acute care services are removed from an SPC building that is intended to be used for outpatient clinical services under the existing acute care hospital license, the building is required to comply with the current OSHPD 3 code requirements for the new service.*

3418A.4.4 SPC buildings removed from general acute care service with new license. *When general acute care services are removed from an SPC building, and new services provided in the SPC building are issued an initial license, as determined by the California Department of Public Health, as a skilled nursing facility or acute psychiatric hospital, the SPC building shall comply with the new building code requirements or equivalent provisions of the California Building Standards code at the time of application.*

3418A.4.5 Change of building occupancy or division. *When an SPC building is removed from general acute care service with or without change of license, the new occupancy group and division of the building, and/or new service or function, shall be established. A new certificate of occupancy shall be required for the building removed from general acute care service.*

3418A.5 Change in jurisdiction for buildings removed from general acute care service. *Except as provided by Section 3418A.5.3, at the hospital's discretion, a building removed from general acute care service shall be permitted to be placed under the jurisdiction of the local enforcement agency. To be eligible for a change in jurisdiction, the building removed from general acute care service shall satisfy the requirements of Section 3418A.5. 1.*

3418A.5.1 Eligibility for change in jurisdiction. *For a building removed from general acute care service to be eligible for a change in jurisdiction to the local enforcing agency, all the following criteria shall be satisfied:*

a. The building removed from general acute care service shall be freestanding, as defined in the California Administrative Code, Section 7-111.

b. Any hospital support services located in the building removed from general acute care service, including administrative services, central sterile supply, storage, morgue and autopsy, employee dressing rooms and lockers, janitorial and housekeeping service, and laundry, shall be in excess of the minimum requirements for licensure and operation. Prior approval by the California Department of Public Health shall be obtained by hospital to locate these services in the building removed from general acute care service.

c. Services/systems and utilities (e.g., power, emergency power, communication/data/nurse-call systems, space-heating systems, fire alarm system, fire-sprinkler system, medical gas and plumbing systems) shall be separate and independent from those serving any buildings under OSHPD jurisdiction.

d. If the building being transferred to the jurisdiction of the local enforcing agency is adjacent to a building under OSHPD jurisdiction and fire resistive construction separations are required, they shall be located in the building under OSHPD jurisdiction.

3418A.5.2 Modification of buildings removed from OSHPD jurisdiction. *The owner of the building shall be responsible for bringing the building into compliance with all requirements of the new authority having jurisdiction. If a building requires modification to become eligible for removal from OSHPD jurisdiction, the construction project shall be closed with compliance by OSHPD prior to the change in jurisdiction. All occupancy separation, set-back, and allowable area requirements shall be enforced.*

3418A.5.3 Buildings not eligible for change in jurisdiction. *The following freestanding buildings shall remain under OSHPD jurisdiction:*

a. Any building in which basic and/or supplementary services are provided for a general acute care hospital, acute psychiatric hospital and general acute care hospital providing only acute medical rehabilitation center services.

b. Any building that provides required patient access, egress, or smoke compartment for a building under OSHPD's jurisdiction.

c. Any building in which services under OSHPD jurisdiction are provided, including skilled nursing services, intermediate care services, acute psychiatric services, and distinct part skilled nursing or intermediate care services.

d. Any building providing central plant or utility services to a building under OSHPD jurisdiction.

e. Any building through which utilities pass through, over or under, to serve a building under OSHPD jurisdiction.

3418A.6 Vacant space. *With the removal of general acute care services, the vacated space must be reclassified with an intended occupancy as required under Section 302. If the hospital determines that the building or space in the SPC building removed from general acute care service will be vacant, the hospital shall demonstrate that unsafe conditions as described in Section 116.1 are not created.*

3418A.7 Demolition. *Demolition of SPC buildings to be removed from general acute care services shall be permitted when buildings remaining under OSHPD's jurisdiction, after demolition, satisfy the requirements of the California Building Standards Code and demolition activity does not impair the operation and/or safety of any buildings that remain under OSHPD's jurisdiction.*

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 35 – REFERENCED STANDARDS

(Matrix Adoption Tables are non-regulatory, intended only as an aid to the user. See Chapter 1 for state agency authority and building applications.)

Adopting agency	BSC	SFM	HCD			DSA			OSHPD				BSCC	DPH	AGR	DWR	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4							
Adopt entire chapter	X								X	X	X	X							
Adopt entire chapter as amended (amended sections listed below)		X	X	X	X		X	X											
Adopt only those sections that are listed below						X													
Chapter/Section																			
AAMA 501.4-09							*X*	*X*											
AAMA 501.6-09							*X*	*X*											
ACI							X	X											
AF & PA							*X*	*X*											
AISC							X	X											
AISI							*X*	*X*											
AITC							X	X											
ANSI						X													
ANSI-S3.4.1						*X*													
ANSI/SDI-C-2012						*X*	*X*	*X*											
ASCE/SEI							X	X											
ASME						X													
ASME A17.1/CSA B44-07		*X*				X													
ASME A17.1A/CSA B44A-08						*X*													
ASME A18.1-2008						*X*													
ASME BPE-2009		X																	
ASTM							X	X											
ASTM C 114-10							*X*	*X*											
ASTM C 1157/C 1157M-11							*X*	*X*											
ASTM C 1240-11							*X*	*X*											
ASTM C 1249-06a (2011)							*X*	*X*											
ASTM C 1260-07							*X*	*X*											
ASTM C 1293-08b							*X*	*X*											
ASTM C 1392-00 (2009)							*X*	*X*											
ASTM C 1394-03 (2008)							*X*	*X*											
ASTM C 1401-09a							*X*	*X*											
ASTM D 1586-11							*X*	*X*											
ASTM D 3441-05							*X*	*X*											
ASTM D 3966-07							*X*	*X*											
ASTM E 648-04		X																	
ASTM E 662-09		X																	
ASTM F 1292-99						*X*													
ASTM F 1292-04						*X*													
ASTM F 1487-01						*X*													
ASTM F 1951-99						*X*													
AWPA							*X*	*X*											
AWS							X	X											
BHMA						X													
BHMA A156.10-2011						*X*													
BHMA A156.19-2007						*X*													
CPSC																			
FEMA 352-00							*X*	*X*											
FM 1950-10							*X*	*X*											
FM 3260-00		X																	

(continued)

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 35 – REFERENCED STANDARDS—continued

Adopting agency	BSC	SFM	HCD			DSA			OSHPD				BSCC	DHS	AGR	DWR	CEC	CA	SL	SLC
			1	2	1/AC	AC	SS	SS/CC	1	2	3	4								
Adopt entire chapter	X								X	X	X	X								
Adopt entire chapter as amended (amended sections listed below)		X	X	X	X		X	X												
Adopt only those sections that are listed below						X														
Chapter / Section																				
FM3011-99		X																		
FM4430-80		X																		
ICC							X	X												
ICC ES AC 331		X																		
ICC ES AC 77		X																		
ISO 9001-08							*X*	*X*												
ISO 17025-05							*X*	*X*												
NFPA						X	X	X												
NFPA 11-13		*X*																		
NFPA 13-*13*		X																		
NFPA 13D-*13*		X																		
NFPA 13R-*13*		X																		
NFPA 14-*13*		X																		
NFPA 15-*12*		X																		
NFPA 17-*13*		*X*																		
NFPA 17A-*13*		*X*																		
NFPA 20-*13*		*X*																		
NFPA 22-*13*		X																		
NFPA 24-*13*		X																		
NFPA 31-11		*X*																		
NFPA 37-*10*																				
NFPA 52-13		*X*																		
NFPA 54-*12*		X																		
NFPA 61-13		X																		
NFPA 72-13		X				X														
NFPA 92a-12		X																		
NFPA 211-13		X																		
NFPA 259-13		X																		
NFPA 275-13		X																		
NFPA 285-13		X																		
NFPA 288-13		X																		
NFPA 289-13		X																		
NFPA 409-13		X																		
NFPA 654-13		X																		
NFPA 703-13		X																		
NFPA 720-12			X	X	X															
NFPA 1124-13		X																		
NFPA 2001-12		X																		
PCI							X	X												
PTI							X	X												
SFM 12-3		X																		
SFM 12-7-3		X																		
SFM 12-7A-1		X																		

(continued)

CHAPTER 35
REFERENCED STANDARDS

This chapter lists the standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard, the standard identification, the effective date and title, and the section or sections of this document that reference the standard. The application of the referenced standards shall be as specified in *Chapter 1, Scope and Administration, Division 1,* Sections *1.1.5 and 1.1.7, and in Chapter 1, Scope and Administration, Division II,* Section 102.4.

[DSA-SS, DSA-SS-CC & OSHPD 1 & 4] Reference to other chapters. *In addition to the code sections referenced, the standards listed in this chapter are applicable to the respective code sections in Chapters 16A, 17A, 18A, 19A, 21A, 22A and 34A.*

AA

Aluminum Association
1525 Wilson Boulevard, Suite 600
Arlington, VA 22209

Standard reference number	Title	Referenced in code section number
ADM1—05	Aluminum Design Manual: Part 1-A Specification for Aluminum Structures, Allowable Stress Design; and Part 1-B—Aluminum Structures, Load and Resistance Factor Design	1604.3.5, 2002.1
ASM 35—00	Aluminum Sheet Metal Work in Building Construction (Fourth Edition)	2002.1

AAMA

American Architectural Manufacturers Association
1827 Waldon Office Square, Suite 550
Schaumburg, IL 60173

Standard reference number	Title	Referenced in code section number
1402—86	Standard Specifications for Aluminum Siding, Soffit and Fascia	1404.5.1
AAMA/WDMA/CSA 101/I.S.2/A440—08	North American Fenestration Standard/Specifications for Windows, Doors and Skylights	1715.5.1, 2405.5
501.4-09	*Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts*	*2410.1*
501.6-09	*Recommended Dynamic Test Method for Determining the Seismic Drift Causing Glass Fallout from a Wall*	*2410.1*

ACI

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331

Standard reference number	Title	Referenced in code section number
216.1—07	Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies	Table 720.1(2), 721.1
318—11	Building Code Requirements for Structural Concrete	1604.3.2, 1614.3.1, 1614.4.1, 1704.3.1.3, Table 1704.3, 1704.4.1, Table 1704.4, *Table 1705A.2.1, 1705A.2.2.1.2,* 1708. 2, 1808.8.2, Table 1808.8.2, 1808.8.5, 1808.8.6, *1810A.3.10.4,* 1810.2.4.1, 1810.3.2.1.1, 1810.3.2.1.2, 1810.3.8.3.1, 1810.3.8.3.3, 1810.3.9.4.2.1, 1810.3.9.4.2.2, 1810.3.11.1, 1901.2, 1901.3, 1901.4, 1902.1, *1903A,* 1903.1, 1904.1, 1904.2, 1904.3, 1904.4.1, 1904.4.2, 1904.5, *1905A,* 1905.1.1, 1905.2, 1905.3, 1905.4, 1905.5, 1905.6.2, 1905.6.3, 1905.6.4, 1905.6.5, 1905.7, 1905.8, 1905.9, 1905.10, 1905.11, 1905.12, 1905.13, 1906.1, 1906.2, 1906.3, 1906.4, 1907.1, 1907.2, 1907.3, 1907.4, 1907.5, 1907.6, 1907.7.1, 1907.7.2, 1907.7.3, 1907.7.4, 1907.7.5, 1907.7.6, 1907.8, 1907.9, 1907.10, 1907.11, 1907.12, 1907.13, 1908.1, 1908.1.1, 1908.1.2, 1908.1.3, 1908.1.4, 1908.1.5, 1908.1.6, 1908.1.7, 1908.1.8, 1908.1.9, 1908.1.10, 1909.1, 1909.3, 1909.4, 1909.5, 1909.6, 1912.1, *1913A.5, 1913A.7.2, 1913.2, 1913.3,* 2108.3, 2205.3
355.2-07	*Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary*	*616A.1.19*
440.2R-08	*Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures*	*1914A.3*
503.7—07	*Specification for Crack Repair by Epoxy Injection*	*1914A.2*

ACI—continued

506—05	*Guide to Shotcrete*	*1913.4.5, 1910A.1, 1910A.3, 1910A.12, 1914A.2*
530—11	Building Code Requirements for Masonry Structures	1405.5, 1405.5.2, 1405.9, 1604.3.4, 1704.5, 1704.5.1, Table 1704.5.1, 1704.5.2, 1704.5.3, Table 1704.5.3, 1807.1.6.3.2, 1808.9, 2101.2.2, 2101.2.3, 2101.2.4, 2101.2.5, 2101.2.6, 2103.1.3.6, 2106.1, 2107.1, 2107.2, 2107.3, 2107.4, 2107.5, 2108.1, 2108.2, 2108.3, 2109.1, 2109.1.1, 2109.2, 2109.2.1, 2109.3, 2110.1, *2114.10, 2114.11*
530.1—08	Specifications for Masonry Structures	1405.5.1, Table 1704.5.1, Table 1704.5.3, 1807.1.6.3, 2103.8, 2103.11, 2103.12, 2103.13, 2104.1, 2104.1.1, 2104.1.2, 2104.1.3, 2104.2, 2104.3, 2104.4, 2105.2.2.1.1, 2105.2.2.1.2, 2105.2.2.1.3

AF&PA

American Forest & Paper Association
1111 19th St, NW Suite 800
Washington, DC 20036

Standard reference number	Title	Referenced in code section number
WCD No. 4—89	Wood Construction Data—Plank and Beam Framing for Residential Buildings	2306.1.2
WFCM—01	Wood Frame Construction Manual for One- and Two-family Dwellings	1609.1.1, 1609.1.1.1, 2301.2, 2308.1, 2308.2.1
NDS—2012	National Design Specification (NDS) for Wood Construction with 2012 Supplement *and addendum*	*1905A.1.21, 721.6.3.2,* 1716.1.1, 1716.1.4, 1809.12, 1810.3.2.4, Table 1810.3.2.6, 2302.1, 2304.12, 2306.1, Table 2306.2.1(1), Table 2306.2.1(2), Table 2306.3, Table 2306.6, 2307.1, 2307.1.1
AF&PA—93	Span Tables for Joists and Rafters	2306.1.1, 2308.8, 2308.10.2, 2308.10.3
ANSI/AF&PA PWF—07	Permanent Wood Foundation Design Specification	1805.2, 1807.1.4, 2304.9.5.2
ANSI/AF&PA SDPWS—08	Special Design Provisions for Wind and Seismic	1613.6.1, 2305.1, 2306.1, 2306.2.1, 2306.2.2, 2306.2.3, 2306.3, Table 2306.3, 2306.4, 2306.5, 2306.6, 2306.7, Table 2306.7, 2307.1, 2307.1.1

AISC

American Institute of Steel Construction
One East Wacker Drive, Suite 700
Chicago, IL 60601-18021

Standard reference number	Title	Referenced in code section number
341—10	Seismic Provisions for Structural Steel Buildings, including Supplement No. 1 dated 2005	1613.6.2, *1705A.2.1, 1707.2,*2, 1708.3, *2212.2, 2205A,* 2205.2.1, 2205.2.2, 2205.3, 2205.3.1, *2206A*
358-10	*Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications including Supplement No. 1*	*2205A, 2206A.2, 2212.3, 3413A*
360—10	Specification for Structural Steel Buildings	1604.3.3, Table 1704.3, 1704.3.3, *1705A.2.1, Table 1705A.2.1,* 2203.1, 2203.2, *2204A.2.2,* 2205.1, 2205.3, *2206A.2, 2212.1.1, 2212.3, 2212A.1.2. 2212A.2.1*

AISI

American Iron and Steel Institute
1140 Connecticut Avenue, 705
Suite 705
Washington, DC 20036

Standard reference number	Title	Referenced in code section number
AISI S100—07/*S2-10*	North American Specification for the Design of Cold-formed Steel Structural Members	1604.3.3, *1905A.1, 1913.3.8,* 2203.1, 2203.2, 2209.1, *2210A.2,* 2210.2, 2210.4, 2210.5, *2211A.1, 2212A.1.2*
S200—07	North American Standard for Cold-formed Steel Framing—General Provisions	2203.1, 2203.2, 2210.1
S210—07	North American Standard for Cold-formed Steel Framing—Floor and Roof System Design	2210.5
S211—07	North American Standard for Cold-formed Steel Framing—Wall Stud Design	2210.4
S212—07	North American Standard for Cold-formed Steel Framing—Header Design	2210.2
S213—07	North American Standard for Cold-formed Steel Framing—Lateral Design with Supplement 1, dated 2010	2210.6, *2212A.2.1, 2212.5.3*
S214—07	North American Standard for Cold-formed Steel Framing—Truss Design, with Supplement 2, dated 2008	2210.3.11, *2211A.3, 2212.5.1.2*
S230—07	Standard for Cold-formed Steel Framing—Prescriptive Method for One- and Two-family Dwellings, with Supplement 2, dated 2008	1609.1.1, 1609.1.1.1, 2210.7

ASTM—continued

E 648–04	*Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source*	*804.4.1, 804.4.2*
E662—09	*Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials*	*804.4.1, 804.4.2*
E 681—04	Test Methods for Concentration Limits of Flammability of Chemical Vapors and Gases	307.2
E 736—00 (2006)	Test Method for Cohesion/Adhesion of Sprayed Fire-resistive Materials Applied to Structural Members	704.13.2, 1704.12.6
E 814—06	Test Method of Fire Tests of Through-penetration Firestops	702.1, 713.3.1.2, 713.3.2, 713.4.1.1.2
E 970—00	Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source	719.3.1
E 1300—04e01	Practice for Determining Load Resistance of Glass in Buildings	2404.1, 2404.2, 2404.3.1, 2404.3.2, 2404.3.3, 2404.3.4, 2404.3.5
E 1354—04a	Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter	402.12.1
E 1592—01	Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference	1504.3.2
E 1602—03	Guide for Construction of Solid Fuel-burning Masonry Heaters	2112.2
E 1886—05	Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials	1609.1.2
E 1966—01	Test Method for Fire-resistant Joint Systems	702.1, 714.3
E 1996—06	Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes	1609.1.2, 1609.1.2.1
E 2072—04	Standard Specification for Photoluminescent (Phosphorescent) Safety Markings	1024.4
E 2273—03	Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies	1408.4.1
E 2307—04e01	Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-scale, Multistory Test Apparatus	714.4
E 2404—07a	Standard Practice for Specimen Preparation and Mounting of Textile, Paper or Vinyl Wall or Ceiling Coverings to Assess Surface Burning Characteristics	803.1.4
E 2568—07	Standard Specification for PB Exterior Insulation and Finish Systems (EIFS)	1408.2
E 2570—07	Standard Test Method for Evaluating Water-resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) for EIFS with Drainage	1408.4.1.1, 1704.12.1
E 2573—07	Standard Practice for Specimen Preparation and Mounting of Site-fabricated Stretch Systems to Assess Surface Burning Characteristics	803.9
F 547—01	Terminology of Nails for Use with Wood and Wood-based Materials	Table 2506.2
F 1292—99	Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment	11B-1008.2.6.2
F 1292—04	Standard Specification for Impact Attenuation of Surface Materials within the Use Zone of Playground Equipment	11B-1008.2.6.2
F 1346—91 (2003)	Performance Specification for Safety Covers and Labeling Requirements for	3109.4, 3109.4.1.8
F 1487—01	Standard Consumer Safety Performance Specification for Playground Equipment for Public Use	202-USE ZONE
F 1667—05	Specification for Driven Fasteners: Nails, Spikes and Staples	Table 720.1(2), Table 720.1(3), 1507.2.6, 2303.6, Table 2506.2
F 1951—99	Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment	11B-1008.2.6.1
F 2006—00 (2005) 10	Standard/Safety Specification for Window Fall Prevention Devices with Emergency Escape (Egress) and Rescue (Ingress) Windows	1405.13.2
F 2090—01a (2007)	Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms	1405.13.2
F 2200—05	Standard Specification for Automated Vehicular Gate Construction	3110.3
G 152—06	Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials	1504.6
G 154—05	Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials	1504.6
G 155—05a	Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials	1504.6

AWCI

Association of the Wall and Ceiling Industry
513 West Broad Street, Suite 210
Falls Church, VA 22046

Standard reference number	Title	Referenced in code section number
12-B—98	Technical Manual 12-B Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-resistive Materials; an Annotated Guide, First Edition	1704.13

AWPA

American Wood Protection Association
P.O. Box 361784
Birmingham, AL 35236-1784

Standard reference number	Title	Referenced in code section number
C1—03	All Timber Products—Preservative Treatment by Pressure Processes	1505.6
M4—06	Standard for the Care of Preservative-treated Wood Products	1810.3.2.4.1, 2303.1.8
U1—07	USE CATEGORY SYSTEM: User Specification for Treated Wood Except Section 6, Commodity Specification H	1403.5, Table 1507.9.6, 1807.1.4, 1807.3.1, 1809.12, 1810.3.2.4.1, 2303.1.8, 2304.11.2, 2304.11.4, 2304.11.6, 2304.11.7, *J106.2.2*

AWS

American Welding Society
550 N.W. LeJeune Road
Miami, FL 33126

Standard reference number	Title	Referenced in code section number
D1.1—10	*Structural Welding Code—Steel*	Table 1704.3, 1704.3.1.1, *Table 1705A.2.1, 1705A.2.2.5, 2212.6.2, 2213A.2*
D1.3—*08*	Structural Welding Code—Sheet Steel	Table 1704.3, 1704.3.1.2, *Table 1705A.2.1, 1705A.2.2.1.1*
D1.4—*11*	Structural Welding Code—Reinforcing Steel	Table 1704.3, 1704.3.1.3, Table 1704.4, *Table 1705A.2.1, 1705.2.2.1.2, 2107A.3, 2107A.4*
D1.8—09	*Structural Welding Code – Seismic Supplement*	*1704A.3.1.4, 1705A.2.2.5, 2204A.1.1, 2204A.1.3, 2211.1*
QC1—06	*Standard for AWS Certification of Welding Inspectors*	*1704A.3.1.4, 1705A.2.2.5*

BHMA

Builders Hardware Manufacturers' Association
355 Lexington Avenue, 17th Floor
New York, NY 10017-6603

Standard reference number	Title	Referenced in code section number
A 156.10—11	Power Operated Pedestrian Doors	11B-404.2.9, 11B-404.3, 1008.1.4.2
A 156.19—07	Standard for Power Assist and Low Energy Operated Doors	11B-404.2.9, 11B-404.3, 11B-408.3.2.1, 11B-409.3.1, 1008.1.4.2

CGSB

Canadian General Standards Board
Place du Portage 111, 6B1
11 Laurier Street
Gatineau, Quebec, Canada KIA 1G6

Standard reference number	Title	Referenced in code section number
37-GP-52M (1984)	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	1504.7, 1507.12.2
37-GP-56M (1980)	Membrane, Modified, Bituminous, Prefabricated and Reinforced for Roofing—with December 1985 Amendment	1507.11.2
CAN/CGSB 37.54—95	Polyvinyl Chloride Roofing and Waterproofing Membrane	1507.13.2

CPA

Composite Panel Association
19465 Deerfield Avenue, Suite 306
Leesburg, VA 20176

Standard reference number	Title	Referenced in code section number
ANSI A135.4—2004	Basic Hardboard	1404.3.1, 2303.1.6
ANSI A135.5—2004	Prefinished Hardboard Paneling	2303.1.6, 2304.6.2
ANSI A135.6—1998	Hardboard Siding	1404.3.2, 2303.1.6

NFPA—continued

Revise Section 6.6.2 as follows:

6.6.2 A sectional valve shall be provided at the following locations: (1) On each bank where a main crosses *a body of* water

(2) Outside the building foundation(s) where a main or a section of a main runs under a building

Revise Section 10.6.5 as follows:

10.6.5 Pipe joints shall not be located under foundation footings. *The pipe under the building or building foundation shall not contain mechanical joints.*

Exceptions:

1. Where allowed in accordance with Section 10.6.2

2. Alternate designs may be utilized where designed by a registered professional engineer and approved by the enforcing agency.

Revise Section 10.9.1 as follows:

10.9.1 *Backfill shall be well tamped in layers or puddle under and around pipes to prevent settlement or lateral movement.* Backfill shall consist of clean fill sand or pea gravel to a minimum 6" below and to a minimum of 12" above the pipe *and shall contain no ashes, cinders, refuse, organic matter, or other corrosive materials. Other backfill materials and methods are permitted where designed by a registered professional engineer and approved by the enforcing agency.*

30—08	Flammable and Combustible Liquids Code	415.3
31—*11*	Installation of Oil-burning Equipment	2113.15
32—07	Dry Cleaning Plants	415.6.4
37—10	*Installation and Use of Stationary Combustion Engines and Gas Turbines*	
40—07	Storage and Handling of Cellulose Nitrate Film	409.1
52—13	*Compressed Natural Gas (CNG) Vehicular Gaseous Fuel Systems Code*	
54—12	*National Fuel Gas Code*	
58—08	Liquefied Petroleum Gas Code	415.6.3
61—*13*	Prevention of Fires and Dust Explosions in Agricultural and Food Product Facilities	415.6.1
70—08	National Electrical Code	108.3, 415.8.2.8.2, 904.3.1, 907.6.1, 909.12.1, 909.16.3, 1205.4.1, 2701.1, 3401.3, H106.1, H106.2, K101, K111.1
72—*13*	National Fire Alarm *and Signaling* Code, *as amended**	901.6, 903.4.1, 904.3.5, 907.2, 907.2.5, 907.2.11, 907.2.13.2, 907.3, 907.3.3, 907.3.4, 907.5.2.1.2, 907.5.2.2, 907.6, 907.6.1, 907.6.5, 907.7, 907.7.1, 907.7.2, 911.1.5, 3006.5, 3007.6

****NFPA 72, Amended Sections as follows:***

10.3.1 Equipment constructed and installed in conformity with this code shall be listed for the purpose for which it is used. *Fire alarm systems and components shall be California State Fire Marshal approved and listed in accordance with California Code of Regulations, Title 19, Division 1.*

10.3.3 All devices and appliances that receive their power from the initiating device circuit or signaling line circuit of a control unit shall be *California State Fire Marshal* listed for use with the control unit.

10.7.1 *Where approved by the authority having jurisdiction,* ECS priority signals when evaluated by stakeholders through risk analysis in accordance with 24.4.2.2 shall be permitted to take precedence over all other signals.

14.4.6.1 **Testing.** Household fire alarm systems shall be tested *in accordance with the manufacturer's published instructions* according to the methods of Table 14.4.2.2.

17.15 Fire Extinguisher Monitoring Device. A fire extinguisher monitoring device shall indicate those conditions for a specific fire extinguisher required by *California Code of Regulations, Title 19, Division 1, Chapter 1, Section 574.2(c) and California Fire Code to a fire alarm control unit.*

21.3.6 Smoke detectors shall not be installed in unsprinklered elevator hoistways unless they are installed to activate the elevator hoistway smoke relief equipment *or where required by Chapter 30 of the California Building Code.*

12.3.7 (4) Where the vertically run conductors are contained in a 2-hour rated cable assembly, or enclosed (installed) in a

2-hour rated enclosure or a listed circuit integrity (C.I.) cable, which meets or exceeds a 2-hour fire resistive rating.

23.8.5.1.2 Where connected to a supervising station, fire alarm systems employing automatic fire detectors or waterflow detection devices shall include a manual fire alarm box to initiate a signal to the supervising station.

Exception: Fire alarm systems dedicated to elevator recall control, supervisory service *and fire sprinkler monitoring.*

23.8.5.4.1 Systems equipped with alarm verification features shall be permitted under the following conditions:

(1) The alarm verification feature is not initially enabled unless conditions or occupant activities that are expected to cause nuisance alarms are anticipated in the area that is protected by the smoke detectors. Enabling of the alarm verification feature shall be protected by password or limited access.

NFPA—continued

(2) A smoke detector that is continuously subjected to a smoke concentration above alarm threshold does not delay the system functions of Sections 10.6 through 10.13, 23.8.1.1, or 21.2.1 by more than *30 seconds.*

(3) Actuation of an alarm-initiating device other than a smoke detector causes the system functions of 4.4.3, 6.8.1.1, or 6.16.2.1 without additional delay.

(4) The current status of the alarm verification feature is shown on the record of completion *(see Figure 4.5.2.1, item 10).*

(5) Operation of a patient room smoke detector in I-2 and R-2.1 Occupancies shall not include an alarm verification feature.

29.3.1 All devices, combinations of devices, and equipment to be installed in conformity with this chapter shall be approved *and* listed *by the California State Fire Marshal* the for the purposes for which they are intended.

29.5.2.1.1* Smoke and Heat Alarms. Unless exempted by applicable laws, codes, or standards, smoke or heat alarms used to provide a fire-warning function, and when two or more alarms are installed within a dwelling unit, suite of rooms, or similar area, shall be arranged so that the operation of any smoke or heat alarm causes all alarms within these locations to sound.

Exception to 29.5.2.1.1 not adopted by the SFM.

29.7.2.1 *The alarm verification feature shall not be used for household fire warning equipment.*

29.7.6.7.1 *The alarm verification feature shall not be used for household fire warning equipment.*

29.8.3.4 Specific Location Requirements. The installation of smoke alarms and smoke detectors shall comply with the following requirements:

(1) Smoke alarms and smoke detectors shall not be located where ambient conditions, including humidity and temperature, are outside the limits specified by the manufacturer's published instructions.

(2) Smoke alarms and smoke detectors shall not be located within unfinished attics or garages or in other spaces where temperatures can fall below 40ºF (4ºC) or exceed 100ºF (38ºC).

(3) Where the mounting surface could become considerably warmer or cooler than the room, such as a poorly insulated ceiling below an unfinished attic or an exterior wall, smoke alarms and smoke detectors shall be mounted on an inside wall.

(4) Smoke alarms or smoke detectors shall be installed a minimum of 20 feet horizontal distance from a permanently installed cooking appliance.

Exception: Ionization smoke alarms with an alarm-silencing switch or photoelectric smoke alarms shall be permitted to be installed 10 feet (3 m) or greater from a permanently installed cooking appliance.

Photoelectric smoke alarms shall be permitted to be installed greater than 6 feet (1.8 m) from a permanently installed cooking appliance where the kitchen or cooking area and adjacent spaces have no clear interior partitions and the 10 ft distances would prohibit the placement of a smoke alarm or smoke detector required by other sections of the code.

Smoke alarms listed for use in close proximity to a permanently installed cooking appliance.

(5) Installation near bathrooms. Smoke alarms shall be installed not less than a 3 foot (0.91 m) horizontal distance from the door or opening of a bathroom that contains a bathtub or shower unless this would prevent placement of a smoke alarm required by other sections of the code.

(6) Smoke alarms and smoke detectors shall not be installed within a 36 in. (910 mm) horizontal path from the supply registers of a forced air heating or cooling system and shall be installed outside of the direct airflow from those registers.

(7) Smoke alarms and smoke detectors shall not be installed within a 36 in. (910 mm) horizontal path from the tip of the blade of a ceiling-suspended (paddle) fan.

(8) Where stairs lead to other occupied levels, a smoke alarm or smoke detector shall be located so that smoke rising in the stairway cannot be prevented from reaching the smoke alarm or smoke detector by an intervening door or obstruction.

(9) For stairways leading up from a basement, smoke alarms or smoke detectors shall be located on the basement ceiling near the entry to the stairs.

(10) For tray-shaped ceilings (coffered ceilings), smoke alarms and smoke detectors shall be installed on the highest portion of the ceiling or on the sloped portion of the ceiling within 12 in. (300 mm) vertically down from the highest point.

(11) Smoke alarms and detectors installed in rooms with joists or beams shall comply with the requirements of 17.7.3.2.4.

(12) Heat alarms and detectors installed in rooms with joists or beams shall comply with the requirements of 17.6.3.

80—*13* Fire Doors and Other Opening Protectives 410.3.5, 508.2.5.2, 715.4, 715.4.5, 715.4.6, 715.4.7.1, 715.4.8.2, 715.5, 715.5.5, 1008.1.4.3

85—07 Boiler and Combustion System Hazards Code 415.6.1
(Note: NFPA 8503 has been incorporated into NFPA 85)

92—12 *Standard for Smoke Control Systems* *909.8*

99—*12* Health Care Facilities *Code* 407.*10*

101—*12* Life Safety Code *807.4.3.2*,1028.6.2

105—*13* Standard for the Installation of Smoke Door Assemblies *and Other Opening Protectives* 405.4.2, 715.4.3.1, 909.20.4.1

110—*13* Emergency and Standby Power Systems 2702.1

NFPA—continued

111—*13*	Stored Electrical Energy Emergency and Standby Power Systems 2702.1
120—10	*Fire Prevention and Control in Coal Mines* *415.6.1*
170—09	*Standard for Fire Safety and Emergency Symbols* *907.1.2*
211—*13*	Chimneys, Fireplaces, Vents and Solid Fuel-burning Appliances 2112.5
252—03	Standard Methods of Fire Tests of Door Assemblies 715.3, 715.4.1, 715.4.2, 715.4.3, 715.4.7.3.1
253—06	Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 402.12.1, 406.6.4, 804.2, 804.3
257—07	Standard for Fire Test for Window and Glass Block Assemblies 715.3, 715.4.3.2, 715.5, 715.5.1, 715.5.2, 715.5.9.1
259—*13*	Test Method for Potential Heat of Building Materials 2603.4.1.10, 2603.5.3
265—07	Method of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings on Full Height Panels and Walls. 803.1.3, 803.1.3.1
268—07	Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source . . . 1406.2.1, 1406.2.1.1, 1406.2.1.2, 2603.5.7, D105.1
275—*13*	Standard Method of Fire Tests for the Evaluation of Thermal Barriers Used Over Foam Plastic Insulation. . . . .
285—06	Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Nonload-bearing Wall Assemblies Containing Combustible Components 1407.10.4, 2603.5.5
286—06	Standard Method of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 402.16.4, 803.1.2, 803.1.2.1, 803.9, 2603.4, 2603.9
288—12	Standard Method of Fire Tests of *Horizontal* Fire Door Assemblies Installed in *Horizontal* Fire-resistance-rated *Assemblies* *712.8*
289—*13*	Standard Method of Fire Test for Individual Fuel Packages . . . . .
409—*11*	Aircraft Hangars . . . . . 412.4.6, Table 412.4.6, 412.4.6.1, 412.6.5
418—06	Standard for Heliports 412.7.4
484—06	Combustible Metals. 415.6.1
654—*13*	Prevention of Fire & Dust Explosions from the Manufacturing, Processing and Handling of Combustible Particulate Solids 415.6.1
655—07	Prevention of Sulfur Fires and Explosions 415.6.1
664—07	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities 415.6.1
701—04	Standard Methods of Fire Tests for Flame-propagation of Textiles and Films 402.12.1, 410.3.6, 801.1.4, 806.1, 806.1.2, 806.2, 3102.3, 3102.3.1, 3102.6.1.1, 3105.4, D102.2.8, H106.1.1
704—07	Standard System for the Identification of the Hazards of Materials for Emergency Response 414.7.2, 415.2
720—12	*Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment* *420.6*
1124—*13*	Manufacture, Transportation, Storage, *and Retail Sales* of Fireworks and Pyrotechnic Articles 415.3.1
2001—*12*	Clean Agent Fire Extinguishing Systems, *as amended** . . . . . Table 901.6.1, 904.10

NFPA 2001, Amended Sections as follows:

4.3.5.1.1 *Alarms signals from the fire extinguishing system shall not interfere with the building fire alarm signal.*

4.3.5.2.1 *The lens on visual appliances shall be "red" in color.*

Exception: Other lens colors are permitted where approved by the enforcing agency.

PCI

Precast Prestressed Concrete Institute
209 W. Jackson Boulevard, Suite 500
Chicago, IL 60606-6938

Standard reference number	Title	Referenced in code section number
MNL 124—89	Design for Fire Resistance of Precast Prestressed Concrete	721.2.3.1
MNL 128—01	Recommended Practice for Glass Fiber Reinforced Concrete Panels.	*1913.2.1*
PCI 120—10	*PCI Design Handbook 7th Edition*	*1905A.1*

PTI

Post-Tensioning Institute
8601 North Black Canyon Highway, Suite 103
Phoenix, AZ 85021

Standard reference number	Title	Referenced in code section number
PTI—2004	*Recommendations for Prestressed Rock and Soil Anchors (4th Edition)*	*1811A.2, 1810A.3.10.4, J106.2.4, J106.2.5*
PTI—2007	Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils, Third Edition.	1808.6.2
PTI—2007	Standard Requirements for Design of Shallow Post-tensioned Concrete Foundation on Expansive Soils, Second Edition	1808.6.2

SFM

State of California
Department of Forestry and Fire Protection
Office of the State Fire Marshal
P.O. Box 944246
Sacramento, CA 94246-2460

Standard reference number	Title	Referenced in code section number
12-3	*Releasing Systems for Security Bars in Dwellings*	1029.4
12-7-3	*Fire-testing Furnaces*	NA
12-7A-1	*Exterior Wall Siding and Sheathing*	703A.7, 707A.2
12-7A-2	*Exterior Window*	703A.7, 708A.2.1
12-7A-3	*Under Eave*	703A.7, 707A.8
12-7A-4	*Decking*	703A.7, 709A.3
SFM 12-7A-4A	*Decking Alternate Method A*	703A.7, 709A.3
SFM 12-7A-5	*Ignition Resistant Building Material*	703A.7, 709A.3
12-8-100	*Room Fire Tests for Wall and Ceiling Materials*	NA
12-10-1	*Power Operated Exit Doors*	NA
12-10-2	*Single Point Latching or Locking Devices*	NA
12-10-3	*Emergency Exit and Panic Hardware*	NA

(The Office of the State Fire Marshal standards referred to above are found in the California Code of Regulations, Title 24, Part 12.)

RMI

Rack Manufacturers Institute
8720 Red Oak Boulevard, Suite 201
Charlotte, NC 28217

Standard reference number	Title	Referenced in code section number
ANSI/MH16.1—08	Specification for Design, Testing and Utilization of Industrial Steel Storage Racks	2208.1

SDI

Steel Deck Institute
P. O. Box 25
Fox River Grove, IL 60021

Standard reference number	Title	Referenced in code section number
ANSI/NC1.0—06	Standard for Noncomposite Steel Floor Deck	2209.2.2, 2209.2.2.1
ANSI/RD1.0—06	Standard for Steel Roof Deck	2209.2.3
ANSI/SDI-C-2012	Standard for Composite Steel Floor Deck Slabs	2210A.1.1.3

SJI

Steel Joist Institute
1173B London Links Drive
Forest, VA 24551

Standard reference number	Title	Referenced in code section number
CJ-1.0—06	Standard Specification for Composite Steel Joists, CJ-series	1604.3.3, 2203.2, 2206.1
JG-1.1—05	Standard Specification for Joist Girders	1604.3.3, 2203.2, 2206.1
K-1.1—05	Standard Specification for Open Web Steel Joists, K-series	1604.3.3, 2203.2, 2206.1
LH/DLH-1.1—05	Standard Specification for Longspan Steel Joists, LH-series and Deep Longspan Steel Joists, DLH-series	1604.3.3, 2203.2, 2206.1

SPRI

Single-Ply Roofing Institute
411 Waverly Oaks Road, Suite 331B
Waltham, MA 02452

Standard reference number	Title	Referenced in code section number
SPRI/ANSI/ES-1—03	Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems	1504.5
RP-4—02	Wind Design Guide for Ballasted Single-ply Roofing Systems	1504.4

APPENDIX J

GRADING

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION J101
GENERAL

J101.1 Scope. The provisions of this chapter apply to grading, excavation and earthwork construction, including fills and embankments. Where conflicts occur between the technical requirements of this chapter and the geotechnical report, the geotechnical report shall govern.

J101.2 Flood hazard areas. The provisions of this chapter shall not apply to grading, excavation and earthwork construction, including fills and embankments, in floodways within flood hazard areas established in Section 1612.3 or in flood hazard areas where design flood elevations are specified but floodways have not been designated, unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed work will not result in any increase in the level of the base flood.

SECTION J102
DEFINITIONS

J102.1 Definitions. The following words and terms shall, for the purposes of this appendix, have the meanings shown herein. Refer to Chapter 2 of the *California Building Code* for general definitions.

BENCH. A relatively level step excavated into earth material on which fill is to be placed.

COMPACTION. The densification of a fill by mechanical means.

CUT. See "Excavation."

DOWN DRAIN. A device for collecting water from a swale or ditch located on or above a slope, and safely delivering it to an approved drainage facility.

EROSION. The wearing away of the ground surface as a result of the movement of wind, water or ice.

EXCAVATION. The removal of earth material by artificial means, also referred to as a cut.

FILL. Deposition of earth materials by artificial means.

GRADE. The vertical location of the ground surface.

GRADE, EXISTING. The grade prior to grading.

GRADE, FINISHED. The grade of the site at the conclusion of all grading efforts.

GRADING. An excavation or fill or combination thereof.

KEY. A compacted fill placed in a trench excavated in earth material beneath the toe of a slope.

SLOPE. An inclined surface, the inclination of which is expressed as a ratio of horizontal distance to vertical distance.

TERRACE. A relatively level step constructed in the face of a graded slope for drainage and maintenance purposes.

SECTION J103
PERMITS REQUIRED

J103.1 Permits required. Except as exempted in Section J103.2, no grading shall be performed without first having obtained a permit therefor from the building official. A grading permit does not include the construction of retaining walls or other structures.

J103.2 Exemptions. A grading permit shall not be required for the following:

1. Grading in an isolated, self-contained area, provided there is no danger to the public, and that such grading will not adversely affect adjoining properties.
2. Excavation for construction of a structure permitted under this code.
3. Cemetery graves.
4. Refuse disposal sites controlled by other regulations.
5. Excavations for wells, or trenches for utilities.
6. Mining, quarrying, excavating, processing or stockpiling rock, sand, gravel, aggregate or clay controlled by other regulations, provided such operations do not affect the lateral support of, or significantly increase stresses in, soil on adjoining properties.
7. Exploratory excavations performed under the direction of a registered design professional.

Exemption from the permit requirements of this appendix shall not be deemed to grant authorization for any work to be done in any manner in violation of the provisions of this code or any other laws or ordinances of this jurisdiction.

SECTION J104
PERMIT APPLICATION AND SUBMITTALS

J104.1 Submittal requirements. In addition to the provisions of Section 105.3, the applicant shall state the estimated quantities of excavation and fill.

J104.2 Site plan requirements. In addition to the provisions of Section 107, a grading plan shall show the existing grade and finished grade in contour intervals of sufficient clarity to indicate the nature and extent of the work and show in detail that it complies with the requirements of this code. The plans shall show the existing grade on adjoining properties in sufficient detail to identify how grade changes will conform to the requirements of this code.

J104.3 Geotechnical report. A geotechnical report prepared by a registered design professional shall be provided. The report shall contain at least the following:

1. The nature and distribution of existing soils;
2. Conclusions and recommendations for grading procedures;
3. Soil design criteria for any structures or embankments required to accomplish the proposed grading; and
4. Where necessary, slope stability studies, and recommendations and conclusions regarding site geology.

Exception: A geotechnical report is not required where the building code official determines that the nature of the work applied for is such that a report is not necessary.

J104.4 Liquefaction study. For sites with mapped maximum considered earthquake spectral response accelerations at short periods (S_s) greater than 0.5g as determined by Section 1613, a study of the liquefaction potential of the site shall be provided, and the recommendations incorporated in the plans.

Exceptions:

1. A liquefaction study is not required where the building official determines from established local data that the liquefaction potential is low.
2. *[OSHPD 1, 2, & 4] Exception 1 not permitted by OSHPD.*

SECTION J105
INSPECTIONS

J105.1 General. Inspections shall be governed by Section 110, *Chapter 1, Division II* of this code.

J105.2 Special inspections. The special inspection requirements of Section 1704.7 shall apply to work performed under a grading permit where required by the building official.

SECTION J106
EXCAVATIONS

J106.1 Maximum slope. The slope of cut surfaces shall be no steeper than is safe for the intended use, and shall be no steeper than two units horizontal to one unit vertical (50-percent slope) unless the owner or authorized agent furnishes a geotechnical report justifying a steeper slope.

Exceptions:

1. A cut surface shall be permitted to be at a slope of 1.5 units horizontal to one unit vertical (67-percent slope) provided that all of the following are met:
   1.1. It is not intended to support structures or surcharges.
   1.2. It is adequately protected against erosion.
   1.3. It is no more than 8 feet (2438 mm) in height.
   1.4. It is approved by the building code official.
   1.5. Ground water is not encountered.
2. A cut surface in bedrock shall be permitted to be at a slope of one unit horizontal to one unit vertical (100-percent slope).

J106.2 Earth retaining shoring. [OSHPD 1 & 4, DSA-SS & DSA-SS/CC]

J106.2.1 General. *The requirements of this section shall apply to temporary and permanent earth retaining shoring using soldier piles and lagging with or without tie-back anchors in soil or rock, only when existing or new DSA-SS, DSA-SS/CC or OSHPD 1 or 4 facilities are affected. Shoring used as construction means and methods only, which does not affect existing or new DSA-SS, DSA-SS/CC or OSHPD 1 or 4 facilities, are not regulated by DSA or OSHPD and shall satisfy the requirements of the authorities having jurisdiction.*

Design, construction, testing and inspection shall satisfy the requirements of this code except as modified in Sections J106.2.2 through J106.2.8.

J106.2.2 Duration. *Shoring shall be considered temporary when elements of the shoring will be exposed to site conditions for a period of less than one (1) year, and shall be considered permanent otherwise. Permanent shoring shall account for the increase in lateral soil pressure due to earthquake. At the end of the construction period, the existing and new structures shall not rely on the temporary shoring for support in any way. Wood components shall not be used for permanent shoring lasting more than two (2) years. Wood components of the temporary shoring that may affect the performance of permanent structure shall be removed after the shoring is no longer required.*

All components of the shoring shall have corrosion protection or preservative treatment for their expected duration. Wood components of the temporary shoring that will not be removed shall be treated in accordance with AWPA U1 (Commodity Specification A, Use Category 4B and Section 5.2), and shall be identified in accordance with Section 2303.1.8.1.

J106.2.3 Surcharge. *Surcharge pressure due to footings, traffic or other sources shall be considered in design. If the footing surcharge is located within the semicircular distribution or bulb of earth pressure (when shoring is located close to a footings), lagging shall be designed for lateral earth pressure due to footing surcharge. Soil arching effects may be considered in the design of lagging. Underpinning of the footing may be used in lieu of designing the shoring and lagging for surcharge pressure. Alternatively, continuously contacting drilled pier shafts near the footings shall be permitted. The lateral surcharge design pressure shall be derived using Boussinesq equations modified for the distribution of stresses in an elastic medium due to a uniform, concentrated or line surface load as appropriate and soil arching effects.*

J106.2.4 Design and testing: *Except for the modifications as set forth in Sections J106.2.4.1 and J106.2.4.2 below, all Prestressed Rock and Soil Tie-back Anchors shall be designed and tested in accordance with PTI Recommendations for Prestressed Rock and Soil Anchors (PTI-2004).*

J107.4 Fill material. Fill material shall not include organic, frozen or other deleterious materials. No rock or similar irreducible material greater than 12 inches (305 mm) in any dimension shall be included in fills.

J107.5 Compaction. All fill material shall be compacted to 90 percent of maximum density as determined by ASTM D 1557, Modified Proctor, in lifts not exceeding 12 inches (305 mm) in depth.

[OSHPD 1, 2, & 4, DSA-SS & DSA-SS/CC] *This section establishes minimum requirements only.*

J107.6 Maximum slope. The slope of fill surfaces shall be no steeper than is safe for the intended use. Fill slopes steeper than two units horizontal to one unit vertical (50-percent slope) shall be justified by a geotechnical report or engineering data.

SECTION J108
SETBACKS

J108.1 General. Cut and fill slopes shall be set back from the property lines in accordance with this section. Setback dimensions shall be measured perpendicular to the property line and shall be as shown in Figure J108.1, unless substantiating data is submitted justifying reduced setbacks.

J108.2 Top of slope. The setback at the top of a cut slope shall not be less than that shown in Figure J108.1, or than is required to accommodate any required interceptor drains, whichever is greater.

J108.3 Slope protection. Where required to protect adjacent properties at the toe of a slope from adverse effects of the grading, additional protection, approved by the *building official*, shall be included. Such protection may include but shall not be limited to:

1. Setbacks greater than those required by Figure J108.1.
2. Provisions for retaining walls or similar construction.
3. Erosion protection of the fill slopes.
4. Provision for the control of surface waters.

SECTION J109
DRAINAGE AND TERRACING

J109.1 General. Unless otherwise recommended by a registered design professional, drainage facilities and terracing shall be provided in accordance with the requirements of this section.

Exception: Drainage facilities and terracing need not be provided where the ground slope is not steeper than 3 horizontal to 1 vertical (33 percent).

J109.2 Terraces. Terraces at least 6 feet (1829 mm) in width shall be established at not more than 30-foot (9144 mm) vertical intervals on all cut or fill slopes to control surface drainage and debris. Suitable access shall be provided to allow for cleaning and maintenance.

Where more than two terraces are required, one terrace, located at approximately mid-height, shall be at least 12 feet (3658 mm) in width.

Swales or ditches shall be provided on terraces. They shall have a minimum gradient of 20 horizontal to 1 vertical (5 percent) and shall be paved with concrete not less than 3 inches (76 mm) in thickness, or with other materials suitable to the application. They shall have a minimum depth of 12 inches (305 mm) and a minimum width of 5 feet (1524 mm).

A single run of swale or ditch shall not collect runoff from a tributary area exceeding 13,500 square feet (1256 m^2) (projected) without discharging into a down drain.

J109.3 Interceptor drains. Interceptor drains shall be installed along the top of cut slopes receiving drainage from a tributary width greater than 40 feet (12 192 mm), measured horizontally. They shall have a minimum depth of 1 foot (305 mm) and a minimum width of 3 feet (915 mm). The slope shall be approved by the building official, but shall not be less than 50 horizontal to 1 vertical (2 percent). The drain shall be paved with concrete not less than 3 inches (76 mm) in thickness, or by other materials suitable to the application. Discharge from the drain shall be accomplished in a manner to prevent erosion and shall be approved by the building official.

J109.4 Drainage across property lines. Drainage across property lines shall not exceed that which existed prior to grading. Excess or concentrated drainage shall be contained on site or directed to an approved drainage facility. Erosion of the ground in the area of discharge shall be prevented by installation of nonerosive down drains or other devices.

SECTION J110
EROSION CONTROL

J110.1 General. The faces of cut and fill slopes shall be prepared and maintained to control erosion. This control shall be permitted to consist of effective planting.

Exception: Erosion control measures need not be provided on cut slopes not subject to erosion due to the erosion-resistant character of the materials.

Erosion control for the slopes shall be installed as soon as practicable and prior to calling for final inspection.

J110.2 Other devices. Where necessary, check dams, cribbing, riprap or other devices or methods shall be employed to control erosion and provide safety.

SECTION J111
REFERENCED STANDARDS

ASTM D 1557-e01	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft-lb/ft^3 (2,700kN-m/m^3)].	J107.6

SECTION J112
VIBRO STONE COLUMNS FOR GROUND IMPROVEMENT
[OSHPD 1, 2 & 4, DSA-SS & DSA-SS/CC]

J112.1 General. *This section shall apply to vibro stone columns (VSCs) for ground improvement using unbounded aggregate materials. Vibro stone column provisions in this section are intended to increase bearing capacity, reduce settlements and mitigate liquefaction for shallow foundations. These requirements shall not be used for grouted or bonded stone columns, ground improvement for deep foundation elements, or changing site class. VSCs shall not be considered a deep foundation element. Ground improvement shall be installed under the entire building/structure footprint and not under isolated foundation elements only. Design, construction, testing and inspection shall satisfy the requirements of this code except as modified in Sections J112.2 through J112.5.*

J112.2 Geotechnical report. *The geotechnical report shall specify vibro stone column requirements to ensure uniformity in total and differential immediate settlement, long term settlement and earthquake induced settlement.*

1. *Soil compaction shall be in accordance with California Geological Survey (CGS) Special Publication 117A (SP-117A): Guidelines for Evaluating and Mitigating Seismic Hazard in California.*

2. *Area replacement ratio for the compaction elements and the basis of its determination shall be explained. Minimum factor of safety for soil compaction shall be in accordance with SP-117A.*

3. *Depth of soil compaction elements and extent beyond the footprint of structures/foundation shall be defined. Extent beyond the foundation shall be half the depth of the VSCs with a minimum of 10 ft or an approved alternative.*

4. *Minimum diameter and maximum spacing of soil compaction elements shall be specified. VSCs shall not be less than 2 feet in diameter, and center to center spacing shall not exceed 8 feet.*

5. *The modulus of subgrade reactions for shallow foundations shall account for the presence of compaction elements.*

6. *The modulus of subgrade reactions, long-term settlement and post-earthquake settlement shall be specified along with expected total and differential settlements for design.*

7. *The acceptance criteria for the cone penetration test (CPT) in accordance with ASTM D 3441 complemented by the standard penetration test (SPT) in accordance with ASTM D 1586, if necessary, to verify soil improvement shall be specified.*

8. *The requirements for special inspection and observation by the geotechnical engineer shall be specified.*

9. *A final verified report (FVR) documenting the installation of the ground improvement system and confirming that the ground improvement acceptance criteria have been met shall be prepared by the geotechnical engineer and submitted to the enforcement agency for review and approval.*

J112.3 Shallow foundations. *VSCs under the shallow foundation shall be located symmetrically around the centroid of the footing or load.*

1. *There shall be a minimum of four stone columns under each isolated or continuous/combined footing or approved equivalent.*

2. *The VSCs or deep foundation elements shall not be used to resist tension or overturning uplift from the shallow foundations.*

3. *The foundation design for the shallow foundation shall consider the increased vertical stiffness of the VSCs as point supports for analysis, unless it is substantiated that the installation of the VSCs result in improvement of the surrounding soils such that the modulus of subgrade reaction, long term settlement, and post-earthquake settlement can be considered uniform throughout.*

J112.4 Installation. *VSCs shall be installed with vibratory probes. Vertical columns of compacted unbounded aggregate shall be formed through the soils to be improved by adding gravel near the tip of the vibrator and progressively raising and repenetrating the vibrator which will results in the gravel being pushed into the surrounding soil. Gravel aggregate for VSCs shall be well graded with a maximum size of 6 inches and not more than 10 percent smaller than $^{3}/_{8}$ inch after compaction.*

J112.5 Construction documents. *Construction documents for VSCs, as a minimum, shall include the following:*

1. *Size, depth and location of VSCs.*

2. *Extent of soil improvements along with building/structure foundation outlines.*

3. *Field verification requirements and acceptance criteria using CPT/SPT.*

4. *The locations where CPT/SPT shall be performed.*

5. *The testing, inspection and observation (TIO) program shall indicate the inspection and observation required for the VSCs.*

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HISTORY NOTE APPENDIX

California Building Code
Title 24, Part 2, California Code of Regulations (CCR)

For prior code history, see the History Note Appendix to the *California Building Code (CBC)*, 2010 Triennial Edition effective January 1, 2011.

1. BSC 03/12, SFM 02/12, OSHPD 03/12 & 04/12, DSA-SS 02/12, HCD 06/12, HCD 08/12, DSA-AC 01/12, BSCC 01/12, CDPH 01/12, SLC 01/12 — Adoption of the 2012 edition of the *International Building Code* published by the International Code Council, for incorporation into the *2013 California Building Code*, CCR Title 24, Part 2 with amendments for State regulated occupancies effective on January 1, 2014.
2. Errata to correct editorial errors within the preface as well as throughout various chapters this code. Effective January 1, 2014.

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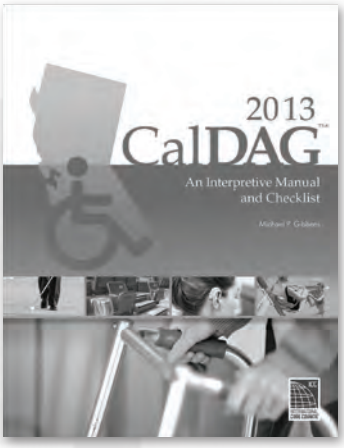

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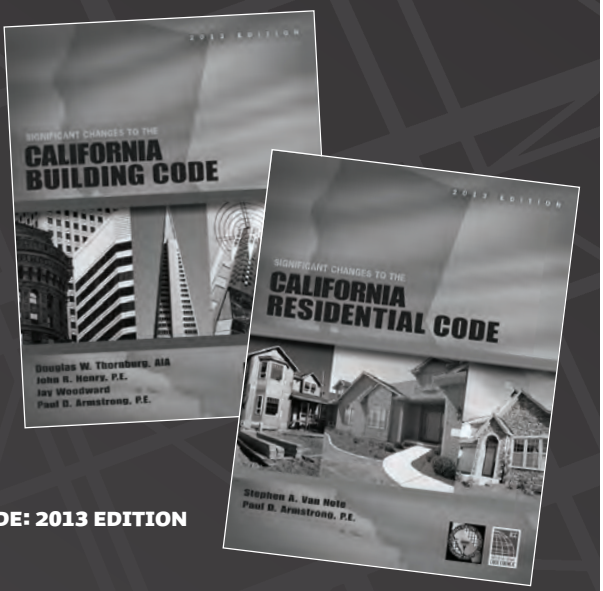

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