2022 CALIFORNIA EXISTING BUILDING CODE

2022 California Historical Building Code, Title 24, Part 8
2022 California Referenced Standards, Title 24, Part 12

INCLUDING 2023 CITY OF LOS ANGELES AMENDMENTS

2022 CALIFORNIA EXISTING BUILDING CODE

INCLUDING 2023 CITY OF LOS ANGELES AMENDMENTS

CITY OF LOS ANGELES
FOUNDED 1781

ICC
INTERNATIONAL CODE COUNCIL®

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(Based on the 2021 IEBC® Including 2023 City of Los Angeles Amendments)

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CITY OF LOS ANGELES
DEPARTMENT OF BUILDING AND SAFETY

Published Codes:

2022 California Building Code including 2023 City of Los Angeles Amendments, Volumes 1 and 2
2022 California Residential Code including 2023 City of Los Angeles Amendments
2022 California Electrical Code including 2023 City of Los Angeles Amendments
2022 California Plumbing Code including 2023 City of Los Angeles Amendments
2022 California Mechanical Code including 2023 City of Los Angeles Amendments
2022 California Green Building Standards Code including 2023 City of Los Angeles Amendments
2022 California Existing Building Code including 2023 City of Los Angeles Amendments

Related Codes and Standards:

City of Los Angeles Municipal Code
City of Los Angeles Planning and Zoning Code
California Building Standards Code, Parts 2–5, 7, 8, 10, and 11

CITY OF LOS ANGELES

DEPARTMENT OF BUILDING AND SAFETY

The mission of the Department of Building and Safety is to protect the lives and safety of the residents and visitors of the City of Los Angeles and enhance the quality of life, housing, economic prosperity, and job creation. Through a timely, cooperative, and transparent process, the Department advises, guides, and assists customers to achieve compliance with the Building, Zoning, Plumbing, Mechanical, Electrical, Disabled Access, Energy, and Green Codes and local State laws to build safe, well, and fast.

The Department of Building and Safety is the largest organization of its kind in the United States with a dedicated staff of more than 1,000 employees. The Department provides service to a population of more than 4 million people in a metropolitan area of more than 470 square miles with its 12 offices located throughout the City.

The Responsibilities of the Department of Building and Safety Are Assigned to Five Bureaus:

The Permit and Engineering Bureau is primarily responsible for the plan checking, report approval, and permit issuance related to building projects within privately owned property in the City of Los Angeles. In the course of carrying out these responsibilities, the Engineering Bureau enforces the structural, building, plumbing, mechanical, electrical, disabled access, green, grading and zoning regulations of the City. In addition, the Permit and Engineering Bureau is responsible for reviewing applications for building, plumbing, mechanical and electrical product approvals through its Building Research Section, and Electrical and Mechanical Test Laboratories.

The Inspection Bureau is responsible for inspection of all construction activities for new and existing buildings, plumbing, mechanical, electrical, elevator and pressure vessel systems, the enforcement of applicable State and local laws relating to existing buildings and property, and the administration of various special programs mandated by the City Council.

The Code Enforcement Bureau was created as a part of a reorganization of code enforcement functions in 1999. This Bureau is responsible for the enforcement of Municipal Code requirements for all existing buildings in the City of Los Angeles, except rental multifamily dwellings. The Bureau handles complaints, citations, processing of vacant and nuisance buildings for repair or demolition, signs, the Vehicle Establishment Inspection Program and the Proactive Code Enforcement Program among others.

The Resource Management Bureau is responsible for the direction and coordination of administrative and financial projects, systems development, training, and acts as the emergency disaster coordinator for all Department operations.

The Technology Service Bureau is responsible to provide oversight over the Build LA Project, and annually provides IT services for more than 3,000 City Staff (Building and Safety and other departments) and over 30,000 public customers; and manages more than 250 servers and 3,000 computer devices.

The Board of Building and Safety Commissioners:

The Board of Building and Safety Commissioners is a five-member board of citizens residing in the City and appointed by the Mayor and confirmed by the City Council. The Commission has the authority to hear and act upon appeals from determinations, orders, or actions of the Department or the Superintendent of Building, pertaining to enforcement of the codes under the jurisdiction of the Department. In addition, the Commission conducts public hearings, as needed, regarding procedures, new codes and various functions of the Department. Finally, the Commission acts in an advisory capacity to the Department and the Superintendent of Building.

The Board of Disabled Access Appeals Commissioners:

The Board of Disabled Access Appeals Commissioners comprises of five qualified persons appointed by the Mayor and confirmed by the City Council. Two members of the commission shall be physically disabled persons, and two members shall be persons experienced in construction. The fifth member may be any resident of the City of Los Angeles. The Commission has the authority to hear and act upon appeals from determinations, orders, or actions of the Department or the Superintendent of Building, pertaining to enforcement of the disabled access codes under the jurisdiction of the Disabled Access Division of the Department.

EFFECTIVE USE OF THE CITY OF LOS ANGELES EXISTING BUILDING CODE

The *City of Los Angeles Existing Building Code* was established in 1889 with the appointment of the first superintendent of building. In 1923, the first of 18 volumes of the *Los Angeles Annual Builder's Guide* was published. This guide is a handbook for architects and builders and contains a complete cross index of the Los Angeles building ordinances, electrical ordinances and supplementary rulings and the California State Housing Act.

After 1936, the building regulations of Chapter IX of the *Los Angeles Municipal Code* (LAMC) were established by the passage of Ordinance No. 77,000. But it was 1943 when Ordinance No. 87,000 amended in its entirety Article 1 of Chapter IX of the *Los Angeles Municipal Code* and a new *Los Angeles City Existing Building Code* was published. This edition of the LAMC established the format of the different divisions and sections relevant to the building regulations in the city.

Through the intervening years, the code has been amended and revised regularly to keep pace with the ever-changing technology of the construction industry and new and proven concepts of structural design.

The State of California has mandated the City of Los Angeles to enforce the *California Existing Building Code* (CEBC). The City Council for the City of Los Angeles has passed Ordinance Number 187,719 (operative January 1, 2023) to amend Article 1 of Chapter IX of the *Los Angeles Municipal Code* and to adopt by reference the 2019 edition of the CEBC and hereinafter shall be called the 2020 edition of the *City of Los Angeles Existing Building Code*.

Marginal Markings

L A L A These symbols indicate that a City of Los Angeles amendment has been added to the 2022 CEBC.

➔ This symbol indicates a deletion of IEBC or CEBC or city of Los Angeles language by the City of Los Angeles.

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CHAPTER 1 – SCOPE AND ADMINISTRATION

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below	X		X	X	X		X	X	X	X	X	X	X	X	X								
Chapter / Section																							
Division I – California Administration																							
1.1	X		X	X	X		X	X	X														
1.2	X																						
1.3 (Reserved)																							
1.4 (Reserved)																							
1.5 (Reserved)																							
1.6 (Reserved)																							
1.7 (Reserved)																							
1.8				X	X																		
1.9.1							X																
1.9.1.1							X																
1.9.2								X	X														
1.9.2.1								X															
1.9.2.2									X														
1.10.1										X	X												
1.10.2												X											
1.10.3													X										
1.10.4														X									
1.10.5															X								
1.11			X																				
Division II – Scope and Administration																							
101.2				X	X																		
101.8	X			X	X																		
101.8.1								X	X														
102.1 – 102.5											X	X		X	X								
104.9 – 104.11											X	X		X	X								
105.1			X																				
105.2 Building: 1-6				X	X																		
105.2.1 – 105.2.2			X																				
105.3 – 105.3.1			X																				
105.4			X																				
105.5.1	X																						

(continued)

CALIFORNIA BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 1 – SCOPE AND ADMINISTRATION—continued

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below	X		X	X	X		X	X	X														
Chapter / Section																							
105.6 – 105.7			X																				
106.1				X	X																		
106.1 – 106.4			X																				
106.2.1				X	X																		
106.2.3				X	X																		
106.2.4				X	X																		
106.2.5	X			X	X			X	X														
106.2.6				X	X																		
106.4			X																				
106.5			X																				
107.1 – 107.4			X																				
109.1 – 109.2				†	†																		
109.3 – 109.3.11				X	X																		
109.3.6	X							X	X														
109.3.6.1				X	X																		
110			X																				
111			X																				
113.1 – 113.2			X																				
114			X																				
115			X																				

The state agency does not adopt sections identified with the following symbol: †

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 1

SCOPE AND ADMINISTRATION

DIVISION I
CALIFORNIA ADMINISTRATION

SECTION 1.1
GENERAL

1.1.1 Title. *These regulations shall be known as the California Existing Building Code, may be cited as such and will be referred to herein as "this code." The California Existing Building Code is Part 10 of thirteen parts of the official compilation and publication of the adoption, amendment and repeal of building regulations to the California Code of Regulations, Title 24, also referred to as the California Building Standards Code. This part incorporates by adoption the 2021 International Existing Building Code of the International Code Council with necessary California amendments.*

1.1.2 Purpose. *The purpose of this code is to establish the minimum requirements to safeguard the public health, safety and general welfare through structural strength, means of egress facilities, stability, access to persons with disabilities, sanitation, adequate lighting and ventilation and energy conservation; safety to life and property from fire and other hazards attributed to the built environment; and to provide safety to fire fighters and emergency responders during emergency operations.*

1.1.3 Scope. *The provisions of this code shall apply to the construction, alteration, movement, enlargement, replacement, repair, equipment, use and occupancy, location, maintenance, removal and demolition of every building or structure or any appurtenances connected or attached to such buildings or structures throughout the State of California.* ***[HCD 1 & 2]*** *The provisions of this code shall apply to repair, alteration, change of occupancy, addition to and relocation of every existing building or structure or any appurtenances connected or attached to such buildings or structures throughout the State of California.*

1.1.3.1 Nonstate-regulated buildings, structures and applications. *Except as modified by local ordinance pursuant to Section 1.1.8, the following standards in the California Code of Regulations, Title 24, Parts 2, 2.5, 3, 4, 5, 6, 9, 10 and 11 shall apply to all occupancies and applications not regulated by a state agency.*

1.1.3.2 State-regulated buildings, structures and applications. *The model code, state amendments to the model code and/or state amendments where there are no relevant model code provisions shall apply to the following buildings, structures and applications regulated by state agencies as specified in Sections 1.2 through 1.14, except where modified by local ordinance pursuant to Section 1.1.8. When adopted by a state agency, the provisions of this code shall be enforced by the appropriate enforcing agency, but only to the extent of authority granted to such agency by the state legislature.*

Note: *See "How to Distinguish Between Model Code Language and California Amendments" in the front of the code.*

1. *State-owned buildings, including buildings constructed by the Trustees of the California State University, and to the extent permitted by California laws, buildings designed and constructed by the Regents of the University of California, and regulated by the Building Standards Commission. See Section 1.2 for additional scope provisions.*
2. *Section 1.3 is reserved for the Board of State Community Corrections.*
3. *Section 1.4 is reserved for the Department of Consumer Affairs.*
4. *Section 1.5 is reserved for the California Energy Commission.*
5. *Section 1.6 is reserved for the Department of Food and Agriculture.*
6. *Section 1.7 is reserved for the Department of Public Health.*
7. *Hotels, motels, lodging houses, apartments, dwellings, dormitories, condominiums, shelters for homeless persons, congregate residences, employee housing, factory-built housing and other types of dwellings containing sleeping accommodations with or without common toilets or cooking facilities. See Section 1.8.2.1.1 for additional scope provisions.*
8. *Accommodations for persons with disabilities in buildings containing newly constructed covered multifamily dwellings, new common use areas serving existing covered multifamily dwellings, additions to existing buildings where the addition alone meets the definition of covered multifamily dwelling, and new common-use areas serving new covered multifamily dwellings, which are regulated by the Department of Housing and Community Development. See Section 1.8.2.1.2 for additional scope provisions.*
9. *Permanent buildings and permanent accessory buildings or structures constructed within mobilehome parks and special occupancy parks regulated by the Department of Housing and Community Development. See Section 1.8.2.1.3 for additional scope provisions.*
10. *Accommodations for persons with disabilities regulated by the Division of the State Architect. See Section 1.9.1 for additional scope provisions.*

11. *Public elementary and secondary schools, community college buildings and state-owned or state-leased essential service buildings regulated by the Division of the State Architect. See Section 1.9.2 for additional scope provisions.*
12. *Qualified historical buildings and structures and their associated sites regulated by the State Historical Building Safety Board with the Division of the State Architect.*
13. *General acute care hospitals, acute psychiatric hospitals, skilled nursing and/or intermediate care facilities, clinics licensed by the Department of Public Health and correctional treatment centers regulated by the Office of Statewide Health Planning and Development. See Section 1.10 for additional scope provisions.*
14. *Applications regulated by the Office of the State Fire Marshal include, but are not limited to, the following in accordance with Section 1.11:*
    - 14.1. *Buildings or structures used or intended for use as an:*
        1. *Asylum, jail, prison*
        2. *Mental hospital, hospital, home for the elderly, children's nursery, children's home or institution, school or any similar occupancy of any capacity*
        3. *Theater, dancehall, skating rink, auditorium, assembly hall, meeting hall, nightclub, fair building or similar place of assemblage where 50 or more persons may gather together in a building, room or structure for the purpose of amusement, entertainment, instruction, deliberation, worship, drinking or dining, awaiting transportation, or education*
        4. *Small family day-care homes, large family day-care homes, residential facilities and residential facilities for the elderly, residential care facilities*
        5. *State institutions or other state-owned or state-occupied buildings*
        6. *High-rise structures*
        7. *Motion picture production studios*
        8. *Organized camps*
        9. *Residential structures*
    - 14.2. *Tents, awnings or other fabric enclosures used in connection with any occupancy*
    - 14.3. *Fire alarm devices, equipment and systems in connection with any occupancy*
    - 14.4. *Hazardous materials, flammable and combustible liquids*
    - 14.5. *Public school automatic fire detection, alarm and sprinkler systems*
    - 14.6. *Wildland-urban interface fire areas*
15. *Section 1.12 is reserved for the State Librarian.*
16. *Section 1.13 is reserved for the Department of Water Resources.*
17. *For applications listed in Section 1.9.1 regulated by the Division of the State Architect-Access Compliance, outdoor environments and uses shall be classified according to accessibility uses described in Chapter 11B contained in the California Building Code.*
18. *Section 1.14 is reserved for the California State Lands Commission.*

1.1.4 Appendices. *Provisions contained in the appendices of this code shall not apply unless specifically adopted by a state agency or adopted by a local enforcing agency in compliance with Health and Safety Code Section 18901 et seq. for Building Standards Law, Health and Safety Code Section 17950 for State Housing Law and Health and Safety Code Section 13869.7 for Fire Protection Districts. See Section 1.1.8 of this code.*

1.1.5 Referenced codes. *The codes, standards and publications adopted and set forth in this code, including other codes, standards and publications referred to therein are, by title and date of publication, hereby adopted as standard reference documents of this code. When this code does not specifically cover any subject related to building design and construction, recognized architectural or engineering practices shall be employed. The National Fire Codes, standards and the Fire Protection Handbook of the National Fire Protection Association are permitted to be used as authoritative guides in determining recognized fire prevention engineering practices.*

1.1.6 Nonbuilding standards, orders and regulations. *Requirements contained in the California Existing Building Code, or in any other referenced standard, code or document, which are not building standards as defined in Health and Safety Code Section 18909, shall not be construed as part of the provisions of this code. For nonbuilding standards, orders and regulations, see other titles of the California Code of Regulations.*

1.1.7 Order of precedence and use.

1.1.7.1 Differences. *In the event of any differences between these building standards and the standard reference documents, the text of these building standards shall govern.*

1.1.7.2 Specific provisions. *Where a specific provision varies from a general provision, the specific provision shall apply.*

1.1.7.3 Conflicts. *When the requirements of this code conflict with the requirements of any other part of the California Building Standards Code, Title 24 the most restrictive requirements shall prevail.*

1.1.7.3.1 Detached one- and two-family dwellings. *Detached one- and two-family dwellings, lodging houses, live/work units, townhouses not more than three stories above grade plane in height with a separate means of* *egress, and their accessory structures, may be designed and constructed in accordance with the California Residential Code or the California Building Code, but not both, unless the proposed structure(s) or element(s) exceed the design limitations established in the California Residential Code, and the code user is specifically directed by the California Residential Code to use the California Building Code.*

1.1.8 City, county, or city and county amendments, additions or deletions. *The provisions of this code do not limit the authority of city, county, or city and county governments to establish more restrictive and reasonably necessary differences to the provisions contained in this code pursuant to complying with Section 1.1.8.1. The effective date of amendments, additions or deletions to this code by a city, county, or city and county filed pursuant to Section 1.1.8.1 shall be the date filed. However, in no case shall the amendments, additions or deletions to this code be effective any sooner than the effective date of this code.*

Local modifications shall comply with Health and Safety Code Section 18941.5 for Building Standards Law, Health and Safety Code Section 17958 for State Housing Law or Health and Safety Code Section 13869.7 for Fire Protection Districts.

1.1.8.1 Findings and filings.

1. *The city, county, or city and county shall make express findings for each amendment, addition or deletion based upon climatic, topographical or geological conditions.*

   Exception: *Hazardous building ordinances and programs mitigating unreinforced masonry buildings.*

2. *The city, county, or city and county shall file the amendments, additions or deletions expressly marked and identified as to the applicable findings. Cities, counties, cities and counties, and fire departments shall file the amendments, additions or deletions, and the findings with the California Building Standards Commission at 2525 Natomas Park Drive, Suite 130, Sacramento, CA 95833.*

3. *Findings prepared by fire protection districts shall be ratified by the local city, county, or city and county and filed with the California Department of Housing and Community Development, Division of Codes and Standards, P.O. Box 278180, Sacramento, CA 95827-8180 or 9342 Tech Center Drive, Suite 500, Sacramento, CA 95826-2581.*

1.1.8.2 Locally adopted energy standards – California Energy Code, Part 6

In addition to the provisions of Section 1.1.8.1 of this Part, the provisions of this section shall apply to a city, county, and city and county adopting local energy standards applicable to buildings and structures subject to the California Energy Code, Part 6.

Applicable provisions of Public Resources Code Section 25402.1(h)(2) and applicable provisions of Section 10-106, Chapter 10 of the California Administrative Code, Part 1 apply to locally adopted energy standards amending the California Energy Code, Part 6.

1.1.9 Effective date of this code. *Only those standards approved by the California Building Standards Commission that are effective at the time an application for building permit is submitted shall apply to the plans and specifications for, and to the construction performed under, that permit. For the effective dates of the provisions contained in this code, see the History Note page of this code.*

Exceptions:

(1) ***[HCD 1 & HCD 2]*** *Retroactive permits issued in accordance with Health and Safety Code Section 17958.12.*

(2) ***[HCD 1 & HCD 2]*** *Plans approved by the Department of Housing and Community Development or a Department-approved design approval agency for factory-built housing as defined by Health and Safety Code Section 19971. Approved plans, pursuant to the California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 1, Article 3, Section 3048 remain valid for a period of 36 months from the date of plan approval.*

1.1.10 Availability of codes. *At least one complete copy each of Titles 8, 19, 20, 24 and 25 with all revisions shall be maintained in the office of the building official responsible for the administration and enforcement of this code. Each state department concerned and each city, county, or city and county shall have an up-to-date copy of the code available for public inspection. See Health and Safety Code Section 18942(e)(1) and (2).*

1.1.11 Format. *This part fundamentally adopts the International Existing Building Code by reference on a chapter-by-chapter basis. When a specific chapter of the International Existing Building Code is not printed in the code and is marked "Reserved", such chapter of the International Existing Building Code is not adopted as a portion of this code. When a specific chapter of the International Existing Building Code is marked "Not adopted by the State of California" but appears in the code, it may be available for adoption by local ordinance.*

Those provisions of the model code used as the basis for this part of the California Building Standards Code in Title 24, California Code of Regulations, that are not printed herein and are marked "Not adopted by the State of California," may be available for adoption by local ordinance, provided such ordinance and related model code provisions do not conflict with Title 24 provisions applicable to the subject occupancy or building feature. Such a local ordinance is not subject to the Express Finding and document filing requirements of Health and Safety Code Sections 13869.7, 17958 and 18941.5.

Note: *Matrix Adoption Tables at the front of each chapter may aid the code user in determining which chapter or sections within a chapter are applicable to buildings under the authority of a specific state agency, but they are not to be considered regulatory.*

1.1.12 Validity. *If any chapter, section, subsection, sentence, clause or phrase of this code is for any reason held to be unconstitutional, contrary to statute, exceeding the authority of the state as stipulated by statutes or otherwise inoperative, such decision shall not affect the validity of the remaining portion of this code.*

SECTION 1.2
BUILDING STANDARDS COMMISSION

1.2.1 BSC. *Specific scope of application of the agency responsible for enforcement, the enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

1. ***State buildings for all occupancies.***

   Application—*State buildings (all occupancies), including buildings constructed by the Trustees of the California State University (CSU) and the Regents of the University of California (UC) where no state agency has the authority to adopt building standards applicable to such buildings.*

   Enforcing agency—*State or local agency specified by the applicable provisions of law.*

   Authority cited—*Health and Safety Code Section 18934.5.*

   Reference—*Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.*

2. ***University of California, California State Universities and California Community Colleges.***

   Application—*Standards for lighting for parking lots and primary campus walkways at the University of California, California State Universities and California Community Colleges.*

   Enforcing agency—*State or local agency specified by the applicable provisions of law.*

   Authority cited—*Government Code Section 14617.*

   Reference—*Government Code Section 14617.*

3. ***Existing state-owned buildings, including those owned by the University of California and by the California State University.***

   Application—*Building seismic retrofit standards including abating falling hazards of structural and nonstructural components and strengthening of building structures. See also Division of the State Architect.*

   Enforcing agency—*State or local agency specified by the applicable provisions of law.*

   Authority cited—*Health and Safety Code Section 16600.*

   Reference—*Health and Safety Code Sections 16600 through 16604.*

4. ***Unreinforced masonry-bearing wall buildings.***

   Application—*Minimum seismic strengthening standards for buildings specified in Appendix Chapter A1 of the California Existing Building Code, except for buildings subject to building standards pursuant to Health and Safety Code (commencing) with Section 17910.*

   Enforcing agency—*State or local agency specified the applicable provisions of law.*

   Authority cited—*Health and Safety Code Section 18934.7.*

   Reference—*Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.*

1.2.1.1 State building. *For purposes of this code, a "state building" is a structure for which a state agency or state entity has authority to construct, alter, enlarge, replace, repair or demolish.*

1.2.1.2 Enforcement. *[CSU, UC, Judicial Council and California Department of Corrections and Rehabilitation] State agencies or state entities authorized to construct state buildings may appoint a building official who is responsible to the agency for enforcement of the provisions of the California Building Standards Code.*

> ***Exception:*** *State buildings regulated by other sections of this code remain the enforcement responsibility of the designated entities.*

1.2.1.3 Enforcement. *Reserved for DGS.*

1.2.1.4 Adopting agency identification. *The provisions of this code applicable to buildings identified in this section will be identified in the Matrix Adoption Tables under the acronym* ***BSC****.*

1.2.2 BSC-CG. *Specific scope of application of the agency responsible for enforcement, the enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

1. ***Green building standards for nonresidential occupancies.***

   Application—*All occupancies where no state agency has the authority to adopt green building standards applicable to those occupancies.*

   Enforcing agency—*State or local agency specified by the applicable provisions of law.*

   Authority cited—*Health and Safety Code Sections 18930.5(a), 18938 and 18940.5.*

   Reference—*Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.*

2. ***Graywater systems for nonresidential occupancies.***

   Application—*The construction, installation and alteration of graywater systems for indoor and outdoor uses in nonresidential occupancies.*

   Enforcing agency—*State or local agency specified by the applicable provisions of law.*

   Authority cited—*Health & Safety Code Section 18941.8.*

   Reference—*Health & Safety Code Section 18941.8.*

1.2.2.1 Adopting agency identification. *The provisions of this code applicable to buildings identified in this section will be identified in the Matrix Adoption Tables under the acronym* ***BSC-CG****.*

1.2.3 Alternative materials, design and methods of construction and equipment. *The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building* *official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.*

1.2.3.1 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.*

1.2.3.2 Tests. *Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official shall have the authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.*

SECTION 1.3 BOARD OF STATE AND COMMUNITY CORRECTIONS
Reserved

SECTION 1.4 DEPARTMENT OF CONSUMER AFFAIRS
Reserved

SECTION 1.5 CALIFORNIA ENERGY COMMISSION
Reserved

SECTION 1.6 DEPARTMENT OF FOOD AND AGRICULTURE
Reserved

SECTION 1.7 DEPARTMENT OF PUBLIC HEALTH
Reserved

SECTION 1.8 DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

1.8.1 Purpose. *The purpose of this code is to establish the minimum requirements necessary to protect the health, safety and general welfare of the occupants and the public by governing accessibility, erection, construction, reconstruction, enlargement, conversion, alteration, repair, moving, removal, demolition, occupancy, use, height, court, area, sanitation, ventilation, maintenance and safety to life and property from fire and other hazards attributed to the built environment.*

SECTION 1.8.2 AUTHORITY AND ABBREVIATIONS

1.8.2.1 General. *The Department of Housing and Community Development is authorized by law to promulgate and adopt building standards and regulations for several types of building applications. The applications under the authority of the Department of Housing and Community Development are listed in Sections 1.8.2.1.1 through 1.8.2.1.3.*

Note: *See the California Residential Code for detached one-and two-family dwellings and townhouses.*

1.8.2.1.1 Housing construction.

Application—*Hotels, motels, lodging houses, apartments, dwellings, dormitories, condominiums, shelters for homeless persons, congregate residences, employee housing, factory-built housing and other types of dwellings containing sleeping accommodations with or without common toilet or cooking facilities including accessory buildings, facilities and uses thereto. Sections of this code which pertain to applications listed in this section are identified using the abbreviation "HCD 1."*

Enforcing agency—*Local building department or the Department of Housing and Community Development.*

Authority cited—*Health and Safety Code Sections 17040, 17920.9, 17921, 17921.5, 17921.6, 17921.10, 17922, 17922.6, 17922.12, 17922.14, 17922.15, 17926, 17927, 17928, 17958.12, 18938.3, 18944.11 and 19990; and Government Code Section 12955.1.*

Reference—*Business and Professions Code Division 5, Health and Safety Code Sections 17000 through 17062.5, 17910 through 17995.5, 18200 through 18700, 18860 through 18874, 18938.6, 18941, 19890, 19891, 19892 and 19960 through 19997; Civil Code Sections 832, 1101.4, 1101.5 and 1954.201, 1954.202 and 5551; Government Code Sections 8698.4, 12955.1 and 12955.1.1. California Code of Regulations, Title 20, Sections 1605.1, 1605.3 and 1607.*

1.8.2.1.2 Housing accessibility.

Application—*Covered multifamily dwellings as defined in Chapter 2 of the California Building Code, including but not limited to, lodging houses, dormitories, timeshares, condominiums, shelters for homeless persons, congregate residences, apartments, dwellings, employee housing, factory-built housing and other types of dwellings containing sleeping accommodations with or without common toilet or cooking facilities.*

Sections of this code identified by the abbreviation "HCD 1-AC" require specific accommodations for persons with disabilities as defined in Chapter 2 of the California Building Code. The application of such provisions shall be in conjunction with other requirements of the California Building Code, and apply only to *newly constructed covered multifamily dwellings as defined in Chapter 2 of the California Building Code. "HCD 1-AC" applications include, but are not limited to, the following:*

1. *All newly constructed covered multifamily dwellings as defined in Chapter 2 of the California Building Code.*
2. *New common use areas as defined in Chapter 2 of the California Building Code, serving existing covered multifamily dwellings.*
3. *Additions to existing buildings, where the addition alone meets the definition of covered multifamily dwellings as defined in Chapter 2 of the California Building Code.*
4. *New common use areas serving new covered multifamily dwellings.*
5. *Where any portion of a building's exterior is preserved, but the interior of the building is removed, including all structural portions of floors and ceilings, the building is considered a new building for determining the application of Chapter 11A of the California Building Code.*

"HCD 1-AC" building standards generally do not apply to public use areas or public accommodations such as hotels and motels, and public housing. Public use areas, public accommodations and public housing, as defined in Chapter 2 of the California Building Code, are subject to the Division of the State Architect (DSA-AC) in Chapter 11B of the California Building Code, and are referenced in Section 1.9.1.

Enforcing agency—*Local building department or the Department of Housing and Community Development.*

Authority cited—*Health and Safety Code Sections 17040, 17920.9, 17921, 17921.5, 17921.6, 17921.10, 17922, 17922.6, 17922.12, 17922.14, 17926, 17927, 17928, 17958.12, 18938.3, 18944.11 and 19990; and Government Code Sections 12955.1 and 12955.1.1.*

Reference—*Health and Safety Code Sections 17000 through 17062.5, 17910 through 17995.5, 18200 through 18700, 18860 through 18874, 18938.6, 18941 and Sections 19960 through 19997; Civil Code Sections 1101.4, 1101.5, 1954.201 and 1954.202; and Government Code Sections 12955.1 and 12955.1.1. California Code of Regulations, Title 20, Sections 1605.1, 1605.3 and 1607.*

1.8.2.1.3 Permanent buildings in mobilehome parks and special occupancy parks.

Application—*Permanent buildings, and permanent accessory buildings or structures, constructed within mobilehome parks and special occupancy parks that are under the control and ownership of the park operator. Sections of this code which pertain to applications listed in this section are identified using the abbreviation "HCD 2."*

Enforcing agency—*The Department of Housing and Community Development, local building department or other local agency that has assumed responsibility for the enforcement of Health and Safety Code, Division 13, Part 2.1, commencing with Section 18200 for mobilehome parks and Health and Safety Code, Division 13, Part 2.3, commencing with Section 18860 for special occupancy parks.*

Authority cited—*Health and Safety Code Sections 17040, 17920.9, 17921, 17921.5, 17921.6, 17921.10, 17922, 17922.6, 17922.12, 17922.14, 17922.15, 17926, 17927, 17928, 17958.12, 18552, 18554, 18620, 18630, 18640, 18670, 18690, 18691, 18865, 18871.3, 18871.4, 18873, 18873.1 through 18873.5, 18938.3, 18944.11 and 19990; and Government Code Section 12955.1.*

Reference—*Health and Safety Code Sections 17000 through 17062.5, 17910 through 17995.5, 18200 through 18700, 18860 through 18874, 18938.6, 18941, 19890, 19891, 19892 and Sections 19960 through 19997; Civil Code Sections 1101.4, 1101.5 and 1954.201; and Government Code Sections 12955.1 and 12955.1.1; and Title 25, Sections 1042 and 2042.*

SECTION 1.8.3
LOCAL ENFORCING AGENCY

1.8.3.1 Duties and powers. *The building department of every city, county, or city and county shall enforce all the provisions of law, this code, and the other rules and regulations promulgated by the Department of Housing and Community Development pertaining to the installation, erection, construction, reconstruction, movement, enlargement, conversion, alteration, repair, removal, demolition or arrangement of apartments, condominiums, hotels, motels, lodging houses and dwellings, including accessory buildings, facilities and uses thereto.*

For additional information regarding the use and occupancy of existing buildings and appurtenant structures, see California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, commencing with Article 1, Section 1.

1.8.3.2 Laws, rules and regulations. *Other than the building standards contained in this code, and notwithstanding other provisions of law, the statutory authority and location of the laws, rules and regulations to be enforced by local enforcing agencies are listed by statute in Sections 1.8.3.2.1 through 1.8.3.2.5 below:*

1.8.3.2.1 State Housing Law. *Refer to the State Housing Law, California Health and Safety Code, Division 13, Part 1.5, commencing with Section 17910 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, commencing with Section 1, for the erection, construction, reconstruction, movement, enlargement, conversion, alteration, repair, removal, demolition or arrangement of apartments, condominiums, hotels, motels, lodging houses and dwellings, including accessory buildings, facilities and uses thereto.*

1.8.3.2.2 Mobilehome Parks Act. *Refer to the Mobilehome Parks Act, California Health and Safety Code, Division 13, Part 2.1, commencing with Section 18200 and California Code of Regulations, Title 25, Division 1, Chapter 2, commencing with Section 1000 for mobilehome park administrative and enforcement authority, permits, plans, fees, violations, inspections and penalties both within and outside mobilehome parks.*

> ***Exception:*** *Mobilehome parks where the Department of Housing and Community Development is the enforcing agency.*

1.8.3.2.3 Special Occupancy Parks Act. *Refer to the Special Occupancy Parks Act, California Health and Safety Code, Division 13, Part 2.3, commencing with Section 18860 and California Code of Regulations, Title 25, Division 1, Chapter 2.2, commencing with Section 2000 for special occupancy park administrative and enforcement authority, permits, fees, violations, inspections and penalties both within and outside of special occupancy parks.*

> ***Exception:*** *Special occupancy parks where the Department of Housing and Community Development is the enforcing agency.*

1.8.3.2.4 Employee Housing Act. *Refer to the Employee Housing Act, California Health and Safety Code, Division 13, Part 1, commencing with Section 17000 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 3, commencing with Section 600 for employee housing administrative and enforcement authority, permits, fees, violations, inspections and penalties.*

1.8.3.2.5 Factory-Built Housing Law. *Refer to the Factory-Built Housing Law, California Health and Safety Code, Division 13, Part 6, commencing with Section 19960 and California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 1, commencing with Section 3000 for factory-built housing administrative and enforcement authority, permits, fees, violations, inspections and penalties.*

SECTION 1.8.4
PERMITS, FEES, APPLICATIONS AND INSPECTIONS

1.8.4.1 Permits. *A written construction permit shall be obtained from the enforcing agency prior to the erection, construction, reconstruction, installation, moving or alteration of any building or structure.*

Exceptions:

1. *Work exempt from permits as specified in Chapter 1, Division II, Scope and Administration, Section 105.2.*
2. *Changes, alterations or repairs of a minor nature not affecting structural features, egress, sanitation, safety or accessibility as determined by the enforcing agency.*
3. *Retroactive permits issued in accordance with Health and Safety Code Section 17958.12.*

Exemptions from permit requirements shall not be deemed to grant authorization for any work to be done in any manner in violation of other provisions of law or this code.

1.8.4.2 Fees. *Subject to other provisions of law, the governing body of any city, county, or city and county may prescribe fees to defray the cost of enforcement of rules and regulations promulgated by the Department of Housing and Community Development. The amount of the fees shall not exceed the amount reasonably necessary to administer or process permits, certificates, forms or other documents, or to defray the costs of enforcement. For additional information, see the State Housing Law, Health and Safety Code, Division 13, Part 1.5, Section 17951 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, Article 3, commencing with Section 6.*

1.8.4.3 Plan review and time limitations. *Subject to other provisions of law, provisions related to plan checking, prohibition of excessive delays and contracting with or employment of private parties to perform plan checking are set forth in the State Housing Law, Health and Safety Code Section 17960.1, and for employee housing, in Health and Safety Code Section 17021.*

1.8.4.3.1 Retention of plans. *The building department of every city, county, or city and county shall maintain an official copy, microfilm, electronic or other type of photographic copy of the plans of every building, during the life of the building, for which the department issued a building permit.*

Exceptions:

1. *Single or multiple dwellings not more than two stories and basement in height.*
2. *Garages and other structures appurtenant to buildings listed in Exception 1.*
3. *Farm or ranch buildings appurtenant to buildings listed in Exception 1.*
4. *Any one-story building where the span between bearing walls does not exceed 25 feet (7620 mm), except a steel frame or concrete building.*

All plans for common interest developments as defined in Section 4100 of the California Civil Code shall be retained. For additional information regarding plan retention and reproduction of plans by an enforcing agency, see Health and Safety Code Sections 19850 through 19852.

1.8.4.4 Inspections. *Construction or work for which a permit is required shall be subject to inspection by the building official, and such construction or work shall remain accessible and exposed for inspection purposes until approved. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or other regulations of the Department of Housing and Community Development. Required inspections are listed in Chapter 1, Division II, Scope and Administration, Sections 109.3.1 through 109.3.11.*

SECTION 1.8.5
RIGHT OF ENTRY FOR ENFORCEMENT

1.8.5.1 General. *Subject to other provisions of law, officers and agents of the enforcing agency may enter and inspect public and private properties to secure compliance with the rules and regulations promulgated by the Department of Housing* *and Community Development. For limitations and additional information regarding enforcement, see the following:*

1. *For applications subject to the State Housing Law as referenced in Section 1.8.3.2.1 of this code, refer to Health and Safety Code, Division 13, Part 1.5, commencing with Section 17910 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, commencing with Section 1.*
2. *For applications subject to the Mobilehome Parks Act as referenced in Section 1.8.3.2.2 of this code, refer to Health and Safety Code, Division 13, Part 2.1, commencing with Section 18200 and California Code of Regulations, Title 25, Division 1, Chapter 2, commencing with Section 1000.*
3. *For applications subject to the Special Occupancy Parks Act as referenced in Section 1.8.3.2.3 of this code, refer to Health and Safety Code, Division 13, Part 2.3, commencing with Section 18860 and California Code of Regulations, Title 25, Division 1, Chapter 2.2, commencing with Section 2000.*
4. *For applications subject to the Employee Housing Act as referenced in Section 1.8.3.2.4 of this code, refer to Health and Safety Code, Division 13, Part 1, commencing with Section 17000 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 3, commencing with Section 600.*
5. *For applications subject to the Factory-Built Housing Law as referenced in Section 1.8.3.2.5 of this code, refer to Health and Safety Code, Division 13, Part 6, commencing with Section 19960 and California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 1, commencing with Section 3000.*

SECTION 1.8.6 LOCAL MODIFICATION BY ORDINANCE OR REGULATION

1.8.6.1 General. *Subject to other provisions of law, a city, county, or city and county may make changes to the provisions adopted by the Department of Housing and Community Development. If any city, county, or city and county does not amend, add or repeal by local ordinances or regulations the provisions published in this code or other regulations promulgated by the Department of Housing and Community Development, those provisions shall be applicable and shall become effective 180 days after publication by the California Building Standards Commission. Amendments, additions and deletions to this code adopted by a city, county, or city and county pursuant to California Health and Safety Code Sections 17958.5, 17958.7 and 18941.5, together with all applicable portions of this code, shall also become effective 180 days after publication of the California Building Standards Code by the California Building Standards Commission.*

1.8.6.2 Findings, filings and rejections of local modifications. *Prior to making any modifications or establishing more restrictive building standards, the governing body shall make express findings and filings, as required by California Health and Safety Code Section 17958.7, showing that such modifications are reasonably necessary due to local climatic, geological or topographical conditions. No modification shall become effective or operative unless the following requirements are met:*

1. *The express findings shall be made available as a public record.*
2. *A copy of the modification and express finding, each document marked to cross-reference the other, shall be filed with the California Building Standards Commission for a city, county, or city and county and with the Department of Housing and Community Development for fire protection districts.*
3. *The California Building Standards Commission has not rejected the modification or change.*

Nothing in this section shall limit the authority of fire protection districts pursuant to California Health and Safety Code Section 13869.7(a).

SECTION 1.8.7 ALTERNATE MATERIALS, DESIGNS, TESTS AND METHODS OF CONSTRUCTION

1.8.7.1 General. *The provisions of this code, as adopted by the Department of Housing and Community Development are not intended to prevent the use of any alternate material, appliance, installation, device, arrangement, design or method of construction not specifically prescribed by this code. Consideration and approval of alternates shall comply with Section 1.8.7.2 for local building departments and Section 1.8.7.3 for the Department of Housing and Community Development.*

1.8.7.2 Local building departments. *The building department of any city, county, or city and county may approve alternates for use in the erection, construction, reconstruction, movement, enlargement, conversion, alteration, repair, removal, demolition or arrangement of apartments, condominiums, hotels, motels, lodging houses, dwellings or accessory structures, except for the following:*

1. *Structures located in mobilehome parks as defined in California Health and Safety Code Section 18214.*
2. *Structures located in special occupancy parks as defined in California Health and Safety Code Section 18862.43.*
3. *Factory-built housing as defined in California Health and Safety Code Section 19971.*

1.8.7.2.1 Approval of alternates. *The consideration and approval of alternates by a local building department shall comply with the following procedures and limitations:*

1. *The approval shall be granted on a case-by-case basis.*
2. *Evidence shall be submitted to substantiate claims that the proposed alternate, in performance, safety and protection of life and health, conforms to, or is at least equivalent to, the standards contained in this code and other rules and regulations promulgated*

by the Department of Housing and Community Development.

3. *The local building department may require tests performed by an approved testing agency at the expense of the owner or owner's agent as proof of compliance.*
4. *If the proposed alternate is related to accessibility in covered multifamily dwellings or in facilities serving covered multifamily dwellings as defined in Chapter 2 of the California Building Code, the proposed alternate must also meet the threshold set for equivalent facilitation as defined in Chapter 2 of the California Building Code.*

For additional information regarding approval of alternates by a building department pursuant to the State Housing Law, see California Health and Safety Code Section 17951(e) and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1.

1.8.7.3 Department of Housing and Community Development. *The Department of Housing and Community Development may approve alternates for use in the erection, construction, reconstruction, movement, enlargement, conversion, alteration, repair, removal or demolition of apartments, condominiums, hotels, motels, lodging houses, dwellings or accessory structures thereto and permanent buildings in mobilehome parks and special occupancy parks. The consideration and approval of alternates shall comply with the following:*

1. *The department may require tests at the expense of the owner or owner's agent to substantiate compliance with the California Building Standards Code.*
2. *The approved alternate shall, for its intended purpose, be at least equivalent in performance and safety to the materials, designs, tests or methods of construction prescribed by this code.*

SECTION 1.8.8
APPEALS BOARD

1.8.8.1 General. *Every city, county, or city and county shall establish a process to hear and decide appeals of orders, decisions and determinations made by the enforcing agency relative to the application and interpretation of this code and other regulations governing construction, use, maintenance and change of occupancy. The governing body of any city, county, or city and county may establish a local appeals board and a housing appeals board to serve this purpose. Members of the appeals board(s) shall not be employees of the enforcing agency and shall be knowledgeable in the applicable building codes, regulations and ordinances as determined by the governing body of the city, county, or city and county.*

Where no such appeals boards or agencies have been established, the governing body of the city, county, or city and county shall serve as the local appeals board or housing appeals board as specified in California Health and Safety Code Sections 17920.5 and 17920.6.

1.8.8.2 Definitions. *The following terms shall for the purposes of this section have the meaning shown.*

HOUSING APPEALS BOARD. *The board or agency of a city, county, or city and county which is authorized by the governing body of the city, county, or city and county to hear appeals regarding the requirements of the city, county, or city and county relating to the use, maintenance and change of occupancy of buildings and structures, including requirements governing alteration, additions, repair, demolition and moving. In any area in which there is no such board or agency, "Housing appeals board" means the local appeals board having jurisdiction over the area.*

LOCAL APPEALS BOARD. *The board or agency of a city, county, or city and county which is authorized by the governing body of the city, county, or city and county to hear appeals regarding the building requirements of the city, county, or city and county. In any area in which there is no such board or agency, "Local appeals board" means the governing body of the city, county, or city and county having jurisdiction over the area.*

1.8.8.3 Appeals. *Except as otherwise provided in law, any person, firm or corporation adversely affected by a decision, order or determination by a city, county, or city and county relating to the application of building standards published in the California Building Standards Code, or any other applicable rule or regulation adopted by the Department of Housing and Community Development, or any lawfully enacted ordinance by a city, county, or city and county, may appeal the issue for resolution to the local appeals board or housing appeals board as appropriate.*

The local appeals board shall hear appeals relating to new building construction and the housing appeals board shall hear appeals relating to existing buildings.

SECTION 1.8.9
UNSAFE BUILDINGS OR STRUCTURES

1.8.9.1 Authority to enforce. *Subject to other provisions of law, the administration, enforcement, actions, proceedings, abatement, violations and penalties for unsafe buildings and structures are contained in the following statutes and regulations:*

1. *For applications subject to the State Housing Law as referenced in Section 1.8.3.2.1 of this code, refer to Health and Safety Code, Division 13, Part 1.5, commencing with Section 17910 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, commencing with Section 1. For enforcement related to accessory dwelling units, see Health and Safety Code Section 17980.12 operative until January 1, 2035.*
2. *For applications subject to the Mobilehome Parks Act as referenced in Section 1.8.3.2.2 of this code, refer to Health and Safety Code, Division 13, Part 2.1, commencing with Section 18200 and California Code of Regulations, Title 25, Division 1, Chapter 2, commencing with Section 1000.*
3. *For applications subject to the Special Occupancy Parks Act as referenced in Section 1.8.3.2.3 of this*

code, refer to Health and Safety Code, Division 13, Part 2.3, commencing with Section 18860 and California Code of Regulations, Title 25, Division 1, Chapter 2.2, commencing with Section 2000.

4. *For applications subject to the Employee Housing Act as referenced in Section 1.8.3.2.4 of this code, refer to Health and Safety Code, Division 13, Part 1, commencing with Section 17000 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 3, commencing with Section 600.*
5. *For applications subject to the Factory-Built Housing Law as referenced in Section 1.8.3.2.5 of this code, refer to Health and Safety Code, Division 13, Part 6, commencing with Section 19960 and California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 1, commencing with Section 3000.*

1.8.9.2 Actions and proceedings. *Subject to other provisions of law, punishments, penalties and fines for violations of building standards are contained in the following statutes and regulations:*

1. *For applications subject to the State Housing Law as referenced in Section 1.8.3.2.1 of this code, refer to Health and Safety Code, Division 13, Part 1.5, commencing with Section 17910 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 1, commencing with Section 1.*
2. *For applications subject to the Mobilehome Parks Act as referenced in Section 1.8.3.2.2 of this code, refer to Health and Safety Code, Division 13, Part 2.1, commencing with Section 18200 and California Code of Regulations, Title 25, Division 1, Chapter 2, commencing with Section 1000.*
3. *For applications subject to the Special Occupancy Parks Act as referenced in Section 1.8.3.2.3 of this code, refer to Health and Safety Code, Division 13, Part 2.3, commencing with Section 18860 and California Code of Regulations, Title 25, Division 1, Chapter 2.2, commencing with Section 2000.*
4. *For applications subject to the Employee Housing Act as referenced in Section 1.8.3.2.4 of this code, refer to Health and Safety Code, Division 13, Part 1, commencing with Section 17000 and California Code of Regulations, Title 25, Division 1, Chapter 1, Subchapter 3, commencing with Section 600.*
5. *For applications subject to the Factory-Built Housing Law as referenced in Section 1.8.3.2.5 of this code, refer to Health and Safety Code, Division 13, Part 6, commencing with Section 19960 and California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 1, commencing with Section 3000.*

SECTION 1.8.10
OTHER BUILDING REGULATIONS

1.8.10.1 Existing structures. *Notwithstanding other provisions of law, the replacement, retention and extension of original materials and the use of original methods of construction for any existing building or accessory structure, or portions thereof, shall be permitted in accordance with the provisions of this code as adopted by the Department of Housing and Community Development. For additional information, see California Health and Safety Code, Sections 17912, 17920.3, 17922 and 17958.8.*

1.8.10.2 Moved structures. *Subject to the requirements of California Health and Safety Code Sections 17922, 17922.3 and 17958.9, local ordinances or regulations relating to a moved residential building or accessory structure thereto, shall permit the replacement, retention and extension of original materials and the use of original methods of construction so long as the structure does not become or continue to be a substandard building.*

SECTION 1.9
DIVISION OF THE STATE ARCHITECT

1.9.1 Division of the State Architect—Access Compliance - Reserved.

Buildings or facilities where accessibility is required for applications listed in California Code of Regulations, Title 24, Part 2 (California Building Code), Chapter 1, Section 1.9.1 regulated by the Division of the State Architect—Access Compliance shall comply with Title 24, Part 2, Chapter 11A or 11B, as applicable under authority cited by CA Government Code Section 4450 and in reference cited by CA Government Code Sections 4450 through 4461, 12955.1(c), and CA Health and Safety Code Sections 18949.1, 19952 through 19959.

1.9.1.1 Adopting agency identification. *Division of the State Architect-Access Compliance amendments in this code appear preceded with the acronym [DSA-AC].*

1.9.2 Division of the State Architect-Structural Safety.

1.9.2.1 DSA-SS Division of the State Architect-Structural Safety.

Application—*Public elementary and secondary schools, community colleges and state-owned or state-leased essential services buildings.*

Enforcing agency—*The Division of the State Architect—Structural Safety [DSA-SS] has been delegated the responsibility and authority by the Department of General Services to review and approve the design and observe the construction of public elementary and secondary schools, community colleges and state-owned or state-leased essential services buildings.*

Authority cited—*Education Code Section 17310 and 81142 and Health and Safety Code Section 16022.*

Reference—*Education Code Sections 17280 through 17317, and 81130 through 81147 and Health and Safety Code Sections 16000 through 16023.*

1.9.2.1.1 Applicable administrative standards.

1. ***Title 24, Part 1, California Code of Regulations:***
   1.1. *Sections 4-301 through 4-355, Group 1, and Sections 4-401 through 4-435, Group 2, Chapter 4, for public elementary and secondary schools and community colleges.*

1.2. *Sections 4-201 through 4-249, Chapter 4, for state-owned or state-leased essential services buildings.*

2. ***Title 24, Part 2, California Code of Regulations:*** *[applies to public elementary and secondary schools, community colleges and state-owned or state-leased essential services building(s)]:*

2.1. *Sections 1.1 and 1.9.2.1 of Chapter 1, Division I.*

2.2. *Sections 102.1, 102.2, 102.3, 102.4, 102.5, 106.1, 107.2.5 and 110.3.6 of Chapter 1, Division II.*

3. ***Title 24, Part 10, California Code of Regulations:*** *[applies to public elementary and secondary schools, community colleges and state-owned or state-leased essential services building(s)]:*

3.1. *Sections 1.1 and 1.9.2.1 of Chapter 1, Division I.*

3.2. *Sections 101.8.1, 106.2.5 and 109.3.6 of Chapter 1, Division II.*

1.9.2.1.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10, 11 and 12, California Code of Regulations, for school buildings, community colleges and state-owned or state-leased essential service buildings.*

The provisions of Title 24, Part 10, as adopted and amended by the Division of the State Architect—Structural Safety [DSA-SS], shall apply to the applications listed in Section 1.9.2.1.

The Division of the State Architect—Structural Safety [DSA-SS] adopts the following building standards in Title 24, Part 10:

Chapters 1, 3 and 5.

1.9.2.1.3 Amendments. Division of the State Architect—*Structural Safety amendments in this code appear preceded with the acronym [DSA-SS].*

> ***Exception:*** *Chapter 3, Sections 317-323-DSA-SS adopts these sections without the use of the DSA-SS acronym.*

1.9.2.1.4 Reference to other chapters. *For public schools, where reference is made to sections in Chapters 16, 17, 18, 19, 21 or 22 of the California Building Code, the provisions in Chapters 16A, 17A, 18A, 19A, 21A and 22A of the California Building Code, respectively, shall apply instead.*

1.9.2.2 DSA-SS/CC Division of the State Architect-Structural Safety/Community Colleges.

Application—*Community Colleges. The Division of the State Architect has been delegated the authority by the Department of General Services to promulgate alternate building standards for application to community colleges, which a community college may elect to use in lieu of standards promulgated by DSA-SS in accordance with Section 1.9.2.1.*

Enforcing agency—*Division of the State Architect-Structural Safety/Community Colleges [DSA-SS/CC].*

The Division of the State Architect has been delegated the authority by the Department of General Services to review and approve the design and oversee construction of community colleges electing to use the alternative building standards as provided in this section.

Authority cited—*Education Code Section 81053.*

Reference—*Education Code Sections 81052, 81053 and 81130 through 81147.*

1.9.2.2.1 Applicable administrative standards.

1. ***Title 24, Part 1, California Code of Regulations:***

1.1. *Sections 4-301 through 4-355, Group 1, and Sections 4-401 through 4-435, Group 2, Chapter 4.*

2. ***Title 24, Part 2, California Code of Regulations:***

2.1. *Sections 1.1 and 1.9.2.2 of Chapter 1, Division I.*

2.2. *Sections 102.1, 102.2, 102.3, 102.4, 102.5, 106.1, 107.2.5 and 110.3.6 of Chapter 1, Division II.*

3. ***Title 24, Part 10, California Code of Regulations:*** *[applies to public elementary and secondary schools, community colleges and state-owned or state-leased essential services building(s)]:*

3.1. *Sections 1.1 and 1.9.2.1 of Chapter 1, Division I.*

3.2. *Sections 101.8.1, 106.2.5 and 109.3.6 of Chapter 1, Division II.*

1.9.2.2.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10, 11 and 12, California Code of Regulations.*

The provisions of Title 24, Part 10, as adopted and amended by the Division of the State Architect—Structural Safety/Community Colleges [DSA-SS/CC], shall apply to the applications listed in Section 1.9.2.2.

The Division of the State Architect—Structural Safety/Community Colleges [DSA-SS/CC] adopts the following building standards in Title 24, Part 10:

Chapters 1, 3 and 5.

1.9.2.2.3 Amendments. *Division of the State Architect—Structural Safety/Community Colleges amendments in this code appear preceded with the acronym [DSA-SS/CC].*

> ***Exception:*** *Chapter 3, Sections 317-323—DSA-SS/CC adopts these sections without the use of the DSA-SS/CC acronym.*

1.9.2.2.4 Reference to other chapters. *For community colleges, where reference is made to sections in Chapters 17 or 18 of the California Building Code, the provisions in Chapters 17A and 18A of the California Building Code, respectively, shall apply instead.*

SECTION 1.10
OFFICE OF STATEWIDE HEALTH PLANNING AND DEVELOPMENT

1.10.1 OSHPD 1 and OSHPD 1R. *Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application [OSHPD 1] *General acute care hospital buildings. [OSHPD 1R] Nonconforming hospital SPC or freestanding buildings that have been removed from acute care service.*

Enforcing agency—*Office of Statewide Health Planning and Development (OSHPD). The office shall enforce the Division of the State Architect—Access Compliance regulations and the regulations of the Office of the State Fire Marshal for the above-stated facility types.*

1.10.1.1 Applicable administrative standards.

1. *Title 24, Part 1, California Code of Regulations: Chapters 6 and 7.*
2. *Title 24, Part 2, California Code of Regulations: Sections 1.1 and 1.10, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.*

1.10.1.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provisions of Title 24, Part 10, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.1.

OSHPD 1 adopts the following building standards in Title 24, Part 10: Chapters 2, 3A, 4A and 5A.

OSHPD 1R adopts the following building standards in Title 24, Part 10: Chapters 2, 3, 4 and 5.

1.10.1.3 Identification of amendments. *For applications listed in Section 1.10.1, amendments in this code appear in this code preceded with the acronym [OSHPD 1], unless the entire chapter is applicable. For nonconforming hospital buildings removed from acute-care service, amendments are preceded with the acronym [OSHPD 1R].*

1.10.1.4 Reference to other chapters. *Where reference is made within this code to sections in Chapters 3, 4 and 5, the respective section in Chapters 3A, 4A and 5A, shall apply instead for hospital buildings under OSHPD 1.*

Authority—*Health and Safety Code Sections 127010, 127015, 1275 and 129850.*

References—*Health and Safety Code Sections 19958, 127010, 127015, 129680, 1275 and 129675 through 130070.*

1.10.2 OSHPD 2. *Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application—*Skilled nursing facility and intermediate care facility buildings.*

Enforcing agency—*Office of Statewide Health Planning and Development (OSHPD). The office shall enforce the Division of the State Architect—Access Compliance regulations and the regulations of the Office of the State Fire Marshal for the above-stated facility types.*

1.10.2.1 Applicable administrative standards.

1. *Title 24, Part 1, California Code of Regulations: Chapter 7.*
2. *Title 24, Part 2, California Code of Regulations: Sections 1.1 and 1.10, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.*

1.10.2.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provisions of Title 24, Part 10, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.2.

OSHPD 2 adopts the following building standards in Title 24, Part 10: Chapters 2, 3, 4 and 5.

1.10.2.3 Identification of amendments. *For applications listed in Section 1.10.2, amendments in this code appear in this code preceded with the acronym [OSHPD 2], unless the entire chapter is applicable.*

Authority—*Health and Safety Code Sections 127010, 127015, 1275 and 129850.*

References—*Health and Safety Code Sections 127010, 127015, 1275 and 129680.*

1.10.3 OSHPD 3. *Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application—*Licensed clinics and any freestanding building under a hospital license where outpatient clinical services are provided.*

Enforcing agency—*Local building department.*

1.10.3.1 Applicable administrative standards.

1. *Title 24, Part 1, California Code of Regulations: Chapter 7.*
2. *Title 24, Part 2, California Code of Regulations: Sections 1.1 and 1.10, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.*

1.10.3.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provisions of Title 24, Part 10, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.3.

OSHPD 3 adopts the following building standards in Title 24, Part 10: Chapters 2, 3, 4 and 5.

Authority—*Health and Safety Code Sections 127010, 127015 and 1226.*

References—*Health and Safety Code Sections 127010, 127015, 129885 and 1226, Government Code Section 54350 and State Constitution Article 11, Section 7.*

1.10.4 OSHPD 4. *Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application—*Correctional treatment centers.*

Enforcing agency—*Office of Statewide Health Planning and Development (OSHPD). The office shall enforce the Division of the State Architect—Access Compliance regulations and the regulations of the Office of the State Fire Marshal for the above-stated facility types.*

1.10.4.1 Applicable administrative standards.

1. *Title 24, Part 1, California Code of Regulations: Chapter 7.*
2. *Title 24, Part 2, California Code of Regulations: Sections 1.1 and 1.10, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.*

1.10.4.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provisions of Title 24, Part 10, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.4.

OSHPD 4 adopts the following building standards in Title 24, Part 10: Chapters 2, 3, 4 and 5.

1.10.4.3 Identification of amendments. *For applications listed in Section 1.10.4, amendments in this code appear in this code preceded with the acronym [OSHPD 4], unless the entire chapter is applicable.*

Authority—*Health and Safety Code Sections 127010, 127015, 1275 and 129790.*

References—*Health and Safety Code Sections 127010, 127015, 1275 and 129674 through 130070.*

1.10.5 OSHPD 5. *Specific scope of application of the agency responsible for enforcement, enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application—*Acute psychiatric hospital buildings.*

Enforcing agency—*Office of Statewide Health Planning and Development (OSHPD). The office shall also enforce the Division of the State Architect—Access Compliance regulations and the regulations of the Office of the State Fire Marshal for the above-stated facility type.*

1.10.5.1 Applicable administrative standards.

1. *Title 24, Part 1, California Code of Regulations: Chapter 7.*
2. *Title 24, Part 2, California Code of Regulations: Sections 1.1 and 1.10, Chapter 1, Division I, and as indicated in the adoption matrix for Chapter 1, Division II.*

1.10.5.2 Applicable building standards. *California Building Standards Code, Title 24, Parts 2, 3, 4, 5, 6, 9, 10 and 11.*

The provision of Title 24, Part 2, as adopted and amended by OSHPD, shall apply to the applications listed in Section 1.10.5.

OSHPD 5 adopts the following building standards in Title 24, Part 10: Chapters 2, 3, 4 and 5.

1.10.5.3 Identification of amendments*. For applications listed in Section 1.10.5, amendments appear in this code preceded with the acronym [OSHPD 5].*

Authority—*Health and Safety Code Sections 127010, 127015, 1275 and 129850.*

References—*Health and Safety Code Sections 127010, 127015, 129680, 1275 and 129675 through 130070.*

SECTION 1.11
OFFICE OF THE STATE FIRE MARSHAL

1.11.1 SFM—Office of the State Fire Marshal. *Specific scope of application of the agency responsible for enforcement, the enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.*

Application:

Institutional, educational or any similar occupancy. *Any building or structure used or intended for use as an asylum, jail, prison, mental hospital, hospital, sanitarium, home for the elderly, children's nursery, children's home or institution, school or any similar occupancy of any capacity.*

Authority cited—*Health and Safety Code Section 13143.*

Reference—*Health and Safety Code Section 13143.*

Assembly or similar place of assemblage. *Any theater, dancehall, skating rink, auditorium, assembly hall, meeting hall, nightclub, fair building or similar place of assemblage where 50 or more persons may gather together in a building, room or structure for the purpose of amusement, entertainment, instruction, deliberation, worship, drinking or dining, awaiting transportation, or education.*

Authority cited—*Health and Safety Code Section 13143.*

Reference—*Health and Safety Code Section 13143.*

Small family day-care homes.

Authority cited—*Health and Safety Code Sections 1597.45, 1597.54, 13143 and 17921.*

Reference—*Health and Safety Code Section 13143.*

Large family day-care homes.

Authority cited—*Health and Safety Code Sections 1597.46, 1597.54 and 17921.*

Reference—*Health and Safety Code Section 13143.*

Residential facilities and residential facilities for the elderly.

Authority cited—*Health and Safety Code Section 13133.*

Reference—*Health and Safety Code Section 13143.*

Any state institution or other state-owned or specified state-occupied building.

Specified state-occupied buildings. *Any building, structure or area that meets any of the following criteria:*

1. *A building where the state has contracted into a build-to-suit lease.*
2. *A courthouse holding facility or trial court with a detention area.*
3. *A building used by the Department of Corrections and Rehabilitation as a community correctional reentry center.*
4. *100 percent state occupied.*
5. *State-occupied areas in a state-leased building that is a high-rise and is 75 percent of the net area floor space or more occupied by state entities.*
6. *State-occupied areas that contain 5,000 square feet (465 m^2) or more space of a state-leased Group H or Group L occupancy.*
7. *A state-leased building with facilities with the primary purpose of housing state records and/or state artifacts of historical significance.*
8. *Properties leased by California State University (CSU) or University of California (UC).*
9. *State institutions and their real property.*
10. *CAL FIRE occupied areas in leased building.*
11. *State-leased facilities where the governing body's fire protection services rely on an all-volunteer fire department.*

Except as provided in Items 1 through 11, buildings shall become the responsibility of the local jurisdiction.

Authority cited—*Health and Safety Code Sections 13108, 13145, 13146, 16022.5 and 17921.*

Reference—*Health and Safety Code Sections 13108, 13143, 13145, 13146, 16022.5 and 17921.*

High-rise structures.

Authority cited—*Health and Safety Code Section 13211.*

Reference—*Health and Safety Code Section 13143.*

Motion picture production studios.

Authority cited—*Health and Safety Code Section 13143.1.*

Reference—*Health and Safety Code Section 13143.*

Organized camps.

Authority cited—*Health and Safety Code Section 18897.3.*

Reference—*Health and Safety Code Section 13143.*

Residential. *All hotels, motels, lodging houses, apartment houses and dwellings, including congregate residences and buildings and structures accessory thereto. Multiple-story structures existing on January 1, 1975, let for human habitation, including and limited to, hotels, motels and apartment houses, less than 75 feet (22 860 mm) above the lowest floor level having building access, wherein rooms used for sleeping are let above the ground floor.*

Authority cited—*Health and Safety Code Sections 13143.2 and 17921.*

Reference—*Health and Safety Code Section 13143.*

Residential care facilities. *Certified family care homes, out-of-home placement facilities, halfway houses, drug and/or alcohol rehabilitation facilities and any building or structure used or intended for use as a home or institution for the housing of any person of any age when such person is referred to or placed within such home or institution for protective social care and supervision services by any governmental agency.*

Authority cited—*Health and Safety Code Section 13143.6.*

Reference—*Health and Safety Code Section 13143.*

Tents, awnings or other fabric enclosures used in connection with any occupancy.

Authority cited—*Health and Safety Code Section 13116.*

Reference—*Health and Safety Code Section 13143.*

Fire alarm devices, equipment and systems in connection with any occupancy.

Authority cited—*Health and Safety Code Section 13114.*

Reference—*Health and Safety Code Section 13143.*

Hazardous materials.

Authority cited—*Health and Safety Code Section 13143.9.*

Reference—*Health and Safety Code Section 13143.*

Flammable and combustible liquids.

Authority cited—*Health and Safety Code Section 13143.6.*

Reference—*Health and Safety Code Section 13143.*

Public school automatic fire detection, alarm and sprinkler systems.

Authority cited—*Health and Safety Code Section 13143 and California Education Code Article 7.5, Sections 17074.50, 17074.52 and 17074.54.*

Reference—*Government Code Section 11152.5, Health and Safety Code Section 13143 and California Education Code Chapter 12.5, Leroy F. Greene School Facilities Act of 1998, Article 1.*

Wildland-Urban interface fire area.

Authority cited—*Health and Safety Code Sections 13143, 13108.5(a) and 18949.2(b) and (c) and Government Code Section 51189.*

Reference—*Health and Safety Code Sections 13143, Government Code Sections 51176, 51177, 51178 and 51179 and Public Resources Code Sections 4201 through 4204.*

1.11.2 Duties and powers of the enforcing agency.

1.11.2.1 Enforcement.

***1.11.2.1.1** The responsibility for enforcement of building standards adopted by the State Fire Marshal and published in the California Building Standards Code relating to fire and panic safety and other regulations of the State Fire Marshal shall except as provided in Section 1.11.2.1.2 be as follows:*

1. *The city, county, or city and county with jurisdiction in the area affected by the standard or regulation shall delegate the enforcement of the building standards relating to fire and panic safety and other regulations of the State Fire Marshal as they relate to Group R-3 occupancies, as described in Section 1.1.3.1 or SFM Part 2 California Building Code, Section 310.1, to either of the following:*
   - 1.1. *The chief of the fire authority of the city, county or city and county, or an authorized representative.*
   - 1.2. *The chief building official of the city, county or city and county, or an authorized representative.*
2. *The chief of any city or county fire department or of any fire protection district, and authorized representatives, shall enforce within the jurisdiction the building standards and other regulations of the State Fire Marshal, except those described in Item 1 or 4.*
3. *The State Fire Marshal shall have authority to enforce the building standards and other regulations of the State Fire Marshal in areas outside of corporate cities and districts providing fire protection services.*
4. *The State Fire Marshal shall have authority to enforce the building standards and other regulations of the State Fire Marshal in corporate cities and districts providing fire protection services on request of the chief fire official or the governing body.*
5. *Any fee charged pursuant to the enforcement authority of this section shall not exceed the estimated reasonable cost of providing the service for which the fee is charged pursuant to Section 66014 of the Government Code.*

***1.11.2.1.2** Pursuant to Health and Safety Code Section 13108, and except as otherwise provided in this section, building standards adopted by the State Fire Marshal published in the California Building Standards Code relating to fire and panic safety shall be enforced by the State Fire Marshal in all state-owned buildings, state-occupied buildings and state institutions throughout the state. Upon the written request of the chief fire official of any city, county, or fire protection district, the State Fire Marshal may authorize such chief fire official and his or her authorized representatives, in their geographical area of responsibility, to make fire prevention inspections of state-owned or state-occupied buildings, other than state institutions, for the purpose of enforcing the regulations relating to fire and panic safety adopted by the State Fire Marshal pursuant to this section and building standards relating to fire and panic safety published in the California Building Standards Code. Authorization from the State Fire Marshal shall be limited to those fire departments or fire districts which maintain a fire prevention bureau staffed by paid personnel.*

Pursuant to Health and Safety Code Section 13108, any requirement or order made by any chief fire official who is authorized by the State Fire Marshal to make fire prevention inspections of state-owned or state-occupied buildings, other than state institutions, may be appealed to the State Fire Marshal. The State Fire Marshal shall, upon receiving an appeal and subject to the provisions of Chapter 5 (commencing with Section 18945) of Part 2.5 of Division 13 of the Health and Safety Code, determine if the requirement or order made is reasonably consistent with the fire and panic safety regulations adopted by the State Fire Marshal and building standards relating to fire and panic safety published in the California Existing Building Code.

Any person may request a code interpretation from the State Fire Marshal relative to the intent of any regulation or provision adopted by the State Fire Marshal. When the request relates to a specific project, occupancy or building, the State Fire Marshal shall review the issue with the appropriate local enforcing agency prior to rendering such code interpretation.

***1.11.2.1.3** Pursuant to Health and Safety Code Section 13112, any person who violates any order, rule or regulation of the State Fire Marshal is guilty of a misdemeanor punishable by a fine of not less than $100.00 or more than $500.00, or by imprisonment for not less than six months, or by both. A person is guilty of a separate offense each day during which he or she commits, continues or permits a violation of any provision of, or any order, rule or regulation of, the State Fire Marshal as contained in this code.*

Any inspection authority who, in the exercise of his or her authority as a deputy State Fire Marshal, causes any legal complaints to be filed or any arrest to be made shall notify the State Fire Marshal immediately following such action.

***1.11.2.2 Right of entry.** The fire chief of any city, county or fire protection district, or such person's authorized representative, may enter any state institution or any other state-owned or state-occupied building for the purpose of preparing a fire suppression preplanning program or for the purpose of investigating any fire in a state-occupied building.*

The State Fire Marshal, his or her deputies or salaried assistants, the chief of any city or county fire department or fire protection district and his or her authorized representatives may enter any building or premises not used for dwelling purposes at any reasonable hour for the purpose *of enforcing this chapter. The owner, lessee, manager or operator of any such building or premises shall permit the State Fire Marshal, his or her deputies or salaried assistants and the chief of any city or county fire department or fire protection district and his or her authorized representatives to enter and inspect them at the time and for the purpose stated in this section.*

1.11.2.3 More restrictive fire and panic safety building standards.

1.11.2.3.1 *Any fire protection district organized pursuant to Health and Safety Code Part 2.7 (commencing with Section 13800) of Division 12 may adopt building standards relating to fire and panic safety that are more stringent than those building standards adopted by the State Fire Marshal and contained in the California Building Standards Code. For these purposes, the district board shall be deemed a legislative body and the district shall be deemed a local agency. Any changes or modifications that are more stringent than the requirements published in the California Building Standards Code relating to fire and panic safety shall be subject to Section 1.1.8.1.*

1.11.2.3.2 *Any fire protection district that proposes to adopt an ordinance pursuant to this section shall, not less than 30 days prior to noticing a proposed ordinance for public hearing, provide a copy of that ordinance, together with the adopted findings made pursuant to Section 1.11.2.3.1, to the city, county, or city and county where the ordinance will apply. The city, county, or city and county may provide the district with written comments, which shall become part of the fire protection district's public hearing record.*

1.11.2.3.3 *The fire protection district shall transmit the adopted ordinance to the city, county, or city and county where the ordinance will apply. The legislative body of the city, county, or city and county may ratify, modify or deny an adopted ordinance and transmit its determination to the district within 15 days of the determination. Any modification or denial of an adopted ordinance shall include a written statement describing the reasons for any modifications or denial. No ordinance adopted by the district shall be effective until ratification by the city, county, or city and county where the ordinance will apply. Upon ratification of an adopted ordinance, the city, county, or city and county shall file a copy of the findings of the district, and any findings of the city, county, or city and county, together with the adopted ordinance expressly marked and identified to which each finding refers, in accordance with Section 1.1.8.1(3).*

1.11.2.4 Request for alternate means of protection*. Requests for approval to use an alternative material, assembly or materials, equipment, method of construction, method of installation of equipment or means of protection shall be made in writing to the enforcing agency by the owner or the owner's authorized representative and shall be accompanied by a full statement of the conditions. Sufficient evidence or proof shall be submitted to substantiate any claim that may be made regarding its conformance. The enforcing agency may require tests and the submission of a test report from an approved testing organization as set forth in Title 19, California Code of Regulation, to substantiate the equivalency of the proposed alternative means of protection.*

When a request for alternate means of protection involves hazardous materials, the authority having jurisdiction may consider implementation of the findings and recommendations identified in a Risk Management Plan (RMP) developed in accordance with Title 19, Division 2, Chapter 4.5, Article 3.

Approval of a request for use of an alternative material, assembly of materials, equipment, method of construction, method of installation of equipment or means of protection made pursuant to these provisions shall be limited to the particular case covered by request and shall not be construed as establishing any precedent for any future request.

1.11.2.5 Appeals. *When a request for an alternate means of protection has been denied by the enforcing agency, the applicant may file a written appeal to the State Fire Marshal for consideration of the applicant's proposal. In considering such appeal, the State Fire Marshal may seek the advice of the State Board of Fire Services. The State Fire Marshal shall, after considering all of the facts presented, including any recommendations of the State Board of Fire Services, determine if the proposal is for the purposes intended, at least equivalent to that specified in these regulations in quality, strength, effectiveness, fire resistance, durability and safety, and shall transmit such findings and any recommendations to the applicant and to the enforcing agency.*

1.11.3 Construction documents.

1.11.3.1 Public schools. *Plans and specifications for the construction, alteration or addition to any building owned, leased or rented by any public school district shall be submitted to the Division of the State Architect.*

1.11.3.2 Movable walls and partitions. *Plans or diagrams shall be submitted to the enforcing agency for approval before the installation of, or rearrangement of, any movable wall or partition in any occupancy. Approval shall be granted only if there is no increase in the fire hazard.*

1.11.3.3 New construction high-rise buildings.

1. *Complete plans or specifications, or both, shall be prepared covering all work required to comply with new construction high-rise buildings. Such plans and specifications shall be submitted to the enforcing agency having jurisdiction.*
2. *All plans and specifications shall be prepared under the responsible charge of an architect or a civil or structural engineer authorized by law to develop construction plans and specifications, or by both such architect and engineer. Plans and specifications shall be prepared by an engineer duly qualified in that branch of engineering necessary to perform such services. Administration of the work of construction shall be under the charge of the*

responsible architect or engineer except that where plans and specifications involve alterations or repairs, such work of construction may be administered by an engineer duly qualified to perform such services and holding a valid certificate under Chapter 7 (commencing with Section 65700) of Division 3 of the Business and Professions Code for performance of services in that branch of engineering in which said plans, specifications and estimates and work of construction are applicable.

This section shall not be construed as preventing the design of fire-extinguishing systems by persons holding a C-16 license issued pursuant to Division 3, Chapter 9, Business and Professions Code. In such instances, however, the responsibility charge of this section shall prevail.

1.11.3.4 Existing high-rise buildings.

1. *Complete plans or specifications, or both, shall be prepared covering all work required by California Building Code Section 312 for existing high-rise buildings. Such plans or specifications shall be submitted to the enforcing agency having jurisdiction.*
2. *When new construction is required to conform with the provisions of these regulations, complete plans or specifications, or both, shall be prepared in accordance with the provisions of this subsection. As used in this section, "new construction" is not intended to include repairs, replacements or minor alterations which do not disrupt or appreciably add to or affect the structural aspects of the building.*

1.11.3.5 Retention of plans. *Refer to Building Standards Law, Health and Safety Code Sections 19850 and 19851 for permanent retention of plans.*

1.11.4 Fees.

1.11.4.1 Other fees. *Pursuant to Health and Safety Code Section 13146.2, a city, county or district which inspects a hotel, motel, lodging house or apartment house may charge and collect a fee for the inspection from the owner of the structure in an amount, as determined by the city, county or district, sufficient to pay its costs of that inspection.*

1.11.4.2 Large family day-care. *Pursuant to Health and Safety Code Section 1597.46, Large Family Day-Care Homes, the local government shall process any required permit as economically as possible, and fees charged for review shall not exceed the costs of the review and permit process.*

1.11.4.3 High-rise. *Pursuant to Health and Safety Code Section 13217, High-rise Structure Inspection: Fees and costs, a local agency which inspects a high-rise structure pursuant to Health and Safety Code Section 13217 may charge and collect a fee for the inspection from the owner of the high-rise structure in an amount, as determined by the local agency, sufficient to pay its costs of that inspection.*

1.11.4.4 Fire clearance preinspection. *Pursuant to Health and Safety Code Section 13235, Fire Clearance Preinspection, fee, upon receipt of a request from a prospective licensee of a community care facility, as defined in Section 1502, of a residential care facility for the elderly, as defined in Section 1569.2, or of a child day-care facility, as defined in Section 1596.750, the local fire enforcing agency, as defined in Section 13244, or State Fire Marshal, whichever has primary jurisdiction, shall conduct a preinspection of the facility prior to the final fire clearance approval. At the time of the preinspection, the primary fire enforcing agency shall price consultation and interpretation of the fire safety regulations and shall notify the prospective licensee of the facility in writing of the specific fire safety regulations which shall be enforced in order to obtain fire clearance approval. A fee equal to, but not exceeding, the actual cost of the preinspection services may be charged for the preinspection of a facility.*

1.11.4.5 Care facilities. *The primary fire enforcing agency shall complete the final fire clearance inspection for a community care facility, residential care facility for the elderly, or child day-care facility within 30 days of receipt of the request for the final inspection, or as of the date the prospective facility requests the final prelicensure inspection by the State Department of Social Services, whichever is later.*

Pursuant to Health and Safety Code Section 13235, a preinspection fee equal to, but not exceeding, the actual cost of the preinspection services may be charged for the preinspection of a facility.

Pursuant to Health and Safety Code Section 13131.5, a reasonable final inspection fee, not to exceed the actual cost of inspection services necessary to complete a final inspection may be charged for occupancies classified as residential care facilities for the elderly (RCFE).

Pursuant to Health and Safety Code Section 1569.84, neither the State Fire Marshal nor any local public entity shall charge any fee for enforcing fire inspection regulations pursuant to state law or regulation or local ordinance, with respect to residential care facilities for the elderly (RCFE) which service six or fewer persons.

1.11.4.6 Requests of the Office of the State Fire Marshal. *Whenever a local authority having jurisdiction requests that the State Fire Marshal perform plan review and/or inspection services related to a building permit, the applicable fees for such shall be payable to the Office of the State Fire Marshal.*

1.11.5 Inspections. *Work performed subject to the provisions of this code shall comply with the inspection requirements of Sections 109.1, 109.3, 109.3.4, 109.3.5, 109.3.6, 109.3.7, 109.3.8, 109.3.9, 109.5 and 109.6 as adopted by the Office of the State Fire Marshal.*

1.11.5.1 Existing Group I-1 or R occupancies. *Licensed 24-hour care in a Group I-1 or R occupancy in existence and originally classified under previously adopted state codes shall be reinspected under the appropriate previous code, provided there is no change in the use or character which would place the facility in a different occupancy group.*

1.11.6 Certificate of Occupancy. *A Certificate of Occupancy shall be issued as specified in Title 24, Part 2, California Building Code, Section 111.*

Exception: *Certificates of occupancy are not required for work exempt from permits in accordance with Section 105.2 of the California Building Code.*

1.11.7 Temporary structures and uses. *See Section 107.*

1.11.8 Service utilities. *See Section 111.*

1.11.9 Stop work order. *See Section 114.*

1.11.10 Unsafe buildings, structures and equipment. *See Section 115.*

1.11.11 Adopting agency identification. *The provisions of this code applicable to buildings identified in this Section 1.11 will be identified in the Matrix Adoption Tables under the acronym SFM.*

SECTION 1.12
STATE LIBRARIAN
Reserved

SECTION 1.13
DEPARTMENT OF WATER RESOURCES
Reserved

SECTION 1.14
CALIFORNIA STATE LANDS COMMISSION
Reserved

DIVISION II

SCOPE AND ADMINISTRATION

Note: *Sections adopted or amended by state agencies are specifically indicated by an agency banner.*

Division II is not adopted by the Department of Housing and Community Development except where specifically indicated.

User note:

About this chapter: *Chapter 1 establishes the limits of applicability of the code and describes how the code is to be applied and enforced. Chapter 1 is in two parts: Part 1—Scope and Administration (Sections 101–102) and Part 2—Administration and Enforcement (Sections 103–117). Section 101 identifies which buildings and structures come under its purview and references other I-Codes® as applicable.*

This code is intended to be adopted as a legally enforceable document, and it cannot be effective without adequate provisions for its administration and enforcement. The provisions of Chapter 1 establish the authority and duties of the code official appointed by the authority having jurisdiction and also establish the rights and privileges of the registered design professional, contractor and property owner.

PART 1—SCOPE AND APPLICATION

SECTION 101
SCOPE AND GENERAL REQUIREMENTS

101.1 Title. Article 1.2 of Chapter IX of the *Los Angeles Municipal Code* (LAMC) shall collectively be known as the *Los Angeles Existing Building Code* or LAEBC.

101.2 Scope. The provisions of the LAEBC shall apply to repair, alteration, change of occupancy, addition to and relocation of every existing building or structure or any appurtenances connected or attached to such buildings or structures throughout the City of Los Angeles. Wherever the word "Code" is used in this Article, it shall mean the *Los Angeles Existing Building Code*.

See Division 1, Article 1, Chapter IX of the *Los Angeles Municipal Code* (Chapter One of the *Los Angeles Building Code*) for administrative and enforcement provisions.

[A] 101.3 Purpose. The intent of this code is to provide flexibility to permit the use of alternative approaches to achieve compliance with minimum requirements to provide a reasonable level of safety, health, property protection and general welfare insofar as they are affected by the repair, alteration, change of occupancy, addition and relocation of existing buildings.

[A] 101.4 Applicability. This code shall apply to the repair, alteration, change of occupancy, addition and relocation of existing buildings, regardless of occupancy, subject to the criteria of Sections 101.4.1 and 101.4.2.

[A] 101.4.1 Buildings not previously occupied. A building or portion of a building that has not been previously occupied or used for its intended purpose, in accordance with the laws in existence at the time of its completion, shall be permitted to comply with the provisions of the laws in existence at the time of its original permit unless such permit has expired. Subsequent permits shall comply with the *California Building Code* or *California Residential Code,* as applicable, for new construction.

[A] 101.4.2 Buildings previously occupied. The legal occupancy of any building existing on the date of adoption of this code shall be permitted to continue without change, except as is specifically covered in this code, the *California Fire Code*, or the *International Property Maintenance Code*, or as is deemed necessary by the code official for the general safety and welfare of the occupants and the public.

[A] 101.5 Safeguards during construction. Construction work covered in this code, including any related demolition, shall comply with the requirements of Chapter 15.

[A] 101.6 Appendices. The code official is authorized to require retrofit of buildings, structures or individual structural members in accordance with the appendices of this code if such appendices have been individually adopted.

[A] 101.7 Correction of violations of other codes. Repairs or alterations mandated by any property, housing or fire safety maintenance code, or mandated by any licensing rule or ordinance adopted pursuant to law, shall conform only to the requirements of that code, rule or ordinance, and shall not be required to conform to this code unless the code requiring such repair or alteration so provides.

101.8 Maintenance. [BSC, HCD 1, HCD 2] *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.*

101.8.1 Maintenance. [DSA-SS, DSA-SS/CC] *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. The requirements of this chapter shall not provide the basis for removal or abrogation of fire protections and safety systems and devices in existing structures.*

SECTION 102
APPLICABILITY

[A] 102.1 General. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

[A] 102.2 Other laws. The provisions of this code shall not be deemed to nullify any provisions of local, state or federal law.

[A] 102.3 Application of references. References to chapter or section numbers or to provisions not specifically identified by number shall be construed to refer to such chapter, section or provision of this code.

[A] 102.4 Referenced codes and standards. The codes and standards referenced in this code shall be considered part of the requirements of this code to the prescribed extent of each such reference and as further regulated in Sections 102.4.1 and 102.4.2.

Exception: Where enforcement of a code provision would violate the conditions of the listing of the equipment or appliance, the conditions of the listing shall govern.

[A] 102.4.1 Conflicts. Where conflicts occur between provisions of this code and referenced codes and standards, the provisions of this code shall apply.

[A] 102.4.2 Conflicting provisions. Where the extent of the reference to a referenced code or standard includes subject matter that is within the scope of this code, the provisions of this code, as applicable, shall take precedence over the provisions in the referenced code or standard.

[A] 102.5 Partial invalidity. In the event that any part or provision of this code is held to be illegal or void, this shall not have the effect of making void or illegal any of the other parts or provisions.

PART 2—ADMINISTRATION AND ENFORCEMENT

SECTION 103
CODE COMPLIANCE AGENCY

[A] 103.1 Creation of agency. The **[INSERT NAME OF DEPARTMENT]** is hereby created, and the official in charge thereof shall be known as the code official. The function of the agency shall be the implementation, administration and enforcement of the provisions of this code.

[A] 103.2 Appointment. The code official shall be appointed by the chief appointing authority of the jurisdiction.

[A] 103.3 Deputies. In accordance with the prescribed procedures of this jurisdiction and with the concurrence of the appointing authority, the code official shall have the authority to appoint a deputy code official, other related technical officers, inspectors and other employees. Such employees shall have powers as delegated by the code official.

SECTION 104
DUTIES AND POWERS OF CODE OFFICIAL

[A] 104.1 General. The code official is hereby authorized and directed to enforce the provisions of this code. The code official shall have the authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in compliance with the intent and purpose of this code. Such policies and procedures shall not have the effect of waiving requirements specifically provided for in this code.

[A] 104.2 Applications and permits. The code official shall receive applications, review construction documents and issue permits for the repair, alteration, addition, demolition, change of occupancy and relocation of buildings; inspect the premises for which such permits have been issued; and enforce compliance with the provisions of this code.

[A] 104.2.1 Determination of substantially improved or substantially damaged existing buildings and structures in flood hazard areas. For applications for reconstruction, rehabilitation, repair, alteration, addition or other improvement of existing buildings or structures located in flood hazard areas, the building official shall determine where the proposed work constitutes substantial improvement or repair of substantial damage. Where the building official determines that the proposed work constitutes substantial improvement or repair of substantial damage, and where required by this code, the building official shall require the building to meet the requirements of Section 1612 of the *California Building Code,* or Section R322 of the *California Residential Code*, as applicable.

[A] 104.2.2 Preliminary meeting. When requested by the permit applicant or the code official, the code official shall meet with the permit applicant prior to the application for a construction permit to discuss plans for the proposed work or change of occupancy in order to establish the specific applicability of the provisions of this code.

Exception: Repairs and Level 1 alterations.

[A] 104.2.2.1 Building evaluation. The code official is authorized to require an existing building to be investigated and evaluated by a registered design professional based on the circumstances agreed on at the preliminary meeting. The design professional shall notify the code official if any potential noncompliance with the provisions of this code is identified.

[A] 104.3 Notices and orders. The code official shall issue necessary notices or orders to ensure compliance with this code.

[A] 104.4 Inspections. The code official shall make the required inspections, or the code official shall have the authority to accept reports of inspection by approved agencies or individuals. Reports of such inspections shall be in writing and be certified by a responsible officer of such approved agency or by the responsible individual. The code official is authorized to engage such expert opinion as deemed necessary to report on unusual technical issues that arise, subject to the approval of the appointing authority.

[A] 104.5 Identification. The code official shall carry proper identification when inspecting structures or premises in the performance of duties under this code.

[A] 104.6 Right of entry. Where it is necessary to make an inspection to enforce the provisions of this code, or where the code official has reasonable cause to believe that there exists in a structure or on a premises a condition that is contrary to or in violation of this code that makes the structure or premises unsafe, dangerous or hazardous, the code official is authorized to enter the structure or premises at reasonable times to inspect or to perform the duties imposed by this code, provided that if such structure or premises be occupied that credentials be presented to the occupant and entry requested. If such structure or premises be unoccupied, the code official shall first make a reasonable effort to locate the owner, the owner's authorized agent or other person having charge or control of the structure or premises and request entry. If entry is refused, the code official shall have recourse to the remedies provided by law to secure entry.

[A] 104.7 Department records. The code official shall keep official records of applications received, permits and certificates issued, fees collected, reports of inspections, and notices and orders issued. Such records shall be retained in the official records for the period required for retention of public records.

[A] 104.8 Liability. The code official, member of the Board of Appeals or employee charged with the enforcement of this code, while acting for the jurisdiction in good faith and without malice in the discharge of the duties required by this code or other pertinent law or ordinance, shall not thereby be rendered civilly or criminally liable personally and is hereby relieved from personal liability for any damage accruing to persons or property as a result of any act or by reason of an act or omission in the discharge of official duties.

[A] 104.8.1 Legal defense. Any suit or criminal complaint instituted against an officer or employee because of an act performed by that officer or employee in the lawful discharge of duties and under the provisions of this code shall be defended by legal representatives of the jurisdiction until the final termination of the proceedings. The code official or any subordinate shall not be liable for cost in any action, suit or proceeding that is instituted in pursuance of the provisions of this code.

[A] 104.9 Approved materials and equipment. Materials, equipment and devices approved by the code official shall be constructed and installed in accordance with such approval.

[A] 104.9.1 Used materials and equipment. The use of used materials that meet the requirements of this code for new materials is permitted. Used equipment and devices shall be permitted to be reused subject to the approval of the code official.

[A] 104.10 Modifications. Wherever there are practical difficulties involved in carrying out the provisions of this code, the code official shall have the authority to grant modifications for individual cases on application of the owner or owner's authorized representative, provided that the code official shall first find that special individual reason makes the strict letter of this code impractical, the modification is in compliance with the intent and purpose of this code and such modification does not lessen health, accessibility, life and fire safety, or structural requirements. The details of action granting modifications shall be recorded and entered in the files of the Department of Building Safety.

[A] 104.10.1 Flood hazard areas. For existing buildings located in flood hazard areas for which repairs, alterations and additions constitute substantial improvement, the code official shall not grant modifications to provisions related to flood resistance unless a determination is made that:

1. The applicant has presented good and sufficient cause that the unique characteristics of the size, configuration or topography of the site render compliance with the flood-resistant construction provisions inappropriate.
2. Failure to grant the modification would result in exceptional hardship.
3. The granting of the modification will not result in increased flood heights, additional threats to public safety, extraordinary public expense nor create nuisances, cause fraud on or victimization of the public, or conflict with existing laws or ordinances.
4. The modification is the minimum necessary to afford relief, considering the flood hazard.
5. A written notice will be provided to the applicant specifying, if applicable, the difference between the design flood elevation and the elevation to which the building is to be built, stating that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced floor elevation and that construction below the design flood elevation increases risks to life and property.

[A] 104.11 Alternative materials, design and methods of construction, and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the code official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety. Where the alternative material, design or method of construction is not approved, the code official shall respond in writing, stating the reasons why the alternative was not approved.

[A] 104.11.1 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.

[A] 104.11.2 Tests. Where there is insufficient evidence of compliance with the provisions of this code or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the code official shall have the authority to require tests as evidence of compliance to be made without expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the code official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the code official for the period required for retention.

SECTION 105
PERMITS

[A] 105.1 Required. Any owner or owner's authorized agent who intends to repair, add to, alter, relocate, demolish or change the occupancy of a building or to repair, install, add, alter, remove, convert or replace any electrical, gas, mechanical or plumbing system, the installation of which is regulated by this code, or to cause any such work to be performed, shall first make application to the code official and obtain the required permit.

[A] 105.1.1 Annual permit. Instead of an individual permit for each alteration to an already approved electrical, gas, mechanical, or plumbing installation, the code official is authorized to issue an annual permit on application therefor to any person, firm or corporation regularly employing one or more qualified trade persons in the building, structure, or on the premises owned or operated by the applicant for the permit.

[A] 105.1.2 Annual permit records. The person to whom an annual permit is issued shall keep a detailed record of alterations made under such annual permit. The code official shall have access to such records at all times, or such records shall be filed with the code official as designated.

[A] 105.2 Work exempt from permit. Exemptions from permit requirements of this code 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. Permits shall not be required for the following:

Building:

1. Sidewalks and driveways not more than 30 inches (762 mm) above grade and not over any basement or story below and that are not part of an accessible route.
2. Painting, papering, tiling, carpeting, cabinets, counter tops and similar finish work.
3. Temporary motion picture, television, and theater stage sets and scenery.
4. Shade cloth structures constructed for nursery or agricultural purposes, and not including service systems.
5. Window awnings supported by an exterior wall of Group R-3 or Group U occupancies.
6. Nonfixed and movable cases, counters and partitions not over 5 feet 9 inches (1753 mm) in height.

Electrical:

1. **Repairs and maintenance:** Minor repair work, including the replacement of lamps or the connection of approved portable electrical equipment to approved permanently installed receptacles.
2. **Radio and television transmitting stations:** The provisions of this code shall not apply to electrical equipment used for radio and television transmissions, but do apply to equipment and wiring for power supply, the installations of towers and antennas.
3. **Temporary testing systems:** A permit shall not be required for the installation of any temporary system required for the testing or servicing of electrical equipment or apparatus.

Gas:

1. Portable heating appliance.
2. Replacement of any minor part that does not alter approval of equipment or make such equipment unsafe.

Mechanical:

1. Portable heating appliance.
2. Portable ventilation equipment.
3. Portable cooling unit.
4. Steam, hot or chilled water piping within any heating or cooling equipment regulated by this code.
5. Replacement of any part that does not alter its approval or make it unsafe.
6. Portable evaporative cooler.
7. Self-contained refrigeration system containing 10 pounds (4.54 kg) or less of refrigerant and actuated by motors of 1 horsepower (746 W) or less.

Plumbing:

1. The stopping of leaks in drains, water, soil, waste or vent pipe; provided, however, that if any concealed trap, drainpipe, water, soil, waste or vent pipe becomes defective and it becomes necessary to remove and replace the same with new material, such work shall be considered as new work, and a

permit shall be obtained and inspection made as provided in this code.

2. The clearing of stoppages or the repairing of leaks in pipes, valves or fixtures, and the removal and reinstallation of water closets, provided that such repairs do not involve or require the replacement or rearrangement of valves, pipes or fixtures.

[A] 105.2.1 Emergency repairs. Where equipment replacements and repairs must be performed in an emergency situation, the permit application shall be submitted within the next working business day to the code official.

[A] 105.2.2 Repairs. Application or notice to the code official is not required for repairs to structures and items listed in Section 105.2 provided that such repairs do not include any of the following:

1. The cutting away of any wall, partition or portion thereof.
2. The removal or cutting of any structural beam or load-bearing support.
3. The removal or change of any required means of egress or rearrangement of parts of a structure affecting the egress requirements.
4. Any addition to, alteration of, replacement or relocation of any standpipe, water supply, sewer, drainage, drain leader, gas, soil, waste, vent or similar piping, or electric wiring.
5. Mechanical or other work affecting public health or general safety.

[A] 105.2.3 Public service agencies. A permit shall not be required for the installation, alteration or repair of generation, transmission, distribution or metering, or other related equipment that is under the ownership and control of public service agencies by established right.

[A] 105.3 Application for permit. To obtain a permit, the applicant shall first file an application therefor in writing on a form furnished by the Department of Building Safety for that purpose. Such application shall:

1. Identify and describe the work in accordance with Chapter 3 to be covered by the permit for which application is made.
2. Describe the land on which the proposed work is to be done by legal description, street address or similar description that will readily identify and definitely locate the proposed building or work.
3. Indicate the use and occupancy for which the proposed work is intended.
4. Be accompanied by construction documents and other information as required in Section 106.3.
5. State the valuation of the proposed work.
6. Be signed by the applicant or the applicant's authorized agent.
7. Give such other data and information as required by the code official.

[A] 105.3.1 Action on application. The code official shall examine or cause to be examined applications for permits and amendments thereto within a reasonable time after filing. If the application or the construction documents do not conform to the requirements of pertinent laws, the code official shall reject such application in writing, stating the reasons therefor. If the code official is satisfied that the proposed work conforms to the requirements of this code and laws and ordinances applicable thereto, the code official shall issue a permit therefor as soon as practicable.

[A] 105.3.2 Time limitation of application. An application for a permit for any proposed work shall be deemed to have been abandoned 180 days after the date of filing, unless such application has been pursued in good faith or a permit has been issued; except that the code official is authorized to grant one or more extensions of time for additional periods not exceeding 90 days each. The extension shall be requested in writing and justifiable cause demonstrated.

[A] 105.4 Validity of permit. The issuance or granting of a permit shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this code or of any other ordinance of the jurisdiction. Permits presuming to give authority to violate or cancel the provisions of this code or other ordinances of the jurisdiction shall not be valid. The issuance of a permit based on construction documents and other data shall not prevent the code official from requiring the correction of errors in the construction documents and other data. The code official is authorized to prevent occupancy or use of a structure where in violation of this code or of any other ordinances of this jurisdiction.

[A] 105.5 Expiration. Every permit issued shall become invalid unless the work on the site authorized by such permit is commenced within 180 days after its issuance, or if the work authorized on the site by such permit is suspended or abandoned for a period of 180 days after the time the work is commenced. The code official is authorized to grant, in writing, one or more extensions of time for periods not more than 180 days each. The extension shall be requested in writing and justifiable cause demonstrated.

105.5.1 Expiration. [BSC] *On or after January 1, 2019, every permit issued shall become invalid unless the work on the site authorized by such permit is commenced within 12 months after its issuance or if the work authorized on the site by such permit is suspended or abandoned for a period of 12 months after the time the work is commenced. The building official is authorized to grant, in writing, one or more extensions of time for periods not more than 180 days each. The extension shall be requested in writing and justifiable cause demonstrated. (See Health and Safety Code Section 18938.5 and 18938.6).*

[A] 105.6 Suspension or revocation. The code official is authorized to suspend or revoke a permit issued under the provisions of this code wherever the permit is issued in error or on the basis of incorrect, inaccurate or incomplete information, or in violation of any ordinance or regulation or any of the provisions of this code.

[A] 105.7 Placement of permit. The building permit or copy shall be kept on the site of the work until the completion of the project.

SECTION 106
CONSTRUCTION DOCUMENTS

[A] 106.1 General. Submittal documents consisting of construction documents, special inspection and structural observation programs, investigation and evaluation reports, and other data shall be submitted in two or more sets, or in a digital format where allowed by the code official, with each application for a permit. The construction documents shall be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed. Where special conditions exist, the code official is authorized to require additional construction documents to be prepared by a registered design professional.

Exception: The code official is authorized to waive the submission of construction documents and other data not required to be prepared by a registered design professional if it is found that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with this code.

[A] 106.2 Construction documents. Construction documents shall be in accordance with Sections 106.2.1 through 106.2.6.

[A] 106.2.1 Construction documents. Construction documents shall be dimensioned and drawn on suitable material. Electronic media documents are permitted to be submitted where approved by the code official. Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the code official. The work areas shall be shown.

[A] 106.2.2 Fire protection system(s) shop drawings. Shop drawings for the fire protection system(s) shall be submitted to indicate compliance with this code and the construction documents and shall be approved prior to the start of system installation. Shop drawings shall contain information as required by the referenced installation standards in Chapter 9 of the *California Building Code*.

[A] 106.2.3 Means of egress. The construction documents for Alterations—Level 2, Alterations—Level 3, additions and changes of occupancy shall show in sufficient detail the location, construction, size and character of all portions of the means of egress in compliance with the provisions of this code. The construction documents shall designate the number of occupants to be accommodated in every work area of every floor and in all affected rooms and spaces.

[A] 106.2.4 Exterior wall envelope. Construction documents for work affecting the exterior wall envelope shall describe the exterior wall envelope in sufficient detail to determine compliance with this code. The construction documents shall provide details of the exterior wall envelope as required, including windows, doors, flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves or parapets, means of drainage, water-resistive barriers and details around openings.

The construction documents shall include manufacturer's installation instructions that provide supporting documentation that the proposed penetration and opening details described in the construction documents maintain the wind and weather resistance of the exterior wall envelope. The supporting documentation shall fully describe the exterior wall system that was tested, where applicable, as well as the test procedure used.

[A] 106.2.5 Exterior balconies and elevated walking surfaces. Where the scope of work involves balconies or other elevated walking surfaces have weather-exposed surfaces, and the structural framing is protected by an impervious moisture barrier, the construction documents shall include details for all elements of the impervious moisture barrier system. The construction documents shall include manufacturer's installation instructions.

[A] 106.2.6 Site plan. The construction documents submitted with the application for permit shall be accompanied by a site plan showing to scale the size and location of new construction and existing structures on the site, distances from lot lines, the established street grades, and the proposed finished grades; and it shall be drawn in accordance with an accurate boundary line survey. In the case of demolition, the site plan shall show construction to be demolished and the location and size of existing structures and construction that are to remain on the site or plot. The code official is authorized to waive or modify the requirement for a site plan where the application for permit is for alteration, repair or change of occupancy.

[A] 106.3 Examination of documents. The code official shall examine or cause to be examined the submittal documents and shall ascertain by such examinations whether the construction or occupancy indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances.

[A] 106.3.1 Approval of construction documents. Where the code official issues a permit, the construction documents shall be approved in writing or by stamp as "Reviewed for Code Compliance." One set of construction documents so reviewed shall be retained by the code official. The other set shall be returned to the applicant, shall be kept at the site of work, and shall be open to inspection by the code official or a duly authorized representative.

[A] 106.3.2 Previous approval. This code shall not require changes in the construction documents, construction or designated occupancy of a structure for which a lawful permit has been issued and the construction of which has been pursued in good faith within 180 days after the effective date of this code and has not been abandoned.

[A] 106.3.3 Phased approval. The code official is authorized to issue a permit for the construction of foundations or any other part of a building before the construction documents for the whole building or structure have been submitted, provided that adequate information and detailed statements have been filed complying with pertinent requirements of this code. The holder of such permit for the foundation or other parts of a building shall proceed at the holder's own risk with the building operation and without assurance that a permit for the entire structure will be granted.

[A] 106.3.4 Deferred submittals. Deferral of any submittal items shall have the prior approval of the code official. The registered design professional in responsible charge shall list the deferred submittals on the construction documents for review by the code official.

Submittal documents for deferred submittal items shall be submitted to the registered design professional in responsible charge who shall review them and forward them to the code official with a notation indicating that the deferred submittal documents have been reviewed and that they have been found to be in general conformance to the design of the building. The deferred submittal items shall not be installed until their deferred submittal documents have been approved by the code official.

[A] 106.4 Amended construction documents. Work shall be installed in accordance with the reviewed construction documents, and any changes made during construction that are not in compliance with the approved construction documents shall be resubmitted for approval as an amended set of construction documents.

[A] 106.5 Retention of construction documents. One set of approved construction documents shall be retained by the code official for a period of not less than the period required for retention of public records.

[A] 106.6 Design professional in responsible charge. Where it is required that documents be prepared by a registered design professional, the code official shall be authorized to require the owner or the owner's authorized agent to engage and designate on the building permit application a registered design professional who shall act as the registered design professional in responsible charge. If the circumstances require, the owner or the owner's authorized agent shall designate a substitute registered design professional in responsible charge who shall perform the duties required of the original registered design professional in responsible charge. The code official shall be notified in writing by the owner or the owner's authorized agent if the registered design professional in responsible charge is changed or is unable to continue to perform the duties. The registered design professional in responsible charge shall be responsible for reviewing and coordinating submittal documents prepared by others, including phased and deferred submittal items, for compatibility with the design of the building. Where structural observation is required, the inspection program shall name the individual or firms who are to perform structural observation and describe the stages of construction at which structural observation is to occur.

SECTION 107
TEMPORARY STRUCTURES AND USES

[A] 107.1 General. The code official is authorized to issue a permit for temporary uses. Such permits shall be limited as to time of service but shall not be permitted for more than 180 days. The code official is authorized to grant extensions for demonstrated cause.

[A] 107.2 Conformance. Temporary uses shall conform to the structural strength, fire safety, means of egress, accessibility, light, ventilation and sanitary requirements of this code as necessary to ensure the public health, safety and general welfare.

[A] 107.3 Temporary power. The code official is authorized to give permission to temporarily supply and use power in part of an electric installation before such installation has been fully completed and the final certificate of completion has been issued. The part covered by the temporary certificate shall comply with the requirements specified for temporary lighting, heat or power in the *California Electrical Code*.

[A] 107.4 Termination of approval. The code official is authorized to terminate such permit for a temporary use and to order the temporary use to be discontinued.

SECTION 108
FEES

[A] 108.1 Payment of fees. A permit shall not be valid until the fees prescribed by law have been paid, nor shall an amendment to a permit be released until the additional fee, if any, has been paid.

[A] 108.2 Schedule of permit fees. Where a permit is required, a fee for each permit shall be paid as required, in accordance with the schedule as established by the applicable governing authority.

[A] 108.3 Permit valuations. The applicant for a permit shall provide an estimated permit value at time of application. Permit valuations shall include total value of work, including materials and labor for which the permit is being issued, such as electrical, gas, mechanical, plumbing equipment and permanent systems. If, in the opinion of the code official, the valuation is underestimated on the application, the permit shall be denied unless the applicant can show detailed estimates to meet the approval of the code official. Final building permit valuation shall be set by the code official.

[A] 108.4 Work commencing before permit issuance. Any person who commences any work before obtaining the necessary permits shall be subject to a fee established by the code official that shall be in addition to the required permit fees.

[A] 108.5 Related fees. The payment of the fee for the construction, alteration, removal or demolition of work done in connection to or concurrently with the work authorized by a permit shall not relieve the applicant or holder of the permit from the payment of other fees that are prescribed by law.

[A] 108.6 Refunds. The code official is authorized to establish a refund policy.

SECTION 109
INSPECTIONS

[A] 109.1 General. Construction or work for which a permit is required shall be subject to inspection by the code official, and such construction or work shall remain visible and able to be accessed for inspection purposes until approved. Approval as a result of an inspection shall not be construed to be an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Inspections presuming to give authority to violate or cancel the provisions of this code or of other ordinances of the jurisdiction shall not be valid. It shall be the duty of the permit applicant to cause the work to remain visible and able to be accessed for inspection purposes. Neither the code official nor the jurisdiction shall be liable for expense entailed in the removal or replacement of any material required to allow inspection.

[A] 109.2 Preliminary inspection. Before issuing a permit, the code official is authorized to examine or cause to be examined buildings and sites for which an application has been filed.

[A] 109.3 Required inspections. The code official, on notification, shall make the inspections set forth in Sections 109.3.1 through 109.3.11.

[A] 109.3.1 Footing or foundation inspection. Footing and foundation inspections shall be made after excavations for footings are complete and any required reinforcing steel is in place. For concrete foundations, any required forms shall be in place prior to inspection. Materials for the foundation shall be on the job, except where concrete is ready-mixed in accordance with ASTM C94, the concrete need not be on the job.

[A] 109.3.2 Concrete slab or under-floor inspection. Concrete slab and under-floor inspections shall be made after in-slab or under-floor reinforcing steel and building service equipment, conduit, piping accessories and other ancillary equipment items are in place but before any concrete is placed or floor sheathing installed, including the subfloor.

[A] 109.3.3 Lowest floor elevation. For additions and substantial improvements to existing buildings in flood hazard areas, on placement of the lowest floor, including basement, and prior to further vertical construction, the elevation documentation required in the *California Building Code,* or the *California Residential Code,* as applicable, shall be submitted to the code official.

[A] 109.3.4 Frame inspection. Framing inspections shall be made after the roof deck or sheathing, framing, fire blocking and bracing are in place and pipes, chimneys and vents to be concealed are complete and the rough electrical, plumbing, heating wires, pipes and ducts are approved.

109.3.4.1 Moisture content verification. [HCD] *Moisture content of framing members shall be verified in accordance with the California Green Building Standards Code (CALGreen), Chapter 4, Division 4.5.*

[A] 109.3.5 Lath or gypsum board inspection. Lath and gypsum board inspections shall be made after lathing and gypsum board, interior and exterior, is in place but before any plastering is applied or before gypsum board joints and fasteners are taped and finished.

Exception: Gypsum board that is not part of a fire-resistance-rated assembly or a shear assembly.

[A] 109.3.6 Weather-exposed balcony and walking surface waterproofing. Where the scope of work involves balconies or other elevated walking surfaces that have weather-exposed surfaces and the structural framing is protected by an impervious moisture barrier, all elements of the impervious moisture barrier system shall not be concealed until inspected and approved.

Exception: ***[DSA-SS, DSA-SS/CC, HCD 1, HCD 2]*** Where special inspections are provided in accordance with *Section 1705A.1.1, Item 3 or* Section 1705.1.1, Item 3, *as applicable,* of the *California Building Code*.

109.3.6.1 Weather-exposed balcony and walking surface (exterior elevated element) inspections for multifamily buildings with three or more dwelling units. [HCD 1 & HCD 2] *Weather-exposed balconies and walking surfaces extending beyond the exterior walls of a building, more than 6 feet (1828.8 mm) above ground level, and that rely on wood or wood-based products for structural support or stability shall be inspected. Inspections shall be conducted in accordance with Health and Safety Code Section 17973(a) through (f) and (m). Weather-exposed balconies and walking surfaces found to be in need of repair or replacement shall be corrected in accordance with Section 17973(g) through (i). Continued and ongoing maintenance of weather-exposed balconies and walking surfaces shall be the responsibility of the building owner in accordance with Section 17973(k). See definition of "exterior elevated element" in Health and Safety Code Section 17973(b)(2) for additional details. See Civil Code Section 5551 for inspections of condominium projects.*

[A] 109.3.7 Fire- and smoke-resistant penetrations. Protection of joints and penetrations in fire-resistance-rated assemblies, smoke barriers and smoke partitions shall not be concealed from view until inspected and approved.

[A] 109.3.8 Other inspections. In addition to the inspections specified in Sections 109.2 through 109.3.7, the code official is authorized to make or require other inspections of any construction work to ascertain compliance with the provisions of this code and other laws that are enforced by the Department of Building Safety.

Note: *All noncompliant plumbing fixtures in any residential real property shall be replaced with water-conserving plumbing fixtures. Plumbing fixture replacement is required prior to issuance of a certificate of final completion, certificate of occupancy or final permit approval by the local building department. See Civil Code Section 1101.1, et seq., for the definition of a noncompliant plumbing fixture, types of residential buildings affected and other important enactment dates.*

[A] 109.3.9 Special inspections. Special inspections shall be required in accordance with the *California Building Code*.

[A] 109.3.10 Flood hazard documentation. Where a building is located in a flood hazard area, documentation of the elevation of the lowest floor as required in the *California Building Code* or the *California Residential Code*, as applicable, shall be submitted to the code official prior to the final inspection.

[A] 109.3.11 Final inspection. The final inspection shall be made after work required by the building permit is completed.

[A] 109.4 Inspection agencies. The code official is authorized to accept reports of approved inspection agencies, provided that such agencies satisfy the requirements as to qualifications and reliability.

[A] 109.5 Inspection requests. It shall be the duty of the holder of the building permit or their duly authorized agent to notify the code official when work is ready for inspection. It shall be the duty of the permit holder to provide access to and means for any inspections of such work that are required by this code.

[A] 109.6 Approval required. Work shall not be done beyond the point indicated in each successive inspection without first obtaining the approval of the code official. The code official, on notification, shall make the requested inspections and shall either indicate the portion of the construction that is satisfactory as completed or shall notify the permit holder or an agent of the permit holder wherein the same fails to comply with this code. Any portions that do not comply shall be corrected and such portion shall not be covered or concealed until authorized by the code official.

SECTION 110 CERTIFICATE OF OCCUPANCY

[A] 110.1 Change of occupancy. A structure shall not be used or occupied in whole or in part, and a change of occupancy of a structure or portion thereof shall not be made until the code official has issued a certificate of occupancy therefor as provided herein. Issuance of a certificate of occupancy shall not be construed as an approval of a violation of the provisions of this code or of other ordinances of the jurisdiction. Certificates presuming to give authority to violate or cancel the provisions of this code or other ordinances of the jurisdiction shall not be valid.

Exception: Certificates of occupancy are not required for work exempt from permits in accordance with Section 105.2.

[A] 110.2 Certificate issued. After the code official inspects the structure and does not find violations of the provisions of this code or other laws that are enforced by the department, the code official shall issue a certificate of occupancy that contains the following:

1. The permit number.
2. The address of the structure.
3. The name and address of the owner or the owner's authorized agent.
4. A description of that portion of the structure for which the certificate is issued.
5. A statement that the described portion of the structure has been inspected for compliance with the requirements of this code for the occupancy and division of occupancy and the use for which the proposed occupancy is classified.
6. The name of the code official.
7. The edition of the code under which the permit was issued.
8. The use and occupancy in accordance with the provisions of the *California Building Code*.
9. The type of construction as defined in the *California Building Code*.
10. The design occupant load and any impact the alteration has on the design occupant load of the area not within the scope of the work.
11. Where an automatic sprinkler system is provided, and whether an automatic sprinkler system is required.
12. Any special stipulations and conditions of the building permit.

[A] 110.3 Temporary occupancy. The code official is authorized to issue a temporary certificate of occupancy before the completion of the entire work covered by the permit, provided that such portion or portions shall be occupied safely. The code official shall set a time period during which the temporary certificate of occupancy is valid.

[A] 110.4 Revocation. The code official is authorized to suspend or revoke a certificate of occupancy or completion issued under the provisions of this code, in writing, wherever the certificate is issued in error or on the basis of incorrect information supplied, or where it is determined that the building or structure or portion thereof is in violation of the provisions of this code or other ordinance of the jurisdiction.

SECTION 111 SERVICE UTILITIES

[A] 111.1 Connection of service utilities. A person shall not make connections from a utility, source of energy, fuel, power, water system or sewer system to any building or system that is regulated by this code for which a permit is required, until approved by the code official.

[A] 111.2 Temporary connection. The code official shall have the authority to authorize the temporary connection of the building or system to the utility, source of energy, fuel, power, water system or sewer system for the purpose of testing systems or for use under a temporary approval.

[A] 111.3 Authority to disconnect service utilities. The code official shall have the authority to authorize disconnection of utility service to the building, structure or system regulated by this code and the referenced codes and standards in case of emergency where necessary to eliminate an immediate hazard to life or property or where such utility connection has been made without the approval required by Section 111.1 or 111.2. The code official shall notify the serving utility and, wherever possible, the owner or the owner's authorized agent and the occupant of the building, structure or service system of the decision to disconnect prior to taking such action. If not notified prior to disconnecting, the owner, the owner's authorized agent or occupant of the building, structure or service system shall be notified in writing, as soon as practical thereafter.

SECTION 112 MEANS OF APPEALS

[A] 112.1 General. In order to hear and decide appeals of orders, decisions or determinations made by the code official relative to the application and interpretation of this code, there shall be and is hereby created a board of appeals. The board of appeals shall be appointed by the applicable governing authority and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business and shall render all decisions and findings in writing to the appellant with a duplicate copy to the code official.

[A] 112.2 Limitations on authority. An application for appeal shall be based on a claim that the true intent of this code or the rules legally adopted thereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equivalent or better form of construction is proposed. The board shall not have authority to waive requirements of this code or interpret the administration of this code.

[A] 112.3 Qualifications. The board of appeals shall consist of members who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction.

[A] 112.4 Administration. The code official shall take immediate action in accordance with the decision of the board.

SECTION 113 VIOLATIONS

[A] 113.1 Unlawful acts. It shall be unlawful for any person, firm or corporation to repair, alter, extend, add, move, remove, demolish or change the occupancy of any building or equipment regulated by this code or cause same to be done in conflict with or in violation of any of the provisions of this code.

[A] 113.2 Notice of violation. The code official is authorized to serve a notice of violation or order on the person responsible for the repair, alteration, extension, addition, moving, removal, demolition or change in the occupancy of a building in violation of the provisions of this code or in violation of a permit or certificate issued under the provisions of this code. Such order shall direct the discontinuance of the illegal action or condition and the abatement of the violation.

[A] 113.3 Prosecution of violation. If the notice of violation is not complied with promptly, the code official is authorized to request the legal counsel of the jurisdiction to institute the appropriate proceeding at law or in equity to restrain, correct or abate such violation or to require the removal or termination of the unlawful occupancy of the building or structure in violation of the provisions of this code or of the order or direction made pursuant thereto.

[A] 113.4 Violation penalties. Any person who violates a provision of this code or fails to comply with any of the requirements thereof or who repairs or alters or changes the occupancy of a building or structure in violation of the approved construction documents or directive of the code official or of a permit or certificate issued under the provisions of this code shall be subject to penalties as prescribed by law.

SECTION 114 STOP WORK ORDER

[A] 114.1 Authority. Where the code official finds any work regulated by this code being performed in a manner contrary to the provisions of this code or in a dangerous or unsafe manner, the code official is authorized to issue a stop work order.

[A] 114.2 Issuance. The stop work order shall be in writing and shall be given to the owner of the property, the owner's authorized agent or the person performing the work. Upon issuance of a stop work order, the cited work shall immediately cease. The stop work order shall state the reason for the order and the conditions under which the cited work is authorized to resume.

[A] 114.3 Emergencies. Where an emergency exists, the code official shall not be required to give a written notice prior to stopping the work.

[A] 114.4 Failure to comply. Any person who shall continue any work after having been served with a stop work order, except such work as that person is directed to perform to remove a violation or unsafe condition, shall be subject to fines established by the authority having jurisdiction.

SECTION 115 UNSAFE STRUCTURES AND EQUIPMENT

[A] 115.1 Unsafe conditions. Structures or existing equipment that are or hereafter become unsafe, insanitary or deficient because of inadequate means of egress facilities, inadequate light and ventilation, or that constitute a fire hazard, or are otherwise dangerous to human life or the public welfare, or that involve illegal or improper occupancy or inadequate maintenance, shall be deemed an unsafe condition. Unsafe structures shall be taken down and removed or made safe as the code official deems necessary and as provided for in this code. A vacant structure that is not secured against unauthorized entry shall be deemed unsafe.

[A] 115.2 Record. The code official shall cause a report to be filed on an unsafe condition. The report shall state the occupancy of the structure and the nature of the unsafe condition.

[A] 115.3 Notice. If an unsafe condition is found, the code official shall serve on the owner of the structure or the owner's authorized agent a written notice that describes the condition deemed unsafe and specifies the required repairs or improvements to be made to abate the unsafe condition, or that requires the unsafe building to be demolished within a stipulated time. Such notice shall require the person thus notified to declare immediately to the code official acceptance or rejection of the terms of the order.

[A] 115.4 Method of service. Such notice shall be deemed properly served where a copy thereof is served in accordance with one of the following methods:

1. A copy is delivered to the owner or the owner's authorized agent personally.
2. A copy is sent by certified or registered mail addressed to the owner at the last known address with the return receipt requested.
3. A copy is delivered in any other manner as prescribed by local law.

If the certified or registered letter is returned showing that the letter was not delivered, a copy thereof shall be posted in a conspicuous place in or about the structure affected by such notice. Service of such notice in the foregoing manner on the owner's authorized agent shall constitute service of notice on the owner.

[A] 115.5 Restoration or abatement. The structure or equipment determined to be unsafe by the code official is permitted to be restored to a safe condition. The owner, the owner's authorized agent, operator or occupant of a structure, premises or equipment deemed unsafe by the code official shall abate or cause to be abated or corrected such unsafe conditions either by repair, rehabilitation, demolition or other approved corrective action. To the extent that repairs, alterations or additions are made, or a change of occupancy occurs during the restoration of the structure, such repairs, alterations, additions or change of occupancy shall comply with the requirements of this code.

SECTION 116
EMERGENCY MEASURES

[A] 116.1 Imminent danger. Where, in the opinion of the code official, there is imminent danger of failure or collapse of a building that endangers life, or where any building or part of a building has fallen and life is endangered by the occupation of the building, or where there is actual or potential danger to the building occupants or those in the proximity of any structure because of explosives, explosive fumes or vapors, or the presence of toxic fumes, gases, or materials, or operation of defective or dangerous equipment, the code official is hereby authorized and empowered to order and require the occupants to vacate the premises forthwith. The code official shall cause to be posted at each entrance to such structure a notice reading as follows: "This Structure Is Unsafe and Its Occupancy Has Been Prohibited by the Code Official." It shall be unlawful for any person to enter such structure except for the purpose of securing the structure, making the required repairs, removing the hazardous condition, or of demolishing the same.

[A] 116.2 Temporary safeguards. Notwithstanding other provisions of this code, whenever, in the opinion of the code official, there is imminent danger due to an unsafe condition, the code official shall order the necessary work to be done, including the boarding up of openings, to render such structure temporarily safe whether or not the legal procedure herein described has been instituted; and shall cause such other action to be taken as the code official deems necessary to meet such emergency.

[A] 116.3 Closing streets. Where necessary for public safety, the code official shall temporarily close structures and close or order the authority having jurisdiction to close sidewalks, streets, public ways and places adjacent to unsafe structures, and prohibit the same from being utilized.

[A] 116.4 Emergency repairs. For the purposes of this section, the code official shall employ the necessary labor and materials to perform the required work as expeditiously as possible.

[A] 116.5 Costs of emergency repairs. Costs incurred in the performance of emergency work shall be paid by the jurisdiction. The legal counsel of the jurisdiction shall institute appropriate action against the owner of the premises or the owner's authorized agent where the unsafe structure is or was located for the recovery of such costs.

[A] 116.6 Hearing. Any person ordered to take emergency measures shall comply with such order forthwith. Any affected person shall thereafter, on petition directed to the appeals board, be afforded a hearing as described in this code.

SECTION 117
DEMOLITION

[A] 117.1 General. The code official shall order the owner or owner's authorized agent of any premises on which is located any structure that in the code official's judgment is so old or dilapidated, or has become so out of repair as to be dangerous, unsafe, insanitary or otherwise unfit for human habitation of occupancy, and such that it is unreasonable to repair the structure, to demolish and remove such structure; or if such structure is capable of being made safe by repairs, to repair and make safe and sanitary or to demolish and remove to the owner's or the owner's authorized agent's option; or where there has been a cessation of normal construction of any structure for a period of more than two years, to demolish and remove such structure.

[A] 117.2 Notices and orders. Notices and orders shall comply with Section 113.

[A] 117.3 Failure to comply. If the owner or the owner's authorized agent of a premises fails to comply with a demolition order within the time prescribed, the code official shall cause the structure to be demolished and removed, either through an available public agency or by contract or arrangement with private persons, and the cost of such demolition and removal shall be charged against the real estate on which the structure is located and shall be a lien on such real estate.

[A] 117.4 Salvage materials. Where any structure has been ordered demolished and removed, the governing body or other designated officer under said contract or arrangement aforesaid shall have the right to sell the salvage and valuable materials at the highest price obtainable. The net proceeds of such sale, after deducting the expenses of such demolition and removal, shall be promptly remitted with a report of such sale or transaction, including the items of expense and the amounts deducted, for the person who is entitled thereto, subject to any order of a court. If such a surplus does not remain to be turned over, the report shall so state.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 2 – DEFINITIONS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter													X										
Adopt Entire Chapter as amended (amended sections listed below)	X			X	X					X	X	X		X	X								
Adopt only those sections that are listed below			X					X	X														
Chapter / Section																							
201								X	X														
201.1										X	X	X		X	X								
ACCESSORY DWELLING UNIT				X	X																		
ADDITION			X																				
ALTERATION			X																				
APPROVED			X	X	X																		
BUILDING				X	X	X																	
BUILDING OFFICIAL	X			X	X			X	X	X	X	X		X	X								
CHANGE OF OCCUPANCY			X																				
CODE OFFICIAL			X	X	X																		
CHANGE IN FUNCTION										X	X	X		X	X								
CRITICAL CARE AREA										X													
DANGEROUS			X																				
ENFORCEMENT AGENCY	X							X	X														
EQUIPMENT OR FIXTURE			X																				
EXISTING BUILDING			X																				
EXISTING STRUCTURE			X																				
EXISTING STRUCTURE										X	X	X		X	X								
EXTERIOR ELEVATED ELEMENT				X	X																		
FACILITY			X																				
GENERAL ACUTE CARE HOSPITAL										X													
INCIDENTAL STRUCTURAL ALTERATIONS, ADDITIONS OR REPAIRS										X				X									
MAJOR STRUCTURAL ALTERATIONS										X				X									
MINOR STRUCTURAL ALTERATIONS, ADDITIONS OR REPAIRS										X				X									
NONCOMBUSTIBLE MATERIAL			X																				
NONSTRUCTURAL ALTERATION										X				X									
PRIMARY FUNCTION			X																				

(continued)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter													X										
Adopt Entire Chapter as amended (amended sections listed below)	X			X	X					X	X	X		X	X								
Adopt only those sections that are listed below			X					X	X														
Chapter / Section																							
REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE			X							X	X	X		X	X								
REHABILITATION			X																				
REPAIR			X																				
REPAIR										X													
REROOFING			X																				
ROOF COATING			X																				
ROOF RECOVER			X																				
ROOF REPAIR			X																				
ROOF REPLACEMENT			X																				
SPC SEISMIC SEPARATION										X	X												
SUBSTANDARD BUILDING				X	X																		
SUBSTANTIAL STRUCTURAL DAMAGE										X	X												
UNREINFORCED CONCRETE										X	X	X		X	X								
UNREINFORCED MASONRY										X				X									
UNSAFE			X	X	X																		
VOLUNTARY STRUCTURAL IMPROVEMENTS										X													
WORK AREA			X																				

The state agency does not adopt sections identified with the following symbol: †

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 2

DEFINITIONS

User note:

About this chapter: *Codes, by their very nature, are technical documents. Every word, term and punctuation mark can add to or change the meaning of a technical requirement. It is necessary to maintain a consensus on the specific meaning of each term contained in the code. Chapter 2 performs this function by stating clearly what specific terms mean for the purpose of the code.*

SECTION 201
GENERAL

201.1 Scope. Unless otherwise expressly stated, the following words and terms shall, for the purposes of this code, have the meanings shown in this chapter. ***[OSHPD 1, 1R, 2, 4 & 5]*** *For terms not defined in this chapter, refer to Part 1, Chapters 6 and 7 of the California Administrative Code, and Part 2, Chapter 2 of the California Building Code.*

201.2 Interchangeability. Words used in the present tense include the future; words stated in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural, the singular.

201.3 Terms defined in other codes. Where terms are not defined in this code and are defined in the other *California Codes*, such terms shall have the meanings ascribed to them in those codes. ***[DSA-SS & DSA-SS/CC]*** *Definitions of terms given in Section 4-208 or 4-314 of the California Administrative Code govern over those in Section 202.*

201.4 Terms not defined. Where terms are not defined through the methods authorized by this chapter, such terms shall have ordinarily accepted meanings such as the context implies.

SECTION 202
GENERAL DEFINITIONS

ACCESSORY DWELLING UNIT. [HCD 1 & HCD 2] *An attached or detached residential dwelling unit that provides complete independent living facilities for one or more persons and is located on a lot with a proposed or existing primary residence. Accessory dwelling units shall include permanent provisions for living, sleeping, eating, cooking and sanitation on the same parcel as the single-family or multifamily dwelling is or will be situated. (See Government Code Section 65852.2.)*

[A] ADDITION. An extension or increase in floor area, number of stories, or height of a building or structure.

[A] ALTERATION. Any construction or renovation to an existing structure other than a repair or addition.

[A] APPROVED. Acceptable to the code official.

Exception: [HCD 1 & HCD 2] *"Approved" means meeting the approval of the Enforcing Agency, except as otherwise provided by law, when used in connection with any system, material, type of construction, fixture or appliance as the result of investigations and tests conducted by the agency, or by reason of accepted principles or tests by national authorities, or technical, health, or scientific organizations or agencies.*

Notes:

1. *See Health and Safety Code Section 17920 for "Approved" as applied to residential construction and buildings or structures accessory thereto as referenced in Section 1.8.2.*
2. *See Health and Safety Code Section 17921.1 for "Approved" as applied to the use of hotplates in residential construction as referenced in Section 1.8.2.*
3. *See Health and Safety Code Section 19966 for "Approved" as applied to Factory-Built Housing as referenced in Section 1.8.3.2.5.*
4. *See Health and Safety Code Section 18201 for "Approved" as applied to Mobilehome Parks as referenced in Section 1.8.2.*
5. *See Health and Safety Code Section 18862.1 for "Approved" as applied to Special Occupancy Parks as referenced in Section 1.8.2.*

[A] BUILDING. Any structure utilized or intended for supporting or sheltering any *use or* occupancy.

Exception: [HCD 1, HCD 2 & HCD 1-AC] *For applications listed in Section 1.8.2 regulated by the Department of Housing and Community Development, "Building" shall not include the following:*

1. *Any mobilehome as defined in Health and Safety Code Section 18008.*
2. *Any manufactured home as defined in Health and Safety Code Section 18007.*
3. *Any commercial modular as defined in Health and Safety Code Section 18001.8 or any special purpose commercial modular as defined in Section 18012.5.*
4. *Any recreational vehicle as defined in Health and Safety Code, Section 18010.*
5. *Any multifamily manufactured home as defined in Health and Safety Code Section 18008.7.*

For additional information, see Health and Safety Code Section 18908.

Note: *Building shall have the same meaning as defined in Health and Safety Code Sections 17920 and 18908 for the applications specified in Section 1.11.*

BUILDING OFFICIAL. See *Los Angeles Municipal Code* Section 91.202.

CHANGE IN FUNCTION. [OSHPD 1, 1R, 2, 4 & 5] *See California Building Code Section 1224.3.*

[A] CHANGE OF OCCUPANCY. Any of the following shall be considered as a change of occupancy where the current *California Building Code* requires a greater degree of safety, accessibility, structural strength, fire protection, means of egress, ventilation or sanitation than is existing in the current building or structure:

1. Any change in the occupancy classification of a building or structure.
2. Any change in the purpose of, or a change in the level of activity within, a building or structure.
3. A change of use.

[A] CHANGE OF USE. A change in the use of a building or a portion of a building, within the same group classification, for which there is a change in application of the code requirements.

CODE OFFICIAL. See "Building Official."

CRITICAL CARE AREA. [OSHPD 1] *See California Administrative Code Chapter 6.*

[BS] DANGEROUS. Any building, structure or portion thereof that meets any of the conditions described below shall be deemed dangerous:

1. The building or structure has collapsed, has partially collapsed, has moved off its foundation or lacks the necessary support of the ground.
2. There exists a significant risk of collapse, detachment or dislodgement of any portion, member, appurtenance or ornamentation of the building or structure under permanent, routine or frequent loads; under actual loads already in effect; or under snow, wind, rain, flood, earthquake or other environmental loads when such loads are imminent.

[A] DEFERRED SUBMITTAL. Those portions of the design that are not submitted at the time of the application and that are to be submitted to the code official within a specified period.

[BS] DISPROPORTIONATE EARTHQUAKE DAMAGE. A condition of earthquake-related damage where both of the following occur:

1. The 0.3-second spectral acceleration at the building site as estimated by the United States Geological Survey for the earthquake in question is less than 40 percent of the mapped acceleration parameter SS.
2. The vertical elements of the lateral force-resisting system have suffered damage such that the lateral load-carrying capacity of any story in any horizontal direction has been reduced by more than 10 percent from its predamage condition.

[BE] EMERGENCY ESCAPE AND RESCUE OPENING. An operable exterior window, door or other similar device that provides for a means of escape and access for rescue in the event of an emergency.

ENFORCEMENT AGENCY. [BSC, DSA-SS, DSA-SS/CC] *The agency or organization charged with responsibility for agency or organization compliance with the requirements of this code, also known as the Authority Having Jurisdiction in ASCE 41.*

EQUIPMENT OR FIXTURE. Any plumbing, heating, electrical, ventilating, air conditioning, refrigerating and fire protection equipment; and elevators, dumbwaiters, escalators, boilers, pressure vessels and other mechanical facilities; or installations that are related to building services. Equipment or fixture shall not include manufacturing, production or process equipment, but shall include connections from building service to process equipment.

[A] EXISTING BUILDING. A building erected prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued.

[A] EXISTING STRUCTURE. A structure erected prior to the date of adoption of the appropriate code, or one for which a legal building permit has been issued.

EXISTING STRUCTURE. [OSHPD 1, 1R, 2, 4 & 5] *A structure that has a valid certificate of occupancy issued by the building official.*

EXTERIOR ELEVATED ELEMENT. *See Government Code Section 17973(b)(2).*

[BF] EXTERIOR WALL COVERING. A material or assembly of materials applied on the exterior side of exterior walls for the purpose of providing a weather-resisting barrier, insulation or for aesthetics, including but not limited to, veneers, siding, exterior insulation and finish systems, architectural trim and embellishments, such as cornices, soffits, facias, gutters and leaders.

[BF] EXTERIOR WALL ENVELOPE. A system or assembly of exterior wall components, including exterior wall finish materials, that provides protection of the building structural members, including framing and sheathing materials, and conditioned interior space from the detrimental effects of the exterior environment.

[A] FACILITY. All or any portion of buildings, structures, site improvements, elements and pedestrian or vehicular routes located on a site.

[BS] FLOOD HAZARD AREA. The greater of the following two areas:

1. The area within a flood plain subject to a 1-percent or greater chance of flooding in any year.

2. The area designated as a flood hazard area on a community's flood hazard map, or otherwise legally designated.

GENERAL ACUTE CARE HOSPITAL. [OSHPD 1] *See California Building Code Section 1224.3.*

[A] HISTORIC BUILDING. Any building or structure that is one or more of the following:

1. Listed, or certified as eligible for listing, by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, in the National Register of Historic Places.
2. Designated as historic under an applicable state or local law.
3. Certified as a contributing resource within a National Register, state designated or locally designated historic district.

INCIDENTAL STRUCTURAL ALTERATIONS, ADDITIONS OR REPAIRS. [OSHPD 1 & 4] *Alterations, additions or repairs which would not reduce the story lateral shear force-resisting capacity by more than 5 percent or increase the story shear by more than 5 percent in any existing story or a combination thereof with equivalent effect (not exceeding 5 percent total). The calculation of lateral shear force-resisting capacity and story shear shall account for the cumulative effects of additions and alterations since original construction.*

MAJOR STRUCTURAL ALTERATIONS, ADDITIONS OR REPAIRS. [OSHPD 1 & 4] *Alterations, additions or repairs of greater extent than minor structural alterations, additions or repairs.*

MINOR STRUCTURAL ALTERATIONS, ADDITIONS OR REPAIRS. [OSHPD 1 & 4] *Alterations, additions or repairs of greater extent than incidental structural additions or alterations which would not reduce the story shear lateral-force-resisting capacity by more than 10 percent or increase the story shear by more than 10 percent in any existing story or a combination thereof with equivalent effect (not exceeding 10 percent total). The calculation of lateral shear force-resisting capacity and story shear shall account for the cumulative effects of additions and alterations since original construction.*

[BF] NONCOMBUSTIBLE MATERIAL. A material that, under the conditions anticipated, will not ignite or burn when subjected to fire or heat. Materials that pass ASTM E136 are considered noncombustible materials.

NONSTRUCTURAL ALTERATION. [OSHPD 1 & 4] *Nonstructural alteration is any alteration which neither affects existing structural elements nor requires new structural elements for vertical or lateral support and which does not increase the lateral shear force in any story by more than 5 percent.*

PRIMARY FUNCTION. A primary function is a major activity for which the facility is intended. Areas that contain a primary function include, but are not limited to, the customer services lobby of a bank, the dining area of a cafeteria, the meeting rooms in a conference center, as well as offices and other work areas in which the activities of the public accommodation or other private entity using the facility are carried out. Mechanical rooms, boiler rooms, supply storage rooms, employee lounges or locker rooms, janitorial closets, entrances, corridors and restrooms are not areas containing a primary function.

[A] REGISTERED DESIGN PROFESSIONAL IN RESPONSIBLE CHARGE. A registered design professional engaged by the owner or the owner's authorized agent to review and coordinate certain aspects of the project, as determined by the code official, for compatibility with the design of the building or structure, including submittal documents prepared by others, deferred submittal documents and phased submittal documents.

REHABILITATION. Any work, as described by the categories of work defined herein, undertaken in an existing building.

[A] RELOCATABLE BUILDING. A partially or completely assembled building constructed and designed to be reused multiple times and transported to different building sites.

[A] REPAIR. The reconstruction, replacement or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.

REPAIR. [OSHPD 1] *as used in this Code means all the design and construction work affecting existing or requiring new structural elements undertaken to restore or enhance the structural and nonstructural load-resisting system participating in vertical or lateral response of a structure primarily intended to correct the effects of deterioration or impending or actual failure, regardless of cause.*

[BS] REROOFING. The process of recovering or replacing an existing roof covering. See "Roof recover" and "Roof replacement."

[BS] RISK CATEGORY. A categorization of buildings and other structures for determination of flood, wind, snow, ice and earthquake loads based on the risk associated with unacceptable performance, as provided in Section 1604.5 of the *California Building Code*.

[BS] ROOF COATING. A fluid-applied adhered coating used for roof maintenance, roof repair or as a component of a roof covering system or roof assembly.

[BS] ROOF RECOVER. The process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

[BS] ROOF REPAIR. Reconstruction or renewal of any part of an existing roof for the purpose of correcting damage or restoring the predamage condition.

[BS] ROOF REPLACEMENT. The process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

[BS] SEISMIC FORCES. The loads, forces and requirements prescribed herein, related to the response of the building to earthquake motions, to be used in the analysis and design of the structure and its components. Seismic forces are considered either full or reduced, as provided in Chapter 3.

SPC SEISMIC SEPARATION. [OSHPD 1 & 1R] *Means a building separation in accordance with the California Administrative Code, Chapter 6 Section 3.4.*

SUBSTANDARD BUILDING. [HCD 1, HCD 2] *See Health and Safety Code Section 17920.3.*

[BS] SUBSTANTIAL DAMAGE. For the purpose of determining compliance with the flood provisions of this code, damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

[BS] SUBSTANTIAL IMPROVEMENT. For the purpose of determining compliance with the flood provisions of this code, any repair, alteration, addition or improvement of a building or structure, the cost of which equals or exceeds 50 percent of the market value of the structure, before the improvement or repair is started. If the structure has sustained substantial damage, any repairs are considered substantial improvement regardless of the actual repair work performed. The term does not, however, include either of the following:

1. Any project for improvement of a building required to correct existing health, sanitary or safety code violations identified by the code official and that is the minimum necessary to ensure safe living conditions.
2. Any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure.

[BS] SUBSTANTIAL STRUCTURAL ALTERATION. An alteration in which the gravity load-carrying structural elements altered within a 5-year period support more than 30 percent of the total floor and roof area of the building or structure. The areas to be counted toward the 30 percent shall include mezzanines, penthouses, and in-filled courts and shafts tributary to the altered structural elements.

[BS] SUBSTANTIAL STRUCTURAL DAMAGE. A condition where any of the following apply:

1. The vertical elements of the lateral force-resisting system have suffered damage such that the lateral load-carrying capacity of any story in any horizontal direction has been reduced by more than 33 percent from its predamage condition.
2. The capacity of any vertical component carrying gravity load, or any group of such components, that has a tributary area more than 30 percent of the total area of the structure's floor(s) and roof(s) has been reduced more than 20 percent from its predamage condition, and the remaining capacity of such affected elements, with respect to all dead and live loads, is less than 75 percent of that required by the *California Building Code* for new buildings of similar structure, purpose and location.
3. The capacity of any structural component carrying snow load, or any group of such components, that supports more than 30 percent of the roof area of similar construction has been reduced more than 20 percent from its predamage condition, and the remaining capacity with respect to dead, live and snow loads is less than 75 percent of that required by the *California Building Code* for new buildings of similar structure, purpose and location.

SUBSTANTIAL STRUCTURAL DAMAGE. [OSHPD 1 & 1R] *A condition where any of the following apply:*

1. *The vertical elements of the lateral force-resisting system have suffered damage such that the lateral load carrying capacity of any story in any horizontal direction has been reduced by more than 10 percent from its predamage condition.*
2. *The capacity of any vertical component carrying gravity load, or any group of such components, has a tributary area more than 15 percent of the total area of the structure's floor(s) and roof(s), has been reduced more than 10 percent from its predamage condition, and the remaining capacity of such affected elements, with respect to all dead and live loads, is less than 75 percent of that required by the California Building Code for new buildings of similar structure, purpose and location.*
3. *The capacity of any structural component carrying snow load, or any group of such components, that supports more than 15 percent of the roof area of similar construction, has been reduced more than 10 percent from its predamage condition, and the remaining capacity with respect to dead, live and snow loads is less than 75 percent of that required by the California Building Code for new buildings of similar structure, purpose and location.*

TECHNICALLY INFEASIBLE. An alteration of a facility that has little likelihood of being accomplished because the existing structural conditions require the removal or alteration of a load-bearing member that is an essential part of the structural frame, or because other existing physical or site constraints prohibit modification or addition of elements, spaces or features which are in full and strict compliance with the minimum requirements for new construction and which are necessary to provide accessibility.

UNREINFORCED CONCRETE. [OSHPD 1, 1R, 2, 4 & 5] *Unreinforced concrete as used in this chapter means plain concrete as defined in ACI 318 Section 2.3.*

UNREINFORCED MASONRY. [OSHPD 1 & 4] *Unreinforced masonry as used in this chapter means masonry construction where reinforcements in any direction is less than minimum reinforcement specified in TMS 402 Section 7.3.2.6.*

UNSAFE. Buildings, structures or equipment that are unsanitary, or that are deficient due to inadequate means of egress facilities, inadequate light and ventilation, or that constitute a fire hazard, or in which the structure or individual structural members meet the definition of *"Dangerous,"* or that are otherwise dangerous to human life or the public welfare, or that involve illegal or improper occupancy or inadequate maintenance shall be deemed unsafe. A vacant structure that is not secured against entry shall be deemed unsafe.

[HCD 1 & HCD 2] *An unsafe building, as defined in this chapter, shall be considered substandard.*

VOLUNTARY STRUCTURAL IMPROVEMENTS (VSIs). [OSHPD 1] *Voluntary structural improvements are any alterations of existing structural element(s) or addition of new structural elements which are not necessary for vertical or lateral support of other work and is initiated by the applicant primarily for the purpose of increasing the vertical or lateral load-carrying strength or stiffness of an existing building.*

WORK AREA. That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building where work not initially intended by the owner is specifically required by this code.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 3 – PROVISIONS FOR ALL COMPLIANCE METHODS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter													X										
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below	X		X	X	X	X		X	X		X	X		X	X								
Chapter / Section																							
301.1 – 301.3.1			X								X	X		X	X								
301.1				X	X																		
301.1 *Exception 1*	X																						
301.1 *Exception 2*								X															
301.1 *Exception 3*									X														
301.1 *Exception 4*				X	X																		
301.1 *Exception 5*											X	X		X	X								
301.1.1	X																						
301.3				X	X	X					X	X		X	X								
301.3.1 *Exception*											X	X		X	X								
301.3.2				X	X																		
301.3.3				X	X																		
301.4				X	X																		
302			X								X	X		X	X								
302.1.1	X																						
302.2				X	X																		
302.4				X																			
302.5	X																						
304.1	X							X	X														
304.2	X							X	X														
304 – 305											X	X		X	X								
305.1	X							X	X														
306													†										
306.1 *Note*						X																	
306.7.7			X																				
307 – 308			X																				
308.2				X	X																		
310 – 311											X	X			X								
312											X												
313 – 316			X																				
317 – 322	X							X	X														
323								X	X														

The state agency does not adopt sections identified with the following symbol: †

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 3

PROVISIONS FOR ALL COMPLIANCE METHODS

User note:

About this chapter: *Chapter 3 explains the three compliance options for alterations and additions available in the code. In addition, this chapter also lays out the methods to be used for seismic design and evaluation throughout this code. Finally, this chapter clarifies that provisions in other I-Codes® related to repairs, alterations, additions, relocation and changes of occupancy must also be addressed unless they conflict with this code. In that case, this code takes precedence.*

SECTION 301
ADMINISTRATION

301.1 Applicability. The repair, alteration, change of occupancy, addition or relocation of all existing buildings shall comply with Section 301.2, 301.3 or 301.4. The provisions of Sections 302 through 309 shall apply to all alterations, repairs, additions, relocation of structures and changes of occupancy regardless of compliance method. ***[OSHPD 1R, 2, 4 and 5]*** *Section 301.4 not adopted by OSHPD.*

Exceptions:

1. ***Existing state-owned structures. [BSC]*** *The repair, alteration, change of occupancy, addition or relocation of all existing buildings shall comply with the provisions of Sections 317 through 322 as the minimum standards for earthquake evaluation and design for retrofit of existing state-owned structures, including buildings owned by the University of California, the California State University or the Judicial Council.*

   The provisions of Sections 317 through 322 may be adopted by a local jurisdiction for earthquake evaluation and design for retrofit of existing buildings.

2. ***Public school buildings [DSA-SS]*** *The provisions of Sections 317 through 323 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 Sections 317 through 323 also establish minimum standards for earthquake evaluation and design for rehabilitation of existing public school buildings currently under the jurisdiction of DSA-SS.

3. ***Community college buildings. [DSA-SS/CC]*** *The provisions of Sections 317 through 323 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 Sections 317 through 323 also establish minimum standards for earthquake evaluation and design for rehabilitation of existing community college buildings currently under the jurisdiction of DSA-SS/CC.

4. ***[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. ***[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.*
   2. ***[HCD 1]*** *Limited-density owner-built rural dwellings, as defined in Chapter 2 of the California Residential Code.*

5. ***Hospital buildings removed from acute care service, skilled nursing facilities, intermediate-care facilities, correctional treatment centers and acute-psychiatric hospitals [OSHPD 1R, 2, 4 and 5].*** *The provisions of adopted sections in Chapters 3 through 5 shall control the alteration, repair and change of occupancy or function of existing structures for applications listed in Section 1.10.1, 1.10.2, 1.10.4 and 1.10.5 regulated by the Office of Statewide Health Planning and Development (OSHPD). Functional service spaces shall comply with the requirements in the California Building Code, Sections 1224, 1225, 1226, 1227 and 1228.*

301.1.1 Bleachers, grandstands and folding and telescopic seating. Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

301.2 Repairs. Repairs shall comply with the requirements of Chapter 4.

301.3 Alteration, addition or change of occupancy. The alteration, addition or change of occupancy of all existing buildings shall comply with one of the methods listed in Section 301.3.1, 301.3.2 or 301.3.3 as selected by the applicant. Sections 301.3.1 through 301.3.3 shall not be applied in combination with each other. ***[OSHPD 1R, 2, 4 and 5]*** *Sections 301.3.2 and 301.3.3, not adopted by OSHPD.*

Note: [HCD 1 & HCD 2] *Sections 301.3.2 and 301.3.3 shall be permitted only if the performance compliance method and/or work area compliance method are adopted by a local ordinance.*

Exception: Subject to the approval of the code official, alterations complying with the laws in existence at the time the building or the affected portion of the building was built shall be considered in compliance with the provisions of this code. New structural members added as part of the alteration shall comply with the *California Building Code*. This exception shall not apply to the following:

1. Alterations for accessibility required by *the California Building Code, Chapter 11A.*
2. Alterations that constitute substantial improvement in flood hazard areas, which shall comply with Sections 503.2, 701.3 or 1301.3.3.
3. Structural provisions of Section 304, Chapter 5 or to the structural provisions of Sections 706, 805 and 906.

301.3.1 Prescriptive compliance method. Alterations, additions and changes of occupancy complying with Chapter 5 of this code in buildings complying with the *California Fire Code* shall be considered in compliance with the provisions of this code.

Exception: Hospital buildings removed from acute care service, skilled nursing facilities, intermediate-care facilities, correctional treatment centers and acute psychiatric hospitals [OSHPD 1R, 2, 4 and 5]. *The provisions of adopted sections in Chapters 3 through 5 shall control the alteration, repair and change of occupancy or function of existing structures for applications listed in Section 1.10.1, 1.10.2, 1.10.4 and 1.10.5 regulated by the Office of Statewide Health Planning and Development (OSHPD). Refer to Chapter 3A for services, systems and utilities that serve OSHPD 1 buildings.*

301.3.2 Work area compliance method. Alterations, additions and changes of occupancy complying with the applicable requirements of Chapters 6 through 12 of this code shall be considered in compliance with the provisions of this code.

Note: [HCD 1 & HCD 2] *The provisions contained in Chapters 6 through 12 are not adopted by HCD, but may be available for adoption by a local ordinance. (See Section 1.1.11.)*

301.3.3 Performance compliance method. Alterations, additions and changes of occupancy complying with Chapter 13 of this code shall be considered in compliance with the provisions of this code.

Note: [HCD 1 & HCD 2] *The provisions contained in Chapter 13 are not adopted by HCD, but may be available for adoption by a local ordinance. (See Section 1.1.11.)*

301.4 Relocated *or moved* buildings. Relocated *or moved* buildings shall comply with the requirements of Chapter 14.

SECTION 302
GENERAL PROVISIONS

302.1 Dangerous conditions. The code official shall have the authority to require the elimination of conditions deemed dangerous.

302.1.1 Dangerous conditions. [BSC] *Regardless of the extent of structural or nonstructural damage, the code official shall have the authority to require the elimination of conditions deemed dangerous.*

302.2 Additional codes. 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 this code and the *California Energy Code*, *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 code, the provisions of this code shall take precedence.

302.2.1 Additional codes in health care. In existing Group I-2 occupancies, ambulatory health care facilities, outpatient clinics and hyperbaric facilities, alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall also comply with NFPA 99.

302.3 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 Official to be unsafe pursuant to CEBC Section 115.

Replacement, Retention and Extension of Original Materials. The replacement, retention and extension of original materials, and the use of original methods of construction for any building or accessory structure may remain, provided the aggregate value of work in any 12-month period does not exceed 10 percent of the replacement value, and provided further that no hazardous conditions exist, and 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.

Exceptions:

1. Replacement, retention and extension of unreinforced masonry wall is not permitted.
2. Alteration, repair or rehabilitation of the existing portion in excess of 10 percent of the replacement value of a building or structure may be made, provided that all the work conforms to this Code for a new building and that no hazardous condition or substandard building is continued or created in the remainder of the building as a result of such work.

302.4 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 that unsafe conditions are not 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. ***[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 Sections 17912, 17920.3, 17922(d), 17922.3, 17958.8 and 17958.9.*

Exception: *No replacement residential garage door shall be installed to connect the replacement door to an existing residential automatic garage door opener that does not have a battery backup function designed to keep the garage door operational without interruption during an electrical outage. See Health and Safety Code Section 19892.*

[BS] 302.4.1 New structural members and connections. New structural members and connections shall comply with the detailing provisions of the *California Building Code* for new buildings of similar structure, purpose and location.

Exception: Where alternative design criteria are specifically permitted.

302.5 Occupancy and use. Where determining the appropriate application of the referenced sections of this code, the occupancy and use of a building shall be determined in accordance with Chapter 3 of the *California Building Code*.

302.6 Maintenance. Buildings and structures, and parts thereof, shall be maintained in a safe and sanitary condition. Devices or safeguards which are required by the CBC and 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 Department 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. Maintenance of buildings and structures shall comply with Chapters 81 and 86 of the LABC.

302.7 Compliance. Alterations, repairs, additions and changes of occupancy to, or relocation of, existing structure shall comply with the provisions for alterations, repairs, additions and changes of occupancy in the *Los Angeles Fire Code*, *Los Angeles Mechanical Code*, *Los Angeles Plumbing Code*, *Los Angeles Residential Code* and *Los Angeles Electrical Code*.

Where there are different requirements in this Code, the most restrictive requirement shall govern. Where there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

SECTION 303
STORM SHELTERS

303.1 Storm shelters. This section applies to the construction of storm shelters constructed as rooms or spaces within existing buildings for the purpose of providing protection during storms that produce high winds, such as tornados and hurricanes. Such structures shall be designated to be hurricane shelters, tornado shelters, or combined hurricane and tornado shelters. Such structures shall be constructed in accordance with this code and ICC 500.

303.2 Addition to a Group E occupancy. Where an addition is added to an existing Group E occupancy located in an area where the shelter design wind speed for tornados is 250 mph (402.3 km/h) in accordance with Figure 304.2(1) of ICC 500 and the occupant load in the addition is 50 or more, the addition shall have a storm shelter constructed in accordance with ICC 500.

Exceptions:

1. Group E day care facilities.
2. Group E occupancies accessory to places of religious worship.
3. Additions meeting the requirements for shelter design in ICC 500.

303.2.1 Required occupant capacity. The required occupant capacity of the storm shelter shall include all buildings on the site, and shall be the total occupant load of the classrooms, vocational rooms and offices in the Group E occupancy.

Exceptions:

1. Where an addition is being added on an existing Group E site, and where the addition is not of sufficient size to accommodate the required occupant capacity of the storm shelter for all of the buildings on-site, the storm shelter shall at a minimum accommodate the required capacity for the addition.
2. Where approved by the code official, the required occupant capacity of the shelter shall be permitted to be reduced by the occupant capacity of any existing storm shelters on the site.

303.2.2 Occupancy classification. The occupancy classification for storm shelters shall be determined in accordance with Section 423.3 of the *California Building Code*.

SECTION 304
STRUCTURAL DESIGN LOADS AND EVALUATION AND DESIGN PROCEDURES

[BS] 304.1 Live loads. Where an addition or 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 addition or alteration. If the approved live load is less than that required by Section 1607 of the *California Building Code*, the area designated for the nonconforming live load shall be posted with placards of approved design indicating the approved live load. Where the addition or alteration results in increased design live load, the live load required by Section 1607 of the *California Building Code* shall be used.

[BS] 304.2 Snow loads on adjacent buildings. Where an alteration or addition changes the potential snow drift effects on an adjacent building, the code official is authorized to enforce Section 7.12 of ASCE 7.

[BS] 304.3 Seismic evaluation and design procedures. Where required, seismic evaluation or design shall be based on the procedures and criteria in this section, regardless of which compliance method is used.

[BS] 304.3.1 Compliance with full seismic forces. Where compliance requires the use of full seismic forces, the criteria shall be in accordance with one of the following:

1. One-hundred percent of the values in the *California Building Code*. Where the existing seismic force-resisting system is a type that can be designated as "Ordinary," values of R, Ω_0 and C_d used for analysis in accordance with Chapter 16 of the *California Building Code* shall be those specified for structural systems classified as "Ordinary" in accordance with Table 12.2-1 of ASCE 7, unless it can be demonstrated that the structural system will provide performance equivalent to that of a "Detailed," "Intermediate" or "Special" system.
2. ASCE 41, using a Tier 3 procedure and the two-level performance objective in Table 304.3.1 for the applicable risk category.

[BS] TABLE 304.3.1
PERFORMANCE OBJECTIVES FOR USE IN ASCE 41 FOR COMPLIANCE WITH FULL SEISMIC FORCES

RISK CATEGORY (Based on IBC Table 1604.5)	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-1N EARTHQUAKE HAZARD LEVEL	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-2N EARTHQUAKE HAZARD LEVEL
I	Life Safety (S-3)	Collapse Prevention (S-5)
II	Life Safety (S-3)	Collapse Prevention (S-5)
III	Damage Control (S-2)	Limited Safety (S-4)
IV	Immediate Occupancy (S-1)	Life Safety (S-3)

[BS] 304.3.2 Compliance with reduced seismic forces. Where seismic evaluation and design is permitted to use reduced seismic forces, the criteria used shall be in accordance with one of the following:

1. The *California Building Code* using 75 percent of the prescribed forces. Values of R, Ω_0 and C_d used for analysis shall be as specified in Section 304.3.1 of this code.
2. Structures or portions of structures that comply with the requirements of the applicable chapter in Appendix A as specified in Items 2.1 through 2.4 and subject to the limitations of the respective Appendix A chapters shall be deemed to comply with this section.
   - 2.1. The seismic evaluation and design of unreinforced masonry bearing wall buildings in Risk Category I or II are permitted to be based on the procedures specified in Appendix Chapter A1.
   - 2.2. Seismic evaluation and design of the wall anchorage system in reinforced concrete and reinforced masonry wall buildings with flexible diaphragms in Risk Category I or II are permitted to be based on the procedures specified in Chapter A2.
   - 2.3. Seismic evaluation and design of cripple walls and sill plate anchorage in residential buildings of light-frame wood construction in Risk Category I or II are permitted to be based on the procedures specified in Chapter A3.
   - 2.4. Seismic evaluation and design of soft, weak or open-front wall conditions in multiple-unit residential buildings of wood construction in Risk Category I or II are permitted to be based on the procedures specified in Chapter A4.
3. ASCE 41, using the performance objective in Table 304.3.2 for the applicable risk category.

[BS] TABLE 304.3.2
PERFORMANCE OBJECTIVES FOR USE IN ASCE 41 FOR COMPLIANCE WITH REDUCED SEISMIC FORCES

RISK CATEGORY (Based on IBC Table 1604.5)	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-1E EARTHQUAKE HAZARD LEVEL	STRUCTURAL PERFORMANCE LEVEL FOR USE WITH BSE-2E EARTHQUAKE HAZARD LEVEL
I	Life Safety (S-3). See Note a	Collapse Prevention (S-5)
II	Life Safety (S-3). See Note a	Collapse Prevention (S-5)
III	Damage Control (S-2). See Note a	Limited Safety (S-4). See Note b
IV	Immediate Occupancy (S-1)	Life Safety (S-3). See Note c

a. For Risk Categories I, II and III, the Tier 1 and Tier 2 procedures need not be considered for the BSE-1E earthquake hazard level.

b. For Risk Category III, the Tier 1 screening checklists shall be based on the Collapse Prevention, except that checklist statements using the Quick Check provisions shall be based on *MS*-factors that are the average of the values for Collapse Prevention and Life Safety.

c. For Risk Category IV, the Tier 1 screening checklists shall be based on Collapse Prevention, except that checklist statements using the Quick Check provisions shall be based on *MS*-factors for Life Safety.

SECTION 305
IN-SITU LOAD TESTS

[BS] 305.1 General. Where used, in-situ load tests shall be conducted in accordance with Section 1708 of the *California Building Code*.

SECTION 306
ACCESSIBILITY FOR EXISTING BUILDINGS
(Not adopted by HCD or OSHPD)

[DSA-AC] *Buildings or facilities where accessibility is required for applications listed in Title 24, Part 2, California Building Code, Chapter 1, Section 1.9.1 regulated by the Division of the State Architect-Access Compliance shall comply with Title 24, Part 2, California Building Code, Chapter 11A or Chapter 11B, as applicable.*

306.1 Scope. The provisions of Sections 306.1 through 306.7.16 apply to maintenance and repair, change of occupancy, additions and alterations to existing buildings, including those identified as historic buildings.

> ***Note: [HCD 1-AC]*** *Accessibility requirements for covered multifamily dwellings, as defined in Chapter 2 of the California Building Code, are promulgated under HCD authority and are located in Chapter 11A of the California Building Code.*

306.2 Design. Buildings and facilities shall be designed and constructed to be accessible in accordance with this code and the alteration and existing building provisions in ICC A117.1, as applicable.

306.3 Maintenance and repair. A facility that is constructed or altered to be accessible shall be maintained accessible during occupancy. Required accessible means of egress shall be maintained during construction, demolition, remodeling or alterations and additions to any occupied building.

Exception: Existing means of egress need not be maintained where approved temporary means of egress and accessible means of egress systems and facilities are provided.

306.3.1 Prohibited reduction in accessibility. An alteration that decreases or has the effect of decreasing accessibility of a building, facility or element, thereof, below the requirements for new construction at the time of the alteration is prohibited. The number of accessible elements need not exceed that required for new construction at the time of alteration.

306.4 Extent of application. An alteration of an existing facility shall not impose a requirement for greater accessibility than that which would be required for new construction.

306.5 Change of occupancy. Existing buildings that undergo a change of group or occupancy shall comply with Section 306.7.

Exception: Type B dwelling or sleeping units required by Section 1108 of the *International Building Code* are not required to be provided in existing buildings and facilities undergoing a change of occupancy in conjunction with alterations where the work area is 50 percent or less of the aggregate area of the building.

306.6 Additions. Provisions for new construction shall apply to additions. An addition that affects the accessibility to, or contains an area of, a primary function shall comply with the requirements in Section 306.7.1.

306.7 Alterations. A facility that is altered shall comply with the applicable provisions in Chapter 11 of the *International Building Code*, ICC A117.1 and the provisions of Sections 306.7.1 through 306.7.16, unless technically infeasible. Where compliance with this section is technically infeasible, the alteration shall provide access to the maximum extent technically feasible.

306.7.1 Alterations affecting an area containing a primary function. Where an alteration affects the accessibility to, or contains an area of primary function, the route to the primary function area shall be accessible. The accessible route to the primary function area shall include toilet facilities and drinking fountains serving the area of primary function.

Exceptions:

1. The costs of providing the accessible route are not required to exceed 20 percent of the costs of the alterations affecting the area of primary function.
2. This provision does not apply to alterations limited solely to windows, hardware, operating controls, electrical outlets and signs.
3. This provision does not apply to alterations limited solely to mechanical systems, electrical systems, installation or alteration of fire protection systems and abatement of hazardous materials.
4. This provision does not apply to alterations undertaken for the primary purpose of increasing the accessibility of a facility.
5. This provision does not apply to altered areas limited to Type B dwelling and sleeping units.

306.7.2 Accessible means of egress. Accessible means of egress required by Chapter 10 of the *International Building Code* are not required to be added in existing facilities.

306.7.3 Alteration of Type A units. The alteration to Type A individually owned dwelling units within a Group R-2 occupancy shall be permitted to meet the provision for a Type B dwelling unit.

306.7.4 Type B units. Type B dwelling or sleeping units required by Section 1108 of the *International Building Code* are not required to be provided in existing buildings and facilities undergoing alterations where the work area is 50 percent or less of the aggregate area of the building.

306.7.5 Entrances. Where an alteration includes alterations to an entrance that is not accessible, and the facility has an accessible entrance, the altered entrance is not required to be accessible unless required by Section 306.7.1. Signs complying with Section 1112 of the *International Building Code* shall be provided.

306.7.6 Accessible route. Exterior accessible routes, including curb ramps, shall be not less than 36 inches (914 mm) minimum in width.

306.7.7 Elevators. Altered elements of existing elevators shall comply with *California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 6, Elevator Safety Orders*. Such elements shall also be altered in elevators programmed to respond to the same hall call control as the altered elevator.

306.7.8 Platform lifts. Platform (wheelchair) lifts installed in accordance with ASME A18.1 shall be permitted as a component of an accessible route.

306.7.9 Stairways and escalators in existing buildings. Where an escalator or stairway is added where none existed previously and major structural modifications are necessary for installation, an accessible route complying with Section 1104.4 of the *International Building Code* is required between levels served by such escalator or stairway.

306.7.10 Determination of number of units. Where Chapter 11 of the *International Building Code* requires Accessible, Type A or Type B units and where such units are being altered or added, the number of Accessible, Type A and Type B units shall be determined in accordance with Sections 306.7.10.1 through 306.7.10.3.

306.7.10.1 Accessible dwelling or sleeping units. Where Group I-1, I-2, I-3, R-1, R-2 or R-4 dwelling or sleeping units are being altered or added, the requirements of Section 1108 of the *International Building Code* for Accessible units apply only to the quantity of spaces being altered or added.

306.7.10.2 Type A dwelling or sleeping units. Where more than 20 Group R-2 dwelling or sleeping units are being altered or added, the requirements of Section 1108 of the *International Building Code* for Type A units apply only to the quantity of the spaces being altered or added.

306.7.10.3 Type B dwelling or sleeping units. Where four or more Group I-1, I-2, R-1, R-2, R-3 or R-4 dwelling or sleeping units are being added, the requirements of Section 1108 of the *International Building Code* for Type B units apply only to the quantity of the spaces being added. Where Group I-1, I-2, R-1, R-2, R-3 or R-4 dwelling or sleeping units are being altered and where the work area is greater than 50 percent of the aggregate area of the building, the requirements of Section 1108 of the *International Building Code* for Type B units apply only to the quantity of the spaces being altered.

306.7.11 Toilet rooms. Where it is technically infeasible to alter existing toilet rooms to be accessible, one accessible single-user toilet room or one accessible family or assisted-use toilet room constructed in accordance with Section 1110.2.1 of the *International Building Code* is permitted. This toilet room shall be located on the same floor and in the same area as the existing toilet rooms. At the inaccessible toilet rooms, directional signs indicating the location of the nearest such toilet room shall be provided. These directional signs shall include the International Symbol of Accessibility, and sign characters shall meet the visual character requirements in accordance with ICC A117.1.

306.7.12 Bathing rooms. Where it is technically infeasible to alter existing bathing rooms to be accessible, one accessible single-user bathing room or one accessible family or assisted-use bathing room constructed in accordance with Section 1110.2.1 of the *International Building Code* is permitted. This accessible bathing room shall be located on the same floor and in the same area as the existing bathing rooms. At the inaccessible bathing rooms, directional signs indicating the location of the nearest such bathing room shall be provided. These directional signs shall include the International Symbol of Accessibility, and sign characters shall meet the visual character requirements in accordance with ICC A117.1.

306.7.13 Additional toilet and bathing facilities. In assembly and mercantile occupancies, where additional toilet fixtures are added, not fewer than one accessible family or assisted-use toilet room shall be provided where required by Section 1110.2.1 of the *International Building Code*. In recreational facilities, where additional bathing rooms are being added, not fewer than one family or assisted-use bathing room shall be provided where required by Section 1110.2.1 of the *International Building Code*.

306.7.14 Dressing, fitting and locker rooms. Where it is technically infeasible to provide accessible dressing, fitting or locker rooms at the same location as similar types of rooms, one accessible room on the same level shall be provided. Where separate-sex facilities are provided, accessible rooms for each sex shall be provided. Separate-sex facilities are not required where only unisex rooms are provided.

306.7.15 Amusement rides. Where the structural or operational characteristics of an amusement ride are altered to the extent that the amusement ride's performance differs from that specified by the manufacturer or the original design, the amusement ride shall comply with requirements for new construction in Section 1111.4.8 of the *International Building Code.*

306.7.16 Historic structures. Where compliance with the requirements for accessible routes, entrances or toilet rooms would threaten or destroy the historic significance of the historic structure, as determined by the authority having jurisdiction, the alternative requirements of Sections 306.7.16.1 through 306.7.16.5 for that element shall be permitted.

Exceptions:

1. Accessible means of egress required by Chapter 10 of the *International Building Code* are not required to be provided in historic structures.
2. The altered element or space is not required to be on an accessible route, unless required by Sections 306.7.16.1 or 306.7.16.2.

306.7.16.1 Site arrival points. Not fewer than one exterior accessible route, including curb ramps from a site arrival point to an accessible entrance, shall be provided and shall not be less than 36 inches (914 mm) minimum in width.

306.7.16.2 Multiple-level buildings and facilities. An accessible route from an accessible entrance to public spaces on the level of the accessible entrance shall be provided.

306.7.16.3 Entrances. Where an entrance cannot be made accessible in accordance with Section 306.7.5, an accessible entrance that is unlocked while the building is occupied shall be provided; or, a locked accessible entrance with a notification system or remote monitoring shall be provided.

Signs complying with Section 1112 of the *International Building Code* shall be provided at the public entrances and the accessible entrance.

306.7.16.4 Toilet facilities. Where toilet rooms are provided, not fewer than one accessible single-user toilet room or one accessible family or assisted-use toilet room complying with Section 1110.2.1 of the *International Building Code* shall be provided.

306.7.16.5 Bathing facilities. Where bathing rooms are provided, not fewer than one accessible single-user bathing room or one accessible family or assisted-use bathing rooms complying with Section 1110.2.1 of the *International Building Code* shall be provided.

306.7.16.6 Type A units. The alteration to Type A individually owned dwelling units within a Group R-2 occupancy shall be permitted to meet the provision for a Type B dwelling unit.

306.7.16.7 Type B units. Type B dwelling or sleeping units required by Section 1108 of the *International Building Code* are not required to be provided in historic buildings.

SECTION 307
SMOKE ALARMS

307.1 Smoke alarms. Where an alteration, addition, change of occupancy or relocation of a building is made to an existing building or structure of a Group R occupancy, the existing building shall be provided with smoke alarms in accordance with the *California Fire Code* or Section R314 of the *California Residential Code*.

Exception: Work classified as Level 1 Alterations in accordance with Chapter 7.

SECTION 308
CARBON MONOXIDE DETECTION

308.1 Carbon monoxide detection. Where an addition, alteration, change of occupancy or relocation of a building is made to Group I-1, I-2, I-4 and R occupancies and classrooms of Group E occupancies, the existing building shall be provided with carbon monoxide detection in accordance with the *California Fire Code* or Section R315 of the *California Residential Code*.

Exceptions:

1. Work involving the exterior surfaces of buildings, such as the replacement of roofing or siding, the addition or replacement of windows or doors, or the addition of porches or decks.
2. Installation, alteration or repairs of plumbing or mechanical systems, other than fuel-burning appliances.
3. Work classified as Level 1 Alterations in accordance with Chapter 7.

308.2 Carbon monoxide alarms in existing portions of a building. [HCD 1 & HCD 2] *Pursuant to Health and Safety Code Section 17926, carbon monoxide detection shall be provided in all existing Group R buildings, as required in Section 915 of the California Building Code or Section R315 of the California Residential Code, as applicable.*

308.2.1 Carbon monoxide detection in existing Group E occupancy buildings. *Where the new addition includes any of the conditions identified in the California Fire Code Sections 915.1.2 through 915.1.6, carbon monoxide detection shall be installed in accordance with Section 915 of the California Fire Code. No person shall install, market, distribute, offer for sale, or sell any carbon monoxide device in the State of California unless the device and instructions have been approved and listed by the Office of the State Fire Marshal.*

SECTION 309
ADDITIONS AND REPLACEMENTS OF EXTERIOR WALL COVERINGS AND EXTERIOR WALL ENVELOPES

309.1 General. The provisions of Section 309 apply to all alterations, repairs, additions, relocations of structures and changes of occupancy regardless of compliance method.

309.2 Additions and replacements. Where an exterior wall covering or exterior wall envelope is added or replaced, the materials and methods used shall comply with the requirements for new construction in Chapter 14 and Chapter 26 of the *California Building Code* if the added or replaced exterior wall covering or exterior wall envelope involves two or more contiguous stories and comprises more than 15 percent of the total wall area on any side of the building.

SECTION 310 [OSHPD 1R, 2 and 5]
SERVICES/SYSTEMS AND UTILITIES

310.1 Services/systems and utilities. *Services/systems and utilities shall only originate in, pass through or under structures which are under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD).*

SECTION 311 [OSHPD 1R, 2 and 5]
MEANS OF EGRESS

311.1 General. *Means of egress through existing buildings shall be in accordance with the California Building Code, except as modified in this section.*

311.1.1 Jurisdiction. *Means of egress shall only pass through buildings that are under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD).*

SECTION 312 [OSHPD 1R]
HOSPITAL SPC AND FREESTANDING BUILDINGS REMOVED FROM GENERAL ACUTE CARE SERVICE REMAINING UNDER THE JURISDICTION OF OSHPD

312.1 General. *The provisions of this section shall apply to hospital SPC and freestanding buildings that have been removed from Acute Care Service per California Existing Building Code Section 312A but remain under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD). These buildings may house various occupancies, uses and functions in accordance with this section. The requirements for those various occupancies, uses and functions shall be in accordance with the provisions of the California Building Standards Code, specific to each. The designation OSHPD 1R shall be limited to provisions applicable to the overall hospital SPC or freestanding building.*

312.1.1 Non-general acute care hospital (non-GACH) SPC buildings. *Non-GACH SPC buildings shall conform to the requirements of Section 1.10.1 [OSHPD 1R].*

312.1.2 Freestanding buildings. *Application and enforcement of freestanding buildings removed from general acute care services but remaining under OSHPD jurisdiction shall be in accordance with Section 1.10.1 [OSHPD 1R].*

Freestanding hospital-owned clinics shall be permitted to be under the jurisdiction of OSHPD in accordance with the California Administrative Code Sections 7-2104, 7-2105 and 7-2106.

312.1.3 Non-General Acute Care Building (non-GACH SPC building) access. *All access points into hospital SPC buildings removed from general acute care service shall prominently display signage at each access point stating* ***"NO GENERAL ACUTE CARE SERVICES BEYOND THIS POINT."***

312.2 Definitions.

FREESTANDING. *Refer to Part 1, California Administrative Code, Chapter 7.*

SPC BUILDING. *Refer to Part 2, California Building Code, Chapter 2.*

312.3 Buildings to remain under OSHPD jurisdiction.

312.3.1 Freestanding buildings containing qualifying nonacute care services. *In order for a freestanding building, as defined in the California Administrative Code, Section 7-111, that is removed from general acute care service, to remain under OSHPD jurisdiction, it shall contain one or more qualifying nonacute care services. Qualifying nonacute care services include:*

a. Services considered "Outpatient Clinical Services" as defined in H&SC §129730(a):

i. Administrative space that directly supports hospital operations

ii. Central sterile supply

iii. Storage

iv. Morgue and autopsy facilities

v. Employee dressing rooms and lockers

vi. Janitorial and housekeeping facilities

vii. Laundry

b. Outpatient portions of the following services (with no more than 25 percent in-patient use), including but not limited to:

i. Surgical

ii. Chronic dialysis

iii. Psychiatry

iv. Rehabilitation, occupational therapy or physical therapy

v. Maternity

vi. Dentistry

viii. Chemical dependency

c. Services that duplicate Basic Services, as defined in H&SC §1250, or services that are provided as part of a Basic Service, but are not required for facility licensure (with no more than 25 percent in-patient use).

All hospital support services listed in Section 312.3.1 Item a that are located in an SPC building at the time general acute care services are removed may remain, provided the California Department of Public Health certifies to the Office that it has received and approved a plan that demonstrates how the health facility will continue to provide all basic services in the event of any emergency when the SPC building may no longer remain functional. This certification shall be submitted by the hospital to the Office prior to approval of the application to remove the SPC building from general acute care service.

312.3.2 SPC non-GACH buildings containing nonacute care services under existing license. *The services listed in Section 312.3.1 shall be permitted as follows:*

a. Existing approved nonacute care services shall be permitted to remain. The enforcement agency may require evidence that the existing occupancies and services were in compliance at the time they were located in the SPC building. All hospital support services listed in Section 312.3.1, Item a that are remaining in the SPC building removed from general acute care service shall be in excess of the minimum requirements for licensure and operation of the general acute care hospital. Prior approval by the California Department of Public Health shall be obtained by the hospital to maintain these services in the SPC building removed from acute care service.

b. New nonacute care services listed in Section 312.3.1, Item a shall be permitted, provided they are in excess of the minimum services required for licensure and operation of the general acute care hospital.

c. New nonacute care services listed in Section 312.3.1, Item b shall be permitted. These services require compliance with the current functional requirements for that service as defined in Part 2, California Building Code, Section 1224.39, subject to the provisions of Section 506.1.

d. New nonacute care services listed in Section 312.3.1, Item c shall be permitted provided they are in excess of the minimum services required for licensure and operation of the general acute care hospital. If patients are served by this service, it must meet the current functional requirements for that service as defined in Part 2, California Building Code, Section 1224.39, subject to the provisions of Section 506.1.

312.3.3 SPC non-GACH buildings containing a change of licensed nursing services under existing license. *A change of service or function for all, or a portion, of the SPC building removed from general acute care service requires compliance with the current functional requirements for that service as defined in Part 2, California Building Code, Section 1224, subject to the provisions of Section 506.1.*

312.3.3.1 Intermediate care and/or skilled nursing services. *When general acute care services are removed from an SPC building which is intended to be used for separate and distinct intermediate care and/or skilled nursing services, and the new services will be licensed under the existing license of the general acute care hospital, these new services shall comply with current functional requirements as defined in Part 2, Section 1224.38 and/or 1224.40, and Section 310A.1.1.1.5 for a nonconforming hospital building.*

312.3.3.2 Psychiatric nursing service. *When general acute care services are removed from an SPC building* *which is intended to be used for separate and distinct psychiatric nursing services, and the new services will be licensed under the existing license of the general acute care hospital, these new services shall comply with current functional requirements for that service as defined in Part 2, Section 1228, and Section 310A.1.1.1.5 for a nonconforming hospital building.*

312.3.4 SPC non-GACH buildings containing other occupancies and/or uses. *Other occupancies and/or uses shall comply with the occupancy/use requirements of the California Building Standards Code for that occupancy or use. Subject to the approval of the building official, the use or occupancy of existing buildings is allowed to be occupied for purposes in other groups, or within the same group, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.*

312.3.5 Vacant space. *Spaces vacated through the removal of general acute care services that are intended to remain vacant must be in conformance with Part 2, California Building Code, Section 116.1. The hospital shall submit a project to the Office to demonstrate remediation of potential unsafe and insanitary conditions.*

SECTION 313 [SFM] EXISTING GROUP R-1 AND GROUP R-2 OCCUPANCIES

313.1 Scope. *The provisions of this section are intended to maintain or increase the current degree of public safety, health and general welfare in existing buildings classified as Group R Occupancies.*

313.1.1 Application. *In accordance with Health and Safety Code Section 13143.2, the provisions of Sections 313.2 through 313.12 shall only apply to multiple-story structures existing on January 1, 1975, let for human habitation, including, and limited to, apartment houses, hotels and motels wherein rooms used for sleeping are let above the ground floor.*

313.2 Number of exits. *Every apartment and every other sleeping room shall have access to not less than two exits when the occupant load is 10 or more (exits need not be directly from the apartment or sleeping room). A fire escape as specified herein may be used as one required exit.*

Subject to approval of the authority having jurisdiction, a ladder device as specified herein may be used in lieu of a fire escape when the construction feature or the location of the building on the property cause the installation of a fire escape to be impractical.

313.3 Stair construction. *All stairs shall have a minimum run of 9 inches (229 mm) and a maximum rise of 8 inches (203 mm) and a minimum width exclusive of handrails of 30 inches (762 mm). Every stairway shall have at least one handrail. A landing having a minimum horizontal dimension of 30 inches (762 mm) shall be provided at each point of access to the stairway.*

313.4 Interior stairways. *Every interior stairway shall be enclosed with walls of not less than 1-hour fire-resistive construction. Where existing partitions form part of a stairwell enclosure, wood lath and plaster in good condition will be acceptable in lieu of 1-hour fire-resistive construction. Doors to such enclosures shall be protected by a self-closing door equivalent to a solid wood door with a thickness of not less than $1^3/_4$ inches (44.5 mm).*

Enclosures shall include all landings between flights and any corridors, passageways or public rooms necessary for continuous exit to the exterior of the buildings. The stairway need not be enclosed in a continuous shaft if cut off at each story by the fire-resistive construction required by this subsection for stairwell enclosures. Enclosures shall not be required if an automatic sprinkler system is provided for all portions of the building except bedrooms, apartments and rooms accessory thereto. Interior stairs and vertical openings need not be enclosed in two-story buildings.

313.5 Exterior stairways. *Exterior stairways shall be noncombustible or of wood of not less than 2-inch (51 mm) nominal thickness with solid treads and risers.*

313.6 Fire escapes, exit ladder devices. *Fire escapes may be used as one means of egress if the pitch does not exceed 60 degrees, the width is not less than 18 inches (457 mm), the treads are not less than 4 inches (102 mm) wide, and they extend to the ground or are provided with counterbalanced stairs reaching to the ground. Access shall be by an opening having a minimum dimension of 29 inches (737 mm) when open. The sill shall not be more than 30 inches (762 mm) above the floor and landing.*

A ladder device, when used in lieu of a fire escape, shall conform to Section 313.6.1 and the following:

1. *Serves an occupant load of nine people or less or a single dwelling unit or hotel room.*
2. *The building does not exceed three stories in height.*
3. *The access is adjacent to an opening as specified for emergency egress or rescue or from a balcony.*
4. *The device does not pass in front of any building opening below the unit being served.*
5. *The availability of activating the ladder device is accessible only to the opening or balcony served.*
6. *The device as installed will not cause a person using it to be within 12 feet (3658 mm) of exposed energized high-voltage conductors.*

313.6.1 Exit ladder devices.

313.6.1.1 Scope. *This standard for exit ladder devices is applicable where such devices are permitted by the building official for installation on existing apartment houses and hotels in conformance with the California Building Code.*

313.6.1.2 Instructions. *Installation shall be in accordance with the manufacturer's instructions. Instructions shall be illustrated and shall include directions and information adequate for attaining proper and safe installation of the product. Where exit ladder devices are intended for mounting on different support surfaces, specific installation instructions shall be provided for each surface.*

313.6.1.3 General design. *All load-bearing surfaces and supporting hardware shall be of noncombustible materials. Exit ladder devices shall have a minimum width of 12 inches (305 mm) when in the position intended for use. The design load shall not be less than 400 pounds (1780N) for 16-foot (4877 mm) length and 600 pounds (2699N) for 25-foot (7620 mm) length.*

313.6.1.4 Performance.

313.6.1.4.1 *Exit ladder devices shall be capable of withstanding an applied load of four times the design load when installed in the manner intended for use. Test loads shall be applied for a period of one hour.*

313.6.1.4.2 *Exit ladder devices of the retractable type shall, in addition to the static load requirements of Section 413.6.1.4.1 of the California Building Code, be capable of withstanding the following tests:*

1. *Rung strength.*
2. *Rung-to-side-rail shear strength.*
3. *Release mechanism.*
4. *Low temperature.*

313.6.1.5 Rung-strength test. *Rungs of retractable exit ladder devices shall be capable of withstanding a load of 1,000 pounds (4448N) when applied to a $3^1/_2$-inch-wide (89 mm) block resting at the center of the rung. The test load shall be applied for a period of 1 hour. The ladder shall remain operational following this test.*

313.6.1.6 Rung-to-side-rail shear test. *Rungs of retractable exit ladder devices shall be capable of withstanding 1,000 (4448N) when applied to a $3^1/_2$-inch-wide (89 mm) block resting on the center rung as near the side rail as possible. The test load shall be applied for a period of 1 hour. Upon removal of the test load the fasteners attaching the rung to the side rail shall show no evidence of failure. The ladder shall remain operational following the test.*

313.6.1.7 Release mechanism test. *The release mechanism of retractable exit ladder devices shall operate with an average applied force of not more than 5 pounds (22.2N) for hand-operated releasing mechanisms and an average applied force of not more than 25 pounds (111N) for foot-pedal types of releasing mechanisms. For these tests, a force gauge shall be applied to the release mechanism, and the average of three consecutive readings shall be computed.*

313.6.1.8 Low temperature operation test. *Representative samples of the exit ladder devices shall be subjected to a temperature of -40ºC in an environmental chamber for a period of 24 hours. The release mechanism shall be operated immediately upon removal from the chamber. The ladder device shall function as intended without any restriction of operation.*

313.7 Doors and openings. *Exit doors and openings shall meet the requirements of Sections 1008.1.2, 1008.8.1.8, 1008.1.9 and 708.6 of the California Building Code. Doors shall not reduce the required width of stairway more than 6 inches (152 mm) when open. Transoms and openings other than doors from corridors to rooms shall be fixed closed and shall be covered with a minimum of $^3/_4$-inch (19 mm) plywood or $^1/_2$-inch (13 mm) gypsum wallboard or equivalent material.*

Exceptions:

1. *Existing solid-bonded wood-core doors $1^3/_8$ inches thick (34.9 mm), or their equivalent may be continued in use.*
2. *Where the existing frame will not accommodate a door complying with Section 708.6 of the California Building Code, a $1^3/_8$-inch-thick (35 mm) solid-bonded wood-core door may be used.*

313.8 Exit signs. *Every exit doorway or change of direction of a corridor shall be marked with a well-lighted exit sign having letters at least 5 inches (127 mm) high.*

313.9 Enclosure of vertical openings. *Elevators, shafts, ducts and other vertical openings shall be enclosed as required for stairways in Section 313.5 or by wired glass set in metal frames. Doors shall be noncombustible or as regulated in Section 313.5.*

313.10 Separation of occupancies. *Occupancy separations shall be provided as specified in Section 508 of the California Building Code. Lobbies and public dining rooms, not including cocktail lounges, shall not require a separation if the kitchen is so separated from the dining room. Every room containing a boiler or central heating plant shall be separated from the rest of the building by not less than a one-hour fire-resistive occupancy separation.*

Exception: *A separation shall not be required for such rooms with equipment serving only one dwelling unit.*

313.11 Equivalent protection. *In lieu of the separation of occupancies required by Section 313.10, equivalent protection may be permitted when approved by the enforcement agency.*

Exception: *The provisions of Sections 313.3 through 313.11 above shall not apply to any existing apartment house, hotel or motel having floors (as measured from the top of the floor surface) used for human occupancy located more than 75 feet (22 860 mm) above the lowest floor level having building access which is subject to the provisions of Section 314 and the California Fire Code, relating to existing high-rise buildings.*

Note: *In accordance with Health and Safety Code Section 17920.7, the provisions of Sections 313.3 through 313.11 above shall apply only to multiple-story structures existing on January 1, 1975, let for human habitation including, and limited to, apartments, houses, hotels and motels wherein rooms used for sleeping are let above the ground floor.*

313.12 Fire alarms.

313.12.1 General. *Every apartment house three or more stories in height or containing more than 15 apartments, every hotel three or more stories in height or containing 20 or more guest rooms, shall have installed therein an automatic or manually operated fire alarm system. Such fire alarm systems shall be so designed that all occupants of the building may be warned simultaneously and shall be in accordance with the California Fire Code. See Section*

314.14 for special requirements in buildings over 75 feet (22 860 mm) in height.

Exception: *A fire alarm system need not be installed provided such apartment house or hotel is separated by an unpierced wall of not less than 4-hour fire resistance in buildings of Type IA, Type IIB, Type III or Type IV construction and 2-hour fire resistance in buildings of all other types of construction provided:*

1. *Areas do not exceed the number of apartments or guest rooms stipulated.*
2. *The fire-resistive wall conforms to the requirements of Section 706.6 of the California Building Code.*
3. *The wall complies with all other applicable provisions of the California Building Code.*
4. *The wall extends to all outer edges of horizontal projecting elements, such as balconies, roof overhangs, canopies, marquees or architectural projections.*
5. *No openings are permitted for air ducts or similar penetrations, except that openings for pipes, conduits and electrical outlets of copper, sheet steel or ferrous material shall be permitted through such wall and need not be protected, provided they do not unduly impair the required fire resistance of the assembly.*
6. *Tolerances around such penetrations shall be filled with approved noncombustible materials.*

313.12.2 Installation. *The installation of all fire alarm equipment shall be in accordance with the California Fire Code.*

313.13 Existing Group R Occupancy high-rise buildings.

313.13.1 General. *Regardless of other provisions of these regulations relating to existing high-rise buildings, requirements relative to existing Group R-1 or Group R-2 Occupancies shall not be less restrictive than those established pursuant to Health and Safety Code Section 13143.2.*

313.13.2 Corridor openings. *Openings in corridor walls and ceilings shall be protected by not less than $1^3/_4$-inch (44.5 mm) solid-bonded wood-core doors, $^1/_4$-inch-thick (6 mm) wired glass conforming to Section 715.1 of the California Building Code, by approved fire dampers or by equivalent protection in lieu of any of these items. Transoms shall be fixed closed with material having a fire-resistive rating equal to $^1/_2$-inch (12.7 mm) Type X gypsum wallboard or equivalent material installed on both sides of the opening.*

313.13.3 Fire alarm systems. *Notwithstanding the provisions of Section 403 of the California Building Code, every existing high-rise building used for the housing of a Group R-1 or Group R-2 Occupancies shall have installed therein a fire alarm system conforming to this subsection.*

313.13.3.1 General. *Every apartment house and every hotel shall have installed therein an automatic or manually operated fire alarm system. Such fire alarm systems shall be so designed that all occupants of the building may be warned simultaneously.*

313.13.3.2 Installation. *The installation of all fire alarm equipment shall be in accordance with the California Fire Code.*

313.13.3.3 Fire-extinguishing systems. *Automatic fire-extinguishing systems installed in any structure subject to these regulations shall have an approved flow indicator electrically interconnected to the required fire alarm system.*

SECTION 314 [SFM]
EXISTING HIGH-RISE BUILDINGS

314.1 Scope and definition. *The provisions of Sections 314.1 through 314.27 shall apply to every existing high-rise building of any type of construction or occupancy having floors (as measured from the top of the floor surface) used for human occupancy located more than 75 feet (22 860 mm) above the lowest floor level having building access.*

Exceptions:

1. *Hospitals, as defined in Section 1250 of the Health and Safety Code.*
2. *The following structures, while classified as high-rise buildings, shall not be subject to the provisions of Sections 314.1 through 314.27, but shall conform to all applicable provisions of these regulations.*
   - 2.1. *Building used exclusively as open parking garages.*
   - 2.2. *Buildings where all floors above the 75 foot (22 860 mm) level are used exclusively as open parking garages.*
   - 2.3. *Floors of buildings used exclusively as open parking garages and located above all other floors used for human occupancy.*
   - 2.4. *Buildings such as power plants, look-out towers, steeples, grain houses and similar structures, when so determined by the enforcing agency.*
   - 2.5. *Buildings used exclusively for jails and prisons. For the purposes of this section, "building access" shall mean an exterior door opening conforming to all of the following:*
     - 2.5.1. *Suitable and available for fire department use.*
     - 2.5.2. *Located not more than 2 feet (610 mm) above the adjacent ground level.*
     - 2.5.3. *Leading to a space, room or area having foot traffic communication capabilities with the remainder of the building.*
     - 2.5.4. *Designed to permit penetration through the use of fire department forcible-entry tools and equipment unless other approved arrangements have been made with the fire authority having jurisdiction.*

"Existing high-rise structure" means a high-rise structure, the construction of which is commenced or completed prior to July 1, 1974.

For the purpose of this section, construction shall be deemed to have commenced when plans and specifications are more than 50 percent complete and have been presented to the local jurisdiction prior to July 1, 1974. Actual construction of such buildings shall commence on or before January 1, 1976, unless all provisions for new buildings have been met.

314.2 Compliance data. *Except as may be otherwise specified, existing high-rise building shall conform to the applicable requirements of these regulations by April 26, 1979.*

> ***Exception:*** *The period of compliance may be extended upon showing of good cause for such extension if a systematic and progressive plan of correction is submitted to, and approved by, the enforcing agency. Such extension shall not exceed two years from the date of approval of such plan. Any plan of correction submitted pursuant to this exception shall be submitted and approved on or before April 26, 1979.*

314.3 Continued use. *Existing high-rise building may have their use continued if they conform, or are made to conform, to the intent of the provisions of Sections 314.5 through 314.27 to provide for the safety of the occupants of the high-rise buildings and person involved in fire-suppression activities.*

314.4 Alternate protection. *Alternate means of egress, fire walls or fire barriers, smoke barriers, automatic fire detection or fire-extinguishing systems, or other fire-protection devices, equipment or installations may be approved by the enforcing agency to provide reasonable and adequate life safety as intended by Sections 314.5 through 314.27 for existing high-rise buildings.*

314.5 Basic provisions. *The provisions outlined in Sections 314.1 through 314.27 are applicable to every existing highrise building.*

314.6 Minimum construction. *Existing wood lath and plaster, existing $^1/_2$-inch (12.7 mm) gypsum wallboard, existing installations of $^1/_2$-inch thick (12.7 mm) wired glass which are or are rendered inoperative and fixed in a closed position, or other existing materials having similar fire-resistive capabilities shall be acceptable. All such assemblies shall be in good repair, free of any condition which would diminish their original fire-resistive characteristics.*

Where $1^3/_4$-inch (44.5 mm) solid-bonded wood-core doors are specified in these regulations for existing high-rise buildings, new or existing $1^3/_8$-inch (34.9 mm) doors shall be acceptable where existing framing will not accommodate a $1^3/_4$-inch (44.5 mm) door.

> ***Note:*** *It is the intent of this provisions that existing wood frames may have their use continued.*

314.7 New construction. *All new construction shall be composed of materials and assemblies of materials conforming to the fire-resistive provisions of these regulations. In no case shall enclosure walls be required to be of more than one-hour fire-resistive construction.*

> ***Exception:*** *When approved by the enforcing agency, materials specified in Section 314.6 may be used for new construction when necessary to maintain continuity of design and measurement of existing construction.*

314.8 Exits. *Every floor from an existing high-rise building shall have access to two separate means of egress, one of which, when approved by the enforcing agency, may be an existing exterior fire escape. New installations of smokeproof enclosures shall not be required.*

> ***Note:*** *In determining the adequacy of exits and their design, Chapter 10 of the California Building Code may be used as a guide. It is the intent of this section that every existing high-rise building need not mandatorily conform or be made to conform with the requirements for new high-rise buildings. Reasonable judgment in the application of requirements must be exercised by the enforcing agency.*

314.9 Fire escapes. *An existing fire escape in good structural condition may be acceptable as one of the required means of egress from each floor. Access to such fire escapes may be by any one of the following:*

1. *Through a room between the corridor and the fire escape if the door to the room is operable from the corridor side without the use of any key, special knowledge or effort.*
2. *By a door operable to a fire escape from the interior without the use of any key, special knowledge or effort.*
3. *By a window operable from the interior. Such window shall have a minimum dimension of 29 inches (737 mm) when open.*
4. *The sill shall not be more than 30 inches (762 mm) above the floor and landing.*

314.10 Protection of exterior openings. *When an existing fire escape is accepted as one of the require means of egress, openings onto the fire escape landing and openings within 5 feet (1524 mm) horizontally of the landings shall be protected in a manner acceptable to the enforcing agency.*

314.11 Locking of stairway doors. *When exit doors from corridors to exit stairways are locked to prohibit access from the stairway side, the locking mechanisms shall be retracted to the unlocked position upon failure of electrical power and a telephone or other two-way communication system connected to an approved emergency service that operates continuously shall be provided at not less than every fifth floor in each required stairway. In lieu thereof, master keys which will unlock all such doors from the stairway side shall be provided in such numbers and locations as approved by the enforcing agency.*

314.12 Enclosures. *Interior vertical shafts, including but not limited to, elevators, stairway and utility, shall be enclosed with construction as set forth in Section 314.6.*

314.13 Opening protection. *Doors in other than elevators, which shall be of a type acceptable to the enforcing agency, shall be approved one-hour, fire-rated, tight-fitting or gasketed doors or equivalent protection, and shall be of the normally closed type, self-closing or a type which will close* *automatically in accordance with Section 715 of the California Building Code.*

Exception: *In lieu of stairway enclosures, smoke barriers may be provided in such a manner that fire and smoke will not spread to other floors or otherwise impair exit facilities. In these instances, smoke barriers shall not be less than one-hour fire resistive with openings protected by not less than approved one-third-hour, fire-rated, tight-fitting or gasketed doors. Such doors shall be of the self-closing type or of a type which will close automatically in the manner specified in Section 715 of the California Building Code.*

Doors crossing corridors shall be provided with wired-glass vision panels set in approved steel frames. Doors for elevators shall not be of the open-grille type.

314.14 Fire alarm system. *Every existing high-rise building shall be provided with an approved fire alarm system. In department stores, retail sales stores and similar occupancies where the general public is admitted, such systems shall be of a type capable of alerting staff and employees. In office buildings and all other high-rise buildings, such systems shall be of a type capable of alerting all occupants simultaneously.*

Exceptions:

1. *In areas of public assemblage, the type and location of audible appliances shall be as determined by the enforcing agency.*
2. *When acceptable to the enforcing agency, the occupant voice notification system required by Section 314.20 may be used in lieu of the fire alarm system required by Section 314.14.*

314.15 Existing systems. *Existing fire systems, when acceptable to the enforcing agency, shall be deemed as conforming to the provisions of these regulations. For requirements for existing Group R-1 Occupancies, see Section 312.13.*

314.16 Annunciation. *When a new fire alarm system is installed, it shall be connected to an annunciator panel installed in a location approved by the enforcing agency. For purposes of annunciation, zoning shall be in accordance with Section 907.6.3 of the California Building Code.*

314.17 Monitoring. *Shall be in accordance with Section 907.6.5 of the California Building Code.*

314.18 Systems interconnection. *When an automatic fire detection system or automatic extinguishing system is installed, activation of such system shall cause the sounding of the fire alarm notification appliances at locations designated by the enforcing agency.*

314.19 Manual fire alarm boxes. *A manual fire alarm box shall be provided in the locations designated by the enforcing agency. Such locations shall be where boxes are readily accessible and visible and in normal paths of daily travel by occupants of the building.*

314.20 Emergency voice/alarm communication system. *An approved emergency voice/alarm system shall be provided in every existing high-rise building which exceeds 150 feet (45 720 mm) in height measured in the manner set forth in Section 312.1. Such system shall provide communication from a location available to and designated by the enforcing agency to not less than all public areas. The emergency voice/alarm system may be combined with a fire alarm system provide the combined system has been approved and listed by the State Fire Marshal. The sounding of a fire alarm signal in any given area or floor shall not prohibit voice communication to other areas of floors. Combination systems shall be designed to permit voice transmission to override the fire alarm signal, but the fire alarm signal shall not terminate in less than three minutes.*

314.21 Fire department system. *When it is determined by test that portable fire department communication equipment is ineffective, a communication system acceptable to the enforcing agency shall be installed within the building to permit emergency communication between fire-suppression personnel.*

314.22 Interior wall and ceiling finish. *Interior wall and ceiling finish of exitways shall conform to the provisions of Chapter 8 of the California Building Code. Where the materials used in such finishes do not conform to the provisions of Chapter 8 of the California Building Code, such finishes may be surfaced with an approved fire-retardant coating.*

314.23 Ventilation. *Natural or mechanical ventilation for the removal of products of combustion shall be provided in every story of an existing high-rise building. Such ventilation shall be any one or combination of the following: Panels or windows in the exterior wall which can be opened. Such venting facilities shall be provided at the rate of at least 20 square feet (1.86 m^2) of opening per 50 lineal feet (15 240 lineal mm) of exterior wall in each story, distributed around the perimeter at not more than 50-foot (15 240 mm) intervals on at least two sides of the building. Approved fixed tempered glass may be used in lieu of openable panels or windows. When only selected panels or windows are of tempered glass, they shall be clearly identified as required by the enforcing agency. Any other design which will produce equivalent results.*

314.24 Smoke control systems. *Existing air-circulation systems shall be provided with an override switch in a location approved by the enforcing agency which will allow for the manual control of shutdown of the systems.*

Exception: *Systems which serve only a single floor, or portion thereof, without any penetration by ducts or other means into adjacent floors.*

314.25 Elevator recall smoke detection. *Smoke detectors for emergency operation of elevators shall be provided as required by Section 3003 of the California Building Code.*

314.26 Exit signs and illumination. *Exits and stairways shall be provided with exit signs and illumination as required by Sections 1011.1 and 1011.2 of the California Building Code.*

314.27 Automatic sprinkler system–Existing high-rise buildings. *Regardless of any other provisions of these regulations, every existing high-rise building of Type II-B, Type III-B or Type V-B construction shall be provided with an approved automatic sprinkler system conforming to NFPA 13.*

SECTION 315 [SFM]
EXISTING GROUP I OCCUPANCIES

315.1 General. *Existing buildings housing existing protective social-care homes or facilities established prior to March 4,* *1972 may have their use continued if they conform, or are made to conform, to the following provisions:*

315.2 Use of floors. *The use of floor levels in buildings of Type III, IV or V nonfire-rated construction may be as follows: Nonambulatory—first floor only; Ambulatory—not higher than the third-floor level, provided walls and partitions are constructed of materials equal in fireresistive quality to that of wood lath and plaster in good repair and all walls are firestopped at each floor level.*

315.3 Enclosure of exits and vertical openings. *Except for two-story structures housing ambulatory guests, all interior stairs shall be enclosed in accordance with Chapter 10 of the California Building Code. In lieu of stairway enclosures, floor separations or smoke barriers may be provided in such a manner that fire and smoke will not spread rapidly to floors above or otherwise impair exit facilities. In these instances, floor separations or smoke barriers shall have a fire resistance equal to not less than* $^1/_2$*-inch (13 mm) gypsum wall board on each side of wood studs with openings protected by not less than a* $1^3/_4$*-inch (44.5 mm) solid bonded wood-core door of the self-closing type. All other vertical openings shall be enclosed in accordance with the provisions of Section 314.6 and 314.13.*

315.4 Exit access. *Each floor or portion thereof of buildings used for the housing of existing protective social-care homes or facilities shall have access to not less than two exits in such a manner as to furnish egress from the building or structure in the event of an emergency substantially equivalent to the provisions of Chapter 10 of the California Building Code.*

315.5 Corridor openings. *Openings from rooms to interior corridors shall be protected by not less than* $1^3/_4$*-inch (44.5 mm) solid-bonded wood-core doors. Transoms and other similar openings shall be sealed with materials equivalent to existing corridor wall construction.*

315.6 Interior finishes. *Interior wall and ceiling finishes shall conform to the requirements for a Group R-1 Occupancy as specified in Chapter 8 of the California Building Code.*

315.7 Automatic fire sprinklers. *Automatic sprinkler systems shall be installed in existing protective social-care occupancies in accordance with the provisions of Section 903.2.6 of the California Building Code.*

315.8 Fire alarm systems. *Automatic fire alarm systems shall be installed in existing protective social-care homes or facilities in accordance with the provisions of Section 907.2.6 of the California Building Code.*

> ***Exception:*** *When an approved automatic sprinkler system conforming to Section 903.2.6 of the California Building Code is installed, a separate fire alarm system as specified in this section need not be provided.*

SECTION 316 [SFM]
EXISTING GROUP L OCCUPANCIES

316.1 Repairs general. *Additions, alterations or repairs may be made to any building or structure without requiring the existing building or structure to comply with all the requirements of this code section, provided the addition, alteration or repair conforms to the requirements of this section.*

316.2 Unsafe condition. *Additions, repairs or alterations shall not be made to an existing building or structure that will cause the existing building or structure to be in violation of any of the provisions of this code, nor shall such additions or alterations cause the existing building or structure to become unsafe, or to be in violation of any of the provisions of this code. An unsafe condition shall be deemed to have been created if an addition or alteration will cause the existing building or structure to become structurally unsafe or overloaded; will not provide adequate egress in compliance with the provisions of this code or will obstruct existing exits; will create a fire hazard; will reduce required fire resistance or will otherwise create conditions dangerous to human life.*

316.3 Changes in use or occupancy. *Any buildings that have alternations or additions, which involves a change in use or occupancy, shall not exceed the height, number of stories and area permitted for new buildings*

316.4 Buildings not in compliance with code. *Additions or alterations shall not be made to an existing building or structure when such existing building or structure is not in full compliance with the provisions of this code except when such addition or alteration will result in the existing building or structure being no more hazardous, based on life safety, fire safety and sanitation, than before such additions or alterations are undertaken.*

316.5 Maintenance of structural and fire resistive integrity. *Alterations or repairs to an existing building or structure that are nonstructural and do not adversely affect any structural member of any part of the building or structure having required fire resistance may be made with the same materials of which the building or structure is constructed. The installation or replacement of glass shall be as required for new installations.*

316.6 Continuation of existing use. *Buildings in existence at the time of the adoption of this code may have their existing use or occupancy continued if such use or occupancy was legal at the time of the adoption of this code, provided such continued use is not dangerous to life.*

316.7 Maximum allowable quantities. *Laboratory suites approved prior to January 1, 2008 shall not exceed the maximum allowable quantities listed in Tables 316.1 and 316.2.*

SECTION 317
EARTHQUAKE EVALUATION AND DESIGN FOR RETROFIT OF EXISTING BUILDINGS

317.1 Purpose.

> ***317.1.1 Existing state-owned structures. [BSC]*** *The provisions of Sections 317 through 322 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 317 through 323 may be adopted by a local jurisdiction for earthquake evaluation and design for retrofit of existing buildings.*

TABLE 316.7(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	—
	II-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 316.7(2)
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 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 1-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.

317.1.2 Public school buildings. [DSA-SS] *The provisions of Sections 317 through 323 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.*

The provisions of Section 317 through 323 also establish minimum standards for earthquake evaluation and design for rehabilitation of existing public buildings currently under the jurisdiction of DSA-SS.

317.1.2.1 Reference to other chapters. *For public schools, where reference within this chapter is made to sections in Chapters 16, 17, 18, 19, 21 or 22 of the California Building Code, the provisions in Chapters 16A, 17A, 18A, 19A, 21A and 22A of the California Building Code, respectively, shall apply instead.*

317.1.3 Community college buildings. [DSA-SS/CC] *The provisions of Sections 317 through 323 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.*

The provisions of Section 317 through 323 also establish minimum standards for earthquake evaluation and design for rehabilitation of existing community college buildings currently under the jurisdiction of DSA-SS/CC.

317.1.3.1 Reference to other chapters. *For community colleges, where reference within this chapter is made to sections in Chapters 17 or 18 of the California Building Code, the provisions in Chapters 17A and 18A of the California Building Code, respectively, shall apply instead.*

317.2 Scope. *All alterations, additions and/or repairs to existing structures or portions thereof shall, at a minimum, be designed and constructed to resist the effects of seismic ground motions as provided in this section. The structural system shall be evaluated by a registered design professional and, if not meeting or exceeding the minimum seismic design performance requirements of this section, shall be retrofitted in compliance with these requirements.*

Exception: *Those structures for which Section 317.3 determines that assessment is not required, or for which Section 317.4 determines that retrofit is not needed, then only the requirements of Section 317.11 apply.*

317.3 Applicability.

317.3.1 Existing state-owned buildings. [BSC] *For existing state-owned structures including all buildings owned by the University of California and the California State University, the requirements of Section 317 apply whenever the structure is to be retrofitted, repaired or modified and any of the following apply:*

1. *Total construction cost, not including cost of furnishings, fixtures and equipment, or normal maintenance, for the building exceeds 25 percent of the construction cost for the replacement of the existing building. The changes are cumulative for past modifications to the building that occurred after adoption of the 1995 California Building Code and did not require seismic retrofit.*
2. *There are changes in risk category.*
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 319. If the building's seismic base shear capacity has been increased since the original construction, the per-*

cent 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.*

317.3.2 Public school buildings. [DSA-SS] *For public schools, the provisions of Section 317 apply when required in accordance with Sections 4-307 and 4-309(c) of the California Administrative Code.*

317.3.3 Community college buildings. [DSA-SS/CC] *For community colleges, the provisions of Section 317 apply when required in accordance with Sections 4-307 and 4-309(c) of the California Administrative Code.*

317.4 Evaluation required. *If the criteria in Section 317.3 apply to the project under consideration, the design professional of record shall provide an evaluation in accordance with Section 317 to determine the seismic performance of the building in its current configuration and condition. If the structure's seismic performance as required by Section 317.5 is evaluated as satisfactory and the peer reviewer(s), when Method B of Section 321 is used, concur, then no structural retrofit is required.*

317.5 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 Seismic Hazard Level (BSE-1N, BSE-2N, BSE-1E, BSE-R or BSE-C), a specified structural performance level (S-1 through S-5) and a nonstructural performance level (N-A through N-E). The minimum seismic performance criteria are given in Table 317.5 according to the Building Regulatory Authority and the Risk Category as determined in Chapter 16 of the California Building Code or by the regulatory authority. The building shall be evaluated in accordance with a Tier 3 Systematic Evaluation and Retrofit per ASCE 41 Chapter 6 for both the Level 1 and Level 2 performance levels, and the more restrictive requirements shall apply.*

Exception: *If the floor area of an addition is greater than the larger of 50 percent of the floor area of the original building or 1,000 square feet (93 m^2), then the Table 317.5 entries for BSE-R (or BSE-1E) and BSE-C are replaced by BSE-1N and BSE-2N, respectively.*

317.6 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 317. Appropriate steps are either: 1) undertake the seismic retrofit as part of the additions, alterations 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.*

317.7 *The additions, alteration or repair to any existing building are permitted to be prepared in accordance with the structural and nonstructural requirements for a new building as given in the California Building Code, applied to the entire building.*

317.8 *The requirements of ASCE 41 Chapters 14 and 15 are to apply to the use of seismic isolation and passive energy systems, respectively, for the repair, voluntary lateral-force-resisting system modification or retrofit of an existing structure. When seismic isolation or passive energy dissipation is*

TABLE 317.5
SEISMIC PERFORMANCE REQUIREMENTS[2, 3] BY BUILDING REGULATORY AUTHORITY AND RISK CATEGORY

BUILDING REGULATORY AUTHORITY	RISK CATEGORY	PERFORMANCE CRITERIA[1]	
		Level 1	Level 2
State-Owned [BSC]	*I, II, III*	*BSE-R, S-3, N-C*	*BSE-C, S-5, N-D*
State-Owned [BSC]	*IV*	*BSE-R, S-2, N-B*	*BSE-C, S-4, N-D*
Division of the State Architect - [DSA-SS]	*I*	*BSE-1N, S-3, N-B*	*BSE-2N, S-5, N-D*
Division of the State Architect - [DSA-SS]	*II, III*	*BSE-1N, S-2, N-B*	*BSE-2N, S-4, N-D*
Division of the State Architect - [DSA-SS]	*IV*	*BSE-1N, S-2, N-A*	*BSE-2N, S-4, N-D*
Division of the State Architect - [DSA-SS/CC]	*I, II*	*BSE-1E, S-3, N-C*	*BSE-2N, S-5, N-D*
Division of the State Architect - [DSA-SS/CC]	*III*	*BSE-1E, S-3, N-B*	*BSE-2N, S-5, N-D*
Division of the State Architect - [DSA-SS/CC]	*IV*	*BSE-1E, S-2, N-B*	*BSE-2N, S-4, N-D*

1. *ASCE 41 provides acceptance criteria (e.g., m, rotation) for Immediate Occupancy (S1), Life Safety (S3) and Collapse Prevention (S5), and specifies in Sections 2.3.1.2.1 and 2.3.1.4.1 the method to interpolate values for S-2 and S-4, respectively. For nonstructural components, N-A corresponds to the Operational level, N-B to the Position Retention, N-C to the Life Safety level, N-D to the Hazards Reduced, and N-E to the Not Considered. When evaluating for the Hazards Reduced Nonstructural Performance Level, the requirements need not be greater than what would be required by ASCE 7 nonstructural provisions for new construction.*
2. *Buildings evaluated and retrofitted to meet the structural and nonstructural requirements for a new building as given in the California Building Code as adopted by DSA or BSC, as applicable, are deemed to meet the seismic performance requirements of this section.*
3. *Buildings complying with the requirements of the exception in Section 319.1 are deemed to meet the seismic performance requirements of this section.*

used, the project must have project peer review as prescribed in Section 322.

317.9 *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 319.10.*

317.10 *Where Method B of Section 321 is used or is required by Section 319.7, the proposed method of building evaluation and design procedures must be accepted by the building official prior to the commencement of the work.*

317.11 Voluntary lateral-force-resisting system modifications. *Where the exception of Section 317.2 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 319.12.*

SECTION 318
DEFINITIONS

318.1 *In addition to the definitions given in Section 202, for the purposes of Sections 317 through 323, certain terms are defined as follows:*

[DSA-SS & DSA-SS/CC] *For the purposes of Section 317 through 323, definitions of terms given in Section 4-208 or 4-314 of the California Administrative Code govern over those in Section 202.*

ADDITION [BSC] *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 [BSC] *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 [BSC] *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 ASCE 41, Section 2.4.2.1.*

BSE-R RESPONSE ACCELERATION PARAMETERS [BSC] *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 ASCE 41, Section 2.4.2.1.*

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.*

SECTION 319
SEISMIC CRITERIA SELECTION FOR EXISTING BUILDINGS

319.1 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 317 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 320;*
2. *Method B of Section 321, with independent review of a peer reviewer as required in Section 322; or*
3. *For state-owned buildings only, the use of one of the specific procedures listed in Section 319.1.1.*

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 the California Building Code.

Exceptions:

1. ***[BSC]*** *For buildings constructed to the requirements of California Building Code, 2016 or later edition, as adopted by the governing jurisdiction, that code is permitted to be used in place of those specified in Section 319.1.*
2. ***[DSA-SS & DSA-SS/CC]*** *For the conversion of nonconforming buildings to conforming school buildings in accordance with Section 4-307 of the California Administrative Code, nonconforming buildings constructed to the requirements of California Building Code, 2016 or later edition, that code as it was adopted by the governing jurisdiction is permitted to be used in place of those specified in Section 319.1 provided the building complies with Seismic Design Category D or higher.*

319.1.1 Specific procedures. [BSC] *For state-owned buildings, the following specific procedures located in 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).*
2. *Earthquake Hazard Reduction in Existing Reinforced Concrete and Reinforced Masonry Wall Buildings with Flexible Diaphragms (Chapter A2).*

319.1.2 *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.*

319.1.3 *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.*

319.1.4 Public schools. [DSA-SS] *For public schools, unreinforced masonry shall not be used to resist in-plane or out-of-plane seismic forces or superimposed gravity loads.*

319.1.5 Public schools. [DSA-SS] *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 clay tile, gypsum wallboard and particleboard sheathing shall not be assumed to resist seismic forces.*

319.2 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 6.2 shall meet the following minimum levels:

1. ***[BSC]*** *For state-owned buildings, the requirements shall be met following the data collection requirements of ASCE 41, Section 6.2.*
2. ***[DSA-SS, DSA-SS/CC]*** *For public schools and community college buildings constructed in conformance with the Field Act, the "Usual" level as defined in ASCE 41, Section 6.2.2.*
3. ***[DSA-SS, DSA-SS/CC]*** *For public schools and community college buildings not constructed in conformance with the Field Act, the "Comprehensive" level as defined in ASCE 41, Section 6.2.3.*

Concrete material requirements and testing for public school and community college buildings shall also comply with Sections 1911A and 1909.5 of the California Building Code, 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.

319.3 Site geology and soil characteristics. *Soil profile shall be assigned in accordance with the requirements of Chapter 18 of the California Building Code.*

319.4 Risk categories. *Each structure shall be placed in one of the Risk Categories in accordance with the requirements of the California Building Code.*

319.5 Configuration requirements. *Each structure shall be designated structurally regular or irregular in accordance with the requirements of ASCE 41, Sections 7.3.1.1.1 to 7.3.1.1.4.*

319.6 General selection of the design method. *The requirements of Method B (Section 321) may be used for any existing building.*

319.7 Prescriptive selection of the design method. *The requirements of Method A (Section 320) or the specific procedures for applicable building types given in Section 319.1.1 are permitted to be used except under the following conditions, where the requirements of Method B (Section 321) must be used.*

319.7.1 *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).*

***319.7.2** When the building is classified as irregular in vertical or horizontal plan. If the evaluation and retrofit is in accordance with Table 317.5 Footnote 2 or 3, the building shall be classified by application of ASCE 7, Section 12.3.2. If the evaluation and retrofit is in accordance with ASCE 41, the building shall be classified as irregular when an irregularity defined in ASCE 41, Sections 7.3.1.1.1 to 7.3.1.1.4 exists.*

> ***Exception:** Section 319.7.2 does not apply in the following conditions:*
>
> 1. *The retrofit design removes the configurational attributes that caused the building to be classified as irregular.*
> 2. *The irregularity is demonstrated not to affect the seismic performance of the building.*

***319.7.3** For any building that is assigned to Risk Category IV.*

***319.7.4** For any building using undefined or hybrid structural systems.*

***319.7.5** 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.*

***319.7.6** When the height of the structure exceeds 240 feet (73 152 mm).*

***319.7.7** When ASCE 41 is the evaluation standard and its application requires the use of nonlinear procedures.*

***319.8 Strength requirements.** All components of the lateral-force-resisting system must have the strength to meet the acceptance criteria prescribed in ASCE 41, Chapter 7 or as prescribed in the applicable Appendix A chapter of this code if a specific procedure in Section 319.1.1 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 317. If this exception is taken for a component, then it cannot be considered part of the primary lateral-load-resisting system.*

***319.9 Nonstructural component requirements.** Where the nonstructural performance levels required by Section 317, Table 317.5 are N-D or higher, mechanical, electrical and plumbing components shall comply with the provisions of ASCE 41, Chapter 13, Section 13.2.*

> ***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.*

***319.10 Structural observation, testing and inspection.** Structural observation, testing and inspection as used in this section shall mean meeting the requirements of Chapter 17 of the California Building Code, with a minimum allowable level of investigation corresponding to seismic design category (SDC) D. Structural observation visits shall occur at significant construction stages and at the completion of the structural retrofit. Structural observation shall be provided for all structures.*

> ***Additional requirements: [DSA-SS, DSA-SS/CC]** For public schools and community colleges, construction material testing, inspection and observation during construction shall also comply with the California Administrative Code.*

> ***319.10.1** 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.*

> ***319.10.2 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.*

***319.11 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 Item 1 in Section 319.12 that allows inadequate capability in some existing components, as long as the required performance levels given in Section 317 can be provided by the permanent structure. The consideration for such temporary actions shall be noted in the design documents.*

***319.12 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 319.8.*
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 the California Building Code.*
4. *New or relocated nonstructural components are detailed and connected to existing or new structural components as required by the California Building Code.*
5. *A dangerous condition is not created.*

Use of ASCE 41 Tier 1 and Tier 2 deficiency only retrofit procedures are pre-approved for use where Section 317.3 does not require an assessment.

319.12.1 State-owned buildings. [BSC] *Voluntary modifications to lateral force-resisting systems conducted in accordance with Appendix A of this code and the referenced standards of the California Building Code shall be permitted.*

319.12.1.1 Design documents. [BSC] *When Section 319.12 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 the California Existing Building Code have not been checked to determine if these structural modifications meet the full seismic evaluation and strengthening requirements of Sections 317-322: the modifications proposed are to a different seismic performance standard than would be required in Section 319 if they were not voluntary as allowed in Section 319.12."*

319.12.2 Public schools and community colleges. [DSA-SS, DSA-SS/CC] *When Section 319.12 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 320
METHOD A

320.1 General. *The retrofit design shall employ the Linear Static or Linear Dynamic Procedures of ASCE 41, Section 7.4.1 or 7.4.2, and comply with the applicable general requirements of ASCE 41, Chapters 6 and 7. The earthquake hazard level and performance level given specified in Section 317.5 for the building's risk category shall be used. Structures shall be designed for seismic forces coming from any horizontal direction.*

SECTION 321
METHOD B

321.1 *The existing or retrofitted structure shall be demonstrated to have the capability to sustain the deformation response due to the specified earthquake ground motions and meet the seismic performance requirements of Section 317. The registered design professional shall provide an evaluation of the response of the existing structure in its modified configuration and condition to the ground motions specified. If the building's seismic performance is evaluated as satisfactory and the peer reviewer(s) and the enforcement agency concurs, then no further structural retrofit and/or repair of the lateral load-resisting system is required.*

When the evaluation indicates the building does not meet the required performance levels given in Table 317.5 for the risk category, then a retrofit and/or repair design shall be prepared that provides a structure that meets these performance objectives and reflects the appropriate consideration of existing conditions. Any approach to analysis and design is permitted to be used, provided that the approach shall be rational, shall be consistent with the established principals of mechanics and shall use the known performance characteristics of materials and assemblages under reversing loads typical of severe earthquake ground motions.

Exception: *Further consideration of the structure's seismic performance may be waived by the enforcement agency if both the registered design professional and peer reviewer(s) conclude that the structural system can be expected to perform at least as well as required by the provisions of this section without completing an analysis of the structure's compliance with these requirements. A detailed report shall be submitted to the responsible building official that presents the reasons and basis for this conclusion. This report shall be prepared by the registered design professional. The peer reviewer(s) shall concur in this conclusion and affirm to it in writing. The building official shall either approve this decision or require completion of the indicated work specified in this section prior to approval.*

321.2 *The approach, models, analysis procedures, assumptions on material and system behavior and conclusions shall be peer reviewed in accordance with the requirements of Section 322 and accepted by the peer reviewer(s).*

Exceptions:

1. *The enforcement agency may perform the work of peer review when qualified staff is available within the jurisdiction.*
2. *The enforcement agency may modify or waive the requirements for peer review when appropriate.*

321.2.1 *The approach used in the development of the design shall be acceptable to the peer reviewer and the enforcement agency and shall be the same method as used in the evaluation of the building. Approaches that are specifically tailored to the type of building, construction materials and specific building characteristics may be used, if they are acceptable to the independent peer reviewer. The use of Method A allowed procedures may also be used under Method B.*

321.2.2 *Any method of analysis may be used, subject to acceptance by the peer reviewer(s) and the building official. The general requirements given in ASCE 41, Chapters 6 and 7, shall be complied with unless exceptions are accepted by the peer reviewer(s) and building official. Use of other than ASCE 41 procedures in Method B requires building official concurrence before implementation.*

321.2.3 *Prior to implementation, the procedures, methods, material assumptions and acceptance/rejection criteria proposed by the registered design professional will be peer reviewed as provided in Section 322. Where nonlinear procedures are used, prior to any analysis, the representation of the seismic ground motion shall be reviewed and approved by the peer reviewer(s) and the building official.*

[DSA-SS, DSA-SS/CC] *For public school and community college projects, the representation of the seismic ground motion shall be reviewed and approved by the California Geological Survey.*

321.2.4 *The conclusions and design decisions shall be reviewed and accepted by the peer reviewer(s) and the building official.*

SECTION 322
PEER REVIEW REQUIREMENTS

322.1 General. *Independent peer review is an objective, technical review by knowledgeable reviewer(s) experienced in the structural design, analysis and performance issues involved. The reviewer(s) shall examine the available information on the condition of the building, the basic engineering concepts employed and the recommendations for action.*

322.2 Timing of independent review. *The independent reviewer(s) shall be selected prior to initiation of substantial portions of the design and/or analysis work that is to be reviewed, and review shall start as soon as practical after Method B is adopted and sufficient information defining the project is available.*

322.3 Qualifications and terms of employment. *The reviewer(s) shall be independent from the design and construction team.*

322.3.1 *The reviewer(s) shall have no other involvement in the project before, during or after the review, except in a review capacity.*

322.3.2 *The reviewer(s) shall be selected and paid by the owner and shall have technical expertise in the evaluation and retrofit of buildings similar to the one being reviewed, as determined by the enforcement agency.*

322.3.3 *The reviewer (or in the case of review teams, the chair) shall be a California-licensed structural engineer who is familiar with the technical issues and regulations governing the work to be reviewed.*

> ***Exception:*** *Other individuals with acceptable qualifications and experience may be a peer reviewer(s) with the approval of the building official.*

322.3.4 *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 the enforcement agency, owner and the registered design professional. When a reviewer is terminated or resigns, a qualified replacement shall be appointed within 10 working days, and the reviewer shall submit copies of all reports, notes and correspondence to the responsible building official, the owner and the registered design professional within 10 working days of such termination.*

322.3.5 *The peer reviewer shall have access in a timely manner to all documents, materials and information deemed necessary by the peer reviewer to complete the peer review.*

322.4 Scope of review. *Review activities shall include, where appropriate, available construction documents, design criteria and representative observations of the condition of the structure, all inspection and testing reports, including methods of sampling, analytical models and analyses prepared by the registered design professional and consultants, and the retrofit or repair design. Review shall include consideration of the proposed design approach, methods, materials, details and constructability.*

Changes observed during construction that affect the seismic-resisting system shall be reported to the reviewer in writing for review and recommendation.

322.5 Reports. *The reviewer(s) shall prepare a written report to the owner and building official that covers all aspects of the review performed, including conclusions reached by the reviewer(s). Reports shall be issued after the schematic phase, during design development, and at the completion of construction documents but prior to submittal of the project plans to the enforcement agency for plan review. When acceptable to the building official, the requirement for a report during a specific phase of the project development may be waived.*

Such reports should include, at the minimum, statements 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 performance criteria with given loads and configuration.*
4. *Degree of structural system redundancy and the deformation compatibility among structural and nonstructural components.*
5. *Basic constructability of the retrofit or repair system.*
6. *Other recommendations that would be appropriate to the specific project.*
7. *Presentation of the conclusions of the reviewer identifying any areas that need further review, investigation and/or clarification.*
8. *Recommendations.*

The last report prepared prior to submittal of permit documents to the enforcement agency shall include a statement indicating that the design is in conformance with the approved evaluation and design criteria.

322.6 Response and resolutions. *The registered design professional shall review the report from the reviewer(s) and shall develop corrective actions and 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 resolutions prepared pursuant to this section shall be submitted to the responsible enforcement agency and the owner along with other plans, specifications and calculations required. If the reviewer resigns or is terminated prior to completion of the project, then the reviewer shall submit copies of all reports, notes and correspondence to the responsible building official, the owner and the registered design professional within 10 working days of such termination.*

322.7 Resolution of conflicts. *When the conclusions and recommendations of the peer reviewer conflict with the registered design professional's proposed design, the enforcement agency shall make the final determination of the requirement for the design.*

SECTION 323 [DSA-SS, DSA-SS/CC] ADDITIONAL REQUIREMENTS FOR PUBLIC SCHOOLS AND COMMUNITY COLLEGES

The requirements of Section 323 apply only to public schools under the jurisdiction of the Division of the State Architect-Structural Safety (DSA-SS, refer to Section 1.9.2.1) and community colleges under the jurisdiction of the Division of the State Architect—Structural Safety/Community Colleges (DSA-SS/CC, refer to Section 1.9.2.2).

323.1 Evaluation and design criteria report. *During the schematic phase of the project, the owner or the registered design professional in charge of the design shall prepare and sign an Evaluation and Design Criteria Report in accordance with Sections 4-306 and 4-307(a) of the California Administrative Code. The report shall be submitted to the DSA for review and approval prior to proceeding with design development of the rehabilitation.*

The Evaluation and Design Criteria Report shall:

1. *Identify the building(s) structural and nonstructural systems, potential deficiencies in the elements or systems and the proposed method for retrofit.*
2. *Identify geological and site-related hazards.*
3. *Propose the methodology for evaluation and retrofit design.*
4. *Propose the complete program for data collection (Section 319.2).*
5. *Include existing or "as-built" building plans, reports and associated documents of the existing construction.*

323.2 Rehabilitation involving only portions of structures. *Where only a portion(s) of a structure is to be rehabilitated, the public school or community college portion of the structure shall:*

1. *Be seismically separated from the unrehabilitated portion in accordance with Chapter 16 of the California Building Code, or the entire structure shall be rehabilitated in accordance with this section. For structures in which the unrehabilitated portion is above or below the school or community college portion, the entire structure shall be rehabilitated in accordance with this division.*
2. *Be retrofitted as necessary to protect the occupants from falling hazards of the unrehabilitated portion of the building, and;*
3. *Be retrofitted as necessary to protect required exitways being blocked by collapse or falling hazards of the unrehabilitated portion.*

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 3*A* – PROVISIONS FOR ALL COMPLIANCE METHODS [OSHPD 1]

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter										X													
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 3*A*

PROVISIONS FOR ALL COMPLIANCE METHODS

User note:

About this chapter: *Chapter 3 explains the three compliance options for alterations and additions available in the code. In addition, this chapter also lays out the methods to be used for seismic design and evaluation throughout this code. Finally, this chapter clarifies that provisions in other I-Codes® related to repairs, alterations, additions, relocation and changes of occupancy must also be addressed unless they conflict with this code. In that case, this code takes precedence.*

SECTION 301*A* ADMINISTRATION

301*A*.1 Applicability. *The provisions of this chapter shall control the alteration, repair, addition and change of occupancy of existing structures for applications listed in Sections 1.10.1 [OSHPD 1] regulated by the Office of Statewide Health Planning and Development (OSHPD).*

California Energy Commission, State Fire Marshal and DSA-AC requirements for existing structures shall be enforced by the Office of Statewide Health Planning and Development (OSHPD).

301*A*.1.1 Bleachers, grandstands and folding and telescopic seating. Existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

301*A*.2 Repairs. Repairs shall comply with the requirements of Chapter 4*A*.

301*A*.3 Alteration, addition or change of occupancy. The alteration, addition or change of occupancy of all existing buildings *or structures* shall comply with one of the methods *or categories* listed in Section 301*A*.3.1, 301*A*.3.2 or 301*A*.3.3. *Section 304A.3.2 applies to all methods or categories.* Sections 301*A*.3.1 through 301*A*.3.3 shall not be applied in combination with each other, *except when permitted by the enforcement agency.*

Exception: Subject to the approval of the *enforcement agency,* alterations complying with the laws in existence at the time the building or the affected portion of the building was built shall be considered in compliance with the provisions of this code. New structural members added as part of the alteration shall comply with the *California Building Code*.

301*A*.3.1 Prescriptive compliance method. Alterations, additions and changes of occupancy complying with Chapter 5*A* of this code *for existing* buildings *or structures* shall be considered in compliance with the provisions of this code.

301*A*.3.2 *Nonconforming buildings*. Alterations, additions and changes of occupancy *to existing buildings or structures designed in accordance with the Pre-1973 building code* complying with *Section 304A.3.1 and* the applicable requirements *herein* shall be considered in compliance with the provisions of this code.

301*A*.3.3 Performance-*based* method. Alterations, additions and changes of occupancy *to existing buildings or structures* complying with *Sections 304A.3.4 and 304A.3.5* of this code shall be considered in compliance with the provisions of this code.

301*A*.4 *Moved structures*. *Structures moved into or within the jurisdiction shall comply with the provisions of the California Building Code for new structures.*

301*A*.5 Compliance with accessibility. Accessibility requirements for existing buildings shall comply with the *California Building Code, Part 2 Volume 1 Chapter 11B, Section 201 "Existing Buildings and Facilities."*

301A.6 Peer review requirements. *Peer review requirements shall comply with California Building Code Section 1617A.1.41.*

301A.7 Earthquake monitoring instruments for existing buildings. *Earthquake monitoring instrumentation of existing buildings shall comply with Section 313A.*

***301A.8 Compliance alternatives for services/systems and utilities*.** *Compliance alternatives for services/systems and utilities shall comply with Section 310A.*

301A.9 Compliance alternatives for means of egress. *Means of egress through existing buildings shall comply with Section 311A.*

301A.10 Removal of hospital buildings from general acute care services. *Removal of hospital buildings from General Acute Care Services shall comply with Section 312A.*

301A.11 Hospital buildings removed from general acute care services. *Hospital buildings removed from general acute care services shall comply with Section 312A.*

SECTION 302*A* GENERAL PROVISIONS

302*A*.1 Dangerous conditions. The code official shall have the authority to require the elimination of conditions deemed dangerous.

302*A*.2 Additional codes. *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 and California Electrical Code. Where provisions of the other codes conflict with provisions of this chapter, the provisions of this chapter shall take precedence.*

302*A*.2.1 Additional codes in health care. In existing Group I-2 occupancies, ambulatory health care facilities, outpatient clinics and hyperbaric facilities, alterations, repairs, additions and changes of occupancy to, or relocation of, existing buildings and structures shall also comply with NFPA 99.

302*A*.3 Existing materials *and equipment*. Materials *and equipment* 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 code official to be unsafe *in accordance with California Building Code Section 116*.

302A.3.1 Existing seismic force-resisting systems. *Where the existing seismic force-resisting system is a type that can be designated ordinary or is a welded steel moment frame constructed under a permit issued prior to October 25, 1994, 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.*

302*A*.4 New and replacement materials. Except as otherwise required or permitted by this code, materials *and equipment* 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.

[BS] 302*A*.4.1 New structural members and connections. New structural members and connections shall comply with the detailing provisions of the *California Building Code* for new buildings of similar structure, purpose and location.

Exception: Where alternative design criteria are specifically permitted.

302*A*.5 Occupancy and use. Where determining the appropriate application of the referenced sections of this code, the occupancy and use of a building shall be determined in accordance with Chapter 3 of the *California Building Code*.

302A.6 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 they were 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 re-inspected. 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.*

302A.7 Construction documents for retrofit or rehabilitation. *The design loads and other information pertinent to the structural design required by California Building Code Section 1603A shall be included in the drawings. In addition to the information required by California Building Code Section 1603A.1.5, the drawings shall show the ground motion hazard used for the retrofit or rehabilitation as either a percentage of the California Building Code prescribed ground motion for new hospital buildings, or ASCE 41 seismic hazard designation, or a probability of exceedance in a specified time period, or a return period for exceedance of the specified ground motion.*

SECTION 303*A*
RESERVED

SECTION 304*A*
STRUCTURAL DESIGN LOADS AND EVALUATION AND DESIGN PROCEDURES

[BS] 304*A*.1 Live loads. Where an addition or 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 addition or alteration. If the approved live load is less than that required by Section 1607*A* of the *California Building Code*, the area designated for the nonconforming live load shall be posted with placards of approved design indicating the approved live load. Where the addition or alteration results in increased design live load, the live load required by Section 1607*A* of the *California Building Code* shall be used.

[BS] 304*A*.2 Snow loads on adjacent buildings. Where an alteration or addition changes the potential snow drift effects on an adjacent building, the code official is authorized to enforce Section 7.12 of ASCE 7.

[BS] 304*A*.3 *Additions, alterations, repairs and seismic retrofit to existing buildings or structures.*

[BS] 304*A*.3.1 *Structures designed in accordance with pre-1973 building code.* *Provisions of this section shall apply to hospital buildings which were originally designed to pre-1973 building codes and not designated as SPC 3 or higher in accordance with Chapter 6 of the California Administrative Code.*

304A.3.1.1 Incidental and minor structural alteration, additions or repairs. *Incidental and minor structural additions shall be permitted, provided the additions meet the California Building Code for new construction using importance factor, I_e, equal to or greater than 1.0. Alterations or repair to existing gravity and lateral force-resisting systems shall be made to conform to the requirements of Section 503A or Chapter 4A, respectively, using importance factor, I_e, equal to or greater than 1.0.*

1. ***Nonstructural components.*** *Component importance factor, I_p, shall be permitted to be 1.0.*

 Exception: *Components required for life-safety purposes after an earthquake, including emergency and standby power systems, mechanical smoke removal systems, fire protection sprinkler systems, fire alarm control panels and egress stairways shall have a component importance factor (I_p) of 1.5.*

304A.3.1.2 Major structural alteration, additions or repairs. *Major structural alterations, additions or* *repairs shall be in accordance with Section 304A.3.4.1 or 304A.3.4.3 as applicable.*

304A.3.2 Seismic evaluation and retrofit of general acute care hospitals for compliance with the California Administrative Code, Chapter 6. *Notwithstanding 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 these provisions. When load combinations which do not include seismic forces are required, the new building provisions of this code shall be applicable.*

304A.3.3 SPC-4D. *Nonconforming hospital buildings satisfying the following requirements and one of Sections 501A.3.1, 501A.3.2 or 304A.3.4.5, but not a combination thereof, shall be considered to satisfy the requirements of SPC-4D.*

1. *Approval of construction documents based on building characterization in accordance with the California Administrative Code (CAC) Chapter 6 Section 2.1.2.1, material properties in accordance with the CAC Chapter 6 Section 2.1.2.2 and Section 304A.5.3 of this code, and a complete rational structural analysis shall be required.*
2. *Where the SPC-4D upgrade involves construction, a building permit prior to construction shall be required.*
3. *Where multiple building permits are used to upgrade a building to SPC-4D, a complete rational structural analysis to justify compliance with SPC-4D, for the building in its final configuration, shall be submitted as part of the construction documents submittal to the Office for the last project.*
4. *Where the SPC-4D upgrade involves construction, buildings shall be assigned to SPC-4D after all projects required for SPC-4D are closed in compliance.*

304A.3.4 Performance objectives of performance-based methods. *Except for the modifications as set forth in Sections 304A.3.4 and 304A.3.5, 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. When load combinations which do not include seismic forces are required, the new building code provisions of this code shall be applicable. Required building performance objectives under ASCE 41 shall be as follows:*

304A.3.4.1 For general acute care hospital buildings along with all structures required for their continuous operation or access/egress:

1. *Immediate Occupancy (IO) Structural Performance Level (S-1) as defined in Section 2.3.1.1 at Basic Safety Earthquake 1N (BSE-1N) Seismic Hazard Level; and*
2. *Life Safety (LS) Structural Performance Level (S-3) as defined in Section 2.3.1.3 at Basic Safety Earthquake 2N (BSE-2N) Seismic Hazard Level; and*
3. *The nonstructural components shall satisfy the requirements of this code for new construction.*

   Exception: *Performance objectives for upgrading nonconforming hospital buildings to SPC-4D and for incidental or minor alterations or repairs of SPC-4D buildings shall be in accordance with Section 304A.3.4.5 of this code.*

304A.3.4.2 For incidental and minor additions, alterations or repairs of pre-1973 hospital buildings which will not be used for general acute care services after January 1, 2030:

1. *Life Safety Structural Performance (S-3) Level as defined in ASCE 41 Section 2.3.1.3 at the Basic Safety Earthquake 1E (BSE-1E) Seismic Hazard Level; and*
2. *Collapse Prevention (CP) Building Performance Level (5-D) in accordance with Section 2.3.3.4 at the Basic Safety Earthquake 2E (BSE-2E) Seismic Hazard Level; and*
3. *The nonstructural components shall satisfy the requirements of Position Retention Nonstructural Performance Level (N-B) in accordance with ASCE 41 Section 2.3.2.2 at BSE-1E Seismic Hazard Level.*

304A.3.4.3 All other hospital buildings:

1. *Operational Building Performance Level of (1-A) as defined in Section 2.3.3.1 at Basic Safety Earthquake 1N (BSE-1N) Seismic Hazard Level; and*
2. *Life Safety (LS) Building Performance Level (S-3) as defined in Section 2.3.1.3 at Basic Safety Earthquake 2N (BSE-2N) Seismic Hazard Level.*

304A.3.4.4 SPC 2 using ASCE 41. *Structures shall be considered to comply with SPC 2 requirements of Table 2.5.3, Chapter 6 of the California Administrative Code, when all of the following are satisfied:*

1. *Life Safety Structural Performance Level (S-3) in accordance with Section 2.3.1.3 of ASCE 41 at BSE-1E; and*
2. *Items identified in Chapter 6, Article 10 of the California Administrative Code satisfying the requirements of Position Retention nonstructural Performance Level (N-B) in accordance with Section 2.3.2.2 at BSE-1E.*

304A.3.4.5 SPC-4D using ASCE 41. *Structures shall be deemed to comply with the SPC-4D requirements of Table 2.5.3, Chapter 6 of the California Administrative Code, when all of the following are satisfied:*

1. *Damage control Structural Performance Level (S-2) in accordance with Section 2.3.1.2.1 of ASCE 41 at BSE-1E; and*

2. *Collapse Prevention Structural Performance Level (S-5) in accordance with Section 2.3.1.5 of ASCE 41 at BSE-2E; and*

3. *Items identified in Chapter 6, Article 10 of the California Administrative Code satisfy the requirements of Position Retention Nonstructural Performance Level (N-B) in accordance with Section 2.3.2.2 at BSE-1E.*

304A.3.4.5.1 *Replace ASCE 41-13 § 7.2.13.2 with the following:*

A. *Where the adjacent building was constructed using the 1989 or later edition of the California Building Code and built under OSHPD jurisdiction, the minimum building separation distance specified in Section 7.2.13.1 need not be evaluated for Structural Performance Level Damage Control or lower.*

B. *Where adjacent structure or building evaluated is not less than half as tall and adjacent structure has floors/levels that match those of the building being evaluated, the following exceptions apply:*

   1) *For Structural Performance Level of Life Safety or lower, the seismic separation between the adjacent structure and the building being evaluated need not be evaluated.*

   2) *For Structural Performance Level of Damage Control, buildings need not meet the minimum separation distance specified in Section 7.2.13.1 where either a) or b) applies:*

      a) *Adjacent structure is more than 2 inches (50.8 mm) times the number of stories below that level away from the building being evaluated at all floor levels that align.*

      b) *The adjacent building does not have any of the following structural deficiencies as defined in the California Administrative Code (CAC), Chapter 6, Article 3:*

         1) *Load path (3.1)*

         2) *Weak story (3.3.1)*

         3) *Soft story (3.3.2)*

         4) *Vertical discontinuity (3.3.5) or*

         5) *Torsion (3.3.6)*

C. *Where an approved pounding analysis procedure that accounts for the change in dynamic response of the structures caused by impact is used, the evaluated and retrofitted buildings need not meet the minimum separation distance specified in Section 7.2.13.1. Such analysis shall demonstrate that:*

   1) *The structures are capable of transferring forces resulting from impact for diaphragms located at the same elevation; or*

   2) *The structures are capable of resisting all required vertical and lateral forces considering the loss of any elements or components damaged by impact of the structures.*

304A.3.4.6 SPC 5 using ASCE 41. *Structures shall be considered to comply with SPC 5 requirements of Table 2.5.3, Chapter 6 of the California Administrative Code where all of the following are satisfied:*

1. *Immediate Occupancy Structural Performance Level (S-1) in accordance with Section 2.3.1.1 of ASCE 41 at BSE-1N;*

2. *Life Safety Performance Level S-3 in accordance with Section 2.3.1.3 of ASCE 41 at BSE-2N; and*

3. *Items identified in Chapter 6, Article 10 of the California Administrative Code, satisfying the requirements of Operational Nonstructural Performance Level (N-A) in accordance with Section 2.3.2.1 of ASCE 41 at BSE-1N.*

304A.3.4.7 NPC-2 and NPC-3 using ASCE 41: *Operational Nonstructural Performance Level (N-A) and Position Retention Nonstructural Performance Level (N-B) of ASCE 41 at BSE-1N shall be considered equivalent to NPC 3/NPC 2 requirements, respectively, of Table 11.1, Chapter 6 of the California Administrative Code. For NPC 3/NPC 2, only components listed in Table 11.1, Chapter 6 of the California Administrative Code for NPC 3/NPC 2 need to satisfy the requirements specified above.*

> ***Exception:*** *Evaluation procedure of Article 11, Chapter 6 of the California Administrative Code shall be used for seismic evaluation of NPC 2, NPC 3, NPC 4 or NPC 4D 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.*

304A.3.4.8 NPC-4 or NPC 4D and NPC-5 using ASCE 41*: Nonstructural components for Operational Nonstructural Performance Level (N-A) in Section 2.3.2.1 or NPC-4/NPC 4D shall satisfy the requirements of the California Building Code for new construction. Nonstructural components for NPC-5 shall satisfy Operational Performance Level N-A/NPC-4/NPC 4D and California Building Code Section 1617A.1.40 Items 1 & 2.*

304A.3.5 Modifications to ASCE 41. *The text of ASCE 41 shall be modified as indicated in Sections 304A.3.5.1 through 304A.3.5.16.*

304A.3.5.1 ASCE 41 Section 1.1. *Modify ASCE 41 Section 1.1 with the following:*

Seismic evaluations shall be performed for performance objective specified in Section 304A.3.4 of this *code (CEBC) using procedure of this standard (ASCE 41) as follows:*

1. *Structural components shall be evaluated in accordance with Tier 3 systematic evaluations procedure in Chapter 6.*
2. *Nonstructural components shall be evaluated in accordance with Chapter 13.*

Exception: *For general acute care hospitals, seismic evaluation shall be permitted to be in accordance with Chapter 6 of the California Administrative Code (CAC) when required by provisions of that chapter.*

304A.3.5.2 Reserved.

304A.3.5.3 ASCE 41 Section 6.2. *Modify ASCE 41 Section 6.2 with the following:*

Data Collection Requirements. *The extent of data collection shall be at Comprehensive level for all structures, including structures upgraded to SPC-4D. A testing program for materials properties shall be approved by the enforcement agent prior to commencement of material testing work. Previously approved material test results shall be permitted to be used to satisfy part of the comprehensive data collection requirements.*

Exception: *Data collection at Usual level shall be permitted for structures with SPC-2 or lower target performance objective.*

Tension testing of reinforcing bars shall be in accordance with ASTM A615. All test specimens shall be the full section of the bar as rolled (8-in. gage length) and shall not be reduced.

At test sample locations, structural members, slabs and walls shall be repaired to a state that is equivalent to their original condition.

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.

304A.3.5.4 ASCE 41 Section 7.3.2.1. *Modify ASCE 41 Section 7.3.2.1 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.*

304A.3.5.5 ASCE 41 Section 7.5.1. *Modify ASCE 41 Section 7.5.1 with the following:*

Acceptance Criteria – 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-1E or BSE-1N, as applicable.*

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.*

304A.3.5.6 ASCE 41 Section 7.5.1.4. *Modify ASCE 41 Section 7.5.1.4 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 8 through 12 and shall be based exclusively on materials tests.*

304A.3.5.7 ASCE 41 Section 8.4. *Modify ASCE 41 Section 8.4 with the following:*

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.*

304A.3.5.8 ASCE 41 Section 8.4.1.1. *Replace ASCE 41 Section 8.4.1.1 as follows:*

Prescriptive Expected Capacities. *Not permitted by OSHPD.*

304A.3.5.9 ASCE 41 Section 8.4.2.3.2.1 Modify ASCE 41 Sections 8.4.2.3.2.1 and 8.4.2.3.2.2 as follows:

8.4.2.3.2.1 *Alternatively, when seismic evaluation is performed for foundation after global analysis of the superstructure is complete, both overturning and axial seismic pseudo force demands are permitted to be divided by the m-factors above, provided the foundation is analyzed as a beam on Winkler springs (soil does not resist tension). The vertical spring stiffness values may be determined either from Figure 8-2 or Equation 8-11, or as provided by the geotechnical engineer. Acceptance criteria for soil bearing shall be considered met, based on one of the following methods, either A or B:*

A) Soil spring reactions are limited by the ultimate soil bearing capacity, and the foundation system is stable under the applied loads.

B) The resisting soil pressure distribution under the footing is triangular such that the maximum soil bearing pressure at any point of the footing is less than the ultimate soil bearing capacity.

Subject to the approval of the authority having jurisdiction, higher soil pressures may be permitted when appropriately justified.

The evaluation of the foundation structural element shall be considered as force controlled in accordance with the material chapters using the bearing pressure distribution under the footing from the same method used for the soil bearing acceptance criteria.

8.4.2.3.2.2 *Alternatively, superstructure pseudo force overturning demands to the foundation are permitted to be divided by the appropriate m-factors above and applied to the mathematical model representing the foundation system only, re-analyzed as a* *beam on Winkler springs (soil does not resist tension). Acceptance criteria for soil bearing shall be considered met, based on one of the following methods, either A or B:*

A) Soil spring reactions are limited by the ultimate soil bearing capacity, and the foundation system is stable under the applied loads.

B) The resisting soil pressure distribution under the footing is triangular, and the maximum soil bearing pressure at any point of the footing is less than the ultimate soil bearing capacity.

Subject to the approval of the authority having jurisdiction, higher soil pressures may be permitted when appropriately justified.

The evaluation of the foundation structural element shall be considered as force controlled in accordance with the material chapters using the bearing pressure distribution under the footing from the same method used for the soil bearing acceptance criteria.

***304A.3.5.10 ASCE 41 Section 8.5.1.** Modify ASCE 41 Section 8.5.1 with the following:*

The product of RRS_{bsa} x RRS_e, shall not be less than 0.7.

The combined effect of kinematic interaction and foundation damping shall meet the following:

1. *The site specific response spectrum modified for soil-structure interaction effects shall not be taken as less than 80 percent of the spectral acceleration as determined from a site-specific response spectrum in accordance with ASCE 7 Section 21.3, or*
2. *The site specific response spectrum modified for soil-structure interaction effects shall not be taken as less than 70 percent of the spectral acceleration as determined from the design response spectrum and MCE_R response spectrum in accordance with ASCE 7 Sections 11.4.5 and 11.4.6, respectively.*

***Exception:** For the seismic retrofit of existing nonconforming buildings, design ground motion shall be consistent with performance objectives in Section 304A.3.4.*

***304A.3.5.11 ASCE 41 Section 8.6.** Modify ASCE 41 Section 8.6 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.*

***304A.3.5.12 ASCE 41 Section 10.7.1.1.** Modify ASCE 41 Section 10.7.1.1 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 Po 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 10-19 through 10-22.

***304A.3.5.13 ASCE 41 Section 10.12.3** Modify ASCE 41 Section 10.12.3 as follows:*

***Exception:** Component actions that are deformation controlled are permitted to use their expected strengths for the acceptance criteria.*

***304A.3.5.14 ASCE 41 Section 11.1.** Modify ASCE 41 Section 11.1 by the following:*

***Scope:** Unreinforced masonry walls (including unreinforced infill walls) and partitions are not permitted for General Acute Care (GAC) hospital buildings.*

***304A.3.5.15 ASCE 41 Section 14.1.** Modify ASCE 41 Section 14.1 by the following:*

***Scope:** For buildings located in Seismic Design Category F, verification of the interstory lateral displacements, the strength adequacy of the seismic force-resisting system and anchorage to the foundation shall be accomplished using the Nonlinear Dynamic Procedure.*

***304A.3.5.16 ASCE 41 Chapter 15 and 16.** Not permitted by OSHPD.*

SECTION 305*A* IN-SITU LOAD TESTS

[BS] 305*A*.1 General. Where used, in-situ load tests shall be conducted in accordance with Section 1708*A* of the *California Building Code*.

SECTION 306*A* ACCESSIBILITY FOR EXISTING BUILDINGS

306*A*.1 Scope. *Accessibility requirements for existing buildings shall comply with the California Building Code, Part 2, Volume 1, Chapter 11B.*

SECTION 307*A*–309*A*
RESERVED

SECTION 310A
COMPLIANCE ALTERNATIVES FOR SERVICES/SYSTEMS AND UTILITIES

310A.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 California Building Code Chapters 2 through 33, or Sections 302A.3 and 502A through 506A, 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 the hospital buildings 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.

310A.1.1 Services/systems and utilities. *Services/systems and utilities that are necessary to the operation of the hospital buildings 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 a conforming building 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 conforming building.

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.*

310A.1.1.1 Services/systems and utilities for hospital buildings.

310A.1.1.1.1 New hospital buildings, additions, alterations and remodels of conforming (SPC-3, -4, -4D or -5) hospital buildings. *Services/systems and utilities for new hospital buildings and additions, alterations or remodels to existing conforming buildings shall originate in hospital buildings that are conforming or have approved performance categories of SPC-3 or higher, and NPC-4/NPC-4D 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/NPC-4D or higher.*

Exceptions:

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 that could be caused by potential failure of overhead or adjacent components.

310A.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.*

310A.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.*

310A.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, of the 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 that could be caused by potential failure of overhead or adjacent components.

310A.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 310A.1.1.1.1. Services/systems and utilities for nonconforming nonacute 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 meets the performance requirements of Section 310A.1.1.1.2.*

Exception*: Service/system and utilities for acute care hospital buildings may pass through or under the buildings that have been removed from acute care service and which do not meet the performance requirements of Section 310A.1.1.1.1 or Section 310A.1.1.1.2, provided all the following are met:*

1. *The building removed from acute care service remains under the jurisdiction of OSHPD.*
2. *The service/system and utilities only support acute care services in SPC-1 or SPC-2 buildings, and where no critical care areas occur.*
3. *The SPC-1 or SPC-2 buildings supported by the service/system and utilities meet the nonstructural requirements of NPC-2, as defined in the CAC, Part 1, Article 11, Table 11.1 and are served with essential power from a conforming building or source which does not pass through or under a building removed from acute care services.*
4. *The SPC-2 buildings supported by the service/system and utilities are removed from acute care service no later than January 1, 2026.*

310A.1.2 Jurisdiction. *Services/systems and utilities 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 311A
COMPLIANCE ALTERNATIVES FOR MEANS OF EGRESS

311A.1 General. *Means of egress through existing buildings shall be in accordance with the California Building Code, except as modified in this section.*

311A.1.1 Means of egress. *Means of egress shall comply with the requirements of Sections 311A.1.1.1 and 311A.1.1.2.*

Exception: *The enforcing agency shall be permitted to exempt minor additions, minor alterations and minor remodel projects from these requirements.*

311A.1.1.1 Means of egress for hospital buildings. *Means of egress for hospital buildings shall comply with the requirements of Sections 311A.1.1.1.1 through 311A.1.1.1.6.*

311A.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 are conforming or comply with the requirements of SPC-3 or higher, and NPC-4/NPC-4D 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.*

311A.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 approved performance categories of SPC-2 or higher and NPC-4/NPC-4D 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.*

311A.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 /NPC-4D 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.*

311A.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 311A.1.1.1.2.*

311A.1.1.1.5 Other 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 hospital buildings, 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 311A.1.1.1.1 through 311A.1.1.1.4.*

311A.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 311A.1.1.1.1 or 311A.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 311A.1.1.1.2 or 311A.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.

311A.1.2 Jurisdiction. *Means of egress shall only pass through buildings that are under the jurisdiction of the Office of Statewide Health Planning and Development (OSHPD).*

SECTION 312A
REMOVAL OF HOSPITAL SPC AND FREESTANDING BUILDINGS FROM GENERAL ACUTE CARE SERVICE

312A.1 General. *The provisions of this section shall apply when hospital SPC or freestanding buildings are being removed from general acute care service, including when freestanding buildings are removed from OSHPD jurisdiction. Removal of these buildings shall satisfy the requirements of this section and the California Building Standards Code. OSHPD approval of construction documents and a building permit are required for removal.*

312A.1.1 Buildings without approved extensions. *An SPC-1 hospital building without an approved delay in compliance requirements in accordance with the California Administrative Code (CAC) Chapter 6 Section 1.5.2 or past the extension date granted in accordance with the CAC Chapter 6 Section 1.5.2 shall not be issued a building permit until a project to remove the subject SPC-1 building from general acute care services has been approved, permitted and closed in compliance by the Office.*

Exception: *Building permits for seismic compliance, maintenance and repair shall be permitted to be issued.*

312A.2 Definitions. *The following words and terms are applicable to this section only:*

BUILDING. *The area included within surrounding exterior walls or any combination of exterior walls and fire walls (as described in California Building Code Sections 202 and 706) exclusive of vent shafts and courts. Areas of the building not provided with surrounding walls shall be included in the building area if such areas are included within the horizontal projection of the roof or floor above. A building may consist of one or more adjacent SPC buildings.*

GENERAL ACUTE CARE SERVICE. *Means basic and supplemental services, as defined in California Building Code Section 1224.3, provided in a general acute care building, as defined in California Building Code Section 202 and the California Administrative Code, Chapter 6, Section 1.2.*

STRUCTURAL SEPARATION. *Means a building separation in accordance with the California Building Code.*

312A.3 Establishing eligibility for removal from general acute care service. *In order to establish that one or more SPC buildings are eligible for removal from general acute care service, the hospital owner shall submit construction documents showing that after the SPC buildings are removed from general acute care service:*

1. *All basic acute care services or supplemental services on the hospital's license are provided in SPC buildings satisfying the requirements for SPC-2, SPC-3, SPC-4, SPC-4D or SPC-5.*

   Exception: *If the hospital includes SPC-1 buildings that are not being removed from general acute care service, and these SPC-1 buildings have an approved extension to the SPC-2 deadline, basic acute care services or supplemental services on the hospital's license are permitted to remain in these SPC buildings for the duration of their extension or until these SPC-1 buildings are removed from general acute care service, whichever comes first.*

2. *All basic acute care services or supplemental services on the hospital's license are provided in SPC buildings satisfying the requirements for NPC-3, NPC-4/NPC-4D or NPC-5.*

   Exception: *Services shall be permitted to be located in SPC buildings satisfying the requirements of NPC-2 if the SPC buildings have an approved extension to NPC-3 deadline.*

3. *The hospital complies with all egress requirements, including occupant load, number of required exits and travel distance to exits, and provides evidence that no egress from any acute care hospital building passes*

through the SPC buildings removed from general acute care service, SPC-1 buildings, or through buildings not under OSHPD jurisdiction.

Exceptions:

1. *If the SPC building has an approved extension to the SPC-2 deadline, existing egress through the SPC-1 building shall be permitted for the duration of the extension or until the SPC-1 building is removed from general acute care service, whichever comes first.*
2. *When permitted by Section 311A.1.1.1.6.*

4. *No SPC building removed from general acute care service is used as a smoke compartment for any acute care hospital building. Buildings not under OSHPD jurisdiction shall not be used as a smoke compartment for any acute care hospital building.*
5. *Structural separation, fire barriers and fire walls shall satisfy the requirements of the California Building Standards Code.*

   Exception: *An SPC seismic separation in accordance with the California Administrative Code Chapter 6 Section 3.4 shall be deemed to satisfy the building structural/seismic separation requirement in this section for SPC buildings that will remain under OSHPD jurisdiction.*
6. *If the SPC building removed from general acute care service shares a common fire alarm system with the acute care hospital, the main fire alarm control panel shall be located in an acute care hospital building. The SPC building removed from general acute care service shall be in a separate zone monitored by the main fire alarm control panel. Flexible connections shall be provided for conduits/conductors crossing structural or SPC seismic separation joints. If the intent is to place the SPC building under local jurisdiction, the building shall satisfy Section 312A.5.1.*

   Exception: *Flexible connections for fire alarm conduits/conductors crossing seismic separation joints between an SPC building removed from general acute care service and adjacent SPC-1 or SPC-2 buildings may be omitted, provided the fire alarm in the adjacent SPC-1 and SPC-2 buildings have no connection to any SPC-3, SPC-4, SPC-4D and SPC-5 buildings providing general acute care service.*
7. *If the SPC building removed from general acute care service shares the fire sprinkler system with the acute care hospital, an isolation valve with a tamper switch shall be provided to isolate the portion of the system serving the SPC building removed from acute care service. Flexible connections shall be provided in piping that crosses structural or SPC seismic separation joints. The fire sprinkler system shall not originate in the SPC building removed from general acute care service. If the intent is to place the building under local jurisdiction, the building shall satisfy Section 312A.5.1.*

   Exception: *Flexible connections for seismic separation joints and fail safe shutoff valves, and disconnects for utilities between an SPC building removed from general acute care service and adjacent SPC-1 or SPC-2 buildings may be omitted, provided utilities in the adjacent SPC-1 and SPC-2 buildings have no connection to any SPC-3, SPC-4, SPC-4D and SPC-5 buildings providing general acute care service.*
8. *Patient access as required by California Building Code Section 1224.4.7.5 does not pass through an SPC building removed from general acute care service or through buildings that are not under the jurisdiction of OSHPD.*
9. *The primary accessible entrance to the hospital is not through an SPC building removed from general acute care service or through buildings that are not under the jurisdiction of OSHPD.*
10. *No utilities servicing acute care hospital buildings originate in or pass through, over or under, an SPC building removed from general acute care service, except as permitted by Section 310A.1.1.1.5, or a building not under OSHPD jurisdiction.*
11. *If utilities originating in an acute care hospital building feed an SPC building removed from general acute care hospital service, fail safe shutoff valves and/or disconnects shall be provided that permit isolation of the SPC building removed from general acute care service from the hospital utilities. Flexible connections shall be provided for all utilities crossing structural or SPC seismic separation joints.*

    Exception: *Flexible connections for seismic separation joints and fail safe shutoff valves, and disconnects for utilities between an SPC building removed from general acute care service and adjacent SPC-1 or SPC-2 buildings may be omitted, provided utilities in the adjacent SPC-1 and SPC-2 buildings have no connection to any SPC-3, SPC-4, SPC-4D and SPC-5 buildings providing general acute care service.*

312A.4 Buildings remaining under OSHPD jurisdiction. *SPC and freestanding buildings removed from acute care service while remaining under the jurisdiction of OSHPD shall be subject to the provisions of Section 312.3.*

312A.5 Change in jurisdiction for buildings removed from general acute care service. *Except as provided by Section 312A.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 312A.5.1.*

312A.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 & 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.

***312A.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, setback and allowable area requirements shall be enforced.*

***312A.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 which 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.

***312A.6 Vacated space.** Vacated spaces intended to remain vacant while under the jurisdiction of OSHPD shall be subject to the provisions of Section 312.3.5.*

***312A.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 the OSHPD's jurisdiction. Demolition shall be in accordance with California Building Code Section 3303.*

SECTION 313A
EARTHQUAKE MONITORING INSTRUMENTS FOR EXISTING BUILDINGS

***313.A.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.*

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 4 – REPAIRS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter													**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**		**X**																				
Chapter / Section																							
401.1			X								X	X		X	X								
401.1.2	X																						
401.2			X																				
401.3	X																						
402			X																				
402.2				X	X																		
402.3				X	X																		
403			X																				
404			X																				
405.2.1 – 405.2.5				†	†																		
405.2.3.1			X																				
405.2.6	X																						
406											†	†		†	†								
407.1				X	X																		
408.1				X	X																		
408.2				X	X																		
408.3				†	†																		

The state agency does not adopt sections identified with the following symbol: †

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 4

REPAIRS

User note:

About this chapter: *Chapter 4 provides requirements for repairs of existing buildings. The provisions define conditions under which repairs may be made using materials and methods like those of the original construction or the extent to which repairs must comply with requirements for new buildings.*

SECTION 401
GENERAL

401.1 Scope. Repairs shall comply with the requirements of this division. Repair to historic buildings need only comply with Chapter 12 of the CEBC. [OSHPD 1R, 2, 4, & 5] repairs to historic buildings not adopted by OSHPD shall comply with the requirements in the *California Building Code*, Sections 1224.2, 1225.2, 1226.2, 1227.2 and 1228.2 for functional requirements. In addition to the requirements of the CEBC, existing buildings and structures shall comply with the applicable regulations of Chapters 81, 82, 83, 84, 85, 86, 88, 89, 91, 93, 95 and 97 of the *Los Angeles Building Code* (LABC), Appendix A Chapters A1 and A2 of the LAEBC, and the voluntary earthquake hazard reduction standards of Divisions 92, 94 and 96 of the LABC.

401.1.1 Bleachers, grandstands and folding and telescopic seating. Repairs to existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

401.1.2 Scope. [BSC] *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 405.2.1 and 405.2.3 are replaced by the requirements of Sections 317 through 322.*

401.2 Compliance. The work shall not make the building less complying than it was before the repair was undertaken.

[BS] 401.3 Flood hazard areas. In flood hazard areas, repairs that constitute substantial improvement shall require that the building comply with Section 1612 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable.

SECTION 402
BUILDING ELEMENTS AND MATERIALS

402.1 Glazing in hazardous locations. Replacement glazing in hazardous locations shall comply with the safety glazing requirements of the *California Building Code* or *California Residential Code* as applicable.

Exception: Glass block walls, louvered windows and jalousies repaired with like materials.

402.2 Existing materials. [HCD] *Existing materials shall comply with Section 302.3.*

402.3 New and replacement materials. [HCD & HCD 2] *New and replacement materials used for repairs shall comply with Section 302.4.*

SECTION 403
FIRE PROTECTION

403.1 General. Repairs shall be done in a manner that maintains the level of fire protection provided.

SECTION 404
MEANS OF EGRESS

404.1 General. Repairs shall be done in a manner that maintains the level of protection provided for the means of egress.

SECTION 405
STRUCTURAL

[BS] 405.1 General. Structural repairs shall be in compliance with this section and Section 401.2.

[BS] 405.2 Repairs to damaged buildings. Repairs to damaged buildings shall comply with this section.

[BS] 405.2.1 Repairs for less than substantial structural damage. Unless otherwise required by this section, for damage less than substantial structural damage, the damaged elements shall be permitted to be restored to their predamage condition.

[BS] 405.2.1.1 Snow damage. Structural components whose damage was caused by or related to snow load effects shall be repaired, replaced or altered to satisfy the requirements of Section 1608 of the *California Building Code*.

[BS] 405.2.2 Disproportionate earthquake damage. A building assigned to Seismic Design Category D, E or F that has sustained disproportionate earthquake damage shall be subject to the requirements for buildings with substantial structural damage to vertical elements of the lateral force-resisting system.

[BS] 405.2.3 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 in accordance with Section 405.2.3.1, and either repaired in accordance with Section 405.2.3.2 or repaired and retrofitted in accordance with Section 405.2.3.3, depending on the results of the evaluation.

Exceptions:

1. Buildings assigned to Seismic Design Category A, B or C whose substantial structural damage was not caused by earthquake need not be evaluated or retrofitted for load combinations that include earthquake effects.
2. One- and two-family dwellings need not be evaluated or retrofitted for load combinations that include earthquake effects.

[BS] 405.2.3.1 Evaluation. The building shall be evaluated by a registered design professional, and the evaluation findings shall be submitted to the code official. The evaluation shall establish whether the damaged building, if repaired to its predamage state, would comply with the provisions of the *California Building Code* for load combinations that include wind or earthquake effects, except that the seismic forces shall be the reduced seismic forces.

[BS] 405.2.3.2 Extent of repair for compliant buildings. If the evaluation establishes that the building in its predamage condition complies with the provisions of Section 405.2.3.1, then the damaged elements shall be permitted to be restored to their predamage condition.

[BS] 405.2.3.3 Extent of repair for noncompliant buildings. If the evaluation does not establish that the building in its predamage condition complies with the provisions of Section 405.2.3.1, then the building shall be retrofitted to comply with the provisions of this section. The wind loads for the repair and retrofit shall be those 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 in accordance with the *California Building Code*. The seismic loads for this retrofit design shall be those required by the building code in effect at the time of original construction, but not less than the reduced seismic forces.

[BS] 405.2.4 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 for dead, live and snow loads in the *California Building Code*. Undamaged gravity load-carrying components that receive dead, live or snow loads from rehabilitated components shall also be rehabilitated if required to comply with the design loads of the rehabilitation design.

[BS] 405.2.4.1 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 seismic effects, then the building shall be evaluated in accordance with Section 405.2.3.1 and, if noncompliant, retrofitted in accordance with Section 405.2.3.3.

Exceptions:

1. Buildings assigned to Seismic Design Category A, B or C whose substantial structural damage was not caused by earthquake need not be evaluated or retrofitted for load combinations that include earthquake effects.
2. One- and two-family dwellings need not be evaluated or retrofitted for load combinations that include earthquake effects.

[BS] 405.2.5 Substantial structural damage to snow load-carrying components. Where substantial structural damage to any snow load-carrying components is caused by or related to snow load effects, any components required to carry snow loads on roof framing of similar construction shall be repaired, replaced or retrofitted to satisfy the requirements of Section 1608 of the *California Building Code*.

[BS] 405.2.6 Flood hazard areas. In flood hazard areas, buildings that have sustained substantial damage shall be brought into compliance with Section 1612 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable.

SECTION 406
ELECTRICAL

***[OSHPD 1R, 2, 4 & 5]** Not adopted by OSHPD. Existing electrical wiring and equipment undergoing repair shall be in accordance with Title 24 Part 3 California Electrical Code (CEC).*

406.1 Material. Existing electrical wiring and equipment undergoing repair shall be allowed to be repaired or replaced with like material.

406.1.1 Receptacles. Replacement of electrical receptacles shall comply with the applicable requirements of Section 406.4(D) of the *California Electrical Code*.

406.1.2 Plug fuses. Plug fuses of the Edison-base type shall be used for replacements only where there is no evidence of over fusing or tampering per applicable requirements of Section 240.51(B) of the *California Electrical Code*.

406.1.3 Nongrounding-type receptacles. For replacement of nongrounding-type receptacles with grounding-type receptacles and for branch circuits that do not have an equipment grounding conductor in the branch circuitry, the grounding conductor of a grounding-type receptacle outlet shall be permitted to be grounded to any accessible point on the grounding electrode system or to any accessible point on the grounding electrode conductor in accordance with Section 250.130(C) of the *California Electrical Code*.

406.1.4 Health care facilities. Portions of electrical systems being repaired in Group I-2, ambulatory care facilities and outpatient clinics shall comply with NFPA 99 requirements for repairs.

406.1.5 Grounding of appliances. Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers and outlet or junction boxes that are part of the existing branch circuit for these appliances shall be permitted to be grounded to the grounded circuit conductor in accordance with Section 250.140 of the *California Electrical Code*.

SECTION 407
MECHANICAL

407.1 General. Existing mechanical systems undergoing repair shall not make the building less complying than it was before the damaged occurred. ***[HCD 1 & HCD 2]*** *Existing mechanical systems undergoing repair shall comply with the California Mechanical Code.*

SECTION 408
PLUMBING

408.1 Materials. Plumbing materials and supplies shall not be used for *repairs* that are prohibited in the *California Plumbing Code*. ***[HCD 1 & HCD 2]*** *Existing plumbing systems undergoing repair shall comply with the California Plumbing Code and Division 4.3 of the CALGreen Code, as applicable.*

408.2 Water closet replacement. The maximum water consumption flow rates and quantities for all replaced water closets shall be *1.28 gallons (4.8 L)* per flushing cycle.

408.3 Health care facilities. Portions of medical gas systems being repaired in Group I-2, ambulatory care facilities and outpatient clinics shall comply with NFPA 99 requirements for repairs.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 4*A* – REPAIRS [OSHPD 1]

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter										X													
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 4*A*

REPAIRS

User note:

About this chapter: *Chapter 4 provides requirements for repairs of existing buildings. The provisions define conditions under which repairs may be made using materials and methods like those of the original construction or the extent to which repairs must comply with requirements for new buildings.*

SECTION 401*A*
GENERAL

401*A*.1 Scope. Repairs shall comply with the requirements of this chapter. *The provisions of this chapter shall apply to existing structures for applications listed in Section 1.10.1 [OSHPD 1] regulated by the Office of Statewide Health Planning and Development (OSHPD).*

401*A*.1.1 Bleachers, grandstands and folding and telescopic seating. Repairs to existing bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

401A.2 Compliance. The work shall not make the building less complying than it was before the repair was undertaken.

[BS] 401*A*.3 Flood hazard areas. *For buildings and structures in flood hazard areas established in California Building Code Section 1612A.3, any repair that constitutes substantial improvement of the existing structure, as defined in Chapter 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 California Building Code Section 1612A.3, any repairs that do not constitute substantial improvement or repair of substantial damage of the existing structure, as defined in Chapter 2, are not required to comply with the flood design requirements for new construction.

SECTION 402*A*
BUILDING ELEMENTS AND MATERIALS

402*A*.1 *Glass replacement.* *The installation or replacement of glass shall be as required for new installations in accordance with the California Building Code.*

SECTION 403*A*
FIRE PROTECTION

403*A*.1 General. *Fire protection shall comply with the California Building Standards Code.*

SECTION 404*A*
MEANS OF EGRESS

404*A*.1 General. Repairs shall be done in a manner that maintains the level of protection provided for the means of egress.

SECTION 405*A*
STRUCTURAL

[BS] 405*A*.1 General. *Buildings and structures, and parts thereof, shall be repaired in conformance with Section 405A.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 Chapter 5A. Routine maintenance required by Chapter 3A, ordinary repairs exempt from permit in accordance with California Building Code Section 105.2, and abatement of wear due to normal service conditions shall not be subject to the requirements for repairs in this section.*

[BS] 405*A*.2 Repairs to damaged buildings. Repairs to damaged buildings shall comply with this section.

[BS] 405*A*.2.1 Repairs for less than substantial structural damage. *For damage less than substantial structural damage, repairs shall be allowed that restore the building to its predamage state. 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.*

[BS] 405*A*.2.1.1 Snow damage. Structural components whose damage was caused by or related to snow load effects shall be repaired, replaced or altered to satisfy the requirements of Section 1608 of the *California Building Code*.

[BS] 405*A*.2.2 Disproportionate earthquake damage. A building assigned to Seismic Design Category D, E or F that has sustained disproportionate earthquake damage shall be subject to the requirements for buildings with substantial structural damage to vertical elements of the lateral force-resisting system.

[BS] 405*A*.2.3 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 405A.2.3.1 through 405A.2.3.3.*

[BS] 405*A*.2.3.1 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 predamage state, would comply with the provisions of this code for wind and earthquake loads. Wind loads for this evaluation shall be those prescribed in California Building Code Section 1609A. Earthquake loads for this evaluation, if required, shall be permitted to be 75 percent of those prescribed in California Building Code Section 1613A. Alternatively, where the earthquake damage has not resulted in disproportionate earthquake damage or did not result in collapse, the earthquake load evaluation shall be permitted to be performed in accordance with Section 304A.3.4.4 for SPC-2 buildings and Section 304A.3.4.5 for buildings rated SPC-3, SPC-4D and SPC-4. SPC-5 buildings shall be evaluated in accordance with Section 304A.3.4.6, except that the seismic hazard may be reduced to BSE-1E and BSE-2E.*

[BS] 405*A*.2.3.2 Extent of repair for compliant buildings. If the evaluation establishes that the building in its predamage condition complies with the provisions of Section 405.2.3.1, then the damaged elements shall be permitted to be restored to their predamage condition.

[BS] 405*A*.2.3.3 Extent of repair for noncompliant buildings. *If the evaluation does not establish compliance of the predamage building in accordance with Section 405A2.3.1, 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 this code. Earthquake loads for this rehabilitation design shall be those required for the design of the predamage building, but not less than 90 percent of those prescribed in California Building Code Section 1613A. Alternatively, where the earthquake damage has not resulted in disproportionate earthquake damage or did not result in collapse, the rehabilitation design shall be permitted to be performed in accordance with Section 304A.3.4.4 for SPC-2 buildings, Section 304A.3.4.5 for SPC-3, SPC-4D and SPC-4 buildings and Section 304A.3.4.6 for SPC-5 buildings. For SPC-5 buildings, the seismic hazard may be reduced to BSE-1E and BSE-2E. Use of Section 304A.3.4.5 to rehabilitate SPC-3, SPC-4D and SPC-4 buildings will result in re-classification of the building to SPC-4D. Noncompliant SPC-4 buildings may be rehabilitated to SPC-5 in accordance with Section 304A.3.4.6 using the reduced seismic hazard. 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.*

[BS] 405*A*.2.4 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. If the approved live load is less than that required by California Building Code Section 1607A, the area designed for the nonconforming live load shall be posted with placards of approved design, indicating the approved live load. 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.*

[BS] 405*A*.2.4.1 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 seismic effects, then the building shall be evaluated in accordance with Section 405*A*.2.3.1 and, if noncompliant, *rehabilitated* in accordance with Section 405*A*.2.3.3.

[BS] 405*A*.2.5 Substantial structural damage to snow load-carrying components. Where substantial structural damage to any snow load-carrying components is caused by or related to snow load effects, any components required to carry snow loads on roof framing of similar construction shall be repaired, replaced or retrofitted to satisfy the requirements of Section 1608 of the *California Building Code*.

[BS] 405*A*.2.6 Flood hazard areas. *For buildings and structures in flood hazard areas established in Section 1612A.3, any repair that constitutes substantial improvement of the existing structure, as defined in Chapter 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 California Building Code Section 1612A.3, any repairs that do not constitute substantial improvement or repair of substantial damage of the existing structure, as defined in Chapter 2, are not required to comply with the flood design requirements for new construction.

SECTION 406*A* ELECTRICAL

406*A*.1 *General.* *Existing electrical wiring and equipment undergoing repair shall be in accordance with Title 24 Part 3 California Electrical Code (CEC).*

SECTION 407*A* MECHANICAL

407*A*.1 General. Existing mechanical systems undergoing *repair* shall not make the building less complying than it was before the damaged occurred.

SECTION 408*A* PLUMBING

408*A*.1 Materials. Plumbing materials and supplies shall not be used for *repairs* that are prohibited in the *Title 24 Part 5 California Plumbing Code (CPC).*

408*A*.2 Water closet replacement. The maximum water consumption flow rates and quantities for all replaced water closets shall be *1.28* gallons (*4.8* L) per flushing cycle.

> **Exception:** Blowout-design water closets [3.5 gallons (13 L) per flushing cycle].

408*A*.3 Health care facilities. Portions of medical gas systems being repaired in Group I-2, ambulatory care *facilities* and outpatient clinics shall comply with NFPA 99 requirements for repairs.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 5 – PRESCRIPTIVE COMPLIANCE METHOD

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter													X										
Adopt Entire Chapter as amended (amended sections listed below)				X	X	X																	
Adopt only those sections that are listed below	X		X					X	X		X	X		X	X								
Chapter / Section																							
501											X	X		X	X								
501.1	X			X																			
501.1 *Exception 1*					X																		
501.1 *Exception 2*				X																			
501.1.1 – 501.5.1			X																				
501.1.2	X																						
501.3				†	†	†																	
501.5			X	X																			
502											X	X		X	X								
502.1 *Exception*	X																						
502.3	X																						
502.4	X																						
502.6				†	†	†																	
503											X	X		X	X								
503.1	X																						
503.2	X																						
503.3	X							X	X														
503.14			X	†	†	†																	
503.15			X																				
503.16				†	†	†																	
503.17			X	†	†	†																	
504			X	†	†	†					X	X		X	X								
505			X								X	X		X	X								
505.2				X	X																		
506			X								X	X		X	X								
506.1	X																						
506.1.1	X																						
506.2	X																						
506.3	X																						
506.4 *Exception*	X																						
506.6				†	†	†																	
507				†	†	†																	

The state agency does not adopt sections identified with the following symbol: †

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 5

PRESCRIPTIVE COMPLIANCE METHOD

User note:

About this chapter: *Chapter 5 provides details for the prescriptive compliance method—one of the three main options of compliance available in this code for buildings and structures undergoing alteration, addition or change of occupancy.*

SECTION 501 GENERAL

501.1 Scope. The provisions of this Chapter shall control the alternation, addition and change of occupancy of existing buildings and structures, [BSC] including state-regulated structures in accordance with Section 501.1.2. In addition to the requirements of the CEBC, existing buildings and structures shall comply with the applicable regulations of Divisions 81, 82, 83, 84, 85, 86, 88, 89, 91, 93, 95 and 97 of the *Los Angeles Building Code* (LABC), Appendix A Chapters A1 and A2 of the LAEBC, and the voluntary earthquake hazard reduction standards of Divisions 92, 94 and 96 of the LABC.

Exceptions:

1. ***[HCD 2]*** *For relocated or 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.*
2. ***[HCD 1]*** *Limited-density owner-built rural dwellings.*

[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.*

501.1.1 Compliance with other methods. Alterations, additions and changes of occupancy to existing buildings and structures shall comply with the provisions of this chapter or with one of the methods provided in Section 301.3.

501.1.2 Existing state-owned structures. [BSC] *The provisions of Sections 317 through 322 establish minimum standards for earthquake evaluation and design for retrofit of existing state-owned structures, including buildings owned by the University of California, the California State University and the Judicial Council.*

The provisions of Sections 317 through 322 may be adopted by a local jurisdiction for earthquake evaluation and design for retrofit of existing buildings.

501.2 Fire-resistance ratings. Where approved by the code official, in buildings where an automatic sprinkler system installed in accordance with Section 903.3.1.1 or 903.3.1.2 of the *California Building Code* has been added, and the building is now sprinklered throughout, the required fire-resistance ratings of building elements and materials shall be permitted to meet the requirements of the current building code. The building is required to meet the other applicable requirements of the *California Building Code*.

Plans, investigation and evaluation reports, and other data shall be submitted indicating which building elements and materials the applicant is requesting the code official to review and approve for determination of applying the current building code fire-resistance ratings. Any special construction features, including fire-resistance-rated assemblies and smoke-resistive assemblies, conditions of occupancy, means of egress conditions, fire code deficiencies, approved modifications or approved alternative materials, design and methods of construction, and equipment applying to the building that impact required fire-resistance ratings shall be identified in the evaluation reports submitted.

501.3 Health care facilities. In Group I-2 facilities, ambulatory care facilities and outpatient clinics, any altered or added portion of an existing electrical or medical gas systems shall be required to meet installation and equipment requirements in NFPA 99.

501.4 Existing Group R occupancies. [SFM] *See the California Residential Code for existing Group R-3 occupancies or Chapter 11 of the California Fire Code for all other existing Group R occupancies.*

501.5 Carbon monoxide alarms. [HCD 1, SFM] *Pursuant to Health and Safety Code Section 17926, carbon monoxide detection shall be provided in all existing Group R buildings, as required in Section 915 of the California Building Code or Section R315 of the California Residential Code, as applicable.*

501.5.1 Carbon monoxide detection in alterations to an existing Group E building. *Where the alteration adds any of the conditions identified in the California Fire Code Sections 915.1.2 through 915.1.6 to an existing Group E building, not previously required to be provided with carbon monoxide detection, new carbon monoxide detection shall be installed in accordance with Section 915 of the California Fire Code.*

Exceptions:

1. *The alteration replaces an existing fossil-fuel burning appliance, fireplace or forced-air fur-*

nace, or any of the conditions identified in Sections 915.1.2 through 9151.6 are already present.

2. *The Group E building was constructed before the adoption of the 2016 California Building Standards Code.*

SECTION 502 ADDITIONS

502.1 General. ***[BSC & HCD]*** Additions to any building or structure shall comply with the requirements of the *California Building Code or California Residential Code, as applicable*, 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 not less complying with the provisions of the *California Building 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 of the *California Building Code or the height provisions of Chapter 3 of the California Residential Code, as applicable.*

Exception: [BSC] *For state-owned buildings, including those owned by the University of California and the California State University and the Judicial Council, the requirements of Section 502.5 are replaced by the requirements of Sections 317 through 322.*

[BS] 502.2 Disproportionate earthquake damage. A building assigned to Seismic Design Category D, E or F that has sustained disproportionate earthquake damage shall be subject to the requirements for buildings with substantial structural damage to vertical elements of the lateral force-resisting system.

[BS] 502.3 Flood hazard areas. For buildings and structures in flood hazard areas established in Section 1612.3 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, any addition that constitutes substantial improvement of the existing structure 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 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, any additions that do not constitute substantial improvement of the existing structure are not required to comply with the flood design requirements for new construction.

[BS] 502.4 Existing structural elements carrying gravity load. Any existing gravity load-carrying structural element for which an addition and its related alterations cause an increase in design dead, live or snow load, including snow drift effects, of more than 5 percent shall be replaced or altered as needed to carry the gravity loads required by the *California Building Code* for new structures. Any existing gravity load-carrying structural element whose vertical load-carrying capacity is decreased as part of the addition and its related alterations shall be considered to be an altered element subject to the requirements of Section 503.3. Any existing element that will form part of the lateral load path for any part of the addition shall be considered to be an existing lateral load-carrying structural element subject to the requirements of Section 502.5.

Exception: Buildings of Group R occupancy with not more than five dwelling or sleeping units used solely for residential purposes where the existing building and the addition together comply with the conventional light-frame construction methods of the *California Building Code* or the provisions of the *California Residential Code*.

502.5 Existing structural elements carrying lateral load. Where the addition is structurally independent of the existing structure, existing lateral load-carrying structural elements shall be permitted to remain unaltered. Where the addition is not structurally independent of the existing structure, the existing structure and its addition acting together as a single structure shall be shown to meet the requirements of Sections 1609 and 1613 of the *California Building Code* using full seismic forces. For purposes of CEBC Section 502, compliance with ASCE 41, using a Tier 3 procedure and the two-level performance objective in CEBC Table 303.3.1 for the applicable risk category, shall be deemed to meet the requirements of CBC Section 1613, with procedures established by the Department.

Exceptions:

1. Except for Unreinforced Masonry (URM) Buildings:

   Any existing lateral load-carrying structural element whose demand-capacity ratio with the addition considered is no more than 10 percent greater than its demand-capacity ratio with the addition 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 in accordance with CBC Sections 1609 and 1613. For purposes of this exception, comparisons of demand-capacity ratios and calculations of design lateral loads, forces and capacities shall account for the cumulative effects of additions and alterations since original construction.

   The additions do not create structural irregularity as defined in ASCE 7 or make an existing structural irregularity more severe.

2. Unreinforced Masonry (URM) Buildings:

   Any existing lateral load-carrying structural element on an unreinforced masonry building whose demand-capacity ratio with the addition considered less than 10 percent greater than its demand-capacity ratio with the addition, must comply with CEBC Appendix Chapter A1. When the demand-capacity ratio with the addition considered is 10 percent or greater than its demand-capacity ratio with the addition ignored, shall be designed per Chapter 16 of the LABC.

502.6 Enhanced classroom acoustics. In Group E occupancies, enhanced classroom acoustics shall be provided in all classrooms in the addition with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

SECTION 503
ALTERATIONS

503.1 General. Alterations to any building or structure shall comply with the requirements of the *California Building Code or California Residential Code, as applicable,* for new construction. Alterations shall be such that the existing building or structure is not less complying with the provisions of the *California Building Code or California Residential Code, as applicable,* than the existing building or structure was prior to the alteration.

Exceptions:

1. An existing stairway shall not be required to comply with the requirements of Section 1011 of the *California Building Code* where the existing space and construction does not allow a reduction in pitch or slope.
2. Handrails otherwise required to comply with Section 1011.11 of the *California Building Code* shall not be required to comply with the requirements of Section 1014.6 of the *California Building Code* regarding full extension of the handrails where such extensions would be hazardous because of plan configuration.
3. Where provided in below-grade transportation stations, existing and new escalators shall be permitted to have a clear width of less than 32 inches (815 mm).
4. ***[BSC]*** *For state-owned buildings, including those owned by the University of California and the California State University and the judicial council, the requirements of Section 503.4 are replaced by the requirements of Sections 317 through 322.*

[BS] 503.2 Flood hazard areas. For buildings and structures in flood hazard areas established in Section 1612.3 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, any alteration that constitutes substantial improvement of the existing structure 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 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, any alterations that do not constitute substantial improvement of the existing structure are not required to comply with the flood design requirements for new construction.

[BS] 503.3 Existing structural elements carrying gravity load. Any existing gravity load-carrying structural element for which an alteration causes an increase in design dead, live or snow load, including snow drift effects, of more than 5 percent shall be replaced or altered as needed to carry the gravity loads required by the *California Building 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 dead, live and snow loads including snow drift effects required by the *California Building Code* for new structures.

Exceptions:

1. Buildings of Group R occupancy with not more than five dwelling or sleeping units used solely for residential purposes where the altered building complies with the conventional light-frame construction methods of the *California Building Code* or the provisions of the *California Residential Code*.
2. Buildings in which the increased dead load is due entirely to the addition of a second layer of roof covering weighing 3 pounds per square foot (0.1437 kN/m^2) or less over an existing single layer of roof covering ***[DSA-SS, DSA-SS/CC]*** *Exception 2 is not permitted*.

503.4 Existing structural elements carrying lateral load. Except as permitted by CEBC Section 503.13, where the alteration increases design lateral loads in accordance with CBC Section 1609 or 1613, or where the alteration results in a prohibited 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 CBC Sections 1609 and 1613. Reduced seismic loads shall be permitted providing the reduced seismic load is not less than the original building permitted seismic loads. For purposes of CEBC Section 503, compliance with ASCE 41, using the performance objective in CEBC Table 303.3.1 for the applicable risk category, shall be deemed to meet the requirements of CBC Section 1613, and using the performance objective in CEBC Table 303.3.2 for the applicable risk category, shall be deemed to meet the requirements of reduced seismic loads, with procedures established by the Department.

Exceptions:

1. Except for Unreinforced Masonry Buildings (URM):

   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 in accordance with CBC Sections 1609 and 1613. Reduced seismic forces shall be permitted. For purposes of this exception, comparisons of demand-capacity ratios and calculations of design lateral loads, forces and capacities shall account for the cumulative effects of additions and alterations since original construction.

The alternations do not create structural irregularity as defined in ASCE 7 or make an existing structural irregularity more severe.

2. Unreinforced Masonry (URM) Buildings:

   Any existing lateral load-carrying structural element on an URM building whose demand-capacity ratio with the alteration considered is less than 10 percent greater than its demand-capacity ratio with the alteration, it shall comply with CEBC Appendix Chapter A1. When the demand-capacity ratio with the alteration considered is 10 percent or greater than its demand-capacity ratio with the alteration ignored, the lateral load-carrying structural element(s) shall be designed per Chapter 16 of the LABC.

   Structural analysis per CEBC Appendix Chapter A1 is required for any alterations to cross walls or diaphragms.

[BS] 503.5 Seismic Design Category F. Where the work area exceeds 50 percent of the building area, and where the building is assigned to Seismic Design Category F, the structure of the altered building shall meet the requirements of Sections 1609 and 1613 of the *California Building Code*. Reduced seismic forces shall be permitted.

[BS] 503.6 Bracing for unreinforced masonry parapets on reroofing. Where the intended alteration requires a permit for reroofing and involves removal of roofing materials from more than 25 percent of the roof area of a building assigned to Seismic Design Category D, E or F that has parapets constructed of unreinforced masonry, the work shall include installation of parapet bracing to resist out-of-plane seismic forces, unless an evaluation demonstrates compliance of such items. Reduced seismic forces shall be permitted.

[BS] 503.7 Anchorage for concrete and reinforced masonry walls. Where the work area exceeds 50 percent of the building area, the building is assigned to Seismic Design Category C, D, E or F and the building's structural system includes concrete or reinforced masonry walls with a flexible roof diaphragm, the alteration work shall include installation of wall anchors at the roof line, unless an evaluation demonstrates compliance of existing wall anchorage. Use of reduced seismic forces shall be permitted.

[BS] 503.8 Anchorage for unreinforced masonry walls in major alterations. Where the work area exceeds 50 percent of the building area, the building is assigned to Seismic Design Category C, D, E or F and the building's structural system includes unreinforced masonry bearing walls, the alteration work shall include installation of wall anchors at the floor and roof lines, unless an evaluation demonstrates compliance of existing wall anchorage. Reduced seismic forces shall be permitted.

[BS] 503.9 Bracing for unreinforced masonry parapets in major alterations. Where the work area exceeds 50 percent of the building area, and where the building is assigned to Seismic Design Category C, D, E or F, parapets constructed of unreinforced masonry shall have bracing installed as needed to resist out-of-plane seismic forces, unless an evaluation demonstrates compliance of such items. Reduced seismic forces shall be permitted.

[BS] 503.10 Anchorage of unreinforced masonry partitions in major alterations. Where the work area exceeds 50 percent of the building area, and where the building is assigned to Seismic Design Category C, D, E or F, unreinforced masonry partitions and nonstructural walls within the work area and adjacent to egress paths from the work area shall be anchored, removed or altered to resist out-of-plane seismic forces, unless an evaluation demonstrates compliance of such items. Use of reduced seismic forces shall be permitted.

[BS] 503.11 Substantial structural alteration. Where the work area exceeds 50 percent of the building area and where work involves a substantial structural alteration, the lateral load-resisting system of the altered building shall satisfy the requirements of Sections 1609 and 1613 of the *California Building Code*. Reduced seismic forces shall be permitted.

Exceptions:

1. Buildings of Group R occupancy with not more than five dwelling or sleeping units used solely for residential purposes that are altered based on the conventional light-frame construction methods of the *California Building Code* or in compliance with the provisions of the *California Residential Code*.
2. Where the intended alteration involves only the lowest story of a building, only the lateral load-resisting components in and below that story need comply with this section.

[BS] 503.12 Roof diaphragms resisting wind loads in high-wind regions. Where the intended alteration requires a permit for reroofing and involves removal of roofing materials from more than 50 percent of the roof diaphragm of a building or section of a building located where the ultimate design wind speed is greater than 130 mph (58 m/s) in accordance with Figure 1609.3(1) of the *California Building Code*, roof diaphragms, connections of the roof diaphragm to roof framing members, and roof-to-wall connections shall be evaluated for the wind loads specified in Section 1609 of the *California Building Code*, including wind uplift. If the diaphragms and connections in their current condition are not capable of resisting 75 percent of those wind loads, they shall be replaced or strengthened in *California* with the loads specified in Section 1609 of the *California Building Code*.

Exception: Buildings that have been demonstrated to comply with the wind load provisions in ASCE 7-88 or later editions.

[BS] 503.13 Voluntary lateral force-resisting system alterations. Structural alterations that are intended exclusively to improve the lateral force-resisting system and are not required by other sections of this code shall not be required to meet the requirements of Section 1609 or 1613 of the *California Building Code*, provided that all of the following apply:

1. The capacity of existing structural systems to resist forces is not reduced.

2. New structural elements are detailed and connected to existing or new structural elements as required by the *California Building Code* for new construction.
3. New or relocated nonstructural elements are detailed and connected to existing or new structural elements as required by the *California Building Code* for new construction.
4. The alterations do not create a structural irregularity as defined in ASCE 7 or make an existing structural irregularity more severe.

503.14 Smoke compartments. In Group I-2 occupancies where the alteration is on a story used for sleeping rooms for more than 30 care recipients, the story shall be divided into not less than two compartments by smoke barrier walls in accordance with Section 407.5 of the *California Building Code* as required for new construction.

503.15 Refuge areas. Where alterations affect the configuration of an area utilized as a refuge area, the capacity of the refuge area shall not be reduced below the required capacity of the refuge area for horizontal exits in accordance with Section 1026.4 of the *California Building Code*.

Where the horizontal exit also forms a smoke compartment, the capacity of the refuge area for Group I-1, I-2 and I-3 occupancies and Group B ambulatory care facilities shall not be reduced below that required in Sections 407.5.3, 408.6.2, 420.6.1 and 422.3.2 of the *California Building Code,* as applicable.

503.16 Enhanced classroom acoustics. In Group E occupancies, where the work area exceeds 50 percent of the building area, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

503.17 Locking arrangements in educational occupancies. In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8 of the *California Building Code*.

503.18 Two-way communications systems. Where the work area for alterations exceeds 50 percent of the building area and the building has elevator service, a two-way communication systems shall be provided where required by Section 1009.8 of the *California Building Code*.

SECTION 504 FIRE ESCAPES *(NOT ADOPTED BY HCD)*

[BE] 504.1 Where permitted. Fire escapes shall be permitted only as provided for in Sections 504.1.1 through 504.1.4.

[BE] 504.1.1 New buildings. Fire escapes shall not constitute any part of the required means of egress in new buildings.

[BE] 504.1.2 Existing fire escapes. Existing fire escapes shall continue to be accepted as a component in the means of egress in existing buildings only.

[BE] 504.1.3 New fire escapes. New fire escapes for existing buildings shall be permitted only where exterior stairways cannot be utilized because of lot lines limiting stairway size or because of sidewalks, alleys or roads at grade level. New fire escapes shall not incorporate ladders or access by windows.

[BE] 504.1.4 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.

[BE] 504.2 Location. Where located on the front of the building and where projecting beyond the building line, the lowest landing shall be not 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 be not less than 12 feet (3658 mm).

[BE] 504.3 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.

[BE] 504.4 Dimensions. Stairways shall be not less than 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 stairways 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.

[BE] 504.5 Opening protectives. Doors and windows within 10 feet (3048 mm) of fire escape stairways shall be protected with $^3/_4$-hour opening protectives.

Exception: Opening protection shall not be required in buildings equipped throughout with an approved automatic sprinkler system.

SECTION 505 WINDOWS AND EMERGENCY ESCAPE OPENINGS

505.1 Replacement windows. The installation or replacement of windows shall be as required for new installations.

505.2 Window opening control devices on replacement windows. In Group *R-1,* R-2 or R-3 buildings containing dwelling *or sleeping* units, and one- and two-family dwellings and townhouses regulated by the *California Residential Code,* window opening control devices or fall prevention devices complying with ASTM F2090 shall be installed where an existing window is replaced and where all of the following apply to the replacement window:

1. The window is operable.

2. One of the following applies:
   2.1. The window replacement includes replacement of the sash and frame.
   2.2. The window replacement includes the sash only where the existing frame remains.
3. One of the following applies:
   3.1. In Group R-2 or R-3 buildings containing dwelling *or sleeping* units, the bottom of the clear opening of the window opening is at a height less than 36 inches (915 mm) above the finished floor.
   3.2. In one- and two-family dwellings and townhouses regulated by the *California Residential Code*, the bottom of the clear opening of the window opening is at a height less than 24 inches (610 mm) above the finished floor.
4. The window will permit openings that will allow passage of a 4-inch-diameter (102 mm) sphere when the window is in its largest opened position.
5. The vertical distance from the bottom of the clear opening of the window opening to the finished grade or other surface below, on the exterior of the building, is greater than 72 inches (1829 mm).

Exception: Operable windows where the bottom of the clear opening of the window opening is located more than 75 feet (22 860 mm) above the finished grade or other surface below, on the exterior of the room, space or building, and that are provided with window fall prevention devices that comply with ASTM F2006.

505.3 Replacement window emergency escape and rescue openings. Where windows are required to provide emergency escape and rescue openings in Group R-2 and R-3 occupancies and one- and two-family dwellings and townhouses regulated by the *California Residential Code*, replacement windows shall be exempt from the requirements of Section 1031.3 of the *California Building Code* and Section R310.2 of the *California Residential Code,* provided that the replacement window meets the following conditions:

1. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.
2. Where the replacement of the window is part of a change of occupancy, it shall comply with Section 1011.5.6.

505.3.1 Control devices. Window opening control devices or fall prevention devices complying with ASTM F2090 shall be permitted for use on windows required to provide emergency escape and rescue openings. After operation to release the control device allowing the window to fully open, the control device shall not reduce the net clear opening area of the window unit. Emergency escape and rescue openings shall be operational from the inside of the room without the use of keys or tools.

505.4 Bars, grilles, covers or screens. Bars, grilles, covers, screens or similar devices are permitted to be placed over emergency escape and rescue openings, bulkhead enclosure or window wells that serve such openings, provided all of the following conditions are met:

1. The minimum net clear opening size complies with the code that was in effect at the time of construction.
2. Such devices shall be releasable or removable from the inside without the use of a key, tool or force greater than that which is required for normal operation of the escape and rescue opening.
3. Where such devices are installed, they shall not reduce the net clear opening of the emergency escape and rescue openings.
4. Smoke alarms shall be installed in accordance with Section 907.2.10 of the *California Building Code*.

SECTION 506 CHANGE OF OCCUPANCY

506.1 Compliance. A change of occupancy shall not be made in any building unless that building is made to comply with the requirements of the *California Building Code* for the use or occupancy. Changes of occupancy in a building or portion thereof shall be such that the existing building is not less complying with the provisions of this code than the existing building or structure was prior to the change. Subject to the approval of the code official, changes of occupancy shall be permitted without complying with all of the requirements of this code for the new occupancy, provided that the new occupancy is less hazardous, based on life and fire risk, than the existing occupancy.

Exception: The building need not be made to comply with Chapter 16 of the *California Building Code* unless required by Section 506.5.

506.1.1 Change in the character of use. A change of occupancy with no change of occupancy classification shall not be made to any structure that will subject the structure to any special provisions of the applicable *California Codes*, without approval of the code official. Compliance shall be only as necessary to meet the specific provisions and is not intended to require the entire building be brought into compliance.

506.1.2 Change in function. [OSHPD 1R, 2, 4 and 5] *A change in function shall require compliance with all the functional requirements for new construction in the California Building Code, including requirements in Sections 1224, 1225, 1226, 1227 and 1228.*

Exception [OSHPD 1R]*: Hospital buildings removed from acute care service adapted for re-use as skilled nursing facilities, acute psychiatric hospitals or outpatient services of a hospital may be permitted to meet the minimum room clearances, areas and dimensions of the 2001 California Building Code for existing rooms re-used for a similar purpose, subject to the approval of OSHPD.*

506.2 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.

506.3 Stairways. An existing stairway shall not be required to comply with the requirements of Section 1011 of the *California Building Code* where the existing space and construction does not allow a reduction in pitch or slope.

506.4 Existing emergency escape and rescue openings. Where a change of occupancy would require an emergency escape and rescue opening in accordance with Section 1031.1 of the *California Building Code*, operable windows serving as the emergency escape and rescue opening shall comply with the following

1. An existing operable window shall provide a minimum net clear opening of 4 square feet (0.38 m^2) with a minimum net clear opening height of 22 inches (559 mm) and a minimum net clear opening width of 20 inches (508 mm).
2. A replacement window where such window complies with both of the following:
   - 2.1. The replacement window meets the size requirements in Item 1.
   - 2.2. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

506.5 Structural. Any building undergoing a change of occupancy shall satisfy the requirements of this section.

Exception: [BSC] *For state-owned buildings, including those owned by the University of California and the California State University and the Judicial Council, the performance level requirements of Section 506.5 are replaced with the performance level requirements of Section 317.5.*

506.5.1 Live loads. Structural elements carrying tributary live loads from an area with a change of occupancy shall satisfy the requirements of Section 1607 of the *California Building Code*. Design live loads for areas of new occupancy shall be based on Section 1607 of the *California Building Code*. Design live loads for other areas shall be permitted to use previously approved design live loads.

Exception: Structural elements whose demand-capacity ratio considering the change of occupancy is not more than 5 percent greater than the demand-capacity ratio based on previously approved live loads need not comply with this section.

506.5.2 Snow and wind loads. Where a change of occupancy results in a structure being assigned to a higher risk category, the structure shall satisfy the requirements of Sections 1608 and 1609 of the *California Building Code* for the new risk category.

Exception: Where the area of the new occupancy is less than 10 percent of the building area, compliance with this section is not required. The cumulative effect of occupancy changes over time shall be considered.

506.5.3 Seismic loads (seismic force-resisting system). Where a change of occupancy results in a building being assigned to a higher risk category, or where the change is from a Group S or U occupancy to an occupancy other then Group S or Group U, the building shall satisfy the requirements of Section 1613 of the *California Building Code* for the new risk category using full seismic forces. For purposes of this section, compliance with ASCE 41, using a Tier 3 procedure and the two-level performance objective in CEBC Table 303.3.1 for the applicable risk category, shall be deemed to meet the requirements of CBC Section 1613, with procedures established by the Department.

Exceptions:

1. Where the area of the new occupancy is less than 10 percent of the building area, the occupancy is not changing from a Group S or Group U, and the new occupancy is not assigned to Risk Category IV, compliance with this section is not required. The cumulative effect of occupancy changes over time shall be considered.
2. When a change of use results in a structure being reclassified from Risk Category I or II to Risk Category III and the structure is located where the seismic coefficient, SDS, is less than 0.33, compliance with the seismic requirements of CBC Section 1613 is not required.
3. Unreinforced masonry bearing wall buildings assigned to Risk Category III and to Seismic Design Category A or B shall be permitted to use Appendix Chapter A1 of this code.
4. Where the change is from a Group S or Group U occupancy and there is no change of risk category, use of reduced seismic forces shall be permitted.

For a change of occupancy of an existing commercial or industrial building to residential use, all existing buildings shall be analyzed for 75 percent of the design earthquake ground motion, as defined in CBC Section 1613, but in no event shall there be a reduction in the capacity of the seismic force-resisting system where that system provides a greater level of protection than the minimum requirements established by this Code.

For an existing URM building, structural analysis per CBC Chapter 16 is required if the risk category is changed to III or IV. Structural analysis per CEBC Appendix A1 is required if the rating classification per LABC Division 88, Table 88-A is changed to I or II.

For URM buildings with an approved occupant load greater than 100, the occupant load may be increased by a maximum of 10 percent without changing the rating class or risk category.

The most restrictive requirement of CEBC Sections 502 (Addition), 503 (Alternation), 405 (Repair) and 506 (Change of Occupancy) shall apply.

506.5.4 Access to Risk Category IV. Any structure that provides operational access to an adjacent structure assigned to Risk Category IV as the result of a change of occupancy shall itself satisfy the requirements of Sections 1608, 1609 and 1613 of the *California Building Code*. For compliance with Section 1613, *California Building Code*-level seismic forces shall be used. Where operational access to the Risk Category IV structure is less than 10 feet (3048 mm) from either an interior lot line or from another structure, access protection from potential falling debris shall be provided.

506.6 Enhanced classroom acoustics. In Group E occupancies, where the work area exceeds 50 percent of the building area, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

SECTION 507 HISTORIC BUILDINGS (NOT ADOPTED BY HCD)

507.1 Historic buildings. The provisions of this code that require improvements relative to a building's existing condition or, in the case of repairs, that require improvements relative to a building's predamage condition, shall not be mandatory for historic buildings unless specifically required by this section.

507.2 Life safety hazards. The provisions of this code shall apply to historic buildings judged by the code official to constitute a distinct life safety hazard.

[BS] 507.3 Flood hazard areas. Within flood hazard areas established in accordance with Section 1612.3 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, where the work proposed constitutes substantial improvement, the building shall be brought into compliance with Section 1612 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable.

Exception: Historic buildings meeting any of the following criteria need not be brought into compliance:

1. Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places.
2. Determined by the Secretary of the US 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.
3. Designated as historic under a state or local historic preservation program that is approved by the Department of Interior.

[BS] 507.4 Structural. Historic buildings shall comply with the applicable structural provisions in this chapter.

Exceptions:

1. The code official shall be authorized to accept existing floors and existing live loads and to approve operational controls that limit the live load on any floor.
2. Repair of substantial structural damage is not required to comply with Sections 405.2.3, and 405.2.4. Substantial structural damage shall be repaired in accordance with Section 405.2.1.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 5*A* – PRESCRIPTIVE COMPLIANCE METHOD [OSHPD 1]

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter										X													
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 5*A*

PRESCRIPTIVE COMPLIANCE METHOD

User note:

About this chapter: *Chapter 5 provides details for the prescriptive compliance method—one of the three main options of compliance available in this code for buildings and structures undergoing alteration, addition or change of occupancy.*

SECTION 501*A*
GENERAL

501*A*.1 Scope. The provisions of this chapter shall control the alteration, addition and change of occupancy of existing buildings and structures, including historic buildings and structures as referenced in Section 301*A*.3.1. *The provisions of this chapter shall apply to existing structures for applications listed in Section 1.10.1 [OSHPD 1] regulated by the Office of Statewide Health Planning and Development (OSHPD).*

➡ **501*A*.1.1 Compliance with other methods.** Alterations, additions and changes of occupancy to existing buildings and structures shall comply with the provisions of this chapter or with one of the methods *or procedures* provided in Section 301.3.

501*A*.2 Fire-resistance ratings. *Fire-resistance ratings shall comply with the California Building Standards Code.*

501A.3 Prescriptive compliance provisions. *Alterations, additions and changes of occupancy to the following categories of existing buildings and structures shall comply with the provisions of this section.*

501A.3.1 Prescriptive compliance provisions for SPC-4D using the California Building Code, 1980 (CBC 1980). *Nonconforming buildings shall satisfy the following requirements:*

1. *The California Building Code, 1980 (CBC 1980), as used in this chapter, consists of the Uniform Building Code, 1979 (UBC 1979) along with requirements contained in:*
   a) *California Code of Regulations, Title 24-Building Standards, dated February 2, 1980 (Revision record for Register 80, No. 5).*
   b) *California Code of Regulations, Title 22 – Social Security, dated October 13, 1979 (Revision Record for Register 79, No 41).*
   c) *California Code of Regulations, Title 17 – Public Health, dated October 13, 1979 (Revision Record for Register 79, No 41-B).*
2. *All existing structural elements of Seismic Force Resisting System (SFRS) shall satisfy the detailing requirements in the CBC 1980 or demonstrate that the level of seismic performance is equivalent to that given in the CBC 1980, as determined by the building official.*
3. *A continuous load path or paths with adequate strength and stiffness to transfer all the forces from the point of origin to final point of resistance shall be justified by analysis.*
4. *Site data report in accordance with the CBC 1980 shall establish that seismically induced differential settlement does not exceed 1″ in 40′.*
5. *Adjacent buildings shall satisfy the SPC building separation requirements in accordance with the California Administrative Code, Chapter 6 Section 3.4.*
6. *The addition of new structural elements or strengthening of existing structural elements for retrofit of nonconforming buildings to SPC-4D shall comply with the following:*
   a) *The seismic demand (forces or displacements) shall be in accordance with the CBC 1980;*
   b) *Capacity, detailing and connections for new structural elements shall satisfy the requirements in the CBC 2019 for new construction; and*
   c) *The strengthening of existing structural elements shall use capacities determined in accordance with the CBC 2019 for new construction consistent with the detailing and connections used in the strengthened member.*
7. *All construction, quality assurance and quality control shall be in accordance with the new construction provisions of CBC 2019.*
8. *Elements not part of the Seismic Force-Resisting System (SFRS), including those identified in the California Administrative Code Chapter 6, Article 10, shall be evaluated using seismic forces and the requirements of the CBC 1980.*
9. *Any column or wall that forms part of two or more intersecting SFRS and is subjected to axial load due to seismic forces acting along either principal plan axis equaling or exceeding 20 percent of the axial design strength of the column or wall shall be evaluated for the most critical load effect due to application of seismic force in any direction. The most critical load effect may be deemed to be satisfied if members and their foundations are evaluated for 100 percent of the forces for one direction plus 30*

percent of the forces for the perpendicular direction, whereby the combination produces the maximum effect.

Exceptions: *The following buildings (with structural irregularities or unusual configuration/system) shall not be eligible for the SPC-4D upgrade using the prescriptive provisions in this section:*

1. *Buildings with prohibited irregularities in accordance with California Building Code Section 1617A.1.10.*
2. *Buildings taller than 5 stories or 65' height above the base having horizontal or vertical irregularities in accordance with ASCE 7 Tables 12.3-1 Items # 1a, 1b and 3 or 12.3-2 Items #1a, 1b, 5a and 5b.*
3. *Buildings with unusual configuration or structural system, as determined by the building official.*

501A.3.2 Prescriptive compliance provisions for SPC-4D using the new building design requirements of this code. *Structures satisfying the requirements of the California Building Code for new general acute care hospital buildings design shall be deemed to satisfy the SPC-4D requirements of Table 2.5.3, Chapter 6 of the California Administrative Code.*

All existing structural elements of a Seismic Force-Resisting System (SFRS) shall satisfy the detailing requirements of the California Building Code for new construction or demonstrate that the level of seismic performance is equivalent, as determined by the building official. A demonstration of equivalence shall consider the regularity, overstrength, redundancy and ductility of the structure.

Elements not part of the Seismic Force-Resisting System (SFRS), including those identified in the California Administrative Code Chapter 6, Article 10, shall be evaluated using seismic forces and the requirements of this code for new general acute care hospital buildings.

501A.3.3 Prescriptive compliance provisions for NPC 2, NPC 3, NPC 4 or NPC 4D and NPC 5.

501A.3.3.1 *Supports and attachments of nonstructural components, except those listed in Section 501A.3.3.2 below, in buildings in seismic performance categories SPC 1 or SPC 2 with a performance level of NPC 3 or higher, and SPC 3, SPC 4 or SPC-4D, 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 the California Building Code for new construction.*

501A.3.3.2 *Supports and attachments for systems listed under NPC-2 and NPC-5 (excluding those specifically listed for NPC-3 and NPC-4 or NPC-4D) in the California Administrative Code, Chapter 6, Table 11.1 shall satisfy the requirements of the California Building Code for new construction and Section 501A.3.3.1 above shall not be applicable.*

501A.3.3.3 *For NPC 3 and NPC 4 or NPC 4D in SPC 2, SPC 3, SPC 4 or SPC-4D buildings, the adequacy and design of nonstructural component or equipment supports and attachments may extend only to the connection of the component or equipment to the support when the total reaction at the point of support (including the application of* F_p*) is less than or equal to 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.*

501*A*.4 Health care facilities. In Group I-2 facilities, ambulatory care facilities and outpatient clinics, any altered or added portion of an existing electrical or medical gas systems shall be required to meet installation and equipment requirements in NFPA 99.

SECTION 502*A*
ADDITIONS

502*A*.1 General. Additions to any building or structure shall comply with the requirements of the *California Building 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 not less complying with the provisions of the *California Building 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 of the *California Building Code*.

[BS] 502*A*.2 Disproportionate earthquake damage. A building assigned to Seismic Design Category D, E or F that has sustained disproportionate earthquake damage shall be subject to the requirements for buildings with substantial structural damage to vertical elements of the lateral force-resisting system.

[BS] 502*A*.3 Flood hazard areas. *For buildings and structures in flood hazard areas established in California Building Code Section 1612A.3, any addition that constitutes substantial improvement of the existing structure, as defined in Chapter 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 California Building Code Section 1612A.3, any additions that do not constitute substantial improvement of the existing structure, as defined in Chapter 2, are not required to comply with the flood design requirements for new construction.

[BS] 502*A*.4 Existing structural elements carrying gravity load. *Any existing gravity load-carrying structural element for which an addition and its related alterations cause 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 shall be considered an altered element subject to the requirements of Section 503A.3. Any existing element that will form part of the lateral load path for any part of the addition shall be considered an existing lateral load-carrying structural element subject to the requirements of Section 502A.5.*

502A.4.1 Design live load. *Where the addition 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 addition. If the approved live load is less than that required by California Building Code 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 addition does result in increased design live load, the live load required by California Building Code Section 1607A shall be used.*

[BS] 502*A*.5 Existing structural elements carrying lateral load. Where the addition is structurally independent of the existing structure, existing lateral load-carrying structural elements shall be permitted to remain unaltered. Where the addition is not structurally independent of the existing structure, the existing structure and its addition acting together as a single structure shall be shown to meet the requirements of Sections 1609*A* and 1613*A* of the *California Building Code*.

Exceptions: *For incidental and minor additions:*

1. Any existing lateral load-carrying structural element whose demand-capacity ratio with the addition considered is no more than 10 percent greater than its demand-capacity ratio with the addition 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 in accordance with Sections 1609*A* and 1613*A* of the *California Building Code*. 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. *Drift limits based on original design code shall be permitted to be used in lieu of the drift limits required by ASCE 7.*

502*A*.6 Enhanced classroom acoustics. In Group E occupancies, enhanced classroom acoustics shall be provided in all classrooms in the addition with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

502*A*.7 Smoke alarms in existing portions of a building. *Shall comply with California Building Standards Code.*

502*A*.8 Carbon monoxide alarms in existing portions of a building. *Shall comply with California Building Standards Code.*

SECTION 503*A*
ALTERATIONS

503*A*.1 General. *Except as provided by this section, alterations to any building or structure shall comply with the requirements of the California Building Code for new construction. Alterations shall be such that the existing building or structure is no less conforming with the provisions of this code than the existing building or structure was prior to the alteration.*

Exceptions:

1. *An existing stairway shall not be required to comply with the requirements of California Building Code Section 1011 where the existing space and construction does not allow a reduction in pitch or slope.*
2. *Handrails otherwise required to comply with California Building Code Section 1011.11 shall not be required to comply with the requirements of California Building Code Section 1014.6 regarding full extension of the handrails where such extensions would be hazardous due to plan configuration.*

[BS] 503*A*.2 Flood hazard areas. For buildings and structures in flood hazard areas established in Section 1612*A*.3 of the *California Building Code*, any alteration that constitutes substantial improvement of the existing structure, *as defined in Chapter 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 of the *California Building Code*, any alterations that do not constitute substantial improvement of the existing structure, *as defined in Chapter 2,* are not required to comply with the flood design requirements for new construction.

[BS] 503*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 replaced or *otherwise* altered as needed to carry the gravity loads 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 load* required by *this code* for new structures.

503A.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 California Building Code 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 California Building Code Section 1607A shall be used.*

[BS] 503*A*.4 Existing structural elements carrying lateral load. Except as permitted by Section 503*A*.13, where the alteration increases design lateral loads *in accordance with California Building Code Section 1609A or 1613A, or where the alteration*, results in a prohibited structural irregularity as defined in the *California Building Code*, or *where the alteration* decreases the capacity of any existing lateral load-carrying structural element, the structure of the altered building or structure shall meet the requirements of Sections 1609*A* and 1613*A* of the *California Building Code*.

Exceptions: *For incidental and minor alterations:*

1. Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is not 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 in accordance with Sections 1609*A* and 1613*A* of the *California Building Code*. Reduced seismic forces shall be permitted. 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. *Drift limits based on original design code shall be permitted to be used in lieu of the drift limits required by ASCE 7.*

[BS] 503*A*.5 Seismic Design Category F. *Not permitted by OSHPD.*

[BS] 503*A*.6 Bracing for unreinforced masonry parapets on reroofing. *Not permitted by OSHPD.*

[BS] 503*A*.7 Anchorage for concrete and reinforced masonry walls. *Not permitted by OSHPD.*

[BS] 503*A*.8 Anchorage for unreinforced masonry walls in major alterations. *Not permitted by OSHPD.*

[BS] 503*A*.9 Bracing for unreinforced masonry parapets in major alterations. *Not permitted by OSHPD.*

[BS] 503*A*.10 Anchorage of unreinforced masonry partitions in major alterations. *Not permitted by OSHPD.*

[BS] 503*A*.11 Substantial structural alteration. *Not permitted by OSHPD.*

[BS] 503*A*.12 Roof diaphragms resisting wind loads in high-wind regions. *Not permitted by OSHPD.*

[BS] 503*A*.13 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 conforming 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 California Building Code Chapter 16A. Alterations of existing structural elements shall be based on design demand required by California Building Code Chapter 16A. Demands for new or altered existing structural elements need not exceed the maximum load effect that can be transferred to the elements by the system.*
3. *New, relocated or altered nonstructural elements are designed, detailed and connected to existing or new structural elements as required by California Building Code Chapter 16A.*
4. *The alterations do not create a structural irregularity as defined in ASCE 7 or make an existing structural irregularity more severe.*

503*A*.14 Smoke compartments. *Shall comply with California Building Standards Code.*

503*A*.15 Refuge areas. *Shall comply with California Building Standards Code.*

503*A*.16 Enhanced classroom acoustics. In Group E occupancies, where the work area exceeds 50 percent of the building area, enhanced classroom acoustics shall be provided in all classrooms with a volume of 20,000 cubic feet (565 m^3) or less. Enhanced classroom acoustics shall comply with the reverberation time in Section 808 of ICC A117.1.

503*A*.17 Locking arrangements in educational occupancies. In Group E occupancies, Group B educational occupancies and Group I-4 occupancies, egress doors with locking arrangements designed to keep intruders from entering the room shall comply with Section 1010.2.8 of the *California Building Code*.

503*A*.18 Two-way communications systems. Where the work area for alterations exceeds 50 percent of the building area and the building has elevator service, a two-way communication systems shall be provided where required by Section 1009.8 of the *California Building Code*.

503*A*.19 Smoke alarms. *Shall comply with California Building Standards Code.*

503*A*.20 Carbon monoxide alarms. *Shall comply with California Building Standards Code.*

SECTION 504*A*
RESERVED

SECTION 505*A*
RESERVED

SECTION 506*A*
CHANGE OF OCCUPANCY

506*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 occupancy or in a different group of occupancies, unless such building is made to comply with the requirements of the California Building Code for the use or occupancy. 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 the California Building Code for those groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.*

506*A*.1.1 Change in function. *A change in function shall require compliance with all the functional requirements for new construction in the California Building Code, including requirements in California Building Code Section 1224.*

Exception: *Minimum room clearances, areas and dimensions may meet the requirements of the 2001 California Building Code for existing rooms re-used for a similar purpose, subject to the approval of OSHPD.*

506*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.

506*A*.3 Stairways. *Existing stairways in an existing structure shall not be required to comply with the requirements of a new stairway as outlined in California Building Code Section 1009 where the existing space and construction will not allow a reduction in pitch or slope.*

506*A*.4 Existing emergency escape and rescue openings. Where a change of occupancy would require an emergency escape and rescue opening in accordance with Section 1031.1 of the *California Building Code*, operable windows serving as the emergency escape and rescue opening shall comply with the following

1. An existing operable window shall provide a minimum net clear opening of 4 square feet (0.38 m^2) with a minimum net clear opening height of 22 inches (559 mm) and a minimum net clear opening width of 20 inches (508 mm).
2. A replacement window where such window complies with both of the following:
   - 2.1. The replacement window meets the size requirements in Item 1.
   - 2.2. The replacement window is the manufacturer's largest standard size window that will fit within the existing frame or existing rough opening. The replacement window shall be permitted to be of the same operating style as the existing window or a style that provides for an equal or greater window opening area than the existing window.

506*A*.5 Structural. *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 in the California Building Code of the higher risk category.*

Exception: *Specific seismic detailing requirements of California Building Code Section 1613A for a new structure shall not be required to be met where it can be shown that the level of performance is equivalent to that of a new structure. A demonstration of equivalence shall consider the regularity, over strength, redundancy and ductility of the structure.*

SECTION 507*A*
HISTORIC BUILDINGS

507*A*.1 Historic buildings. The provisions of this code that require improvements relative to a building's existing condition or, in the case of repairs, that require improvements relative to a building's predamage condition, shall not be mandatory for historic buildings unless specifically required by this section.

507*A*.2 Life safety hazards. The provisions of this code shall apply to historic buildings judged by the code official to constitute a distinct life safety hazard.

[BS] 507*A*.3 Flood hazard areas. Within flood hazard areas established in accordance with Section 1612.3 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable, where the work proposed constitutes substantial improvement, the building shall be brought into compliance with Section 1612 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable.

Exception: Historic buildings meeting any of the following criteria need not be brought into compliance:

1. Listed or preliminarily determined to be eligible for listing in the National Register of Historic Places.
2. Determined by the Secretary of the US 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.
3. Designated as historic under a state or local historic preservation program that is approved by the Department of Interior.

[BS] 507*A*.4 Structural. Historic buildings shall comply with the applicable structural provisions in this chapter.

Exceptions:

1. The code official shall be authorized to accept existing floors and existing live loads and to approve operational controls that limit the live load on any floor.
2. Repair of substantial structural damage is not required to comply with Sections 405*A*.2.3, and 405*A*.2.4. Substantial structural damage shall be repaired in accordance with Section 405*A*.2.1.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 6 – CLASSIFICATION OF WORK

Not adopted by the State of California
(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 7 – ALTERATIONS—LEVEL 1

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

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CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 8 – ALTERATIONS—LEVEL 2

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 9 – ALTERATIONS—LEVEL 3

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 10 – CHANGE OF OCCUPANCY

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 11 – ADDITIONS

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 12 – HISTORIC BUILDINGS

Not adopted by the State of California

(Historic buildings and structures shall comply with Part 8, Title 24, California Code of Regulations)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 13 – PERFORMANCE COMPLIANCE METHODS

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 14 – RELOCATED OR MOVED BUILDINGS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)				X	X	X																	
Adopt only those sections that are listed below																							
Chapter / Section																							
1401				X	X																		
1401.1				X	X																		
1401.2				X	X																		

CHAPTER 14

RELOCATED OR MOVED BUILDINGS

User note:

About this chapter: *Chapter 14 is applicable to any building that is moved or relocated. The relocation of a building will automatically cause an inspection and evaluation process that enables the jurisdiction to determine the level of compliance with the* California Fire Code *and the* California Existing Building Code*. These two codes, by their scope, are applicable to existing buildings. This is the case regardless of any repair, remodeling, alteration work or change of occupancy occurring (see the* California Fire Code *and* California Existing Building Code*).*

SECTION 1401 GENERAL

1401.1 Scope. This chapter provides requirements for relocated or moved structures, including relocatable buildings as defined in Chapter 2. ***[HCD]*** *The provisions of Chapter 14 are not applicable to commercial modulars, manufactured homes, mobilehomes, multi-unit manufactured housing and special purpose commercial modulars as defined in Health and Safety Code Sections 18001.8, 18007, 18008, 18008.7 and 18012.5, respectively. These structures are subject to installation/reinstallation requirements specified in the Mobilehome Parks Act (Health and Safety Code Section 18200 et seq.) and the California Code of Regulations, Title 25, Division 1, Chapter 2. Manufactured homes must meet unit identification (data plate) and certification label requirements as specified in the Code of Federal Regulations, Title 24, Subtitle B, Chapter XX, Part 3280 and Health and Safety Code Section 18032. Commercial modulars and special purpose commercial modulars must meet identification requirements in the California Code of Regulations, Title 25, Division 1, Chapter 3, Subchapter 2.*

1401.1.1 Bleachers, grandstands and folding and telescopic seating. Relocated or moved bleachers, grandstands and folding and telescopic seating shall comply with ICC 300.

LALA **1401.2 Conformance.** Structures moved into or within the City shall comply with the provisions of Chapter 83 of the LABC.

SECTION 1402 REQUIREMENTS

1402.1 Location on the lot. The building shall be located on the lot in accordance with the requirements of the *California Building Code* or the *California Residential Code*, as applicable.

[BS] 1402.2 Foundation. The foundation system of relocated buildings shall comply with the *California Building Code* or the *California Residential Code*, as applicable.

[BS] 1402.2.1 Connection to the foundation. The connection of the relocated building to the foundation shall comply with the *California Building Code* or the *California Residential Code*, as applicable.

[BS] 1402.3 Wind loads. Buildings shall comply with *California Building Code* or *California Residential Code* wind provisions, as applicable.

Exceptions:

1. Detached one- and two-family dwellings and Group U occupancies where wind loads at the new location are not higher than those at the previous location.
2. Structural elements whose stress is not increased by more than 10 percent.

[BS] 1402.4 Seismic loads. Buildings shall comply with *California Building Code* or *California Residential Code* seismic provisions at the new location, as applicable.

Exceptions:

1. Structures in Seismic Design Categories A and B and detached one- and two-family dwellings in Seismic Design Categories A, B and C where the seismic loads at the new location are not higher than those at the previous location.
2. Structural elements whose stress is not increased by more than 10 percent.

[BS] 1402.5 Snow loads. Structures shall comply with *California Building Code* or *California Residential Code* snow loads, as applicable, where snow loads at the new location are higher than those at the previous location.

Exception: Structural elements whose stress is not increased by more than 5 percent.

[BS] 1402.6 Flood hazard areas. If relocated or moved into a flood hazard area, structures shall comply with Section 1612 of the *California Building Code*, or Section R322 of the *California Residential Code*, as applicable.

[BS] 1402.7 Required inspection and repairs. The code official shall be authorized to inspect, or to require approved professionals to inspect at the expense of the owner, the various structural parts of a relocated building to verify that structural components and connections have not sustained structural damage. Any repairs required by the code official as a result of such inspection shall be made prior to the final approval.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 15 – CONSTRUCTION SAFEGUARDS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter	**X**																						
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below				**X**	**X**																		
Chapter / Section																							
1501				X	X																		
1502				X	X																		
1503				X	X																		
1505				X	X																		
1508				X	X																		

The state agency does not adopt sections identified with the following symbol: †

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 15

CONSTRUCTION SAFEGUARDS

User note:

About this chapter: *Chapter 15 looks to the construction process. Parameters are provided for demolition and for protecting adjacent property during demolition and construction. Issues such as how to provide egress and adequate water supply while the building is growing, the timing of standpipe and sprinkler installation, and protection of pedestrians are addressed. Note that this chapter is consistent with Chapter 33 of the* California Building Code *and Chapter 33 of the* California Fire Code*.*

SECTION 1501
GENERAL

[BG] 1501.1 Scope. The provisions of this chapter shall govern safety during construction and the protection of adjacent public and private properties.

[BG] 1501.2 Storage and placement. Construction equipment and materials shall be stored and placed so as not to endanger the public, the workers or adjoining property for the duration of the construction project.

** **[BS] 1501.2.1 Structural and construction loads.** Structural roof components shall be capable of supporting the roof-covering system and the material and equipment loads that will be encountered during installation of the system.

[BG] 1501.3 Alterations, repairs and additions. Required exits, existing structural elements, fire protection devices and sanitary safeguards shall be maintained at all times during alterations, repairs or additions to any building or structure.

Exceptions:

1. Where such required elements or devices are being altered or repaired, adequate substitute provisions shall be made.
2. Maintenance of such elements and devices is not required where the existing building is not occupied.

[BG] 1501.4 Manner of removal. Waste materials shall be removed in a manner that prevents injury or damage to persons, adjoining properties and public rights-of-way.

[BG] 1501.5 Fire safety during construction. Fire safety during construction shall comply with the applicable requirements of the *California Building Code* and the applicable provisions of Chapter 33 of the *California Fire Code*.

[BS] 1501.6 Protection of pedestrians. Pedestrians shall be protected during construction and demolition activities as required by Sections 1501.6.1 through 1501.6.7 and Table 1501.6. Signs shall be provided to direct pedestrian traffic.

[BS] 1501.6.1 Walkways. A walkway shall be provided for pedestrian travel in front of every construction and demolition site unless the applicable governing authority authorizes the sidewalk to be fenced or closed. A walkway shall be provided for pedestrian travel that leads from a building entrance or exit of an occupied structure to a public way. Walkways shall be of sufficient width to accommodate the pedestrian traffic, but shall be not less than 4 feet (1219 mm) in width. Walkways shall be provided with a durable walking surface and shall be accessible in accordance with Chapter 11*A* of the *California Building Code*. Walkways shall be designed to support all imposed loads and the design live load shall be not less than 150 pounds per square foot (psf) (7.2 kN/m^2).

[BS] TABLE 1501.6
PROTECTION OF PEDESTRIANS

HEIGHT OF CONSTRUCTION	DISTANCE OF CONSTRUCTION TO LOT LINE	TYPE OF PROTECTION REQUIRED
8 feet or less	Less than 5 feet	Construction railings
	5 feet or more	None
More than 8 feet	Less than 5 feet	Barrier and covered walkway
	5 feet or more, but not more than one-fourth the height of construction	Barrier and covered walkway
	5 feet or more, but between one-fourth and one-half the height of construction	Barrier
	5 feet or more, but exceeding one-half the height of construction	None

For SI: 1 foot = 304.8 mm.

[BS] 1501.6.2 Directional barricades. Pedestrian traffic shall be protected by a directional barricade where the walkway extends into the street. The directional barricade shall be of sufficient size and construction to direct vehicular traffic away from the pedestrian path.

[BS] 1501.6.3 Construction railings. Construction railings shall be not less than 42 inches (1067 mm) in height and shall be sufficient to direct pedestrians around construction areas.

[BS] 1501.6.4 Barriers. Barriers shall be not less than 8 feet (2438 mm) in height and shall be placed on the side of the walkway nearest the construction. Barriers shall extend the entire length of the construction site. Openings in such barriers shall be protected by doors that are normally kept closed.

[BS] 1501.6.4.1 Barrier design. Barriers shall be designed to resist loads required in Chapter 16 of the *California Building Code* unless constructed as follows:

1. Barriers shall be provided with 2-inch by 4-inch (51 mm by 102 mm) top and bottom plates.
2. The barrier material shall be boards not less than $^3/_4$ inch (19.1 mm) in thickness or wood structural use panels not less than $^1/_4$ inch (6.4 mm) in thickness.
3. Wood structural use panels shall be bonded with an adhesive identical to that for exterior wood structural use panels.
4. Wood structural use panels $^1/_4$ inch (6.4 mm) or $^{15}/_{16}$ inch (23.8 mm) in thickness shall have studs spaced not more than 2 feet (610 mm) on center.
5. Wood structural use panels $^3/_8$ inch (9.5 mm) or $^1/_2$ inch (12.7 mm) in thickness shall have studs spaced not more than 4 feet (1219 mm) on center, provided that a 2-inch by 4-inch (51 mm by 102 mm) stiffener is placed horizontally at mid-height where the stud spacing is greater than 2 feet (610 mm) on center.
6. Wood structural use panels $^5/_8$ inch (15.9 mm) or thicker shall not span over 8 feet (2438 mm).

[BS] 1501.6.5 Covered walkways. Covered walkways shall have a clear height of not less than 8 feet (2438 mm) as measured from the floor surface to the canopy overhead. Adequate lighting shall be provided at all times. Covered walkways shall be designed to support all imposed loads. The design live load shall be not less than 150 psf (7.2 kN/m^2) for the entire structure.

Exception: Roofs and supporting structures of covered walkways for new, light-frame construction not exceeding two stories above grade plane are permitted to be designed for a live load of 75 psf (3.6 kN/m^2) or the loads imposed on them, whichever is greater. In lieu of such designs, the roof and supporting structure of a covered walkway are permitted to be constructed as follows:

1. Footings shall be continuous 2-inch by 6-inch (51 mm by 152 mm) members.
2. Posts not less than 4 inches by 6 inches (102 mm by 152 mm) shall be provided on both sides of the roof and spaced not more than 12 feet (3658 mm) on center.
3. Stringers not less than 4 inches by 12 inches (102 mm by 305 mm) shall be placed on edge on the posts.
4. Joists resting on the stringers shall be not less than 2 inches by 8 inches (51 mm by 203 mm) and shall be spaced not more than 2 feet (610 mm) on center.
5. The deck shall be planks not less than 2 inches (51 mm) thick or wood structural panels with an exterior exposure durability classification not less than $^{23}/_{32}$ inch (18.3 mm) thick nailed to the joists.
6. Each post shall be knee-braced to joists and stringers by members not less than 2 inches by 4 inches (51 mm by 102 mm); 4 feet (1219 mm) in length.
7. A curb that is not less than 2 inches by 4 inches (51 mm by 102 mm) shall be set on edge along the outside edge of the deck.

[BS] 1501.6.6 Repair, maintenance and removal. Pedestrian protection required by Section 1501.6 shall be maintained in place and kept in good order for the entire length of time pedestrians are subject to being endangered. The owner or the owner's authorized agent, on completion of the construction activity, shall immediately remove walkways, debris and other obstructions and leave such public property in as good a condition as it was before such work was commenced.

[BS] 1501.6.7 Adjacent to excavations. Every excavation on a site located 5 feet (1524 mm) or less from the street lot line shall be enclosed with a barrier not less than 6 feet (1829 mm) in height. Where located more than 5 feet (1524 mm) from the street lot line, a barrier shall be erected where required by the code official. Barriers shall be of adequate strength to resist wind pressure as specified in Chapter 16 of the *California Building Code*.

[BG] 1501.7 Facilities required. Sanitary facilities shall be provided during construction or demolition activities in accordance with the *California Plumbing Code*.

SECTION 1502
PROTECTION OF ADJOINING PROPERTY

[BS] 1502.1 Protection required. Adjoining public and private property shall be protected from damage during construction and demolition work. Protection must be provided for footings, foundations, party walls, chimneys, skylights and roofs. Provisions shall be made to control water runoff and erosion during construction or demolition activities. The person making or causing an excavation to be made shall provide written notice to the owners of adjoining buildings advising them that the excavation is to be made and that the adjoining buildings should be protected. Said notification shall be delivered not less than 10 days prior to the scheduled starting date of the excavation.

[BS] 1502.2 Excavation retention systems. Where a retention system is used to provide support of an excavation for protection of adjacent structures, the system shall conform to the requirements in Section 1502.2.1 through 1502.2.3.

[BS] 1502.2.1 Excavation retention system design. Excavation retention systems shall be designed by a registered design professional to provide vertical and lateral support.

[BS] 1502.2.2 Excavation retention system monitoring. The retention system design shall include requirements for monitoring of the system and adjacent structures for horizontal and vertical movement.

[BS] 1502.2.3 Retention system removal. Elements of the system shall only be removed or decommissioned where adequate replacement support is provided by backfill or by the new structure. Removal or decommissioning shall be performed in such a manner that protects the adjacent property.

SECTION 1503
TEMPORARY USE OF STREETS, ALLEYS AND PUBLIC PROPERTY

[BG] 1503.1 Storage and handling of materials. The temporary use of streets or public property for the storage or handling of materials or equipment required for construction or demolition, and the protection provided to the public shall comply with the provisions of the applicable governing authority and this chapter.

[BG] 1503.2 Obstructions. Construction materials and equipment shall not be placed or stored so as to obstruct access to fire hydrants, standpipes, fire or police alarm boxes, catch basins or manholes, nor shall such material or equipment be located within 20 feet (6096 mm) of a street intersection, or placed so as to obstruct normal observations of traffic signals or to hinder the use of public transit loading platforms.

[BG] 1503.3 Utility fixtures. Building materials, fences, sheds or any obstruction of any kind shall not be placed so as to obstruct free approach to any fire hydrant, fire department connection, utility pole, manhole, fire alarm box or catch basin, or so as to interfere with the passage of water in the gutter. Protection against damage shall be provided to such utility fixtures during the progress of the work, but sight of them shall not be obstructed.

SECTION 1504
FIRE EXTINGUISHERS

[F] 1504.1 Where required. Structures under construction, alteration or demolition shall be provided with not fewer than one approved portable fire extinguisher in accordance with Section 906 of the *California Fire Code* and sized for not less than ordinary hazard as follows:

1. At each stairway on all floor levels where combustible materials have accumulated.
2. In every storage and construction shed.
3. Additional portable fire extinguishers shall be provided where special hazards exist, such as the storage and use of flammable and combustible liquids.

[F] 1504.2 Fire hazards. The provisions of this code and of the *California Fire Code* shall be strictly observed to safeguard against all fire hazards attendant upon construction operations.

SECTION 1505
MEANS OF EGRESS

[BE] 1505.1 Stairways required. Where building construction exceeds 40 feet (12 192 mm) in height above the lowest level of fire department vehicle access, a temporary or permanent stairway shall be provided. As construction progresses, such stairway shall be extended to within one floor of the highest point of construction having secured decking or flooring.

[F] 1505.2 Maintenance of means of egress. Means of egress and required accessible means of egress shall be maintained at all times during construction, demolition, remodeling or alterations and additions to any building.

> **Exception:** Existing means of egress need not be maintained where approved temporary means of egress and accessible means of egress systems and facilities are provided.

SECTION 1506
STANDPIPES

[F] 1506.1 Where required. In buildings required to have standpipes by Section 905.3.1 of the *California Building Code*, not less than one standpipe shall be provided for use during construction. Such standpipes shall be installed prior to construction exceeding 40 feet (12 192 mm) in height above the lowest level of fire department vehicle access. Such standpipes shall be provided with fire department hose connections at locations adjacent to *stairways*, complying with Section 1505.1. As construction progresses, such standpipes shall be extended to within one floor of the highest point of construction having secured decking or flooring.

[F] 1506.2 Buildings being demolished. Where a building or portion of a building is being demolished and a standpipe is existing within such a building, such standpipe shall be maintained in an operable condition so as to be available for use by the fire department. Such standpipe shall be demolished with the building but shall not be demolished more than one floor below the floor being demolished.

[F] 1506.3 Detailed requirements. Standpipes shall be installed in accordance with the provisions of Chapter 9 of the *California Building Code*.

> **Exception:** Standpipes shall be either temporary or permanent in nature, and with or without a water supply, provided that such standpipes conform to the requirements of Section 905 of the *California Building Code* as to capacity, outlets and materials.

SECTION 1507
AUTOMATIC SPRINKLER SYSTEM

[F] 1507.1 Completion before occupancy. In buildings where an automatic sprinkler system is required by this code or the *California Building Code*, it shall be unlawful to occupy any portions of a building or structure until the automatic sprinkler system installation has been tested and *approved*, except as provided in Section 110.3.

[F] 1507.2 Operation of valves. Operation of sprinkler control valves shall be permitted only by properly authorized personnel and shall be accompanied by notification of duly designated parties. When the sprinkler protection is being regularly turned off and on to facilitate connection of newly completed segments, the sprinkler control valves shall be checked at the end of each work period to ascertain that protection is in service.

SECTION 1508 ACCESSIBILITY

[BE] 1508.1 Construction sites. Structures, sites and equipment directly associated with the actual process of construction, including, but not limited to, scaffolding, bridging, material hoists, material storage or construction trailers, are not required to be accessible.

SECTION 1509 WATER SUPPLY FOR FIRE PROTECTION

[F] 1509.1 When required. An approved water supply for fire protection, either temporary or permanent, shall be made available as soon as combustible building material arrives on the site, on commencement of vertical combustible construction, and on installation of a standpipe system in buildings under construction, in accordance with Sections 1509.1 through 1509.5.

Exception: The fire code official is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

[F] 1509.2 Combustible building materials. When combustible building materials of the building under construction are delivered to a site, a minimum fire flow of 500 gallons per minute (1893 L/m) shall be provided. The fire hydrant used to provide this fire flow supply shall be within 500 feet (152 m) of the combustible building materials as measured along an *approved* fire apparatus access lane. Where the site configuration is such that one fire hydrant cannot be located within 500 feet (152 m) of all combustible building materials, additional fire hydrants shall be required to provide coverage in accordance with this section.

[F] 1509.3 Vertical construction of Types III, IV and V construction. Prior to commencement of vertical construction of Type III, IV or V buildings that utilize any combustible building materials, the fire flow required by Sections 1509.3.1 through 1509.3.3 shall be provided, accompanied by fire hydrants in sufficient quantity to deliver the required fire flow and proper coverage.

[F] 1509.3.1 Fire separation up to 30 feet. Where a building of Type III, IV or V construction has a fire separation distance of less than 30 feet (9144 mm) from property lot lines, and an adjacent property has an existing structure or otherwise can be built on, the water supply shall provide either a minimum of 500 gallons per minute (1893 L/m), or the entire fire flow required for the building when constructed, whichever is greater.

[F] 1509.3.2 Fire separation of 30 feet up to 60 feet. Where a building of Type III, IV or V construction has a fire separation distance of 30 feet (9144 mm) up to 60 feet (18 288 mm) from property lot lines, and an adjacent property has an existing structure or otherwise can be constructed upon, the water supply shall provide a minimum of 500 gallons per minute (1893 L/m), or 50 percent of the fire flow required for the building when constructed, whichever is greater.

[F] 1509.3.3 Fire separation of 60 feet or greater. Where a building of Type III, IV or V construction has a fire separation of 60 feet (18 288 mm) or greater from a property lot line, a water supply of 500 gallons per minute (1893 L/m) shall be provided.

[F] 1509.4 Vertical construction, Types I and II construction. If combustible construction materials are delivered to the construction site, water supply in accordance with Section 1509.2 shall be provided. Additional water supply for fire flow is not required prior to commencing vertical construction of Type I and II buildings.

[F] 1509.5 Standpipe supply. Regardless of the presence of combustible building materials, the construction type or the fire separation distance, where a standpipe is required in accordance with Section 1506, a water supply providing a minimum flow of 500 gallons per minute (1893 L/m) shall be provided. The fire hydrant used for this water supply shall be located within 100 feet (30 480 mm) of the fire department connection supplying the standpipe.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
CHAPTER 16 – REFERENCED STANDARDS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter	**X**			**X**	**X**								**X**										
Adopt Entire Chapter as amended (amended sections listed below)			**X**					**X**	**X**	**X**	**X**	**X**		**X**	**X**								
Adopt only those sections that are listed below																							
Chapter / Section																							
ASCE/SEI 7—2016								X	X	X	X	X		X	X								
ASCE/SEI 41—*2013*										X													
ASCE/SEI 41—2017											X	X		X	X								
ASTM A615—15ae1										X													
ICC CBC—22										X													
NFPA 13R—*22*			X																				
NFPA 72—*22*			X																				

The state agency does not adopt sections identified with the following symbol: †

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 16

REFERENCED STANDARDS

User note:

About this chapter: *This code contains numerous references to standards that are used to regulate materials and methods of construction. Chapter 16 contains a comprehensive list of all standards that are referenced in the code, including the appendices. The standards are part of the code to the extent of the reference to the standard. Compliance with the referenced standard is necessary for compliance with this code. By providing specifically adopted standards, the construction and installation requirements necessary for compliance with the code can be readily determined. The basis for code compliance is, therefore, established and available on an equal basis to the building code official, contractor, designer and owner.*

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 Section 102.4, or California Administration Division 1, as applicable. ***[OSHPD 1] 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 2, 3A, 4A and 5A.*

ASCE/SEI

American Society of Civil Engineers
Structural Engineering Institute
1801 Alexander Bell Drive
Reston, VA 20191-4400

7—1988: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—1993: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—1995: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—1998: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—2002: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—2005: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—2010: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
503.12, 706.3.2

7—2016: Minimum Design Loads and Associated Criteria for Buildings and Other Structures with Supplement 1 ***[OSHPD 1, 1R, 2, 4 and 5, DSA-SS, DSA-SS/CC] and Supplement 3***
304.2, *304A.2,* 304.3.1, *501A.3, 502A.5,* 503.4, 503.12, 503.13, *503A.13,* 706.3.2, 805.3, 805.4

41—*2013*: *[OSHPD 1]* Seismic Evaluation and Retrofit of Existing Buildings
304A.2, 304A.3.4, 304A.3.5

41—2017: Seismic Evaluation and Retrofit of Existing Buildings ***[OSHPD 1R, 2, 4 and 5] with Supplement No. 1***
304.3.1, Table 304.3.1, 304.3.2, Table 304.3.2

ASHRAE

ASHRAE
1791 Tullie Circle NE
Atlanta, GA 30329

62.1—2019: Ventilation for Acceptable Indoor Air Quality
807.2

ASME

American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016

A17.1—2019/CSA B44—19: Safety Code for Elevators and Escalators
306.7.7, 902.1.2

ASME—continued

A17.3—2020: Safety Code for Existing Elevators and Escalators

902.1.2

A18.1—2020: Safety Standard for Platform Lifts and Stairway Chair Lifts

306.7.8

ASTM

ASTM International
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

A615 –15ae1: Specification for Deformed and Plain Carbon-steel Bars for Concrete Reinforcement:

303A.3.5.3

C94/C94M—17A: Specification for Ready-mixed Concrete

109.3.1

E108—17: Standard Test Methods for Fire Tests of Roof Coverings

1204.5

E136—16A: Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C

202

F2006—17: Standard Safety Specification for Window Fall Prevention Devices for Non-Emergency Escape (Egress) and Rescue (Ingress) Windows

505.2, 702.4

F2090—17: Standard Specification for Window Fall Prevention Devices with Emergency (Egress) Release Mechanisms

505.2, 505.3.1, 702.4, 702.5.1

ICC

International Code Council, Inc.
500 New Jersey Avenue NW 6th Floor
Washington, DC 20001

CBC—22: California Building Code

101.4.1, 104.2.1, 106.2.2, 109.3.3, 109.3.6, 109.3.9, 109.3.10, 110.2, *201A.3*, 202, *202A*, *301A.1*, *301A.5*, 301.3, *302A.4*, 302.4.1, 302.5, 303.1, *303A.1*, 303.2.2, 304.1, *304A.1*, 304.3.1, 304.3.2, 305.1, 306.5, 306.7, 306.7.2, 306.7.4, 306.7.5, 306.7.9, 306.7.10, 306.7.10.1, 306.7.10.2, 306.7.10.3, 306.7.11, 306.7.12, 306.7.13, 306.7.15, 306.7.16, 306.7.16.3, 306.7.16.4, 306.7.16.5, 306.7.16.7, 309.2, *309A.2, 309A.3, 309A.6, 310A.2, 310A.3*, 401.3, *401A.3, 402A*, 402.1, *405A.1, 405A.2*, 405.2.1.1, 405.2.3.1, 405.2.3.3, 405.2.4, 405.2.5, 405.2.6, 501.2, *501A.3*, *502A.1*, 502.1, 502.3, *502A.3*, 502.4, *502A.4*, 502.5, *502A.5*, 503.1, *503A.1*, 503.2, *503A.2*, 503.3, *503A.3*, 503.4, *503A.4*, 503.5, 503.11, 503.12, 503.13, *503A.13*, 503.14, 503.15, 503.17, 503.18, 505.3, 505.4, 506.1, *506A.1*, 506.3, *506A.3, 506A.4*, 506.4, 506.5.1, 506.5.2, 506.5.3, 506.5.4, 507.3, 701.2, 701.3, 702.1, 702.2, 702.3, 702.5, 702.6, 702.7, 704.1.1, 704.3, 705.1, 705.2, 706.2, 706.3.2, 802.2.1, 802.2.3, 802.3, 802.4, 802.5.2, 802.6, 802.6, 803.1.1, 803.2, 803.2.2, 803.2.3, 803.2.4, 803.2.5, 803.3, 804.1, 804.4.1, 804.4.1.1, Table 804.4.1.1(1), 804.4.1.2.1, 804.5.1.2, 804.5.3, 804.5.4, 804.5.5, 804.6, 804.7, 804.8.1, 804.9.1, 804.10.2, 804.11, 804.12.2, 805.2, 805.3, 805.4, 904.1.2, 904.1.3, 904.1.4, 904.1.6, 904.1.7, 904.2, 904.2.1, 904.2.2, 905.2, 905.3, 905.4, 906.2, 906.3, 906.6, 1001.2, 1001.3, 1002.1, 1002.2, 1002.3, 1002.4, 1004.1, 1006.1, 1006.2, 1006.3, 1006.4, 1010.1, 1011.1, 1011.2.1, 1011.2.2, 1011.3, 1011.5.1, 1011.5.2, 1011.5.3, 1011.5.6, 1011.6.1, 1011.6.1.1, 1011.6.3, 1011.7.1, 1011.7.2, 1011.7.3, 1011.8.1, 1011.8.2, 1011.8.3, 1102.1, 1102.2, 1102.3, 1103.1, 1103.2, 1103.3, 1201.4, 1202.2, 1203.12, 1204.2, 1204.9, 1206.1, 1301.2.2, 1301.2.3, 1301.2.4, 1301.3.3, 1301.4.1, 1301.6.1, 1301.6.1.1, 1301.6.2, 1301.6.2.1, 1301.6.3.2, 1301.6.3.3, 1301.6.4.1, 1301.6.5, 1301.6.5.1, 1301.6.6, 1301.6.7.1, 1301.6.8, 1301.6.9, 1301.6.9.1, 1301.6.10, 1301.6.10.1, 1301.6.11, 1301.6.11.1, 1301.6.12.1, 1301.6.13, Table 1301.6.15, 1301.6.15.1, 1301.6.16.1, 1301.6.17, 1301.6.17.1, 1301.6.18, 1301.6.18.1, 1301.6.19, Table 1301.6.19, 1301.6.20, 1301.6.20.1, 1301.9.1, 1401.2, 1402.1, 1402.2, 1402.2.1, 1402.3, 1402.4, 1402.5, 1402.6, 1501.5, 1501.6.1, 1501.6.4.1, 1501.6.7, 1506.1, 1506.3, 1507.1

ICC 300—17: ICC Standard on Bleachers, Folding and Telescopic Seating and Grandstands

301.1.1

ICC 500—20: Standard for the Design and Construction of Storm Shelters

303.1, 303.2

ICC A117.1—17: Accessible and Usable Buildings and Facilities

306.3, 306.7, 306.7.11, 306.7.12

CEC*—21: *California Energy Code

302.2, 702.7, 708.1, 809.1, 907.1, 1104.1

ICC—continued

CFC—22: California Fire Code

101.2.1, 101.4.2, 301.3.1, 302.2, 307.1, 308.1, 802.2.1, 802.2.3, 803.2.3, 803.4.1.1, 803.4.1.2, 803.4.1.3, 803.4.1.4, 803.4.1.5, 803.4.1.6, 904.1.5, 1011.6.1.1, 1301.3.2, 1301.6.8.1, 1301.6.14, 1301.6.14.1, 1401.2, 1501.5, 1504.1, 1504.2

IFGC—21: International Fuel Gas Code®

302.2, 702.7.1

CMC—22: California Mechanical Code

302.2, 702.7, 807.1, 902.1.1, 1008.1, 1301.6.7.1, 1301.6.8, 1301.6.8.1

CPC—22: California Plumbing Code

302.2, 408.1, 702.7, 1009.1, 1009.2, 1009.3, 1009.5, 1501.7

IPMC—21: International Property Maintenance Code®

101.4.2, 302.2, 1301.3.2, 1401.2

CRC—22: California Residential Code

101.2, 101.4.1, 104.2.1, 109.3.3, 109.3.10, 302.2, 307.1, 308.1, 401.3, 402.1, 405.2.6, 502.3, 502.4, 502.5, 503.2, 503.3, 503.11, 505.2, 505.3, 507.3, 701.3, 702.4, 702.5, 706.2, 708.1, 805.2, 806.4, 809.1, 906.2, 907.1, 1011.2.1, 1103.1, 1103.2, 1103.3, 1104.1, 1201.4, 1301.2.2, 1301.2.3, 1301.3.3, 1401.2, 1402.1, 1402.2, 1402.2.1, 1402.3, 1402.4, 1402.5, 1402.6

NFPA

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471

NFPA 13R—*22*: Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height

803.2.4

Add new Sections 6.6.10 and 6.6.10.1 as follows:

6.6.10 Solar photovoltaic panel structures.

6.6.10.1 Sprinklers shall be permitted to be omitted from the following structures:

(1) Solar photovoltaic panel structures with no use underneath. Signs may be provided, as determined by the enforcing agency prohibiting any use underneath including storage.

(2) Solar photovoltaic (PV) panels supported by framing that have sufficient uniformly distributed and unobstructed openings throughout the top of the array (horizontal plane) to allow heat and gases to escape, as determined by the enforcing agency.

Revise Section 11.4 as follows:

11.4 Instructions.

The installing contractor shall provide the property owner or the property owner's authorized representative with the following:

(1) All literature and instructions provided by the manufacturer describing proper operation and maintenance of any equipment and devices installed.

(2) NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems 2013 California Edition and Title 19, California Code of Regulations, Chapter 5.

(3) Once the system is accepted by the authority having jurisdiction, a label as prescribed by Title 19, California Code of Regulations, Chapter 5, shall be affixed to each system riser.

CEC—22: California Electrical Code

107.3, 302.2, 406.1.1, 406.1.2, 406.1.3, 406.1.5, 806.1, 806.4.4, 1007.1, 1007.2, 1007.3, 1007.4

NFPA 72—*22*: National Fire Alarm and Signaling Code

803.2.6, 803.4

Revise Section 10.3.1 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.*

Revise Section 10.3.3 as follows:

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.*

NFPA—continued

Revise Section 12.3.8.1 as follows:

12.3.8.1 *The outgoing and return (redundant) circuit conductors shall be permitted in the same cable assembly (i.e., multiconductor cable), enclosure or raceway only under the following conditions:*

(1) For a distance not to exceed 10 feet (3.0 m) where the outgoing and return conductors enter or exit the initiating device, notification appliance, or control unit enclosures.

(2) Single drops installed in the raceway to individual devices or appliances.

*(3) *In a single room not exceeding 1000 feet*^{2} *(93 m*^{2}*) in area, a drop installed in the raceway to multiple devices or appliances that does not include any emergency control function devices.*

(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.

Revise Section 14.4.6.1 as follows:

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 14.4.3.2.*

Revise Section 17.16 as follows:

17.16 Fire Extinguisher Electronic Monitoring Device*. A fire extinguisher electronic 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.*

Revise Section 12.3.8 as follows:

12.3.8 *(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.*

Revise Section 23.8.5.1.2 as follows:

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 as permitted in Section 17.15 of NFPA 72.*

Revise Section 23.8.5.4.1 as follows:

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.

(2) A smoke detector that is continuously subjected to a smoke concentration above alarm threshold does not delay the system functions of Sections 10.7 through 10.16, 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 Sections 10.7 through 10.16, 23.8.1.1, or 21.2.1 without additional delay.

(4) The current status of the alarm verification feature is shown on the record of completion [see Figure 7.8.2(a), Item 4.3].

(5) Operation of a patient room smoke detector in I-2 and R-2.1 occupancies shall not include an alarm verification feature.

Revise Section 29.3.1 as follows:

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 for the purposes for which they are intended.*

Revise Section 29.5.2.1.1 as follows:

29.5.2.1.1* Smoke and Heat Alarms. *Where connected to a supervising station 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.*

Note: Exception to 29.8.2.1.1 not adopted by the SFM.

Add Section 29.10.2.1 as follows:

29.10.2.1 *The alarm verification feature shall not be used for household fire warning equipment.*

Add Section 29.10.6.8.1 as follows:

29.10.6.8.1 *The alarm verification feature shall not be used for household fire warning equipment.*

NFPA 99—21: Health Care Facilities Code

302.2.1, 406.1.4, 408.3, 501.3, 707.1, 806.3, 808.1, 1007.1

NFPA 101—21: Life Safety Code

804.2

UL

UL LLC
333 Pfingsten Road
Northbrook, IL 60062

790—04: Standard Test Methods for Fire Tests of Roof Coverings—with Revisions through October 2018
1204.5

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX A
CHAPTER A1 – SEISMIC STRENGTHENING PROVISIONS FOR UNREINFORCED MASONRY BEARING WALL BUILDINGS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)	**X**			**X**	**X**																		
Adopt only those sections that are listed below																							
Chapter / Section																							
A100.1	X			X	X																		
A103.1	X			X	X																		
A105.4				X	X																		

The state agency does not adopt sections identified with the following symbol: †

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.

Appendix A: GUIDELINES FOR THE SEISMIC RETROFIT OF EXISTING BUILDINGS

CHAPTER A1

SEISMIC STRENGTHENING PROVISIONS FOR UNREINFORCED MASONRY BEARING WALL BUILDINGS

User note:

About this appendix: *Appendix A provides guidelines for upgrading the seismic-resistance capacity of different types of existing buildings. It is organized into separate chapters that deal with buildings of different types, including unreinforced masonry buildings, reinforced concrete and reinforced masonry wall buildings, and light-frame wood buildings.*

SECTION A100
APPLICATION

[BS] A100.1 Vesting authority. *When adopted by a state agency, the provisions of these regulations shall be enforced by the appropriate enforcing agency, but only to the extent of authority granted to such agency by the state legislature.*

Following is a list of the state agencies that adopt building standards, the specific scope of application of the agency responsible for enforcement, and the specific statutory authority of each agency to adopt and enforce such provisions of building standards of this code, unless otherwise stated.

1. ***BSC—California Building Standards Commission.***

   Application—Existing buildings as specified in Section A102 having at least one unreinforced masonry bearing wall, with the exception of buildings subject to building standards pursuant to Health and Safety Code, commencing with Section 17910.

   Enforcing Agency—State or local agency specified by the applicable provisions of the law.

   Authority Cited—Health and Safety Code Section 18934.7.

   Reference— Health and Safety Code Sections 18901 through 18949.

2. ***HCD 1—The Department of Housing and Community Development.***

   Application—Hotels, motels, lodging houses, apartments, dwellings, employee housing and factory-built housing.

   Enforcing Agency—The local building department or the Department of Housing and Community Development.

   Authority Cited—Health and Safety Code Sections 17040, 17921, 17922 and 19990.

   Reference—Health and Safety Code Sections 17000 through 17060, 17910 through 17990, 19960 through 19997; and Government Code Section 12955.1.

3. ***HCD 2—The Department of Housing and Community Development.***

   Application—Permanent buildings and permanent accessory buildings or structures constructed within mobilehome parks and special occupancy parks.

   Enforcing Agency—The local building department or the Department of Housing and Community Development.

   Authority Cited—Health and Safety Code Sections 18300, 18620, 18640, 18865, 18873 and 18873.2.

   Reference—Health and Safety Code Sections 18200 through 18700 and 18860 through 18874.

SECTION A101
PURPOSE

[BS] A101.1 Purpose. The purpose of this chapter is to promote public safety and welfare by reducing the risk of death or injury from the effects of earthquakes on existing unreinforced masonry bearing wall buildings.

The provisions of this chapter are intended as minimum standards for structural seismic resistance, and are established primarily to reduce the risk of life loss or injury. Compliance with these provisions will not necessarily prevent loss of life or injury, or prevent earthquake damage to retrofitted buildings.

SECTION A102
SCOPE

[BS] A102.1 General. The provisions of this chapter shall apply to all existing buildings not more than six stories in height above the base of the structure and having not fewer than one unreinforced masonry bearing wall. The elements regulated by this chapter shall be determined in accordance with Table A102.1. Except as provided herein, other structural provisions of the building code shall apply. This chapter does not apply to the alteration of existing electrical, plumbing, mechanical or fire safety systems.

[BS] A102.2 Essential and hazardous facilities. The provisions of this chapter shall not apply to the strengthening of

[BS] TABLE A102.1
ELEMENTS REGULATED BY THIS CHAPTER

BUILDING ELEMENTS	S_{D1}			
	≥ 0.067$_g$ < 0.133$_g$	≥ 0.133$_g$ < 0.20$_g$	≥ 0.20$_g$ < 0.30$_g$	≥ 0.30$_g$
Parapets	X	X	X	X
Walls, anchorage	X	X	X	X
Walls, *h/t* ratios		X	X	X
Walls, in-plane shear		X	X	X
Diaphragms[a]			X	X
Diaphragms, shear transfer[b]		X	X	X
Diaphragms, demand-capacity ratios[b]			X	X

a. Applies only to buildings designed according to the general procedures of Section A110.
b. Applies only to buildings designed according to the special procedures of Section A111.

buildings in Risk Category III or IV. Such buildings shall be strengthened to meet the requirements of the *California Building Code* for new buildings of the same risk category or other such criteria approved by the code official.

SECTION A103
DEFINITIONS

[BS] A103.1 Definitions. For the purpose of this chapter, the applicable definitions in the *California Building Code as adopted by the California Building Standards Commission (BSC)* shall also apply.

BUILDING CODE. [BSC, HCD 1 and HCD 2] *"Building Code" shall mean the most current edition of the California Building Code, Title 24, Part 2 as adopted by the California Building Standards Commission (BSC).*

[BS] BED JOINT. The horizontal layer of mortar on which a masonry unit is laid.

[BS] COLLAR JOINT. The vertical space between adjacent wythes. A collar joint may contain mortar or grout.

[BS] CROSSWALL. A new or existing wall that meets the requirements of Section A111.3. A crosswall is not a shear wall.

[BS] CROSSWALL SHEAR CAPACITY. The unit shear value times the length of the crosswall, $v_c L_c$.

[BS] DETAILED BUILDING SYSTEM ELEMENTS. The localized elements and the interconnections of these elements that define the design of the building.

[BS] DIAPHRAGM EDGE. The intersection of the horizontal diaphragm and a shear wall.

[BS] DIAPHRAGM SHEAR CAPACITY. The unit shear value times the depth of the diaphragm, $v_u D$.

[BS] FLEXIBLE DIAPHRAGM. A diaphragm of wood or untopped metal deck construction in which the horizontal deformation along its length is at least two times the average story drift.

HEAD JOINT. The vertical mortar joint placed between masonry units within the wythe.

[BS] NORMAL WALL. A wall perpendicular to the direction of seismic forces.

[BS] OPEN FRONT. An exterior building wall line on one side only without vertical elements of the seismic force-resisting system in one or more stories.

[BS] POINTING. The process of removal of deteriorated mortar from between masonry units and placement of new mortar. Also known as repointing or tuckpointing for purposes of this chapter.

[BS] REPOINTING. See "*Pointing*."

[BS] RIGID DIAPHRAGM. A diaphragm of concrete construction or concrete-filled metal deck construction.

[BS] TUCKPOINTING. See "*Pointing*."

[BS] UNREINFORCED MASONRY (URM). Includes burned clay, concrete or sand-lime brick; hollow clay or concrete block; plain concrete; and hollow clay tile. These materials shall comply with the requirements of Section A106 as applicable.

[BS] UNREINFORCED MASONRY BEARING WALL. A URM wall that provides the vertical support for the reaction of floor or roof-framing members for which the total superimposed vertical load exceeds 100 pounds per linear foot (1459 N/m) of wall length.

[BS] UNREINFORCED MASONRY WALL. A masonry wall that relies on the tensile strength of masonry units, mortar and grout in resisting design loads, and in which the area of reinforcement is less than the minimum amounts as defined for reinforced masonry walls.

[BS] YIELD STORY DRIFT. The lateral displacement of one level relative to the level above or below at which yield stress is first developed in a frame member.

SECTION A104
SYMBOLS AND NOTATIONS

[BS] A104.1 Symbols and notations. For the purpose of this chapter, the following notations supplement the applicable symbols and notations in the building code.

a_n = Diameter of core multiplied by its length or the area of the side of a square prism.

A = Cross-sectional area of unreinforced masonry pier or wall, square inches (10^{-6} m^2).

A_b = Total area of the bed joints above and below the test specimen for each in-place shear test, square inches (10^{-6} m^2).

A_n = Area of net mortared or grouted section of a wall or wall pier.

D = In-plane width dimension of pier, inches (10^{-3} m), or depth of diaphragm, feet (m).

DCR = Demand-capacity ratio specified in Section A111.4.2.

f'_m = Lower bound masonry compressive strength.

f_{sp} = Tensile-splitting strength of masonry.

F_{wx} = Force applied to a wall at level x, pounds (N).

H = Least clear height of opening on either side of a pier, inches (10^{-3} m).

h/t = Height-to-thickness ratio of URM wall. Height, h, is measured between wall anchorage levels and/or slab-on-grade.

L = Span of diaphragm between shear walls, or span between shear wall and open front, feet (m).

L_c = Length of crosswall, feet (m).

L_i = Effective diaphragm span for an open-front building specified in Section A111.8, feet (m).

P = Applied force as determined by standard test method of ASTM C496 or ASTM E519, pounds (N).

P_D = Superimposed dead load at the location under consideration, pounds (N). For determination of the rocking shear capacity, dead load at the top of the pier under consideration shall be used.

P_{D+L} = Stress resulting from the dead plus actual live load in place at the time of testing, pounds per square inch (kPa).

P_{test} = Splitting tensile test load determined by standard test method ASTM C496, pounds (N).

P_w = Weight of wall, pounds (N).

R = Response modification factor for Ordinary plain masonry shear walls in Bearing Wall System from Table 12.2-1 of ASCE 7, where R = 1.5.

S_{DS} = Design spectral acceleration at short period, in g units.

S_{D1} = Design spectral acceleration at 1-second period, in g units.

v_a = The shear strength of any URM pier, $v_m A/1.5$ pounds (N).

v_c = Unit shear strength for a crosswall sheathed with any of the materials given in Table A108.1(1) or Table A108.1(2), pounds per foot (N/m).

v_{mL} = Shear strength of unreinforced masonry, pounds per square inch (kPa).

V_{aa} = The shear strength of any URM pier or wall, pounds (N).

V_{ca} = Total shear capacity of crosswalls in the direction of analysis immediately above the diaphragm level being investigated, $v_c L_c$, pounds (N).

V_{cb} = Total shear capacity of crosswalls in the direction of analysis immediately below the diaphragm level being investigated, $v_c L_c$, pounds (N).

V_p = Shear force assigned to a pier on the basis of its relative shear rigidity, pounds (N).

V_r = Pier rocking shear capacity of any URM wall or wall pier, pounds (N).

v_{test} = Load at incipient cracking for each in-place shear test performed in accordance with Section A106.2.3.6, pounds (N).

v_{tl} = Lower bound mortar shear strength, pounds per square inch (kPa).

v_{to} = Mortar shear test values as specified in Section A106.2.3.6, pounds per square inch (kPa).

v_u = Unit shear capacity value for a diaphragm sheathed with any of the materials given in Table A108.1(1) or A108.1(2), pounds per foot (N/m).

V_{wx} = Total shear force resisted by a shear wall at the level under consideration, pounds (N).

W = Total seismic dead load as defined in the building code, pounds (N).

W_d = Total dead load tributary to a diaphragm level, pounds (N).

W_w = Total dead load of a URM wall above the level under consideration or above an open-front building, pounds (N).

W_{wx} = Dead load of a URM wall assigned to level x halfway above and below the level under consideration, pounds (N).

$\Sigma v_u D$ = Sum of diaphragm shear capacities of both ends of the diaphragm, pounds (N).

$\Sigma\Sigma v_u D$ = For diaphragms coupled with crosswalls, $v_u D$ includes the sum of shear capacities of both ends of diaphragms coupled at and above the level under consideration, pounds (N).

ΣW_d = Total dead load of all the diaphragms at and above the level under consideration, pounds (N).

SECTION A105 GENERAL REQUIREMENTS

[BS] A105.1 General. The seismic force-resisting system specified in this chapter shall comply with the *California Building Code* and referenced standards, except as modified herein.

[BS] A105.2 Alterations and repairs. Alterations and repairs required to meet the provisions of this chapter shall comply with applicable structural requirements of the building code unless specifically provided for in this chapter.

[BS] A105.3 Requirements for plans. The following construction information shall be included in the plans required by this chapter:

1. Dimensioned floor and roof plans showing existing walls and the size and spacing of floor and roof-framing members and sheathing materials. The plans shall

indicate all existing URM walls, and new crosswalls and shear walls, and their materials of construction. The location of these walls and their openings shall be fully dimensioned and drawn to scale on the plans.

2. Dimensioned URM wall elevations showing openings, piers, wall classes as defined in Section A106.2.3.9, thickness, heights, wall shear test locations, cracks or damaged portions requiring repairs, the general condition of the mortar joints, and if and where pointing is required. Where the exterior face is veneer, the type of veneer, its thickness and its bonding and/or ties to the structural wall masonry shall be noted.
3. The type of interior wall and ceiling materials, and framing.
4. The extent and type of existing wall anchorage to floors and roof where used in the design.
5. The extent and type of parapet corrections that were previously performed, if any.
6. Repair details, if any, of cracked or damaged unreinforced masonry walls required to resist forces specified in this chapter.
7. All other plans, sections and details necessary to delineate required retrofit construction.
8. The design procedure used shall be stated on both the plans and the permit application.
9. Details of the anchor prequalification program required by Section A107.5.3, if used, including location and results of all tests.
10. Quality assurance requirements of special inspection for all new construction materials and for retrofit construction including: anchor tests, pointing or repointing of mortar joints, installation of adhesive or mechanical anchors, and other elements as deemed necessary to ensure compliance with this chapter.

[BS] A105.4 Structural observation, testing and inspection. Structural observation, in accordance with Section 1704 of the *California Building Code*, shall be required for all structures in which seismic retrofit is being performed in accordance with this chapter. Structural observation shall include visual observation of work for compliance with the *approved* construction documents and confirmation of existing conditions assumed during design.

Structural testing and inspection for new and existing construction materials shall be in accordance with the building code, except as modified by this chapter.

Special inspection as described in Section A105.3, Item 10, shall be provided equivalent to Level 3 as prescribed in TMS 402, Table 3.1(2).

SECTION A106 MATERIALS REQUIREMENTS

[BS] A106.1 Condition of existing materials. Existing materials used as part of the required vertical load-carrying or seismic force-resisting system shall be evaluated by on-site investigation and: determined to be in good condition (free of degraded mortar, degraded masonry units or significant cracking); or shall be repaired, enhanced, retrofitted or removed and replaced with new materials. Mortar joint deterioration shall be patched by pointing or repointing of the eroded joint in accordance with Section A106.2.3.10. Existing significant cracks in solid unit unreinforced and solid grouted hollow unit masonry shall be repaired.

[BS] A106.2 Existing unreinforced masonry.

[BS] A106.2.1 General. Unreinforced masonry walls used to support vertical loads or seismic forces parallel and perpendicular to the wall plane shall be tested as specified in this section. Masonry that does not meet the minimum requirements established by this chapter shall be repaired, enhanced, removed and replaced with new materials, or alternatively, shall have its structural functions replaced with new materials and shall be anchored to supporting elements.

[BS] A106.2.2 Lay-up of walls. Unreinforced masonry walls shall be laid in a running bond pattern.

[BS] A106.2.2.1 Header in multiple-wythe solid brick. The facing and backing wythes of multiple-wythe walls shall be bonded so that not less than 10 percent of the exposed face area is composed of solid headers extending not less than 4 inches (102 mm) into the backing wythes. The clear distance between adjacent header courses shall not exceed 24 inches (610 mm) vertically or horizontally. Where backing consists of two or more wythes, the headers shall extend not less than 4 inches (102 mm) into the most distant wythe, or the backing wythes shall be bonded together with separate headers for which the area and spacing conform to the foregoing. Wythes of walls not meeting these requirements shall be considered to be veneer, and shall not be included in the effective thickness used in calculating the height-to-thickness ratio and the shear capacity strength of the wall.

Exception: Where SD1 is 0.3 g or less, veneer wythes anchored and made composite with backup masonry are permitted to be used for calculation of the effective thickness.

[BS] A106.2.2.2 Lay-up patterns. Lay-up patterns other than those specified in Section A106.2.2.1 are allowed if their performance can be justified.

[BS] A106.2.3 Testing of masonry.

[BS] A106.2.3.1 Concrete masonry units and structural clay load-bearing tile. Grouted or ungrouted hollow concrete masonry units shall be tested in accordance with ASTM C140. Grouted or ungrouted structural clay load-bearing tile shall be tested in accordance with ASTM C67.

[BS] A106.2.3.2 In-place mortar joint shear tests. Mortar joint shear test values, v_{to}, shall be obtained by one of the following:

1. ASTM C1531.

2. For masonry walls that have high shear strength mortar, or where in-place testing is not practical because of crushing or other failure mode of the masonry, alternative procedures for testing shall be used in accordance with Section A106.2.3.2.

[BS] A106.2.3.3 Alternative procedures for testing masonry. The splitting tensile strength of existing masonry, f_{sp}, or the prism strength of existing masonry, f'_m, is permitted to be determined in accordance with ASTM C496 and calculated by the following equation:

$$f_{sp} = \frac{0.494P}{a_n} \qquad \textbf{(Equation A1-1)}$$

[BS] A106.2.3.4 Location of tests. The shear tests shall be taken at locations representative of the mortar conditions throughout the building. Test locations shall be determined at the building site by the registered design professional in charge. Results of all tests and their locations shall be recorded.

[BS] A106.2.3.5 Number of tests. The minimum number of tests per masonry class shall be determined as follows:

1. At each of both the first and top stories, not less than two tests per wall or line of wall elements providing a common line of resistance to seismic forces.
2. At each of all other stories, not less than one test per wall or line of wall elements providing a common line of resistance to seismic forces.
3. In any case, not less than one test per 1,500 square feet (139.4 m^2) of wall surface and not less than a total of eight tests.

[BS] A106.2.3.6 Minimum quality of mortar.

1. Mortar shear test values, v_{to}, in pounds per square inch (kPa), shall be obtained for each in-place shear test in accordance with the following equation:

   $$v_{to} = (V_{test}/A_b) - P_{D+L} \qquad \textbf{(Equation A1-2)}$$

   where:

   V_{test} = Load at first observed movement.

   A_b = Total area of the bed joints above and below the test specimen.

   P_{D+L} = Stress resulting from actual dead plus live loads in place at the time of testing.

2. Individual unreinforced masonry walls with more than 50 percent of mortar test values, v_{to}, less than 30 pounds per square inch (207 kPa) shall be pointed prior to and retested.
3. The lower bound mortar shear strength, v_{tL}, is defined as the mean minus one standard deviation of the mortar shear test values, v_{to}.
4. Unreinforced masonry with mortar shear strength, v_{tL}, less than 30 pounds per square inch (207 kPa) shall be pointed and retested or shall have its structural function replaced, and shall be anchored to supporting elements in accordance with Sections A106.2.1 and A113.8. When existing mortar in any wythe is pointed to increase its shear strength and is retested, the condition of the mortar in the adjacent bed joints of the inner wythe or wythes and the opposite outer wythe shall be examined for extent of deterioration. The shear strength of any wall class shall be not greater than that of the weakest wythe of that class.

[BS] A106.2.3.7 Minimum quality of masonry. Where the alternative procedures of Section A106.2.3.2 are used to determine masonry quality, the following minimums apply:

1. The minimum average value of splitting tensile strength, f_{sp}, as calculated by Equation A1-1 shall be 50 pounds per square inch (344.7 kPa).
2. Individual unreinforced masonry walls with average splitting tensile strength of less than 50 pounds per square inch (344.7 kPa) shall be pointed and retested.
3. The lower-bound mortar strength f_{spL} is defined as the mean minus one standard deviation P_{D+L} of the splitting tensile test values f_{sp}.

[BS] A106.2.3.8 Collar joints. The collar joints shall be inspected at the test locations during each in-place shear test, and estimates of the percentage of surfaces of the adjacent wythe that are covered with mortar shall be reported along with the results of the in-place shear tests.

[BS] A106.2.3.9 Unreinforced masonry classes. Existing unreinforced masonry shall be categorized into one or more classes based on shear strength, quality of construction, state of repair, deterioration and weathering. A class shall be characterized by the masonry shear strength determined in accordance with Section A108.2. Classes are defined for whole walls, not for small areas of masonry within a wall. Discretion in the definition of classes of masonry is permitted to avoid unnecessary testing.

[BS] A106.2.3.10 Pointing. Deteriorated mortar joints in unreinforced masonry walls shall be pointed in accordance with the following requirements:

1. **Joint preparation**. Deteriorated mortar shall be cut out by means of a toothing chisel or nonimpact power tool until sound mortar is reached, to a depth not less than $^3/_4$ inch (19.1 mm) or twice the thickness of the joint, whichever is less, but not greater than 2 inches (50 mm). Care shall be taken not to damage the masonry edges. After cutting is complete, all loose material shall be removed with a brush, or air or water stream.
2. **Mortar preparation.** The mortar mix shall be proportioned as required by the construction specifications and manufacturer's approved instructions.

3. **Packing.** The joint into which the mortar is to be packed shall be dampened but without free-standing water. The mortar shall be tightly packed into the joint in layers not exceeding $^1/_4$ inch (6.4 mm) deep until it is filled; then it shall be tooled to a smooth surface to match the original profile.

Nothing shall prevent pointing of any masonry wall joints before testing is performed in accordance with Section A106.2.3, except as required in Section A107.2.

SECTION A107
QUALITY CONTROL

[BS] A107.1 Pointing. Preparation and mortar pointing shall be performed with special inspection.

Exception: At the discretion of the code official, incidental pointing may be performed without special inspection.

[BS] A107.2 Masonry shear tests. In-place masonry shear tests shall comply with Section A106.2.3.1. Testing of masonry for determination of splitting tensile strength shall comply with Section A106.2.3.3.

[BS] A107.3 Existing wall anchors. Existing wall anchors used as all or part of the required tension anchors shall be tested in pullout according to Section A107.5.1. Not fewer than four anchors tested per floor shall be tested in pullout, with not fewer than two tests at walls with joists framing into the wall and two tests at walls with joists parallel to the wall, but not less than 10 percent of the total number of existing tension anchors at each level.

[BS] A107.4 New wall anchors. New wall anchors embedded in URM walls shall be subject to special inspection prior to placement of the anchor and grout or adhesive in the drilled hole. Five percent of all anchors that do not extend through the wall shall be subject to a direct-tension test, and an additional 20 percent shall be tested using a calibrated torque wrench. Testing shall be performed in accordance with Section A107.5.

New wall anchors embedded in URM walls resisting tension forces or a combination of tension and shear forces shall be subject to special inspection, prior to placement of the anchor and grout or adhesive in the drilled hole. Five percent of all anchors resisting tension forces shall be subject to a direct-tension test, and an additional 20 percent shall be tested using a calibrated torque wrench. Testing shall be performed in accordance with Section A107.5.

Exception: New bolts that extend through the wall with steel plates on the far side of the wall need not be tested.

[BS] A107.5 Tests of anchors in unreinforced masonry walls. Tests of anchors in unreinforced masonry walls shall be in accordance with Sections A107.5.1 through A107.5.3. Results of all tests shall be reported to the authority having jurisdiction. The report shall include the test results of maximum load for each test; pass-fail results; corresponding anchor size and type; orientation of loading; details of the anchor installation, testing apparatus and embedment; wall thickness; and joist orientation and proximity to the tested anchor.

[BS] A107.5.1 Direct tension testing of existing anchors and new anchors. The test apparatus shall be supported by the masonry wall. The test procedure for prequalification of tension and shear anchors shall comply with ASTM E488. Existing wall anchors shall be given a preload of 300 pounds (1335 N) before establishing a datum for recording elongation. The tension test load reported shall be recorded at $^1/_8$ inch (3.2 mm) relative movement between the existing anchor and the adjacent masonry surface. New embedded tension anchors shall be subject to a direct tension load of not less than 2.5 times the design load but not less than 1,500 pounds (6672 N) for 5 minutes.

Exception: Where obstructions occur, the distance between the anchor and the test apparatus support shall be not less than one-half the wall thickness for existing anchors and 75 percent of the embedment length for new embedded anchors.

[BS] A107.5.2 Torque testing of new anchors. Anchors embedded in unreinforced masonry walls shall be tested using a torque-calibrated wrench to the following minimum torques:

- $^1/_2$-inch-diameter (12.7 mm) bolts: 40 foot pounds (54.2 N-m).
- $^5/_8$-inch-diameter (15.9 mm) bolts: 50 foot pounds (67.8 N-m).
- $^3/_4$-inch-diameter (19.1 mm) bolts: 60 foot pounds (81.3 N-m).

[BS] A107.5.3 Prequalification test for bolts and other types of anchors. ASTM E488 or the test procedure in Section A107.5.1 is permitted to be used to determine tension or shear strength values for anchors greater than those permitted by Table A108.1(2). Anchors shall be installed in the same manner and using the same materials as will be used in the actual construction. Not fewer than five tests for each bolt size and type shall be performed for each class of masonry in which they are proposed to be used. The tension and shear strength values for such anchors shall be the lesser of the average ultimate load divided by 5.0 or the average load at which $^1/_8$ inch (3.2 mm) elongation occurs for each size and type of anchor and class of masonry.

SECTION A108
DESIGN STRENGTHS

[BS] A108.1 Strength values.

1. Strength values for existing materials are given in Table A108.1(1) and for new materials in Table A108.1(2).
2. The strength reduction factor, Φ, shall be taken equal to 1.0.
3. The use of materials not specified herein shall be based on substantiating research data or engineering judgment, as approved by the code official.

[BS] TABLE A108.1(1)
STRENGTH VALUES FOR EXISTING MATERIALS

EXISTING MATERIALS OR CONFIGURATION OF MATERIALS[a]		STRENGTH VALUES x 14.594 for N/m
Horizontal diaphragms	Roofs with straight sheathing and roofing applied directly to the sheathing.	300 lbs. per ft. for seismic shear
	Roofs with diagonal sheathing and roofing applied directly to the sheathing.	750 lbs. per ft. for seismic shear
	Floors with straight tongue-and-groove sheathing.	300 lbs. per ft. for seismic shear
	Floors with straight sheathing and finished wood flooring with board edges offset or perpendicular.	1,500 lbs. per ft. for seismic shear
	Floors with diagonal sheathing and finished wood flooring.	1,800 lbs. per ft. for seismic shear
	Metal deck welded with minimal welding.[c]	1,800 lbs. per ft. for seismic shear
	Metal deck welded for seismic resistance.[d]	3,000 lbs. per ft. for seismic shear
Crosswalls[b]	Plaster on wood or metal lath.	600 lbs. per ft. for seismic shear
	Plaster on gypsum lath.	550 lbs. per ft. for seismic shear
	Gypsum wallboard, unblocked edges.	200 lbs. per ft. for seismic shear
	Gypsum wallboard, blocked edges.	400 lbs. per ft. for seismic shear
Existing footing, wood framing, structural steel, reinforcing steel	Plain concrete footings.	f'_c = 1,500 psi unless otherwise shown by tests
	Douglas fir wood.	Same as D.F. No. 1
	Reinforcing steel.	F_y = 40,000 psi maximum
	Structural steel.	F_y = 33,000 psi maximum

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 pound = 4.4 N, 1 pound per square inch = 6894.75 N/m^2, 1 pound per foot = 14.43 N/m.

a. Material must be sound and in good condition.

b. Shear values of these materials may be combined, except the total combined value should not exceed 900 pounds per foot.

c. Minimum 22-gage steel deck with welds to supports satisfying the standards of the Steel Deck Institute.

d. Minimum 22-gage steel deck with $^3/_4$-inch diameter plug welds at an average spacing not exceeding 8 inches and with sidelap welds appropriate for the deck span.

[BS] A108.2 Masonry shear strength. The unreinforced masonry shear strength, v_{mL}, shall be determined for each masonry class from one of the following equations:

1. When testing is performed in accordance with Section A106.2.3.1, the unreinforced masonry shear strength, v_m, shall be determined by Equation A1-3.

$$v_{mL} = \frac{0.75\left(0.75 v_{tL} \frac{P_D}{A_n}\right)}{1.5} \qquad \textbf{(Equation A1-3)}$$

The mortar shear strength values, v_{tL}, shall be determined in accordance with Section A106.2.3.6.

2. When alternate testing is performed in accordance with Section A106.2.3.3, unreinforced masonry shear, v_{mL}, shall be determined by Equation A1-4.

$$v_{mL} = \frac{0.75\left(f_{sp} + \frac{P_D}{A_n}\right)}{1.5} \qquad \textbf{(Equation A1-4)}$$

[BS] A108.3 Masonry compression. Where any increase in wall dead plus live load compression stress occurs, the maximum compression stress in unreinforced masonry, Q_G/A_n, shall not exceed 300 pounds per square inch (2070 kPa).

[BS] A108.4 Masonry tension. Unreinforced masonry shall be assumed to have no tensile capacity.

[BS] A108.5 Wall tension anchors. The tension strength of wall anchors shall be the average of the tension test values for anchors having the same wall thickness and framing orientation.

[BS] A108.6 Foundations. For existing foundations, new total dead loads are permitted to be increased over the existing dead load by 25 percent. New total dead load plus live load plus seismic forces may be increased over the existing dead load plus live load by 50 percent. Higher values may be justified only in conjunction with a geotechnical investigation.

SECTION A109
ANALYSIS AND DESIGN PROCEDURE

[BS] A109.1 General. The elements of buildings hereby required to be analyzed are specified in Table A102.1.

[BS] A109.2 Selection of procedure. Buildings with rigid diaphragms shall be analyzed by the general procedure of Section A110. Buildings with flexible diaphragms shall be analyzed by the general procedure or, where applicable, are permitted to be analyzed by the special procedure of Section A111.

**[BS] TABLE A108.1(2)
STRENGTH VALUES OF NEW MATERIALS USED IN CONJUNCTION WITH EXISTING CONSTRUCTION**

NEW MATERIALS OR CONFIGURATION OF MATERIALS		STRENGTH VALUES
Horizontal diaphragms	Plywood sheathing applied directly over existing straight sheathing with ends of plywood sheets bearing on joists or rafters and edges of plywood located on center of individual sheathing boards.	675 lbs. per ft.
Crosswalls	Plywood sheathing applied directly over wood studs; no value should be given to plywood applied over existing plaster or wood sheathing.	1.2 times the value specified in the current building code.
	Drywall or plaster applied directly over wood studs.	The value specified in the current building code.
	Drywall or plaster applied to sheathing over existing wood studs.	50 percent of the value specified in the current building code.
Tension anchors[f]	Anchors extending entirely through unreinforced masonry wall secured with bearing plates on far side of a wall 30 square inches of area.[b, c]	5,400 lbs. per anchor for three-wythe minimum walls. 2,700 lbs. for two-wythe walls.
Shear bolts[e, f]	Anchors embedded not less than 8 inches into unreinforced masonry walls; anchors should be centered in $2^1/_2$-inch-diameter holes with dry-pack or nonshrink grout around the circumference of the anchor.	The value for plain masonry specified for solid masonry TMS 402; and no value larger than those given for $^3/_4$-inch bolts should be used.
Combined tension and shear anchors[f]	Through-anchors—anchors meeting the requirements for shear and for tension anchors.[b, c]	Tension—same as for tension anchors. Shear—same as for shear anchors.
	Embedded anchors—anchors extending to the exterior face of the wall with a $2^1/_2$-inch round plate under the head and drilled at an angle of $22^1/_2$ degrees to the horizontal; installed as specified for shear anchors.[a, b, c]	Tension—3,600 lbs. per anchor. Shear—same as for shear anchors.
Infilled walls	Reinforced masonry infilled openings in existing unreinforced masonry walls; provide keys or dowels to match reinforcing.	Same as values specified for unreinforced masonry walls.
Reinforced masonry[d]	Masonry piers and walls reinforced per the current building code.	The value specified in the current building code for strength design.
Reinforced concrete[d]	Concrete footings, walls and piers reinforced as specified in the current building code.	The value specified in the current building code for strength design.

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm^2, 1 pound = 4.4 N, 1 degree = 0.017 rad, 1 pound per foot = 14.43 N/m, 1 foot = 304.8 mm.

a. Embedded anchors to be tested as specified in Section A107.4.

b. Anchors shall be $^1/_2$ inch minimum in diameter.

c. Drilling for anchors shall be done with an electric rotary drill; impact tools should not be used for drilling holes or tightening anchors and shear bolt nuts.

d. Load factors or capacity reduction factors shall not be used.

e. Other bolt sizes, values and installation methods may be used, provided that a testing program is conducted in accordance with Section A107.5.3. The strength value shall be determined by multiplying the calculated allowable value, determined in accordance with Section A107.5.3, by 3.0, and the usable value shall be limited to not greater than 1.5 times the value given in the table. Bolt spacing shall not exceed 6 feet on center and shall be not less than 12 inches on center.

f. An alternative adhesive anchor bolt system is permitted to be used providing: its properties and installation conform to an ICC Evaluation Service Report; and the report states that the system's use is in unreinforced masonry as an acceptable alternative to Sections A107.4 and A113.1 or TMS 402, Section 2.1.4. The report's allowable values shall be multiplied by a factor of three to obtain strength values and the strength reduction factor, Φ, shall be taken equal to 1.0.

SECTION A110
GENERAL PROCEDURE

[BS] A110.1 Minimum design lateral forces. Buildings shall be analyzed to resist minimum lateral forces assumed to act nonconcurrently in the direction of each of the main axes of the structure in accordance with the following:

$$V = \frac{0.75 S_{DS} W}{R} \qquad \textbf{(Equation A1-5)}$$

[BS] A110.2 Seismic forces on elements of structures. Parts and portions of a structure not covered in Section A110.3 shall be analyzed and designed per the current building code, using force levels defined in Section A110.1.

Exceptions:

1. Unreinforced masonry walls for which height-tothickness ratios do not exceed ratios set forth in Table A110.2 need not be analyzed for out-of-plane loading. Unreinforced masonry walls that exceed the allowable *h/t* ratios of Table A110.2 shall be braced according to Section A113.5.
2. Parapets complying with Section A113.6 need not be analyzed for out-of-plane loading.
3. Where walls are to be anchored to flexible floor and roof diaphragms, the anchorage shall be in accordance with Section A113.1.

[BS] TABLE A110.2
ALLOWABLE VALUE OF HEIGHT-TO-THICKNESS RATIO OF UNREINFORCED MASONRY WALLS

WALL TYPES	$0.13_g \le S_{D1} < 0.25_g$	$0.25_g \le S_{D1} < 0.4_g$	$S_{D1} \ge 0.4_g$ BUILDINGS WITH CROSSWALLS[a]	$S_{D1} \ge 0.4_g$ ALL OTHER BUILDINGS
Walls of one-story buildings	20	16	16[b, c]	13
First-story wall of multiple-story building	20	18	16	15
Walls in top story of multiple-story building	14	14	14[b, c]	9
All other walls	20	16	16	13

For SI:1 pound per square inch = 6894.75 N/m^2.

a. Applies to the special procedures of Section A111 only. See Section A111.7 for other restrictions.

b. This value of height-to-thickness ratio shall be used where mortar shear tests establish a tested mortar shear strength, v_t, of not less than 100 pounds per square inch. This value shall also be used where the tested mortar shear strength is not less than 60 pounds per square inch, and where a visual examination of the collar joint indicates not less than 50-percent mortar coverage.

c. Where a visual examination of the collar joint indicates not less than 50-percent mortar coverage, and the tested mortar shear strength, v_t, is greater than 30 pounds per square inch but less than 60 pounds per square inch, the allowable height-to-thickness ratio may be determined by linear interpolation between the larger and smaller ratios in direct proportion to the tested mortar shear strength.

[BS] A110.3 In-plane loading of URM shear walls and frames. Vertical seismic force-resisting elements shall be analyzed in accordance with Section A112.

[BS] A110.4 Redundancy and overstrength factors. Any redundancy or overstrength factors contained in the building code may be taken as unity. The vertical component of seismic force (E_v) may be taken as zero.

SECTION A111
SPECIAL PROCEDURE

[BS] A111.1 Limits for the application of this procedure. The special procedures of this section shall be applied only to buildings having the following characteristics:

1. Flexible diaphragms at all levels above the base of the structure.
2. Vertical elements of the seismic force-resisting system consisting predominantly of masonry or a combination of masonry and concrete shear walls.
3. Except for single-story buildings with an open front on one side only, not fewer than two lines of vertical elements of the seismic force-resisting system parallel to each axis of the building (see Section A111.8 for open front buildings).

[BS] A111.2 Seismic forces on elements of structures. With the exception of the provisions in Sections A111.4 through A111.7, elements of structures shall comply with Sections A110.2 through A110.4.

[BS] A111.3 Crosswalls. Crosswalls shall meet the requirements of this section.

[BS] A111.3.1 Crosswall definition. A crosswall is a wood-framed wall sheathed with any of the materials described in Table A108.1(1) or Table A108.1(2) or other system as defined in Section A111.3.5. Crosswalls shall be spaced not more than 40 feet (12 192 mm) on center measured perpendicular to the direction of consideration, and shall be placed in each story of the building. Crosswalls shall extend the full story height between diaphragms.

Exceptions:

1. Crosswalls need not be provided at all levels where used in accordance with Section A111.4.2, Item 4.
2. Existing crosswalls need not be continuous below a wood diaphragm at or within 4 feet (1219 mm) of grade, provided that:
   2.1. Shear connections and anchorage requirements of Section A111.5 are satisfied at all edges of the diaphragm.
   2.2. Crosswalls with total shear capacity of $0.5S_{D1}\Sigma W_d$ interconnect the diaphragm to the foundation.
   2.3. The demand-capacity ratio of the diaphragm between the crosswalls that are continuous to their foundations does not exceed 2.5, calculated as follows:

$$DCR = \frac{(2.1S_{D1}W_d + V_{ca})}{2v_uD}$$

(Equation A1-6)

[BS] A111.3.2 Crosswall shear capacity. Within any 40 feet (12 192 mm) measured along the span of the diaphragm, the sum of the crosswall shear capacities shall be not less than 30 percent of the diaphragm shear capacity of the strongest diaphragm at or above the level under consideration.

[BS] A111.3.3 Existing crosswalls. Existing crosswalls shall have a maximum height-to-length ratio between openings of 1.5 to 1. Existing crosswall connections to diaphragms need not be investigated as long as the crosswall extends to the framing of the diaphragms above and below.

[BS] A111.3.4 New crosswalls. New crosswall connections to the diaphragm shall develop the crosswall shear capacity. New crosswalls shall have the capacity to resist an overturning moment equal to the crosswall shear capacity times the story height. Crosswall overturning moments need not be cumulative over more than two stories.

[BS] A111.3.5 Other crosswall systems. Other systems, such as moment-resisting frames, may be used as crosswalls provided that the yield story drift does not exceed 1 inch (25 mm) in any story.

[BS] A111.4 Wood diaphragms.

[BS] A111.4.1 Acceptable diaphragm span. A diaphragm is acceptable if the point (*L*,*DCR*) on Figure A111.4.1 falls within Region 1, 2 or 3.

[BS] A111.4.2 Demand-capacity ratios. Demand-capacity ratios shall be calculated for the diaphragm at any level according to the following formulas:

1. For a diaphragm without qualifying crosswalls at levels immediately above or below:

$$DCR = 2.1S_{D1}W_d/\Sigma v_u D \quad \textbf{(Equation A1-7)}$$

2. For a diaphragm in a single-story building with qualifying crosswalls, or for a roof diaphragm coupled by crosswalls to the diaphragm directly below:

$$DCR = 2.1S_{D1}W_d/\Sigma v_u D + V_{cb}$$

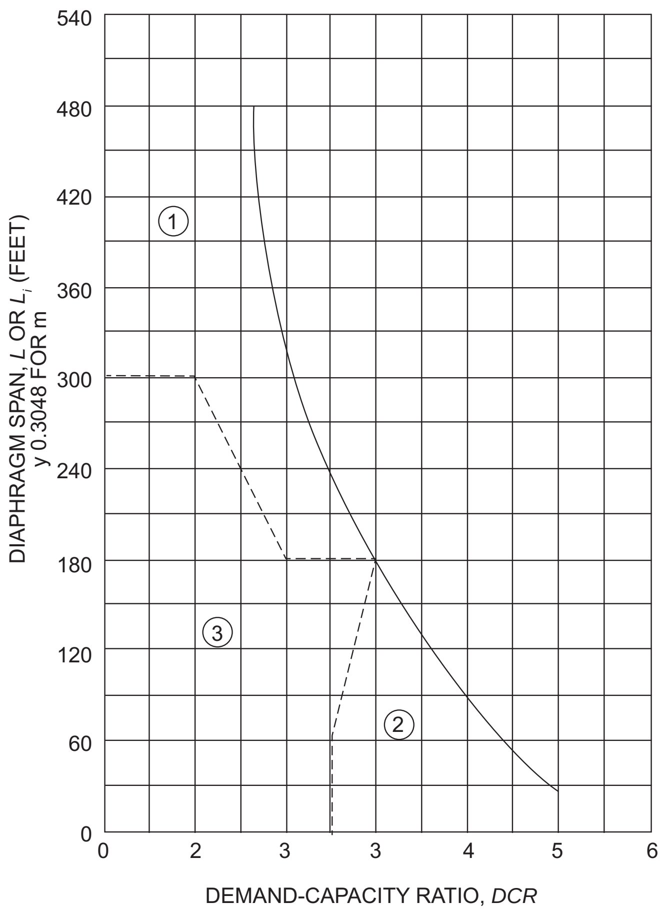
(Equation A1-8)

3. For diaphragms in a multiple-story building with qualifying crosswalls in all levels:

$$DCR = 2.1S_{D1}\Sigma W_d/(\Sigma\Sigma v_u D + V_{cb})$$

(Equation A1-9)

DCR shall be calculated at each level for the set of diaphragms at and above the level under consideration. In addition, the roof diaphragm shall meet the requirements of Equation A1-10.



1. Region of demand-capacity ratios where crosswalls may be used to increase *h/t* ratios.
2. Region of demand-capacity ratios where *h/t* ratios of "buildings with crosswalls" may be used, whether or not crosswalls are present.
3. Region of demand-capacity ratios where *h/t* ratios of "all other buildings" shall be used, whether or not crosswalls are present.

For SI: 1 foot = 304.8 mm.

[BS] FIGURE A111.4.1
ACCEPTABLE DIAPHRAGM SPAN

4. For a roof diaphragm and the diaphragm directly below, if coupled by crosswalls:

$$DCR = 2.1S_{D1}\Sigma W_d/\Sigma\Sigma v_u D \quad \textbf{(Equation A1-10)}$$

[BS] A111.4.3 Chords. An analysis for diaphragm flexure need not be made, and chords need not be provided.

[BS] A111.4.4 Collectors. An analysis of diaphragm collector forces shall be made for the transfer of diaphragm edge shears into vertical elements of the lateral force-resisting system. Collector forces may be resisted by new or existing elements.

[BS] A111.4.5 Diaphragm openings.

1. Diaphragm forces at corners of openings shall be investigated and shall be developed into the diaphragm by new or existing materials.
2. In addition to the demand-capacity ratios of Section A111.4.2, the demand-capacity ratio of the portion of the diaphragm adjacent to an opening shall be calculated using the opening dimension as the span.
3. Where an opening occurs in the end quarter of the diaphragm span, the calculation of v_uD for the demand-capacity ratio shall be based on the net depth of the diaphragm.

[BS] A111.5 Diaphragm shear transfer. Diaphragms shall be connected to shear walls and new vertical seismic force-resisting elements with connections capable of developing the diaphragm-loading tributary to the shear wall or new seismic force-resisting elements given by the lesser of the following formulas:

$$V = 1.2S_{D1}C_pW_d \quad \textbf{(Equation A1-11)}$$

using the C_p values in Table A111.5, or

$$V = v_uD \quad \textbf{(Equation A1-12)}$$

[BS] TABLE A111.5
HORIZONTAL FORCE FACTOR, C_p

CONFIGURATION OF MATERIALS	C_p
Roofs with straight or diagonal sheathing and roofing applied directly to the sheathing, or floors with straight tongue-and-groove sheathing.	0.50
Diaphragms with double or multiple layers of boards with edges offset, and blocked plywood systems.	0.75
Diaphragms of metal deck without topping:	
Minimal welding or mechanical attachment.	0.6
Welded or mechanically attached for seismic resistance.	0.68

[BS] A111.6 Shear walls (In-plane loading).

[BS] A111.6.1 Wall story force. The wall story force distributed to a shear wall at any diaphragm level shall be the lesser value calculated as:

$$F_{wx} = 0.8S_{D1}(W_{wx} + W_d/2) \quad \textbf{(Equation A1-13)}$$

but need not exceed

$$F_{wx} = 0.8S_{D1}W_{wx} + v_uD \quad \textbf{(Equation A1-14)}$$

[BS] A111.6.2 Wall story shear. The wall story shear shall be the sum of the wall story forces at and above the level of consideration.

$$V_{wx} = \Sigma F_{wx} \quad \textbf{(Equation A1-15)}$$

[BS] A111.6.3 Shear wall analysis. Shear walls shall comply with Section A112.

[BS] A111.6.4 New seismic force-resisting elements. New seismic force-resisting elements such as moment frames, braced frames or shear walls shall be designed as required by the building code, except that the seismic forces shall be as specified in Section A111.6.1, and the story drift ratio shall be limited to 0.015, except as further limited by Section A112.4.2 for moment frames.

[BS] A111.7 Out-of-plane forces—unreinforced masonry walls.

[BS] A111.7.1 Allowable unreinforced masonry wall height-to-thickness ratios. The provisions of Section A110.2 are applicable, except the allowable height-to-thickness ratios given in Table A110.2 shall be determined from Figure A111.4.1 as follows:

1. In Region 1, height-to-thickness ratios for buildings with crosswalls may be used if qualifying crosswalls are present in all stories.
2. In Region 2, height-to-thickness ratios for buildings with crosswalls may be used whether or not qualifying crosswalls are present.
3. In Region 3, height-to-thickness ratios for "all other buildings" shall be used whether or not qualifying crosswalls are present.

[BS] A111.7.2 Walls with diaphragms in different regions. Where diaphragms above and below the wall under consideration have demand-capacity ratios in different regions of Figure A111.4.1, the lesser height-to-thickness ratio shall be used.

[BS] A111.8 Open-front design procedure. A single-story building with an open front on one side and crosswalls parallel to the open front may be designed by the following procedure:

1. Effective diaphragm span, L_i, for use in Figure A111.4.1 shall be determined in accordance with the following formula:

$$L_i = 2[(W_w/W_d)L + L] \quad \textbf{(Equation A1-16)}$$

2. Diaphragm demand-capacity ratio shall be calculated as:

$$DCR = 2.1S_{D1}(W_d + W_w)/[(v_uD) + V_{cb}]$$
(Equation A1-17)

SECTION A112
ANALYSIS AND DESIGN

[BS] A112.1 General. The following requirements are applicable to both the general procedure and the special procedure for analyzing vertical elements of the lateral force-resisting system.

[BS] A112.2 In-plane shear of unreinforced masonry walls.

[BS] A112.2.1 Flexural rigidity. Flexural components of deflection need not be considered in determining the rigidity of an unreinforced masonry wall.

[BS] A112.2.2 Shear walls with openings. Wall piers shall be analyzed according to the following procedure, which is diagrammed in Figure A112.2.2.

1. For any pier,

   1.1. The pier shear capacity shall be calculated as:

   $v_a = v_m A_n$ **(Equation A1-18)**

   where:

   A_n = area of net mortared or grouted section of a wall or wall pier.

   1.2. The pier rocking shear capacity shall be calculated as:

   $V_r = 0.9 P_D D/H$ **(Equation A1-19)**

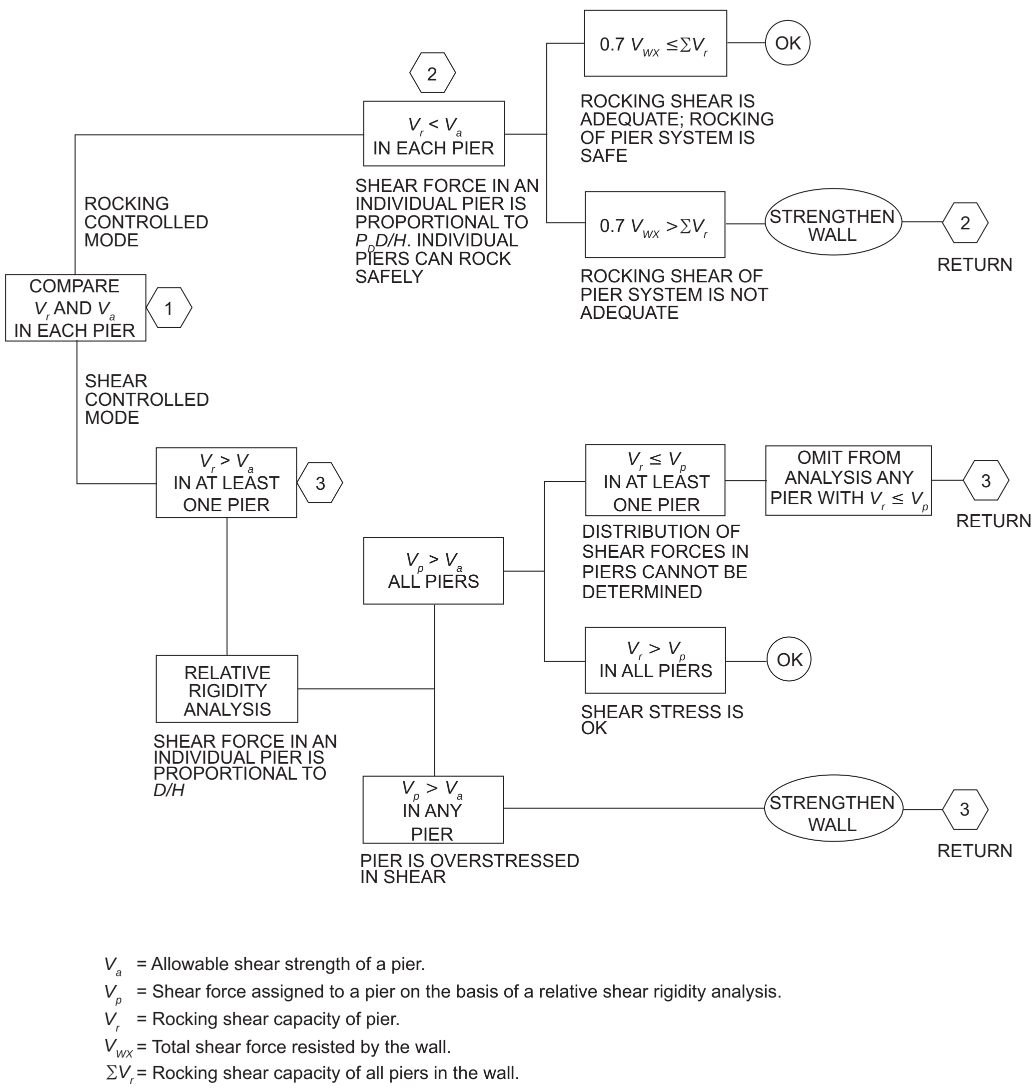
2. The wall piers at any level are acceptable if they comply with one of the following modes of behavior:

   2.1. Rocking controlled mode. Where the pier rocking shear capacity is less than the pier shear capacity, in other words, $V_r < v_a$, for each pier in a level, forces in the wall at that level, V_{wx}, shall be distributed to each pier in proportion to $P_D D/H$.

   For the wall at that level:

   $0.7V_{wx} < \Sigma V_r$ **(Equation A1-20)**

   2.2. Shear controlled mode. Where the pier shear capacity is less than the pier rocking capac-



[BS] FIGURE A112.2.2
ANALYSIS OF URM WALL IN-PLANE SHEAR FORCES

ity, in other words, $v_a < V_r$ in one or more pier(s) in a level, forces in the wall at the level, V_{wx}, shall be distributed to each pier in proportion to *D/H*.

For each pier at that level:

$$V_p < v_a \quad \textbf{(Equation A1-21)}$$

and

$$V_p < V_r \quad \textbf{(Equation A1-22)}$$

If $V_p < v_a$ for each pier and $V_p > V_r$ for one or more piers, such piers shall be omitted from the analysis, and the procedure shall be repeated for the remaining piers, unless the wall is strengthened and reanalyzed.

3. Masonry pier tension stress. Unreinforced masonry wall piers need not be analyzed for tension stress.

[BS] A112.2.3 Shear walls without openings. Shear walls without openings shall be analyzed the same as for walls with openings, except that V_r shall be calculated as follows:

$$V_r = 0.9(P_D + 0.5P_w)D/H \quad \textbf{(Equation A1-23)}$$

[BS] A112.3 Plywood-sheathed shear walls. Plywood-sheathed shear walls may be used to resist lateral forces for URM buildings with flexible diaphragms analyzed according to provisions of Section A111. Plywood-sheathed shear walls shall not be used to share lateral forces with other materials along the same line of resistance.

[BS] A112.4 Combinations of vertical elements.

[BS] A112.4.1 Seismic force distribution. Seismic forces shall be distributed among the vertical-resisting elements in proportion to their relative rigidities, except that moment-resisting frames shall comply with Section A112.4.2.

[BS] A112.4.2 Moment-resisting frames. Moment resisting frames shall not be used with an unreinforced masonry wall in a single line of resistance unless the wall has piers that have adequate shear capacity to sustain rocking in accordance with Section A112.2.2. The frames shall be designed in accordance with the building code to resist 100 percent of the seismic forces tributary to that line of resistance, as determined from Section A111.2. The story drift ratio shall be limited to 0.0075.

SECTION A113 DETAILED BUILDING SYSTEM DESIGN REQUIREMENTS

[BS] A113.1 Wall anchorage.

[BS] A113.1.1 Anchor locations. Unreinforced masonry walls shall be anchored at the roof and floor levels as required in Section A110.2. Ceilings of plaster or similar materials, where not attached directly to roof or floor framing and where abutting masonry walls, shall either be anchored to the walls at a maximum spacing of 6 feet (1829 mm) or be removed.

[BS] A113.1.2 Anchor requirements. Anchors shall consist of bolts installed through the wall as specified in Table A108.1(2), or an *approved* equivalent at a maximum anchor spacing of 6 feet (1829 mm). Wall anchors shall be secured to the framing members parallel or perpendicular to the wall to develop the required forces.

[BS] A113.1.3 Minimum wall anchorage. Anchorage of masonry walls to each floor or roof shall resist a minimum force determined as $0.9S_{DS}$ times the tributary weight or 200 pounds per linear foot (2920 N/m), whichever is greater, acting normal to the wall at the level of the floor or roof. Existing wall anchors, if used, must be tested and meet the requirements of Section A107.5.1 or be upgraded.

[BS] A113.1.4 Anchors at corners. At the roof and floor levels, both shear and tension anchors shall be provided within 2 feet (610 mm) horizontally from the inside of the corners of the walls.

[BS] A113.2 Diaphragm shear transfer. Anchors transmitting shear forces shall have a maximum spacing of 6 feet (1829 mm) and shall have nuts installed over malleable iron or plate washers where bearing on wood, and heavy-cut washers where bearing on steel.

[BS] A113.3 Collectors. Collector elements shall be provided that are capable of transferring the seismic forces originating in other portions of the building to the element providing the resistance to those forces.

[BS] A113.4 Ties and continuity. Ties and continuity shall conform to the requirements of the building code.

[BS] A113.5 Wall bracing.

[BS] A113.5.1 General. Where a wall height-to-thickness ratio exceeds the specified limits, the wall may be laterally supported by vertical bracing members per Section A113.5.2 or by reducing the wall height by bracing per Section A113.5.3.

[BS] A113.5.2 Vertical bracing members. Vertical bracing members shall be attached to floor and roof construction for their design loads independently of required wall anchors. Horizontal spacing of vertical bracing members shall not exceed one-half of the unsupported height of the wall or 10 feet (3048 mm). Deflection of such bracing members at design loads shall not exceed one-tenth of the wall thickness.

[BS] A113.5.3 Intermediate wall bracing. The wall height may be reduced by bracing elements connected to the floor or roof. Horizontal spacing of the bracing elements and wall anchors shall be as required by design, but shall not exceed 6 feet (1829 mm) on center. Bracing elements shall be detailed to minimize the horizontal displacement of the wall by the vertical displacement of the floor or roof.

[BS] A113.6 Parapets. Parapets and exterior wall appendages not conforming to this chapter shall be removed, or stabilized or braced to ensure that the parapets and appendages remain in their original positions.

The maximum height of an unbraced unreinforced masonry parapet above the lower of either the level of tension anchors or the roof sheathing shall not exceed the height-to-thickness ratio shown in Table A113.6. If the required parapet height exceeds this maximum height, a bracing system designed for the forces determined in accordance with the building code shall support the top of the parapet. Parapet corrective work must be performed in conjunction with the installation of tension roof anchors.

The height of a URM parapet above any wall anchor shall be not less than 12 inches (305 mm).

Exception: If a reinforced concrete beam is provided at the top of the wall, the height above the wall anchor is permitted to be not less than 6 inches (152 mm).

[BS] A113.7 Veneer.

1. Veneer shall be anchored with approved anchor ties conforming to the required design capacity specified in the building code and shall be placed at a maximum spacing of 24 inches (610 mm) with a maximum supported area of 4 square feet (0.372 m^2).

   Exception: Existing anchor ties for attaching brick veneer to brick backing shall be acceptable, provided that the ties are in good condition and conform to the following minimum size and material requirements.

   Existing veneer anchor ties shall be considered adequate if they are of corrugated galvanized iron strips not less than 1 inch (25 mm) in width, 8 inches (203 mm) in length and $^1/_{16}$ inch (1.6 mm) in thickness, or the equivalent.

2. The location and condition of existing veneer anchor ties shall be verified as follows:

   2.1. An approved testing laboratory shall verify the location and spacing of the ties and shall submit a report to the code official for approval as part of the structural analysis.

   2.2. The veneer in a selected area shall be removed to expose a representative sample of ties (not less than four) for inspection by the code official.

[BS] A113.8 Nonstructural masonry walls. Unreinforced masonry walls that do not carry design vertical or lateral loads and that are not required by the design to be part of the lateral force-resisting system shall be adequately anchored to new or existing supporting elements. The anchors and elements shall be designed for the out-of-plane forces specified in the building code. The height- or length-to-thickness ratio between such supporting elements for such walls shall not exceed nine.

[BS] A113.9 Truss and beam supports. Where trusses and beams other than rafters or joists are supported on masonry, independent secondary columns shall be installed to support vertical loads of the roof or floor members.

Exception: Secondary supports are not required where S_{D1} is less than 0.3 g.

[BS] A113.10 Adjacent buildings. Where elements of adjacent buildings do not have a separation of 5 inches (127 mm) or greater, the allowable height-to-thickness ratios for "all other buildings" per Table A110.2 shall be used in the direction of consideration.

SECTION A114
WALLS OF UNBURNED CLAY, ADOBE OR STONE MASONRY

[BS] A114.1 General. Walls of unburned clay, adobe or stone masonry construction shall conform to the following:

1. Walls of unburned clay, adobe or stone masonry shall not exceed a height- or length-to-thickness ratio specified in Table A114.1.
2. Adobe shall be allowed a maximum value of 9 pounds per square inch (62.1 kPa) for shear unless higher values are justified by test.
3. Mortar for repointing may be of the same soil composition and stabilization as the brick, in lieu of cement mortar.

[BS] TABLE A113.6
MAXIMUM ALLOWABLE HEIGHT-TO-THICKNESS RATIO FOR PARAPETS

	S_{D1}		
	$0.13_g \le S_{D1} \le 0.25g$	$0.25_g \le S_{D1} < 0.4g$	$S_{D1} \ge 0.4_g$
Maximum allowable height-to-thickness ratios	2.5	2.5	1.5

[BS] TABLE A114.1
MAXIMUM HEIGHT-TO-THICKNESS RATIO FOR ADOBE OR STONE WALLS

	S_{D1}		
	$0.13_g \le S_{D1} < 0.25_g$	$0.25_g \le S_{D1} < 0.4_g$	$S_{D1} \ge 0.4_g$
One-story buildings	12	10	8
Two-story buildings			
First story	14	11	9
Second story	12	10	8

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX A
CHAPTER A2 – EARTHQUAKE HAZARD REDUCTION IN EXISTING REINFORCED CONCRETE AND REINFORCED MASONRY WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)	**X**																						
Adopt only those sections that are listed below																							
Chapter / Section																							
A202.1	X																						

The state agency does not adopt sections identified with the following symbol: †

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 A2

EARTHQUAKE HAZARD REDUCTION IN EXISTING REINFORCED CONCRETE AND REINFORCED MASONRY WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

SECTION A201 PURPOSE

[BS] A201.1 Purpose. The purpose of this chapter is to promote public safety and welfare by reducing the risk of death or injury as a result of the effects of earthquakes on reinforced concrete and reinforced masonry wall buildings with flexible diaphragms. Based on past earthquakes, these buildings have been categorized as being potentially hazardous and prone to significant damage, including possible collapse in a moderate to major earthquake. The provisions of this chapter are minimum standards for structural seismic resistance established primarily to reduce the risk of life loss or injury on both subject and adjacent properties. These provisions will not necessarily prevent loss of life or injury, or prevent earthquake damage to an existing building that complies with these standards.

SECTION A202 SCOPE

[BS] A202.1 Scope. The provisions of this chapter shall apply to wall anchorage systems that resist out-of-plane forces and to collectors in existing reinforced concrete or reinforced masonry buildings with flexible diaphragms. Wall anchorage systems that were designed and constructed in accordance with the 1997 *Uniform Building Code* or the 2001 or subsequent editions of the *California Building Code* shall be deemed to comply with these provisions.

SECTION A203 DEFINITIONS

[BS] A203.1 Definitions. For the purpose of this chapter, the applicable definitions in the *California Building Code* and the following shall apply:

[BS] CONTINUITY CONNECTOR. A component, typically a plate, rod, strap or hold-down, that ensures load path continuity along the full length of a crosstie or strut.

[BS] CROSSTIE. A member or group of members continuous across the main diaphragm that connects opposite wall lines and transfers out-of-plane wall anchorage forces into the diaphragm.

[BS] FLEXIBLE DIAPHRAGM. A roof or floor sheathed with plywood, wood decking (1-by or 2-by) or metal deck without a concrete topping slab.

[BS] STRUT. A member or group of members continuous across a subdiaphragm that transfers out-of-plane wall anchorage forces into the subdiaphragm.

[BS] WALL ANCHORAGE SYSTEM. The components comprising a complete load path for out-of-plane wall forces from the wall to the main diaphragm, typically including anchors embedded in or fastened to the wall; rods, straps, plates, hold-downs or other hardware; subdiaphragms and their chords; crossties; struts; and continuity connectors.

[BS] WALL SEGMENT. Any length of concrete wall with continuous horizontal reinforcing and not interrupted or intersected by a pilaster or vertical construction joint, or any length of reinforced masonry wall with continuous horizontal reinforcing and not interrupted or intersected by a pilaster or vertical control joint.

SECTION A204 SYMBOLS AND NOTATIONS

[BS] A204.1 General. For the purpose of this chapter, the applicable symbols and notations in the *California Building Code* shall apply.

SECTION A205 GENERAL REQUIREMENTS

[BS] A205.1 General. The seismic-resisting elements specified in this chapter shall comply with applicable provisions of Section 1613 of the *California Building Code* and Chapter 12 of ASCE 7, except as modified herein.

[BS] A205.2 Requirements for plans. The plans shall accurately reflect the results of the engineering investigation and design and shall show all pertinent dimensions and sizes for plan review and construction. The following shall be provided:

1. Floor plans and roof plans shall show existing framing construction, diaphragm construction, proposed wall anchors, crossties and collectors. Existing nailing, anchors, crossties and collectors shall be shown on the plans if they are considered part of the lateral force-resisting systems.
2. Typical wall panel details and sections with panel thickness, height, pilasters and location of anchors shall be provided.
3. Details shall include existing and new anchors and the method of developing anchor forces into the diaphragm framing, existing and new crossties, and existing and new or improved support of roof and floor girders at pilasters or walls.
4. The basis for design and the building code used for the design shall be stated on the plans.

[BS] A205.3 Structural observation. Structural observation, in accordance with Section 1704.6 of the *California Building Code* is required, regardless of seismic design category, height or other conditions. Structural observation shall include visual observation of work for conformance to the *approved* construction documents and confirmation of existing conditions assumed during design.

A205.3.1 Additional special inspection. In addition to the requirements of Section 1705.13 of the *California Building Code*, special inspection shall be required for:

1. Installation of anchors into existing concrete or masonry walls to form part of a wall anchorage system.
2. Fastening of new or existing steel deck forming part of a wall anchorage system.
3. Installation of continuity connectors along the length of crossties, to ensure compliance with Section A206.2. This inspection may be periodic special inspection.

A205.3.2 Testing to establish adequacy of existing wall anchors. Testing shall show that the existing anchors can sustain a test load of 1.5 times the design tension load without noticeable deformation or damage to the anchor, to the masonry or concrete element, or to any part of the existing load path between the anchor and new retrofit components. Three anchors of each existing detail type shall be tested, and all three shall satisfy the requirement. Prior to testing, the design professional shall submit a test plan for code official approval identifying the expected locations of the existing anchors in question, the locations of the proposed tests, and the test procedure and criteria. After testing, the design professional shall submit a report of the satisfactory testing showing the test results, the design strengths derived from them, and the size and spacing as confirmed by investigation.

A205.4 Testing and Inspection. Structural testing and inspection for new construction materials, submittals, reports and certificates of compliance shall be in accordance with Sections 1704 and 1705 of the *California Building Code*. Work done to comply with this chapter shall not be eligible for Exception 1 to Section 1704.2 of the *California Building Code* or Exception 2 to Section 1705.13 of the *California Building Code*.

SECTION A206 ANALYSIS AND DESIGN

[BS] A206.1 Reinforced concrete and reinforced masonry wall anchorage. Concrete and masonry walls shall be anchored to all floors and roofs that provide lateral support for the wall in accordance with Section 12.11.2 of ASCE 7. The anchorage shall provide a direct connection capable of resisting 75 percent of the forces specified in Section 12.11.2.1 of ASCE 7.

Exceptions:

1. Existing walls need not be evaluated or retrofitted for bending between anchors.
2. Work required by this chapter need not consider shrinkage, thermal changes or differential settlement.

A206.1.1 Seismicity parameters, site class and geologic hazards. For any site designated as Site Class E, the value of F_a shall be taken as 1.2. Site-specific procedures are not required for compliance with this chapter. Mitigation of existing geologic site hazards such as liquefiable soil, fault rupture or landslide is not required for compliance with this chapter.

[BS] A206.2 Additional requirements for wall anchorage systems. The wall anchorage system shall comply with the requirements of this section and Section 12.11.2.2 of ASCE 7.

The maximum spacing between wall anchors shall be 8 feet (2438 mm), and each wall segment shall have at least two wall anchors.

The wall anchorage system, excluding subdiaphragms and existing roof or floor framing members, shall be designed and installed to limit the relative movement between the wall and the diaphragm to no more than $^1/_8$ inch before engagement of the anchors. Wall anchors shall be provided to resist out-of-plane forces, independent of existing shear anchors.

Where new members are added as crossties, they shall be spaced no more than 24 feet (7315 mm) apart. Where existing girders are used as crossties, their actual spacing shall be deemed adequate even where the spacing exceeds 24 feet (7315 mm), as long as the girders are provided with continuity connectors as required.

Wall anchorage shall not be provided by fastening the edge of plywood sheathing to steel ledgers. Wall anchorage shall not be provided solely by fastening the edge of steel decking to steel ledgers unless analysis demonstrates acceptable capacity. The existing connections shall be subject to field verification and the new connections shall be subject to special inspection.

New wall anchors shall be provided to resist the full wall anchorage design force independent of existing shear or tension anchors.

Exception: Existing cast-in-place anchors shall be permitted as part of the wall anchorage system if the tie element can be readily attached to the anchors, and if the anchors are capable of resisting the total vertical and lateral shear load (including dead load) while being acted on by the maximum wall anchorage tension force caused by an earthquake. Acceptable tension values for the existing anchors shall be established by testing in accordance with Section A205.4.

[BS] A206.3 Development of anchor forces into the diaphragm. Development of the required anchorage forces into roof and floor diaphragms shall comply with the requirements of this section and Section 12.11.2.2 of ASCE 7.

Lengths of development of anchor loads in wood diaphragms shall be based on existing field nailing of the sheathing unless existing edge nailing is positively identified on the original construction plans or at the site.

[BS] A206.4 Anchorage at pilasters. Where pilasters are present, the wall anchorage system shall comply with the requirements of this section and Section 12.11.2.2.7 of ASCE 7. The pilasters or the walls immediately adjacent to the pilasters shall be anchored directly to the roof framing such that the existing vertical anchor bolts at the top of the pilasters are bypassed without permitting tension or shear failure at the top of the pilasters.

Exception: If existing vertical anchor bolts at the top of the pilasters are used for the anchorage, additional exterior confinement shall be provided as required to resist the total anchorage force.

[BS] A206.5 Combination of anchor types. New anchors used in combination on a single framing member shall be of compatible behavior and stiffness.

[BS] A206.6 Anchorage at interior walls. Existing interior reinforced concrete or reinforced masonry walls that extend to the floor above or to the roof diaphragm shall be anchored for out-of-plane forces per Sections A206.1 and A206.3. Walls extending through the roof diaphragm shall be anchored for out-of-plane forces on both sides, and continuity ties shall be spliced across or continuous through the interior wall to provide diaphragm continuity.

[BS] A206.7 Collectors. Collectors designed in accordance with this section shall be provided at reentrant corners and at interior shear walls. Existing or new collectors shall have the capacity to develop into the diaphragm a force equal to the lesser of the rocking or shear capacity of the reentrant wall or the tributary shear based on 75 percent of the diaphragm design forces specified in Section 12.10 of ASCE 7. The capacity of the collector need not exceed the capacity of the diaphragm to deliver loads to the collector. A connection shall be provided from the collector to the reentrant wall to transfer the full collector internal force. If a truss or beam other than a rafter or purlin is supported by the reentrant wall or by a column integral with the reentrant wall, then an independent secondary column is required to support the roof or floor members whenever rocking or shear capacity of the reentrant wall is less than the tributary shear.

[BS] A206.8 Mezzanines. Existing mezzanines relying on reinforced concrete or reinforced masonry walls for vertical or lateral support shall be anchored to the walls for the tributary mezzanine load. Walls depending on the mezzanine for lateral support shall be anchored per Sections A206.1, A206.2 and A206.3.

Exception: Existing mezzanines that have independent lateral and vertical support need not be anchored to the walls.

SECTION A207 MATERIALS OF CONSTRUCTION

[BS] A207.1 Materials. Materials permitted by the building code, including their appropriate strength or allowable stresses, shall be used to meet the requirements of this chapter.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX A
CHAPTER A3 – PRESCRIPTIVE PROVISIONS FOR SEISMIC STRENGTHENING OF CRIPPLE WALLS AND SILL PLATE ANCHORAGE OF LIGHT, WOOD-FRAME RESIDENTIAL BUILDINGS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)				**X**	**X**																		
Adopt only those sections that are listed below																							
Chapter / Section																							
A302.1 *CODE OFFICIAL*				X	X																		
A302.1 *ENFORCING AGENCY*				X	X																		
TABLE A304.3.1																							
TABLE A304.3.2																							
FIGURES A304.1.3 – A304.4.2				X	X																		
A304.3.1(1) *ANCHORING*																							
A304.4.1(3)																							
A304.4.2																							
A304.5				X	X																		
A304.6				X	X																		

CHAPTER A3

PRESCRIPTIVE PROVISIONS FOR SEISMIC STRENGTHENING OF CRIPPLE WALLS AND SILL PLATE ANCHORAGE OF LIGHT, WOOD-FRAME RESIDENTIAL BUILDINGS

SECTION A301 GENERAL

[BS] A301.1 Purpose. The provisions of this chapter are intended to promote public safety and welfare by reducing the risk of earthquake-induced damage to existing wood-frame residential buildings. The requirements contained in this chapter are prescriptive minimum standards intended to improve the seismic performance of residential buildings; however, they will not necessarily prevent earthquake damage.

This chapter sets standards for strengthening that may be approved by the code official without requiring plans or calculations prepared by a registered design professional. The provisions of this chapter are not intended to prevent the use of any material or method of construction not prescribed herein. The code official may require that construction documents for strengthening using alternative materials or methods be prepared by a registered design professional.

[BS] A301.2 Scope. The provisions of this chapter apply to residential buildings of light-frame wood construction containing one or more of the structural weaknesses specified in Section A303.

> **Exception:** The provisions of this chapter do not apply to the buildings, or elements thereof, listed as follows. These buildings or elements require analysis by a registered design professional in accordance with Section A301.3 to determine appropriate strengthening:
>
> 1. Group R-1.
> 2. Group R with more than four dwelling units.
> 3. Buildings with a lateral force-resisting system using poles or columns embedded in the ground.
> 4. Cripple walls that exceed 4 feet (1219 mm) in height.
> 5. Buildings exceeding three stories in height and any three-story building with cripple wall studs exceeding 14 inches (356 mm) in height.
> 6. Buildings where the code official determines that conditions exist that are beyond the scope of the prescriptive requirements of this chapter.
> 7. Buildings or portions thereof constructed on concrete slabs on grade.

[BS] A301.3 Alternative design procedures. The details and prescriptive provisions herein are not intended to be the only acceptable strengthening methods permitted. Alternative details and methods shall be permitted to be used where approved by the code official. Approval of alternatives shall be based on a demonstration that the method or material used is at least equivalent in terms of strength, deflection and capacity to that provided by the prescriptive methods and materials.

Where analysis by a registered design professional is required, such analysis shall be in accordance with all requirements of the building code, except that the seismic forces may be taken as 75 percent of those specified in the *California Building Code*.

SECTION A302 DEFINITIONS

[BS] A302.1 Definitions. For the purpose of this chapter, in addition to the applicable definitions in the building code, certain additional terms are defined as follows:

[BS] ADHESIVE ANCHOR. An assembly consisting of a threaded rod, washer, nut, and chemical adhesive approved by the code official for installation in existing concrete or masonry.

CODE OFFICIAL. *"Code Official" shall have the same meaning as Enforcing Agency.*

[BS] CRIPPLE WALL. A wood-frame stud wall extending from the top of the foundation to the underside of the lowest floor framing.

ENFORCING AGENCY. *The designated department or agency as specified by statute or regulation.*

[BS] EXPANSION ANCHOR. An approved post-installed anchor, inserted into a predrilled hole in existing concrete or masonry, that transfers loads to or from the concrete or masonry by direct bearing or friction or both.

[BS] PERIMETER FOUNDATION. A foundation system that is located under the exterior walls of a building.

[BS] SNUGTIGHT. As tight as an individual can torque a nut on a bolt by hand, using a wrench with a 10-inch-long (254 mm) handle, and the point at which the full surface of the plate washer is contacting the wood member and slightly indenting the wood surface.

[BS] WOOD STRUCTURAL PANEL. A panel manufactured from veneers, wood strands or wafers or a combination of veneer and wood strands or wafers bonded together with waterproof synthetic resins or other suitable bonding systems. Examples of wood structural panels are:

> **Composite panels.** A wood structural panel that is comprised of wood veneer and reconstituted wood-based material and bonded together with waterproof adhesive.
>
> **Oriented strand board (OSB).** A mat-formed wood structural panel comprised of thin rectangular wood

strands arranged in cross-aligned layers with surface layers normally arranged in the long panel direction and bonded with waterproof adhesive.

Plywood. A wood structural panel comprised of plies of wood veneer arranged in cross-aligned layers. The plies are bonded with waterproof adhesive that cures on application of heat and pressure.

SECTION A303 STRUCTURAL WEAKNESSES

[BS] A303.1 General. For the purposes of this chapter, any of the following conditions shall be deemed a structural weakness:

1. Sill plates or floor framing that are supported directly on the ground without a foundation system that conforms to the building code.
2. A perimeter foundation system that is constructed only of wood posts supported on isolated pad footings.
3. Perimeter foundation systems that are not continuous.

    Exceptions:

    1. Existing single-story exterior walls not exceeding 10 feet (3048 mm) in length, forming an extension of floor area beyond the line of an existing continuous perimeter foundation.
    2. Porches, storage rooms and similar spaces not containing fuel-burning appliances.
4. A perimeter foundation system that is constructed of unreinforced masonry or stone.
5. Sill plates that are not connected to the foundation or that are connected with less than what is required by the building code.

    Exception: Where approved by the code official, connections of a sill plate to the foundation made with other than sill bolts shall be accepted if the capacity of the connection is equivalent to that required by the building code.
6. Cripple walls that are not braced in accordance with the requirements of Section A304.4 and Table A304.3.1, or cripple walls not braced with diagonal sheathing or wood structural panels in accordance with the building code.

SECTION A304 STRENGTHENING REQUIREMENTS

[BS] A304.1 General.

[BS] A304.1.1 Scope. The structural weaknesses noted in Section A303 shall be strengthened in accordance with the requirements of this section. Strengthening work may include both new construction and alteration of existing construction. Except as provided herein, all strengthening work and materials shall comply with the applicable provisions of the *California Building Code*.

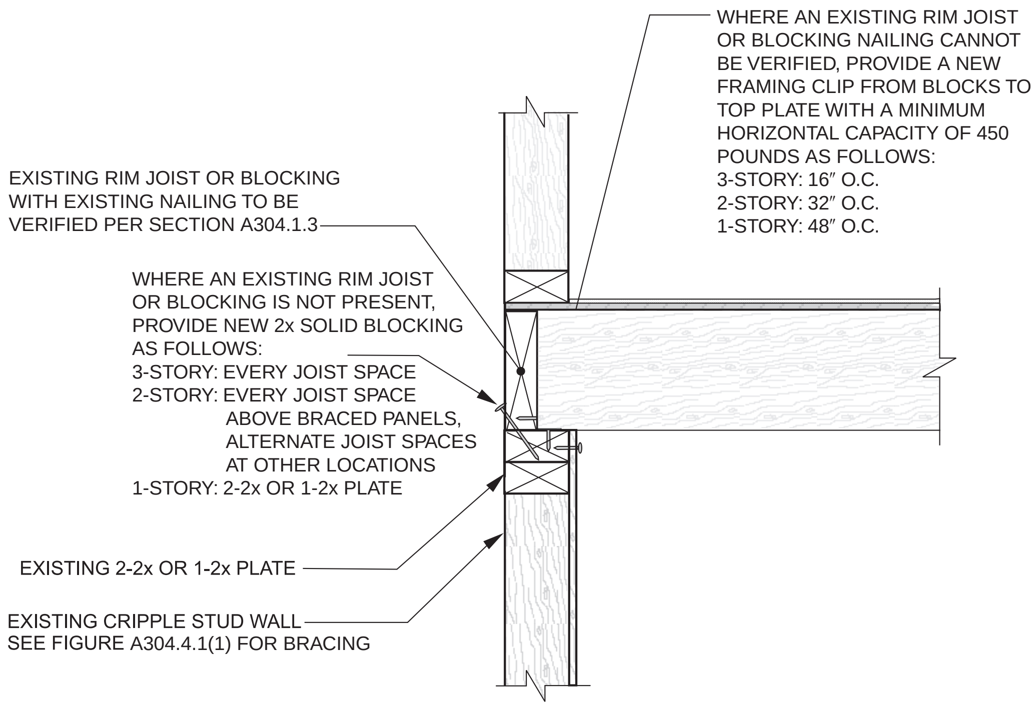
[BS] A304.1.2 Condition of existing wood materials. Existing wood materials that will be a part of the strengthening work (such as sills, studs and sheathing) shall be in a sound condition and free from defects that substantially reduce the capacity of the member. Any wood material found to contain fungus infection shall be removed and replaced with new material. Any wood material found to be infested with insects or to have been infested with insects shall be strengthened or replaced with new materials to provide a net dimension of sound wood equal to or greater than its undamaged original dimension.

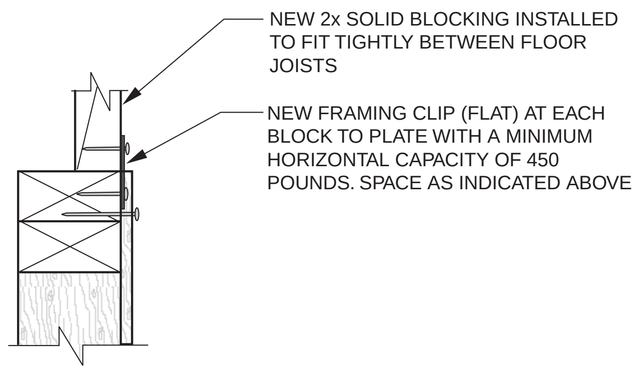
[BS] A304.1.3 Floor joists not parallel to foundations. Floor joists framed perpendicular or at an angle to perimeter foundations shall be restrained either by an existing nominal 2-inch-wide (51 mm) continuous rim joist or by a nominal 2-inch-wide (51 mm) full-depth block between alternate joists in one- and two-story buildings, and between each joist in three-story buildings. Existing blocking for multiple-story buildings must occur at each joist space above a braced cripple wall panel.

Existing connections at the top and bottom edges of an existing rim joist or blocking need not be verified in one story buildings. In multiple-story buildings, the existing top edge connection need not be verified; however, the bottom edge connection to either the foundation sill plate or the top plate of a cripple wall shall be verified. The minimum existing bottom edge connection shall consist of 8d toenails spaced 6 inches (152 mm) apart for a continuous rim joist, or three 8d toenails per block. Where this minimum bottom edge-connection is not present or cannot be verified, a supplemental connection installed as shown in Figure A304.1.3 or A304.1.4(2) shall be provided.

Where an existing continuous rim joist or the minimum existing blocking does not occur, new $^{3}/_{4}$-inch (19.1 mm) or $^{23}/_{32}$-inch (18 mm) wood structural panel blocking installed tightly between floor joists and nailed as shown in Figure A304.1.4(3) shall be provided at the inside face of the cripple wall. In lieu of wood structural panel blocking, tight fitting, full-depth 2-inch (51 mm) blocking may be used. New blocking may be omitted where it will interfere with vents or plumbing that penetrates the wall.

[BS] A304.1.4 Floor joists parallel to foundations. Where existing floor joists are parallel to the perimeter foundations, the end joist shall be located over the foundation and, except for required ventilation openings, shall be continuous and in continuous contact with the foundation sill plate or the top plate of the cripple wall. Existing connections at the top and bottom edges of the end joist need not be verified in one-story buildings. In multiple-story buildings, the existing top edge connection of the end joist need not be verified; however, the bottom edge connection to either the foundation sill plate or the top plate of a cripple wall shall be verified. The minimum bottom edge connection shall be 8d toenails spaced 6 inches (152 mm) apart. If this minimum bottom edge connection is not present or cannot be verified, a supplemental connection installed as shown in Figure A304.1.4(1), A304.1.4(2) or A304.1.4(3) shall be provided.

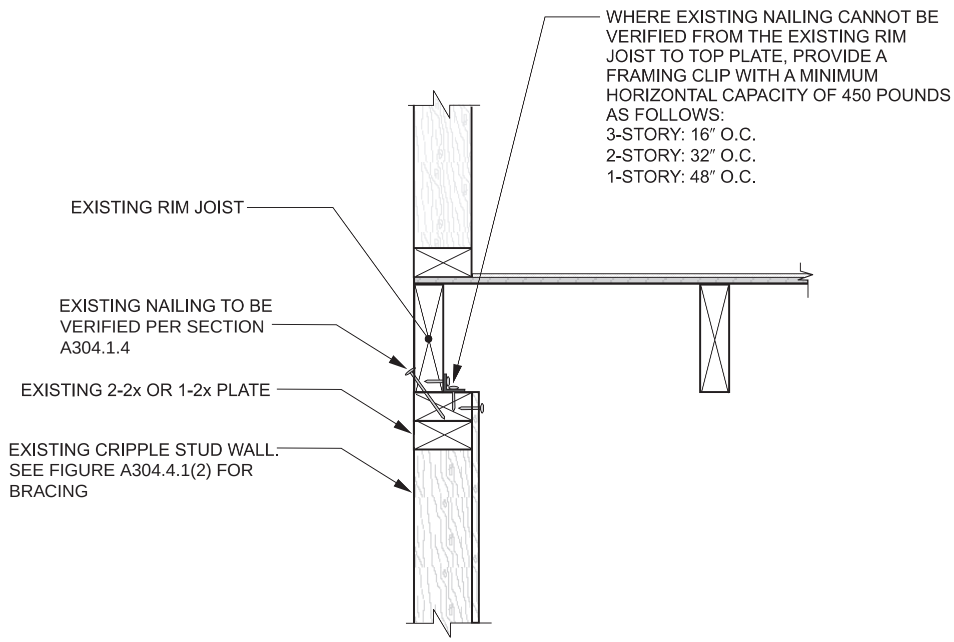


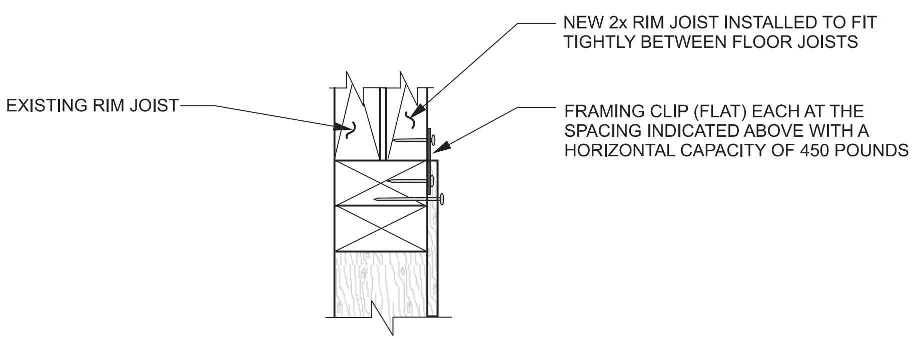


ALTERNATE CONNECTION FOR FLUSH CONNECTION

For SI: 1 inch = 25.4 mm, 1 pound = 4.4 N.
NOTE: See manufacturing instructions for nail sizes associated with metal framing clips.

[BS] FIGURE A304.1.3
TYPICAL FLOOR TO CRIPPLE WALL CONNECTION (FLOOR JOISTS NOT PARALLEL TO FOUNDATIONS)

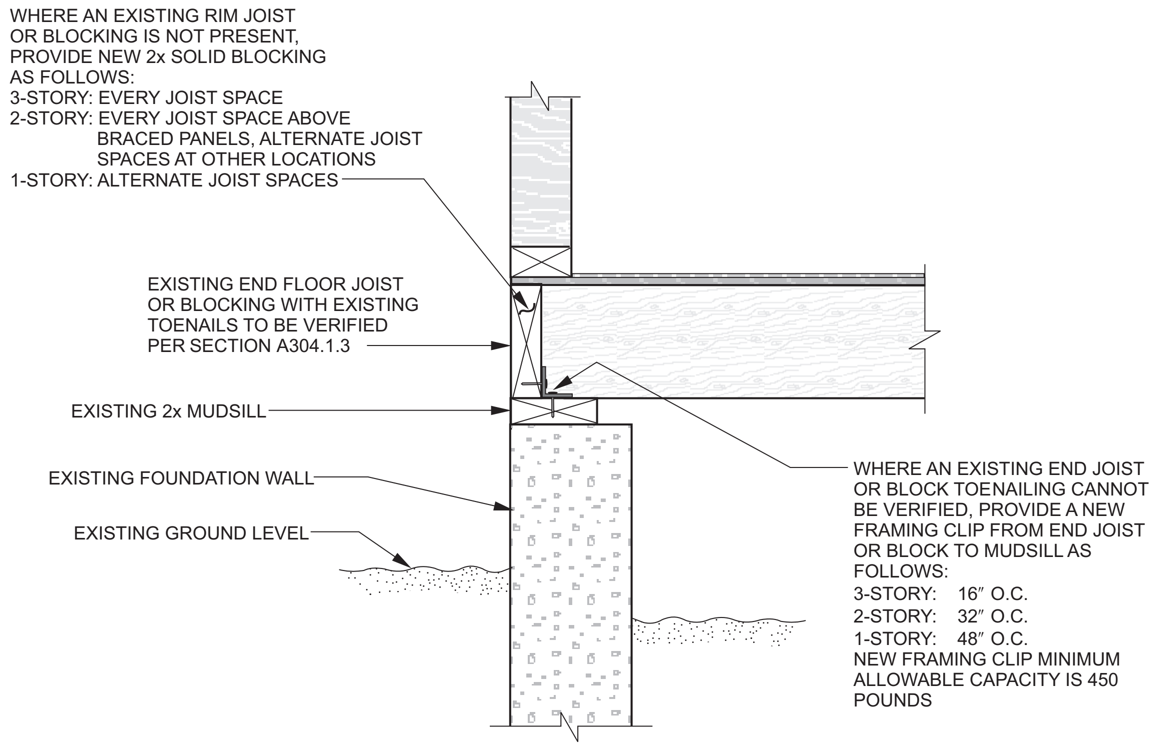




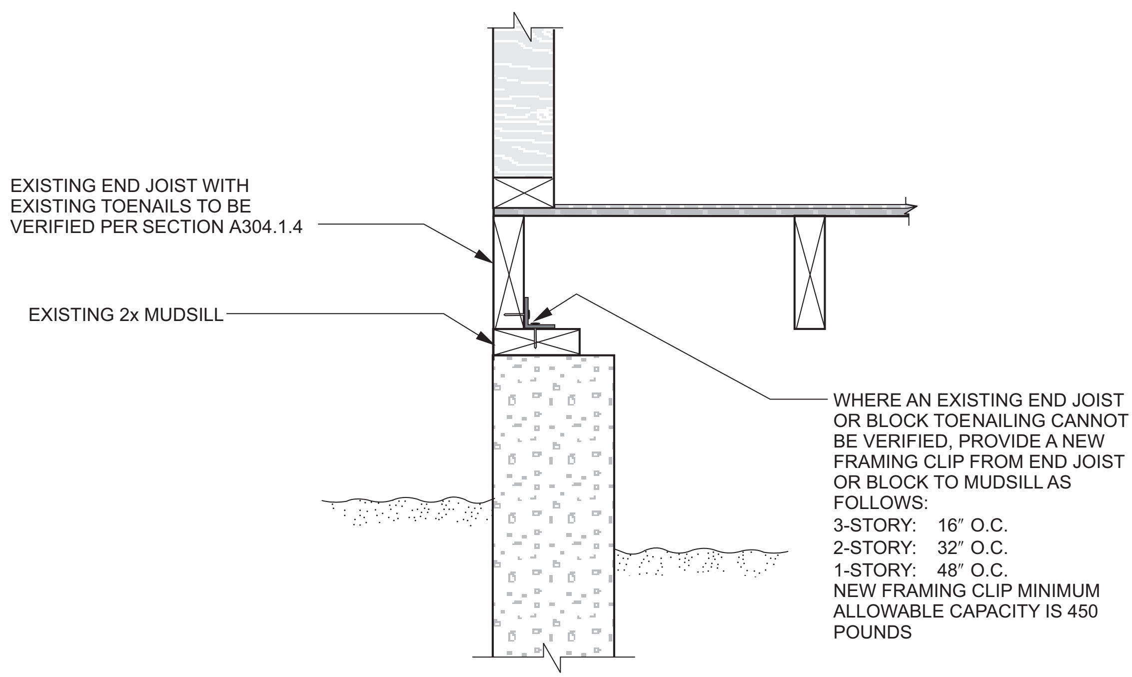
ALTERNATE CONNECTION FOR FLUSH CONNECTION

For SI: 1 inch = 25.4 mm, 1 pound = 4.4 N.
NOTE: See manufacturing instructions for nail sizes associated with metal framing clips.

[BS] FIGURE A304.1.4(1)
TYPICAL FLOOR TO CRIPPLE WALL CONNECTION (FLOOR JOISTS PARALLEL TO FOUNDATIONS)



FLOOR JOISTS NOT PARALLEL TO FOUNDATIONS



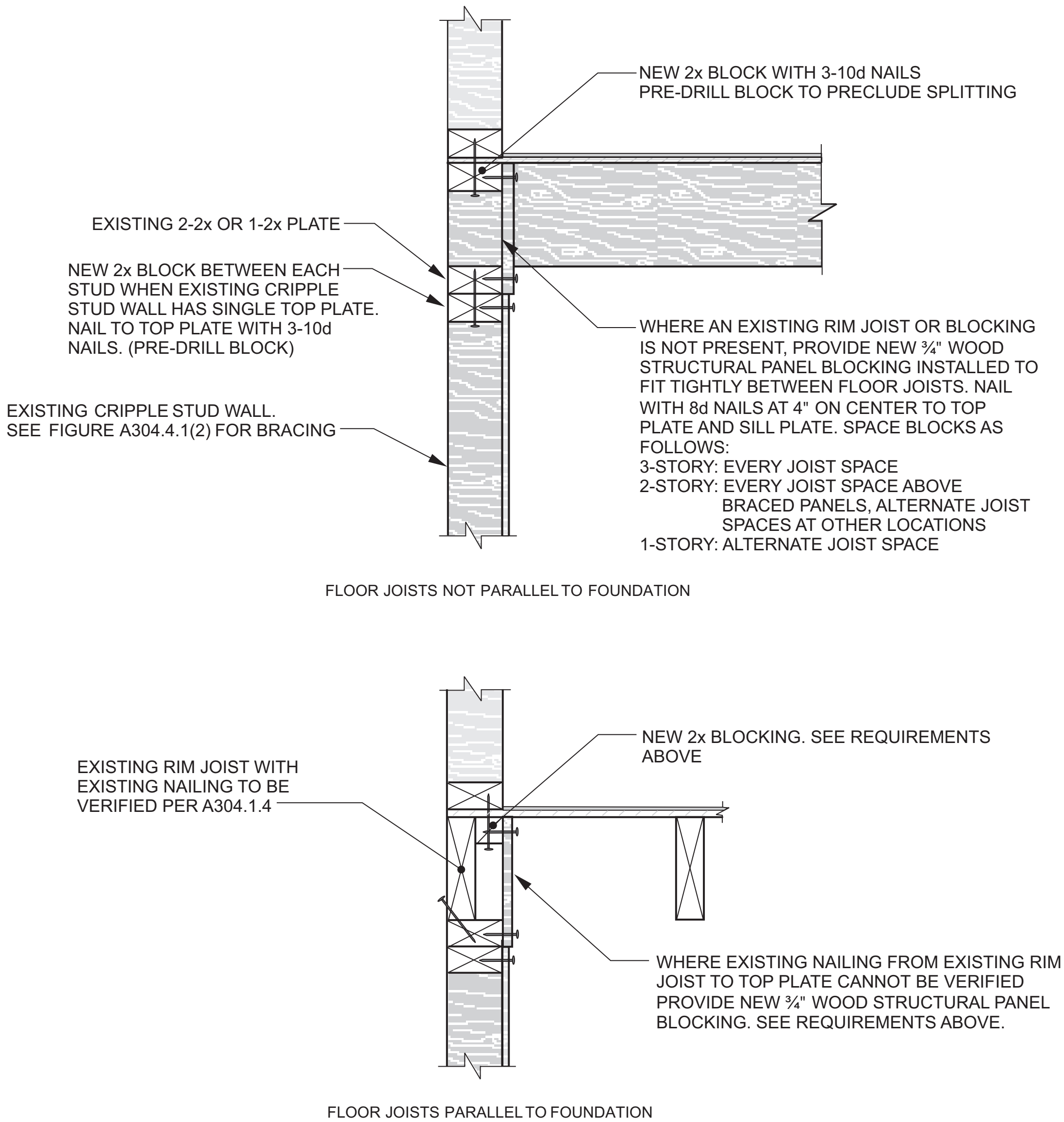
FLOOR JOISTS PARALLEL TO FOUNDATIONS

For SI: 1 inch = 25.4 mm.

NOTES:

1. See Section A304.3 for sill plate anchorage.
2. See manufacturing instructions for nail sizes associated with metal framing clips.

[BS] FIGURE A304.1.4(2)
TYPICAL FLOOR TO MUDSILL CONNECTIONS



For SI: 1 inch = 25.4 mm, 1 pound = 4.4 N.
NOTE: See Section A304.4 for cripple wall bracing.

[BS] FIGURE A304.1.4(3)
ALTERNATIVE FLOOR FRAMING TO CRIPPLE WALL CONNECTION

[BS] A304.2 Foundations.

[BS] A304.2.1 New perimeter foundations. New perimeter foundations shall be provided for structures with the structural weaknesses noted in Items 1 and 2 of Section A303. Soil investigations or geotechnical studies are not required for this work unless the building is located in a special study zone as designated by the code official or other authority having jurisdiction.

[BS] A304.2.2 Evaluation of existing foundations. Partial perimeter foundations or unreinforced masonry foundations shall be evaluated by a registered design professional for the force levels specified in Section A301.3. Test reports or other substantiating data to determine existing foundation material strengths shall be submitted to the code official. Where approved by the code official, these existing foundation systems shall be strengthened in accordance with the recommendations included with the evaluation in lieu of being replaced.

Exception: In lieu of testing existing foundations to determine material strengths, and where approved by the code official, a new nonperimeter foundation system designed for the forces specified in Section A301.3 shall be used to resist lateral forces from perimeter walls. A registered design professional shall confirm the ability of the existing diaphragm to transfer seismic forces to the new nonperimeter foundations.

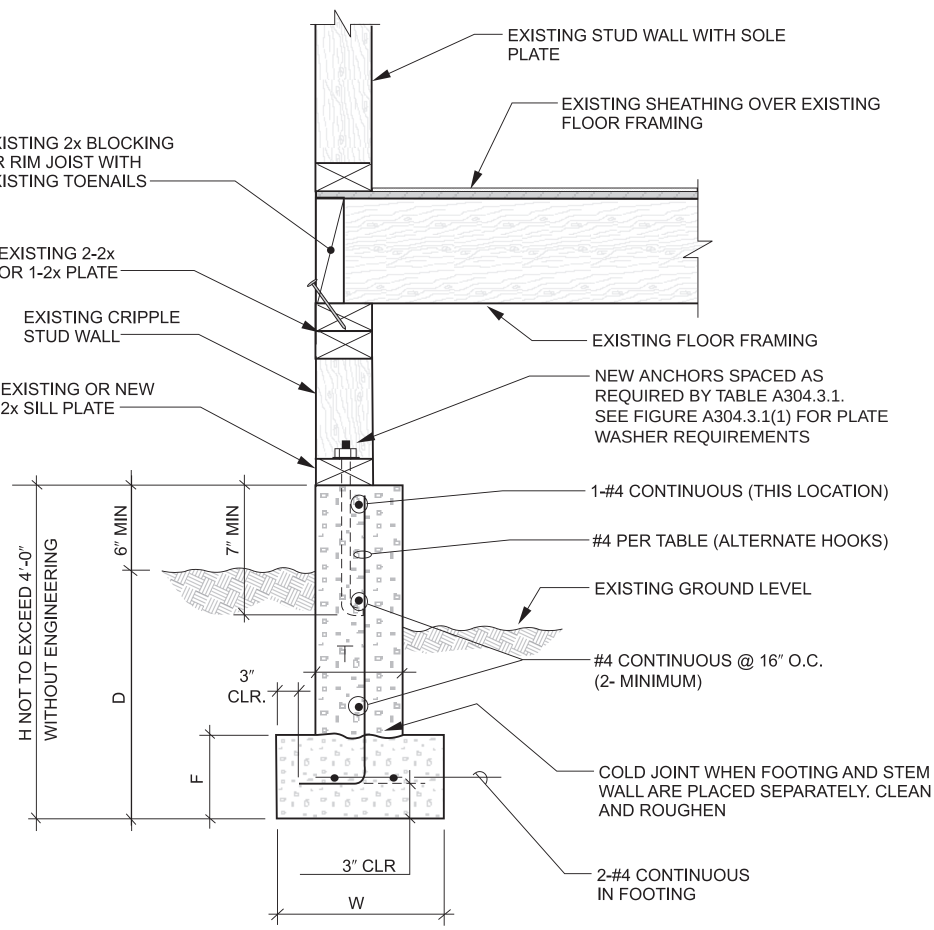
[BS] A304.2.3 Details for new perimeter foundations. All new perimeter foundations shall be continuous and constructed according to Figure A304.2.3(1) and Table A304.2.3(1) or Figure A304.2.3(2) and Table A304.2.3(2). New construction materials shall comply with the requirements of building code. Where approved by the code official, the existing clearance between existing floor joists or girders and existing grade below the floor need not comply with the building code.

> **Exception:** Where designed by a registered design professional and approved by the code official, partial perimeter foundations shall be used in lieu of a continuous perimeter foundation.

[BS] A304.2.4 New concrete foundations. New concrete foundations shall have a minimum compressive strength of 2,500 pounds per square inch (17.24 MPa) at 28 days.

[BS] A304.2.5 New hollow-unit masonry foundations. New hollow-unit masonry foundations shall be solidly grouted. The grout shall have minimum compressive strength of 2,000 pounds per square inch (13.79 MPa). Mortar shall be Type M or S.

[BS] A304.2.6 New sill plates. Where new sill plates are used in conjunction with new foundations, they shall be minimum two times nominal thickness and shall be preservative-treated wood or naturally durable wood permitted by the building code for similar applications, and shall be marked or branded by an approved agency. Fasteners in contact with preservative-treated wood shall be hot-dip galvanized or other material permitted by the building code for similar applications. Anchors, that attach a preservative-treated sill plate to the foundation, shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B695, Class 55 minimum. Metal framing anchors in contact with preservative-treated wood shall be galvanized in accordance with ASTM A653 with a G185 coating.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] FIGURE A304.2.3(1)
NEW REINFORCED CONCRETE FOUNDATION SYSTEM

[BS] TABLE A304.2.3(1)
NEW REINFORCED CONCRETE FOUNDATION SYSTEM

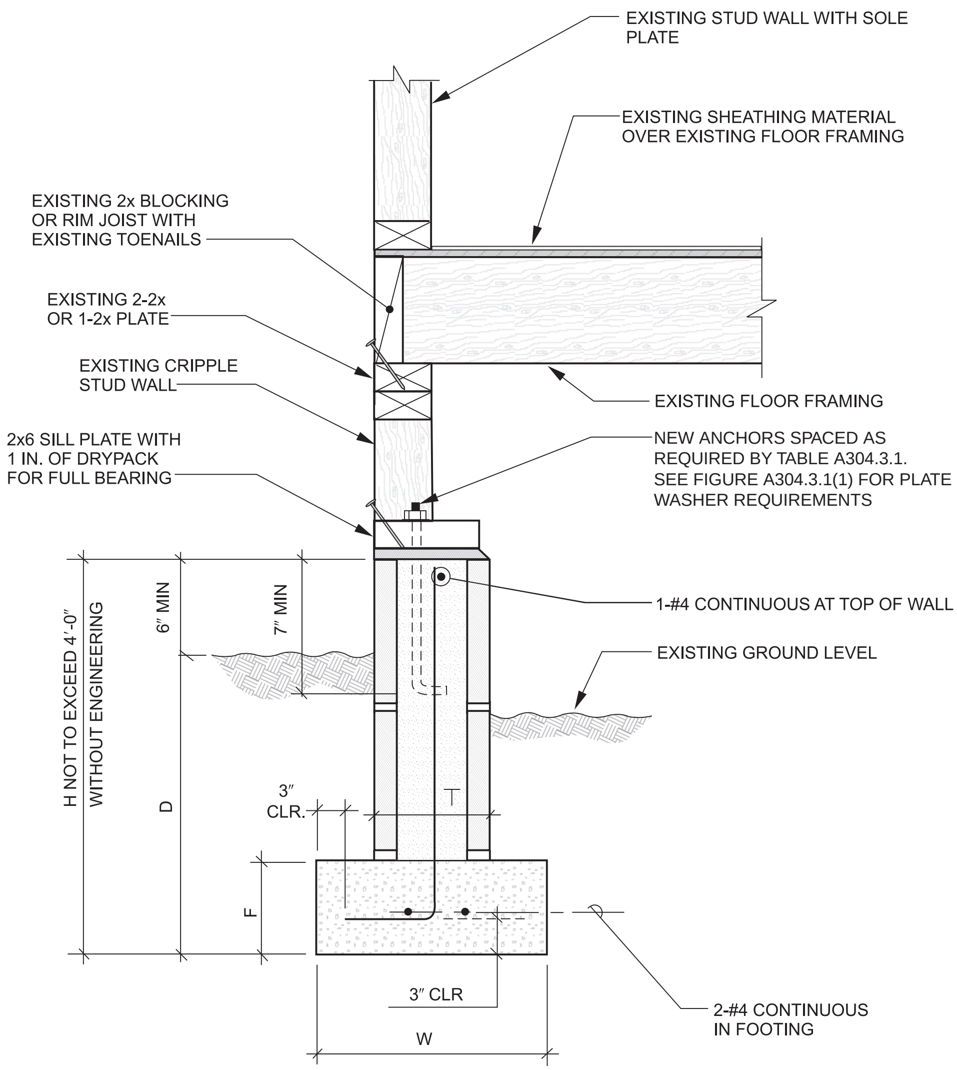
MINIMUM FOUNDATION DIMENSIONS						MINIMUM FOUNDATION REINFORCING	
						VERTICAL REINFORCING	
NUMBER OF STORIES	W	F	D[a, b, c]	T	H	Single-pour wall and footing	Footing placed separate from wall
1	12 inches	6 inches	12 inches	6 inches	≤ 24 inches	#4 @ 48 inches on center	#4 @ 32 inches on center
2	15 inches	7 inches	18 inches	8 inches	≥ 36 inches	#4 @ 48 inches on center	#4 @ 32 inches on center
3	18 inches	8 inches	24 inches	10 inches	≥ 36 inches	#4 @ 48 inches on center	#4 @ 18 inches on center

For SI: 1 inch = 25.4 mm.

a. Where frost conditions occur, the minimum depth shall extend below the frost line.

b. The ground surface along the interior side of the foundation may be excavated to the elevation of the top of the footing.

c. Where the soil is designated as expansive, the foundation depth and reinforcement shall be approved by the code official.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] FIGURE A304.2.3(2)
NEW MASONRY CONCRETE FOUNDATION

[BS] TABLE A304.2.3(2)
NEW MASONRY CONCRETE FOUNDATION

MINIMUM FOUNDATION DIMENSIONS						MINIMUM FOUNDATION REINFORCING	
NUMBER OF STORIES	W	F	D[a, b, c]	T	H	VERTICAL REINFORCING	HORIZONTAL REINFORCING
1	12 inches	6 inches	12 inches	6 inches	≤ 24 inches	#4 @ 24 inches on center	#4 continuous at top of stem wall
2	15 inches	7 inches	18 inches	8 inches	≥ 24 inches	#4 @ 24 inches on center	#4 @ 16 inches on center
3	18 inches	8 inches	24 inches	10 inches	≥ 36 inches	#4 @ 24 inches on center	#4 @ 16 inches on center

For SI: 1 inch = 25.4 mm.

a. Where frost conditions occur, the minimum depth shall extend below the frost line.

b. The ground surface along the interior side of the foundation may be excavated to the elevation of the top of the footing.

c. Where the soil is designated as expansive, the foundation depth and reinforcement shall be approved by the code official.

[BS] A304.3 Foundation sill plate anchorage.

[BS] A304.3.1 Existing perimeter foundations. Where the building has an existing continuous perimeter foundation, all perimeter wall sill plates shall be anchored to the foundation with adhesive anchors or expansion anchors in accordance with Table A304.3.1.

Anchors shall be installed in accordance with Figure A304.3.1(1), with the plate washer installed between the nut and the sill plate. The nut shall be tightened to a snug-tight condition after curing is complete for adhesive anchors and after expansion wedge engagement for expansion anchors. Anchors shall be installed in accordance with manufacturer's recommendations. Expansion anchors shall not be used where the installation causes surface cracking of the foundation wall at the locations of the anchor.

Where existing conditions prevent anchor installations through the top of the sill plate, this connection shall be made in accordance with Figure A304.3.1(2), A304.3.1(3) or A304.3.1(4). Alternative anchorage methods having a minimum shear capacity of 900 pounds (4003 N) per connection parallel to the wall shall be permitted. The spacing of these alternative connections shall comply with the maximum spacing requirements of Table A304.3.1 for $^1/_2$-inch (12.7 mm) bolts.

[BS] A304.3.2 Placement of anchors. Anchors shall be placed within 12 inches (305 mm), but not less than 9 inches (229 mm), from the ends of sill plates and shall be placed in the center of the stud space closest to the required spacing. New sill plates may be installed in pieces where necessary because of existing conditions. For lengths of sill plates 12 feet (3658 mm) or greater, anchors shall be spaced along the sill plate as specified in Table A304.3.1. For other lengths of sill plate, anchor placement shall be in accordance with Table A304.3.2.

Exception: Where physical obstructions such as fireplaces, plumbing or heating ducts interfere with the placement of an anchor, the anchor shall be placed as close to the obstruction as possible, but not less than 9

[BS] TABLE A304.3.1
SILL PLATE ANCHORAGE AND CRIPPLE WALL BRACING

NUMBER OF STORIES ABOVE CRIPPLE WALLS	MINIMUM SILL PLATE CONNECTION AND MAXIMUM SPACING[a, b, c]	AMOUNT OF BRACING FOR EACH WALL LINE[d, e, f]	
		A Combination of Exterior Walls Finished with Portland Cement Plaster and Roofing Using Clay Tile or Concrete Tile Weighing More than 6 psf (287 N/m^2)	All Other Conditions
One story	$^1/_2$ inch spaced 6 feet, 0 inch center-to-center with washer plate	Each end and not less than 50 percent of the wall length	Each end and not less than 40 percent of the wall length
Two stories	$^1/_2$ inch spaced 4 feet, 0 inch center-to-center with washer plate; or $^5/_8$ inch spaced 6 feet, 0 inch center-to-center with washer plate	Each end and not less than 70 percent of the wall length	Each end and not less than 50 percent of the wall length
Three stories	$^5/_8$ inch spaced 4 feet, 0 inch center-to-center with washer plate	100 percent of the wall length[g]	Each end and not less than 80 percent of the wall length[g]

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 47.88 N/m^2.

a. Sill plate anchors shall be adhesive anchors or expansion anchors in accordance with Section A304.3.1.

b. All washer plates shall be 3 inches by 3 inches by 0.229 inch minimum. The hole in the plate washer is permitted to be diagonally slotted with a width of up to $^3/_{16}$ inch larger than the bolt diameter and a slot length not to exceed 1$^3/_4$ inches, provided that a standard cut washer is placed between the plate washer and the nut.

c. This table shall also be permitted for the spacing of the alternative connections specified in Section A304.3.1.

d. See Figure A304.4.2 for braced panel layout.

e. Braced panels at ends of walls shall be located as near to the end as possible.

f. All panels along a wall shall be nearly equal in length and shall be nearly equal in spacing along the length of the wall.

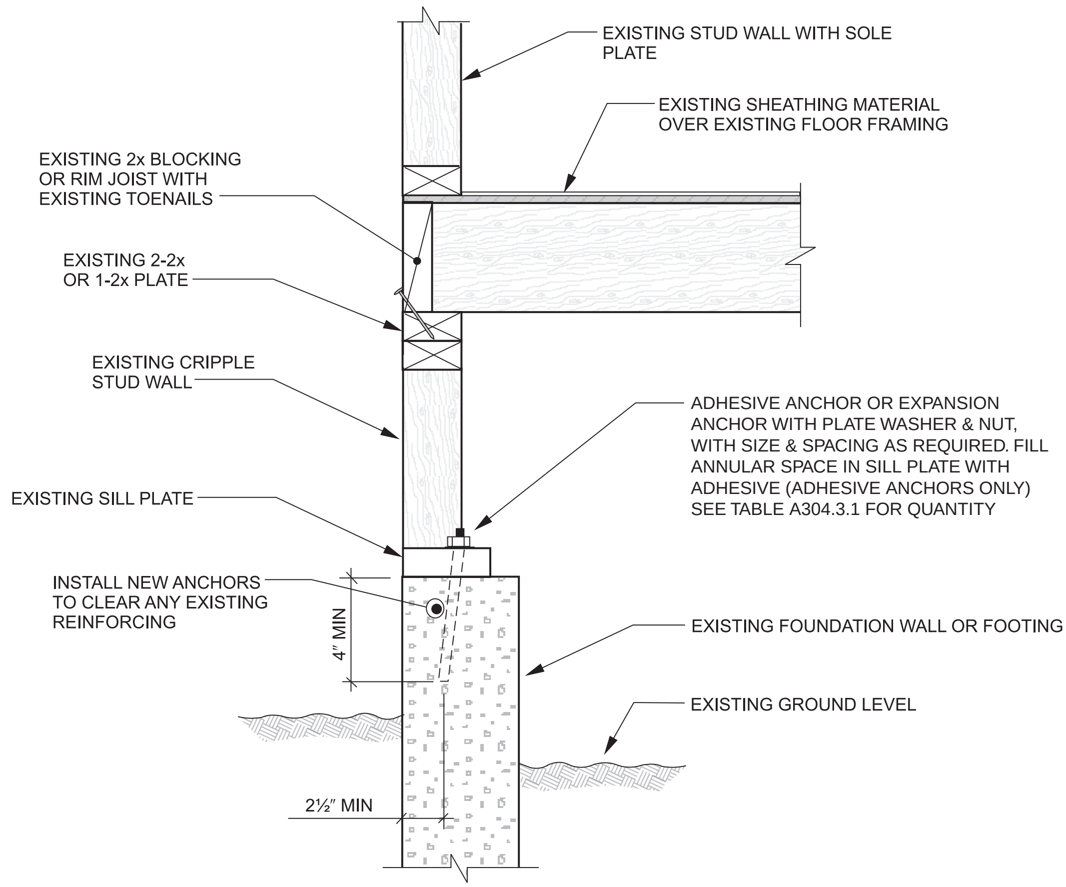
g. The minimum required underfloor ventilation openings are permitted in accordance with Section A304.4.4.

inches (229 mm) from the end of the plate. Center-to-center spacing of the anchors shall be reduced as necessary to provide the minimum total number of anchors required based on the full length of the wall. Center-to-center spacing shall be not less than 12 inches (305 mm).

[BS] A304.3.3 New perimeter foundations. Sill plates for new perimeter foundations shall be anchored in accordance with Table A304.3.1 and Figure A304.2.3(1) and Table A304.2.3(1) or Figure A304.2.3(2) and Table A304.2.3(2).

[BS] A304.4 Cripple wall bracing.

[BS] A304.4.1 General. Exterior cripple walls not exceeding 4 feet (1219 mm) in height shall be permitted to be specified by the prescriptive bracing method in Section A304.4. Cripple walls over 4 feet (1219 mm) in height require analysis by a registered design professional in accordance with Section A301.3.



For SI: 1 inch = 25.4 mm.

a. Plate washers shall comply with the following:

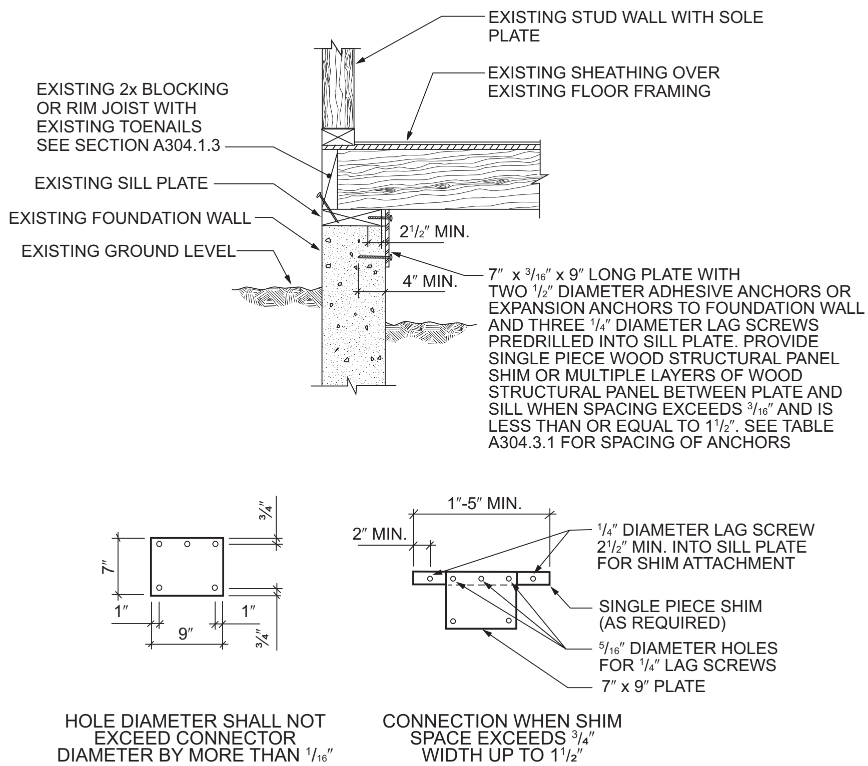
$^{1}/_{2}$-inch anchor or bolt—3 inches × 3 inches × 0.229 inch minimum.

$^{5}/_{8}$-inch anchor or bolt—3 inches × 3 inches × 0.229 inch minimum.

A diagonal slot in the plate washer is permitted in accordance with Table A304.3.1, Note b.

b. See Figure A304.4.1(1) or A304.4.1(2) for cripple wall bracing.

[BS] FIGURE A304.3.1(1)
SILL PLATE *ANCHORING* TO EXISTING FOUNDATION[a, b]



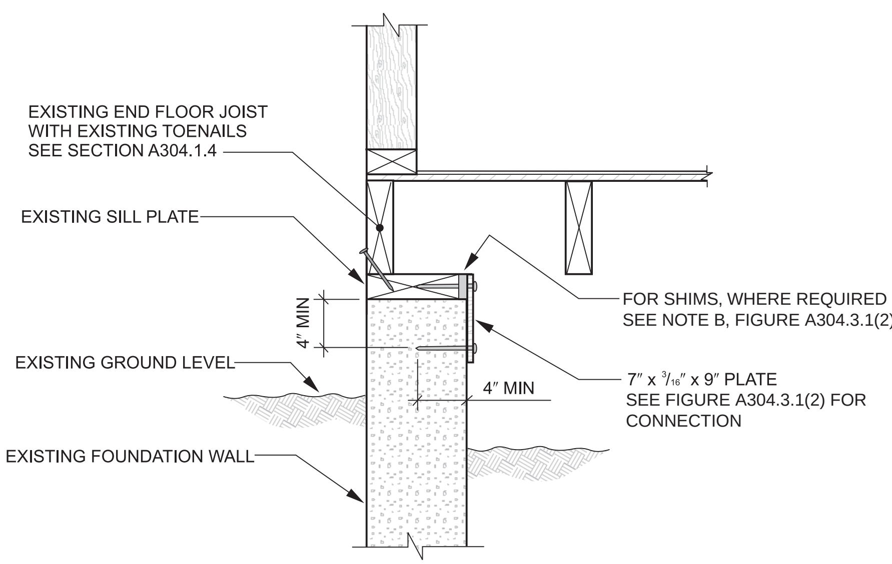
For SI: 1 inch = 25.4 mm.

NOTES:

a. If shim space exceeds $1^1/_2$ inches, alternative details will be required.

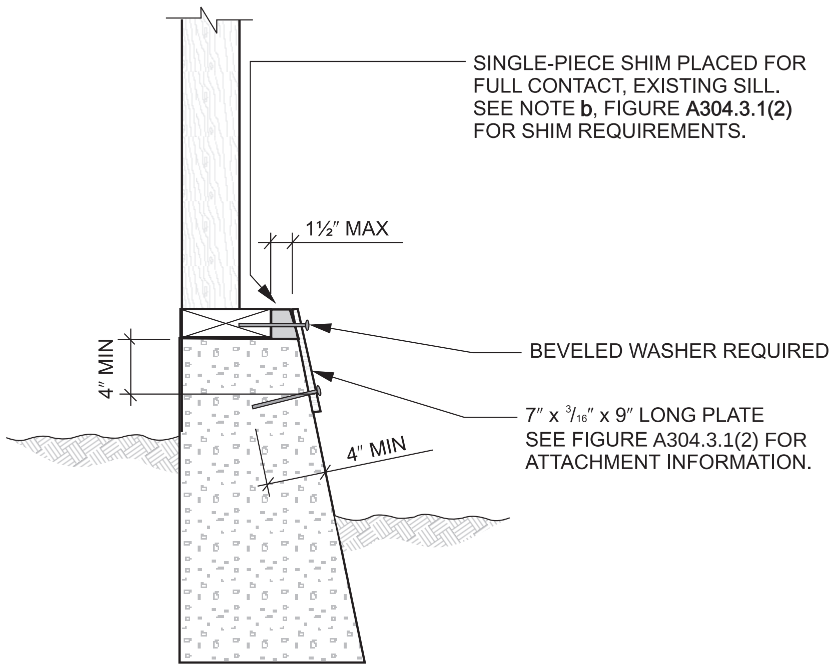
b. Where required, single piece shim shall be naturally durable wood or preservative-treated wood. If preservative-treated wood is used, it shall be isolated from the foundation system with a moisture barrier.

[BS] FIGURE A304.3.1(2)
ALTERNATIVE SILL PLATE ANCHORING IN EXISTING FOUNDATION—WITHOUT CRIPPLE WALLS AND FLOOR FRAMING NOT PARALLEL TO FOUNDATIONS[a, b]



For SI: 1 inch = 25.4 mm.

[BS] FIGURE A304.3.1(3)
ALTERNATIVE SILL PLATE ANCHOR TO EXISTING FOUNDATION WITHOUT CRIPPLE WALL AND FLOOR FRAMING PARALLEL TO FOUNDATIONS



For SI: 1 inch = 25.4 mm.

[BS] FIGURE A304.3.1(4)
SILL PLATE ANCHORING TO EXISTING FOUNDATION—ALTERNATIVE CONNECTION FOR BATTERED FOOTING

[BS] TABLE A304.3.2
SILL PLATE ANCHORAGE FOR VARIOUS LENGTHS OF SILL PLATE[a, b]

NUMBER OF STORIES	LENGTHS OF SILL PLATE		
	Less than 12 feet to 6 feet	Less than 6 feet to 30 inches	Less than 30 inches[c]
One story	Three connections	Two connections	One connection
Two stories	Four connections for $^1/_2$-inch anchors or bolts or three connections for $^5/_8$-inch anchors or bolts	Two connections	One connection
Three stories	Four connections	Two connections	One connection

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Connections shall be either adhesive anchors or expansion anchors.

b. See Section A304.3.2 for minimum end distances.

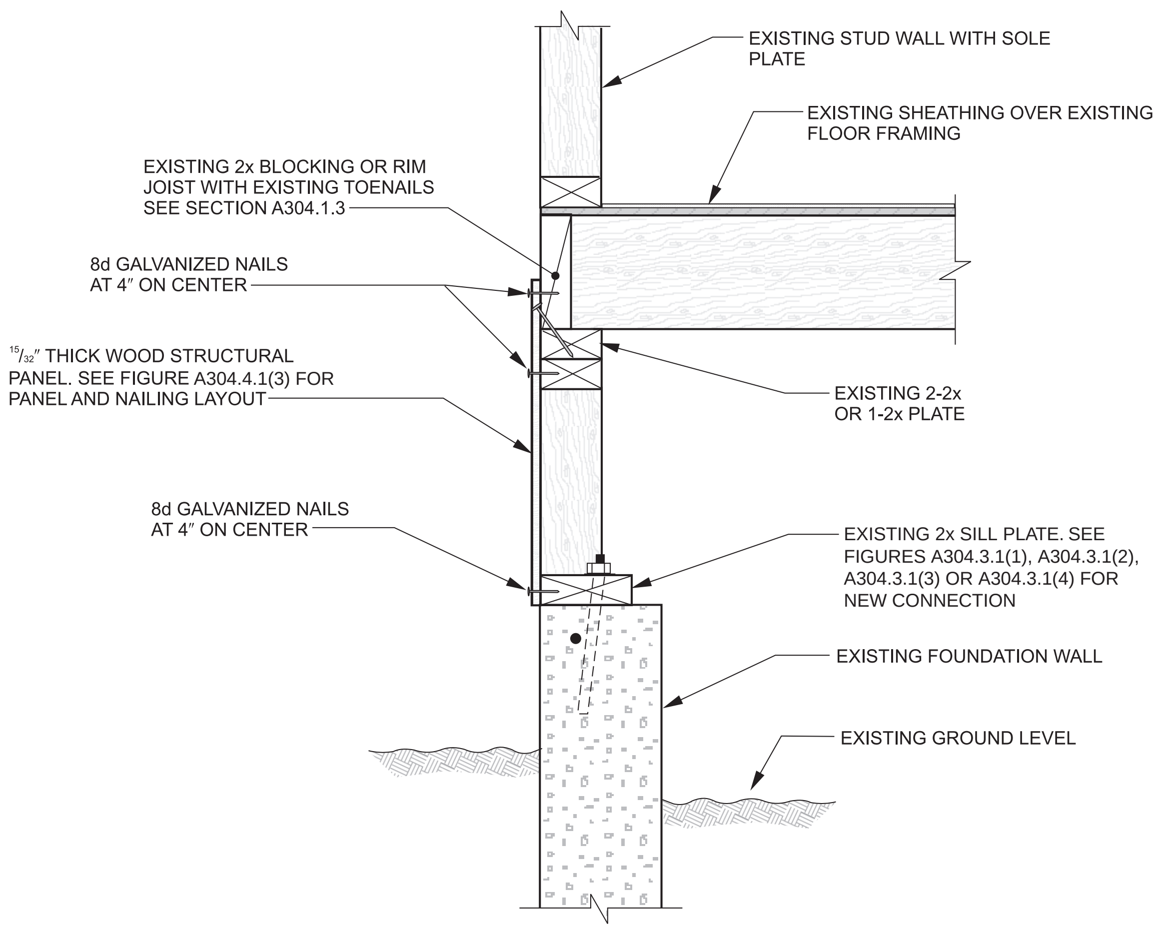
c. Connections shall be placed as near to the center of the length of plate as possible.

[BS] A304.4.1.1 Sheathing installation requirements. Wood structural panel sheathing shall be not less than $^{15}/_{32}$-inch (12 mm) thick and shall be installed in accordance with Figure A304.4.1(1) or A304.4.1(2). Individual pieces of wood structural panels shall be nailed with 8d common nails spaced 4 inches (102 mm) on center at all edges and 12 inches (305 mm) on center at each intermediate support with not less than two nails for each stud. Nails shall be driven so that their heads are flush with the surface of the sheathing and shall penetrate the supporting member not less than $1^1/_2$ inches (38 mm). When a nail fractures the surface, it shall be left in place and not counted as part of the required nailing. A new 8d nail shall be located within 2 inches (51 mm) of the discounted nail and be hand-driven flush with the sheathing surface. Where the installation involves horizontal joints, those joints shall occur over nominal 2-inch by 4-inch (51 mm by 102 mm) blocking installed with the nominal 4-inch (102 mm) dimension against the face of the plywood.

Vertical joints at adjoining pieces of wood structural panels shall be centered on studs such that there is a minimum $^1/_8$ inch (3.2 mm) between the panels. Where required edge distances cannot be maintained because of the width of the existing stud, a new stud shall be added adjacent to the existing studs and connected in accordance with Figure A304.4.1(3).

[BS] A304.4.2 Distribution and amount of bracing. See Table A304.3.1 and Figure A304.4.2 for the distribution and amount of bracing required for each wall line. Each braced panel length must be not less than two times the height of the cripple stud. Where the minimum amount of bracing prescribed in Table A304.3.1 cannot be installed along any walls, the bracing must be designed in accordance with Section A301.3.

Exception: Where physical obstructions such as fireplaces, plumbing or heating ducts interfere with the placement of cripple wall bracing, the bracing shall then be placed as close to the obstruction as possible. The total amount of bracing required shall not be reduced because of obstructions.



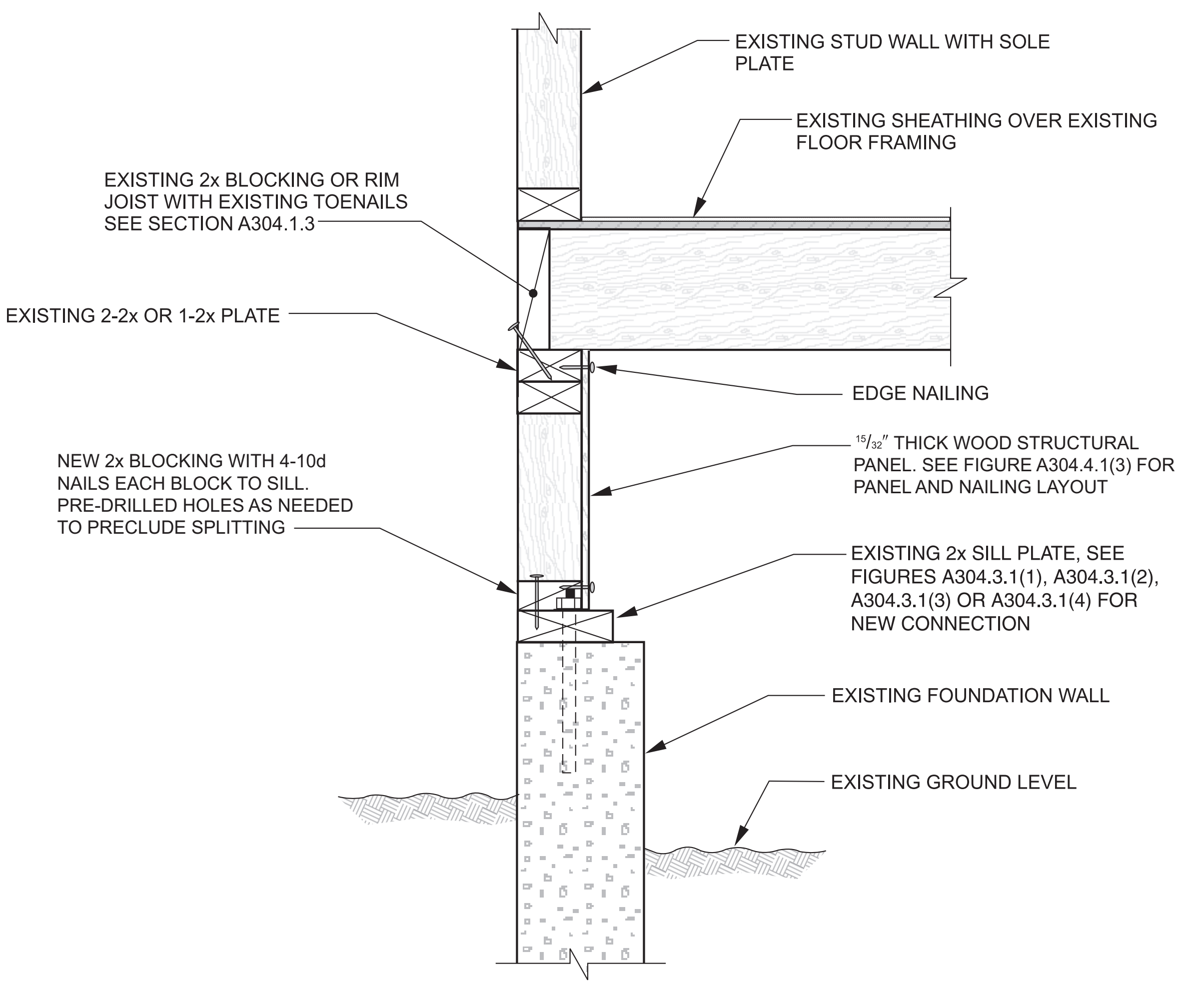
For SI: 1 inch = 25.4 mm.
NOTE: See Figure A304.3.1(1) for sill plate anchoring.

[BS] FIGURE A304.4.1(1)
CRIPPLE WALL BRACING WITH NEW WOOD STRUCTURAL PANEL ON EXTERIOR FACE OF CRIPPLE STUDS

[BS] A304.4.3 Stud space ventilation. Where bracing materials are installed on the interior face of studs forming an enclosed space between the new bracing and the existing exterior finish, each braced stud space must be ventilated. Adequate ventilation and access for future inspection shall be provided by drilling one 2-inch to 3-inch-diameter (51 mm to 76 mm) round hole through the sheathing, nearly centered between each stud at the top and bottom of the cripple wall. Such holes should be spaced not less than 1 inch (25 mm) clear from the sill or top plates. In stud spaces containing sill bolts, the hole shall be located on the centerline of the sill bolt but not closer than 1 inch (25 mm) clear from the nailing edge of the sheathing. Where existing blocking occurs within the stud space, additional ventilation holes shall be placed above and below the blocking, or the existing block shall be removed and a new nominal 2-inch by 4-inch (51 mm by 102 mm) block shall be installed with the nominal 4-inch (102 mm) dimension against the face of the plywood. For stud heights less than 18 inches (457 mm), only one ventilation hole need be provided.

[BS] A304.4.4 Existing underfloor ventilation. Existing underfloor ventilation shall not be reduced without providing equivalent new ventilation as close to the existing ventilation as possible. Braced panels may include underfloor ventilation openings where the height of the opening, measured from the top of the foundation wall to the top of the opening, does not exceed 25 percent of the height of the cripple stud wall; however, the length of the panel shall be increased a distance equal to the length of the opening or one stud space minimum. Where an opening exceeds 25 percent of the cripple wall height, braced panels shall not be located where the opening occurs. See Figure A304.4.1(3).

Exception: For homes with a post and pier foundation system where a new continuous perimeter foundation system is being installed, new ventilation shall be provided in accordance with the building code.



For SI: 1 inch = 25.4 mm.

[BS] FIGURE A304.4.1(2)
CRIPPLE WALL BRACING WITH WOOD STRUCTURAL PANEL ON INTERIOR FACE OF CRIPPLE STUDS

[BS] A304.5 *Inspections*. All work shall be subject to inspection by the code official including, but not limited to:

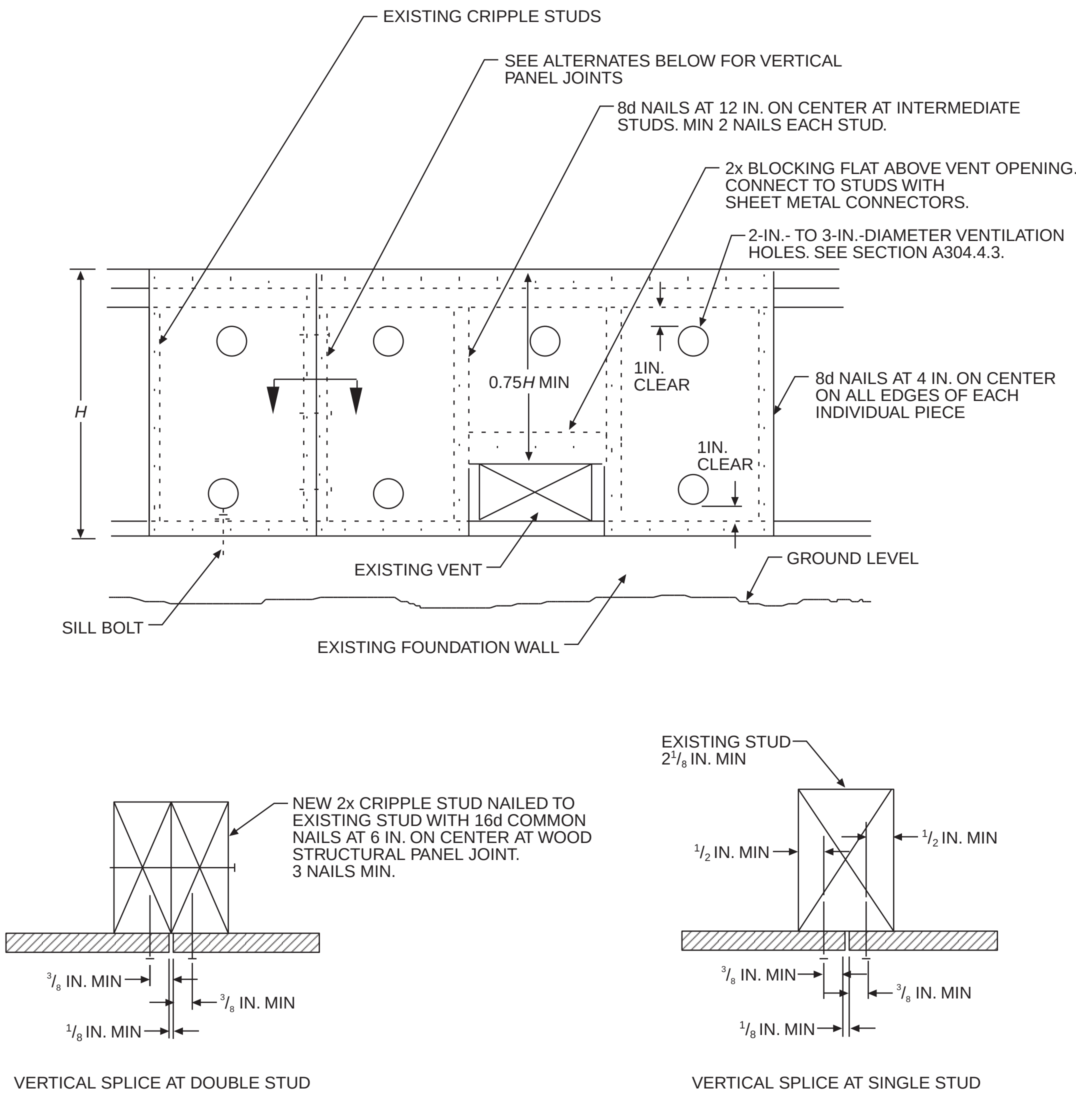
1. Placement and installation of new adhesive or expansion anchors installed in existing foundations. Special inspection *may be* required for adhesive anchors installed in existing foundations regulated by the prescriptive provisions of this chapter.
2. Installation and nailing of new cripple wall bracing.
3. Any work shall be subject to special inspection where required by the code official in accordance with the building code.

[BS] A304.5.1 Nails. All nails specified in this chapter shall be common wire nails of the following diameters and lengths:

1. 8d nails = 0.131 inch (3.3 mm) by $2^1/_2$ inches (64 mm).
2. 10d nails = 0.148 inch (3.8 mm) by 3 inches (76 mm).
3. 12d nails = 0.148 inch (3.8 mm) by $3^1/_4$ inches (83 mm).
4. 16d nails = 0.162 inch (4.1 mm) by $3^1/_2$ inches (89 mm).

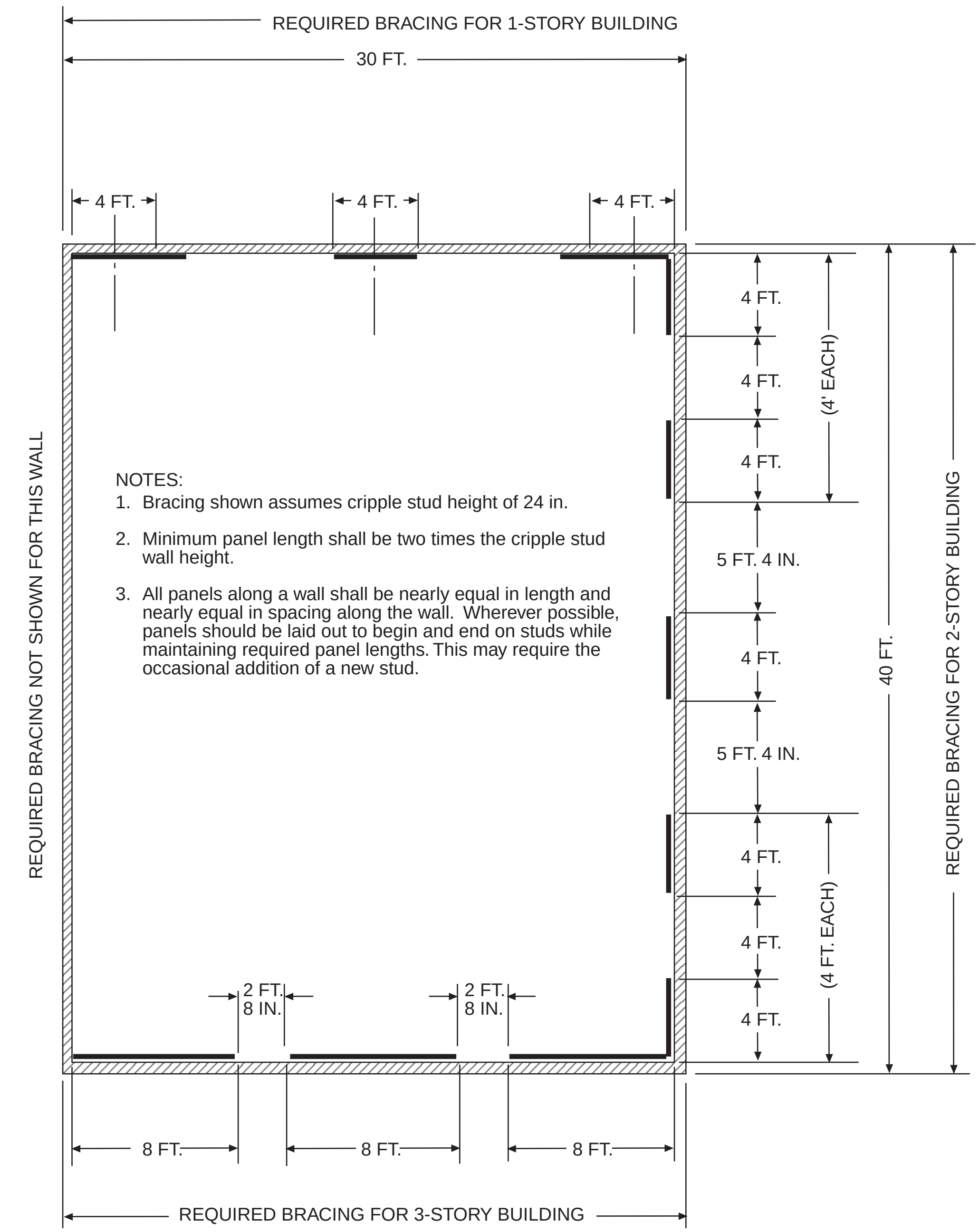
Nails used to attach metal framing connectors directly to wood members shall be as specified by the connector manufacturer in an approved report.

A304.6 Phasing of the strengthening work. *When approved by the Enforcing Agency, the strengthening work contained in this chapter may be completed in phases.*



For SI: 1 inch = 25.4 mm.

[BS] FIGURE A304.4.1(3)
PARTIAL CRIPPLE STUD WALL ELEVATION



Bracing determination:

1-story building—each end and not less than 40% of wall length.[a]
Transverse wall—30 ft. × 0.40 = 12 ft. minimum panel length = 4 ft. 0 in.

2-story building—each end and not less than 50% of wall length.[a]
Longitudinal wall—40 ft. × 0.50 = 20 ft. 0 in. minimum of bracing.

3-story building—each end and not less than 80% of wall length.[a]
Transverse wall —30 ft. × 0.80 = 24 ft. 0 in. minimum of bracing.

a. See Table 304.3.1 for buildings with both plaster walls and roofing exceeding 6 psf.

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot = 42.88 N/m^2.

[BS] FIGURE A304.4.2
FLOOR PLAN-CRIPPLE WALL BRACING LAYOUT

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX A
CHAPTER A4 – EARTHQUAKE RISK REDUCTION IN WOOD-FRAME RESIDENTIAL BUILDINGS WITH SOFT, WEAK OR OPEN FRONT WALLS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 A4

EARTHQUAKE RISK REDUCTION IN WOOD-FRAME RESIDENTIAL BUILDINGS WITH SOFT, WEAK OR OPEN FRONT WALLS

SECTION A401
GENERAL

[BS] A401.1 Purpose. The purpose of this chapter is to promote public welfare and safety by reducing the risk of death or injury as a result of the effects of earthquakes on existing wood-frame, multiple-unit residential buildings. The ground motions of past earthquakes have caused the loss of human life, personal injury and property damage in these types of buildings. This chapter creates minimum standards to strengthen the more vulnerable portions of these structures. Where fully followed, these minimum standards will improve the performance of these buildings but will not necessarily prevent all earthquake-related damage.

[BS] A401.2 Scope. The provisions of this chapter apply to existing buildings of wood construction that contain residential occupancies and are assigned to Risk Category II, and where the structure has a soft, weak or open-front wall line, and there exists one or more stories above**.**

SECTION A402
DEFINITIONS

[BS] A402.1 Definitions. Notwithstanding the applicable definitions, symbols and notations in the building code, the following definitions shall apply for the purposes of this chapter:

[BS] ASPECT RATIO. The span-width ratio for horizontal diaphragms and the height-length ratio for shear walls.

[BS] NONCONFORMING STRUCTURAL MATERIALS. Wall bracing materials other than wood structural panels or diagonal sheathing.

[BS] OPEN-FRONT WALL LINE. An exterior wall line, without vertical elements of the lateral force-resisting system, that requires tributary seismic forces to be resisted by diaphragm rotation or excessive cantilever beyond parallel lines of shear walls. Diaphragms that cantilever more than 25 percent of the distance between lines of lateral force-resisting elements from which the diaphragm cantilevers shall be considered to be excessive. Exterior exit balconies of 6 feet (1829 mm) or less in width shall not be considered excessive cantilevers.

[BS] RETROFIT. An improvement of the lateral force-resisting system by alteration of existing structural elements or addition of new structural elements.

[BS] SOFT WALL LINE. A wall line whose lateral stiffness is less than that required by story drift limitations or deformation compatibility requirements of this chapter. In lieu of analysis, a soft wall line may be defined as a wall line in a story where the story stiffness is less than 70 percent of the story above for the direction under consideration.

[BS] STORY. A story as defined by the building code, including any basement or underfloor space of a building with cripple walls exceeding 4 feet (1219 mm) in height.

[BS] WALL LINE. Any length of wall along a principal axis of the building used to provide resistance to lateral loads. Parallel wall lines separated by less than 4 feet (1219 mm) shall be considered to be one wall line for the distribution of loads.

[BS] WEAK WALL LINE. A wall line in a story where the story strength is less than 80 percent of the story above in the direction under consideration.

SECTION A403
ANALYSIS AND DESIGN

[BS] A403.1 General. Modifications required by the provisions in this chapter shall be designed in accordance with the *California Building Code* provisions for new construction, except as modified by this chapter.

> **Exception:** Buildings for which the prescriptive measures provided in Section A404 apply and are used.

Alteration of the existing lateral force-resisting system or vertical load-carrying system shall not reduce the strength or stiffness of the existing structure, unless the altered structure would remain in conformance to the building code and this chapter.

[BS] A403.2 Scope of analysis. This chapter requires the *alteration*, *repair*, replacement or addition of structural elements and their connections to meet the strength and stiffness requirements herein. The lateral load-path analysis shall include the resisting elements and connections from the wood diaphragm immediately above any soft, weak or open-front wall lines to the foundation soil interface or to the uppermost story of a podium structure comprised of steel, masonry, or concrete structural systems that supports the upper wood-framed structure. Stories above the uppermost story with a soft, weak or open-front wall line shall be considered in the analysis but need not be modified. The lateral load-path analysis for added structural elements shall include evaluation of the allowable soil-bearing and lateral pressures in accordance with the building code. Where any portion of a building within the scope of this chapter is constructed on or into a slope steeper than one unit vertical in three units horizontal (33-percent slope), the lateral force-resisting system at and below the base level diaphragm shall be analyzed for the effects of concentrated lateral forces at the base caused by this hillside condition.

[BS] A403.3 Design base shear and design parameters. The design base shear in a given direction shall be permitted to be 75 percent of the value required for similar new construction in accordance with the building code. The value of R used in the design of the strengthening of any story shall not exceed the lowest value of R used in the same direction at any story above. The system overstrength factor, Ω_0, and the deflection amplification factor, C_d, shall be not less than the largest respective value corresponding to the R factor being used in the direction under consideration.

Exceptions:

1. For structures assigned to Seismic Design Category B, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening.
2. For structures assigned to Seismic Design Category C or D, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening, provided that when the strengthening is complete, the strengthened structure will not have an extreme weak story irregularity defined as Type 5b in ASCE 7 Table 12.3-2.
3. For structures assigned to Seismic Design Category E, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening, provided that when the strengthening is complete, the strengthened structure will not have an extreme soft story, a weak story, or an extreme weak story irregularity defined, respectively, as Types 1b, 5a and 5b in ASCE 7 Table 12.3-2.
4. For retrofit systems involving different seismic force-resisting systems in the same direction within the same story, resisting elements are permitted to be designed using the least value of R for the different structural systems found in each independent line of resistance if all of the following conditions are met:
   4.1. The building is assigned to *Risk Category* I or II.
   4.2. The building height is no more than four stories above grade plane.
   4.3. The seismic force-resisting systems of the retrofitted building comprise only wood structural panel shear walls, steel moment-resisting frames, steel cantilever columns and steel-braced frames. Values for C and Ω_0 shall be consistent with the R value used.
5. With reference to ASCE 7 Table 12.2-1, ordinary, intermediate and special steel systems, and all light-frame systems shall be permitted without limitation where those systems are used only for retrofit to comply with the requirements of this chapter.

[BS] A403.3.1 Expected story strength. Despite any other requirement of Section A403.3 or A403.4, the total expected strength of retrofit elements added to any story need not exceed 1.7 times the expected strength of the story immediately above in a two-story building, or 1.3 times the expected strength of the story immediately above in a three-story or taller building, as long as the retrofit elements are located symmetrically about the center of mass of the story above, or so as to minimize torsion in the retrofitted story. Calculation of expected story strength and identification of irregularities in Section A403.3 shall be based on the expected strength of all wall lines, even if sheathed with nonconforming materials. The strength of a wall line above the retrofitted story shall be permitted to be reduced to account for inadequate load path or overturning resistance.

[BS] A403.3.2 Seismicity parameters, site class and geologic hazards. For any site designated as Site Class E, the value of F shall be taken as 1.2. Site-specific procedures are not required for compliance with this chapter. Mitigation of existing geologic site hazards such as liquefiable soil, fault rupture or landslide is not required for compliance with this chapter.

[BS] A403.4 Story drift limitations. The calculated story drift for each retrofitted story shall not exceed the allowable deformation compatible with all vertical load-resisting elements and 0.025 times the story height. The calculated story drift shall not be reduced by the effects of horizontal diaphragm stiffness but shall be increased where these effects produce rotation. Drift calculations shall be in accordance with the building code.

[BS] A403.4.1 Pole structures. The effects of rotation and soil stiffness shall be included in the calculated story drift where lateral loads are resisted by vertical elements whose required depth of embedment is determined by pole formulas. The coefficient of subgrade reaction used in deflection calculations shall be based on a geotechnical investigation conducted in accordance with the building code.

[BS] A403.5 Deformation compatibility and P Δ effects. The requirements of the building code shall apply, except as modified herein. Structural framing elements and their connections not required by design to be part of the lateral force-resisting system shall be designed and detailed to be adequate to maintain support of expected gravity loads when subjected to the expected deformations caused by seismic forces. Increased demand caused by P Δ effects and story sidesway stability shall be considered in retrofit stories that rely on the strength and stiffness of cantilever columns for lateral resistance.

[BS] A403.6 Ties and continuity. All parts of the structure included in the scope of Section A403.2 shall be interconnected as required by the building code.

[BS] A403.7 Collector elements. Collector elements shall be provided to transfer the seismic forces between the elements within the scope of Section A403.2.

[BS] A403.8 Floor diaphragms. Floor diaphragms within the scope of Section A403.2 shall be shown to have adequate strength at the following locations:

1. For straight lumber sheathed diaphragms without integral hardwood flooring throughout the diaphragm: The code official is authorized to waive the requirement where it is shown that the condition occurs in areas

small enough not to affect overall building performance.

2. For all other diaphragms adequate strength shall be shown to be provided at locations where forces are transferred between the diaphragm and each new or strengthened vertical element of the seismic force-resisting system. Collector elements shall be provided where needed to distribute the transferred force over a greater length of diaphragm.

   Exception: Where the existing vertical elements of the seismic force-resisting system are shown to comply with this chapter, diaphragms need not be evaluated.

[BS] A403.9 Wood-framed shear walls. Wood-framed shear walls shall have strength and stiffness sufficient to resist the seismic loads and shall conform to the requirements of this section. Where new sheathing is applied to existing studs to create new wood-framed shear walls, the new wall elements shall be considered bearing wall systems for purposes of determining seismic design parameters.

[BS] A403.9.1 Gypsum or cement plaster products. Gypsum or cement plaster products shall not be used to provide the strength required by Section A403.3 or the stiffness required by Section A403.4.

[BS] A403.9.2 Wood structural panels.

[BS] A403.9.2.1 Drift limit. Wood structural panel shear walls shall meet the story drift limitation of Section A403.4. Conformance to the story drift limitation shall be determined by approved testing or calculation. Individual shear panels shall be permitted to exceed the maximum aspect ratio, provided that the allowable story drift and allowable shear capacities are not exceeded.

[BS] A403.9.2.2 Openings. Shear walls are permitted to be designed for continuity around openings in accordance with the building code. Blocking and steel strapping shall be provided at corners of the openings to transfer forces from discontinuous boundary elements into adjoining panel elements. Alternatively, perforated shear wall provisions of the building code are permitted to be used.

[BS] A403.9.3 Hold-down connectors.

[BS] A403.9.3.1 Expansion anchors in tension. Expansion anchors that provide tension strength by friction resistance shall not be used to connect hold-down devices to existing concrete or masonry elements.

[BS] A403.9.3.2 Required depth of embedment. The required depth of embedment or edge distance for the anchor used in the hold-down connector shall be provided in the concrete or masonry below any plain concrete slab unless satisfactory evidence is submitted to the code official that shows that the concrete slab and footings are of monolithic construction.

A403.10 Steel retrofit systems. Steel retrofit systems shall have strength and stiffness sufficient to resist the seismic loads and shall conform to the requirements of this section.

A403.10.1 Special moment frames. Steel special moment frames shall comply with all applicable provisions of AISC 341, except that Section E3.4a addressing strong-column/weak-beams of AISC 341, is not required for columns that carry no gravity load.

A403.10.2 Inverted moment frame systems. Cantilevered column systems shall be permitted to be designed as inverted special, intermediate or ordinary moment frames, with corresponding moment frame seismic design coefficients, where the system satisfies the following conditions:

1. The columns carry no gravity load.
2. The columns are configured in pairs or larger groups connected by a continuous reinforced concrete foundation or grade beam.
3. The foundation or grade beam shall be designed to resist the expected plastic moment at the base of each column, computed as R_yF_yZ in accordance with AISC 341.
4. The flexibility of the foundation or grade beam, considering cracked section properties of the reinforced concrete, shall be included in computing the deformation of the steel frame system.
5. The column height shall be taken as twice the actual height when checking lateral torsional buckling.

SECTION A404
PRESCRIPTIVE MEASURES FOR WEAK STORY

[BS] A404.1 Limitation. These prescriptive measures shall apply only to two-story buildings and only where deemed appropriate by the code official. These prescriptive measures rely on rotation of the second floor diaphragm to distribute the seismic load between the side and rear walls around a ground floor open area. In the absence of an existing floor diaphragm of wood structural panel or diagonal sheathing at the top of the first story, a new wood structural panel diaphragm of minimum thickness of $^3/_4$ inch (19.1 mm) and with 10d common nails at 6 inches (152 mm) on center shall be applied.

[BS] A404.1.1 Additional conditions. To qualify for these prescriptive measures, the following additional conditions need to be satisfied by the retrofitted structure:

1. Diaphragm aspect ratio *L/W* is less than 0.67, where *W* is the diaphragm dimension parallel to the soft, weak or open-front wall line and *L* is the distance in the orthogonal direction between that wall line and the rear wall of the ground floor open area.
2. Minimum length of side shear walls = 20 feet (6096 mm).
3. Minimum length of rear shear wall = three-fourths of the total rear wall length.
4. Plan or vertical irregularities shall not be other than a soft, weak or open-front wall line.
5. Roofing weight less than or equal to 5 pounds per square foot (240 N/m^2).

6. Aspect ratio of the full second floor diaphragm meets the requirements of the building code for new construction.

[BS] A404.2 Minimum required retrofit.

[BS] A404.2.1 Anchor size and spacing. The anchor size and spacing shall be not less than $^3/_4$ inch (19.1 mm) in diameter at 32 inches (813 mm) on center. Where existing anchors are inadequate, supplemental or alternative approved connectors (such as new steel plates bolted to the side of the foundation and nailed to the sill) shall be used.

[BS] A404.2.2 Connection to floor above. Shear wall top plates shall be connected to blocking or rim joist at upper floor with not less than 18-gage galvanized steel angle clips $4^1/_2$ inches (114 mm) long with 12-8d nails spaced not farther than 16 inches (406 mm) on center, or by equivalent shear transfer methods.

[BS] A404.2.3 Shear wall sheathing. The shear wall sheathing shall be not less than $^{15}/_{32}$-inch (11.9 mm), 5-ply Structural I with 10d nails at 4 inches (102 mm) on center at edges and 12 inches (305 mm) on center at field; blocked all edges with 3 by 4 board or larger. Where existing sill plates are less than 3-by thick, place flat 2-by on top of sill between studs, with flat 18-gage galvanized steel clips $4^1/_2$ inches (114 mm) long with 12-8d nails or $^3/_8$-inch-diameter (9.5 mm) lags through blocking for shear transfer to sill plate. Stagger nailing from wall sheathing between existing sill and new blocking. Anchor new blocking to foundation as specified in this section.

[BS] A404.2.4 Shear wall hold-downs. Shear walls shall be provided with hold-down anchors at each end. Two hold-down anchors are required at intersecting corners. Hold-downs shall be approved connectors with a minimum $^5/_8$-inch-diameter (15.9 mm) threaded rod or other approved anchor with a minimum allowable load of 4,000 pounds (17.8 kN). Anchor embedment in concrete shall be not less than 5 inches (127 mm). Tie-rod systems shall be not less than $^5/_8$ inch (15.9 mm) in diameter unless using high-strength cable. High-strength cable elongation shall not exceed $^5/_8$ inch (15.9 mm) under a 4,000 pound (17.8 kN) axial load.

SECTION A405
MATERIALS OF CONSTRUCTION

[BS] A405.1 New materials. New materials shall meet the requirements of the *California Building Code*, except where allowed by this chapter.

[BS] A405.2 Allowable foundation and lateral pressures. The use of default values from the building code for continuous and isolated concrete spread footings shall be permitted. For soil that supports embedded vertical elements, Section A403.4.1 shall apply.

[BS] A405.3 Existing materials. The physical condition, strengths and stiffnesses of existing building materials shall be taken into account in any analysis required by this chapter. The verification of existing materials conditions and their conformance to these requirements shall be made by physical observation, material testing or record drawings as determined by the registered design professional subject to the approval of the code official.

[BS] A405.3.1 Wood-structural-panel shear walls.

[BS] A405.3.1.1 Existing nails. Where the required calculations rely on design values for common nails or surfaced dry lumber, their use in construction shall be verified by exposure.

[BS] A405.3.1.2 Existing plywood. Where verification of the existing plywood is by use of record drawings alone, plywood shall be assumed to be of three plies.

[BS] A405.3.2 Existing wood framing. Wood framing is permitted to use the design stresses specified in the building code under which the building was constructed or other stress criteria approved by the code official.

[BS] A405.3.3 Existing structural steel. All existing structural steel shall be permitted to be assumed to comply with ASTM A36. Existing pipe or tube columns shall be assumed to be of minimum wall thickness unless verified by testing or exposure.

[BS] A405.3.4 Existing concrete. All existing concrete footings shall be permitted to be assumed to be plain concrete with a compressive strength of 2,000 pounds per square inch (13.8 MPa). Existing concrete compressive strength taken greater than 2,000 pounds per square inch (13.8 MPa) shall be verified by testing, record drawings or department records.

[BS] A405.3.5 Existing sill plate anchorage. The analysis of existing cast-in-place anchors shall be permitted to assume proper anchor embedment for purposes of evaluating shear resistance to lateral loads.

SECTION A406
CONSTRUCTION DOCUMENTS

[BS] A406.1 General. The plans shall show all information necessary for plan review and for construction and shall accurately reflect the design. The plans shall contain a note that states that this retrofit was designed in compliance with the criteria of this chapter.

[BS] A406.2 Existing construction. The plans shall show existing diaphragm and shear wall sheathing and framing materials; fastener type and spacing; diaphragm and shear wall connections; continuity ties; collector elements; and the portion of the existing materials that needs verification during construction. If the cap allowed by Section A403.3.1 is used to limit the scope of retrofit, the foregoing information shall be shown for each retrofitted story and at least one story above the uppermost retrofitted story. If the cap allowed by Section A403.3.1 is not used, the foregoing information need only be shown for each retrofitted story and for the floor at the top of that story.

[BS] A406.3 New construction.

[BS] A406.3.1 Foundation plan elements. The foundation plan shall include the size, type, location and spacing of all anchor bolts with the required depth of embedment, edge and end distance; the location and size of all shear walls and all columns for braced frames or moment frames; referenced details for the connection of shear walls, braced frames or moment-resisting frames to their footing; and referenced sections for any grade beams and footings.

[BS] A406.3.2 Framing plan elements. The framing plan shall include the length, location and material of shear walls; the location and material of frames; references or details for the column-to-beam connectors, beam-to-wall connections and shear transfers at floor and roof diaphragms; and the required nailing and length for wall top plate splices.

[BS] A406.3.3 Shear wall schedule, notes and details. Shear walls shall have a referenced schedule on the plans that includes the correct shear wall capacity in pounds per foot (N/m); the required fastener type, length, gage and head size; and a complete specification for the sheathing material and its thickness. The schedule shall also show the required location of 3-inch (76 mm) nominal or two 2-inch (51 mm) nominal edge members; the spacing of shear transfer elements such as framing anchors or added sill plate nails; the required hold-down with its bolt, screw or nail sizes; and the dimensions, lumber grade and species of the attached framing member.

Notes shall show required edge distance for fasteners of structural wood panels and framing members; required flush nailing at the plywood surface; limits of mechanical penetrations; and the sill plate material assumed in the design. The limits of mechanical penetrations shall be detailed showing the maximum notching and drilled hole sizes.

[BS] A406.3.4 General notes. General notes shall show the requirements for material testing, special inspection and structural observation.

SECTION A407
QUALITY CONTROL

[BS] A407.1 Structural observation. Structural observation, in accordance with Section 1704.6 of the *California Building Code* is required, regardless of seismic design category, height or other conditions. Structural observation shall include visual observation of work for conformance to the *approved* construction documents and confirmation of existing conditions assumed during design.

A407.2 Contractor responsibility. Contractor responsibility shall be in accordance with Section 1704.4 of the *California Building Code.*

A407.3 Testing and inspection. Structural testing and inspection for new construction materials, submittals, reports and certificates of compliance shall be in accordance with Sections 1704 and 1705 of the *California Building Code*. Work done to comply with this chapter shall not be eligible for Exceptions 1, 2, or 3 of Section 1704.2 of the *California Building Code* or for the exception to Section 1705.13.2 of the *California Building Code*.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX A
CHAPTER A5 – REFERENCED STANDARDS

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

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter	X			X	X																		
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 A5
REFERENCED STANDARDS

SECTION A501
REFERENCED STANDARDS

A501.1 General. See Table A501.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix that references the standard.

TABLE A501.1
REFERENCED STANDARDS

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
AISC 341-16	*Seismic Provisions for Structural Steel Buildings*	A403.10.1, A403.10.2
ASCE/SEI 7 —16	*Minimum Design Loads for Buildings and Other Structures with Supplement No. 1*	A104.1, A205.1, A206.1, A206.2, A206.3, A206.4, A206.7, A403.3
ASTM A36/A36M— 14	*Specification for Carbon Structural Steel*	A405.3.3
ASTM A653/A653M —15	*Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process*	A304.2.6
ASTM B695 —04(2009)	*Standard Specification for Coating of Zinc Mechanically Deposited on Iron and Steel*	A304.2.6
ASTM C67- 14	*Test Methods of Sampling and Testing Brick and Structural Clay Tile*	A106.2.3.1
ASTM C140/C140M —15	*Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units*	A106.2.3.1
ASTM C496 —96/ C496M —11	*Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens*	A104.1, A106.2.3.3
ASTM C1531—15	*Standard Test Methods for In Situ Measurement of Masonry Mortar Joint Shear Strength Index*	A106.2.3.2
ASTM E488/E488M —15	*Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements*	A107.5.1, A107.5.3
ASTM E519/ E519M —2010	*Standard Test Method for Diagonal Tension (Shear) in Masonry Assemblages*	A104.1
CBC—01	*California Building Code*	A202.1
CBC—07	*California Building Code*	A202.1
CBC—10	*California Building Code*	A202.1
CBC—13	*California Building Code*	A202.1
CBC—16	*California Building Code*	A202.1
CBC—19	*California Building Code*	A202.1
CBC—22	*California Building Code*	A102.2, A105.1, A105.4, A202.1, A203.1, A204.1, A205.1, A205.3, A205.3.1, A205.4, A301.3, A304.1.1, A403.1, A405.1, A407.1, A407.2, A407.3
UBC—97	*Uniform Building Code*	A202.1

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX B
SUPPLEMENTARY ACCESSIBILITY REQUIREMENTS FOR EXISTING BUILDINGS AND FACILITIES

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

APPENDIX B

SUPPLEMENTARY ACCESSIBILITY REQUIREMENTS FOR EXISTING BUILDINGS AND FACILITIES

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User note:

About this appendix: *Chapter 11 of the* International Building Code® *contains provisions that set forth requirements for accessibility to buildings and their associated sites and facilities for people with physical disabilities. Sections 306 and 1508 in the code address accessibility provisions and alternatives permitted in existing buildings. Appendix B was added to address accessibility in construction for items that are not typically enforceable through the traditional building code enforcement process.*

SECTION B101 QUALIFIED HISTORIC BUILDINGS AND FACILITIES

[BE] B101.1 General. Qualified historic buildings and facilities shall comply with Sections B101.2 through B101.5.

[BE] B101.2 Qualified historic buildings and facilities. These procedures shall apply to buildings and facilities designated as historic structures that undergo alterations or a change of occupancy.

[BE] B101.3 Qualified historic buildings and facilities subject to Section 106 of the National Historic Preservation Act. Where an alteration or change of occupancy is undertaken to a qualified historic building or facility that is subject to Section 106 of the National Historic Preservation Act, the federal agency with jurisdiction over the undertaking shall follow the Section 106 process. Where the state historic preservation officer or Advisory Council on Historic Preservation determines that compliance with the requirements for accessible routes, ramps, entrances, or toilet facilities would threaten or destroy the historic significance of the building or facility, the alternative requirements of Section 306.7.16 for that element are permitted.

[BE] B101.4 Qualified historic buildings and facilities not subject to Section 106 of the National Historic Preservation Act. Where an alteration or change of occupancy is undertaken to a qualified historic building or facility that is not subject to Section 106 of the National Historic Preservation Act, and the entity undertaking the alterations believes that compliance with the requirements for accessible routes, ramps, entrances or toilet facilities would threaten or destroy the historic significance of the building or facility, the entity shall consult with the state historic preservation officer. Where the state historic preservation officer determines that compliance with the accessibility requirements for accessible routes, ramps, entrances or toilet facilities would threaten or destroy the historical significance of the building or facility, the alternative requirements of Section 306.7.16 for that element are permitted.

[BE] B101.4.1 Consultation with interested persons. Interested persons shall be invited to participate in the consultation process, including state or local accessibility officials, individuals with disabilities, and organizations representing individuals with disabilities.

[BE] B101.4.2 Certified local government historic preservation programs. Where the state historic preservation officer has delegated the consultation responsibility for purposes of this section to a local government historic preservation program that has been certified in accordance with Section 101 of the National Historic Preservation Act of 1966 [(16 U.S.C. 470a(c)] and implementing regulations (36 CFR 61.5), the responsibility shall be permitted to be carried out by the appropriate local government body or official.

[BE] B101.5 Displays. In qualified historic buildings and facilities where alternative requirements of Section 306.7.16 are permitted, displays and written information shall be located where they can be seen by a seated person. Exhibits and signs displayed horizontally shall be 44 inches (1120 mm) maximum above the floor.

SECTION B102 FIXED TRANSPORTATION FACILITIES AND STATIONS

[BE] B102.1 General. Existing fixed transportation facilities and stations shall comply with Section B102.2.

[BE] B102.2 Existing facilities—key stations. Rapid rail, light rail, commuter rail, intercity rail, high-speed rail and other fixed guideway systems, altered stations, and intercity rail and key stations, as defined under criteria established by the Department of Transportation in Subpart C of 49 CFR Part 37, shall comply with Sections B102.2.1 through B102.2.3.

[BE] B102.2.1 Accessible route. One accessible route, or more, from an accessible entrance to those areas necessary for use of the transportation system shall be provided. The accessible route shall include the features specified in Section E109.2 of the *California Building Code*, except that escalators shall comply with Section 3004.2.2 of the *California Building Code*. Where technical unfeasibility in existing stations requires the accessible route to lead from the public way to a paid area of the transit system, an accessible fare collection machine complying with Section E109.2.3 of the *California Building Code* shall be provided along such accessible route.

[BE] B102.2.2 Platform and vehicle floor coordination. Station platforms shall be positioned to coordinate with vehicles in accordance with applicable provisions of 36 CFR Part 1192. Low-level platforms shall be 8 inches (250 mm) minimum above top of rail.

Exception: Where vehicles are boarded from sidewalks or street-level, low-level platforms shall be permitted to be less than 8 inches (250 mm).

[BE] B102.2.3 Direct connections. New direct connections to commercial, retail or residential facilities shall, to the maximum extent feasible, have an accessible route complying with Section 306.7.1 from the point of connection to boarding platforms and transportation system elements used by the public. Any elements provided to facilitate future direct connections shall be on an accessible route connecting boarding platforms and transportation system elements used by the public.

SECTION B103 DWELLING UNITS AND SLEEPING UNITS

[BE] B103.1 Communication features. Where dwelling units and sleeping units are altered or added, the requirements of Section E104.2 of the *California Building Code* shall apply only to the units being altered or added until the number of units with accessible communication features complies with the minimum number required for new construction.

SECTION B104 REFERENCED STANDARDS

[BE] B104.1 General. See Table B104.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix that reference the standard.

[BE] TABLE B104.1 REFERENCED STANDARDS

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
Y3.H626 2P	*National Historic Preservation J101.2, 43/933 Act of 1966 as amended J101.3, 3rd Edition*	B101.3, B101.4, B101.4.2
CBC—21	*California Building Code*	B102.2.1, B103.1
36 CFR Part 1192	*Americans with Disabilities Act Guidelines for Transportation Vehicles—Rapid Rail Vehicles and Systems*	B102.2.2
49 CFR Part 37 Subpart C	*Alteration of Transportation Facilities by Public Entities Department of Transportation*	B102.2

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX C
CHAPTER C1 – GABLE END RETROFIT FOR HIGH-WIND AREAS

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

APPENDIX C: GUIDELINES FOR THE WIND RETROFIT OF EXISTING BUILDINGS

CHAPTER C1

GABLE END RETROFIT FOR HIGH-WIND AREAS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User note:

About this appendix: *Appendix C is intended to provide guidance for retrofitting existing structures to strengthen their resistance to wind forces. This appendix is similar in scope to Appendix A, which addresses seismic retrofits for existing buildings, except that the subject matter is related to wind retrofits. These retrofits are voluntary measures that serve to better protect the public and reduce damage from high-wind events for existing buildings.*

The purpose of this appendix is to provide prescriptive alternatives for addressing retrofit of buildings in high-wind areas. Currently there are two chapters that deal with the retrofit of gable ends and the fastening of roof decks, Appendix Chapters C1 and C2, respectively.

SECTION C101 GENERAL

[BS] C101.1 Purpose. This chapter provides prescriptive methods for partial structural retrofit of an *existing building* to increase its resistance to out-of-plane wind loads. It is intended for voluntary use and for reference by mitigation programs. The provisions of this chapter do not necessarily satisfy requirements for new construction. Unless specifically cited, the provisions of this chapter do not necessarily satisfy requirements for structural improvements triggered by *addition, alteration, repair, change of occupancy*, building relocation or other circumstances.

[BS] C101.2 Eligible buildings and gable end walls. The provisions of this chapter are applicable only to buildings that meet the following eligibility requirements:

1. The building is not more than three stories tall, from adjacent grade to the bottom plate of each gable end wall being retrofitted with this chapter.
2. The building is classified as Occupancy Group R3 or is within the scope of the *California Residential Code*.
3. The structure includes one or more wood-framed gable end walls, either conventionally framed or metal-plate-connected.

In addition, the provisions of this chapter are applicable only to gable end walls that meet the following eligibility requirements:

4. Each gable end wall has or shall be provided with studs or vertical webs spaced 24 inches (610 mm) on center maximum.
5. Each gable end wall has a maximum height of 16 feet (4877 mm).

[BS] C101.3 Compliance Eligible gable end walls in eligible buildings may be retrofitted in accordance with this chapter. Other modifications required for compliance with this chapter shall be designed and constructed in accordance with the *California Building Code* or *California Residential Code* provisions for new construction, except as specifically provided for by this chapter.

SECTION C102 DEFINITIONS

[BS] C102.1 Definitions. The following words and terms shall, for the purposes of this chapter, have the meanings shown herein.

[BS] ANCHOR BLOCK. A piece of lumber secured to horizontal braces and filling the gap between existing framing members for the purpose of restraining horizontal braces from movement perpendicular to the framing members.

[BS] COMPRESSION BLOCK. A piece of lumber used to restrain in the compression mode (force directed toward the interior of the attic) an existing or retrofit stud. It is attached to a horizontal brace and bears directly against the existing or retrofit stud.

[BS] CONVENTIONALLY FRAMED GABLE END. A gable end framed with studs whose faces are perpendicular to the gable end wall.

[BS] GABLE END FRAME. A factory or site-fabricated frame, installed as a complete assembly that incorporates vertical webs with their faces parallel to the plane of the frame.

[BS] HORIZONTAL BRACE. A piece of lumber used to restrain both compression and tension loads applied by a retrofit stud. It is typically installed horizontally on the top of attic floor framing members (truss bottom chords or ceiling joists) or on the bottom of pitched roof framing members (truss top chord or rafters).

[BS] HURRICANE TIES. Manufactured metal connectors designed to provide uplift and lateral restraint for roof framing members.

[BS] NAIL PLATE. A manufactured metal plate made of galvanized steel with factory-punched holes for fasteners. A nail plate may have the geometry of a strap.

[BS] RETROFIT. The voluntary process of strengthening or improving buildings or structures, or individual components of buildings or structures for the purpose of making existing conditions better serve the purpose for which they were originally intended or the purpose that current building codes intend.

[BS] RETROFIT STUD. A lumber member used to structurally supplement an existing gable end wall stud or gable end frame web.

[BS] STUD-TO-PLATE CONNECTOR. A manufactured metal connector designed to connect studs to plates.

SECTION C103
MATERIALS OF CONSTRUCTION

[BS] C103.1 Existing materials. Existing wood materials that will be part of the retrofitting work (such as trusses, rafters, ceiling joists, top plates and wall studs) shall be in sound condition and free from defects or damage that substantially reduces the load-carrying capacity of the member. Any wood materials found to be damaged or deteriorated shall be strengthened or replaced with new materials to provide a net dimension of sound wood equivalent to its undamaged original dimensions.

[BS] C103.2 New materials. All new materials shall comply with the standards for those materials as specified in the *California Building Code* or the *California Residential Code*.

[BS] C103.3 Material specifications for retrofits. Materials for retrofitting gable end walls shall comply with Table C103.3.

[BS] C103.4 Twists in straps. Straps shall be permitted to be twisted or bent where they transition between framing members or connection points. Straps shall be bent only once at a given location though it is permissible that they be bent or twisted at multiple locations along their length.

[BS] C103.5 Fasteners. Fasteners shall meet the requirements of Table C103.5, Sections C103.5.1 and C103.5.2, and shall be permitted to be screws or nails meeting the minimum length requirement shown in the figures and specified in the tables of this appendix. Fastener spacing shall meet the requirements of Section C103.5.3.

[BS] C103.5.1 Screws. Unless otherwise indicated in the appendix, screw sizes and lengths shall be in accordance with Table C103.5. Permissible screws include deck screws and wood screws. Screws shall have not less than 1 inch (25 mm) of thread. Fine threaded screws or drywall screws shall not be permitted. Select the largest possible diameter screw such that the shank adjacent to the head fits through the hole in the strap.

[BS] C103.5.2 Nails. Unless otherwise indicated in this appendix, nail sizes and lengths shall be in accordance with Table C103.5.

[BS] C103.5.3 General fastener spacing. Fastener spacing for shear connections of lumber-to-lumber shall meet the requirements shown in Figure C103.5.3 and the following conditions.

[BS] TABLE C103.3
MATERIAL SPECIFICATIONS FOR RETROFITS[a]

COMPONENT	MINIMUM SIZE OR THICKNESS	MINIMUM MATERIAL GRADE	MINIMUM CAPACITY
Anchor blocks, compression blocks and horizontal braces	2 × 4 nominal lumber	#2 Spruce-Pine-Fir or better	NA
Nail plates	20 gage thickness 8d minimum nail holes	Galvanized sheet steel	NA
Retrofit studs	2 × 4 nominal lumber	#2 Spruce-Pine-Fir or better	NA
Gusset angle	14 gage thickness	Galvanized sheet steel	350 pounds uplift and lateral load
Stud-to-plate connector	20 gage thickness	Galvanized sheet steel	500 pounds uplift
Metal plate connectors, straps and anchors	20 gage thickness	Galvanized sheet steel	NA

For SI: 1 pound = 4.4 N.

NA = Not Applicable.

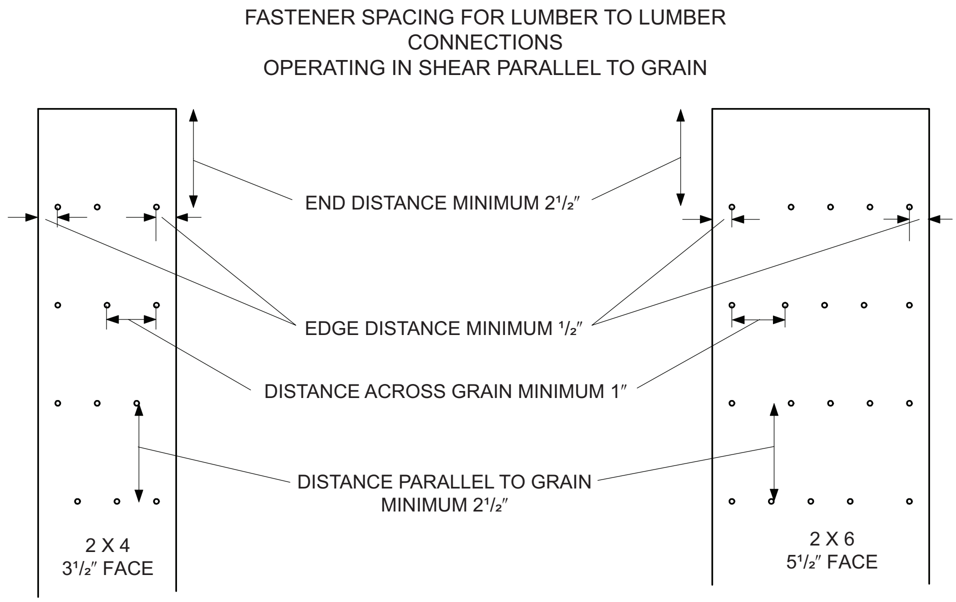
a. Metal plate connectors, nail plates, stud-to-plate connectors, straps and anchors shall be products approved for connecting wood-to-wood or wood-to-concrete as appropriate.

[BS] TABLE C103.5
NAIL AND SCREW REQUIREMENTS

FASTENER TYPE	MINIMUM SHANK DIAMETER	MINIMUM HEAD DIAMETER	MINIMUM FASTENER LENGTH
#8 screws	NA	0.28 inches	$1^1/_4$ inches
8d common nails	0.131 inches	0.28 inches	$2^1/_2$ inches
10d common nails	0.148 inches	0.28 inches	3 inches

For SI: 1 inch = 25.4 mm.

NA = Not Applicable.



For SI: 1 inch = 25.4 mm.

[BS] FIGURE C103.5.3
FASTENER SPACINGS FOR LUMBER-TO-LUMBER CONNECTIONS OPERATING IN SHEAR PARALLEL TO GRAIN

[BS] C103.5.3.1 General fastener spacing. Fastener spacing shall meet the following conditions except as provided for in Section C103.5.3.

The distance between fasteners and the edge of lumber that is less than $3^1/_2$ inches deep (89 mm) in the direction of the fastener length shall be not less than $^3/_4$ inch (19.1 mm).

1. The distance between fasteners and the edge of lumber that is more than 2 inches (51 mm) thick in the direction of the fastener length shall be not less than $^1/_2$ inch (12.7 mm).
2. The distance between a fastener and the end of lumber shall be not less than $2^1/_2$ inches (64 mm).
3. The distance between fasteners parallel to the grain (center-to-center) shall be not less than $2^1/_2$ inches (64 mm).
4. The distance between fasteners perpendicular to the grain (center-to-center) in lumber that is less than $3^1/_2$ inches (89 mm) deep in the direction of the fastener length shall be 1 inch (25 mm).
5. The distance between fasteners perpendicular to the grain (center-to-center) in lumber that is more than 2 inches (51 mm) thick in the direction of the fastener length shall be $^1/_2$ inch (12.7 mm).

[BS] C103.5.3.2 Wood-to-wood connections of two members each 2 inches or less in thickness. Wood-to-wood connections fastener spacing shall meet the following conditions.

1. The distance between fasteners parallel to grain (center-to-center) shall be not less than $2^1/_2$ inches (64 mm).
2. The distance between fasteners across grain (center-to-center) shall be not less than 1 inch (25 mm).
3. For wood-to-wood connections of lumber at right angles, fasteners shall be spaced not less than $2^1/_2$ inches (64 mm) parallel to the grain and 1 inch (25 mm) perpendicular to the grain in any direction.

[BS] C103.5.3.3 Metal connectors for wood-to-wood connections. Metal connectors for wood-to-wood connections shall meet the following conditions.

1. Fastener spacing to edge or ends of lumber shall be as dictated by the prefabricated holes in the connectors and the connectors shall be installed in a configuration that is similar to that shown by the connector manufacturer.
2. Fasteners in $1^1/_4$-inch-wide (32 mm) metal straps that are installed on the narrow face of lumber shall be a minimum $^1/_4$ inch (6.4 mm) from either edge of the lumber. Consistent with Section C103.5.3.1, fasteners shall be permitted to be spaced according to the fastener holes fabricated into the strap.
3. Fasteners in metal nail plates shall be spaced not less than $^1/_2$ inch (12.7 mm) perpendicular to grain and not less than $1^1/_2$ inches (38 mm) parallel to grain.

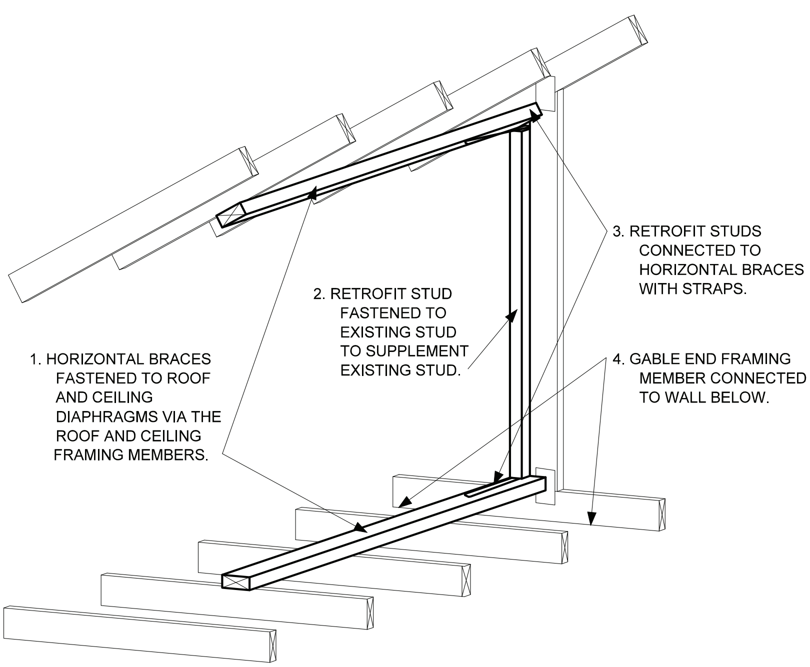
SECTION C104
RETROFITTING GABLE END WALLS TO ENHANCE WIND RESISTANCE

[BS] C104.1 General. These prescriptive methods of retrofitting are intended to increase the resistance of existing gable end construction for out-of-plane wind loads resulting from high-wind events. The ceiling diaphragm shall be comprised of minimum $^1/_2$-inch-thick (12.7 mm) gypsum board, minimum nominal $^3/_8$-inch-thick (9.5 mm) wood structural panels, or plaster. An overview isometric drawing of one type of gable end retrofit to improve wind resistance is shown in Figure C104.1.

[BS] C104.2 Horizontal braces. Horizontal braces shall be installed perpendicular to the roof and ceiling framing members at the location of each existing gable end stud greater than 3 feet (91 cm) in length. Unless it is adjacent to an omitted horizontal brace location, horizontal braces shall be minimum 2-inch by 4-inch (38 mm by 89 mm) dimensional lumber as defined in Section C103.3. A single horizontal brace is required at the top and bottom of each gable end stud for Retrofit Configuration A, B, or C. Two horizontal braces are required at the top and bottom of each gable end stud for Retrofit Configuration D. Maximum heights of gable end wall studs and associated retrofit studs for each Retrofit Configuration shall not exceed the values listed in Table C104.2. Horizontal braces shall be oriented with their wide faces across the roof or ceiling framing members, be fastened to not fewer than three framing members, and extend not less than 6 feet (183 cm) measured perpendicularly from the gable end plus $2^1/_2$ inches (64 mm) beyond the last top chord or bottom chord member (rafter or ceiling joist) from the gable end as shown in Figures C104.2(1), C104.2(2), C104.2(3) and C104.2(4).

[BS] C104.2.1 Existing gable end studs. If the spacing of existing vertical gable end studs is greater than 24 inches (64 mm), a new stud and corresponding horizontal braces shall be installed such that the maximum spacing between existing and added studs shall be not greater than 24 inches (64 mm). Additional gable end wall studs shall not be required at locations where their length would be 3 feet (914 mm) or less. Each end of each required new stud shall be attached to the existing roofing framing members (truss top chord or rafter and truss bottom chord or ceiling joist) using not fewer than two 3-inch (76 mm) toenail fasteners (#8 wood screws or 10d nails) and a metal connector with minimum uplift capacity of 175 pounds (778 N), or nail plates with not fewer than four $1^1/_4$-inch-long (32 mm) fasteners (No. 8 wood screws or 8d nails).

[BS] C104.2.2 Main method of installation. Each horizontal brace shall be fastened to each existing roof or ceiling member that it crosses using three 3-inch-long (76 mm) fasteners (No. 8 wood screws or 10d nails) as indicated in Figure C104.2(1) and Figure C104.2(3) for trusses and Figure C104.2(2) and Figure C104.2(4) for conventionally framed gable end walls. Alternative methods for providing horizontal bracing of the gable end studs as provided in Sections C104.2.3 through C104.2.9 shall be permitted.



THIS FIGURE SHOWS A TRUSS GABLE END.
THE METHODOLOGY FOR A CONVENTIONALLY FRAMED GABLE END IS SIMILAR.
THE NUMBERS INDICATE A TYPICAL SEQUENCE OF INSTALLATION.
IN ORDER TO SHOW STRAPS COMPRESSION BLOCKS ARE NOT SHOWN.

[BS] FIGURE C104.1
BASIC GABLE END RETROFIT METHODOLOGY

[BS] TABLE C104.2
STUD LENGTH LIMITATIONS BASED ON EXPOSURE AND DESIGN WIND SPEED

EXPOSURE CATEGORY	MAXIMUM 3-SEC GUST BASIC WIND SPEED[a]	MAXIMUM HEIGHT OF GABLE END RETROFIT STUD[b]			
C	140	8′-0″	11′-3″	14′-9″	16′-0″
C	150	7′-6″	10′-6″	13′-6″	16′-0″
C	165	7′-0″	10′-0″	12′-3″	16′-0″
C	180	7′-0″	10′-0″	12′-3″	16′-0″
C	190	6′-6″	8′-9″	11′-0″	16′-0″
B	140	8′-0″	12′-3″	16′-0″	NR[c]
B	150	8′-0″	11′-3″	14′-9″	16′-0″
B	165	8′-0″	11′-3″	14′-9″	16′-0″
B	180	7′-6″	10′-6″	13′-6″	16′-0″
B	190	7′-0″	10′-0″	12′-3″	16′-0″
	Retrofit Configuration	A	B	C	D

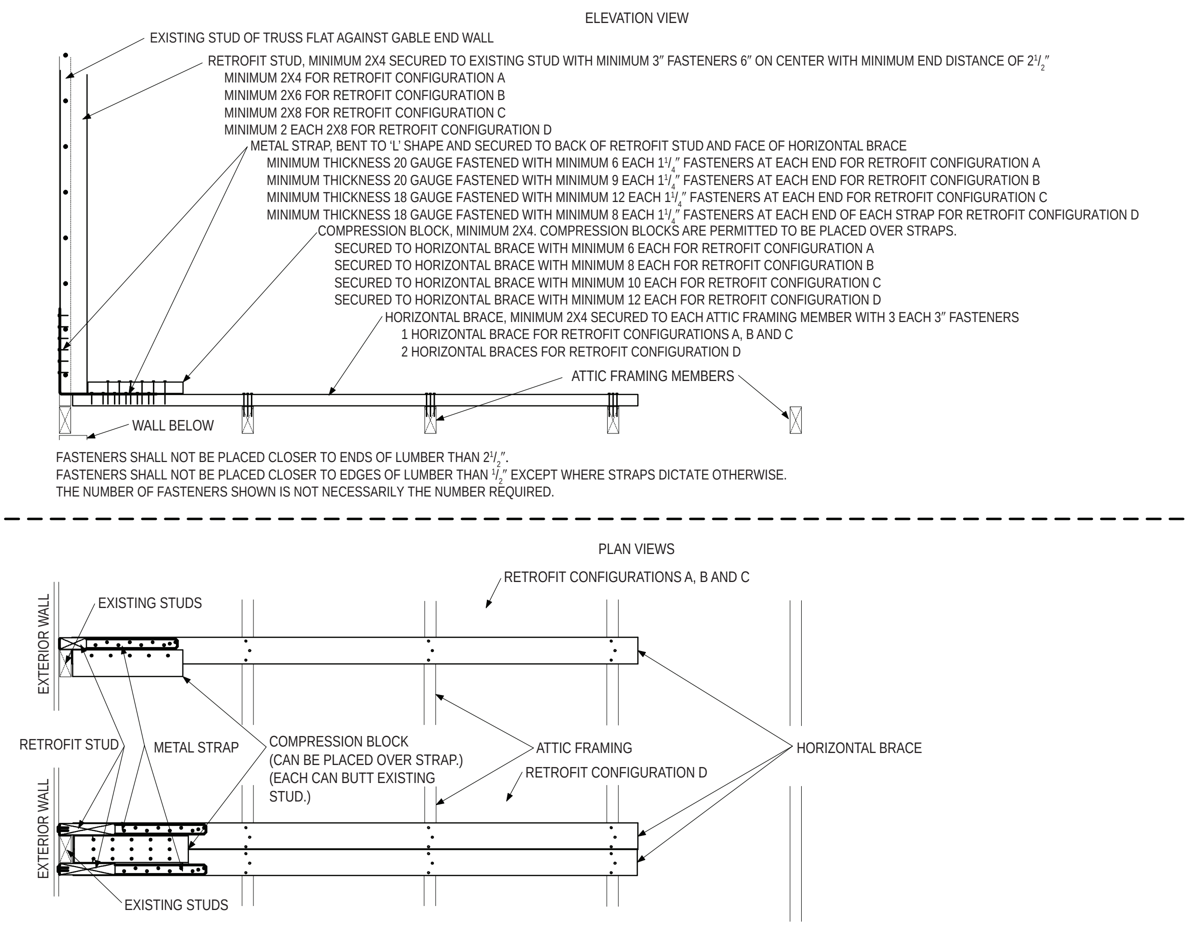
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

NR = Not Required.

a. Interpolation between given wind speeds is not permitted.

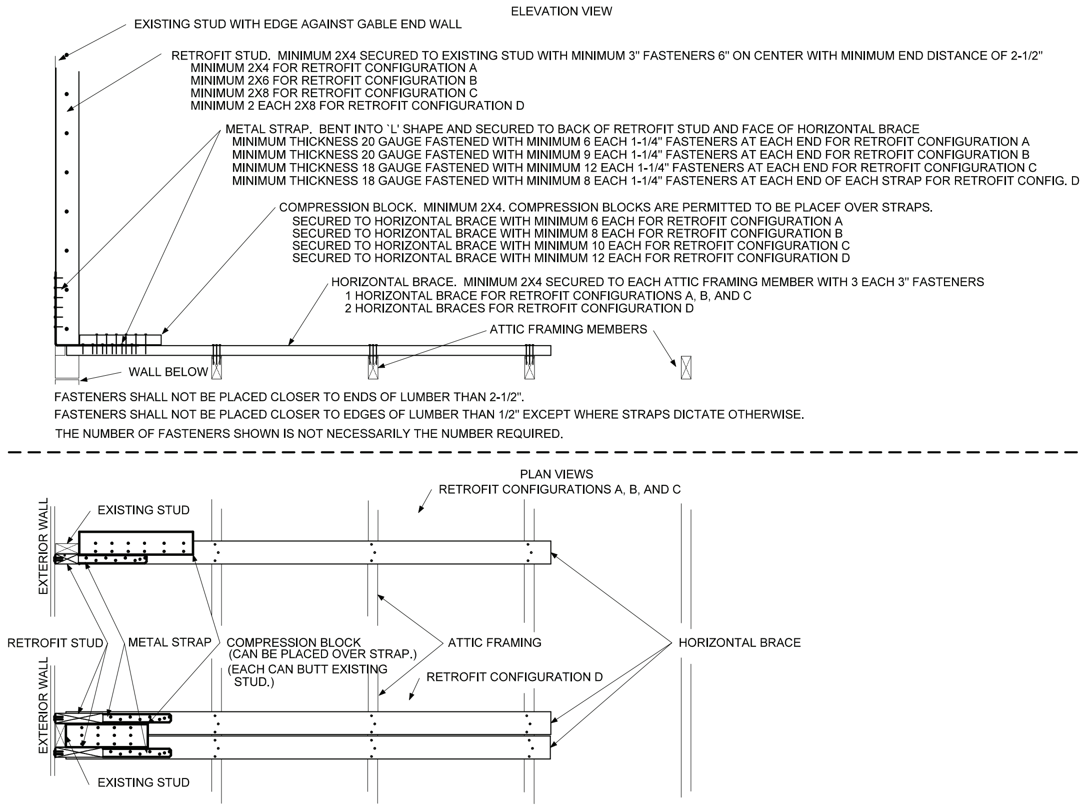
b. Existing gable end studs less than or equal to 3 feet 0 inches in height shall not require retrofitting.

c. Configuration C is acceptable to 16 feet 0 inches maximum height.



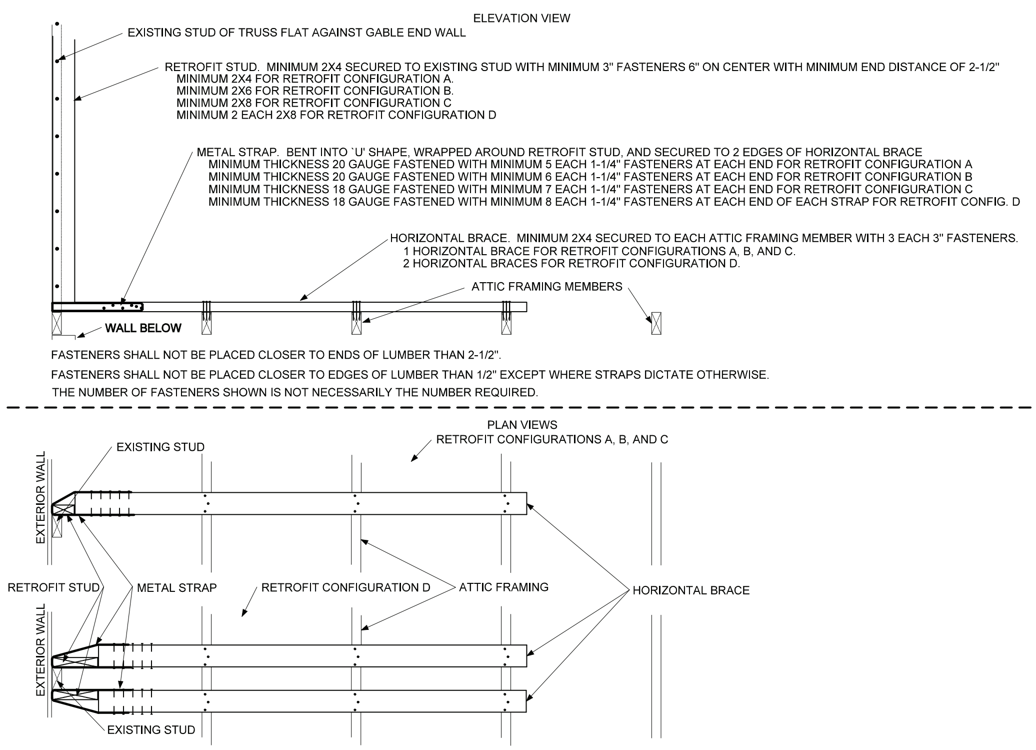
For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2(1)
TRUSS FRAMED GABLE END



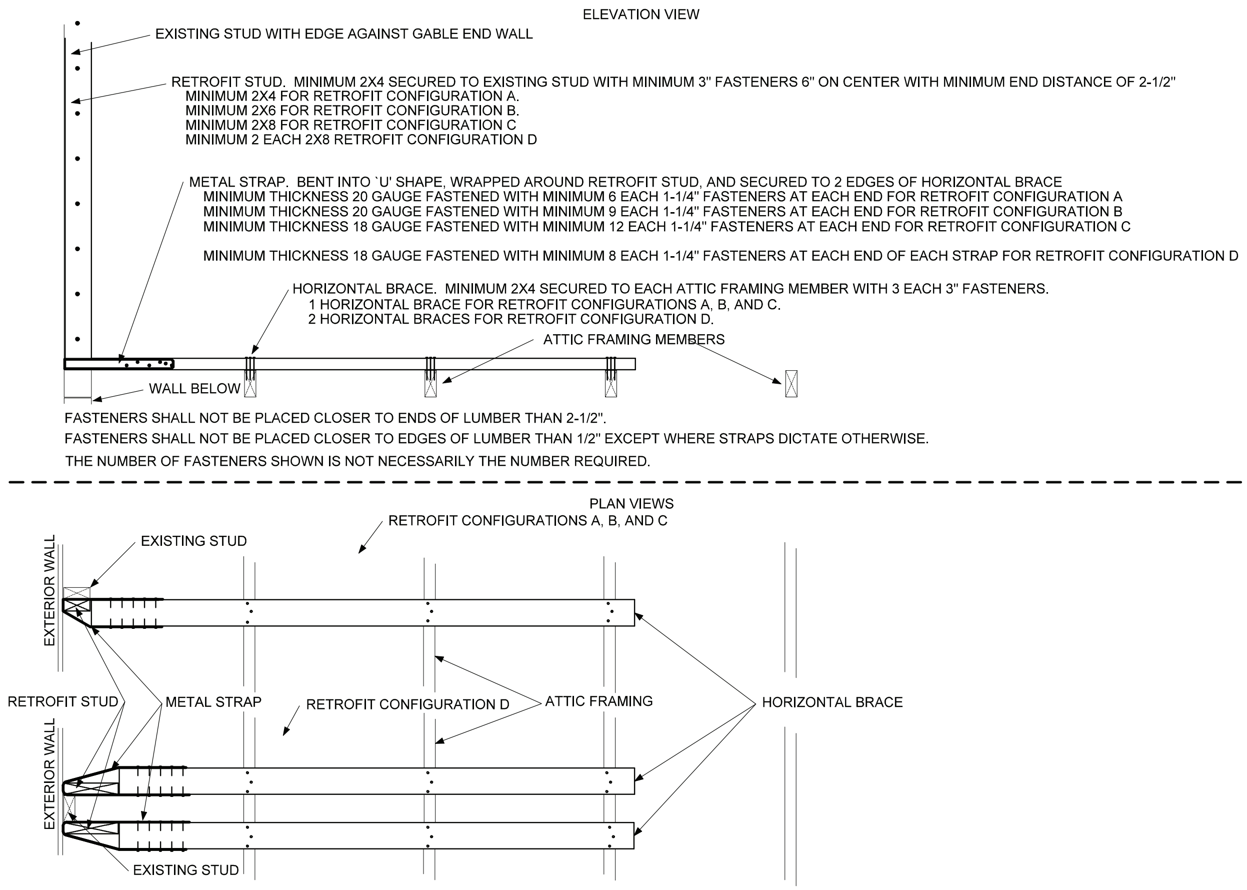
For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2(2)
CONVENTIONALLY FRAMED GABLE END L-BENT STRAP



For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2(3)
TRUSS FRAMED GABLE END U-BENT STRAP



For SI: 1 inch = 25.4 mm.

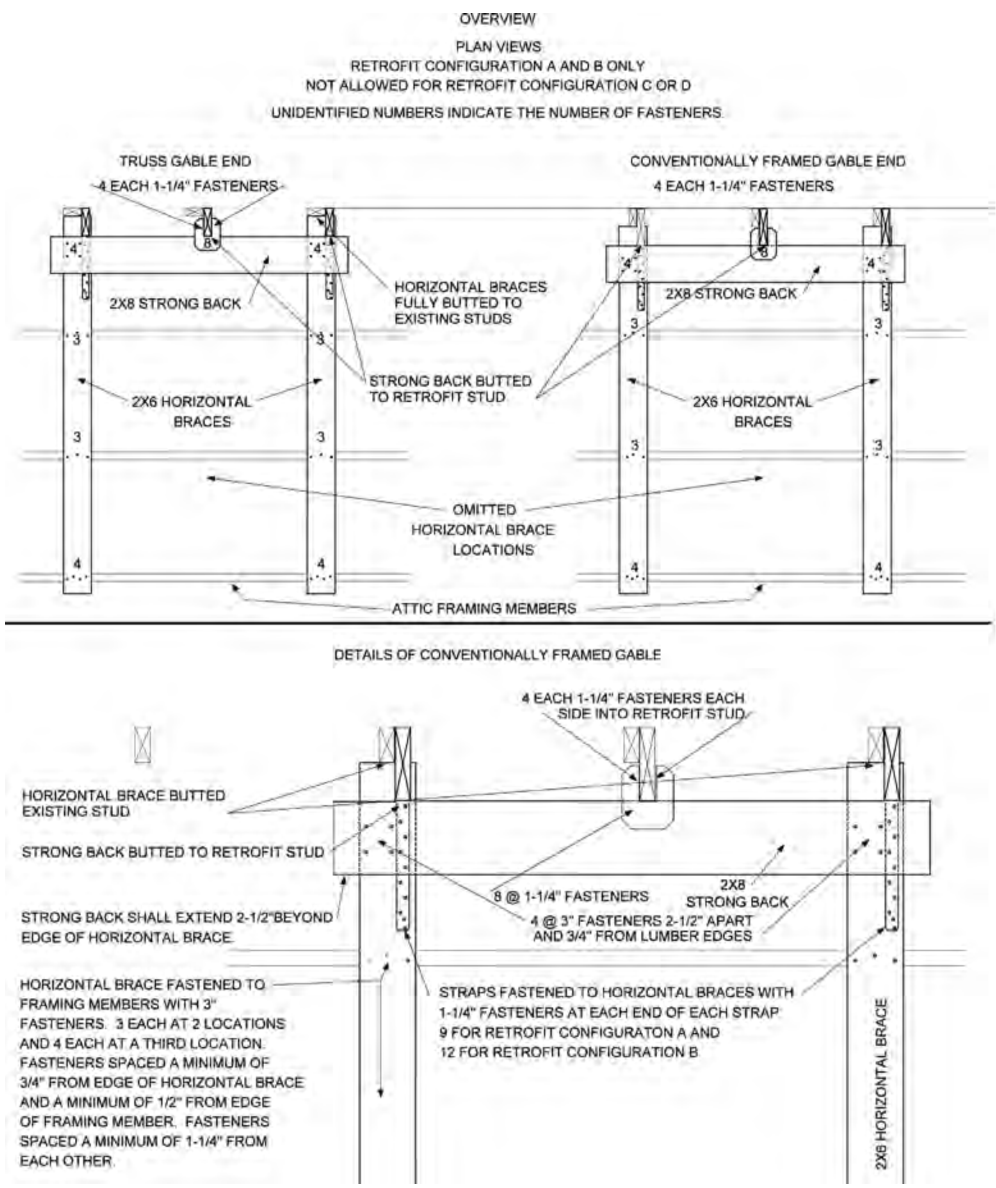
[BS] FIGURE C104.2(4)
CONVENTIONALLY FRAMED GABLE END U-BENT STRAP

[BS] C104.2.3 Omitted horizontal brace. Where conditions exist that prevent installation in accordance with Section C104.2.2, horizontal braces shall be permitted to be omitted for height limitations corresponding to Retrofit Configurations A and B as defined in Table C104.2 provided that installation is as indicated in Figure C104.2.3 and provided that all of the following conditions are met. This method is not permitted for Retrofit Configurations C or D.

1. There shall be not fewer than two horizontal braces on each side of an omitted horizontal brace or not fewer than one horizontal brace if it is the end horizontal brace. Omitted horizontal braces must be separated by not fewer than two horizontal braces even if that location is composed of two retrofit studs and two horizontal braces.
2. Horizontal braces adjacent to the omitted horizontal brace shall be 2-inch by 6-inch (38 mm by 140 mm) lumber, shall butt against the existing studs, and shall be fastened to each existing roof or ceiling member crossed using three 3-inch-long (76 mm) fasteners (No. 8 wood screws or 10d nails). For Retrofit Configuration B, four fasteners shall be required on not fewer than one of the connections between the horizontal brace and the existing roof and ceiling framing members. Fasteners shall be spaced a not less than $^3/_4$ inch (19.1 mm) from the edges of the horizontal braces and not less than $1^3/_4$ inches (44 mm) from adjacent fasteners.
3. Where the existing studs on each side of an omitted horizontal brace have their wide face perpendicular to the gable end wall, the retrofit studs at those locations and the retrofit stud at the omitted horizontal brace locations shall extend not less than $3^3/_4$ inches (95 mm) beyond the interior edge of the existing studs for both Retrofit Configurations A and B. The edges of the three retrofit studs facing towards the interior of the attic shall be aligned such that they are the same distance from the gable end wall.
4. Retrofit studs shall be fastened to existing studs in accordance with Section C104.3.
5. Retrofit studs adjacent to the omitted horizontal brace shall be fastened to the horizontal brace using straps in accordance with Table C104.4.1 consistent with the size of the retrofit stud. The method applicable to Table C104.4.2 is not permitted.
6. A strong back made of minimum of 2-inch by 8-inch (38 mm by 184 mm) nominal lumber shall be placed parallel to the gable end and shall be located on and

span between horizontal braces on the two sides of the omitted horizontal brace and shall extend beyond each horizontal brace by not less than $2^1/_2$ inches (64 mm). The strong back shall be butted to the three retrofit studs. The strong back shall be attached to each of the horizontal braces on which it rests with five 3-inch-long (76 mm) fasteners (#8 screws or 8d nails). The fasteners shall have a minimum $^3/_4$-inch (19.1 mm) edge distance and a minimum $2^1/_2$-inch (64 mm) spacing between fasteners. Additional compression blocks shall not be required at locations where a strong back butts against a retrofit stud.

7. The retrofit stud at the location of the omitted horizontal braces shall be fastened to the strong back using a connector with minimum uplift capacity of 800 pounds (3559 N) and installed such that this capacity is oriented in the direction perpendicular to the gable end wall.
8. The use of shortened horizontal braces using the alternative method of Section C104.2.5 is not permitted for horizontal braces adjacent to the omitted horizontal braces.
9. Horizontal braces shall be permitted to be interrupted in accordance with Section C104.2.8.



For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2.3
OMITTED HORIZONTAL BRACE

[BS] C104.2.4 Omitted horizontal brace and retrofit stud. Where conditions exist that prevent installation in accordance with Section C104.2.2 or C104.2.3, then retrofit studs and horizontal braces shall be permitted to be omitted from those locations by installation of ladder assemblies for Retrofit Configurations A and B as defined in Table C104.2 provided that all of the following conditions are met. This method is not permitted for Retrofit Configurations C or D.

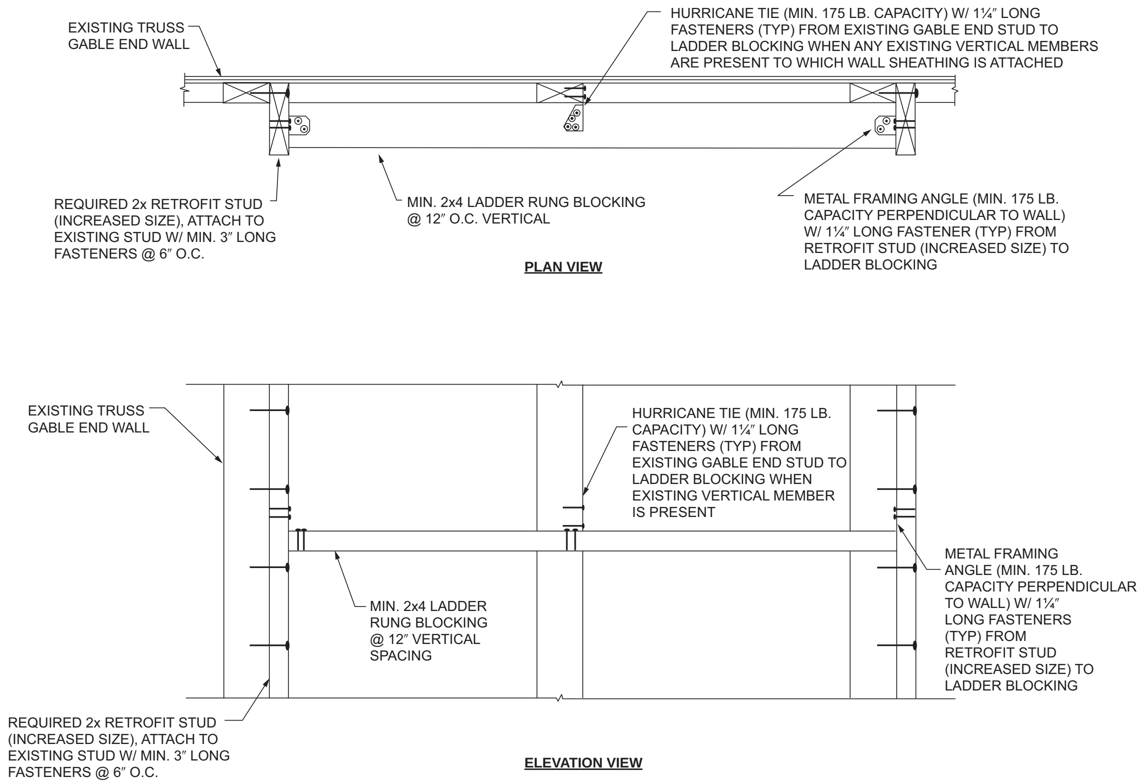
1. Not more than two ladder assemblies are permitted on a single gable end.
2. There shall be not fewer than two retrofit studs and horizontal brace assemblies on either side of the locations where the retrofit studs and horizontal bracing members are omitted (two ladder braces shall not bear on a single retrofit stud).
3. Where the existing studs on each side of an omitted horizontal brace have their wide face parallel to the gable end wall the retrofit studs at those locations and the retrofit stud at the omitted horizontal brace locations shall be 2-inch by 6-inch (38 mm by 180 mm) nominal lumber for Retrofit Configuration A and 2-inch by 8-inch (38 mm by 184 mm) lumber for Retrofit Configuration B.
4. Horizontal braces adjacent to the omitted horizontal brace shall be 2-inch by 6-inch (38 mm by 180 mm) nominal lumber and be fastened to each existing roof or ceiling member crossed using three 3-inchlong (76 mm) fasteners (#8 wood screws or 10d nails) as indicated in Figures C104.2(1) and C104.2(3) for gable end frames and Figures C104.2(2) and C104.2(4) for conventionally framed gable end walls. For Retrofit Configuration B, four fasteners shall be required on one of the connections between the horizontal brace and the existing roof and ceiling framing members.
5. Ladder rungs shall be provided across the location of the omitted retrofit studs as indicated in Figure C104.2.4(1) for gable end frames and Figure C104.2.4(2) for conventionally framed gable end walls.
6. Ladder rungs shall be minimum 2-inch by 4-inch (38 mm by 89 mm) lumber oriented with their wide face horizontal and spaced not greater than 16 inches (406 mm) on center vertically.
7. Where ladder rungs cross wall framing members they shall be connected to the wall framing members with a metal connector with a minimum capacity of 175 pounds (778 N) in the direction perpendicular to the gable end wall.
8. Notching of the ladder rungs shall not be permitted unless the net depth of the framing member is not less than $3^1/_2$ inches (89 mm).

[BS] C104.2.5 Short horizontal brace. Where conditions exist that prevent installation in accordance with Section C104.2.2, C104.2.3 or C104.2.4, the horizontal braces shall be permitted to be shortened provided that installation is as indicated in Figure C104.2.5 and all of the following conditions are met.

1. The horizontal brace shall be installed across not fewer than two framing spaces, extend not less than 4 feet (1220 mm) from the gable end wall plus $2^1/_2$ inches (64 mm) beyond the farthest roof or ceiling framing member from the gable end, and be fastened to each existing framing member with three 3-inch-long (76 mm) fasteners (#8 wood screws or 10d nails).
2. An anchor block shall be fastened to the side of the horizontal brace in the second framing space from the gable end wall as shown in Figure C104.2.5. The anchor block lumber shall have a minimum edge thickness of $1^1/_2$ inches (38 mm) and the depth shall be at a minimum the depth of the existing roof or ceiling framing member. Six 3-inch-long (76 mm) fasteners (#8 wood screws or 10d nails) shall be used to fasten the anchor block to the side of the horizontal brace.
3. The anchor block shall extend into the space between the roof or ceiling framing members not less than one-half the depth of the existing-framing members at the location where the anchor block is installed. The anchor block shall be installed tightly between the existing framing members such that the gap at either end shall not exceed $^1/_8$ inch (3.2 mm).
4. The use of omitted horizontal braces using the method of Section C104.2.3 adjacent to a short horizontal brace as defined in this section is not permitted.

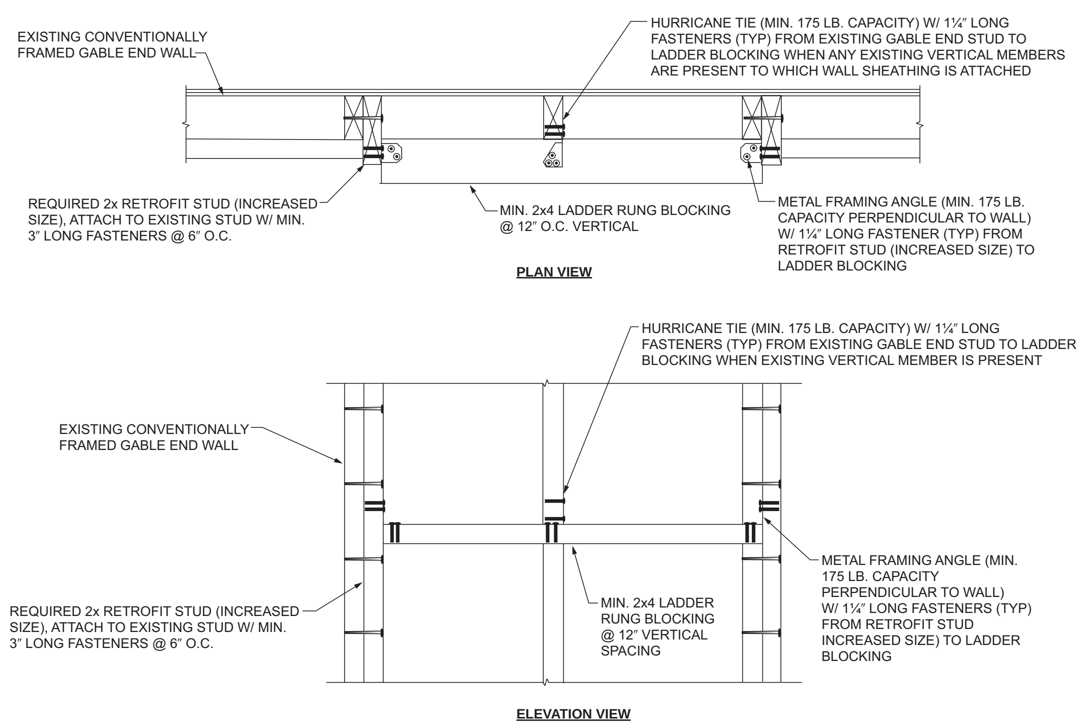
[BS] C104.2.6 Installation of horizontal braces onto webs of trusses. Where existing conditions preclude installation of horizontal braces on truss top or bottom chords they shall be permitted to be installed on truss webs provided that all of the following conditions are met.

1. Horizontal braces shall be installed as close to the top or bottom chords as practical without altering the truss or any of its components and not more than three times the depth of the truss member to which it would ordinarily be attached.
2. A racking block, comprised of an anchor block meeting the definition of "Anchor block" in Section C102 or comprised of minimum $^{15}/_{32}$-inch (12 mm) plywood or $^7/_{16}$-inch (11.1 mm) oriented strand board (OSB), shall be fastened to the horizontal brace in the second framing space from the gable end wall. The racking block shall extend toward the roof or ceiling diaphragm so that the edge of the racking block closest to the diaphragm is within one-half the depth of the existing framing member from the diaphragm surface. The racking block shall be attached to horizontal braces using six fasteners (No. 8 wood screws or 10d nails) of sufficient length to provide $1^1/_2$ inches (38 mm) of penetration into the horizontal brace.
3. Racking blocks shall be permitted to be fastened to any face or edge of horizontal braces between each web or truss vertical posts to which a horizontal brace is attached. Racking blocks shall be permitted to be on alternate sides of horizontal braces. Racking blocks shall be installed tightly between the lumber of truss members or truss plates such that the gap at either end shall be not greater than $^1/_8$ inch (3.2 mm).



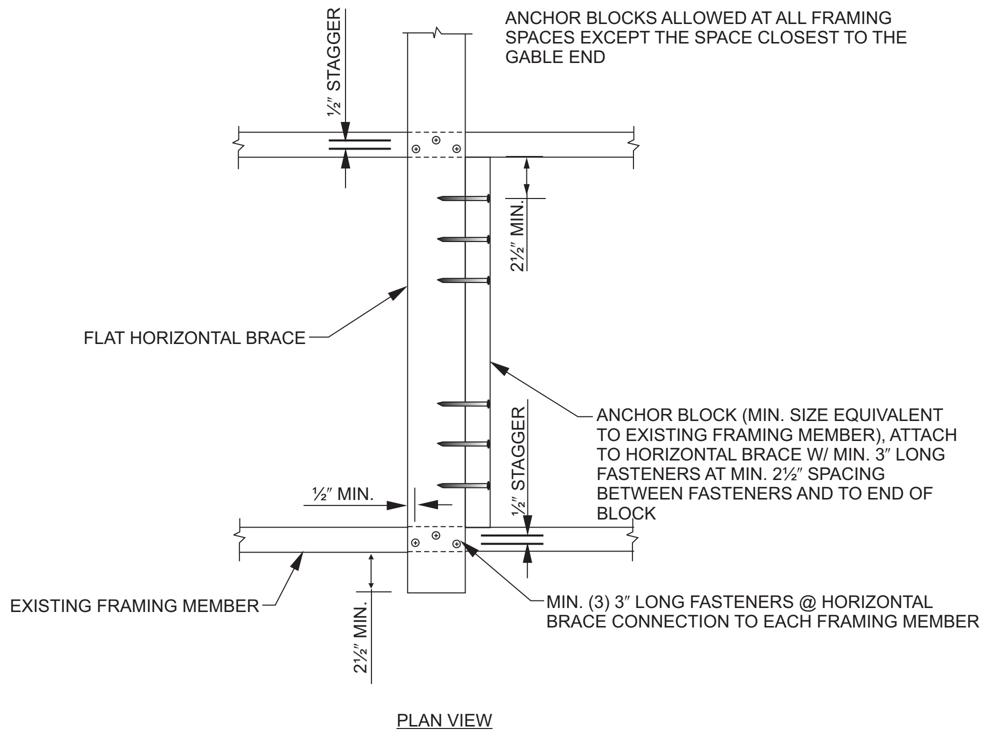
For SI: 1 inch = 25.4 mm, 1 pound = 4.4 N.

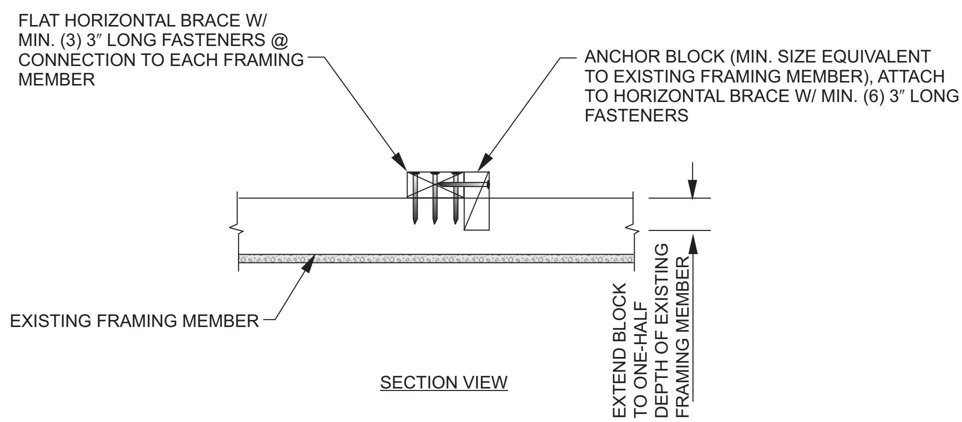
[BS] FIGURE C104.2.4(1)
LADDER BRACING FOR OMITTED RETROFIT STUD (GABLE END FRAME)



For SI: 1 inch = 25.4 mm, 1 pound = 4.4 N.

[BS] FIGURE C104.2.4(2)
LADDER BRACING FOR OMITTED RETROFIT STUD (CONVENTIONALLY FRAMED GABLE END)



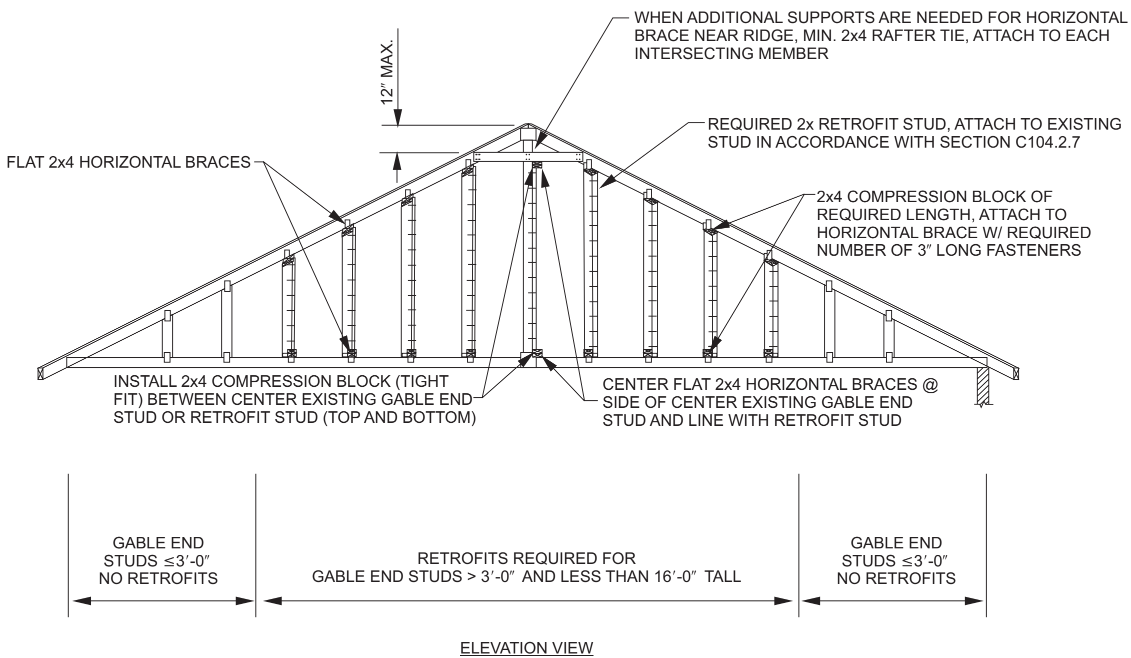


For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2.5
ANCHOR BLOCK INSTALLATION

[BS] C104.2.7 Alternative method of installation of horizontal braces at truss ridges. Where conditions exist that limit or restrict installation of horizontal braces near the peak of the roof, ridge ties shall be added to provide support for the required horizontal brace. The top of additional ridge tie members shall be installed not greater than 16 inches (406 mm) below the existing ridge line or 4 inches (102 mm) below impediments. A minimum 2-inch by 4-inch (38 mm by 89 mm) nominal member shall be used for each ridge tie, and fastening shall consist of two 3-inch-long (76 mm) wood screws, four 3-inch-long (76 mm) 10d nails or two $3^1/_2$-inch-long (89 mm) 16d nails driven through and clinched at each top chord or web member intersected by the ridge tie as illustrated in Figure C104.2.7.

[BS] C104.2.8 Interrupted horizontal braces. Where conditions exist that prevent the installation of a continuous horizontal brace then horizontal braces shall be permitted to be interrupted using the methods shown in Figures C104.2.8(1), C104.2.8(2), and C104.2.8(3). For interruptions that occur in the attic framing space closest to the gable end, nine 3-inch (76 mm) fasteners shall be used to connect each section of the interrupted horizontal braces. For interruptions that occur in the second attic space from the gable end, six 3-inch (76 mm) fasteners shall be used to connect each section of the interrupted



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] FIGURE C104.2.7
DETAIL OF RETROFIT TIE INSTALLATION

horizontal braces. For interruptions that occur in the attic framing space farthest from the gable end, three 3-inch (76 mm) fasteners shall be used to connect each section of the interrupted horizontal braces. Horizontal braces shall be continued far enough to allow connections to three existing roof framing members as shown in Figure C104.2.8(1), C104.2.8(2) or C104.2.8(3). Fasteners shall be spaced in accordance with Section C103.5.3. Horizontal braces shall be the same width and depth as required for an uninterrupted member.

[BS] C104.2.9 Piggyback gable end frames. Piggyback gable end frames (gable end frames built in two sections one above the other) shall be permitted to be retrofitted if either of the following cases is true:

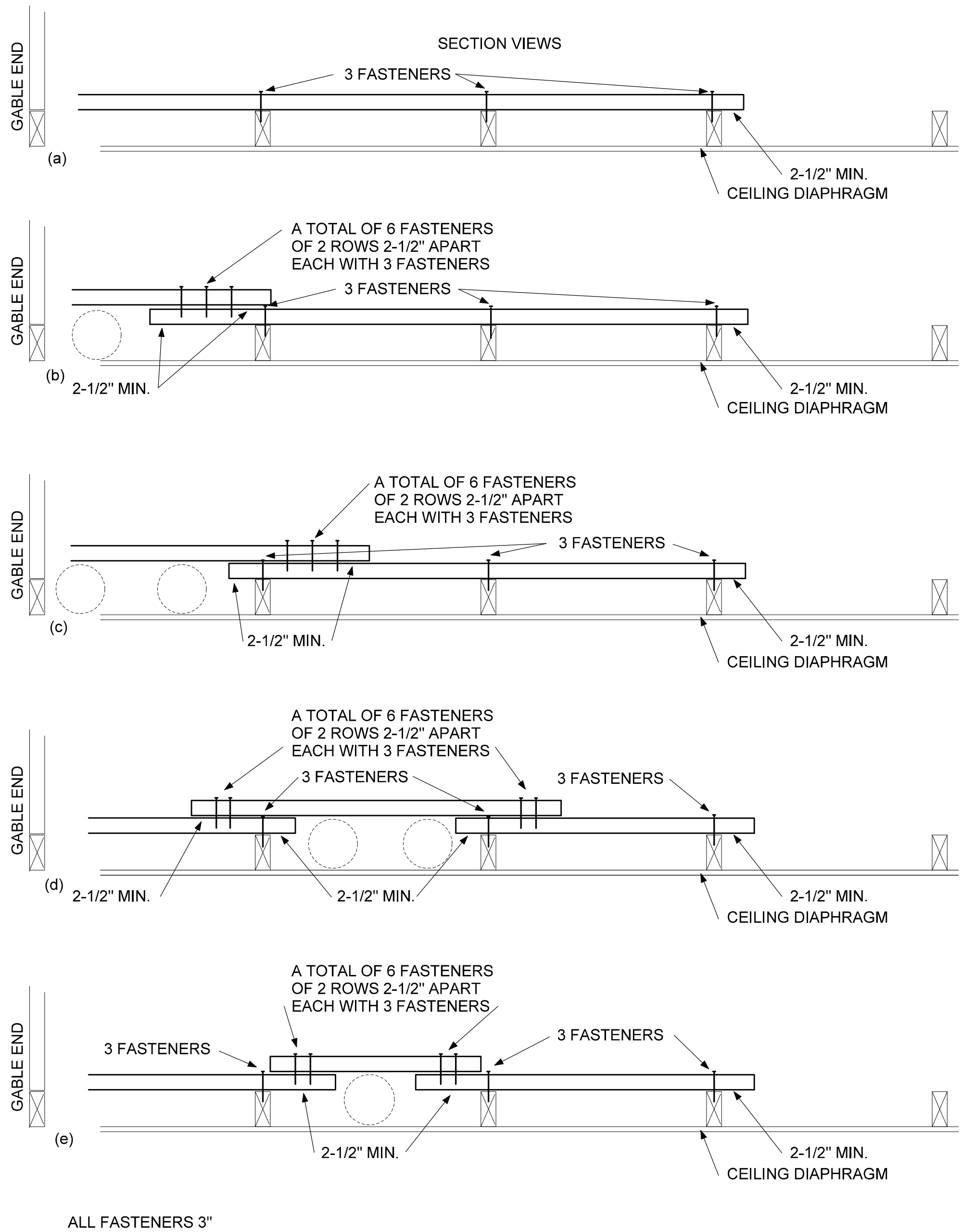
1. The existing studs in both the upper gable end frames and the lower gable end frames to which wall sheathing, panel siding, or other wall covering are attached are sufficiently in line that retrofit studs can be installed and connections made between the two with retrofit stud(s).
2. Existing studs in the upper frame are not sufficiently in line with the studs in the frame below and the existing studs in the upper frame are 3 feet (91 cm) or shorter.

For Condition 1 both the lower stud and the upper stud shall be retrofitted using the methods of Section C104.2. For Condition 2 the retrofit stud shall be connected to the lower studs using the methods of Section C104.2 and be continuous from the bottom horizontal brace to the top horizontal brace. Connection is not required between the retrofit stud and the upper stud. In both conditions the bottom chord of the piggyback truss section shall be fastened to each retrofit stud using a connector with minimum axial capacity of 175 pounds (778 N).

[BS] C104.3 Retrofit studs. Retrofit studs shall be installed in accordance with Section C104.3.1 using one of the five methods of Sections C104.3.2, C104.3.3, C104.3.4, C104.3.5 or C104.3.6. Figure C104.3 shows these methods of installation. For the Retrofit Configuration obtained from Table C104.2, the size of retrofit studs shall be as indicated in Table C104.4.1 or Table C104.4.2. Retrofit studs shall extend from the top of the lower horizontal brace to the bottom of the upper horizontal brace except that a maximum gap of $^1/_8$ inch (3.2 mm) is permitted at the bottom and $^1/_2$ inch (12.7 mm) at the top. Where wall sheathing, panel siding or other wall covering is fastened to a conventionally framed gable end, retrofit studs shall be applied in accordance with Section C104.2.1.

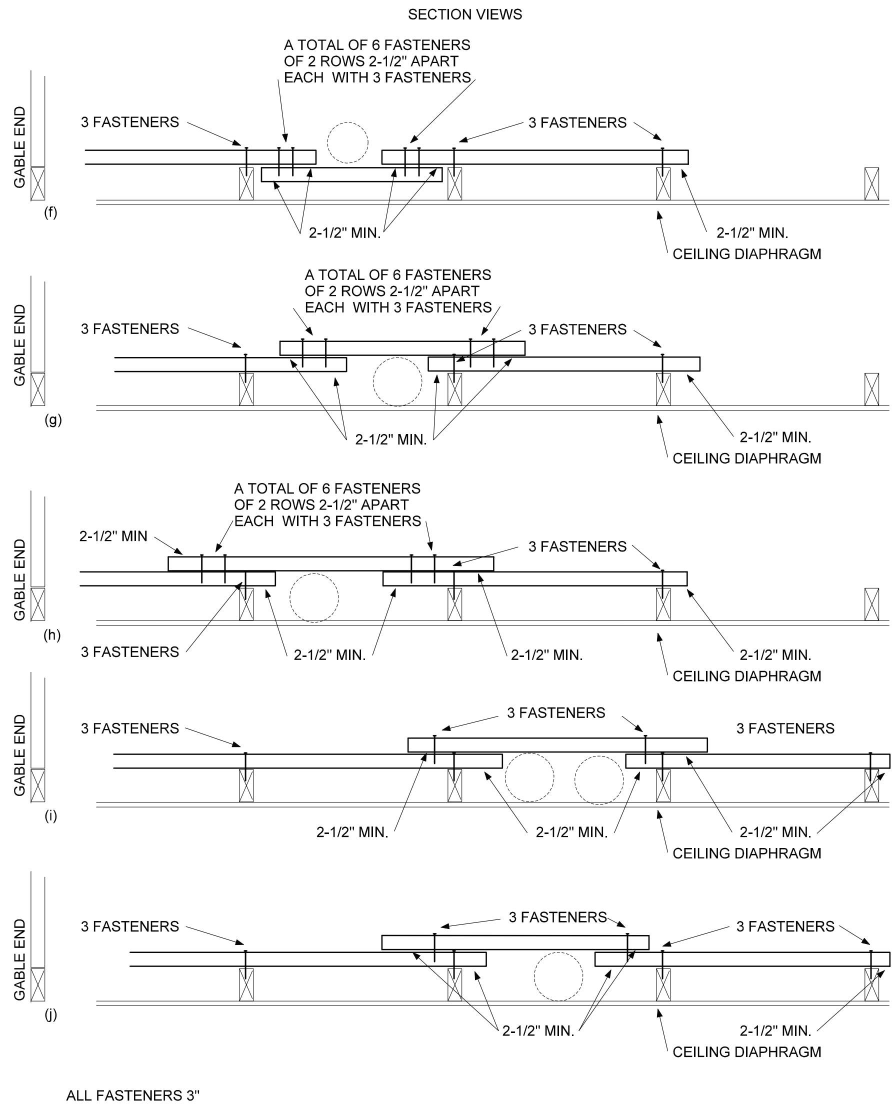
[BS] C104.3.1 Fastening. Where nail plates are not used, retrofit studs shall be attached to existing studs using 3-inch (76 mm) fasteners at not greater than 6 inches (152 mm) on center but not closer than $2^1/_2$ inches (64 mm) on center with fasteners not closer to ends of members than $2^1/_2$ inches (64 mm).

[BS] C104.3.2 Method #1: Face-to-edge or face-to-face method. Retrofit studs shall be installed immediately adjacent to existing gable end wall studs as indicated in Figure C104.3(a). The retrofit studs shall overlap the edge or side of the existing stud by not less than $1^1/_4$ inches (32 mm). Fasteners shall be installed as specified in Section C104.3.1.



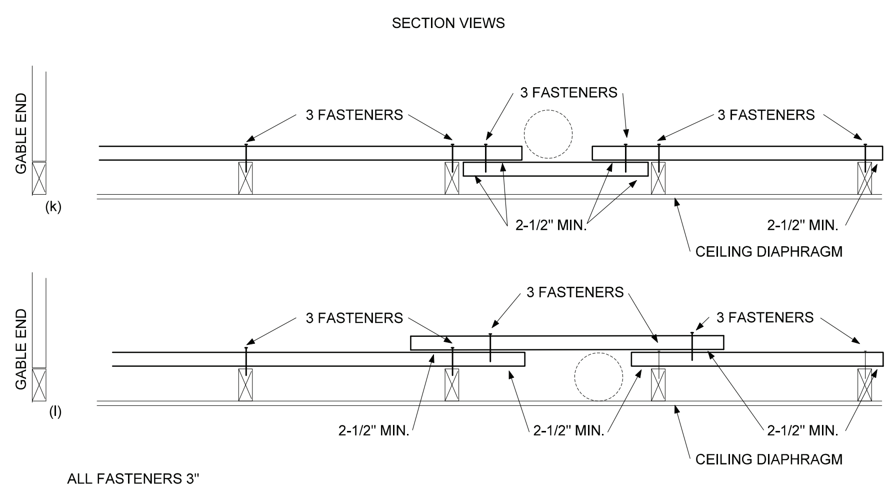
For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2.8(1)
SPLICED HORIZONTAL BRACES



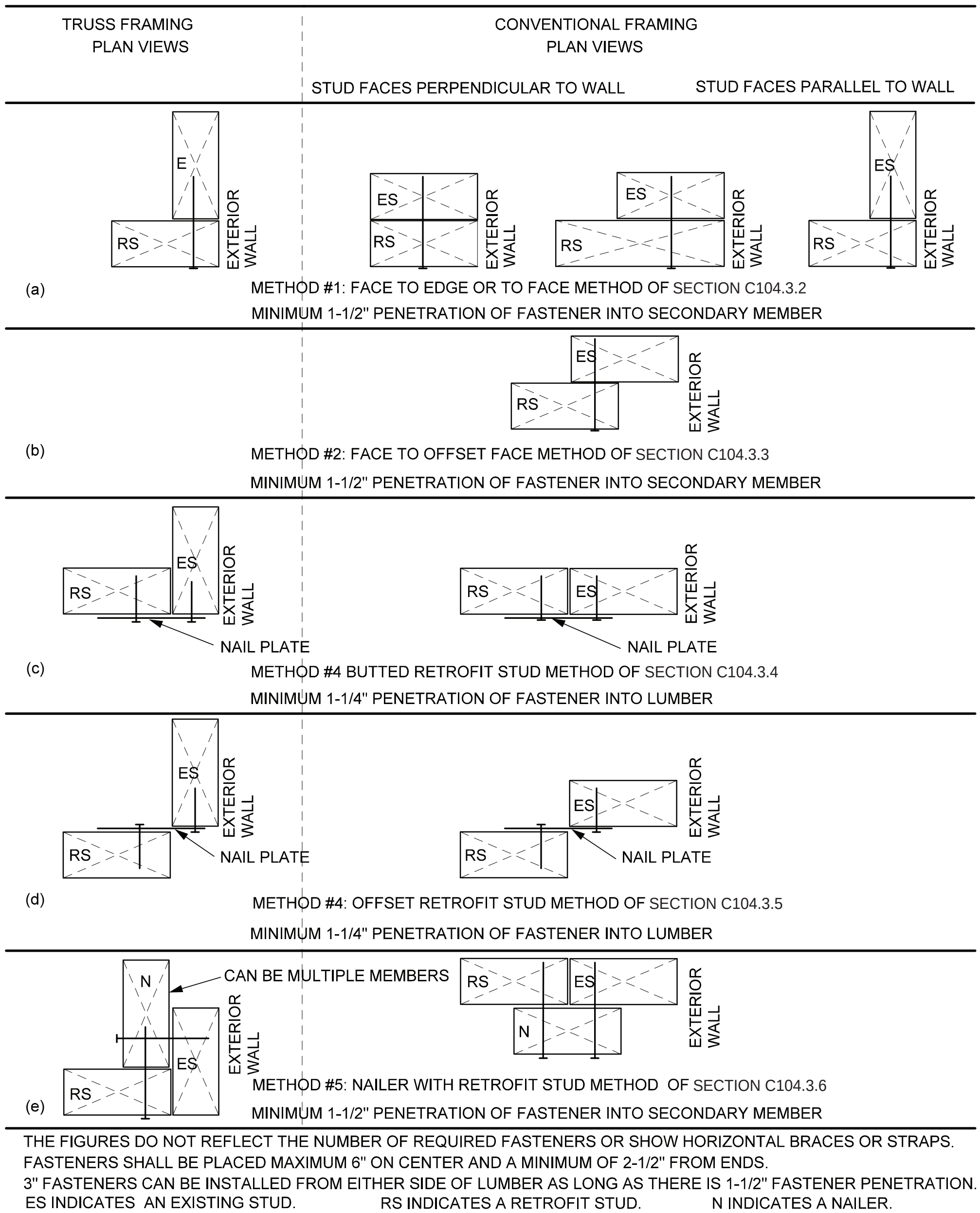
For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2.8(2)
SPLICED HORIZONTAL BRACES



For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.2.8(3)
SPLICED HORIZONTAL BRACES



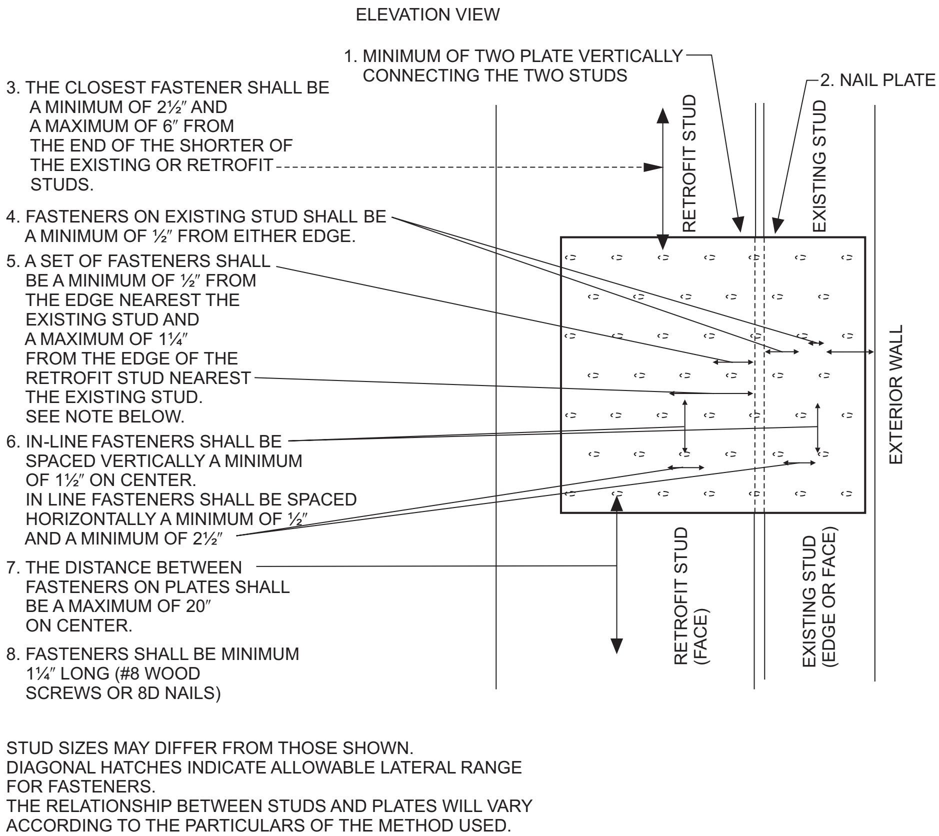
For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.3
METHOD OF INSTALLING RETROFIT STUDS

[BS] C104.3.3 Method #2: Face-to-face offset method. Retrofit studs shall be installed against the face of existing studs as indicated in Figure C104.3(b) such that the faces overlap not less than $1^1/_2$ inches (38 mm) and the edge distance to fasteners is not less than $^3/_4$ inch (19.1 mm). Fasteners shall be installed as specified in Section C104.3.1.

[BS] C104.3.4 Method #3: Butted retrofit stud method. Provided that all of the following fastening conditions are met, retrofit studs shall be permitted to be butted by their edge to existing studs with the addition of nail plates as indicated in Figure C104.3(c) and Figure C104.3.4.

1. The narrow edge of retrofit studs shall be installed against the narrow or the wide face of existing studs.
2. Not fewer than two nail plates shall be used.
3. Fasteners used to secure nail plates to studs shall be a minimum $1^1/_4$ inches (32 mm) long (#8 wood screws or 8d nails).
4. Fasteners placed in nail plates shall have a minimum end distance of $2^1/_2$ inches (64 mm) for both studs and a maximum end distance of 6 inches (152 mm) from the ends of the shorter stud.



For SI: 1 inch = 25.4 mm.

[BS] FIGURE C104.3.4
NAIL PLATE FASTENING

5. Fasteners shall have a minimum $^1/_2$-inch (12.7 mm) edge distance. Fasteners shall be placed not greater than $1^1/_2$ inches (38 mm) from the abutting vertical edges of existing studs and retrofit studs.
6. There shall be at least three fasteners through nail plates into all existing and retrofit studs to which the nail plate is attached.
7. Nail plates with three fasteners onto a single existing or retrofit stud shall be spaced not greater than 15 inches (38 cm) on center.
8. Nail plates with more than three fasteners onto a single existing or retrofit stud shall be spaced not greater than 20 inches (51 cm) on center.
9. Fasteners used to secure nail plates shall be spaced vertically not less than $1^1/_2$ inches (38 mm) on center. Staggered fasteners used to secure nail plates shall be spaced horizontally not less than $^1/_2$ inch (12.7 mm).

[BS] C104.3.5 Method #4: Offset retrofit stud method. Retrofit studs may be offset from existing studs by use of nail plates as shown in Figure C104.3(d) such that the vertical corner of a retrofit stud shall align with the vertical corner of an existing stud as indicated in Figure C104.3(d) and Figure C104.3.4, and the fastening conditions of Section C104.3.4 are met.

[BS] C104.3.6 Method #5: Nailer with retrofit stud method. Retrofit studs and existing studs shall be permitted to be connected using noncontinuous 2-inch by 4-inch (38 mm by 89 mm) nailers as indicated in Figure C104.3(e) provided that the following conditions are met.

1. Both the existing stud and the retrofit stud shall be butted to nailers and both shall be fastened to the nailer with 3-inch-long (76 mm) fasteners (#8 wood screws or 8d nails). Fasteners connecting each stud to the nailer shall be a spaced 6 inches (152 mm) o.c.
2. Fasteners into nailers from any direction shall be offset vertically by not less than $2^1/_2$ inches (64 mm).
3. Fasteners into nailers shall be not less than $2^1/_2$ inches (64 mm) but not more than 6 inches (152 mm) from the end of the shorter of the existing stud and retrofit stud to which they are fastened.

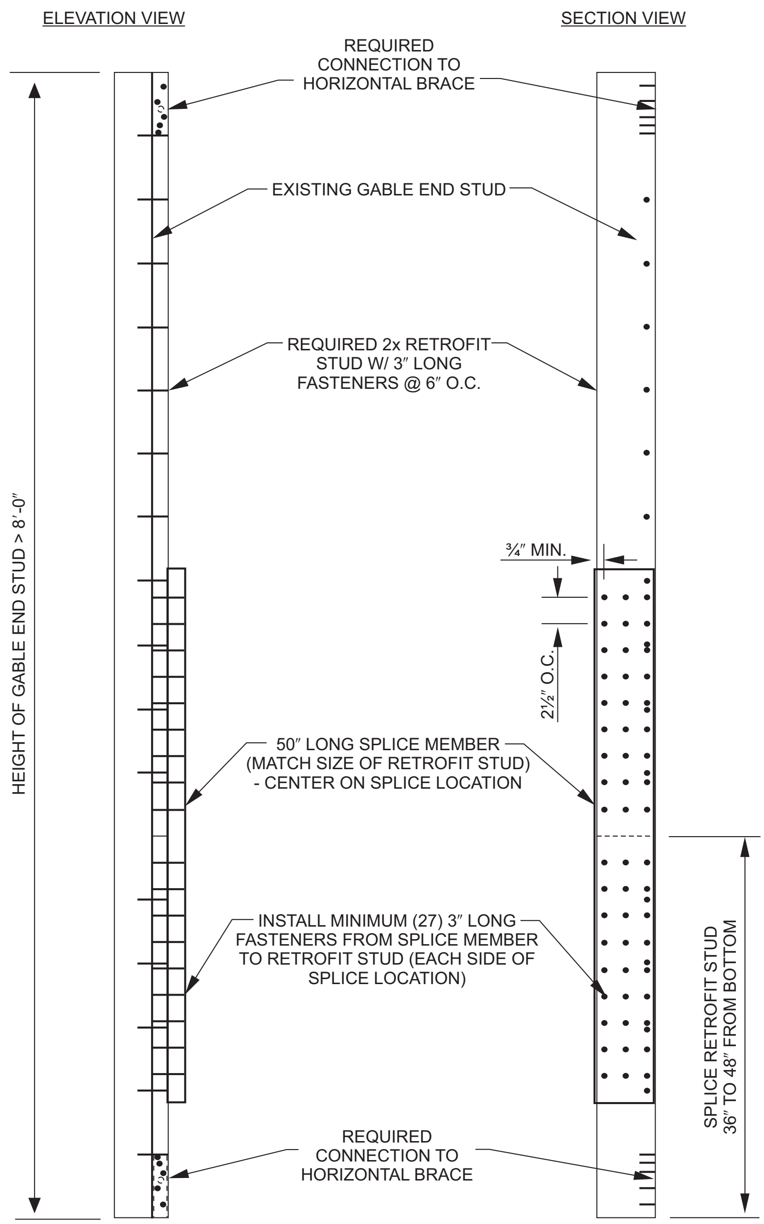
[BS] C104.3.7 Reduced depth of retrofit studs. Retrofit studs may be reduced in depth by notching, tapering or other methods at any number of locations along their length provided that all of the following conditions are met:

1. Retrofit studs to be reduced in depth shall be sized such that the remaining minimum depth of member at the location of the notch (including cross-cut

kerfs) shall be not less than that required by Table C104.4.1 or Table C104.4.2.

2. Reduced in-depth retrofit stud shall not be spliced within 12 inches (30 cm) of the location of notches. Splice members shall not be notched.
3. The vertical extent of notches shall not exceed 12 inches (30 cm) as measured at the depth of location of reduced depth.
4. A reduced in-depth retrofit stud member shall be fastened to the side of the existing gable end wall studs in accordance with Section C104.3.1. Two additional 3-inch (76 mm) fasteners (#8 wood screws or 10d nails) shall be installed on each side of notches in addition to those required by Section C104.3.1.

[BS] C104.3.8 Retrofit stud splices. Retrofit studs greater than 8 feet (244 cm) in height may be field spliced in accordance with Figure C104.3.8.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] FIGURE C104.3.8
RETROFIT STUD SPLICES

[BS] C104.4 Connection between horizontal braces and retrofit studs. Connections between horizontal braces and retrofit studs shall comply with Section C104.4.1 or C104.4.2. Each retrofit stud shall be connected to the top and bottom horizontal brace members with a minimum 20-gage $1^1/_4$-inch-wide (32 mm) flat or coil metal strap with prepunched holes for fasteners. Straps shall be fastened with $1^1/_4$-inch-long (32 mm) fasteners (#8 wood screws or 8d nails) with the number of fasteners as indicated in Table C104.4.1 and Table C104.4.2. Fasteners shall be not closer to the end of lumber than $2^1/_2$ inches (64 mm).

[BS] C104.4.1 L-bent strap method. Retrofit studs shall be connected to horizontal braces or to strong backs in accordance with Figure C104.2(1), C104.2(2) or C104.2.3, and shall comply with the following conditions.

1. A strap shall be applied to the edges of a retrofit stud nearest the gable end wall and to the face of horizontal braces using at each end of the strap the number of fasteners specified in Table C104.4.1. Straps shall be long enough so that each strap extends sufficient distance onto the vertical face of the retrofit stud that the fastener closest to the ends of the studs is not less than $2^1/_2$ inches (64 mm) from the end of the stud. Straps shall be permitted to be twisted to accommodate the transition between the tops of retrofit studs and horizontal bracings following roof pitches.
2. Compression blocks shall be installed on the horizontal braces directly against either the existing vertical gable end wall stud or the retrofit stud. Figure C104.2(1) (trusses) and Figure C104.2(2) (conventionally framed) show the installation of the compression block against the existing vertical gable end wall stud with the strap from the retrofit stud running beside the compression block. Compression blocks shall be permitted to be placed over straps. Compression blocks shall be fastened to the horizontal braces with not fewer than the minimum number of 3-inch-long (76 mm) fasteners (#8 wood screws or 10d nails) specified in Table C104.4.1. End and edge distances for fasteners shall be in accordance with Section C103.5.3.

[BS] C104.4.2 U-bent strap method. Retrofit studs shall be connected to horizontal braces in accordance with Figure C104.2(3) or C104.2(4), shall be limited to Retrofit Configurations A and B as defined in Table C104.2, and shall comply with the following conditions.

1. Straps of sufficient length to meet the requirements for the number of fasteners in accordance with Table C104.4.2 and meet the end distance requirements of Section C103.5.3 shall be shaped around retrofit studs and fastened to the edges of horizontal braces. Straps shall wrap the back edge of the retrofit stud snugly with a maximum gap of $^1/_4$ inch (6.4 mm). Rounded bends of straps shall be permitted. One fastener shall be installed that connects each strap to the side of the associated retrofit stud.
2. The horizontal brace shall butt snugly against the retrofit stud with a maximum gap of $^1/_4$ inch (6.4 mm).
3. Straps shall be permitted to be twisted to accommodate the transition between the tops of retrofit studs and horizontal braces that follow the roof pitch.

[BS] TABLE C104.4.1
ELEMENT SIZING AND SPACING FOR L-BENT RETROFIT METHOD

RETROFIT ELEMENTS	RETROFIT CONFIGURATION			
	A	B	C	D
Minimum size and number of Horizontal Braces	2 × 4	2 × 4	2 × 4	2 each 2 × 4
Minimum size and number of Retrofit Studs	2 × 4	2 × 6	2 × 8	2 each 2 × 8
Minimum number of fasteners connecting each end of straps to Retrofit Studs or to Horizontal Braces #8 screws or 10d nails $1^1/_4$″ long	6	9	12	8 on each strap
Minimum number of fasteners to connect Compression Blocks to Horizontal Braces #8 screws or 10d nails 3″ long	6	8	10	12

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] TABLE C104.4.2
ELEMENT SIZING AND SPACING FOR U-BENT RETROFIT METHOD

RETROFIT ELEMENTS	RETROFIT CONFIGURATION			
	A	B	C	D
Minimum size and number of Horizontal Braces	2 × 4	2 × 4	2 × 4	2 each 2 × 4
Minimum size and number of Retrofit Studs	2 × 4	2 × 6	2 × 8	2 each 2 × 8
Minimum number of fasteners connecting Straps to each edge of Horizontal Braces #8 screws or 10d nails $1^1/_4$″ long	6	7	7	6 on each side of strap

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

[BS] C104.5 Connection of gable end wall to wall below. The bottom chords or bottom members of wood-framed gable end walls shall be attached to the wall below using one of the methods prescribed in Section C104.5.1 or C104.5.2. The particular method chosen shall correspond to the framing system and type of wall construction encountered.

[BS] C104.5.1 Gable end frame. The bottom chords of the gable end frame shall be attached to the wall below using gusset angles. Not fewer than two fasteners shall be installed into the bottom chord. The gusset angles shall be installed throughout the portion of the gable end where the gable end wall height is greater than 3 feet (91 cm) at the spacing specified in Table C104.5.1. Connection to the wall below shall be by one of the following methods:

1. For a wood-frame wall below, not fewer than two fasteners shall be installed. The fasteners shall be of the same diameter and style specified by the gusset angle manufacturer and sufficient length to extend through the double top plate of the wall below.
2. For a concrete or masonry wall below without a sill plate, the type and number of fasteners into the wall shall be consistent with the gusset angle manufacturer's specifications for fasteners installed in concrete or masonry.
3. For a concrete or masonry wall below with a 2x sill plate, the fasteners into the wall below shall be of the diameter and style specified by the gusset angle manufacturer for concrete or masonry connections; but, long enough to pass through the wood sill plate and provide the required embedment into the concrete or masonry below. Alternatively, the gusset angle can be anchored to the sill plate using four each $1^1/_2$-inch-long (38 mm) fasteners of the same type as specified by the gusset angle manufacturer for wood connections, provided that the sill plate is anchored to the wall on each side of the gusset angle by a $^1/_4$-inch-diameter (6.4 mm) masonry screw with $2^3/_4$ inches (70 mm) of embedment into the concrete or masonry wall. A $^1/_4$-inch (6.4 mm) washer shall be placed under the heads of the masonry screws.

[BS] TABLE C104.5.1
SPACING OF GUSSET ANGLES

EXPOSURE CATEGORY	BASIC WIND SPEED (mph)	SPACING OF GUSSET ANGLES (inches)
C	140	38
C	150	32
C	165	28
C	180	24
C	190	20
B	140	48
B	150	40
B	165	36
B	180	30
B	190	26

For SI: 1 inch = 25.4 mm, 1 mile per hour = 0.447 m/s.

[BS] C104.5.2 Conventionally framed gable end wall. Each stud in a conventionally framed gable end wall, throughout the length of the gable end wall where the wall height is greater than 3 feet (914 mm), shall be attached to the bottom or sill plate using a stud to plate connector with minimum uplift capacity of 175 pounds (778 N). The bottom or sill plate shall then be connected to the wall below using one of the following methods:

1. For a wood frame wall below, the sill or bottom plate shall be connected to the top plate of the wall below using $^1/_4$-inch-diameter (6.4 mm) lag bolt fasteners of sufficient length to penetrate the bottom plate of the upper gable end wall and extend through the bottom top plate of the wall below. A washer sized for the diameter of the lag bolt shall be placed under the head of each lag bolt. The fasteners shall be installed at the spacing indicated in Table C104.5.2.
2. For a concrete or masonry wall below, the sill or bottom plate shall be connected to the concrete or masonry wall below using $^1/_4$-inch-diameter (6.4 mm) concrete or masonry screws of sufficient length to provide $2^3/_4$ inches (70 mm) of embedment into the top of the concrete or masonry wall. A washer sized for the diameter of the lag bolt shall be placed under the head of each lag bolt. The fasteners shall be installed at the spacing indicated in Table C104.5.2.

[BS] TABLE C104.5.2
SPACING OF LAG OR MASONRY SCREWS USED TO CONNECT SILL PLATE OF GABLE END WALL TO TOP OF THE WALL BELOW

EXPOSURE CATEGORY	BASIC WIND SPEED (mph)	SPACING OF LAG OR MASONRY SCREWS (inches)
C	140	19
C	150	16
C	165	14
C	180	14
C	190	10
B	140	24
B	150	20
B	165	18
B	180	15
B	190	13

For SI: 1 inch = 25.4 mm, 1 mile per hour = 0.447 m/s.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX C
CHAPTER C2 – ROOF DECK FASTENING FOR HIGH-WIND AREAS

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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 C2

ROOF DECK FASTENING FOR HIGH-WIND AREAS

SECTION C201
GENERAL

[BS] C201.1 Purpose. This chapter provides prescriptive methods for partial structural retrofit of an existing building to increase its resistance to wind loads. It is intended for voluntary use where the ultimate design wind speed, V_{ult}, determined in accordance with Figure 1609.3(1) of the *California Building Code* exceeds 130 mph (58 m/s) and for reference by mitigation programs. The provisions of this chapter do not necessarily satisfy requirements for new construction. Unless specifically cited, the provisions of this chapter do not necessarily satisfy requirements for structural improvements triggered by addition, alteration, repair, change of occupancy, building relocation or other circumstances.

[BS] C201.2 Eligible conditions. The provisions of this chapter are applicable only to buildings that meet either of the following eligibility requirements:

1. Buildings assigned to *Risk Category* I or II in accordance with Table 1604.5 of the *California Building Code*.
2. Buildings within the scope of the *California Residential Code*.

SECTION C202
ROOF DECK ATTACHMENT FOR WOOD ROOFS

[BS] C202.1 Roof decking attachment for one- and two-family dwellings. For one- and two-family dwellings, fastening shall be in accordance with Section C202.1.1 or C202.1.2 as appropriate for the existing construction. The diameter of 8d nails shall be not less than 0.131 inch (3 mm) and the length shall be not less than $2^1/_4$ inches (57 mm) to qualify for the provisions of this section for existing nails regardless of head shape or head diameter.

[BS] C202.1.1 Sawn lumber or wood plank roofs. Roof decking consisting of sawn lumber or wood planks up to 12 inches (30 cm) wide and secured with not fewer than two nails (minimum size 8d) to each roof framing member it crosses shall be deemed to be sufficiently connected. Sawn lumber or wood plank decking secured with smaller fasteners than 8d nails or with fewer than two nails (minimum size 8d) to each framing member it crosses shall be deemed sufficiently connected if fasteners are added such that two clipped head, round head or ring shank nails (minimum size 8d) are in place on each framing member the nail crosses.

[BS] C202.1.2 Wood structural panel roofs For roof decking consisting of wood structural panels, fasteners and spacings required in Table C202.1.2 shall be deemed to comply with the requirements of Section 706.3.

Supplemental fasteners as required by Table C202.1.2 shall be 8d ring shank nails with round heads and the following minimum dimensions:

1. 0.113-inch-nominal (3 mm) shank diameter.
2. Ring diameter not less than 0.012 inch (0.3 mm) greater than shank diameter.
3. 16 to 20 rings per inch.
4. A minimum 0.280-inch (7 mm) full round head diameter.
5. Ring shank to extend not less than $1^1/_2$ inches (38 mm) from the tip of the nail.
6. Minimum $2^1/_4$-inch (57 mm) nail length.

[BS] TABLE C202.1.2
SUPPLEMENT FASTENERS AT PANEL EDGES AND INTERMEDIATE FRAMING

EXISTING FASTENERS	EXISTING FASTENER SPACING (EDGE OR INTERMEDIATE SUPPORTS)	MAXIMUM SUPPLEMENTAL FASTENER SPACING FOR 130 MPH < V_{ult} ≤ 140 MPH	MAXIMUM SUPPLEMENTAL FASTENER SPACING FOR INTERIOR ZONE[c] LOCATIONS FOR MPH V_{ult} > 140 MPH AND EDGE ZONES NOT COVERED BY THE COLUMN TO THE RIGHT	EDGE ZONE[d] FOR V_{ult} > 160 MPH AND EXPOSURE C, OR V_{ult} > 180 MPH AND EXPOSURE B
Staples or 6d	Any	6″ o.c.[b]	6″ o.c.[b]	4″ o.c.[b] at panel edges and 4″ o.c.[b] at intermediate supports
8d clipped head or round head smooth shank	6″ o.c. or less	None necessary	None necessary along edges of panels but 6″ o.c.[b] at intermediate supports of panel	4″ o.c.[a] at panel edges and 4″ o.c.[a] at intermediate supports
8d clipped head or round head ring shank	6″ o.c. or less	None necessary	None necessary	4″ o.c.[a] at panel edges and 4″ o.c.[a] at intermediate supports
8d clipped head or round head smooth shank	Greater than 6″ o.c.	6″ o.c.[a]	6″ o.c.[a] along panel edges and 6″ o.c.[b] at intermediate supports of panel	4″ o.c.[a] at panel edges and 4″ o.c.[a] at intermediate supports
8d clipped head or round head ring shank	Greater than 6″ o.c.	6″ o.c.[a]	6″ o.c.[a]	4″ o.c.[a] at panel edges and 4″ o.c.[a] at intermediate supports

For SI: 1 inch = 25.4 mm; 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.

a. Maximum spacing determined based on existing fasteners and supplemental fasteners.

b. Maximum spacing determined based on supplemental fasteners only.

c. Interior zone = sheathing that is not located within 4 feet of the perimeter edge of the roof or within 4 feet of each side of a ridge.

d. Edge zone = sheathing that is located within 4 feet of the perimeter edge of the roof and within 4 feet of each side of a ridge.

CHAPTER C3

REFERENCED STANDARDS

SECTION C301
REFERENCED STANDARDS

[BS] C301.1 General. See Table C301.1 for standards that are referenced in various sections of this appendix. Standards are listed by the standard identification with the effective date, standard title, and the section or sections of this appendix that reference the standard.

[BS] TABLE C301.1
REFERENCED STANDARDS

STANDARD ACRONYM	STANDARD NAME	SECTIONS HEREIN REFERENCED
CBC—21	*California Building Code*	C101.3, C103.2, C201.1, C201.2
CRC—21	*California Residential Code*	C101.2, C101.3, C103.2, C201.2

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
APPENDIX D
BOARD OF APPEALS

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

APPENDIX D

BOARD OF APPEALS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

User notes:

About this appendix: *Appendix D provides criteria for Board of Appeals members. Also provided are procedures by which the Board of Appeals should conduct its business.*

Code development reminder: *Code change proposals to this appendix will be considered by the Administrative Code Development Committee during the 2022 (Group B) Code Development Cycle.*

SECTION D101 GENERAL

[A] D101.1 Scope. A board of appeals shall be established within the jurisdiction for the purpose of hearing applications for modification of the requirements of this code pursuant to the provisions of Section 112. The board shall be established and operated in accordance with this section, and shall be authorized to hear evidence from appellants and the code official pertaining to the application and intent of this code for the purpose of issuing orders pursuant to these provisions.

[A] D101.2 Application for appeal. Any person shall have the right to appeal a decision of the code official to the board. An application for appeal shall be based on a claim that the intent of this code or the rules legally adopted hereunder have been incorrectly interpreted, the provisions of this code do not fully apply or an equally good or better form of construction is proposed. The application shall be filed on a form obtained from the code official within 20 days after the notice was served.

[A] D101.2.1 Limitation of authority. The board shall not have authority to waive requirements of this code or interpret the administration of this code.

[A] D101.2.2 Stays of enforcement. Appeals of notice and orders, other than Imminent Danger notices, shall stay the enforcement of the notice and order until the appeal is heard by the board.

[A] D101.3 Membership of board. The board shall consist of five voting members appointed by the chief appointing authority of the jurisdiction. Each member shall serve for **[INSERT NUMBER OF YEARS]** years or until a successor has been appointed. The board member's terms shall be staggered at intervals, so as to provide continuity. The code official shall be an ex officio member of said board but shall not vote on any matter before the board.

[A] D101.3.1 Qualifications. The board shall consist of five individuals, who are qualified by experience and training to pass on matters pertaining to building construction and are not employees of the jurisdiction.

[A] D101.3.2 Alternate members. The chief appointing authority is authorized to appoint two alternate members who shall be called by the board chairperson to hear appeals during the absence or disqualification of a member. Alternate members shall possess the qualifications required for board membership, and shall be appointed for the same term or until a successor has been appointed.

[A] D101.3.3 Vacancies. Vacancies shall be filled for an unexpired term in the same manner in which original appointments are required to be made.

[A] D101.3.4 Chairperson. The board shall annually select one of its members to serve as chairperson.

[A] D101.3.5 Secretary. The chief appointing authority shall designate a qualified clerk to serve as secretary to the board. The secretary shall file a detailed record of all proceedings, which shall set forth the reasons for the board's decision, the vote of each member, the absence of a member and any failure of a member to vote.

[A] D101.3.6 Conflict of interest. A member with any personal, professional or financial interest in a matter before the board shall declare such interest and refrain from participating in discussions, deliberations and voting on such matters.

[A] D101.3.7 Compensation of members. Compensation of members shall be determined by law.

[A] D101.3.8 Removal from the board. A member shall be removed from the board prior to the end of their terms only for cause. Any member with continued absence from regular meeting of the board may be removed at the discretion of the chief appointing authority.

[A] D101.4 Rules and procedures. The board shall establish policies and procedures necessary to carry out its duties consistent with the provisions of this code and applicable state law. The procedures shall not require compliance with strict rules of evidence, but shall mandate that only relevant information be presented.

[A] D101.5 Notice of meeting. The board shall meet upon notice from the chairperson, within 10 days of the filing of an appeal or at stated periodic intervals.

[A] D101.5.1 Open hearing. All hearings before the board shall be open to the public. The appellant, the appellant's representative, the code official and any person whose interests are affected shall be given an opportunity to be heard.

[A] D101.5.2 Quorum. Three members of the board shall constitute a quorum.

[A] D101.5.3 Postponed hearing. When five members are not present to hear an appeal, either the appellant or the appellant's representative shall have the right to request a postponement of the hearing.

[A] D101.6 Legal counsel. The jurisdiction shall furnish legal counsel to the board to provide members with general legal advice concerning matters before them for consideration. Members shall be represented by legal counsel at the jurisdiction's expense in all matters arising from service within the scope of their duties.

[A] D101.7 Board decision. The board shall only modify or reverse the decision of the *code official* by a concurring vote of three or more members.

[A] D101.7.1 Resolution. The decision of the board shall be by resolution. Every decision shall be promptly filed in writing in the office of the code official within three days and shall be open to the public for inspection. A certified copy shall be furnished to the appellant or the appellant's representative and to the code official.

[A] D101.7.2 Administration. The code official shall take immediate action in accordance with the decision of the board.

[A] D101.8 Court review. Any person, whether or not a previous party of the appeal, shall have the right to apply to the appropriate court for a writ of certiorari to correct errors of law. Application for review shall be made in the manner and time required by law following the filing of the decision in the office of the chief administrative officer.

CALIFORNIA EXISTING BUILDING CODE – MATRIX ADOPTION TABLE
RESOURCE A
GUIDELINES ON FIRE RATINGS OF ARCHAIC MATERIALS AND ASSEMBLIES

Not adopted by the State of California

(May be available for adoption by local ordinance. See Section 1.1.11.)

Adopting Agency	BSC	BSC-CG	SFM	HCD			DSA			OSHPD						BSCC	DPH	AGR	DWR	CEC	CA	SL	SLC
				1	2	1/AC	AC	SS	SS/CC	1	1R	2	3	4	5								
Adopt Entire Chapter																							
Adopt Entire Chapter as amended (amended sections listed below)																							
Adopt only those sections that are listed below																							
Chapter / Section																							

The state agency does not adopt sections identified with the following symbol: †

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.

RESOURCE A

GUIDELINES ON FIRE RATINGS OF ARCHAIC MATERIALS AND ASSEMBLIES

User note:

About this resource: *In the process of repair and alteration of existing buildings, based on the nature and the extent of the work, this code might require certain upgrades in the fire-resistance rating of building elements, at which time it becomes critical for the designers and the code officials to be able to determine the fire-resistance rating of the existing building elements as part of the overall evaluation for the assessment of the need for improvements. This resource document provides a guideline for such an evaluation for fire-resistance rating of archaic materials that is not typically found in the modern model building codes.*

Introduction

The *International Existing Building Code*® (IEBC®) is a comprehensive code with the goal of addressing all aspects of work taking place in existing buildings and providing user-friendly methods and tools for regulation and improvement of such buildings. This resource document is included within the cover of the IEBC with that goal in mind and as a step towards accomplishing that goal.

In the process of repair and alteration of existing buildings, based on the nature and the extent of the work, the IEBC might require certain upgrades in the fire-resistance rating of building elements, at which time it becomes critical for the designers and the code officials to be able to determine the fire-resistance rating of the *existing building* elements as part of the overall evaluation for the assessment of the need for improvements. This resource document provides a guideline for such an evaluation for fire-resistance ratings of archaic materials that are not typically found in the modern model building codes.

Resource A is only a guideline and is not intended to be a document for specific adoption as it is not written in the format or language of ICC's International Codes and is not subject to the code development process.

PURPOSE

The *Guidelines on Fire Ratings of Archaic Materials and Assemblies* focuses upon the fire-related performance of archaic construction. "Archaic" encompasses construction typical of an earlier time, generally prior to 1950. "Fire-related performance" includes fire resistance, flame spread, smoke production and degree of combustibility.

The purpose of this guideline is to update the information which was available at the time of original construction, for use by architects, engineers and code officials when evaluating the fire safety of a rehabilitation project. In addition, information relevant to the evaluation of general classes of materials and types of construction is presented for those cases when documentation of the fire performance of a particular archaic material or assembly cannot be found.

It has been assumed that the building materials and their fastening, joining and incorporation into the building structure are sound mechanically. Therefore, some determination must be made that the original manufacture, the original construction practice, and the rigors of aging and use have not weakened the building. This assessment can often be difficult because process and quality control was not good in many industries, and variations among locally available raw materials and manufacturing techniques often resulted in a product which varied widely in its strength and durability. The properties of iron and steel, for example, varied widely, depending on the mill and the process used.

There is nothing inherently inferior about archaic materials or construction techniques. The pressures that promote fundamental change are most often economic or technological matters not necessarily related to concerns for safety. The high cost of labor made wood lath and plaster uneconomical. The high cost of land and the congestion of the cities provided the impetus for high-rise construction. Improved technology made it possible. The difficulty with archaic materials is not a question of suitability, but familiarity.

Code requirements for the fire performance of key building elements (e.g., walls, floor/ceiling assemblies, doors, shaft enclosures) are stated in performance terms: hours of fire resistance. It matters not whether these elements were built in 1908 or 1980, only that they provide the required degree of fire resistance. The level of performance will be defined by the local community, primarily through the enactment of a building or rehabilitation code. This guideline is only a tool to help evaluate the various building elements, regardless of what the level of performance is required to be.

The problem with archaic materials is simply that documentation of their fire performance is not readily available. The application of engineering judgment is more difficult because building officials may not be familiar with the materials or construction method involved. As a result, either a full-scale fire test is required or the archaic construction in question removed and replaced. Both alternatives are time consuming and wasteful.

This guideline and the accompanying appendix are designed to help fill this information void. By providing the necessary documentation, there will be a firm basis for the continued acceptance of archaic materials and assemblies.

1
FIRE-RELATED PERFORMANCE OF ARCHAIC MATERIALS AND ASSEMBLIES

1.1
FIRE PERFORMANCE MEASURES

This guideline does not specify the level of performance required for the various building components. These requirements are controlled by the building occupancy and use and are set forth in the local building or rehabilitation code.

The fire resistance of a given building element is established by subjecting a sample of the assembly to a "standard" fire test which follows a "standard" time-temperature curve. This test method has changed little since the 1920s. The test results tabulated in the Appendix have been adjusted to reflect current test methods.

The current model building codes cite other fire-related properties not always tested for in earlier years: flame spread, smoke production, and degree of combustibility. However, they can generally be assumed to fall within well defined values because the principal combustible component of archaic materials is cellulose. Smoke production is more important today because of the increased use of plastics. However, the early flame spread tests, developed in the early 1940s, also included a test for smoke production.

"Plastics," one of the most important classes of contemporary materials, were not found in the review of archaic materials. If plastics are to be used in a rehabilitated building, they should be evaluated by contemporary standards. Information and documentation of their fire-related properties and performance is widely available.

Flame spread, smoke production and degree of combustibility are discussed in detail below. Test results for eight common species of lumber, published in an Underwriter's Laboratories' report (104), are noted in the following table:

TUNNEL TEST RESULTS FOR EIGHT SPECIES OF LUMBER

SPECIES OF LUMBER	FLAME SPREAD	FUEL CONTRIBUTED	SMOKE DEVELOPED
Western White Pine	75	50-60	50
Northern White Pine	120–215	120–140	60–65
Ponderosa Pine	80–215	120–135	100–110
Yellow Pine	180–190	130–145	275–305
Red Gum	140–155	125–175	40–60
Yellow Birch	105–110	100–105	45–65
Douglas Fir	65–100	50–80	10–100

Flame Spread

The flame spread of interior finishes is most often measured by the ASTM E84 "tunnel test." This test measures how far and how fast the flames spread across the surface of the test sample. The resulting flame spread rating (FSR) is expressed as a number on a continuous scale where cement-asbestos board is 0 and red oak is 100. (Materials with a flame spread greater than red oak have an FSR greater than 100.) The scale is divided into distinct groups or classes. The most commonly used flame spread classifications are: Class I or A*, with a 0–25 FSR; Class II or B, with a 26–75 FSR; and Class III or C, with a 76–200 FSR. The *NFPA Life Safety Code* also has a Class D (201–500 FSR) and Class E (over 500 FSR) interior finish.

These classifications are typically used in modern building codes to restrict the rate of fire spread. Only the first three classifications are normally permitted, though not all classes of materials can be used in all places throughout a building. For example, the interior finish of building materials used in exits or in corridors leading to exits is more strictly regulated than materials used within private dwelling units.

In general, inorganic archaic materials (e.g., bricks or tile) can be expected to be in Class I. Materials of whole wood are mostly Class II. Whole wood is defined as wood used in the same form as sawn from the tree. This is in contrast to the contemporary reconstituted wood products such as plywood, fiberboard, hardboard, or particle board. If the organic archaic material is not whole wood, the flame spread classification could be well over 200 and thus would be particularly unsuited for use in exits and other critical locations in a building. Some plywoods and various wood fiberboards have flame spreads over 200. Although they can be treated with fire retardants to reduce their flame spread, it would be advisable to assume that all such products have a flame spread over 200 unless there is information to the contrary.

Smoke Production

The evaluation of smoke density is part of the ASTM E84 tunnel test. For the eight species of lumber shown in the table above, the highest levels are 275–305 for Yellow Pine, but most of the others are less smoky than red oak which has an index of 100. The advent of plastics caused substantial increases in the smoke density values measured by the tunnel test. The ensuing limitation of the smoke production for wall and ceiling materials by the model building codes has been a reaction to the introduction of plastic materials. In general, cellulosic materials fall in the 50–300 range of smoke density which is below the general limitation of 450 adopted by many codes.

Degree of Combustibility

The model building codes tend to define "noncombustibility" on the basis of having passed ASTM E136 or if the material is totally inorganic. The acceptance of gypsum wallboard as noncombustible is based on limiting paper thickness to not over $^1/_8$ inch and a 0–50 flame spread rating by ASTM E84. At times there were provisions to define a Class I or A material (0–25 FSR) as noncombustible, but this is not currently recognized by most model building codes.

* Some codes are Roman numerals, others use letters.

If there is any doubt whether or not an archaic material is noncombustible, it would be appropriate to send out samples for evaluation. If an archaic material is determined to be noncombustible according to ASTM E136, it can be expected that it will not contribute fuel to the fire.

1.2 COMBUSTIBLE CONSTRUCTION TYPES

One of the earliest forms of timber construction used exterior load-bearing masonry walls with columns and/or wooden walls supporting wooden beams and floors in the interior of the building. This form of construction, often called “mill” or “heavy timber” construction, has approximately 1 hour fire resistance. The exterior walls will generally contain the fire within the building.

With the development of dimensional lumber, there was a switch from heavy timber to “balloon frame” construction. The balloon frame uses load-bearing exterior wooden walls which have long timbers often extending from foundation to roof. When longer lumber became scarce, another form of construction, “platform” framing, replaced the balloon framing. The difference between the two systems is significant because platform framing is automatically fire-blocked at every floor while balloon framing commonly has concealed spaces that extend unblocked from basement to attic. The architect, engineer, and *code official* must be alert to the details of construction and the ease with which fire can spread in concealed spaces.

2 BUILDING EVALUATION

A given rehabilitation project will most likely go through several stages. The preliminary evaluation process involves the designer in surveying the prospective building. The fire resistance of *existing building* materials and construction systems is identified; potential problems are noted for closer study. The final evaluation phase includes: developing design solutions to upgrade the fire resistance of building elements, if necessary; preparing working drawings and specifications; and the securing of the necessary code approvals.

2.1 PRELIMINARY EVALUATION

A preliminary evaluation should begin with a building survey to determine the existing materials, the general arrangement of the structure and the use of the occupied spaces, and the details of construction. The designer needs to know “what is there” before a decision can be reached about what to keep and what to remove during the rehabilitation process. This preliminary evaluation should be as detailed as necessary to make initial plans. The fire-related properties need to be determined from the applicable building or rehabilitation code, and the materials and assemblies existing in the building then need to be evaluated for these properties. Two work sheets are shown below to facilitate the preliminary evaluation.

Two possible sources of information helpful in the preliminary evaluation are the original building plans and the building code in effect at the time of original construction. Plans may be on file with the local building department or in the offices of the original designers (e.g., architect, engineer) or their successors. If plans are available, the investigator should verify that the building was actually constructed as called for in the plans, as well as incorporate any later alterations or changes to the building. Earlier editions of the local building code should be on file with the building official. The code in effect at the time of construction will contain fire performance criteria. While this is no guarantee that the required performance was actually provided, it does give the investigator some guidance as to the level of performance which may be expected. Under some code administration and enforcement systems, the code in effect at the time of construction also defines the level of performance that must be provided at the time of rehabilitation.

Figure 1 illustrates one method for organizing preliminary field notes. Space is provided for the materials, dimensions, and condition of the principal building elements. Each floor of the structure should be visited and the appropriate information obtained. In practice, there will often be identical materials and construction on every floor, but the exception may be of vital importance. A schematic diagram should be prepared of each floor showing the layout of exits and hallways and indicating where each element described in the field notes fits into the structure as a whole. The exact arrangement of interior walls within apartments is of secondary importance from a fire safety point of view and need not be shown on the drawings unless these walls are required by code to have a fire-resistance rating.

The location of stairways and elevators should be clearly marked on the drawings. All exterior means of escape (e.g., fire escapes) should be identified.[1]

The following notes explain the entries in Figure 1.

<u>Exterior Bearing Walls</u>: Many old buildings utilize heavily constructed walls to support the floor/ceiling assemblies at the exterior of the building. There may be columns and/or interior bearing walls within the structure, but the exterior walls are an important factor in assessing the fire safety of a building.

The field investigator should note how the floor/ceiling assemblies are supported at the exterior of the building. If columns are incorporated in the exterior walls, the walls may be considered nonbearing.

<u>Interior Bearing Walls</u>: It may be difficult to determine whether or not an interior wall is load bearing, but the field investigator should attempt to make this determination. At a later stage of the rehabilitation process, this question will need to be determined exactly. Therefore, the field notes should be as accurate as possible.

1. Problems providing adequate exiting are discussed at length in the *Egress Guideline for Residential Rehabilitation*.

Exterior Nonbearing Walls: The fire resistance of the exterior walls is important for two reasons. These walls (both bearing and nonbearing) are depended upon to: a) contain a fire within the building of origin; or b) keep an exterior fire *outside* the building. It is therefore important to indicate on the drawings where any openings are located as well as the materials and construction of all doors or shutters. The drawings should indicate the presence of wired glass, its thickness and framing, and identify the materials used for windows and door frames. The protection of openings adjacent to exterior means of escape (e.g., exterior stairways, fire escapes) is particularly important. The ground floor drawing should locate the building on the property and indicate the precise distances to adjacent buildings.

Interior Nonbearing Walls (Partitions): A partition is a "wall that extends from floor to ceiling and subdivides space within any story of a building." (48) Figure 1 has two categories (A & B) for Interior Nonbearing Walls (Partitions) which can be used for different walls, such as hallway walls as compared to inter-apartment walls. Under some circumstances there may be only one type of wall construction; in others, three or more types of wall construction may occur.

The field investigator should be alert for differences in function as well as in materials and construction details. In general, the details within apartments are not as important as the major exit paths and exit stairways. The preliminary field investigation should attempt to determine the thickness of all walls. A term introduced below called "thickness design" will depend on an accurate (± $^1/_4$ inch) determination. Even though this initial field survey is called "preliminary," the data generated should be as accurate and complete as possible.

The field investigator should note the exact location from which observations are recorded. For instance, if a hole is found through a wall enclosing an exit stairway which allows a cataloguing of the construction details, the field investigation notes should reflect the location of the "find." At the preliminary stage it is not necessary to core every wall; the interior details of construction can usually be determined at some location.

Structural Frame: There may or may not be a complete skeletal frame, but usually there are columns, beams, trusses, or other like elements. The dimensions and spacing of the structural elements should be measured and indicated on the drawings. For instance, if there are 10-inch square columns located on a 30-foot square grid throughout the building, this should be noted. The structural material and cover or protective materials should be identified wherever possible. The thickness of the cover materials should be determined to an accuracy of ± $^1/_4$ inch. As discussed above, the preliminary field survey usually relies on accidental openings in the cover materials rather than a systematic coring technique.

Floor/Ceiling Structural Systems: The span between supports should be measured. If possible, a sketch of the cross-section of the system should be made. If there is no location where accidental damage has opened the floor/ceiling construction to visual inspection, it is necessary to make such an opening. An evaluation of the fire resistance of a floor/ceiling assembly requires detailed knowledge of the materials and their arrangement. Special attention should be paid to the cover on structural steel elements and the condition of suspended ceilings and similar membranes.

Roofs: The preliminary field survey of the roof system is initially concerned with watertightness. However, once it is apparent that the roof is sound for ordinary use and can be

FIGURE 1
PRELIMINARY EVALUATION FIELD NOTES

BUILDING ELEMENT		MATERIALS	THICKNESS	CONDITION	NOTES
Exterior Bearing Walls					
Interior Bearing Walls					
Exterior Nonbearing Walls					
Interior Nonbearing Walls or Partitions:	A				
	B				
Structural Frame: Columns					
Beams					
Other					
Floor/Ceiling Structural System Spanning					
Roofs					
Doors (including frame and hardware): a) Enclosed vertical exitway					
b) Enclosed horizontal exitway					
c) Other					

retained in the rehabilitated building, it becomes necessary to evaluate the fire performance. The field investigator must measure the thickness and identify the types of materials which have been used. Be aware that there may be several layers of roof materials.

Doors: Doors to stairways and hallways represent some of the most important fire elements to be considered within a building. The uses of the spaces separated largely controls the level of fire performance necessary. Walls and doors enclosing stairways or elevator shafts would normally require a higher level of performance than between the bedroom and bath. The various uses are differentiated in Figure 1.

Careful measurements of the thickness of door panels must be made, and the type of core material within each door must be determined. It should be noted whether doors have self-closing devices; the general operation of the doors should be checked. The latch should engage and the door should fit tightly in the frame. The hinges should be in good condition. If glass is used in the doors, it should be identified as either plain glass or wired glass mounted in either a wood or steel frame.

Materials: The field investigator should be able to identify ordinary building materials. In situations where an unfamiliar material is found, a sample should be obtained. This sample should measure at least 10 cubic inches so that an ASTM E136 fire test can be conducted to determine if it is combustible.

Thickness: The thickness of all materials should be measured accurately since, under certain circumstances, the level of fire resistance is very sensitive to the material thickness.

Condition: The method of attaching the various layers and facings to one another or to the supporting structural element should be noted under the appropriate building element. The "secureness" of the attachment and the general condition of the layers and facings should be noted here.

Notes: The "Notes" column can be used for many purposes, but it might be a good idea to make specific references to other field notes or drawings.

After the building survey is completed, the data collected must be analyzed. A suggested work sheet for organizing this information is given below as Figure 2.

The required fire resistance and flame spread for each building element are normally established by the local building or rehabilitation code. The fire performance of the existing materials and assemblies should then be estimated, using one of the techniques described below. If the fire performance of the *existing building* element(s) is equal to or greater than that required, the materials and assemblies may remain. If the fire performance is less than required, then corrective measures must be taken.

FIGURE 2
PRELIMINARY EVALUATION WORKSHEET

BUILDING ELEMENT		REQUIRED FIRE RESISTANCE	REQUIRED FLAME SPREAD	ESTIMATED FIRE RESISTANCE	ESTIMATED FLAME SPREAD	METHOD OF UPGRADING	ESTIMATED UPGRADED PROTECTION	NOTES
Exterior Bearing Walls								
Interior Bearing Walls								
Exterior Nonbearing Walls								
Interior Nonbearing Walls or Partitions:	A							
	B							
Structural Frame: Columns								
Beams								
Other								
Floor/Ceiling Structural System Spanning								
Roofs								
Doors (including frame and hardware): a) Enclosed vertical exitway								
b) Enclosed horizontal exitway								
c) Others								

The most common methods of upgrading the level of protection are to either remove and replace the existing building element(s) or to repair and upgrade the existing materials and assemblies. Other fire protection measures, such as automatic sprinklers or detection and alarm systems, also could be considered, though they are beyond the scope of this guideline. If the upgraded protection is still less than that required or deemed to be acceptable, additional corrective measures must be taken. This process must continue until an acceptable level of performance is obtained.

2.2 FIRE RESISTANCE OF EXISTING BUILDING ELEMENTS

The fire resistance of the existing building elements can be estimated from the tables and histograms contained in the Appendix. The Appendix is organized first by type of building element: walls, columns, floor/ceiling assemblies, beams, and doors. Within each building element, the tables are organized by type of construction (e.g., masonry, metal, wood frame), and then further divided by minimum dimensions or thickness of the building element.

A histogram precedes every table that has 10 or more entries. The X-axis measures fire resistance in hours; the Y-axis shows the number of entries in that table having a given level of fire resistance. The histograms also contain the location of each entry within that table for easy cross-referencing.

The histograms, because they are keyed to the tables, can speed the preliminary investigation. For example, Table 1.3.2, *Wood Frame Walls 4" to Less Than 6" Thick*, contains 96 entries. Rather than study each table entry, the histogram shows that every wall assembly listed in that table has a fire resistance of less than 2 hours. If the building code required the wall to have 2 hours fire resistance, the designer, with a minimum of effort, is made aware of a problem that requires closer study.

Suppose the code had only required a wall of 1 hour fire resistance. The histogram shows far fewer complying elements (19) than noncomplying ones (77). If the existing assembly is not one of the 19 complying entries, there is a strong possibility the existing assembly is deficient. The histograms can also be used in the converse situation. If the existing assembly is not one of the smaller number of entries with a lower than required fire resistance, there is a strong possibility the existing assembly will be acceptable.

At some point, the existing building component or assembly must be located within the tables. Otherwise, the fire resistance must be determined through one of the other techniques presented in the guideline. Locating the building component in the Appendix Tables not only guarantees the accuracy of the fire-resistance rating, but also provides a source of documentation for the building official.

2.3 EFFECTS OF PENETRATIONS IN FIRE-RESISTANT ASSEMBLIES

There are often many features in existing walls or floor/ceiling assemblies which were not included in the original certification or fire testing. The most common examples are pipes and utility wires passed through holes poked through an assembly. During the life of the building, many penetrations are added, and by the time a building is ready for rehabilitation it is not sufficient to just consider the fire resistance of the assembly as originally constructed. It is necessary to consider all penetrations and their relative impact upon fire performance. For instance, the fire resistance of the corridor wall may be less important than the effect of plain glass doors or transoms. In fact, doors are the most important single class of penetrations.

A fully developed fire generates substantial quantities of heat and excess gaseous fuel capable of penetrating any holes which might be present in the walls or ceiling of the fire compartment. In general, this leads to a severe degradation of the fire resistance of those building elements and to a greater potential for fire spread. This is particularly applicable to penetrations located high in a compartment where the positive pressure of the fire can force the unburned gases through the penetration.

Penetrations in a floor/ceiling assembly will generally completely negate the barrier qualities of the assembly and will lead to rapid spread of fire to the space above. It will not be a problem, however, if the penetrations are filled with noncombustible materials strongly fastened to the structure. The upper half of walls are similar to the floor/ceiling assembly in that a positive pressure can reasonably be expected in the top of the room, and this will push hot and/or burning gases through the penetration unless it is completely sealed.

Building codes require doors installed in fire resistive walls to resist the passage of fire for a specified period of time. If the door to a fully involved room is not closed, a large plume of fire will typically escape through the doorway, preventing anyone from using the space outside the door while allowing the fire to spread. This is why door closers are so important. Glass in doors and transoms can be expected to rapidly shatter unless constructed of listed or approved wire glass in a steel frame. As with other building elements, penetrations or nonrated portions of doors and transoms must be upgraded or otherwise protected.

Table 5.1 in Section V of the Appendix contains 41 entries of doors mounted in sound tight-fitting frames. Part 3.4 below outlines one procedure for evaluating and possibly upgrading existing doors.

3 FINAL EVALUATION AND DESIGN SOLUTION

The final evaluation begins after the rehabilitation project has reached the final design stage and the choice is made to keep certain archaic materials and assemblies in the rehabilitated building. The final evaluation process is essentially a more refined and detailed version of the preliminary evaluation. The specific fire resistance and flame spread requirements are determined for the project. This may involve local building and fire officials reviewing the preliminary evaluation as depicted in Figures 1 and 2 and the field drawings and notes. When necessary, provisions must be made to upgrade existing building elements to provide the required level of fire performance.

There are several approaches to design solutions that can make possible the continued use of archaic materials and assemblies in the rehabilitated structure. The simplest case occurs when the materials and assembly in question are found within the Appendix Tables and the fire performance properties satisfy code requirements. Other approaches must be used, though, if the assembly cannot be found within the Appendix or the fire performance needs to be upgraded. These approaches have been grouped into two classes: experimental and theoretical.

3.1 THE EXPERIMENTAL APPROACH

If a material or assembly found in a building is not listed in the Appendix Tables, there are several other ways to evaluate fire performance. One approach is to conduct the appropriate fire test(s) and thereby determine the fire-related properties directly. There are a number of laboratories in the United States which routinely conduct the various fire tests. A current list can be obtained by writing the Center for Fire Research, National Bureau of Standards, Washington, D.C. 20234.

The contract with any of these testing laboratories should require their observation of specimen preparation as well as the testing of the specimen. A complete description of where and how the specimen was obtained from the building, the transportation of the specimen, and its preparation for testing should be noted in detail so that the building official can be satisfied that the fire test is representative of the actual use.

The test report should describe the fire test procedure and the response of the material or assembly. The laboratory usually submits a cover letter with the report to describe the provisions of the fire test that were satisfied by the material or assembly under investigation. A building official will generally require this cover letter, but will also read the report to confirm that the material or assembly complies with the code requirements. Local code officials should be involved in all phases of the testing process.

The experimental approach can be costly and time consuming because specimens must be taken from the building and transported to the testing laboratory. When a load bearing assembly has continuous reinforcement, the test specimen must be removed from the building, transported, and tested in one piece. However, when the fire performance cannot be determined by other means, there may be no alternative to a full-scale test.

A “nonstandard” small-scale test can be used in special cases. Sample sizes need only be 10–25 square feet (0.93–2.3 m^2), while full-scale tests require test samples of either 100 or 180 square feet (9.3 or 17 m^2) in size. This small-scale test is best suited for testing nonload-bearing assemblies against thermal transmission only.

3.2 THE THEORETICAL APPROACH

There will be instances when materials and assemblies in a building undergoing rehabilitation cannot be found in the Appendix Tables. Even where test results are available for more or less similar construction, the proper classification may not be immediately apparent. Variations in dimensions, loading conditions, materials, or workmanship may markedly affect the performance of the individual building elements, and the extent of such a possible effect cannot be evaluated from the tables.

Theoretical methods being developed offer an alternative to the full-scale fire tests discussed above. For example, Section 4302(b) of the 1979 edition of the *Uniform Building Code* specifically allows an engineering design for fire resistance in lieu of conducting full-scale tests. These techniques draw upon computer simulation and mathematical modeling, thermodynamics, heat-flow analysis, and materials science to predict the fire performance of building materials and assemblies.

One theoretical method, known as the “Ten Rules of Fire Endurance Ratings,” was published by T. Z. Harmathy in the May, 1965 edition of *Fire Technology*. (35) Harmathy’s Rules provide a foundation for extending the data within the Appendix Tables to analyze or upgrade current as well as archaic building materials or assemblies.

HARMATHY'S TEN RULES

Rule 1: The “thermal”[1] *fire endurance of a construction consisting of a number of parallel layers is greater than the sum of the “thermal” fire endurances characteristic of the individual layers when exposed separately to fire.*

The minimum performance of an untested assembly can be estimated if the fire endurance of the individual components is known. Though the exact rating of the assembly cannot be stated, the endurance of the assembly is greater than the sum of the endurance of the components.

When a building assembly or component is found to be deficient, the fire endurance can be upgraded by providing a protective membrane. This membrane could be a new layer of brick, plaster, or drywall. The fire endurance of this membrane is called the “finish rating.” Appendix Tables 1.5.1 and 1.5.2 contain the finish ratings for the most commonly employed materials. (See also the notes to Rule 2).

The test criteria for the finish rating is the same as for the thermal fire endurance of the total assembly: average temperature increases of 250°F (121°C) above ambient or 325°F (163°C) above ambient at any one place with the membrane

1. The “thermal” fire endurance is the time at which the average temperature on the unexposed side of a construction exceeds its initial value by 250° when the other side is exposed to the “standard” fire specified by ASTM Test Method E-19.

being exposed to the fire. The temperature is measured at the interface of the assembly and the protective membrane.

Rule 2: The fire endurance of a construction does not decrease with the addition of further layers.

Harmathy notes that this rule is a consequence of the previous rule. Its validity follows from the fact that the additional layers increase both the resistance to heat flow and the heat capacity of the construction. This, in turn, reduces the rate of temperature rise at the unexposed surface.

This rule is not just restricted to "thermal" performance but affects the other fire test criteria: direct flame passage, cotton waste ignition, and load bearing performance. This means that certain restrictions must be imposed on the materials to be added and on the loading conditions. One restriction is that a new layer, if applied to the exposed surface, must not produce additional thermal stresses in the construction, i.e., its thermal expansion characteristics must be similar to those of the adjacent layer. Each new layer must also be capable of contributing enough additional strength to the assembly to sustain the added dead load. If this requirement is not fulfilled, the allowable live load must be reduced by an amount equal to the weight of the new layer. Because of these limitations, this rule should not be applied without careful consideration.

Particular care must be taken if the material added is a good thermal insulator. Properly located, the added insulation could improve the "thermal" performance of the assembly. Improperly located, the insulation could block necessary thermal transmission through the assembly, thereby subjecting the structural elements to greater temperatures for longer periods of time, and could cause premature structural failure of the supporting members.

Rule 3: The fire endurance of constructions containing continuous air gaps or cavities is greater than the fire endurance of similar constructions of the same weight, but containing no air gaps or cavities.

By providing for voids in a construction, additional resistances are produced in the path of heat flow. Numerical heat flow analyses indicate that a 10 to 15 percent increase in fire endurance can be achieved by creating an air gap at the midplane of a brick wall. Since the gross volume is also increased by the presence of voids, the air gaps and cavities have a beneficial effect on stability as well. However, constructions containing combustible materials within an air gap may be regarded as exceptions to this rule because of the possible development of burning in the gap.

There are numerous examples of this rule in the tables. For instance:

Table 1.1.4; Item W-8-M-82: Cored concrete masonry, nominal 8 inch thick wall with one unit in wall thickness and with 62 percent minimum of solid material in each unit, load bearing (80 PSI). Fire endurance: $2^1/_2$ hours.

Table 1.1.5; Item W-10-M-11: Cored concrete masonry, nominal 10 inch thick wall with two units in wall thickness and a 2-inch (51 mm) air space, load bearing (80 PSI). The units are essentially the same as item W-8-M-82. Fire endurance: $3^1/_2$ hours.

These walls show 1 hour greater fire endurance by the addition of the 2-inch (51 mm) air space.

Rule 4: The farther an air gap or cavity is located from the exposed surface, the more beneficial is its effect on the fire endurance.

Radiation dominates the heat transfer across an air gap or cavity, and it is markedly higher where the temperature is higher.

The air gap or cavity is thus a poor insulator if it is located in a region which attains high temperatures during fire exposure.

Some of the clay tile designs take advantage of these factors. The double cell design, for instance, ensures that there is a cavity near the unexposed face. Some floor/ceiling assemblies have air gaps or cavities near the top surface and these enhance their thermal performance.

Rule 5: The fire endurance of a construction cannot be increased by increasing the thickness of a completely enclosed air layer.

Harmathy notes that there is evidence that if the thickness of the air layer is larger than about $^1/_2$ inch (12.7 mm), the heat transfer through the air layer depends only on the temperature of the bounding surfaces, and is practically independent of the distance between them. This rule is not applicable if the air layer is not completely enclosed, i.e., if there is a possibility of fresh air entering the gap at an appreciable rate.

Rule 6: Layers of materials of low thermal conductivity are better utilized on that side of the construction on which fire is more likely to happen.

As in Rule 4, the reason lies in the heat transfer process, though the conductivity of the solid is much less dependent on the ambient temperature of the materials. The low thermal conductor creates a substantial temperature differential to be established across its thickness under transient heat flow conditions. This rule may not be applicable to materials undergoing physico-chemical changes accompanied by significant heat absorption or heat evolution.

Rule 7: The fire endurance of asymmetrical constructions depends on the direction of heat flow.

This rule is a consequence of Rules 4 and 6, as well as other factors. This rule is useful in determining the relative protection of corridors and walls enclosing an exit stairway from the surrounding spaces. In addition, there are often situations where a fire is more likely, or potentially more severe, from one side or the other.

Rule 8: The presence of moisture, if it does not result in explosive spalling, increases the fire endurance.

The flow of heat into an assembly is greatly hindered by the release and evaporation of the moisture found within cementitious materials such as gypsum, Portland cement, or magnesium oxychloride. Harmathy has shown that the gain in fire endurance may be as high as 8 percent for each percent (by volume) of moisture in the construction. It is the moisture chemically bound within the construction material at the time of manufacture or processing that leads to increased fire endurance. There is no direct relationship between the relative humidity of the air in the pores of the material and the increase in fire endurance.

Under certain conditions there may be explosive spalling of low permeability cementitious materials such as dense concrete. In general, one can assume that extremely old concrete has developed enough minor cracking that this factor should not be significant.

Rule 9: Load-supporting elements, such as beams, girders and joists, yield higher fire endurances when subjected to fire endurance tests as parts of floor, roof, or ceiling assemblies than they would when tested separately.

One of the fire endurance test criteria is the ability of a load-supporting element to carry its design load. The element will be deemed to have failed when the load can no longer be supported.

Failure usually results for two reasons. Some materials, particularly steel and other metals, lose much of their structural strength at elevated temperatures. Physical deflection of the supporting element, due to decreased strength or thermal expansion, causes a redistribution of the load forces and stresses throughout the element. Structural failure often results because the supporting element is not designed to carry the redistributed load.

Roof, floor, and ceiling assemblies have primary (e.g., beams) and secondary (e.g., floor joists) structural members. Since the primary load-supporting elements span the largest distances, their deflection becomes significant at a stage when the strength of the secondary members (including the roof or floor surface) is hardly affected by the heat. As the secondary members follow the deflection of the primary load-supporting element, an increasingly larger portion of the load is transferred to the secondary members.

When load-supporting elements are tested separately, the imposed load is constant and equal to the design load throughout the test. By definition, no distribution of the load is possible because the element is being tested by itself. Without any other structural members to which the load could be transferred, the individual elements cannot yield a higher fire endurance than they do when tested as parts of a floor, roof or ceiling assembly.

Rule 10: The load-supporting elements (beams, girders, joists, etc.) of a floor, roof, or ceiling assembly can be replaced by such other load-supporting elements which, when tested separately, yielded fire endurances not less than that of the assembly.

This rule depends on Rule 9 for its validity. A beam or girder, if capable of yielding a certain performance when tested separately, will yield an equally good or better performance when it forms a part of a floor, roof, or ceiling assembly. It must be emphasized that the supporting element of one assembly must not be replaced by the supporting element of another assembly if the performance of this latter element is not known from a separate (beam) test. Because of the load-reducing effect of the secondary elements that results from a test performed on an assembly, the performance of the supporting element alone cannot be evaluated by simple arithmetic. This rule also indicates the advantage of performing separate fire tests on primary load-supporting elements.

ILLUSTRATION OF HARMATHY’S RULES

Harmathy provided one schematic figure which illustrated his Rules.[1] It should be useful as a quick reference to assist in applying his Rules.

EXAMPLE APPLICATION OF HARMATHY’S RULES

The following examples, based in whole or in part upon those presented in Harmathy’s paper (35), show how the Rules can be applied to practical cases.

Example 1

Problem

A contractor would like to keep a partition which consists of a $3^3/_4$ inch (95 mm) thick layer of red clay brick, a $1^1/_4$ inch (32 mm) thick layer of plywood, and a $^3/_8$ inch (9.5 mm) thick layer of gypsum wallboard, at a location where 2-hour fire endurance is required. Is this assembly capable of providing a 2-hour protection?

Solution

(1) This partition does not appear in the Appendix Tables.

(2) Bricks of this thickness yield fire endurances of approximately 75 minutes (Table 1.1.2, Item W-4-M-2).

(3) The $1^1/_4$ inch (32 mm) thick plywood has a finish rating of 30 minutes.

(4) The $^3/_8$ inch (9.5 mm) gypsum wallboard has a finish rating of 10 minutes.

(5) Using the recommended values from the tables and applying Rule 1, the fire endurance (FI) of the assembly is larger than the sum of the individual layers, or

$$FI > 75 + 30 + 10 = 115 \text{ minutes}$$

Discussion

This example illustrates how the Appendix Tables can be utilized to determine the fire resistance of assemblies not explicitly listed.

Example 2

Problem

(1) A number of buildings to be rehabilitated have the same type of roof slab which is supported with different structural elements.

(2) The designer and contractor would like to determine whether or not this roof slab is capable of yielding a 2-hour fire endurance. According to a rigorous interpretation of ASTM E119, however, only the roof assembly, including the roof slab as well as the cover and the supporting elements, can be subjected to a fire test.

1. Reproduced from the May 1065 *Fire Technology* (Vol. 1, No. 2). Copyright National Fire Protection Association, Boston. Reproduced by permission.

Therefore, a fire endurance classification cannot be issued for the slabs separately.

(3) The designer and contractor believe this slab will yield a 2-hour fire endurance even without the cover, and any beam of at least 2-hour fire endurance will provide satisfactory support. Is it possible to obtain a classification for the slab separately?

Solution

(1) The answer to the question is yes.

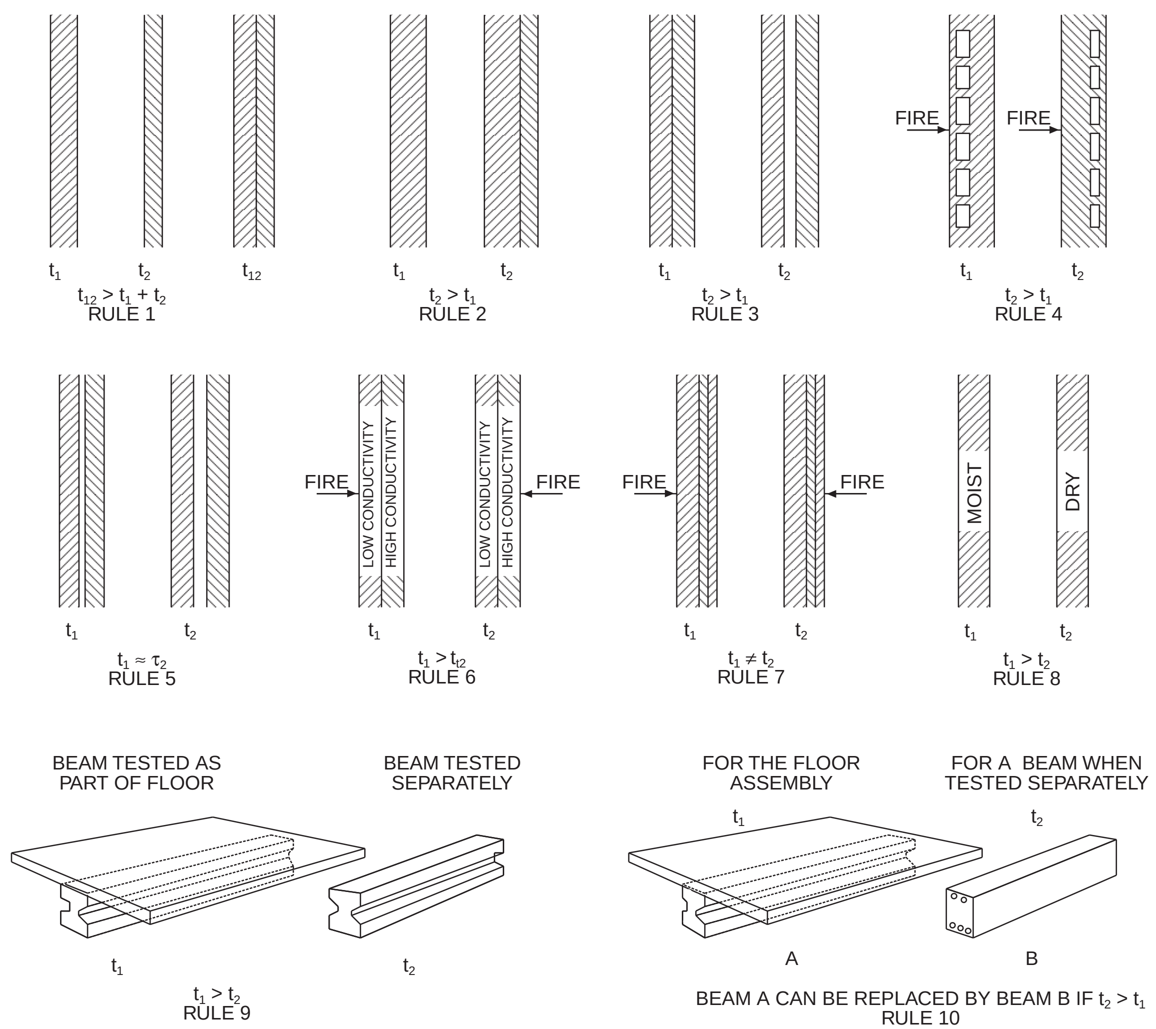
(2) According to Rule 10 it is not contrary to common sense to test and classify roofs and supporting elements separately. Furthermore, according to Rule 2, if the roof slabs actually yield a 2-hour fire endurance, the endurance of an assembly, including the slabs, cannot be less than 2 hours.

(3) The recommended procedure would be to review the tables to see if the slab appears as part of any tested roof or floor/ceiling assembly. The supporting system can be regarded as separate from the slab specimen, and the fire endurance of the assembly listed in the table is at least the fire endurance of the slab. There would have to be an adjustment for the weight of the roof cover in the allowable load if the test specimen did not contain a cover.

(4) The supporting structure or element would have to have at least a 2-hour fire endurance when tested separately.

Discussion

If the tables did not include tests on assemblies which contained the slab, one procedure would be to assemble the roof slabs on any convenient supporting system (not regarded as part of the specimen) and to subject them to a load which, besides the usually required superimposed load, includes some allowances for the weight of the cover.



Diagrammatic illustration of 10 rules.
t = fire endurance

Example 3

Problem

A steel-joisted floor and ceiling assembly is known to have yielded a fire endurance of 1 hour and 35 minutes. At a certain location, a 2-hour endurance is required. What is the most economical way of increasing the fire endurance by at least 25 minutes?

Solution

(1) The most effective technique would be to increase the ceiling plaster thickness. Existing coats of paint would have to be removed and the surface properly prepared before the new plaster could be applied. Other materials (e.g., gypsum wallboard) could also be considered.

(2) There may be other techniques based on other principles, but an examination of the drawings would be necessary.

Discussion

(1) The additional plaster has at least three effects:

a) The layer of plaster is increased and thus there is a gain of fire endurance (Rule 1).

b) There is a gain due to shifting the air gap farther from the exposed surface (Rule 4).

c) There is more moisture in the path of heat flow to the structural elements (Rules 7 and 8).

(2) The increase in fire endurance would be at least as large as that of the finish rating for the added thickness of plaster. The combined effects in (1) above would further increase this by a factor of 2 or more, depending upon the geometry of the assembly.

Example 4

Problem

The fire endurance of item W-10-M-l in Table 1.1.5 is 4 hours. This wall consists of two $3^3/_4$ inch (95 mm) thick layers of structural tiles separated by a 2-inch (51 mm) air gap and $^3/_4$ inch (19 mm) Portland cement plaster or stucco on both sides. If the actual wall in the building is identical to item W-10-M-1 except that it has a 4-inch (102 mm) air gap, can the fire endurance be estimated at 5 hours?

Solution

The answer to the question is no for the reasons contained in Rule 5.

Example 5

Problem

In order to increase the insulating value of its precast roof slabs, a company has decided to use two layers of different concretes. The lower layer of the slabs, where the strength of the concrete is immaterial (all the tensile load is carried by the steel reinforcement), would be made with a concrete of low strength but good insulating value. The upper layer, where the concrete is supposed to carry the compressive load, would remain the original high strength, high thermal conductivity concrete. How will the fire endurance of the slabs be affected by the change?

Solution

The effect on the thermal fire endurance is beneficial:

(1) The total resistance to heat flow of the new slabs has been increased due to the replacement of a layer of high thermal conductivity by one of low conductivity.

(2) The layer of low conductivity is on the side more likely to be exposed to fire, where it is more effectively utilized according to Rule 6. The layer of low thermal conductivity also provides better protection for the steel reinforcement, thereby extending the time before reaching the temperature at which the creep of steel becomes significant.

3.3 “THICKNESS DESIGN” STRATEGY

The “thickness design” strategy is based upon Harmathy’s Rules 1 and 2. This design approach can be used when the construction materials have been identified and measured, but the specific assembly cannot be located within the tables. The tables should be surveyed again for thinner walls of like material and construction detail that have yielded the desired or greater fire endurance. If such an assembly can be found, then the thicker walls in the building have more than enough fire resistance. The thickness of the walls thus becomes the principal concern.

This approach can also be used for floor/ceiling assemblies, except that the thickness of the cover[1] and the slab become the central concern. The fire resistance of the untested assembly will be at least the fire resistance of an assembly listed in the table having a similar design but with less cover and/or thinner slabs. For other structural elements (e.g., beams and columns), the element listed in the table must also be of a similar design but with less cover thickness.

3.4 EVALUATION OF DOORS

A separate section on doors has been included because the process for evaluation presented below differs from those suggested previously for other building elements. The impact of unprotected openings or penetrations in fire resistant assemblies has been detailed in Part 2.3 above. It is sufficient to note here that openings left unprotected will likely lead to failure of the barrier under actual fire conditions.

For other types of building elements (e.g., beams, columns), the Appendix Tables can be used to establish a minimum level of fire performance. The benefit to rehabilitation is that the need for a full-scale fire test is then eliminated. For doors, however, this cannot be done. The data contained in Appendix Table 5.1, Resistance of Doors to Fire Exposure, can only provide guidance as to whether a successful fire test is even feasible.

1. Cover: the protective layer or membrane of material which slows the flow of heat to the structural elements.

For example, a door required to have 1 hour fire resistance is noted in the tables as providing only 5 minutes. The likelihood of achieving the required 1 hour, even if the door is upgraded, is remote. The ultimate need for replacement of the doors is reasonably clear, and the expense and time needed for testing can be saved. However, if the performance documented in the table is near or in excess of what is being required, then a fire test should be conducted. The test documentation can then be used as evidence of compliance with the required level of performance.

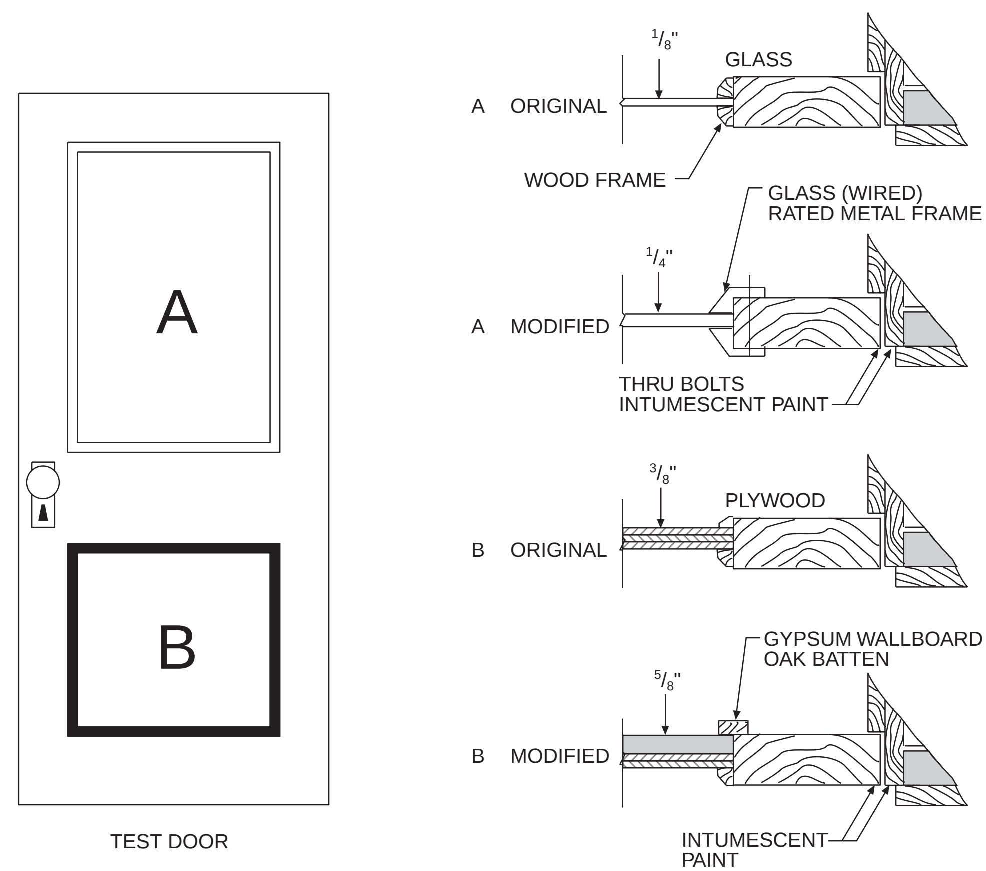
The table entries cannot be used as the sole proof of performance of the door in question because there are too many unknown variables which could measurably affect fire performance. The wood may have dried over the years; coats of flammable varnish could have been added. Minor deviations in the internal construction of a door can result in significant differences in performance. Methods of securing inserts in panel doors can vary. The major non-destructive method of analysis, an x-ray, often cannot provide the necessary detail. It is for these, and similar reasons, that a fire test is still felt to be necessary.

It is often possible to upgrade the fire performance of an existing door. Sometimes, “as is” and modified doors are evaluated in a single series of tests when failure of the unmodified door is expected. Because doors upgraded after an initial failure must be tested again, there is a potential savings of time and money.

The most common problems encountered are plain glass, panel inserts of insufficient thickness, and improper fit of a door in its frame. The latter problem can be significant because a fire can develop a substantial positive pressure, and the fire will work its way through otherwise innocent-looking gaps between door and frame.

One approach to solving these problems is as follows. The plain glass is replaced with approved or listed wire glass in a steel frame. The panel inserts can be upgraded by adding an additional layer of material. Gypsum wallboard is often used for this purpose. Intumescent paint applied to the edges of the door and frame will expand when exposed to fire, forming an effective seal around the edges. This seal, coupled with the generally even thermal expansion of a wood door in a wood frame, can prevent the passage of flames and other fire gases. Figure 3 below illustrates these solutions.

Because the interior construction of a door cannot be determined by a visual inspection, there is no absolute guarantee that the remaining doors are identical to the one(s) removed from the building and tested. But the same is true for doors constructed today, and reason and judgment must be applied. Doors that appear identical upon visual inspection can be weighed. If the weights are reasonably close, the doors



For SI: 1 inch = 25.4 mm.

FIGURE 3
MODIFICATION DETAILS

can be assumed to be identical and therefore provide the same level of fire performance. Another approach is to fire test more than one door or to dismantle doors selected at random to see if they had been constructed in the same manner. Original building plans showing door details or other records showing that doors were purchased at one time or obtained from a single supplier can also be evidence of similar construction.

More often though, it is what is visible to the eye that is most significant. The investigator should carefully check the condition and fit of the door and frame, and for frames out of plumb or separating from the wall. Door closers, latches, and hinges must be examined to see that they function properly and are tightly secured. If these are in order and the door and frame have passed a full-scale test, there can be a reasonable basis for allowing the existing doors to remain.

4
SUMMARY

This section summarizes the various approaches and design solutions discussed in the preceding sections of the guideline. The term "structural system" includes: frames, beams, columns, and other structural elements. "Cover" is a protective layer(s) of materials or membrane which slows the flow of heat to the structural elements. It cannot be stressed too strongly that the fire endurance of actual building elements can be greatly reduced or totally negated by removing part of the cover to allow pipes, ducts, or conduits to pass through the element. This must be repaired in the rehabilitation process.

The following approaches shall be considered equivalent.

4.1 The fire resistance of a building element can be established from the Appendix Tables. This is subject to the following limitations:

The building element in the rehabilitated building shall be constructed of the same materials with the same nominal dimensions as stated in the tables.

All penetrations in the building element or its cover for services such as electricity, plumbing, and HVAC shall be packed with noncombustible cementitious materials and so fixed that the packing material will not fall out when it loses its water of hydration.

The effects of age and wear and tear shall be repaired so that the building element is sound and the original thickness of all components, particularly covers and floor slabs, is maintained.

This approach essentially follows the approach taken by model building codes. The assembly must appear in a table either published in or accepted by the code for a given fire-resistance rating to be recognized and accepted.

4.2 The fire resistance of a building element which does not explicitly appear in the Appendix Tables can be established if one or more elements of same design but different dimensions have been listed in the tables. For walls, the existing element must be thicker than the one listed. For floor/ceiling assemblies, the assembly listed in the table must have the same or less cover and the same or thinner slab constructed of the same material as the actual floor/ceiling assembly. For other structural elements, the element listed in the table must be of a similar design but with less cover thickness. The fire resistance in all instances shall be the fire resistance recommended in the table. This is subject to the following limitations:

The actual element in the rehabilitated building shall be constructed of the same materials as listed in the table. Only the following dimensions may vary from those specified: for walls, the overall thickness must exceed that specified in the table; for floor/ceiling assemblies, the thickness of the cover and the slab must be greater than, or equal to, that specified in the table; for other structural elements, the thickness of the cover must be greater than that specified in the table.

All penetrations in the building element or its cover for services such as electricity, plumbing, or HVAC shall be packed with noncombustible cementitious materials and so fixed that the packing material will not fall out when it loses its water of hydration.

The effects of age and wear and tear shall be repaired so that the building element is sound and the original thickness of all components, particularly covers and floor slabs, is maintained.

This approach is an application of the "thickness design" concept presented in Part 3.3 of the guideline. There should be many instances when a thicker building element was utilized than the one listed in the Appendix Tables. This guideline recognizes the inherent superiority of a thicker design. Note: "thickness design" for floor/ceiling assemblies and structural elements refers to cover and slab thickness rather than total thickness.

The "thickness design" concept is essentially a special case of Harmathy's Rules (specifically Rules 1 and 2). It should be recognized that the only source of data is the Appendix Tables. If other data are used, it must be in connection with the approach below.

4.3 The fire resistance of building elements can be established by applying Harmathy's Ten Rules of Fire Resistance Ratings as set forth in Part 3.2 of the guideline. This is subject to the following limitations:

The data from the tables can be utilized subject to the limitations in 4.2 above.

Test reports from recognized journals or published papers can be used to support data utilized in applying Harmathy's Rules.

Calculations utilizing recognized and well established computational techniques can be used in applying Harmathy's Rules. These include, but are not limited to, analysis of heat flow, mechanical properties, deflections, and load bearing capacity.

APPENDIX

INTRODUCTION

The fire-resistance tables that follow are a part of Resource A and provide a tabular form of assigning fire-resistance ratings to various archaic building elements and assemblies.

These tables for archaic materials and assemblies do for archaic materials what Tables 721.1(1) through 721.1(3) of the *California Building Code* do for more modern building elements and assemblies. The fire-resistance tables of Resource A should be used as described in the "Purpose and Procedure" that follows the table of contents for these tables.

RESOURCE A TABLE OF CONTENTS

PURPOSE AND PROCEDURE

The tables and histograms which follow are to be used only within the analytical framework detailed in the main body of this guideline.

Histograms precede any table with 10 or more entries. The use and interpretation of these histograms is explained in Part 2 of the guideline. The tables are in a format similar to that found in the model building codes. The following example, taken from an entry in Table 1.1.2, best explains the table format.

1. Item Code: The item code consists of a four place series in the general form w-x-y-z in which each member of the series denotes the following:

   w = Type of building element (e.g., W=Walls; F=Floors, etc.)

   x = The building element thickness rounded down to the nearest 1-inch increment (e.g., $4^5/_8$ inches is rounded off to 4 inches)

   y = The general type of material from which the building element is constructed (e.g., M=Masonry; W=Wood, etc.)

   z = The item number of the particular building element in a given table

   The item code shown in the example W-4-M-50 denotes the following:

   W = Wall, as the building element

   4 = Wall thickness in the range of 4 inches (102 mm) to less than 5 inches (127 mm)

   M = Masonry construction

   50 = The 50th entry in Table 1.1.2

2. The specific name or heading of this column identifies the dimensions which, if varied, has the greatest impact on fire resistance. The critical dimension for walls, the example here, is thickness. It is different for other building elements (e.g., depth for beams; membrane thickness for some floor/ceiling assemblies). The table entry is the named dimension of the building element measured at the time of actual testing to within $\pm^1/_8$ inch (3.2 mm) tolerance. The thickness tabulated includes facings where facings are a part of the wall construction.

3. Construction Details: The construction details provide a brief description of the manner in which the building element was constructed.

4. Performance: This heading is subdivided into two columns. The column labeled “Load” will either list the load that the building element was subjected to during the fire test or it will contain a note number which will list the load and any other significant details. If the building element was not subjected to a load during the test, this column will contain “n/a,” which means “not applicable.”

   The second column under performance is labeled “Time” and denotes the actual fire endurance time observed in the fire test.

5. Reference Number: This heading is subdivided into three columns: Pre-BMS-92; BMS-92; and Post-BMS-92. The table entry under this column is the number in the Bibliography of the original source reference for the test data.

6. Notes: Notes are provided at the end of each table to allow a more detailed explanation of certain aspects of the test. In certain tables the notes given to this column have also been listed under the “Construction Details” and/or “Load” columns.

7. Rec Hours: This column lists the recommended fire endurance rating, in hours, of a building element. In some cases, the recommended fire endurance will be less than that listed under the “Time” column. In no case is the “Rec Hours” greater than given in the “Time” column.

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-50	$4^5/_8''$	Core: structural clay tile, See notes 12, 16, 21; Facings on unexposed side only, see note 18	N/A	25 min.		1		3, 4, 24	$^1/_3$

SECTION I - WALLS

FIGURE 1.1.1
MASONRY WALLS
0″ TO LESS THAN 4″ THICK

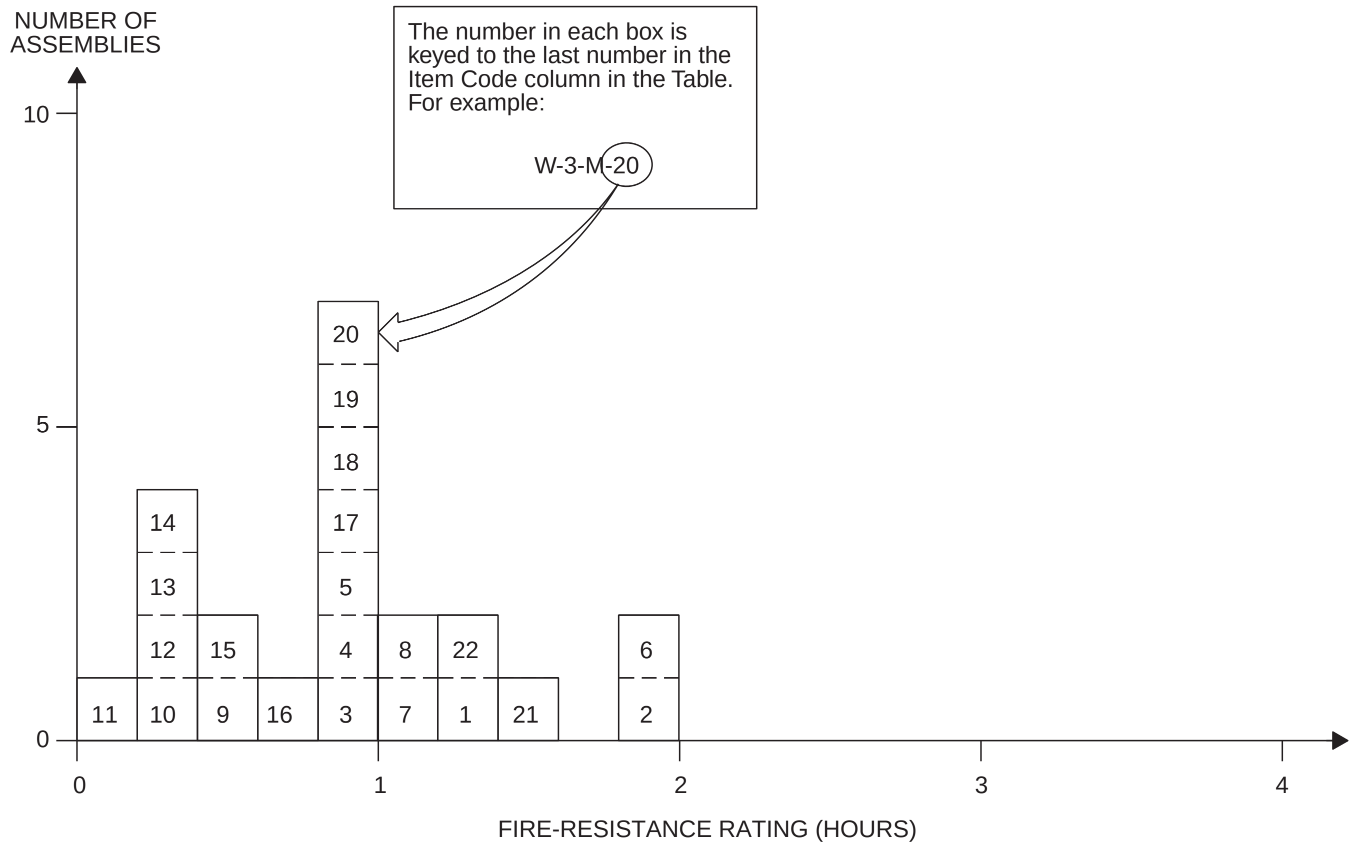


TABLE 1.1.1
MASONRY WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-2-M-1	2$^{1}/_{4}$″	Solid partition; $^{3}/_{4}$″ gypsum plank- 10′ ×1′6″; $^{3}/_{4}$″ plus gypsum plaster each side.	N/A	1 hr. 22 min.			7	1	1$^{1}/_{4}$
W-3-M-2	3″	Concrete block (18″ × 9″ × 3″) of fuel ash, Portland cement and plasticizer; cement/sand mortar.	N/A	2 hrs.			7	2, 3	2
W-2-M-3	2″	Solid gypsum block wall; No facings	N/A	1 hr.		1		4	1
W-3-M-4	3″	Solid gypsum blocks, laid in 1:3 sanded gypsum mortar.	N/A	1 hr.		1		4	1
W-3-M-5	3″	Magnesium oxysulfate wood fiber blocks; 2″ thick, laid in Portland cement-lime mortar; Facings: $^{1}/_{2}$″ of 1:3 sanded gypsum plaster on both sides.	N/A	1 hr.		1		4	1
W-3-M-6	3″	Magnesium oxysulfate bound wood fiber blocks; 3″ thick; laid in Portland cement-lime mortar; Facings: $^{1}/_{2}$″ of 1:3 sanded gypsum plaster on both sides.	N/A	2 hrs.		1		4	2

(continued)

TABLE 1.1.1—continued
MASONRY WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-3-M-7	3″	Clay tile; Ohio fire clay; single cell thick; Face plaster: $^5/_8$″ (both sides) 1:3 sanded gypsum; Design "E," Construction "A."	N/A	1 hr. 6 min.	0		2	5, 6, 7, 11, 12, 39	1
W-3-M-8	3″	Clay tile; Illinois surface clay; single cell thick; Face plaster: $^5/_8$″ (both sides) 1:3 sanded gypsum; Design "A," Construction "E."	N/A	1 hr. 1 min			2	5, 8, 9, 11, 12, 39	1
W-3-M-9	3″	Clay tile; Illinois surface clay; single cell thick; No face plaster; Design "A," Construction "C."	N/A	25 min.			2	5, 10, 11, 12, 39	$^1/_3$
W-3-M-10	$3^7/_8$″	8″ × $4^7/_8$″ glass blocks; weight 4 lbs. each; Portland cement-lime mortar; horizontal mortar joints reinforced with metal lath.	N/A	15 min.		1		4	$^1/_4$
W-3-M-11	3″	Core: structural clay tile; see Notes 14, 18, 13; No facings.	N/A	10 min.		1		5, 11, 26	$^1/_6$
W-3-M-12	3″	Core: structural clay tile; see Notes 14, 19, 23; No facings.	N/A	20 min.		1		5, 11, 26	$^1/_3$
W-3-M-13	$3^5/_8$″	Core: structural clay tile; see Notes 14, 18, 23; Facings: unexposed side; see Note 20.	N/A	20 min.		1		5, 11, 26	$^1/_3$
W-3-M-14	$3^5/_8$″	Core: structural clay tile; see Notes 14, 19, 23; Facings: unexposed side only; see Note 20.	N/A	20 min.		1		5, 11, 26	$^1/_3$
W-3-M-15	$3^5/_8$″	Core: clay structural tile; see Notes 14, 18, 23; Facings: side exposed to fire; see Note 20.	N/A	30 min.		1		5, 11, 26	$^1/_2$
W-3-M-16	$3^5/_8$″	Core: clay structural tile; see Notes 14, 19, 23; Facings: side exposed to fire; see Note 20.	N/A	45 min.		1		5, 11, 26	$^3/_4$
W-2-M-17	2″	2″ thick solid gypsum blocks; see Note 27.	N/A	1 hr.		1		27	1
W-3-M-18	3″	Core: 3″ thick gypsum blocks 70% solid; see Note 2; No facings.	N/A	1 hr.		1		27	1
W-3-M-19	3″	Core: hollow concrete units; see Notes 29, 35, 36, 38; No facings.	N/A	1 hr.		1		27	1
W-3-M-20	3″	Core: hollow concrete units; see Notes 28, 35, 36, 37, 38; No facings.	N/A	1 hr.		1			1
W-3-M-21	$3^1/_2$″	Core: hollow concrete units; see Notes 28, 35, 36, 37, 38; Facings: one side; see Note 37.	N/A	$1^1/_2$ hrs.		1			$1^1/_2$
W-3-M-22	$3^1/_2$″	Core: hollow concrete units; see Notes 29, 35, 36, 38; Facings: one side, see Note 37.	N/A	$1^1/_4$ hrs.		1			$1^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, °C = [(°F) - 32]/1.8.

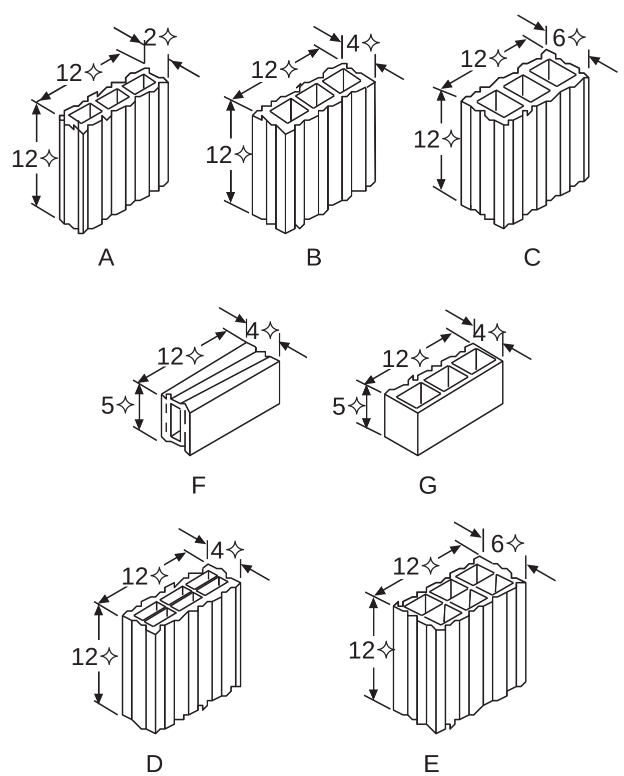
Notes:

1. Failure mode—flame thru.
2. Passed 2-hour fire test (Grade "C" fire res. - British).
3. Passed hose stream test.
4. Tested at NBS under ASA Spec. No. A2-1934. As nonload bearing partitions.
5. Tested at NBS under ASA Spec. No. 42-1934 (ASTM C19-33) except that hose stream testing where carried was run on test specimens exposed for full test duration, not for a reduced period as is contemporarily done.
6. Failure by thermal criteria—maximum temperature rise 325°F.
7. Hose stream failure.
8. Hose stream—pass.
9. Specimen removed prior to any failure occurring.
10. Failure mode—collapse.
11. For clay tile walls, unless the source or density of the clay can be positively identified or determined, it is suggested that the lowest hourly rating for the fire endurance of a clay tile partition of that thickness be followed. Identified sources of clay showing longer fire endurance can lead to longer time recommendations.

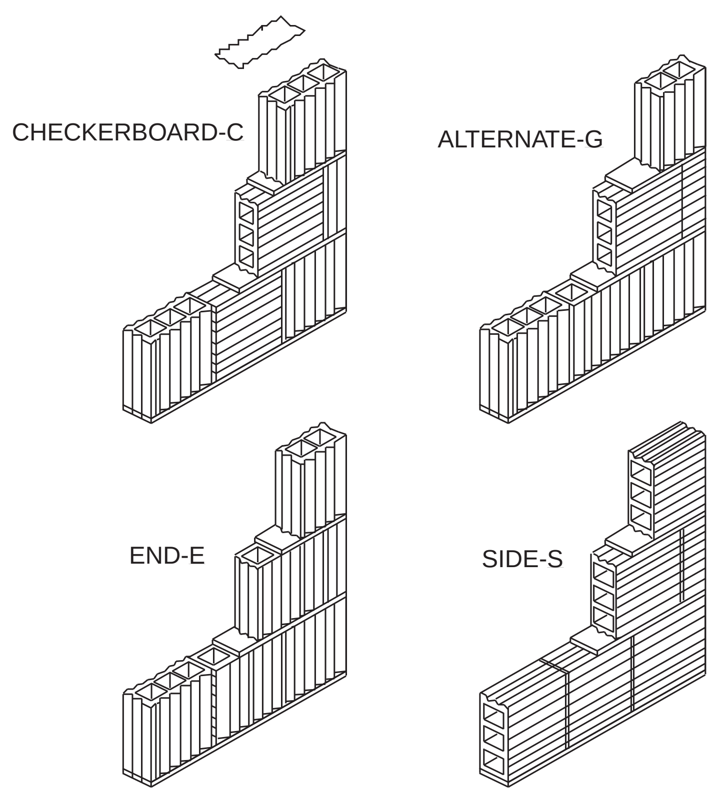
(continued)

TABLE 1.1.1—continued
MASONRY WALLS
0″ TO LESS THAN 4″ THICK

12. See appendix for construction and design details for clay tile walls.
13. Load: 80 psi for gross wall area.
14. One cell in wall thickness.
15. Two cells in wall thickness.
16. Double shells plus one cell in wall thickness.
17. One cell in wall thickness, cells filled with broken tile, crushed stone, slag cinders or sand mixed with mortar.
18. Dense hard-burned clay or shale tile.
19. Medium-burned clay tile.
20. Not less than $^{5}/_{8}$ inch thickness of 1:3 sanded gypsum plaster.
21. Units of not less than 30 percent solid material.
22. Units of not less than 40 percent solid material.
23. Units of not less than 50 percent solid material.
24. Units of not less than 45 percent solid material.
25. Units of not less than 60 percent solid material.
26. All tiles laid in Portland cement-lime mortar.
27. Blocks laid in 1:3 sanded gypsum mortar voids in blocks not to exceed 30 percent.
28. Units of expanded slag or pumice aggregate.
29. Units of crushed limestone, blast furnace, slag, cinders and expanded clay or shale.
30. Units of calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
31. Units of siliceous sand and gravel. Ninety percent or more quartz, chert or flint.
32. Unit at least 49 percent solid.
33. Unit at least 62 percent solid.
34. Unit at least 65 percent solid.
35. Unit at least 73 percent solid.
36. Ratings based on one unit and one cell in wall thickness.
37. Minimum of $^{1}/_{2}$ inch—1:3 sanded gypsum plaster.
38. Nonload bearing.
39. See Clay Tile Partition Design Construction drawings below.



DESIGNS OF TILES USED IN FIRE-TEST PARTITIONS



THE FOUR TYPES OF CONSTRUCTION USED IN FIRE-TEST PARTITIONS

FIGURE 1.1.2
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

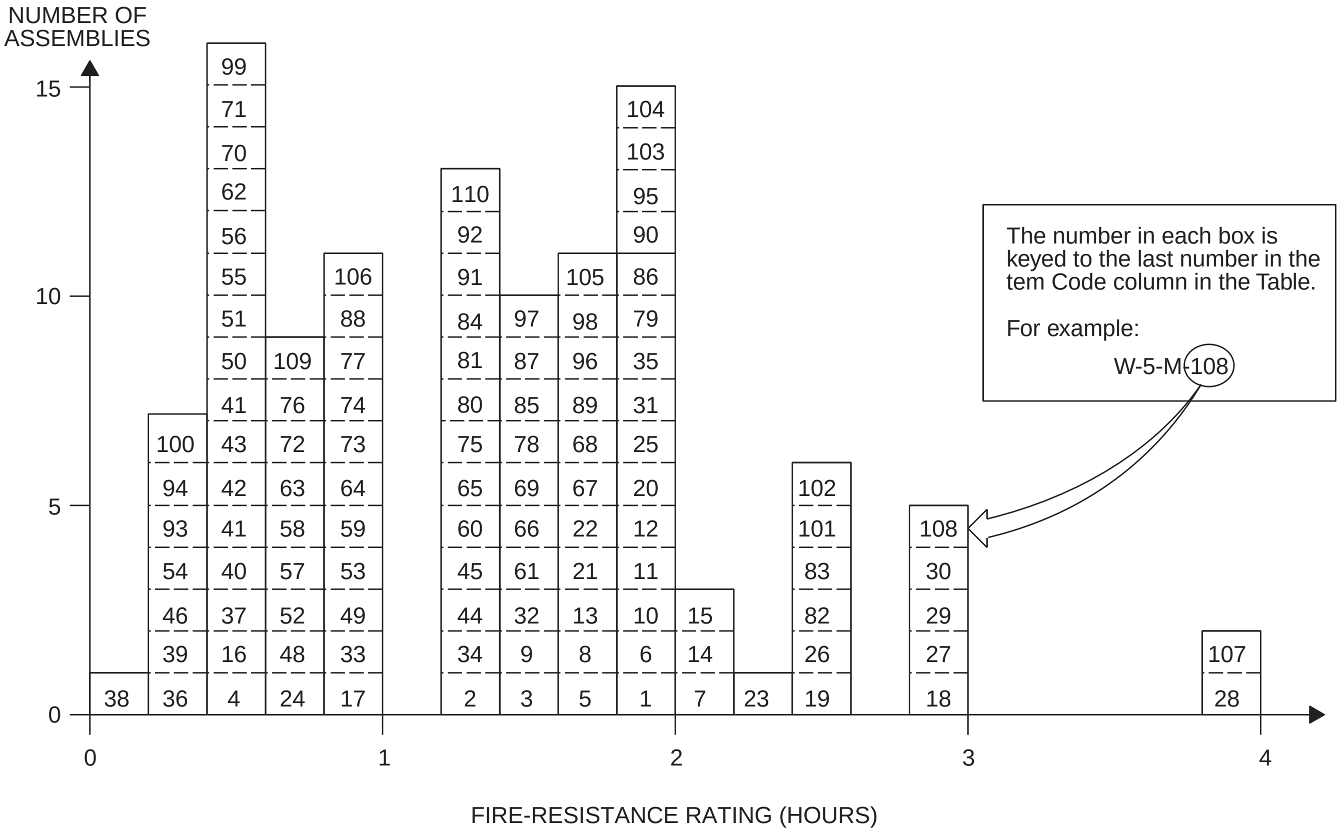


TABLE 1.1.2
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-1	4″	Solid 3″ thick, gypsum blocks laid in 1:3 sanded gypsum mortar; Facings: $^1/_2$″ of 1:3 sanded gypsum plaster (both sides).	N/A	2 hrs.		1		1	2
W-4-M-2	4″	Solid clay or shale brick.	N/A	1 hr. 15 min		1		1, 2	$1^1/_4$
W-4-M-3	4″	Concrete; No facings.	N/A	1 hr. 30 min.		1		1	$1^1/_2$
W-4-M-4	4″	Clay tile; Illinois surface clay; single cell thick; No face plaster; Design “B,” Construction “C.”	N/A	25 min.			2	3-7, 36	$^1/_3$
W-4-M-5	4″	Solid sand-lime brick.	N/A	1 hr. 45 min.		1		1	$1^3/_4$
W-4-M-6	4″	Solid wall; 3″ thick block; $^1/_2$″ plaster each side; $17^3/_4$″ × $8^3/_4$″ × 4″ “Breeze Blocks”; Portland cement/sand mortar.	N/A	1 hr. 52 min.			7	2	$1^3/_4$
W-4-M-7	4″	Concrete (4020 psi); Reinforcement: vertical $^3/_8$″; horizontal $^1/_4$″; 6″ × 6″ grid.	N/A	2 hrs. 10 min.			7	2	2
W-4-M-8	4″	Concrete wall (4340 psi crush); reinforcement $^1/_4$″ diameter rebar on 8″ centers (vertical and horizontal).	N/A	1 hr. 40 min.			7	2	$1^2/_3$

(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-9	$4^3/_{16}''$	$4^3/_{16}''$ × $2^5/_8''$ cellular fletton brick (1873 psi) with $^1/_2''$ sand mortar; bricks are U-shaped yielding hollow cover (approx. 2″ × 4″) in final cross-section configuration.	N/A	1 hr. 25 min.			7	2	$1^1/_3$
W-4-M-10	$4^1/_4''$	$4^1/_4''$ × $2^1/_2''$ fletton (1831 psi) brick in $^1/_2''$ sand mortar.	N/A	1 hr. 53 min			7	2	$1^3/_4$
W-4-M-11	$4^1/_4''$	$4^1/_4''$ × $2^1/_2''$ London stock (683 psi) brick; $^1/_2''$ grout.	N/A	1 hr. 52 min.			7	2	$1^3/_4$
W-4-M-12	$4^1/_2''$	$4^1/_4''$ × $2^1/_2''$ Leicester red, wire-cut brick (4465 psi) in $^1/_2''$ sand mortar.	N/A	1 hr. 56 min.			7	6	$1^3/_4$
W-4-M-13	$4^1/_4''$	$4^1/_4''$ × $2^1/_2''$ stairfoot brick (7527 psi) $^1/_2''$ sand mortar.	N/A	1 hr. 37 min.			7	2	$1^1/_2$
W-4-M-14	$4^1/_4''$	$4^1/_4''$ × $2^1/_2''$ sand-lime brick (2603 psi) $^1/_2''$ sand mortar.	N/A	2 hrs. 6 min.			7	2	2
W-4-M-15	$4^1/_4''$	$4^1/_4''$ × $2^1/_2''$ concrete brick (2527 psi) $^1/_2''$ sand mortar.	N/A	2 hrs. 10 min.			7	2	2
W-4-M-16	$4^1/_2''$	4″ thick clay tile; Ohio fire clay; single cell thick; No plaster exposed face; $^1/_2''$ 1:2 gypsum back face; Design “F,” Construction “S.”	N/A	31 min.			2	3-6, 36	$^1/_2$
W-4-M-17	$4^1/_2''$	4″ thick clay tile; Ohio fire clay; single cell thick; Plaster exposed face; $^1/_2''$ 1:2 sanded gypsum; Back Face: none; Construction “S,” Design “F.”	80 psi	50 min.			2	3-5, 8, 36	$^3/_4$
W-4-M-18	$4^1/_2''$	Core: solid sand-lime brick; $^1/_2''$ sanded gypsum plaster facings on both sides.	80 psi	3 hrs.		1		1, 11	3
W-4-M-19	$4^1/_2''$	Core: solid sand-lime brick; $^1/_2''$ sanded gypsum plaster facings on both sides.	80 psi	2 hrs. 30 min.		1		1, 11	$2^1/_2$
W-4-M-20	$4^1/_2''$	Core: concrete brick $^1/_2''$ of 1:3 sanded gypsum plaster facings on both sides.	80 psi	2 hrs.		1		1, 11	2
W-4-M-21	$4^1/_2''$	Core: solid clay or shale brick; $^1/_2''$ thick, 1:3 sanded gypsum plaster facings on fire sides.	80 psi	1 hr. 45 min.		1		1, 2, 11	$1^3/_4$
W-4-M-22	$4^3/_4''$	4″ thick clay tile; Ohio fire clay; single cell thick; cells filled with cement and broken tile concrete; Plaster on exposed face; none on unexposed face; $^3/_4''$ 1:3 sanded gypsum; Design “G,” Construction “E.”	N/A	1 hr. 48 min.			2	2, 3-5, 9, 36	$1^3/_4$
W-4-M-23	$4^3/_4''$	4″ thick clay tile; Ohio fire clay; single cell thick; cells filled with cement and broken tile concrete; No plaster exposed faced; $^3/_4''$ neat gypsum plaster on unexposed face; Design “G,” Construction “E.”	N/A	2 hrs. 14 min.			2	2, 3-5, 9, 36	2
W-5-M-24	5″	3″ × 13″ air space; 1″ thick metal reinforced concrete facings on both sides; faces connected with wood splines.	2,250 lbs./ft.	45 min.		1		1	$^3/_4$
W-5-M-25	5″	Core: 3″ thick void filled with “nondulated” mineral wool weighing 10 lbs./ft.^{3}; 1″ thick metal reinforced concrete facings on both sides.	2,250 lbs./ft.	2 hrs.		1		1	2
W-5-M-26	5″	Core: solid clay or shale brick; $^1/_2''$ thick, 1:3 sanded gypsum plaster facings on both sides.	40 psi	2 hrs. 30 min.		1		1, 2, 11	$2^1/_2$
W-5-M-27	5″	Core: solid 4″ thick gypsum blocks, laid in 1:3 sanded gypsum mortar; $^1/_2''$ of 1:3 sanded gypsum plaster facings on both sides.	N/A	3 hrs.		1		1	3

(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-5-M-28	5″	Core: 4″ thick hollow gypsum blocks with 30% voids; blocks laid in 1:3 sanded gypsum mortar; No facings.	N/A	4 hrs.		1		1	4
W-5-M-29	5″	Core: concrete brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	160 psi	3 hrs.		1		1	3
W-5-M-30	$5^1/_4$″	4″ thick clay tile; Illinois surface clay; double cell thick; Plaster: $^5/_8$″ sanded gypsum 1:3 both faces; Design “D,” Construction “S.”	N/A	2 hrs. 53 min.			2	2-5, 9, 36	$2^3/_4$
W-5-M-31	$5^1/_4$″	4″ thick clay tile; New Jersey fire clay; double cell thick; Plaster: $^5/_8$″ sanded gypsum 1:3 both faces; Design “D,” Construction “S.”	N/A	1 hr. 52 min.			2	2-5, 9, 36	$1^3/_4$
W-5-M-32	$5^1/_4$″	4″ thick clay tile; New Jersey fire clay; single cell thick; Plaster: $^5/_8$″ sanded gypsum 1:3 both faces; Design “D,” Construction “S.”	N/A	1 hr. 34 min.	2		2	2-5, 9, 36	$1^1/_2$
W-5-M-33	$5^1/_4$″	4″ thick clay tile; New Jersey fire clay; single cell thick; Face plaster: $^5/_8$″ both sides; 1:3 sanded gypsum; Design “B,” Construction “S.”	N/A	50 min.			2	3-5, 8, 36	$^3/_4$
W-5-M-34	$5^1/_4$″	4″ thick clay tile; Ohio fire clay; single cell thick; Face plaster: $^5/_8$″ both sides; 1:3 sanded gypsum; Design “B,” Construction “A.”	N/A	1 hr. 19 min.			2	2-5, 9, 36	$1^1/_4$
W-5-M-35	$5^1/_4$″	4″ thick clay tile; Illinois surface clay; single cell thick; Face plaster: $^5/_8$″ both sides; 1:3 sanded gypsum; Design “B,” Construction “S.”	N/A	1 hr. 59 min.			2	2-5, 10 36	$1^3/_4$
W-5-M-36	4″	Core: structural clay tile; see Notes 12, 16, 21; No facings.	N/A	15 min.		1		3, 4, 24	$^1/_4$
W-4-M-37	4″	Core: structural clay tile; see Notes 12, 17, 21; No facings.	N/A	25 min.		1		3, 4, 24	$^1/_3$
W-4-M-38	4″	Core: structural clay tile; see Notes 12, 16, 20; No facings.	N/A	10 min.		1		3, 4, 24	$^1/_6$
W-4-M-39	4″	Core: structural clay tile; see Notes 12, 17, 20; No facings.	N/A	20 min.		1		3, 4, 24	$^1/_3$
W-4-M-40	4″	Core: structural clay tile; see Notes 13, 16, 23; No facings.	N/A	30 min.		1		3, 4, 24	$^1/_2$
W-4-M-41	4″	Core: structural clay tile; see Notes 13, 17, 23; No facings.	N/A	35 min.		1		3, 4, 24	$^1/_2$
W-4-M-42	4″	Core: structural clay tile; see Notes 13, 16, 21; No facings.	N/A	25 min.		1		3, 4, 24	$^1/_3$
W-4-M-43	4″	Core: structural clay tile; see Notes 13, 17, 21; No facings.	N/A	30 min.		1		3, 4, 24	$^1/_2$
W-4-M-44	4″	Core: structural clay tile; see Notes 15, 16, 20; No facings	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-4-M-45	4″	Core: structural clay tile; see Notes 15, 17, 20; No facings.	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-4-M-46	4″	Core: structural clay tile; see Notes 14, 16, 22; No facings.	N/A	20 min.		1		3, 4, 24	$^1/_3$
W-4-M-47	4″	Core: structural clay tile; see Notes 14, 17, 22; No facings.	N/A	25 min.		1		3, 4, 24	$^1/_3$
W-4-M-48	$4^1/_4$″	Core: structural clay tile; see Notes 12, 16, 21; Facings: both sides; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$

(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-49	$4^1/_4$″	Core: structural clay tile; see Notes 12, 17, 21; Facings: both sides; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-4-M-50	$4^5/_8$″	Core: structural clay tile; see Notes 12, 16, 21; Facings: unexposed side only; see Note 18.	N/A	25 min.		1		3, 4, 24	$^1/_3$
W-4-M-51	$4^5/_8$″	Core: structural clay tile; see Notes 12, 17, 21; Facings: unexposed side only; see Note 18.	N/A	30 min.		1		3, 4, 24	$^1/_2$
W-4-M-52	$4^5/_8$″	Core: structural clay tile; see Notes 12, 16, 21; Facings: unexposed side only; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$
W-4-M-53	$4^5/_8$″	Core: structural clay tile; see Notes 12, 17, 21; Facings: fire side only; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-4-M-54	$4^5/_8$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: unexposed side; see Note 18.	N/A	20 min.		1		3, 4, 24	$^1/_3$
W-4-M-55	$4^5/_8$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: exposed side; see Note 18.	N/A	25 min.		1		3, 4, 24	$^1/_3$
W-4-M-56	$4^5/_8$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: fire side only; see Note 18.	N/A	30 min.		1		3, 4, 24	$^1/_2$
W-4-M-57	$4^5/_8$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: fire side only; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$
W-4-M-58	$4^5/_8$″	Core: structural clay tile; see Notes 13, 16, 23; Facings: unexposed side only; see Note 18.	N/A	40 min.		1		3, 4, 24	$^2/_3$
W-4-M-59	$4^5/_8$″	Core: structural clay tile; see Notes 13, 17, 23; Facings: unexposed side only; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-4-M-60	$4^5/_8$″	Core: structural clay tile; see Notes 13, 16, 23; Facings: fire side only; see Note 18.	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-4-M-61	$4^5/_8$″	Core: structural clay tile; see Notes 13, 17, 23; Facings: fire side only; see Note 18.	N/A	1 hr. 30 min.		1		3, 4, 24	$1^1/_2$
W-4-M-62	$4^5/_8$″	Core: structural clay tile; see Notes 13, 16, 21; Facings: unexposed side only; see Note 18.	N/A	35 min.		1		3, 4, 24	$^1/_2$
W-4-M-63	$4^5/_8$″	Core: structural clay tile; see Notes 13, 17, 21; Facings: unexposed face only; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$
W-4-M-64	$4^5/_8$″	Core: structural clay tile; see Notes 13, 16, 23; Facings: exposed face only; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-4-M-65	$4^5/_8$″	Core: structural clay tile; see Notes 13, 17, 21; Facings: exposed side only; see Note 18.	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-4-M-66	$4^5/_8$″	Core: structural clay tile; see Notes 15, 17, 20; Facings: unexposed side only; see Note 18	N/A	1 hr. 30 min.		1		3, 4, 24	$1^1/_2$
W-4-M-67	$4^5/_8$″	Core: structural clay tile; see Notes 15, 16, 20; Facings: exposed side only; see Note 18.	N/A	1 hr. 45 min.		1		3, 4, 24	$1^3/_4$
W-4-M-68	$4^5/_8$″	Core: structural clay tile; see Notes 15, 17, 20; Facings: exposed side only; see Note 18.	N/A	1 hr. 45 min.		1		3, 4, 24	$1^3/_4$
W-4-M-69	$4^5/_8$″	Core: structural clay tile; see Notes 15, 16, 20; Facings: unexposed side only; see Note 18.	N/A	1 hr. 30 min.		1		3, 4, 24	$1^3/_4$
W-4-M-70	$4^5/_8$″	Core: structural clay tile; see Notes 14, 16, 22; Facings: unexposed side only; see Note 18.	N/A	30 min.		1		3, 4, 24	$^1/_2$

(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-71	$4^5/_8$″	Core: structural clay tile; see Notes 14, 17, 22; Facings: exposed side only; see Note 18.	N/A	35 min.		1		3, 4, 24	$^1/_2$
W-4-M-72	$4^5/_8$″	Core: structural clay tile; see Notes 14, 16, 22; Facings: fire side of wall only; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$
W-4-M-73	$4^5/_8$″	Core: structural clay tile; see Notes 14, 17, 22; Facings: fire side of wall only; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-4-M-74	$5^1/_4$″	Core: structural clay tile; see Notes 12, 16, 21; Facings: both sides; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-5-M-75	$5^1/_4$″	Core: structural clay tile; see Notes 12, 17, 21; Facings: both sides; see Note 18	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-5-M-76	$5^1/_4$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: both sides; see Note 18.	N/A	45 min.		1		3, 4, 24	$^3/_4$
W-5-M-77	$5^1/_4$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: both sides; see Note 18.	N/A	1 hr.		1		3, 4, 24	1
W-5-M-78	$5^1/_4$″	Core: structural clay tile; see Notes 13, 16, 23; Facings: both sides of wall; see Note 18.	N/A	1 hr. 30 min.		1		3, 4, 24	$1^1/_2$
W-5-M-79	$5^1/_4$″	Core: structural clay tile; see Notes 13, 17, 23; Facings: both sides of wall; see Note 18.	N/A	2 hrs.		1		3, 4, 24	2
W-5-M-80	$5^1/_4$″	Core: structural clay tile; see Notes 13, 16, 21; Facings: both sides of wall; see Note 18.	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-5-M-81	$5^1/_4$″	Core: structural clay tile; see Notes 13, 16, 21; Facings: both sides of wall; see Note 18.	N/A	1 hr. 30 min.		1		3, 4, 24	$1^1/_2$
W-5-M-82	$5^1/_4$″	Core: structural clay tile; see Notes 15, 16, 20; Facings: both sides; see Note 18.	N/A	2 hrs. 30 min.		1		3, 4, 24	$2^1/_2$
W-5-M-83	$5^1/_4$″	Core: structural clay tile; see Notes 15, 17, 20; Facings: both sides; see Note 18.	N/A	2 hrs. 30 min.		1		3, 4, 24	$2^1/_2$
W-5-M-84	$5^1/_4$″	Core: structural clay tile; see Notes 14, 16, 22; Facings: both sides of wall; see Note 18.	N/A	1 hr. 15 min.		1		3, 4, 24	$1^1/_4$
W-5-M-85	$5^1/_4$″	Core: structural clay tile; see Notes 14, 17, 22; Facings: both sides of wall; see Note 18.	N/A	1 hr. 30 min.		1		3, 4, 24	$1^1/_2$
W-4-M-86	4″	Core: 3″ thick gypsum blocks 70% solid; see Note 26; Facings: both sides; see Note 25.	N/A	2 hrs.		1			2
W-4-M-87	4″	Core: hollow concrete units; see Notes 27, 34, 35; No facings.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-4-M-88	4″	Core: hollow concrete units; see Notes 28, 33, 35; No facings.	N/A	1 hr.		1			1
W-4-M-89	4″	Core: hollow concrete units; see Notes 28, 34, 35; Facings: both sides; see Note 25.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-4-M-90	4″	Core: hollow concrete units; see Notes 27, 34, 35; Facings: both sides; see Note 25.	N/A	2 hrs.		1			2
W-4-M-91	4″	Core: hollow concrete units; see Notes 27, 32, 35; No facings.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-4-M-92	4″	Core: hollow concrete units; see Notes 28, 34, 35; No facings.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-4-M-93	4″	Core: hollow concrete units; see Notes 29, 32, 35; No facings.	N/A	20 min.		1			$^1/_3$

(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-M-94	4″	Core: hollow concrete units; see Notes 30, 34, 35; No facings.	N/A	15 min.		1			$^1/_4$
W-4-M-95	$4^1/_2$″	Core: hollow concrete units; see Notes 27, 34, 35; Facings: one side only; see Note 25.	N/A	2 hrs.		1			2
W-4-M-96	$4^1/_2$″	Core: hollow concrete units; see Notes 27, 32, 35; Facings: one side only; see Note 25.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-4-M-97	$4^1/_2$″	Core: hollow concrete units; see Notes 28, 33, 35; Facings: one side; see Note 25.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-4-M-98	$4^1/_2$″	Core: hollow concrete units; see Notes 28, 34, 35; Facings: one side only; see Note 25.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-4-M-99	$4^1/_2$″	Core: hollow concrete units; see Notes 29, 32, 35; Facings: one side; see Note 25.	N/A	30 min.		1			$^1/_2$
W-4-M-100	$4^1/_2$″	Core: hollow concrete units; see Notes 30, 34, 35; Facings: one side; see Note 25.	N/A	20 min.		1			$^1/_3$
W-5-M-101	5″	Core: hollow concrete units; see Notes 27, 34, 35; Facings: both sides; see Note 25.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-5-M-102	5″	Core: hollow concrete units; see Notes 27, 32, 35; Facings: both sides; see Note 25.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-5-M-103	5″	Core: hollow concrete units; see Notes 28, 33, 35; Facings: both sides; see Note 25.	N/A	2 hrs.		1			2
W-5-M-104	5″	Core: hollow concrete units; see Notes 28, 31, 35; Facings: both sides; see Note 25.	N/A	2 hrs.		1			2
W-5-M-105	5″	Core: hollow concrete units; see Notes 29, 32, 35; Facings: both sides; see Note 25.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-5-M-106	5″	Core: hollow concrete units; see Notes 30, 34, 35; Facings: both sides; see Note 25.	N/A	1 hr.		1			1
W-5-M-107	5″	Core: 5″ thick solid gypsum blocks; see Note 26; No facings.	N/A	4 hrs.		1			4
W-5-M-108	5″	Core: 4″ thick hollow gypsum blocks; see Note 26; Facings: both sides; see Note 25.	N/A	3 hrs.		1			3
W-5-M-109	4″	Concrete with 4″ × 4″ No. 6 welded wire mesh at wall center.	100 psi	45 min.			43	2	$^3/_4$
W-4-M-110	4″	Concrete with 4″ × 4″ No. 6 welded wire mesh at wall center.	N/A	1 hr. 15 min.			43	2	$1^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

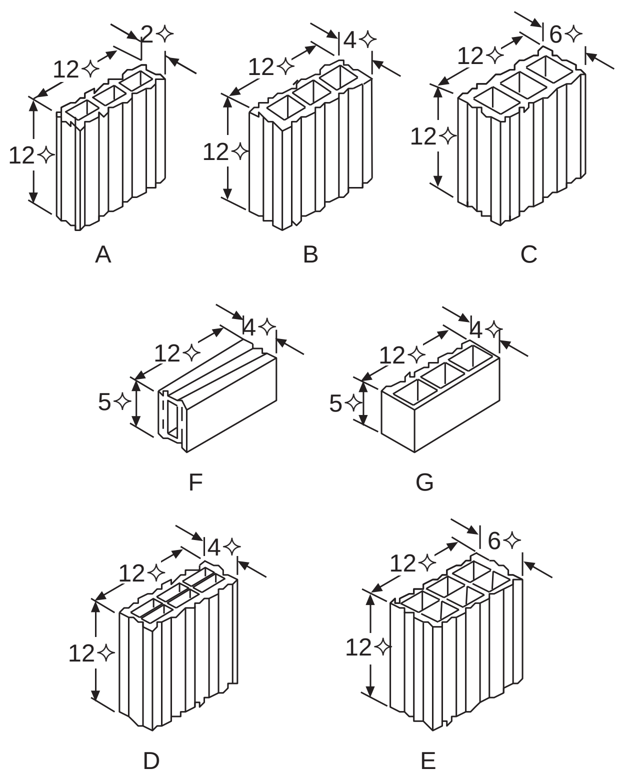
Notes:

1. Tested as NBS under ASA Spec. No. A 2-1934.
2. Failure mode—maximum temperature rise.
3. Treated at NBS under ASA Spec. No. 42-1934 (ASTM C19-53) except that hose stream testing where carried out was run on test specimens exposed for full test duration, not for or reduced period as is contemporarily done.
4. For clay tile walls, unless the source the clay can be positively identified, it is suggested that the most pessimistic hour rating for the fire endurance of a clay tile partition of that thickness to be followed. Identified sources of clay showing longer fire endurance can lead to longer time recommendations.
5. See appendix for construction and design details for clay tile walls.
6. Failure mode—flame thru or crack formation showing flames.
7. Hole formed at 25 minutes; partition collapsed at 42 minutes or removal from furnace.
8. Failure mode—collapse.
9. Hose stream pass.
10. Hose stream hole formed in specimen.
11. Load: 80 psi for gross wall cross sectional area.
12. One cell in wall thickness.
13. Two cells in wall thickness.

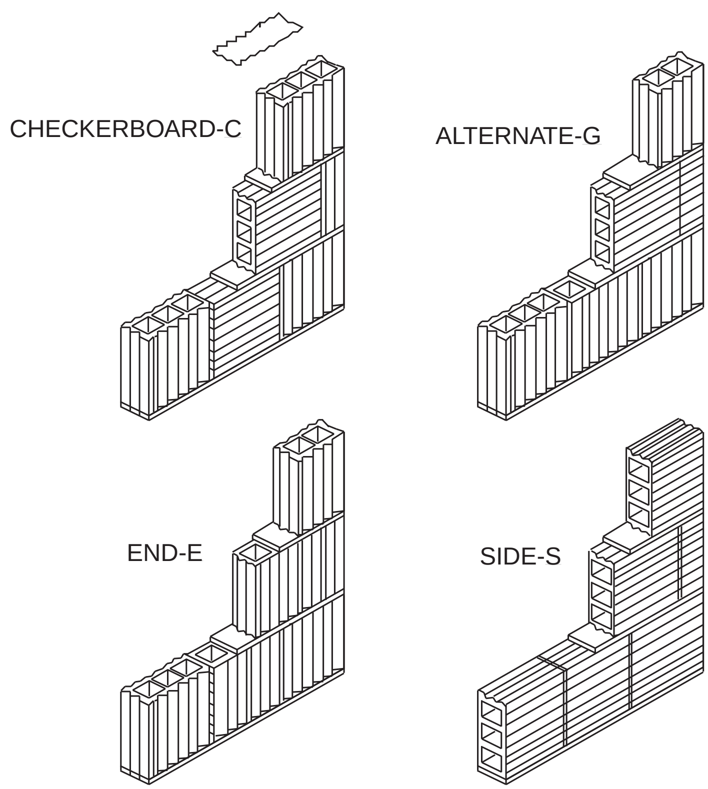
(continued)

TABLE 1.1.2—continued
MASONRY WALLS
4″ TO LESS THAN 6″ THICK

14. Double cells plus one cell in wall thickness.
15. One cell in wall thickness, cells filled with broken tile, crushed stone, slag, cinders or sand mixed with mortar.
16. Dense hard-burned clay or shale tile.
17. Medium-burned clay tile.
18. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
19. Units of not less than 30 percent solid material.
20. Units of not less than 40 percent solid material.
21. Units of not less than 50 percent solid material.
22. Units of not less than 45 percent solid material.
23. Units of not less than 60 percent solid material.
24. All tiles laid in Portland cement-lime mortar.
25. Minimum $^1/_2$ inch—1:3 sanded gypsum plaster.
26. Laid in 1:3 sanded gypsum mortar. Voids in hollow units not to exceed 30 percent.
27. Units of expanded slag or pumice aggregate.
28. Units of crushed limestone, blast furnace slag, cinders and expanded clay or shale.
29. Units of calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
30. Units of siliceous sand and gravel. Ninety percent or more quartz, chert or flint.
31. Unit at least 49 percent solid.
32. Unit at least 62 percent solid.
33. Unit at least 65 percent solid.
34. Unit at least 73 percent solid.
35. Ratings based on one unit and one cell in wall thickness.
36. See Clay Tile Partition Design Construction drawings below.



DESIGNS OF TILES USED IN FIRE-TEST PARTITIONS



THE FOUR TYPES OF CONSTRUCTION USED IN FIRE-TEST PARTITIONS

FIGURE 1.1.3
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

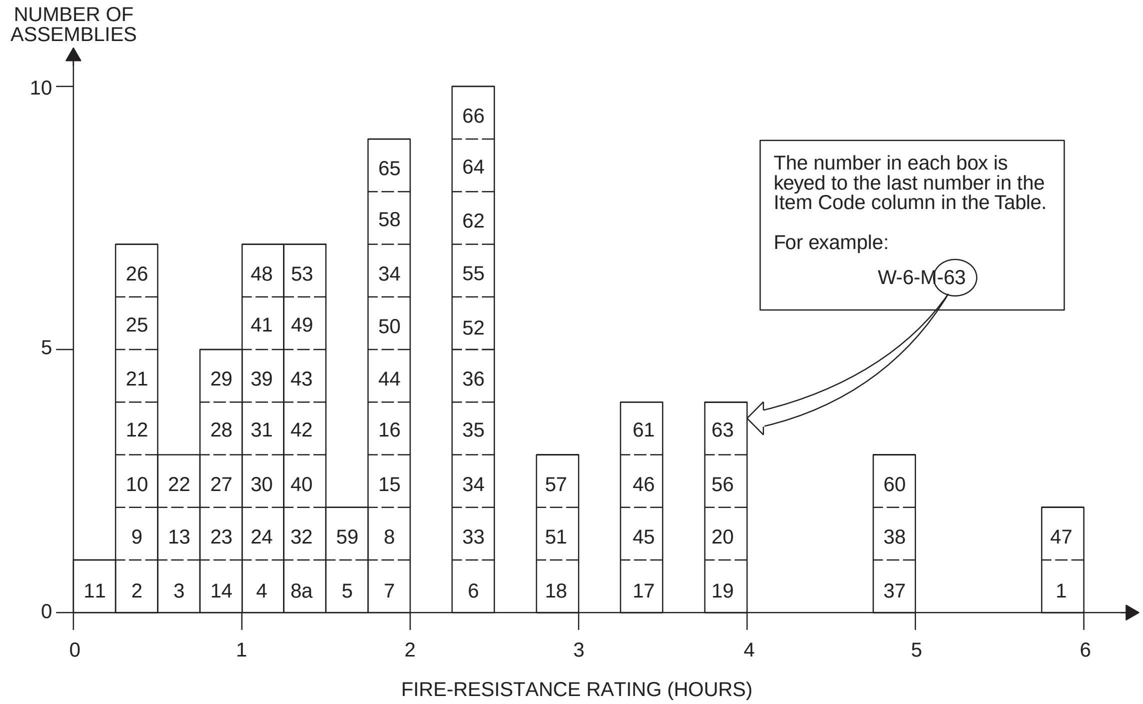


TABLE 1.1.3
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-M-1	6″	Core: 5″ thick, solid gypsum blocks laid in 1:3 sanded gypsum mortar; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	N/A	6 hrs.		1			6
W-6-M-2	6″	6″ clay tile; Ohio fire clay; single cell thick; No plaster; Design “C,” Construction “A.”	N/A	17 min.			2	1, 3, 4, 6, 55	$^1/_4$
W-6-M-3	6″	6″ clay tile; Illinois surface clay; double cell thick; No plaster; Design “E,” Construction “C.”	N/A	45 min.			2	1-4, 7, 55	$^3/_4$
W-6-M-4	6″	6″ clay tile; New Jersey fire clay; double cell thick; No plaster; Design “E,” Construction “S.”	N/A	1 hr. 1 min.			2	1-4, 8, 55	1
W-7-M-5	$7^1/_4$″	6″ clay tile; Illinois surface clay; double cell thick; Plaster: $^5/_8$″—1:3 sanded gypsum both faces; Design “E,” Construction “A.”	N/A	1 hr. 41 min.			2	1-4, 55	$1^2/_3$
W-7-M-6	$7^1/_4$″	6″ clay tile; New Jersey fire clay; double cell thick; Plaster: $^5/_8$″—1:3 sanded gypsum both faces; Design “E,” Construction “S.”	N/A	2 hrs. 23 min.			2	1-4, 9, 55	$2^1/_3$
W-7-M-7	$7^1/_4$″	6″ clay tile; Ohio fire clay; single cell thick; Plaster: $^5/_8$″ sanded gypsum; 1:3 both faces; Design “C,” Construction “A.”	N/A	1 hr. 54 min.			2	1-4, 9, 55	$2^3/_4$
W-7-M-8	$7^1/_4$″	6″ clay tile; Illinois surface clay; single cell thick; Plaster: $^5/_8$″ sanded gypsum 1:3 both faces; Design “C,” Construction “S.”	N/A	2 hrs.			2	1, 3, 4, 9, 10, 55	2
W-7-M-8a	$7^1/_4$″	6″ clay tile; Illinois surface clay; single cell thick; Plaster: $^5/_8$″ sanded gypsum 1:3 both faces; Design “C,” Construction “E.”	N/A	1 hr. 23 min			2	1-4, 9, 10, 55	$1^3/_4$

(continued)

TABLE 1.1.3—continued
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-M-9	6″	Core: structural clay tile; see Notes 12, 16, 20; No facings.	N/A	20 min.		1		3, 5, 24	$^1/_3$
W-6-M-10	6″	Core: structural clay tile; see Notes 12, 17, 20; No facings.	N/A	25 min.		1		3, 5, 24	$^1/_3$
W-6-M-11	6″	Core: structural clay tile; see Notes 12, 16, 19; No facings.	N/A	15 min.		1		3, 5, 24	$^1/_4$
W-6-M-12	6″	Core: structural clay tile; see Notes 12, 17, 19; No facings.	N/A	20 min.		1		3, 5, 24	$^1/_3$
W-6-M-13	6″	Core: structural clay tile; see Notes 13, 16, 22; No facings.	N/A	45 min.		1		3, 5, 24	$^3/_4$
W-6-M-14	6″	Core: structural clay tile; see Notes 13, 17, 22; No facings.	N/A	1 hr.		1		3, 5, 24	1
W-6-M-15	6″	Core: structural clay tile; see Notes 15, 17, 19; No facings.	N/A	2 hrs.		1		3, 5, 24	2
W-6-M-16	6″	Core: structural clay tile; see Notes 15, 16, 19; No facings.	N/A	2 hrs.		1		3, 5, 24	2
W-6-M-17	6″	Cored concrete masonry; see Notes 12, 34, 36, 38, 41; No facings.	80 psi	3 hrs. 30 min.		1		5, 25	$3^1/_2$
W-6-M-18	6″	Cored concrete masonry; see Notes 12, 33, 36, 38, 41; No facings.	80 psi	3 hrs.		1		5, 25	3
W-6-M-19	$6^1/_2$″	Cored concrete masonry; see Notes 12, 34, 36, 38, 41; Facings: side 1; see Note 35.	80 psi	4 hrs.		1		5, 25	4
W-6-M-20	$6^1/_2$″	Cored concrete masonry; see Notes 12, 33, 36, 38, 41; Facings: side 1; see Note 35.	80 psi	4 hrs.		1		5, 25	4
W-6-M-21	$6^5/_8$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: unexposed face only; see Note 18.	N/A	30 min.		1		3, 5, 24	$^1/_2$
W-6-M-22	$6^5/_8$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: unexposed face only; see Note 18.	N/A	40 min.		1		3, 5, 24	$^2/_3$
W-6-M-23	$6^5/_8$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: exposed face only; see Note 18.	N/A	1 hr.		1		3, 5, 24	1
W-6-M-24	$6^5/_8$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: exposed face only; see Note 18.	N/A	1 hr. 5 min.		1		3, 5, 24	1
W-6-M-25	$6^5/_8$″	Core: structural clay tile; see Notes 12, 16, 19; Facings: unexposed side only; see Note 18.	N/A	25 min.		1		3, 5, 24	$^1/_3$
W-6-M-26	$6^5/_8$″	Core: structural clay tile; see Notes 12, 7, 19; Facings: unexposed face only; see Note 18.	N/A	30 min.		1		3, 5, 24	$^1/_2$
W-6-M-27	$6^5/_8$″	Core: structural clay tile; see Notes 12, 16, 19; Facings: exposed side only; see Note 18.	N/A	1 hr.		1		3, 5, 24	1
W-6-M-28	$6^5/_8$″	Core: structural clay tile; see Notes 12, 17, 19; Facings: fire side only; see Note 18.	N/A	1 hr.		1		3, 5, 24	1
W-6-M-29	$6^5/_8$″	Core: structural clay tile; see Notes 13, 16, 22; Facings: unexposed side only; see Note 18.	N/A	1 hr.		1		3, 5, 24	1
W-6-M-30	$6^5/_8$″	Core: structural clay tile; see Notes 13, 17, 22; Facings: unexposed side only; see Note 18.	N/A	1 hr. 15 min.		1		3, 5, 24	$1^1/_4$
W-6-M-31	$6^5/_8$″	Core: structural clay tile; see Notes 13, 16, 22; Facings: fire side only; see Note 18.	N/A	1 hr. 15 min.		1		3, 5, 24	$1^1/_4$
W-6-M-32	$6^5/_8$″	Core: structural clay tile; see Notes 13, 17, 22; Facings: fire side only; see Note 18.	N/A	1 hr. 30 min.		1		3, 5, 24	$1^1/_2$

(continued)

TABLE 1.1.3—continued
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-M-33	$6^5/_8$″	Core: structural clay tile; see Notes 15, 16, 19; Facings: unexposed side only; see Note 18.	N/A	2 hrs. 30 min.		1		3, 5, 24	$2^1/_2$
W-6-M-34	$6^5/_8$″	Core: structural clay tile; see Notes 15, 17, 19; Facings: unexposed side only; see Note 18.	N/A	2 hrs. 30 min.		1		3, 5, 24	$2^1/_2$
W-6-M-35	$6^5/_8$″	Core: structural clay tile; see Notes 15, 16, 19; Facings: fire side only; see Note 18.	N/A	2 hrs. 30 min.		1		3, 5, 24	$2^1/_2$
W-6-M-36	$6^5/_8$″	Core: structural clay tile; see Notes 15, 17, 19; Facings: fire side only; see Note 18.	N/A	2 hrs. 30 min.		1		3, 5, 24	$2^1/_2$
W-6-M-37	7″	Cored concrete masonry; see Notes 12, 34, 36, 38, 41; see Note 35 for facings on both sides.	80 psi	5 hrs.		1		5, 25	5
W-6-M-38	7″	Cored concrete masonry; see Notes 12, 33, 36, 38, 41; see Note 35 for facings.	80 psi	5 hrs.		1		5, 25	5
W-6-M-39	$7^1/_4$″	Core: structural clay tile; see Notes 12, 16, 20; Facings: both sides; see Note 18.	N/A	1 hr. 15 min.		1		3, 5, 24	$1^1/_4$
W-6-M-40	$7^1/_4$″	Core: structural clay tile; see Notes 12, 17, 20; Facings: both sides; see Note 18.	N/A	1 hr. 30 min.		1		3, 5, 24	$1^1/_2$
W-6-M-41	$7^1/_4$″	Core: structural clay tile; see Notes 12, 16, 19; Facings: both sides; see Note 18.	N/A	1 hr. 15 min.		1		3, 5, 24	$1^1/_4$
W-6-M-42	$7^1/_4$″	Core: structural clay tile; see Notes 12, 17, 19; Facings: both sides; see Note 18.	N/A	1 hr. 30 min.		1		3, 5, 24	$1^1/_2$
W-7-M-43	$7^1/_4$″	Core: structural clay tile; see Notes 13, 16, 22; Facings: both sides of wall; see Note 18.	N/A	1 hr. 30 min.		1		3, 5, 24	$1^1/_2$
W-7-M-44	$7^1/_4$″	Core: structural clay tile; see Notes 13, 17, 22; Facings: both sides of wall; see Note 18.	N/A	2 hrs.		1		3, 5, 24	$1^1/_2$
W-7-M-45	$7^1/_4$″	Core: structural clay tile; see Notes 15, 16, 19; Facings: both sides; see Note 18.	N/A	3 hrs. 30 min.		1		3, 5, 24	$3^1/_2$
W-7-M-46	$7^1/_4$″	Core: structural clay tile; see Notes 15, 17, 19; Facings: both sides; see Note 18.	N/A	3 hrs. 30 min.		1		3, 5, 24	$3^1/_2$
W-6-M-47	6″	Core: 5″ thick solid gypsum blocks; see Note 45; Facings: both sides; see Note 45.	N/A	6 hrs.		1			6
W-6-M-48	6″	Core: hollow concrete units; see Notes 47, 50, 54; No facings.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-6-M-49	6″	Core: hollow concrete units; see Notes 46, 50, 54; No facings.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-6-M-50	6″	Core: hollow concrete units; see Notes 46, 41, 54; No facings.	N/A	2 hrs.		1			2
W-6-M-51	6″	Core: hollow concrete units; see Notes 46, 53, 54; No facings.	N/A	3 hrs.		1			3
W-6-M-52	6″	Core: hollow concrete units; see Notes 47, 53, 54; No facings.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-6-M-53	6″	Core: hollow concrete units; see Notes 47, 51, 54; No facings.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-6-M-54	$6^1/_2$″	Core: hollow concrete units; see Notes 46, 50, 54; Facings: one side only; see Note 35.	N/A	2 hrs.		1			2
W-6-M-55	$6^1/_2$″	Core: hollow concrete units; see Notes 4, 51, 54; Facings: one side; see Note 35.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-6-M-56	$6^1/_2$″	Core: hollow concrete units; see Notes 46, 53, 54; Facings: one side; see Note 35.	N/A	4 hrs.		1			4

(continued)

TABLE 1.1.3—continued
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-M-57	$6^1/_2$″	Core: hollow concrete units; see Notes 47, 53, 54; Facings: one side; see Note 35.	N/A	3 hrs.		1			3
W-6-M-58	$6^1/_2$″	Core: hollow concrete units; see Notes 47, 51, 54; Facings: one side; see Note 35.	N/A	2 hrs.		1			2
W-6-M-59	$6^1/_2$″	Core: hollow concrete units; see Notes 47, 50, 54; Facings: one side; see Note 35.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-7-M-60	7″	Core: hollow concrete units; see Notes 46, 53, 54; Facings: both sides; see Note 35.	N/A	5 hrs.		1			5
W-7-M-61	7″	Core: hollow concrete units; see Notes 46, 51, 54; Facings: both sides; see Note 35.	N/A	3 hrs. 30 min.		1			$3^1/_2$
W-7-M-62	7″	Core: hollow concrete units; see Notes 46, 50, 54; Facings: both sides; see Note 35.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-7-M-63	7″	Core: hollow concrete units; see Notes 47, 53, 54; Facings: both sides; see Note 35.	N/A	4 hrs.		1			4
W-7-M-64	7″	Core: hollow concrete units; see Notes 47, 51, 54; Facings: both sides; see Note 35.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-7-M-65	7″	Core: hollow concrete units; see Notes 47, 50, 54; Facings: both sides; see Note 35.	N/A	2 hrs.		1			2
W-6-M-66	6″	Concrete wall with 4″ × 4″ No. 6 wire fabric (welded) near wall center for reinforcement.	N/A	2 hrs. 30 min.			43	2	$2^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

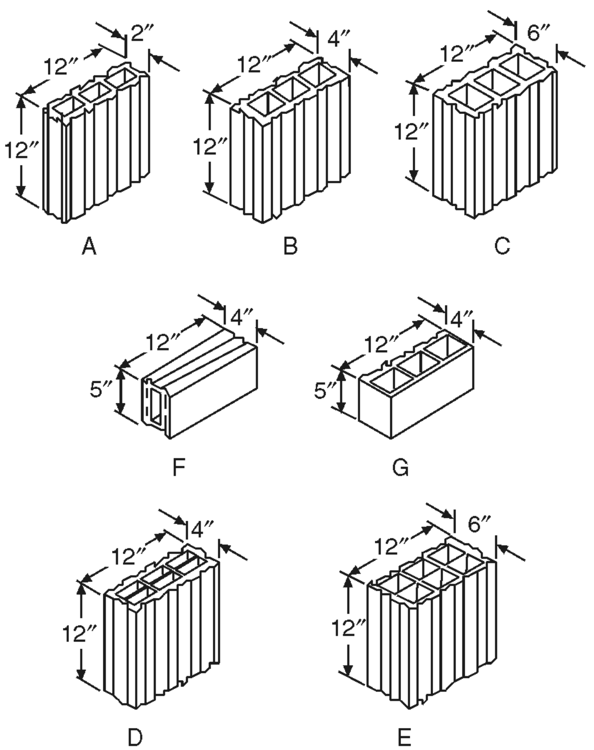
Notes:

1. Tested at NBS under ASA Spec. No. 43-1934 (ASTM C19-53) except that hose stream testing where carried out was run on test specimens exposed for full test duration, not for a reduced period as is contemporarily done.
2. Failure by thermal criteria—maximum temperature rise.
3. For clay tile walls, unless the source or density of the clay can be positively identified or determined, it is suggested that the lowest hourly rating for the fire endurance of a clay tile partition of that thickness be followed. Identified sources of clay showing longer fire endurance can lead to longer time recommendations.
4. See Note 55 for construction and design details for clay tile walls.
5. Tested at NBS under ASA Spec. No. A2-1934.
6. Failure mode—collapse.
7. Collapsed on removal from furnace at 1 hour 9 minutes.
8. Hose stream—failed.
9. Hose stream—passed.
10. No end point met in test.
11. Wall collapsed at 1 hour 28 minutes.
12. One cell in wall thickness.
13. Two cells in wall thickness.
14. Double shells plus one cell in wall thickness.
15. One cell in wall thickness, cells filled with broken tile, crushed stone, slag, cinders or sand mixed with mortar.
16. Dense hard-burned clay or shale tile.
17. Medium-burned clay tile.
18. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
19. Units of not less than 30 percent solid material.
20. Units of not less than 40 percent solid material.
21. Units of not less than 50 percent solid material.
22. Units of not less than 45 percent solid material.
23. Units of not less than 60 percent solid material.
24. All tiles laid in Portland cement-lime mortar.
25. Load: 80 psi for gross cross sectional area of wall.
26. Three cells in wall thickness.
27. Minimum percent of solid material in concrete units = 52.
28. Minimum percent of solid material in concrete units = 54.
29. Minimum percent of solid material in concrete units = 55.
30. Minimum percent of solid material in concrete units = 57.

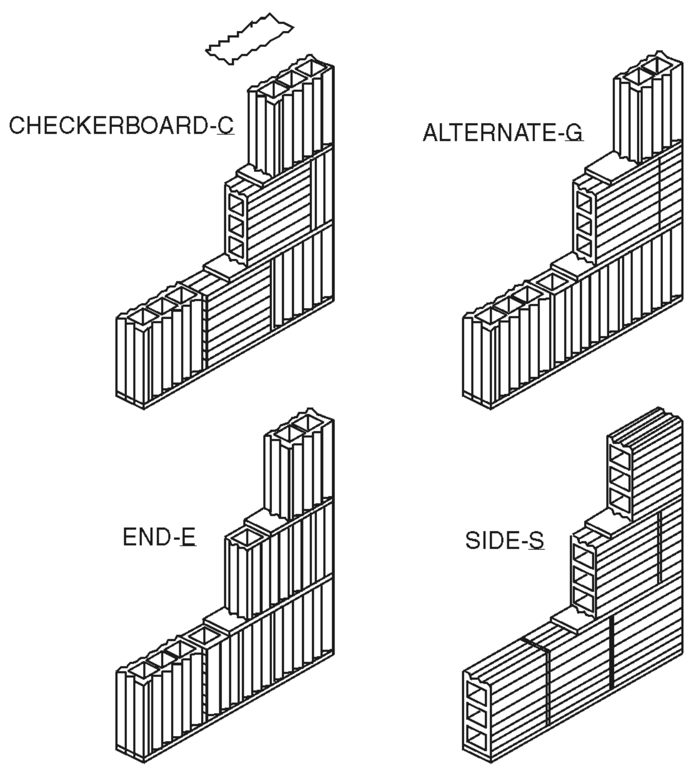
(continued)

TABLE 1.1.3—continued
MASONRY WALLS
6″ TO LESS THAN 8″ THICK

31. Minimum percent of solid material in concrete units = 62.
32. Minimum percent of solid material in concrete units = 65.
33. Minimum percent of solid material in concrete units = 70.
34. Minimum percent of solid material in concrete units = 76.
35. Not less than $^1/_2$ inch of 1:3 sanded gypsum plaster.
36. Noncombustible or no members framed into wall.
37. Combustible members framed into wall.
38. One unit in wall thickness.
39. Two units in wall thickness.
40. Three units in wall thickness.
41. Concrete units made with expanded slag or pumice aggregates.
42. Concrete units made with expanded burned clay or shale, crushed limestone, air cooled slag or cinders.
43. Concrete units made with calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
44. Concrete units made with siliceous sand and gravel. Ninety percent or more quartz, chert or flint.
45. Laid in 1:3 sanded gypsum mortar.
46. Units of expanded slag or pumice aggregate.
47. Units of crushed limestone, blast furnace, slag, cinder and expanded clay or shale.
48. Units of calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
49. Units of siliceous sand and gravel. Ninety percent or more quartz, chert or flint.
50. Unit minimum 49 percent solid.
51. Unit minimum 62 percent solid.
52. Unit minimum 65 percent solid.
53. Unit minimum 73 percent solid.
54. Ratings based on one unit and one cell in wall section.
55. See Clay Tile Partition Design Construction drawings below.



DESIGNS OF TILES USED IN FIRE-TEST PARTITIONS



THE FOUR TYPES OF CONSTRUCTION USED IN FIRE-TEST PARTITIONS

FIGURE 1.1.4
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

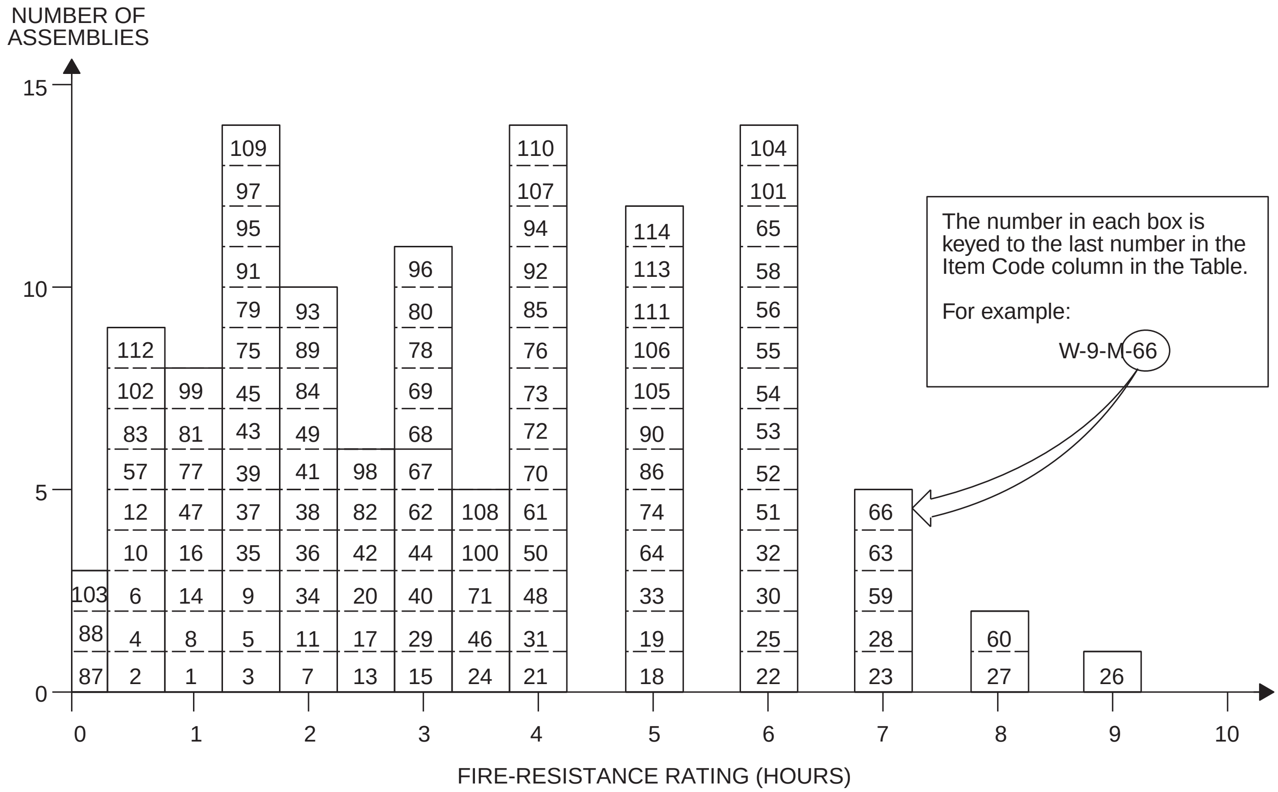


TABLE 1.1.4
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-1	8″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 40.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$
W-8-M-2	8″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 40; No facings; Result for wall with combustible members framed into interior.	80 psi	45 min.		1		1, 20	$^3/_4$
W-8-M-3	8″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 43.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-8-M-4	8″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 43; No facings; Combustible members framed into wall.	80 psi	45 min.		1		1, 20	$^3/_4$
W-8-M-5	8″	Core: clay or shale structural tile; No facings.	See Notes	1 hr. 30 min.		1		1, 2, 5, 10, 18, 20, 21	$1^1/_2$
W-8-M-6	8″	Core: clay or shale structural tile; No facings.	See Notes	45 min.		1		1, 2, 5, 10,19, 20, 21	$^3/_4$

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-7	8″	Core: clay or shale structural tile; No facings	See Notes	2 hrs.		1		1, 2, 5, 13, 18, 20, 21	2
W-8-M-8	8″	Core: clay or shale structural tile; No facings.	See Notes	1 hr. 45 min.		1		1, 2, 5, 13, 19, 20, 21	1$^1/_4$
W-8-M-9	8″	Core: clay or shale structural tile; No facings.	See Notes	1 hr. 15 min.		1		1, 2, 6, 9, 18, 20, 21	1$^3/_4$
W-8-M-10	8″	Core: clay or shale structural tile; No facings.	See Notes	45 min.		1		1, 2, 6, 9, 19, 20, 21	$^3/_4$
W-8-M-11	8″	Core: clay or shale structural tile; No facings.	See Notes	2 hrs.		1		1, 2, 6, 10, 18, 20, 21	2
W-8-M-12	8″	Core: clay or shale structural tile; No facings.	See Notes	45 min.		1		1, 2, 6, 10, 19, 20, 21	$^3/_4$
W-8-M-13	8″	Core: clay or shale structural tile; No facings.	See Notes	2 hrs. 30 min.		1		1, 3, 6, 12, 18, 20, 21	2$^1/_2$
W-8-M-14	8″	Core: clay or shale structural tile; No facings.	See Notes	1 hr.		1		1, 2, 6, 12, 19, 20, 21	1
W-8-M-15	8″	Core: clay or shale structural tile; No facings.	See Notes	3 hrs.		1		1, 2, 6, 16, 18, 20, 21	3
W-8-M-16	8″	Core: clay or shale structural tile; No facings.	See Notes	1 hr. 15 min.		1		1, 2, 6, 16, 19, 20, 21	1$^1/_4$
W-8-M-17	8″	Cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 1; Minimum % solids: 70; No facings.	See Notes	2 hrs. 30 min.		1		1, 44	2$^1/_2$
W-8-M-18	8″	Cored clay or shale brick; Units in wall thickness: 2; Cells in wall thickness: 2; Minimum % solids: 87; No facings.	See Notes	5 hrs.		1		1, 45	5
W-8-M-19	8″	Core: solid clay or shale brick; No facings.	See Notes	5 hrs.		1		1, 22, 45	5
W-8-M-20	8″	Core: hollow rolok of clay or shale.	See Notes	2 hrs. 30 min.		1		1, 22, 45	2$^1/_2$
W-8-M-21	8″	Core: hollow rolok bak of clay or shale; No facings.	See Notes	4 hrs.		1		1, 45	4
W-8-M-22	8″	Core: concrete brick; No facings.	See Notes	6 hrs.		1		1, 45	6
W-8-M-23	8″	Core: sand-lime brick; No facings.	See Notes	7 hrs.		1		1, 45	7
W-8-M-24	8″	Core: 4″, 40% solid clay or shale structural tile; 1 side 4″ brick facing.	See Notes	3 hrs. 30 min.		1		1, 20	3$^1/_2$
W-8-M-25	8″	Concrete wall (3220 psi); Reinforcing vertical rods 1″ from each face and 1″ diameter; horizontal rods $^5/_8$″ diameter.	22,200 lbs./ft.	6 hrs.			7		6
W-8-M-26	8″	Core: sand-line brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	9 hrs.		1		1, 45	9
W-8-M-27	8$^1/_2$″	Core: sand-line brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	8 hrs.		1		1, 45	8
W-8-M-28	8$^1/_2$″	Core: concrete; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	7 hrs.		1		1, 45	7

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-29	8$^{1}/_{2}$″	Core: hollow rolok of clay or shale; $^{1}/_{2}$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	3 hrs.		1		1, 45	3
W-8-M-30	8$^{1}/_{2}$″	Core: solid clay or shale brick $^{1}/_{2}$″ thick, 1:3 sanded gypsum plaster facings on one side.	See Notes	6 hrs.		1		1, 22, 45,	6
W-8-M-31	8$^{1}/_{2}$″	Core: cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 1; Minimum % solids: 70; $^{1}/_{2}$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	4 hrs.		1		1, 44	4
W-8-M-32	8$^{1}/_{2}$″	Core: cored clay or shale brick; Units in wall thickness: 2; Cells in wall thickness: 2; Minimum % solids: 87; $^{1}/_{2}$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	6 hrs.		1		1, 45	6
W-8-M-33	8$^{1}/_{2}$″	Core: hollow rolok bak of clay or shale; $^{1}/_{2}$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	5 hrs.		1		1, 45	5
W-8-M-34	8$^{5}/_{8}$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 40; $^{5}/_{8}$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	2 hrs.		1		1, 20 21	2
W-8-M-35	8$^{5}/_{8}$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 40; Exposed face: $^{5}/_{8}$″ of 1:3 sanded gypsum plaster.	See Notes	1 hr. 30 min.		1		1, 20, 21	1$^{1}/_{2}$
W-8-M-36	8$^{5}/_{8}$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 43; $^{5}/_{8}$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	2 hrs.				1, 20,21	2
W-8-M-37	8$^{5}/_{8}$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 43; $^{5}/_{8}$″ of 1:3 sanded gypsum plaster of the exposed face only.	See Notes	1 hr. 30 min.		1		1, 20, 21	1$^{1}/_{2}$
W-8-M-38	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: side 1; see Note 17.	See Notes	2 hrs.		1		1, 2, 5, 10, 18, 20, 21	2
W-8-M-39	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: exposed side only; see Note 17.	See Notes	1 hr. 30 min.		1		1, 2, 5, 10, 19, 20, 21	1$^{1}/_{2}$
W-8-M-40	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: exposed side only; see Note 17.	See Notes	3 hrs.		1		1, 2, 5, 13, 18, 20, 21	3
W-8-M-41	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: exposed side only; see Note 17.	See Notes	2 hrs.		1		1, 2, 5, 13, 19, 20, 21	2
W-8-M-42	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: side 1; see Note 17.	See Notes	2 hrs. 30 min.		1		1, 2, 9, 18, 20, 21	2$^{1}/_{2}$
W-8-M-43	8$^{5}/_{8}$″	Core: clay or shale structural tile; Facings: exposed side only; see Note 17.	See Notes	1 hr. 30 min.		1		1, 2, 6, 9, 19, 20, 21	1$^{1}/_{2}$

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-44	$8^5/_8$″	Core: clay or shale structural tile; Facings: side 1, see Note 17; side 2, none.	See Notes	3 hrs.		1		1, 2, 10, 18, 20, 21	3
W-8-M-45	$8^5/_8$″	Core: clay or shale structural tile; Facings: fire side only; see Note 17.	See Notes	1 hr. 30 min.		1		1, 2, 6, 10, 19, 20, 21	$1^1/_2$
W-8-M-46	$8^5/_8$″	Core: clay or shale structural tile; Facings: side 1, see Note 17; side 2, none.	See Notes	3 hrs. 30 min.		1		1, 2, 6, 12, 18, 20, 21	$3^1/_2$
W-8-M-47	$8^5/_8$″	Core: clay or shale structural tile; Facings: exposed side only; see Note 17.	See Notes	1 hr. 45 min.		1		1, 2, 6, 12, 19, 20, 21	$1^3/_4$
W-8-M-48	$8^5/_8$″	Core: clay or shale structural tile; Facings: side 1, see Note 17; side 2, none.	See Notes	4 hrs.		1		1, 2, 6, 16, 18, 20, 21	4
W-8-M-49	$8^5/_8$″	Core: clay or shale structural tile; Facings: fire side only; see Note 17.	See Notes	2 hrs.		1		1, 2, 6, 16, 19, 20, 21	2
W-8-M-50	$8^5/_8$″	Core: 4″, 40% solid clay or shale clay structural tile; 4″ brick plus $^5/_8$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	4 hrs.		1		1, 20	4
W-8-M-51	$8^3/_4$″	$8^3/_4$″ × $2^1/_2$″ and 4″ × $2^1/_2$″ cellular fletton (1873 psi) single and triple cell hollow brick set in $^1/_2$″ sand mortar in alternate courses.	3.6 tons/ft.	6 hrs.			7	23, 29	6
W-8-M-52	$8^3/_4$″	$8^3/_4$″ thick cement brick (2527 psi) with P.C. and sand mortar.	3.6 tons/ft.	6 hrs.			7	23, 24	6
W-8-M-53	$8^3/_4$″	$8^3/_4$″ × $2^1/_2$″ fletton brick (1831 psi) in $^1/_2$″ sand mortar.	3.6 tons/ft.	6 hrs.			7	23, 24	6
W-8-M-54	$8^3/_4$″	$8^3/_4$″ × $2^1/_2$″ London stock brick (683 psi) in $^1/_2$″ P.C. - sand mortar.	7.2 tons/ft.	6 hrs.			7	23, 24	6
W-9-M-55	9″	9″ × $2^1/_2$″ Leicester red wire-cut brick (4465 psi) in $^1/_2$″ P.C. - sand mortar.	6.0 tons/ft.	6 hrs.			7	23, 24	6
W-9-M-56	9″	9″ × 3″ sand-lime brick (2603 psi) in $^1/_2$″ P.C. - sand mortar.	3.6 tons/ft.	6 hrs.			7	23, 24	6
W-9-M-57	9″	2 layers $2^7/_8$″ fletton brick (1910 psi) with $3^1/_4$″ air space; Cement and sand mortar.	1.5 tons/ft.	32 min.			7	23, 25	$^1/_3$
W-9-M-58	9″	9″ × 3″ stairfoot brick (7527 psi) in $^1/_2$″ sand-cement mortar.	7.2 tons/ft.	6 hrs.			7	23, 24	6
W-9-M-59	9″	Core: solid clay or shale brick; $^1/_2$″ thick; 1:3 sanded gypsum plaster facings on both sides.	See Notes	7 hrs.		1		1, 22, 45	7
W-9-M-60	9″	Core: concrete brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	8 hrs.		1		1, 45	8
W-9-M-61	9″	Core: hollow rolok of clay or shale; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	4 hrs.		1		1, 45	4
W-9-M-62	9″	Cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 1; Minimum % solids: 70; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	3 hrs.		1		1, 44	3

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-9-M-63	9″	Cored clay or shale brick; Units in wall thickness: 2; Cells in wall thickness: 2; Minimum % solids: 87; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	7 hrs.		1		1, 45	7
W-9-M-64	9-10″	Core: cavity wall of clay or shale brick; No facings.	See Notes	5 hrs.		1		1, 45	5
W-9-M-65	9-10″	Core: cavity construction of clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	See Notes	6 hrs.		1		1, 45	6
W-9-M-66	9-10″	Core: cavity construction of clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	7 hrs.		1		1, 45	7
W-9-M-67	$9^1/_4$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 40; $^5/_8$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	3 hrs.		1		1, 20, 21	3
W-9-M-68	$9^1/_4$″	Core: clay or shale structural tile; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids in units: 43; $^5/_8$″ of 1:3 sanded gypsum plaster facings on both sides.	See Notes	3 hrs.		1		1, 20, 21	3
W-9-M-69	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	3 hrs.		1		1, 2, 5, 10, 18, 20, 21	3
W-9-M-70	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	4 hrs.		1		1, 2, 5, 13, 18, 20, 21	4
W-9-M-71	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	3 hrs. 30 min.		1		1, 2, 6, 9, 18, 20, 21	$3^1/_2$
W-9-M-72	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	4 hrs.		1		1, 2, 6, 10, 18, 20, 21	4
W-9-M-73	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	4 hrs.		1		1, 2, 6, 12, 18, 20, 21	4
W-9-M-74	$9^1/_4$″	Core: clay or shale structural tile; Facings: sides 1 and 2; see Note 17.	See Notes	5 hrs.		1		1, 2, 6 16, 18, 20, 21	5
W-9-M-75	8″	Cored concrete masonry; see Notes 2, 19, 26, 34, 40; No facings.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-8-M-76	8″	Cored concrete masonry; see Notes 2, 18, 26, 34, 40; No facings	80 psi	4 hrs.		1		1, 20	4
W-8-M-77	8″	Cored concrete masonry; see Notes 2, 19, 26, 31, 40; No facings.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$
W-8-M-78	8″	Cored concrete masonry; see Notes 2, 18, 26, 31, 40; No facings.	80 psi	3 hrs.		1		1, 20	3
W-8-M-79	8″	Cored concrete masonry; see Notes 2, 19, 26, 36, 42; No facings.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-80	8″	Cored concrete masonry; see Notes 2, 18, 26, 36, 41; No facings.	80 psi	3 hrs.		1		1, 20	3
W-8-M-81	8″	Cored concrete masonry; see Notes 2, 19, 26, 34, 41; No facings.	80 psi	1 hr.		1		1, 20	1
W-8-M-82	8″	Cored concrete masonry; see Notes 2, 18, 26, 34, 41; No facings.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-8-M-83	8″	Cored concrete masonry; see Notes 2, 19, 26, 29, 41; No facings.	80 psi	45 min.		1		1, 20	$^3/_4$
W-8-M-84	8″	Cored concrete masonry; see Notes 2, 18, 26, 29, 41; No facings.	80 psi	2 hrs.		1		1, 20	2
W-8-M-85	$8^1/_2$″	Cored concrete masonry; see Notes 3, 18, 26, 34, 41; Facings: $2^1/_4$″ brick.	80 psi	4 hrs.		1		1, 20	4
W-8-M-86	8″	Cored concrete masonry; see Notes 3, 18, 26, 34, 41; Facings: $3^3/_4$″ brick face.	80 psi	5 hrs.		1		1, 20	5
W-8-M-87	8″	Cored concrete masonry; see Notes 2, 19, 26, 30, 43; No facings.	80 psi	12 min.		1		1, 20	$^1/_5$
W-8-M-88	8″	Cored concrete masonry; see Notes 2, 18, 26, 30, 43; No facings.	80 psi	12 min.		1		1, 20	$^1/_5$
W-8-M-89	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 34, 40; Facings: fire side only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-8-M-90	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 34, 40; Facings: side 1; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-8-M-91	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 31, 40; Facings: fire side only; see Note 38.	80 psi	1 hr. 45 min.		1		1, 20	$1^3/_4$
W-8-M-92	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 31, 40; Facings: one side; see Note 38.	80 psi	4 hrs.		1		1, 20	4
W-8-M-93	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 36, 41; Facings: fire side only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-8-M-94	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 36, 41; Facings: fire side only; see Note 38.	80 psi	4 hrs.		1		1, 20	4
W-8-M-95	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 34, 41; Facings: fire side only; see Note 38.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-8-M-96	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 34, 41; Facings: one side; see Note 38.	80 psi	3 hrs.				1, 20	3
W-8-M-97	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 29, 41; Facings: fire side only; see Note 38.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-8-M-98	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 29, 41; Facings: one side; see Note 38.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-8-M-99	$8^1/_2$″	Cored concrete masonry; see Notes 3, 19, 23, 27, 41; No facings.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-8-M-100	$8^1/_2$″	Cored concrete masonry; see Notes 3, 18, 23, 27, 41; No facings.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-8-M-101	$8^1/_2$″	Cored concrete masonry; see Notes 3, 18, 26, 34, 41; Facings: $3^3/_4$″ brick face; one side only; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-8-M-102	$8^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 30, 43; Facings: fire side only; see Note 38.	80 psi	30 min.		1		1, 20	$^1/_2$
W-8-M-103	$8^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 30, 43; Facings: one side only; see Note 38.	80 psi	12 min.		1		1, 20	$^1/_5$
W-8-M-104	9″	Cored concrete masonry; see Notes 2, 18, 26, 34, 40; Facings: both sides; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-8-M-105	9″	Cored concrete masonry; see Notes 2, 18, 26, 31, 40; Facings: both sides; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-8-M-106	9″	Cored concrete masonry; see Notes 2, 18, 26, 36, 41; Facings: both sides of wall; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-8-M-107	9″	Cored concrete masonry; see Notes 2, 18, 26, 34, 41; Facings: both sides; see Note 38.	80 psi	4 hrs.		1		1, 20	4
W-8-M-108	9″	Cored concrete masonry; see Notes 2, 18, 26, 29, 41; Facings: both sides; see Note 38.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-8-M-109	9″	Cored concrete masonry; see Notes 3, 19, 23, 27, 40; Facings: fire side only; see Note 38.	80 psi	1 hr. 45 min.		1		1, 20	$1^3/_4$
W-8-M-110	9″	Cored concrete masonry; see Notes 3, 18, 23, 27, 41; Facings: one side only; see Note 38.	80 psi	4 hrs.		1		1, 20	4
W-8-M-111	9″	Cored concrete masonry; see Notes 3, 18, 26, 34, 41; $2^1/_4$″ brick face on one side only; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-8-M-112	9″	Cored concrete masonry; see Notes 2, 18, 26, 30, 43; Facings: both sides; see Note 38.	80 psi	30 min.		1		1, 20	$^1/_2$
W-9-M-113	$9^1/_2$″	Cored concrete masonry; see Notes 3, 18, 23, 27, 41; Facings: both sides; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-8-M-114	8″		200 psi	5 hrs.			43	22	5

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Tested at NBS under ASA Spec. No. 43-1934 (ASTM C19-53).
2. One unit in wall thickness.
3. Two units in wall thickness.
4. Two or three units in wall thickness.
5. Two cells in wall thickness.
6. Three or four cells in wall thickness.
7. Four or five cells in wall thickness.
8. Five or six cells in wall thickness.
9. Minimum percent of solid materials in units = 40%.
10. Minimum percent of solid materials in units = 43%.
11. Minimum percent of solid materials in units = 46%.
12. Minimum percent of solid materials in units = 48%.
13. Minimum percent of solid materials in units = 49%.
14. Minimum percent of solid materials in units = 45%.
15. Minimum percent of solid materials in units = 51%.
16. Minimum percent of solid materials in units = 53%.
17. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
18. Noncombustible or no members framed into wall.

(continued)

TABLE 1.1.4—continued
MASONRY WALLS
8″ TO LESS THAN 10″ THICK

19. Combustible members framed into wall.
20. Load: 80 psi for gross cross-sectional area of wall.
21. Portland cement-lime mortar.
22. Failure mode thermal.
23. British test.
24. Passed all criteria.
25. Failed by sudden collapse with no preceding signs of impending failure.
26. One cell in wall thickness.
27. Two cells in wall thickness.
28. Three cells in wall thickness.
29. Minimum percent of solid material in concrete units = 52.
30. Minimum percent of solid material in concrete units = 54.
31. Minimum percent of solid material in concrete units = 55.
32. Minimum percent of solid material in concrete units = 57.
33. Minimum percent of solid material in concrete units = 60.
34. Minimum percent of solid material in concrete units = 62.
35. Minimum percent of solid material in concrete units = 65.
36. Minimum percent of solid material in concrete units = 70.
37. Minimum percent of solid material in concrete units = 76.
38. Not less than $^1/_2$ inch of 1:3 sanded gypsum plaster.
39. Three units in wall thickness.
40. Concrete units made with expanded slag or pumice aggregates.
41. Concrete units made with expanded burned clay or shale, crushed limestone, air cooled slag or cinders.
42. Concrete units made with calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
43. Concrete units made with siliceous sand and gravel. Ninety percent or more quartz, chert and dolomite.
44. Load: 120 psi for gross cross-sectional area of wall.
45. Load: 160 psi for gross cross-sectional area of wall.

FIGURE 1.1.5
MASONRY WALLS
10″ TO LESS THAN 12″ THICK

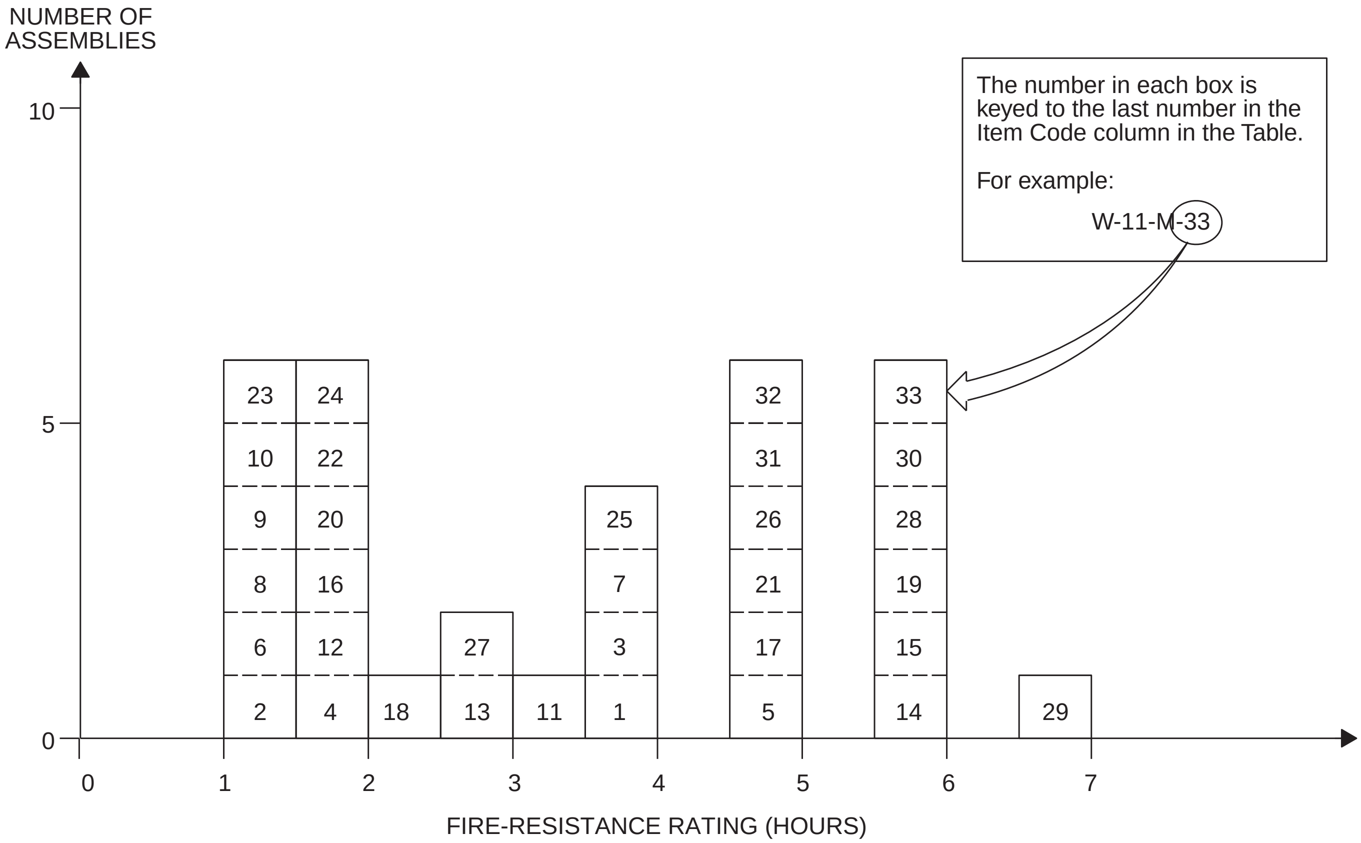


TABLE 1.1.5
MASONRY WALLS
10″ TO LESS THAN 12″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-10-M-1	10″	Core: two $3^3/_4$″, 40% solid clay or shale structural tiles with 2″ air space between; Facings: $^3/_4$″ Portland cement plaster on stucco on both sides.	80 psi	4 hrs.		1		1, 20	4
W-10-M-2	10″	Core: cored concrete masonry, 2″ air cavity; see Notes 3, 19, 27, 34, 40; No facings.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-10-M-3	10″	Cored concrete masonry; see Notes 3, 18, 27, 34, 40; No facings.	80 psi	4 hrs.		1		1, 20	4
W-10-M-4	10″	Cored concrete masonry; see Notes 2, 19, 26, 34, 40; No facings.	80 psi	2 hrs.		1		1, 20	2
W-10-M-5	10″	Cored concrete masonry; see Notes 2, 18, 26, 33, 40; No facings.	80 psi	5 hrs.		1		1, 20	5
W-10-M-6	10″	Cored concrete masonry; see Notes 2, 19, 26, 33, 41; No facings.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-10-M-7	10″	Cored concrete masonry; see Notes 2, 18, 26, 33, 41; No facings.	80 psi	4 hrs.		1		1, 20	4
W-10-M-8	10″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 19, 27, 34, 42; No facings.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$

(continued)

TABLE 1.1.5—continued
MASONRY WALLS
10″ TO LESS THAN 12″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-10-M-9	10″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 42; No facings.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$
W-10-M-10	10″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 19, 27, 34, 41; No facings.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$
W-10-M-11	10″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 41; No facings.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-10-M-12	10″	9″ thick concrete block ($11^3/_4$″ × 9″ × $4^1/_4$″) with two 2″ thick voids included; $^3/_8$″ P.C. plaster $^1/_8$″ neat gypsum.	N/A	1 hr. 53 min.			7	23, 44	$1^3/_4$
W-10-M-13	10″	Holly clay tile block wall - $8^1/_2$″ block with two 3″ voids in each $8^1/_2$″ section; $^3/_4$″ gypsum plaster - each face.	N/A	2 hrs. 42 min.			7	23, 25	$2^1/_2$
W-10-M-14	10″	Two layers $4^1/_4$″ brick with $1^1/_2$″ air space; No ties sand cement mortar. (Fletton brick - 1910 psi).	N/A	6 hrs.			7	23, 24	6
W-10-M-15	10″	Two layers $4^1/_4$″ thick Fletton brick (1910 psi); $1^1/_2$″ air space; Ties: 18″ o.c. vertical; 3′ o.c. horizontal.	N/A	6 hrs.			7	23, 24	6
W-10-M-16	$10^1/_2$″	Cored concrete masonry; 2″ air cavity; see Notes 3, 19, 27, 34, 40; Facings: fire side only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-10-M-17	$10^1/_2$″	Cored concrete masonry; see Notes 3, 18, 27, 34, 40; Facings: side 1 only; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-10-M-18	$10^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 33, 40; Facings: fire side only; see Note 38.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-10-M-19	$10^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 33, 40; Facings: one side; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-10-M-20	$10^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 33, 41; Facings: fire side of wall only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-10-M-21	$10^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 33, 41; Facings: one side only; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-10-M-22	$10^1/_2$″	Cored concrete masonry (cavity type 2″ air space); see Notes 3,19, 27, 34, 42; Facings: fire side only; see Note 38.	80 psi	1 hr. 45 min.		1		1, 20	$1^3/_4$
W-10-M-23	$10^1/_2$″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 42; Facings: one side only; see Note 38.	80 psi	1 hr. 15 min.		1		1, 20	$1^1/_4$
W-10-M-24	$10^1/_2$″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 19, 27, 34, 41; Facings: fire side only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-10-M-25	$10^1/_2$″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 41; Facings: one side only; see Note 38.	80 psi	4 hrs.		1		1, 20	4
W-10-M-26	$10^5/_8$″	Core: 8″, 40% solid tile plus 2″ furring tile; $^5/_8$″ sanded gypsum plaster between tile types; Facings: both sides $^3/_4$″ Portland cement plaster or stucco.	80 psi	5 hrs.		1		1, 20	5

(continued)

TABLE 1.1.5—continued
MASONRY WALLS
10″ TO LESS THAN 12″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-10-M-27	$10^5/_8$″	Core: 8″, 40% solid tile plus 2″ furring tile; $^5/_8$″ sanded gypsum plaster between tile types; Facings: one side $^3/_4$″ Portland cement plaster or stucco.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-11-M-28	11″	Cored concrete masonry; see Notes 3, 18, 27, 34, 40; Facings: both sides; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-11-M-29	11″	Cored concrete masonry; see Notes 2, 18, 26, 33, 40; Facings: both sides; see Note 38.	80 psi	7 hrs.		1		1, 20	7
W-11-M-30	11″	Cored concrete masonry; see Notes 2, 18, 26, 33, 41; Facings: both sides of wall; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-11-M-31	11″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 42; Facings: both sides; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-11-M-32	11″	Cored concrete masonry (cavity type 2″ air space); see Notes 3, 18, 27, 34, 41; Facings: both sides; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-11-M-33	11″	Two layers brick ($4^1/_2$″ Fletton, 2,428 psi) 2″ air space; galvanized ties; 18″ o.c. - horizontal; 3′ o.c. - vertical.	3 tons/ft.	6 hrs.			7	23, 24	6

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Tested at NBS - ASA Spec. No. A2-1934.
2. One unit in wall thickness.
3. Two units in wall thickness.
4. Two or three units in wall thickness.
5. Two cells in wall thickness.
6. Three or four cells in wall thickness.
7. Four or five cells in wall thickness.
8. Five or six cells in wall thickness.
9. Minimum percent of solid materials in units = 40%.
10. Minimum percent of solid materials in units = 43%.
11. Minimum percent of solid materials in units = 46%.
12. Minimum percent of solid materials in units = 48%.
13. Minimum percent of solid materials in units = 49%.
14. Minimum percent of solid materials in units = 45%.
15. Minimum percent of solid materials in units = 51%.
16. Minimum percent of solid materials in units = 53%.
17. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
18. Noncombustible or no members framed into wall.
19. Combustible members framed into wall.
20. Load: 80 psi for gross cross sectional area of wall.
21. Portland cement-lime mortar.
22. Failure mode—thermal.
23. British test.
24. Passed all criteria.
25. Failed by sudden collapse with no preceding signs of impending failure.
26. One cell in wall thickness.
27. Two cells in wall thickness.
28. Three cells in wall thickness.
29. Minimum percent of solid material in concrete units = 52%.
30. Minimum percent of solid material in concrete units = 54%.
31. Minimum percent of solid material in concrete units = 55%.
32. Minimum percent of solid material in concrete units = 57%.
33. Minimum percent of solid material in concrete units = 60%.
34. Minimum percent of solid material in concrete units = 62%.
35. Minimum percent of solid material in concrete units = 65%.

(continued)

TABLE 1.1.5—continued
MASONRY WALLS
10″ TO LESS THAN 12″ THICK

36. Minimum percent of solid material in concrete units = 70%.
37. Minimum percent of solid material in concrete units = 76%.
38. Not less than $^1/_2$ inch of 1:3 sanded gypsum plaster.
39. Three units in wall thickness.
40. Concrete units made with expanded slag or pumice aggregates.
41. Concrete units made with expanded burned clay or shale, crushed limestone, air cooled slag or cinders.
42. Concrete units made with calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.

FIGURE 1.1.6
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

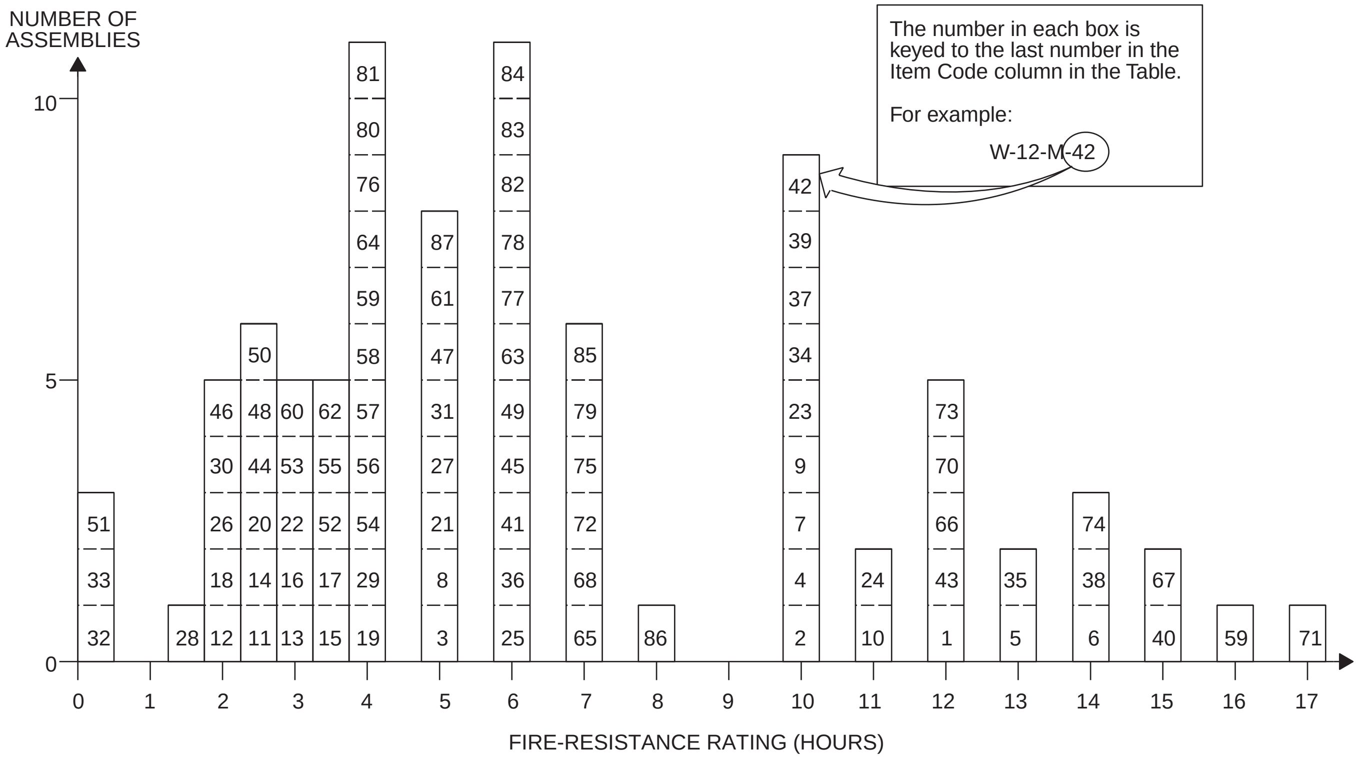


TABLE 1.1.6
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-12-M-1	12″	Core: solid clay or shale brick; No facings.	N/A	12 hrs.		1		1	12
W-12-M-2	12″	Core: solid clay or shale brick; No facings.	160 psi	10 hrs.		1		1, 44	10
W-12-M-3	12″	Core: hollow rolok of clay or shale; No facings.	160 psi	5 hrs.		1		1, 44	5
W-12-M-4	12″	Core: hollow rolok bak of clay or shale; No facings.	160 psi	10 hrs.		1		1, 44	10
W-12-M-5	12″	Core: concrete brick; No facings.	160 psi	13 hrs.		1		1, 44	13
W-12-M-6	12″	Core: sand-lime brick; No facings.	N/A	14 hrs.		1		1	14
W-12-M-7	12″	Core: sand-lime brick; No facings.	160 psi	10 hrs.		1		1, 44	10
W-12-M-8	12″	Cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids: 70; No facings.	120 psi	5 hrs.		1		1, 45	5
W-12-M-9	12″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 3; Minimum % solids: 87; No facings.	160 psi	10 hrs.		1		1, 44	10
W-12-M-10	12″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 3; Minimum % solids: 87; No facings.	N/A	11 hrs.		1		1	11

(continued)

TABLE 1.1.6—continued
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-12-M-11	12″	Core: clay or shale structural tile; see Notes 2, 6, 9, 18; No facings.	80 psi	2 hrs.		1		1, 20	$2^1/_2$
W-12-M-12	12″	Core: clay or shale structural tile; see Notes 2, 4, 9, 19; No facings.	80 psi	2 hrs.		1		1, 20	2
W-12-M-13	12″	Core: clay or shale structural tile; see Notes 2, 6, 14, 19; No facings.	80 psi	3 hrs.		1		1, 20	3
W-12-M-14	12″	Core: clay or shale structural tile; see Notes 2, 6, 14, 18; No facings.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-12-M-15	12″	Core: clay or shale structural tile; see Notes 2, 4, 13, 18; No facings.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-12-M-16	12″	Core: clay or shale structural tile; see Notes 2, 4, 13, 19; No facings.	80 psi	3 hrs.		1		1, 20	3
W-12-M-17	12″	Core: clay or shale structural tile; see Notes 3, 6, 9, 18; No facings.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-12-M-18	12″	Core: clay or shale structural tile; see Notes 3, 6, 9, 19; No facings.	80 psi	2 hrs.		1		1, 20	2
W-12-M-19	12″	Core: clay or shale structural tile; see Notes 3, 6, 14, 18; No facings.	80 psi	4 hrs.		1		1, 20	4
W-12-M-20	12″	Core: clay or shale structural tile; see Notes 3, 6, 14, 19; No facings.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-12-M-21	12″	Core: clay or shale structural tile; see Notes 3, 6, 16, 18; No facings.	80 psi	5 hrs.		1		1, 20	5
W-12-M-22	12″	Core: clay or shale structural tile; see Notes 3, 6, 16, 19; No facings.	80 psi	3 hrs.		1		1, 20	3
W-12-M-23	12″	Core: 8″, 70% solid clay or shale structural tile; 4″ brick facings on one side.	80 psi	10 hrs.		1		1, 20	10
W-12-M-24	12″	Core: 8″, 70% solid clay or shale structural tile; 4″ brick facings on one side.	N/A	11 hrs.		1		1	11
W-12-M-25	12″	Core: 8″, 40% solid clay or shale structural tile; 4″ brick facings on one side.	80 psi	6 hrs.		1		1, 20	6
W-12-M-26	12″	Cored concrete masonry; see Notes 1, 9, 15, 16, 20; No facings.	80 psi	2 hrs.		1		1, 20	2
W-12-M-27	12″	Cored concrete masonry; see Notes 2, 18, 26, 34, 41; No facings.	80 psi	5 hrs.		1		1, 20	5
W-12-M-28	12″	Cored concrete masonry; see Notes 2, 19, 26, 31, 41; No facings.	80 psi	1 hr. 30 min.		1		1, 20	$1^1/_2$
W-12-M-29	12″	Cored concrete masonry; see Notes 2, 18, 26, 31, 41; No facings.	80 psi	4 hrs.		1		1, 20	4
W-12-M-30	12″	Cored concrete masonry; see Notes 3, 19, 27, 31, 43; No facings.	80 psi	2 hrs.		1		1, 20	2
W-12-M-31	12″	Cored concrete masonry; see Notes 3, 18, 27, 31, 43; No facings.	80 psi	5 hrs.		1		1, 20	5
W-12-M-32	12″	Cored concrete masonry; see Notes 2, 19, 26, 32, 43; No facings.	80 psi	25 min.		1		1, 20	$^1/_3$
W-12-M-33	12″	Cored concrete masonry; see Notes 2, 18, 26, 32, 43; No facings.	80 psi	25 min.		1		1, 20	$^1/_3$

(continued)

TABLE 1.1.6—continued
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-12-M-34	$12^1/_2$″	Core: solid clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	10 hrs.		1		1, 44	10
W-12-M-35	$12^1/_2$″	Core: solid clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	N/A	13 hrs.		1		1	13
W-12-M-36	$12^1/_2$″	Core: hollow rolok of clay or shale; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	6 hrs.		1		1, 44	6
W-12-M-37	$12^1/_2$″	Core: hollow rolok bak of clay or shale; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	10 hrs.		1		1, 44	10
W-12-M-38	$12^1/_2$″	Core: concrete; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	14 hrs.		1		1, 44	14
W-12-M-39	$12^1/_2$″	Core: sand-lime brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	10 hrs.		1		1, 44	10
W-12-M-40	$12^1/_2$″	Core: sand-lime brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	N/A	15 hrs.		1		1	15
W-12-M-41	$12^1/_2$″	Cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids: 70; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	120 psi	6 hrs.		1		1, 45	6
W-12-M-42	$12^1/_2$″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 3; Minimum % solids: 87; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	160 psi	10 hrs.		1		1, 44	10
W-12-M-43	$12^1/_2$″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 3; Minimum % solids: 87; $^1/_2$″ of 1:3 sanded gypsum plaster facings on one side.	N/A	12 hrs.		1		1	12
W-12-M-44	$12^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 34, 41; Facings: fire side only; see Note 38.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-12-M-45	$12^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 34, 39, 41; Facings: one side only; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-12-M-46	$12^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 31, 41; Facings: fire side only; see Note 38.	80 psi	2 hrs.		1		1, 20	2
W-12-M-47	$12^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 31, 41; Facings: one side of wall only; see Note 38.	80 psi	5 hrs.		1		1, 20	5
W-12-M-48	$12^1/_2$″	Cored concrete masonry; see Notes 3, 19, 27, 31, 43; Facings: fire side only; see Note 38.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$
W-12-M-49	$12^1/_2$″	Cored concrete masonry; see Notes 3, 18, 27, 31, 43; Facings: one side only; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-12-M-50	$12^1/_2$″	Cored concrete masonry; see Notes 2, 19, 26, 32, 43; Facings: fire side only; see Note 38.	80 psi	2 hrs. 30 min.		1		1, 20	$2^1/_2$

(continued)

TABLE 1.1.6—continued
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-12-M-51	$12^1/_2$″	Cored concrete masonry; see Notes 2, 18, 26, 32, 43; Facings: one side only; see Note 38.	80 psi	25 min.		1		1, 20	$^1/_3$
W-12-M-52	$12^5/_8$″	Clay or shale structural tile; see Notes 2, 6, 9, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-12-M-53	$12^5/_8$″	Clay or shale structural tile; see Notes 2, 6, 9, 19; Facings: fire side only; see Note 17.	80 psi	3 hrs.		1		1, 20	3
W-12-M-54	$12^5/_8$″	Clay or shale structural tile; see Notes 2, 6, 14, 19; Facings: side 1, see Note 17; side 2, none.	80 psi	4 hrs.		1		1, 20	4
W-12-M-55	$12^5/_8$″	Clay or shale structural tile; see Notes 2, 6, 14, 18; Facings: exposed side only; see Note 17.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-12-M-56	$12^5/_8$″	Clay or shale structural tile; see Notes 2, 4, 13, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	4 hrs.		1		1, 20	4
W-12-M-57	$12^5/_8$″	Clay or shale structural tile; see Notes 1, 4, 13, 19; Facings: fire side only; see Note 17.	80 psi	4 hrs.		1		1, 20	4
W-12-M-58	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 9, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	4 hrs.		1		1, 20	4
W-12-M-59	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 9, 19; Facings: fire side only; see Note 17.	80 psi	3 hrs.		1		1, 20	3
W-12-M-60	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 14, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	5 hrs.		1		1, 20	5
W-12-M-61	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 14, 19; Facings: fire side only; see Note 17.	80 psi	3 hrs. 30 min.		1		1, 20	$3^1/_2$
W-12-M-62	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 16, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	6 hrs.		1		1, 20	6
W-12-M-63	$12^5/_8$″	Clay or shale structural tile; see Notes 3, 6, 16, 19; Facings: fire side only; see Note 17.	80 psi	4 hrs.		1		1, 20	4
W-12-M-64	$12^5/_8$″	Core: 8″, 40% solid clay or shale structural tile; Facings: 4″ brick plus $^5/_8$″ of 1:3 sanded gypsum plaster on one side.	80 psi	7 hrs.		1		1, 20	7
W-13-M-65	13″	Core: solid clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	160 psi	12 hrs.		1		1, 44	12
W-13-M-66	13″	Core: solid clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	N/A	15 hrs.		1		1, 20	15
W-13-M-67	13″	Core: solid clay or shale brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	N/A	15 hrs.		1		1	15
W-13-M-68	13″	Core: hollow rolok of clay or shale; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	80 psi	7 hrs.		1		1, 20	7
W-13-M-69	13″	Core: concrete brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	160 psi	16 hrs.		1		1, 44	16

(continued)

TABLE 1.1.6—continued
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-13-M-70	13″	Core: sand-lime brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	160 psi	12 hrs.		1		1, 44	12
W-13-M-71	13″	Core: sand-lime brick; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	N/A	17 hrs.		1		1	17
W-13-M-72	13″	Cored clay or shale brick; Units in wall thickness: 1; Cells in wall thickness: 2; Minimum % solids: 70; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	120 psi	7 hrs.		1		1, 45	7
W-13-M-73	13″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 3; Minimum % solids: 87; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	160 psi	12 hrs.		1		1, 44	12
W-13-M-74	13″	Cored clay or shale brick; Units in wall thickness: 3; Cells in wall thickness: 2; Minimum % solids: 87; $^1/_2$″ of 1:3 sanded gypsum plaster facings on both sides.	N/A	14 hrs.		1		1	14
W-13-M-75	13″	Cored concrete masonry; see Notes 18, 23, 28, 39, 41; No facings.	80 psi	7 hrs.		1		1, 20	7
W-13-M-76	13″	Cored concrete masonry; see Notes 19, 23, 28, 39, 41; No facings.	80 psi	4 hrs.		1		1, 20	4
W-13-M-77	13″	Cored concrete masonry; see Notes 3, 18, 27, 31, 43; Facings: both sides; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-13-M-78	13″	Cored concrete masonry; see Notes 2, 18, 26, 31, 41; Facings: both sides; see Note 38.	80 psi	6 hrs.		1		1, 20	6
W-13-M-79	13″	Cored concrete masonry; see Notes 2, 18, 26, 34, 41; Facings: both sides of wall; see Note 38.	80 psi	7 hrs.		1		1, 20	7
W-13-M-80	13$^1/_4$″	Core: clay or shale structural tile; see Notes 2, 6, 9, 18; Facings: both sides; see Note 17.	80 psi	4 hrs.		1		1, 20	4
W-13-M-81	13$^1/_4$″	Core: clay or shale structural tile; see Notes 2, 6, 14, 19; Facings: both sides; see Note 17.	80 psi	4 hrs.		1		1, 20	4
W-13-M-82	13$^1/_4$″	Core: clay or shale structural tile; see Notes 2, 4, 13, 18; Facings: both sides; see Note 17.	80 psi	6 hrs.		1		1, 20	6
W-13-M-83	13$^1/_4$″	Core: clay or shale structural tile; see Notes 3, 6, 9, 18; Facings: both sides; see Note 17.	80 psi	6 hrs.		1		1, 20	6
W-13-M-84	13$^1/_4$″	Core: clay or shale structural tile; see Notes 3, 6, 14, 18; Facings: both sides; see Note 17.	80 psi	6 hrs.		1		1, 20	6
W-13-M-85	13$^1/_4$″	Core: clay or shale structural tile; see Notes 3, 6, 16, 18; Facings: both sides; see Note 17.	80 psi	7 hrs.		1		1, 20	7

(continued)

TABLE 1.1.6—continued
MASONRY WALLS
12″ TO LESS THAN 14″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-13-M-86	$13^1/_2$″	Cored concrete masonry; see Notes 18, 23, 28, 39, 41; Facings: one side only; see Note 38.	80 psi	8 hrs.		1		1, 20	8
W-13-M-87	$13^1/_2$″	Cored concrete masonry; see Notes 19, 23, 28, 39, 41; Facings: fire side only; see Note 38.	80 psi	5 hrs.		1		1, 20	5

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Tested at NBS - ASA Spec. No. A2-1934.
2. One unit in wall thickness.
3. Two units in wall thickness.
4. Two or three units in wall thickness.
5. Two cells in wall thickness.
6. Three or four cells in wall thickness.
7. Four or five cells in wall thickness.
8. Five or six cells in wall thickness.
9. Minimum percent of solid materials in units = 40%.
10. Minimum percent of solid materials in units = 43%.
11. Minimum percent of solid materials in units = 46%.
12. Minimum percent of solid materials in units = 48%.
13. Minimum percent of solid materials in units = 49%.
14. Minimum percent of solid materials in units = 45%.
15. Minimum percent of solid materials in units = 51%.
16. Minimum percent of solid materials in units = 53%.
17. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
18. Noncombustible or no members framed into wall.
19. Combustible members framed into wall.
20. Load: 80 psi for gross area.
21. Portland cement-lime mortar.
22. Failure mode-thermal.
23. British test.
24. Passed all criteria.
25. Failed by sudden collapse with no preceding signs of impending failure.
26. One cell in wall thickness.
27. Two cells in wall thickness.
28. Three cells in wall thickness.
29. Minimum percent of solid material in concrete units = 52%.
30. Minimum percent of solid material in concrete units = 54%.
31. Minimum percent of solid material in concrete units = 55%.
32. Minimum percent of solid material in concrete units = 57%.
33. Minimum percent of solid material in concrete units = 60%.
34. Minimum percent of solid material in concrete units = 62%.
35. Minimum percent of solid material in concrete units = 65%.
36. Minimum percent of solid material in concrete units = 70%.
37. Minimum percent of solid material in concrete units = 76%.
38. Not less than $^1/_2$ inch of 1:3 sanded gypsum plaster.
39. Three units in wall thickness.
40. Concrete units made with expanded slag or pumice aggregates.
41. Concrete units made with expanded burned clay or shale, crushed limestone, air cooled slag or cinders.
42. Concrete units made with calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
43. Concrete units made with siliceous sand and gravel. Ninety percent or more quartz, chert or flint.
44. Load: 160 psi of gross wall cross sectional area.
45. Load: 120 psi of gross wall cross sectional area.

FIGURE 1.1.7
MASONRY WALLS
14″ OR MORE THICK

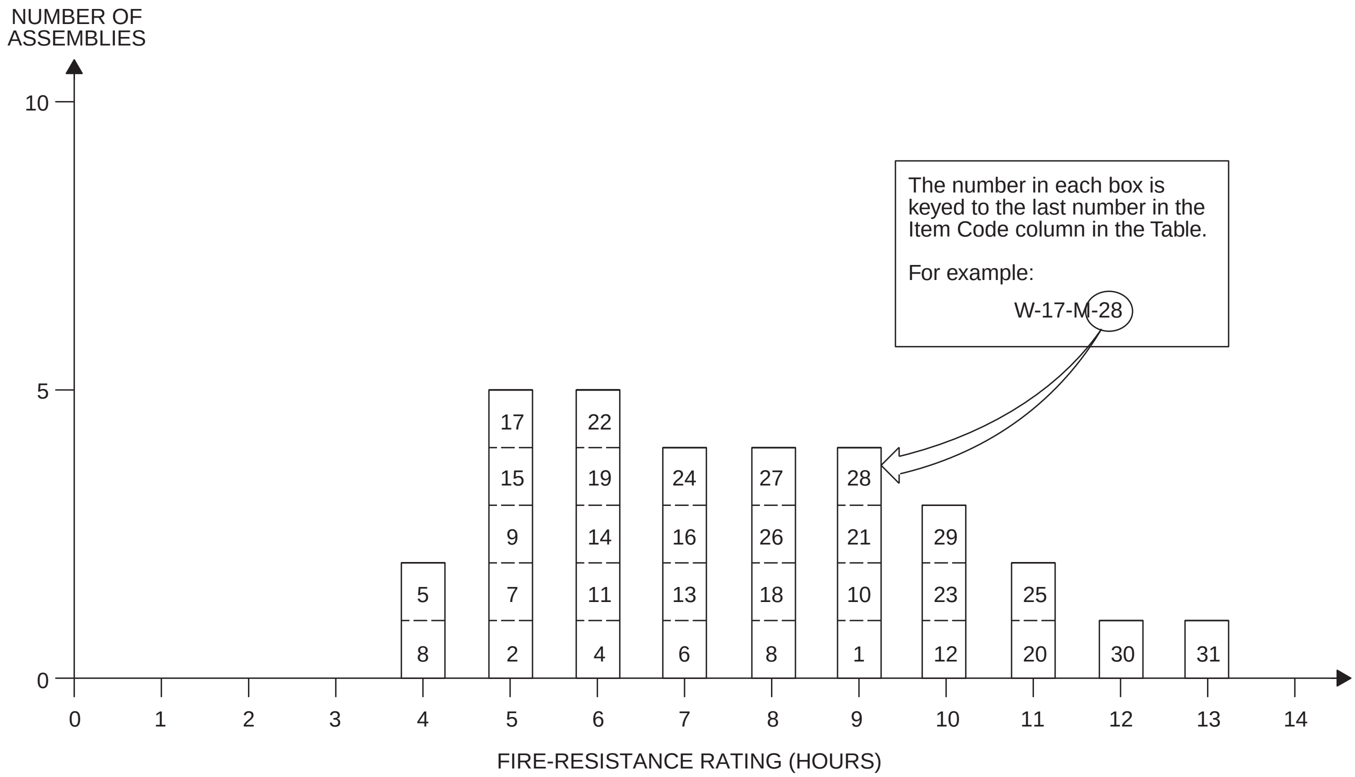


TABLE 1.1.7
MASONRY WALLS
14″ OR MORE THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-14-M-1	14″	Core: cored masonry; see Notes 18, 28, 33, 39, 41; Facings: both sides; see Note 38.	80 psi	9 hrs.		1		1, 20	9
W-16-M-2	16″	Core: clay or shale structural tile; see Notes 4, 7, 9, 19; No facings.	80 psi	5 hrs.		1		1, 20	5
W-16-M-3	16″	Core: clay or shale structural tile; see Notes 4, 7, 9, 19; No facings.	80 psi	4 hrs.		1		1, 20	4
W-16-M-4	16″	Core: clay or shale structural tile; see Notes 4, 7, 10, 18; No facings.	80 psi	6 hrs.		1		1, 20	6
W-16-M-5	16″	Core: clay or shale structural tile; see Notes 4, 7, 10, 19; No facings.	80 psi	4 hrs.		1		1, 20	4
W-16-M-6	16″	Core: clay or shale structural tile; see Notes 4, 7, 11, 18; No facings.	80 psi	7 hrs.		1		1, 20	7
W-16-M-7	16″	Core: clay or shale structural tile; see Notes 4, 7, 11, 19; No facings.	80 psi	5 hrs.		1		1, 20	5
W-16-M-8	16″	Core: clay or shale structural tile; see Notes 4, 8, 13, 18; No facings.	80 psi	8 hrs.		1		1, 20	8
W-16-M-9	16″	Core: clay or shale structural tile; see Notes 4, 8, 13, 19; No facings.	80 psi	5 hrs.		1		1, 20	5

(continued)

TABLE 1.1.7—continued
MASONRY WALLS
14″ OR MORE THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-16-M-10	16″	Core: clay or shale structural tile; see Notes 4, 8, 15, 18; No facings.	80 psi	9 hrs.		1		1, 20	9
W-16-M-11	16″	Core: clay or shale structural tile; see Notes 3, 7, 14, 18; No facings.	80 psi	6 hrs.		1		1, 20	6
W-16-M-12	16″	Core: clay or shale structural tile; see Notes 4, 8, 16, 18; No facings.	80 psi	10 hrs.		1		1, 20	10
W-16-M-13	16″	Core: clay or shale structural tile; see Notes 4, 6, 16, 19; No facings.	80 psi	7 hrs.		1		1, 20	7
W-16-M-14	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 9, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	6 hrs.		1		1, 20	6
W-16-M-15	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 9, 19; Facings: fire side only; see Note 17.	80 psi	5 hrs.		1		1, 20	5
W-16-M-16	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 10, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	7 hrs.		1		1, 20	7
W-16-M-17	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 10, 19; Facings: fire side only; see Note 17.	80 psi	5 hrs.		1		1, 20	5
W-16-M-18	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 11, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	5 hrs.		1		1, 20	5
W-16-M-19	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 7, 11, 19; Facings: fire side only; see Note 17.	80 psi	6 hrs.		1		1, 20	6
W-16-M-20	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 8, 13, 18; Facings: sides 1 and 2; see Note 17.	80 psi	11 hrs.		1		1, 20	11
W-16-M-21	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 8, 13 18; Facings: side 1, see Note 17; side 2, none.	80 psi	9 hrs.		1		1, 20	9
W-16-M-22	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 8, 13, 19; Facings: fire side only; see Note 17.	80 psi	6 hrs.		1		1, 20	6
W-16-M-23	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 8, 15, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	10 hrs.		1		1, 20	10
W-16-M-24	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 8, 15, 19; Facings: fire side only; see Note 17.	80 psi	7 hrs.		1		1, 20	7
W-16-M-25	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 6, 16, 18; Facings: side 1, see Note 17; side 2, none.	80 psi	11 hrs.		1		1, 20	11
W-16-M-26	$16^5/_8$″	Core: clay or shale structural tile; see Notes 4, 6, 16, 19; Facings: fire side only; see Note 17.	80 psi	8 hrs.		1		1, 20	8

(continued)

TABLE 1.1.7—continued
MASONRY WALLS
14″ OR MORE THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-17-M-27	$17^1/_4$″	Core: clay or shale structural tile; see Notes 4, 7, 9, 18; Facings: sides 1 and 2; see Note 17.	80 psi	8 hrs.		1		1, 20	8
W-17-M-28	$17^1/_4$″	Core: clay or shale structural tile; see Notes 4, 7, 10, 18; Facings: sides 1 and 2; see Note 17.	80 psi	9 hrs.		1		1, 20	9
W-17-M-29	$17^1/_4$″	Core: clay or shale structural tile; see Notes 4, 7, 11, 18; Facings: sides 1 and 2; see Note 17.	80 psi	10 hrs.		1		1, 20	10
W-17-M-30	$17^1/_4$″	Core: clay or shale structural tile; see Notes 4, 8, 15, 18; Facings: sides 1 and 2; see Note 17.	80 psi	12 hrs.		1		1, 20	12
W-17-M-31	$17^1/_4$″	Core: clay or shale structural tile; see Notes 4, 6, 16, 18; Facings: sides 1 and 2; see Note 17.	80 psi	13 hrs.		1		1, 20	13

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1 Tested at NBS - ASA Spec. No. A2-1934.
2. One unit in wall thickness.
3. Two units in wall thickness.
4. Two or three units in wall thickness.
5. Two cells in wall thickness.
6. Three or four cells in wall thickness.
7. Four or five cells in wall thickness.
8. Five or six cells in wall thickness.
9. Minimum percent of solid materials in units = 40%.
10. Minimum percent of solid materials in units = 43%.
11. Minimum percent of solid materials in units = 46%.
12. Minimum percent of solid materials in units = 48%.
13. Minimum percent of solid materials in units = 49%.
14. Minimum percent of solid materials in units = 45%.
15. Minimum percent of solid materials in units = 51%.
16. Minimum percent of solid materials in units = 53%.
17. Not less than $^5/_8$ inch thickness of 1:3 sanded gypsum plaster.
18. Noncombustible or no members framed into wall.
19. Combustible members framed into wall.
20. Load: 80 psi for gross area.
21. Portland cement-lime mortar.
22. Failure mode—thermal.
23. British test.
24. Passed all criteria.
25. Failed by sudden collapse with no preceding signs of impending failure.
26. One cell in wall thickness.
27. Two cells in wall thickness.
28. Three cells in wall thickness.
29. Minimum percent of solid material in concrete units = 52%.
30. Minimum percent of solid material in concrete units = 54%.
31. Minimum percent of solid material in concrete units = 55%.
32. Minimum percent of solid material in concrete units = 57%.
33. Minimum percent of solid material in concrete units = 60%.
34. Minimum percent of solid material in concrete units = 62%.
35. Minimum percent of solid material in concrete units = 65%.
36. Minimum percent of solid material in concrete units = 70%.
37. Minimum percent of solid material in concrete units = 76%.
38. Not less than $^1/_2$ inch of 1:3 sanded gypsum plaster.
39. Three units in wall thickness.
40. Concrete units made with expanded slag or pumice aggregates.
41. Concrete units made with expanded burned clay or shale, crushed limestone, air cooled slag or cinders.
42. Concrete units made with calcareous sand and gravel. Coarse aggregate, 60 percent or more calcite and dolomite.
43. Concrete units made with siliceous sand and gravel. Ninety percent or more quartz, chert or flint.

FIGURE 1.2.1
METAL FRAME WALLS
0″ TO LESS THAN 4″ THICK

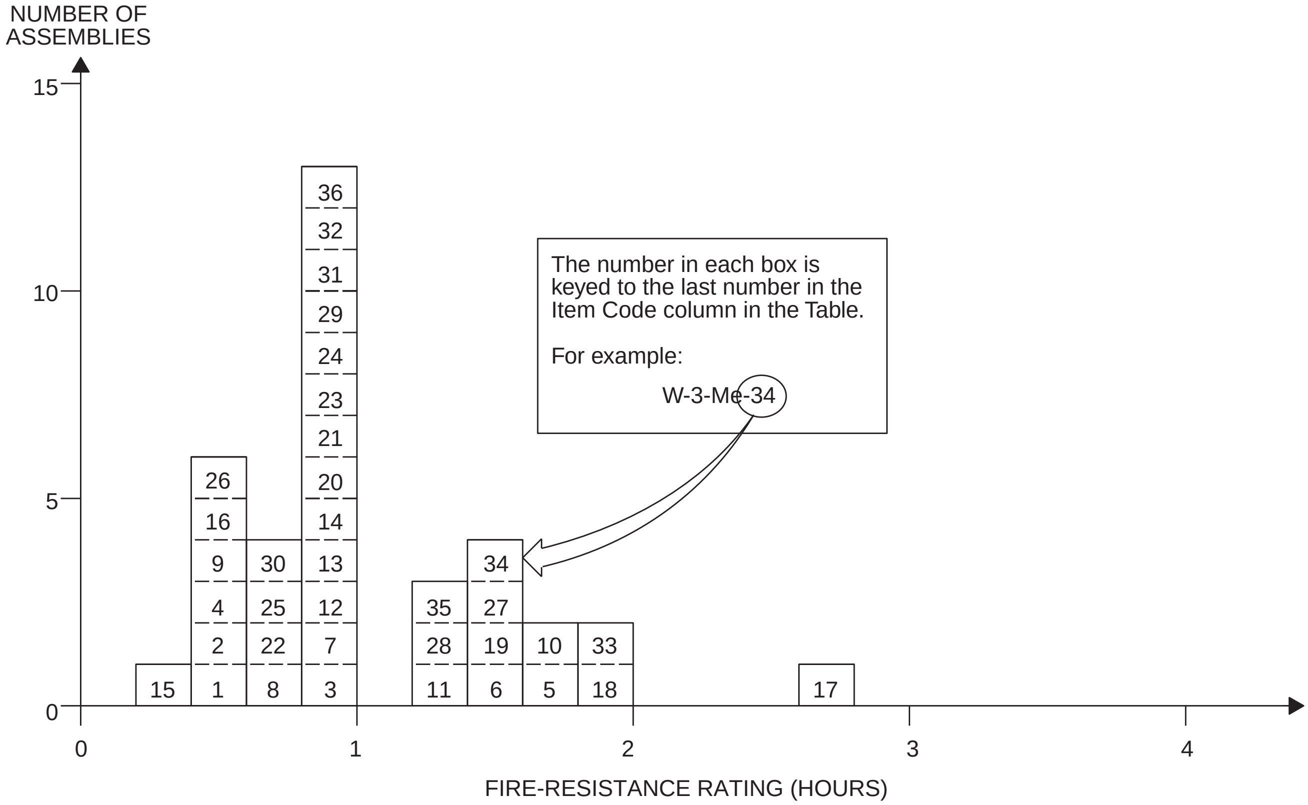


TABLE 1.2.1
METAL FRAME WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-3-Me-1	3″	Core: steel channels having three rows of 4″ × $^1/_8$″ staggered slots in web; core filled with heat expanded vermiculite weighing 1.5 lbs./ft.^{2} of wall area; Facings: sides 1 and 2, 18 gage steel, spot welded to core.	N/A	25 min.		1			$^1/_3$
W-3-Me-2	3″	Core: steel channels having three rows of 4″ × $^1/_8$″ staggered slots in web; core filled with heat expanded vermiculite weighing 2 lbs./ft.^{2} of wall area; Facings: sides 1 and 2, 18 gage steel, spot welded to core.	N/A	30 min.		1			$^1/_2$
W-3-Me-3	2$^1/_2$″	Solid partition: $^3/_8$″ tension rods (vertical) 3′ o.c. with metal lath; Scratch coat: cement/sand/lime plaster; Float coats: cement/sand/lime plaster; Finish coats: neat gypsum plaster.	N/A	1 hr.			7	1	1
W-2-Me-4	2″	Solid wall: steel channel per Note 1; 2″ thickness of 1:2; 1:3 Portland cement on metal lath.	N/A	30 min.		1			$^1/_2$

(continued)

TABLE 1.2.1—continued
METAL FRAME WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-2-Me-5	2″	Solid wall: steel channel per Note 1; 2″ thickness of neat gypsum plaster on metal lath.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-2-Me-6	2″	Solid wall: steel channel per Note 1; 2″ thickness of $1:1^1/_2$; $1:1^1/_2$ gypsum plaster on metal lath.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-2-Me-7	2″	Solid wall: steel channel per Note 2; 2″ thickness of 1:1; 1:1 gypsum plaster on metal lath.	N/A	1 hr.		1			1
W-2-Me-8	2″	Solid wall: steel channel per Note 1; 2″ thickness of 1:2; 1:2 gypsum plaster on metal lath.	N/A	45 min.		1			$^3/_4$
W-2-Me-9	$2^1/_4$″	Solid wall: steel channel per Note 2; $2^1/_4$″ thickness of 1:2; 1:3 Portland cement on metal lath.	N/A	30 min.		1			$^1/_2$
W-2-Me-10	$2^1/_4$″	Solid wall: steel channel per Note 2; $2^1/_4$″ thickness of neat gypsum plaster on metal lath.	N/A	2 hrs.		1			2
W-2-Me-11	$2^1/_4$″	Solid wall: steel channel per Note 2; $2^1/_4$″thickness of $1:^1/_2$; $1:^1/_2$ gypsum plaster on metal lath.	N/A	1 hr. 45 min.		1			$1^3/_4$
W-2-Me-12	$2^1/_4$″	Solid wall: steel channel per Note 2; $2^1/_4$″ thickness of 1:1; 1:1 gypsum plaster on metal lath.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-2-Me-13	$2^1/_4$″	Solid wall: steel channel per Note 2; $2^1/_4$″ thickness of 1:2; 1:2 gypsum plaster on metal lath.	N/A	1 hr.		1			1
W-2-Me-14	$2^1/_2$″	Solid wall: steel channel per Note 1; $2^1/_2$″ thickness of 4.5:1:7; 4.5:1:7 Portland cement, sawdust and sand sprayed on wire mesh; see Note 3.	N/A	1 hr.		1			1
W-2-Me-15	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:4; 1:4 Portland cement sprayed on wire mesh; see Note 3.	N/A	20 min.		1			$^1/_3$
W-2-Me-16	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:2; 1:3 Portland cement on metal lath.	N/A	30 min.		1			$^1/_2$
W-2-Me-17	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of neat gypsum plaster on metal lath.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-2-Me-18	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of $1:^1/_2$; $1:^1/_2$ gypsum plaster on metal lath.	N/A	2 hrs.		1			2
W-2-Me-19	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:1; 1:1 gypsum plaster on metal lath.	N/A	1 hr. 30 min.		1			$1^1/_2$

(continued)

TABLE 1.2.1—continued
METAL FRAME WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-2-Me-20	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:2; 1:2 gypsum plaster on metal lath.	N/A	1 hr.		1			1
W-2-Me-21	$2^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:2; 1:3 gypsum plaster on metal lath.	N/A	1 hr.		1			1
W-3-Me-22	3″	Core: steel channel per Note 2; 1:2; 1:2 gypsum plaster on $^3/_4$″ soft asbestos lath; plaster thickness 2″.	N/A	45 min.		1			$^3/_4$
W-3-Me-23	$3^1/_2$″	Solid wall: steel channel per Note 2; $2^1/_2$″ thickness of 1:2; 1:2 gypsum plaster on $^3/_4$″ asbestos lath.	N/A	1 hr.		1			1
W-3-Me-24	$3^1/_2$″	Solid wall: steel channel per Note 2; lath over and $1:2^1/_2$; $1:2^1/_2$ gypsum plaster on 1″ magnesium oxysulfate wood fiberboard; plaster thickness $2^1/_2$″.	N/A	1 hr.		1			1
W-3-Me-25	$3^1/_2$″	Core: steel studs; see Note 4; Facings: $^3/_4$″ thickness of $1:^1/_{30}:2$; $1:^1/_{30}$: 3 Portland cement and asbestos fiber plaster.	N/A	45 min.		1			$^3/_4$
W-3-Me-26	$3^1/_2$″	Core: steel studs; see Note 4; Facings: both sides $^3/_4$″ thickness of 1:2; 1:3 Portland cement.	N/A	30 min.		1			$^1/_2$
W-3-Me-27	$3^1/_2$″	Core: steel studs; see Note 4; Facings: both sides $^3/_4$″ thickness of neat gypsum plaster.	N/A	1 hr. 30 min.		1			$1^1/_2$
W-3-Me-28	$3^1/_2$″	Core: steel studs; see Note 4; Facings: both sides $^3/_4$″ thickness of $1:^1/_2$; $1:^1/_2$ gypsum plaster.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-3-Me-29	$3^1/_2$″	Core: steel studs; see Note 4; Facings: both sides $^3/_4$″ thickness of 1:2; 1:2 gypsum plaster.	N/A	1 hr.		1			1
W-3-Me-30	$3^1/_2$″	Core: steel studs; see Note 4; Facings: both sides $^3/_4$″ thickness of 1:2; 1:3 gypsum plaster.	N/A	45 min.		1			$^3/_4$
W-3-Me-31	$3^3/_4$″	Core: steel studs; see Note 4; Facings: both sides $^7/_8$″ thickness of $1:^1/_{30}$: 2; $1:^1/_{30}$: 3 Portland cement and asbestos fiber plaster.	N/A	1 hr.		1			1
W-3-Me-32	$3^3/_4$″	Core: steel studs; see Note 4; Facings: both sides $^7/_8$″ thickness of 1:2; 1:3 Portland cement.	N/A	45 min.		1			$^3/_4$
W-3-Me-33	$3^3/_4$″	Core: steel studs; see Note 4; Facings: both sides $^7/_8$″ thickness of neat gypsum plaster.	N/A	2 hrs.		1			2
W-3-Me-34	$3^3/_4$″	Core: steel studs; see Note 4; Facings: both sides $^7/_8$″ thickness of $1:^1/_2$; $1:^1/_2$ gypsum plaster.	N/A	1 hr. 30 min.		1			$1^1/_2$

(continued)

TABLE 1.2.1—continued
METAL FRAME WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-3-Me-35	$3^3/_4$″	Core: steel studs; see Note 4; Facings: both sides $^7/_8$″ thickness of 1:2; 1:2 gypsum plaster.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-3-Me-36	$3^3/_4$″	Core: steel; see Note 4; Facings: $^7/_8$″ thickness of 1:2; 1:3 gypsum plaster on both sides.	N/A	1 hr.		1			1

For SI: 1 inch = 25.4 mm.

Notes:

1. Failure mode—local temperature rise—back face.
2. Three-fourths inch or 1 inch channel framing—hot-rolled or strip-steel channels.
3. Reinforcement is 4-inch square mesh of No. 6 wire welded at intersections (no channels).
4. Ratings are for any usual type of nonload-bearing metal framing providing 2 inches (or more) air space.

General Note:

The construction details of the wall assemblies are as complete as the source documentation will permit. Data on the method of attachment of facings and the gauge of steel studs was provided when known. The cross-sectional area of the steel stud can be computed, thereby permitting a reasoned estimate of actual loading conditions. For load-bearing assemblies, the maximum allowable stress for the steel studs has been provided in the table "Notes." More often, it is the thermal properties of the facing materials, rather than the specific gauge of the steel, that will determine the degree of fire resistance. This is particularly true for nonbearing wall assemblies.

FIGURE 1.2.2
METAL FRAME WALLS
4″ TO LESS THAN 6″ THICK

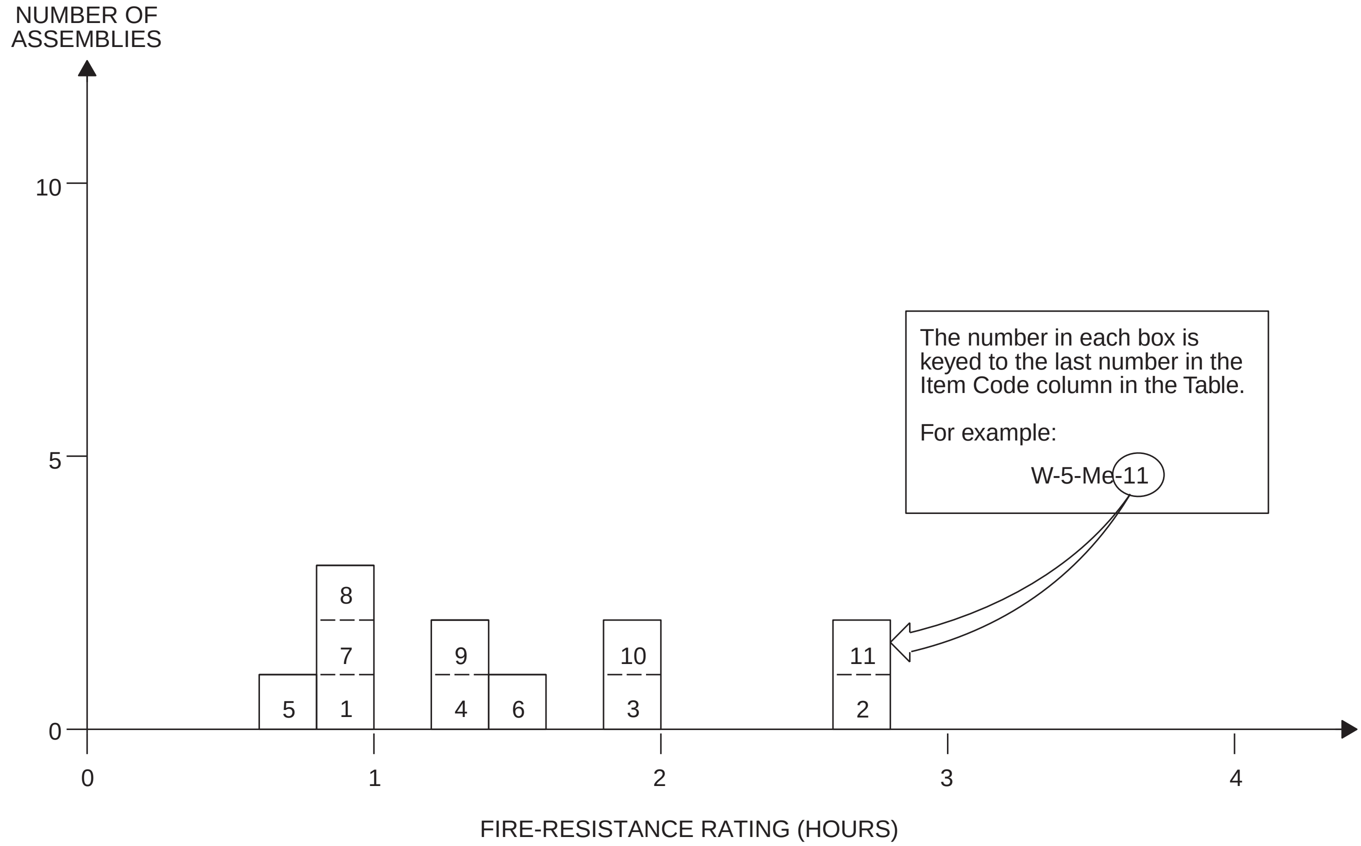


TABLE 1.2.2
METAL FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-5-Me-1	$5^1/_2$″	3″ cavity with 16 ga. channel studs ($3^1/_2$″ o.c.) of $^1/_2$″ × $^1/_2$″ channel and 3″ spacer; Metal lath on ribs with plaster (three coats) $^3/_4$″ over face of lath; Plaster (each side): scratch coat, cement/lime/sand with hair; float coat, cement/lime/sand; finish coat, neat gypsum.	N/A	1 hr. 11 min.			7	1	1
W-4-Me-2	4″	Core: steel studs; see Note 2; Facings: both sides 1″ thickness of neat gypsum plaster.	N/A	2 hrs. 30 min.		1			$2^1/_2$
W-4-Me-3	4″	Core: steel studs; see Note 2; Facings: both sides 1″ thickness of 1:$^1/_2$; 1:$^1/_2$ gypsum plaster.	N/A	2 hrs.		1			2
W-4-Me-4	4″	Core: steel; see Note 2; Facings: both sides 1″ thickness of 1:2; 1:3 gypsum plaster.	N/A	1 hr. 15 min.		1			$1^1/_4$
W-4-Me-5	$4^1/_2$″	Core: lightweight steel studs 3″ in depth; Facings: both sides $^3/_4$″ thick sanded gypsum plaster, 1:2 scratch coat, 1:3 brown coat applied on metal lath.	See Note 4	45 min.		1		5	$^3/_4$

(continued)

TABLE 1.2.2—continued
METAL FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-Me-6	$4^1/_2$″	Core: lightweight steel studs 3″ in depth; Facings: both sides $^3/_4$″ thick neat gypsum plaster on metal lath.	See Note 4	1 hr. 30 min.		1		5	$1^1/_2$
W-4-Me-7	$4^1/_2$″	Core: lightweight steel studs 3″ in depth; Facings: both sides $^3/_4$″ thick sanded gypsum plaster, 1:2 scratch and brown coats applied on metal lath.	See Note 4	1 hr.		1		5	1
W-4-Me-8	$4^3/_4$″	Core: lightweight steel studs 3″ in depth; Facings: both sides $^7/_8$″ thick sanded gypsum plaster, 1:2 scratch coat, 1:3 brown coat, applied on metal lath.	See Note 4	1 hr.		1		5	1
W-4-Me-9	$4^3/_4$″	Core: lightweight steel studs 3″ in depth; Facings: both sides $^7/_8$″ thick sanded gypsum plaster, 1:2 scratch and 1:3 brown coats applied on metal lath.	See Note 4	1 hr. 15 min.		1		5	$1^1/_4$
W-5-Me-10	5″	Core: lightweight steel studs 3″ in depth; Facings: both sides 1″ thick neat gypsum plaster on metal lath.	See Note 4	2 hrs.		1		5	2
W-5-Me-11	5″	Core: lightweight steel studs 3″ in depth; Facings: both sides 1″ thick neat gypsum plaster on metal lath.	See Note 4	2 hrs. 30 min.		1		5, 6	$2^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Failure mode—local back face temperature rise.
2. Ratings are for any usual type of nonbearing metal framing providing a minimum 2 inches air space.
3. Facing materials secured to lightweight steel studs not less than 3 inches deep.
4. Rating based on loading to develop a maximum stress of 7270 psi for net area of each stud.
5. Spacing of steel studs must be sufficient to develop adequate rigidity in the metal-lath or gypsum-plaster base.
6. As per Note 4 but load/stud not to exceed 5120 psi.

General Note:

The construction details of the wall assemblies are as complete as the source documentation will permit. Data on the method of attachment of facings and the gauge of steel studs was provided when known. The cross sectional area of the steel stud can be computed, thereby permitting a reasoned estimate of actual loading conditions. For load-bearing assemblies, the maximum allowable stress for the steel studs has been provided in the table “Notes.” More often, it is the thermal properties of the facing materials, rather than the specific gauge of the steel, that will determine the degree of fire resistance. This is particularly true for nonbearing wall assemblies.

TABLE 1.2.3
METAL FRAME WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-Me-1	$6^5/_8$″	On one side of 1″ magnesium oxysulfate wood fiberboard sheathing attached to steel studs (see Notes 1 and 2), 1″ air space, $3^3/_4$″ brick secured with metal ties to steel frame every fifth course; Inside facing of $^7/_8$″ 1:2 sanded gypsum plaster on metal lath secured directly to studs; Plaster side exposed to fire.	See Note 2	1 hr. 45 min.		1		1	$1^3/_4$
W-6-Me-2	$6^5/_8$″	On one side of 1″ magnesium oxysulfate wood fiberboard sheathing attached to steel studs (see Notes 1 and 2), 1″ air space, $3^3/_4$″ brick secured with metal ties to steel frame every fifth course; Inside facing of $^7/_8$″ 1:2 sanded gypsum plaster on metal lath secured directly to studs; Brick face exposed to fire.	See Note 2	4 hrs.		1		1	4
W-6-Me-3	$6^5/_8$″	On one side of 1″ magnesium oxysulfate wood fiberboard sheathing attached to steel studs (see Notes 1 and 2), 1″ air space, $3^3/_4$″ brick secured with metal ties to steel frame every fifth course; Inside facing of $^7/_8$″ vermiculite plaster on metal lath secured directly to studs; Plaster side exposed to fire.	See Note 2	2 hrs.		1		1	2

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Lightweight steel studs (minimum 3 inches deep) used. Stud spacing dependent on loading, but in each case, spacing is to be such that adequate rigidity is provided to the metal lath plaster base.
2. Load is such that stress developed in studs is not greater than 5120 psi calculated from net stud area.

General Note:

The construction details of the wall assemblies are as complete as the source documentation will permit. Data on the method of attachment of facings and the gauge of steel studs was provided when known. The cross sectional area of the steel stud can be computed, thereby permitting a reasoned estimate of actual loading conditions. For load-bearing assemblies, the maximum allowable stress for the steel studs has been provided in the table "Notes." More often, it is the thermal properties of the facing materials, rather than the specific gauge of the steel, that will determine the degree of fire resistance. This is particularly true for nonbearing wall assemblies.

TABLE 1.2.4
METAL FRAME WALLS
8″ TO LESS THAN 10″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-9-Me-1	$9^1/_{16}$″	On one side of $^1/_2$″ wood fiberboard sheathing next to studs, $^3/_4$″ air space formed with $^3/_4$″ × $1^5/_8$″ wood strips placed over the fiberboard and secured to the studs, paper backed wire lath nailed to strips $3^3/_4$″ brick veneer held in place by filling a $^3/_4$″ space between the brick and paper backed lath with mortar; Inside facing of $^3/_4$″ neat gypsum plaster on metal lath attached to $^5/_{16}$″ plywood strips secured to edges of steel studs; Rated as combustible because of the sheathing; See Notes 1 and 2; Plaster exposed.	See Note 2	1 hr. 45 min.		1		1	$1^3/_4$
W-9-Me-2	$9^1/_{16}$″	Same as above with brick exposed.	See Note 2	4 hrs.		1		1	4
W-8-Me-3	$8^1/_2$″	On one side of paper backed wire lath attached to studs and $3^3/_4$″ brick veneer held in place by filling a 1″ space between the brick and lath with mortar; Inside facing of 1″ paper-enclosed mineral wool blanket weighing 0.6 lb./ft.^{2} attached to studs, metal lath or paper backed wire lath laid over the blanket and attached to the studs, $^3/_4$″ sanded gypsum plaster 1:2 for the scratch coat and 1:3 for the brown coat; See Notes 1 and 2; Plaster face exposed.	See Note 2	4 hrs.		1		1	4
W-8-Me-4	$8^1/_2$″	Same as above with brick exposed.	See Note 2	5 hrs.		1		1	5

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Lightweight steel studs ≥ 3 inches in depth. Stud spacing dependent on loading, but in any case, the spacing is to be such that adequate rigidity is provided to the metal-lath plaster base.
2. Load is such that stress developed in studs is ≤ 5120 psi calculated from the net area of the stud.

General Note:

The construction details of the wall assemblies are as complete as the source documentation will permit. Data on the method of attachment of facings and the gauge of steel studs was provided when known. The cross sectional area of the steel stud can be computed, thereby permitting a reasoned estimate of actual loading conditions. For load-bearing assemblies, the maximum allowable stress for the steel studs has been provided in the table “Notes.” More often, it is the thermal properties of the facing materials, rather than the specific gauge of the steel, that will determine the degree of fire resistance. This is particularly true for nonbearing wall assemblies.

TABLE 1.3.1
WOOD FRAME WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-3-W-1	$3^3/_4$″	Solid wall: $2^1/_4$″ wood-wool slab core; $^3/_4$″ gypsum plaster each side.	N/A	2 hrs.			7	1, 6	2
W-3-W-2	$3^7/_8$″	2 × 4 stud wall; $^3/_{16}$″ thick cement asbestos board on both sides of wall.	360 psi net area	10 min.		1		2-5	$^1/_6$
W-3-W-3	$3^7/_8$″	Same as W-3-W-2 but stud cavities filled with 1 lb./ft.^{2} mineral wool batts.	360 psi net area	40 min.		1		2-5	$^2/_3$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa.

Notes:

1. Achieved “Grade C” fire resistance (British).
2. Nominal 2 × 4 wood studs of No. 1 common or better lumber set edgewise, 2 × 4 plates at top and bottom and blocking at mid height of wall.
3. All horizontal joints in facing material backed by 2 × 4 blocking in wall.
4. Load: 360 psi of net stud cross sectional area.
5. Facings secured with 6d casing nails. Nail holes predrilled and 0.02 inch to 0.03 inch smaller than nail diameter.
6. The wood-wool core is a pressed excelsior slab which possesses insulating properties similar to cellulosic insulation.

FIGURE 1.3.2
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

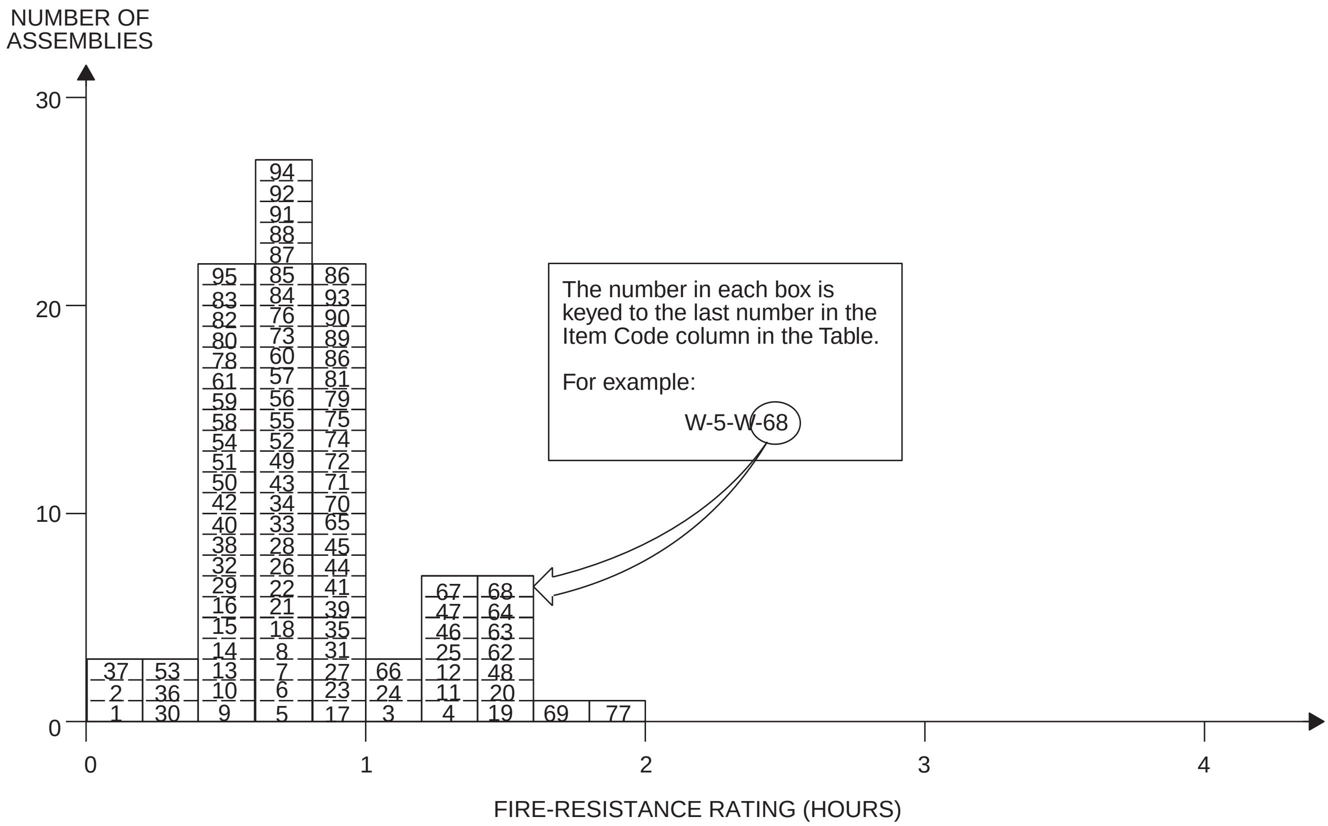


TABLE 1.3.2
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-W-1	4″	2″ × 4″ stud wall; $^3/_{16}$″ CAB; no insulation; Design A.	35 min.	10 min.			4	1-10	$^1/_6$
W-4-W-2	$4^1/_8$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB; no insulation; Design A.	38 min.	9 min.			4	1-10	$^1/_6$
W-4-W-3	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB and $^3/_8$″ gypsum board face (both sides); Design B.	62 min.	64 min.			4	1-10	1
W-5-W-4	5″	2″ × 4″ stud wall; $^3/_{16}$″ CAB and $^1/_2$″ gypsum board (both sides); Design B.	79 min.	Greater than 90 min.			4	1-10	1
W-4-W-5	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB and $^3/_8$″ gypsum board (both sides); Design B.	45 min.	45 min.			4	1-12	—
W-5-W-6	5″	2″ × 4″ stud wall; $^3/_{16}$″ CAB and $^1/_2$″ gypsum board face (both sides); Design B.	45 min.	45 min.			4	1-10, 12, 13	—
W-4-W-7	4″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $3^1/_2$″ mineral wool insulation; Design C.	40 min.	42 min.			4	1-10	$^2/_3$
W-4-W-8	4″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $3^1/_2$″ mineral wool insulation; Design C.	46 min.	46 min.			4	1-10, 43	$^2/_3$
W-4-W-9	4″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $3^1/_2$″ mineral wool insulation; Design C.	30 min.	30 min.			4	1-10, 12, 14	—

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-W-10	$4^1/_8$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $3^1/_2$″ mineral wool insulation; Design C.	—	30 min.			4	1-8, 12, 14	—
W-4-W-11	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $^3/_8$″ gypsum strips over studs; $5^1/_2$″ mineral wool insulation; Design D.	79 min.	79 min.			4	1-10	1
W-4-W-12	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $^3/_8$″ gypsum strips at stud edges; $7^1/_2$″ mineral wool insulation; Design D.	82 min.	82 min.			4	1-10	1
W-4-W-13	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $^3/_8$″ gypsum board strips over studs; $5^1/_2$″ mineral wool insulation; Design D.	30 min.	30 min.			4	1-12	—
W-4-W-14	$4^3/_4$″	2″ × 4″ stud wall; $^3/_{16}$″ CAB face; $^3/_8$″ gypsum board strips over studs; 7″ mineral wool insulation; Design D.	30 min.	30 min.			4	1-12	—
W-5-W-15	$5^1/_2$″	2″ × 4″ stud wall; Exposed face: CAB shingles over 1″ × 6″; Unexposed face: $^1/_8$″ CAB sheet; $^7/_{16}$″ fiberboard (wood); Design E.	34 min.	—			4	1-10	$^1/_2$
W-5-W-16	$5^1/_2$″	2″ × 4″ stud wall; Exposed face: $^1/_8$″ CAB sheet; $^7/_{16}$″ fiberboard; Unexposed face: CAB shingles over 1″ × 6″; Design E.	32 min.	33 min.			4	1-10	$^1/_2$
W-5-W-17	$5^1/_2$″	2″ × 4″ stud wall; Exposed face: CAB shingles over 1″ × 6″; Unexposed face: $^1/_8$″ CAB sheet; gypsum at stud edges; $3^1/_2$″ mineral wood insulation; Design F.	51 min.	—			4	1-10	$^3/_4$
W-5-W-18	$5^1/_2$″	2″ × 4″ stud wall; Exposed face: $^1/_8$″ CAB sheet; gypsum board at stud edges; Unexposed face: CAB shingles over 1″ × 6″; $3^1/_2$″ mineral wool insulation; Design F.	42 min.	—			4	1-10	$^2/_3$
W-5-W-19	$5^5/_8$″	2″ × 4″ stud wall; Exposed face: CAB shingles over 1″ × 6″; Unexposed face: $^1/_8$″ CAB sheet; gypsum board at stud edges; $5^1/_2$″ mineral wool insulation; Design G.	74 min.	85 min.			4	1-10	1
W-5-W-20	$5^5/_8$″	2″ × 4″ stud wall; Exposed face: $^1/_8$″ CAB sheet; gypsum board at $^3/_{16}$″ stud edges; $^7/_{16}$″ fiberboard; Unexposed face: CAB shingles over 1″ × 6″; $5^1/_2$″ mineral wool insulation; Design G.	79 min.	85 min.			4	1-10	$1^1/_4$
W-5-W-21	$5^5/_8$″	2″ × 4″ stud wall; Exposed face: CAB shingles 1″ × 6″ sheathing; Unexposed face: CAB sheet; gypsum board at stud edges; $5^1/_2$″ mineral wool insulation; Design G.	38 min.	38 min.			4	1-10, 12, 14	—
W-5-W-22	$5^5/_8$″	2″ × 4″ stud wall; Exposed face: CAB sheet; gypsum board at stud edges; Unexposed face: CAB shingles 1″ × 6″ sheathing; $5^1/_2$″ mineral wool insulation; Design G.	38 min.	38 min.			4	1-12	—
W-6-W-23	6″	2″ × 4″ stud wall; 16″ o.c.; $^1/_2$″ gypsum board each side; $^1/_2$″ gypsum plaster each side.	N/A	60 min.			7	15	1

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK.

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-W-24	6″	2″ × 4″ stud wall; 16″ o.c.; $^1/_2$″ gypsum board each side; $^1/_2$″ gypsum plaster each side.	N/A	68 min.			7	16	1
W-6-W-25	$6^7/_8$″	2″ × 4″ stud wall; 18″ o.c.; $^3/_4$″ gypsum plank each side; $^3/_{16}$″ gypsum plaster each side.	N/A	80 min.			7	15	$1^1/_3$
W-5-W-26	$5^1/_8$″	2″ × 4″ stud wall; 16″ o.c.; $^3/_8$″ gypsum board each side; $^3/_{16}$″ gypsum plaster each side.	N/A	37 min.			7	15	$^1/_2$
W-5-W-27	$5^3/_4$″	2″ × 4″ stud wall; 16″ o.c.; $^3/_8$″ gypsum lath each side; $^1/_2$″ gypsum plaster each side.	N/A	52 min.			7	15	$^3/_4$
W-5-W-28	5″	2″ × 4″ stud wall; 16″ o.c.; $^1/_2$″ gypsum board each side.	N/A	37 min.			7	16	$^1/_2$
W-5-W-29	5″	2″ × 4″ stud wall; $^1/_2$″ fiberboard both sides 14% M.C. with F.R. paint at 35 gm./ft.^{2}.	N/A	28 min.			7	15	$^1/_3$
W-4-W-30	$4^3/_4$″	2″ × 4″ stud wall; Fire side: $^1/_2$″ (wood) fiberboard; Back side: $^1/_4$″ CAB; 16″ o.c.	N/A	17 min.			7	15, 16	$^1/_4$
W-5-W-31	$5^1/_8$″	2″ × 4″ stud wall; 16″ o.c.; $^1/_2$″ fiberboard insulation with $^1/_{32}$″ asbestos (both sides of each board).	N/A	50 min.			7	16	$^3/_4$
W-4-W-32	$4^1/_4$″	2″ × 4″ stud wall; $^3/_8$″ thick gypsum wallboard on both faces; insulated cavities.	See Note 23	25 min.		1		17, 18, 23	$^1/_3$
W-4-W-33	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick gypsum wallboard on both faces.	See Note 17	40 min.		1		17, 23	$^1/_3$
W-4-W-34	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick gypsum wallboard on both faces; insulated cavities.	See Note 17	45 min.		1		17, 18, 23	$^3/_4$
W-4-W-35	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick gypsum wallboard on both faces; insulated cavities.	N/A	1 hr.		1		17, 18, 24	1
W-4-W-36	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick, 1.1 lbs./ft.^{2} wood fiberboard sheathing on both faces.	See Note 23	15 min.		1		17, 23	$^1/_4$
W-4-W-37	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick, 0.7 lb./ft.^{2} wood fiberboard sheathing on both faces.	See Note 23	10 min.		1		17, 23	$^1/_6$
W-4-W-38	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick, flameproofed 1.6 lbs./ft.^{2} wood fiberboard sheathing on both faces.	See Note 23	30 min.		1		17, 23	$^1/_2$
W-4-W-39	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick gypsum wallboard on both faces; insulated cavities.	See Note 23	1 hr.		1		17, 18, 23	1
W-4-W-40	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick, 1:2; 1:3 gypsum plaster on wood lath on both faces.	See Note 23	30 min.		1		17, 21, 23	$^1/_2$
W-4-W-41	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″, 1:2; 1:3 gypsum plaster on wood lath on both faces; insulated cavities.	See Note 23	1 hr.		1		17, 18, 21, 24	1

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-W-42	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″, 1:5; 1:7.5 lime plaster on wood lath on both wall faces.	See Note 23	30 min.		1		17, 21, 23	$^1/_2$
W-4-W-43	$4^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick 1:5; 1:7.5 lime plaster on wood lath on both faces; insulated cavities.	See Note 23	45 min.		1		17, 18, 21, 23	$^3/_4$
W-4-W-44	$4^5/_8$″	2″ × 4″ stud wall; $^3/_{16}$″ thick cement-asbestos over $^3/_8$″ thick gypsum board on both faces.	See Note 23	1 hr.		1		23, 25, 26, 27	1
W-4-W-45	$4^5/_8$″	2″ × 4″ stud wall; studs faced with 4″ wide strips of $^3/_8$″ thick gypsum board; $^3/_{16}$″ thick gypsum cement-asbestos board on both faces; insulated cavities.	See Note 23	1 hr.		1		23, 25, 27, 28	1
W-4-W-46	$4^5/_8$″	Same as W-4-W-45 but nonload bearing.	N/A	1 hr. 15 min.		1		24, 28	$1^1/_4$
W-4-W-47	$4^7/_8$″	2″ × 4″ stud wall; $^3/_{16}$″ thick cement-asbestos board over $^1/_2$″ thick gypsum sheathing on both faces.	See Note 23	1 hr. 15 min.		1		23, 25, 26, 27	$1^1/_4$
W-4-W-48	$4^7/_8$″	Same as W-4-W-47 but nonload bearing.	N/A	1 hr. 30 min.		1		24, 27	$1^1/_2$
W-5-W-49	5″	2″ × 4″ stud wall; Exterior face: $^3/_4$″ wood sheathing; asbestos felt 14 lbs./100 ft.^{2} and $^5/_{32}$″ cement-asbestos shingles; Interior face: 4″ wide strips of $^3/_8$″ gypsum board over studs; wall faced with $^3/_{16}$″ thick cement-asbestos board.	See Note 23	40 min.		1		18, 23, 25, 26, 29	$^2/_3$
W-5-W-50	5″	2″ × 4″ stud wall; Exterior face: as per W-5-W-49; Interior face: $^9/_{16}$″ composite board consisting of $^7/_{16}$″ thick wood fiberboard faced with $^1/_8$″ thick cement-asbestos board; Exterior side exposed to fire.	See Note 23	30 min.		1		23, 25, 26, 30	$^1/_2$
W-5-W-51	5″	Same as W-5-W-50 but interior side exposed to fire.	See Note 23	30 min.		1		23, 25, 26	$^1/_2$
W-5-W-52	5″	Same as W-5-W-49 but exterior side exposed to fire.	See Note 23	45 min.		1		18, 23, 25, 26	$^3/_4$
W-5-W-53	5″	2″ × 4″ stud wall; $^3/_4$″ thick T&G wood boards on both sides.	See Note 23	20 min.		1		17, 23	$^1/_3$
W-5-W-54	5″	Same as W-5-W-53 but with insulated cavities.	See Note 23	35 min.		1		17, 18, 23	$^1/_2$
W-5-W-55	5″	2″ × 4″ stud wall; $^3/_4$″ thick T&G wood boards on both sides with 30 lbs./100 ft.^{2} asbestos; paper, between studs and boards.	See Note 23	45 min.		1		17, 23	$^3/_4$
W-5-W-56	5″	2″ × 4″ stud wall; $^1/_2$″ thick, 1:2; 1:3 gypsum plaster on metal lath on both sides of wall.	See Note 23	45 min.		1		17, 21, 34	$^3/_4$

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-5-W-57	5″	2″ × 4″ stud wall; $^3/_4$″ thick 2:1:8; 2:1:12 lime and Keene's cement plaster over metal lath on both sides of wall.	See Note 23	45 min.		1		17, 21, 23	$^1/_2$
W-5-W-58	5″	2″ × 4″ stud wall; $^3/_4$″ thick 2:1:8; 2:1:10 lime Portland cement plaster over metal lath on both sides of wall.	See Note 23	30 min.		1		17, 21, 23	$^1/_2$
W-5-W-59	5″	2″ × 4″ stud wall; $^3/_4$″ thick 1:5; 1:7.5 lime plaster on metal lath on both sides of wall.	See Note 23	30 min.		1		17, 21, 23	$^1/_2$
W-5-W-60	5″	2″ × 4″ stud wall; $^3/_4$″ thick 1:$^1/_{30}$:2; 1:$^1/_{30}$:3 Portland cement, asbestos fiber plaster on metal lath on both sides of wall.	See Note 23	45 min.		1		17, 21, 23	$^3/_4$
W-5-W-61	5″	2″ × 4″ stud wall; $^3/_4$″ thick 1:2; 1:3 Portland cement plaster on metal lath on both sides of wall.	See Note 23	30 min.		1		17, 21, 23	$^1/_2$
W-5-W-62	5″	2″ × 4″ stud wall; $^3/_4$″ thick neat gypsum plaster on metal lath on both sides of wall.	N/A	1 hr. 30 min.		1		17, 22, 24	$1^1/_2$
W-5-W-63	5″	2″ × 4″ stud wall; $^3/_4$″ thick neat gypsum plaster on metal lath on both sides of wall.	See Note 23	1 hr. 30 min.		1		17, 21, 23	$1^1/_2$
W-5-W-64	5″	2″ × 4″ stud wall; $^3/_4$″ thick 1:2; 1:2 gypsum plaster on metal lath on both sides of wall; insulated cavities.	See Note 23	1 hr. 30 min.		1		17, 18, 21, 23	$1^1/_2$
W-5-W-65	5″	2″ × 4″ stud wall; same as W-5-W-64 but cavities not insulated.	See Note 23	1 hr.		1		17, 21, 23	1
W-5-W-66	5″	2″ × 4″ stud wall; $^3/_4$″ thick 1:2; 1:3 gypsum plaster on metal lath on both sides of wall; insulated cavities.	See Note 23	1 hr. 15 min.		1		17, 18, 21, 23	$1^1/_4$
W-5-W-67	$5^1/_{16}$″	Same as W-5-W-49 except cavity insulation of 1.75 lbs./ft.^{2} mineral wool bats; rating applies when either wall side exposed to fire.	See Note 23	1 hr. 15 min.		1		23, 26, 25	$1^1/_4$
W-5-W-68	$5^1/_4$″	2″ × 4″ stud wall, $^7/_8$″ thick 1:2; 1:3 gypsum plaster on metal lath on both sides of wall; insulated cavities.	See Note 23	1 hr. 30 min.		1		17, 18, 21, 23	$1^1/_2$
W-5-W-69	$5^1/_4$″	2″ × 4″ stud wall; $^7/_8$″ thick neat gypsum plaster applied on metal lath on both sides of wall.	N/A	1 hr. 45 min.		1		17, 22, 24	$1^3/_4$
W-5-W-70	$5^1/_4$″	2″ × 4″ stud wall; $^1/_2$″ thick neat gypsum plaster on $^3/_8$″ plain gypsum lath on both sides of wall.	See Note 23	1 hr.		1		17, 22, 23	1
W-5-W-71	$5^1/_4$″	2″ × 4″ stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster on $^3/_8$″ thick plain gypsum lath with $1^3/_4$″ × $1^3/_4$″ metal lath pads nailed 8″ o.c. vertically and 16″ o.c. horizontally on both sides of wall.	See Note 23	1 hr.		1		17, 21, 23	1
W-5-W-72	$5^1/_4$″	2″ × 4″ stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster on $^3/_8$″ perforated gypsum lath, one $^3/_4$″ diameter hole or larger per 16″ square of lath surface, on both sides of wall.	See Note 23	1 hr.		1		17, 21, 23	1

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-5-W-73	5$^1/_4$″	2″ × 4″ stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster on $^3/_8$″ gypsum lath (plain, indented or perforated) on both sides of wall.	See Note 23	45 min.		1		17, 21, 23	$^3/_4$
W-5-W-74	5$^1/_4$″	2″ × 4″ stud wall; $^7/_8$″ thick of 1:2; 1:3 gypsum plaster over metal lath on both sides of wall.	See Note 23	1 hr.		1		17, 21, 23	1
W-5-W-75	5$^1/_4$″	2″ × 4″ stud wall; $^7/_8$″ thick of 1:$^1/_{30}$:2; 1:$^1/_{30}$:3 Portland cement, asbestos plaster applied over metal lath on both sides of wall.	See Note 23	1 hr.		1		17, 21, 23	1
W-5-W-76	5$^1/_4$″	2″ × 4″ stud wall; $^7/_8$″ thick of 1:2; 1:3 Portland cement plaster over metal lath on both sides of wall.	See Note 23	45 min.		1		17, 21, 23	$^3/_4$
W-5-W-77	5$^1/_2$″	2″ × 4″ stud wall; 1″ thick neat gypsum plaster over metal lath on both sides of wall; nonload bearing.	N/A	2 hrs.		1		17, 22, 24	2
W-5-W-78	5$^1/_2$″	2″ × 4″ stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster on $^1/_2$″ thick, 0.7 lb./ft.^{2} wood fiberboard on both sides of wall.	See Note 23	35 min.		1		17, 21, 23	$^1/_2$
W-4-W-79	4$^3/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over wood lath on both sides of wall; mineral wool insulation.	N/A	1 hr.			43	21, 31, 35, 38	1
W-4-W-80	4$^3/_4$″	Same as W-4-W-79 but uninsulated.	N/A	35 min.			43	21, 31, 35	$^1/_2$
W-4-W-81	4$^3/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 3:1:8; 3:1:12 lime, Keene's cement, sand plaster over wood lath on both sides of wall; mineral wool insulation.	N/A	1 hr.			43	21, 31, 35, 40	1
W-4-W-82	4$^3/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:6$^1/_4$; 1:6$^1/_4$ lime Keene's cement plaster over wood lath on both sides of wall; mineral wool insulation.	N/A	30 min.			43	21, 31, 35, 40	$^1/_2$
W-4-W-83	4$^3/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:5; 1:7.5 lime plaster over wood lath on both sides of wall.	N/A	30 min.			43	21, 31, 35	$^1/_2$
W-5-W-84	5$^1/_8$″	2″ × 4″ wood stud wall; $^{11}/_{16}$″ thick of 1:5; 1:7.5 lime plaster over wood lath on both sides of wall; mineral wool insulation.	N/A	45 min.			43	21, 31, 35, 39	$^3/_4$
W-5-W-85	5$^1/_4$″	2″ × 4″ wood stud wall; $^3/_4$″thick of 1:5; 1:7 lime plaster over wood lath on both sides of wall; mineral wool insulation.	N/A	40 min.			43	21, 31, 35, 40	$^2/_3$
W-5-W-86	5$^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 2:1:12 lime, Keene's cement and sand scratch coat; $^1/_2$″ thick 2:1:18 lime, Keene's cement and sand brown coat over wood lath on both sides of wall; mineral wool insulation.	N/A	1 hr.			43	21, 31, 35, 40	1
W-5-W-87	5$^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ plaster board on both sides of wall.	N/A	45 min.			43	21, 31	$^3/_4$

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-5-W-88	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ gypsum lath on both sides of wall.	N/A	45 min.			43	21, 31	$^3/_4$
W-5-W-89	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ gypsum lath on both sides of wall.	N/A	1 hr.			43	21, 31, 33	1
W-5-W-90	$5^1/_4$″	2″ × 4 ″ wood stud wall; $^1/_2$″ thick neat plaster over $^3/_8$″ thick gypsum lath on both sides of wall.	N/A	1 hr.			43	21, 22, 31	1
W-5-W-91	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ thick indented gypsum lath on both sides of wall.	N/A	45 min.			43	21, 31	$^3/_4$
W-5-W-92	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ thick perforated gypsum lath on both sides of wall.	N/A	45 min.			43	21, 31, 34	$^3/_4$
W-5-W-93	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ perforated gypsum lath on both sides of wall.	N/A	1 hr.			43	21, 31	1
W-5-W-94	$5^1/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^3/_8$″ thick perforated gypsum lath on both sides of wall.	N/A	45 min.			43	21, 31, 34	$^3/_4$
W-5-W-95	$5^1/_2$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^1/_2$″ thick wood fiberboard plaster base on both sides of wall.	N/A	35 min.			43	21, 31, 36	$^1/_2$
W-5-W-96	$5^3/_4$″	2″ × 4″ wood stud wall; $^1/_2$″ thick of 1:2; 1:2 gypsum plaster over $^7/_8$″ thick flameproofed wood fiberboard on both sides of wall.	N/A	1 hr.			43	21, 31, 37	1

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.

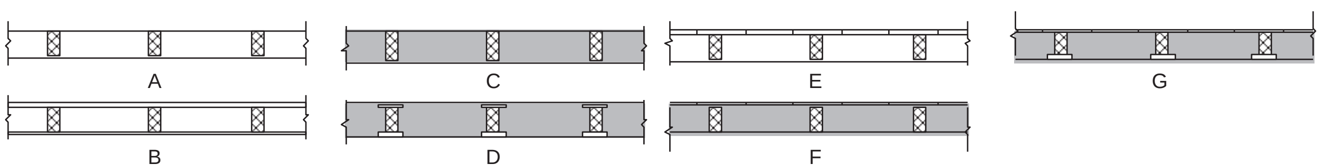
Notes:

1. All specimens 8 feet or 8 feet 8 inches by 10 feet 4 inches, i.e. one-half of furnace size. See Note 42 for design cross section.
2. Specimens tested in tandem (two per exposure).
3. Test per ASA No. A2-1934 except where unloaded. Also, panels were of “half” size of furnace opening. Time value signifies a thermal failure time.
4. Two-inch by 4-inch studs: 16 inches on center.; where 10 feet 4 inches, blocking at 2-foot 4-inch height.
5. Facing 4 feet by 8 feet, cement-asbestos board sheets, $^3/_{16}$ inch thick.
6. Sheathing (diagonal): 25/22 inch by $5^1/_2$ inch, 1 inch by 6 inches pine.
7. Facing shingles: 24 inches by 12 inches by $^5/_{32}$ inch where used.
8. Asbestos felt: asphalt sat between sheathing and shingles.
9. Load: 30,500 pounds or 360 psi/stud where load was tested.
10. Walls were tested beyond achievement of first test end point. A load-bearing time in excess of performance time indicates that although thermal criteria were exceeded, load-bearing ability continued.
11. Wall was rated for one hour combustible use in original source.
12. Hose steam test specimen. See table entry of similar design above for recommended rating.
13. Rated one and one-fourth hour load bearing. Rated one and one-half hour nonload bearing.
14. Failed hose stream.
15. Test terminated due to flame penetration.
16. Test terminated—local back face temperature rise.
17. Nominal 2-inch by 4-inch wood studs of No. 1 common or better lumber set edgewise. Two-inch by four-inch plates at top and bottom and blocking at mid height of wall.
18. Cavity insulation consists of rock wool bats 1.0 lb./ft.^{2} of filled cavity area.
19. Cavity insulation consists of glass wool bats 0.6 lb./ft.^{2} of filled cavity area.
20. Cavity insulation consists of blown-in rock wool 2.0 lbs./ft.^{2} of filled cavity area
21. Mix proportions for plastered walls as follows: first ratio indicates scratch coat mix, weight of dry plaster: dry sand; second ratio indicates brown coat mix.
22. “Neat” plaster is taken to mean unsanded wood-fiber gypsum plaster.
23. Load: 360 psi of net stud cross sectional area.
24. Rated as nonload bearing.

(continued)

TABLE 1.3.2—continued
WOOD FRAME WALLS
4″ TO LESS THAN 6″ THICK

25. Nominal 2-inch by 4-inch studs per Note 17, spaced at 16 inches on center.
26. Horizontal joints in facing material supported by 2-inch by 4-inch blocking within wall.
27. Facings secured with 6d casing nails. Nail holes predrilled and were 0.02 to 0.03 inch smaller than nail diameter.
28. Cavity insulation consists of mineral wool bats weighing 2 lbs./ft.^{2} of filled cavity area.
29. Interior wall face exposed to fire.
30. Exterior wall faced exposed to fire.
31. Nominal 2-inch by 4-inch studs of yellow pine or Douglas-fir spaced 16 inches on center in a single row.
32. Studs as in Note 31 except double row, with studs in rows staggered.
33. Six roofing nails with metal-lath pads around heats to each 16-inch by 48-inch lath.
34. Areas of holes less than $2^3/_4$ percent of area of lath.
35. Wood laths were nailed with either 3d or 4d nails, one nail to each bearing, and the end joining broken every seventh course.
36. One-half-inch thick fiberboard plaster base nailed with 3d or 4d common wire nails spaced 4 to 6 inches on center.
37. Seven-eighths-inch thick fiberboard plaster base nailed with 5d common wire nails spaced 4 to 6 inches on center.
38. Mineral wood bats 1.05 to 1.25 lbs./ft.^{2} with waterproofed-paper backing.
39. Blown-in mineral wool insulation, 2.2 lbs./ft.^{2}.
40. Mineral wool bats, 1.4 lbs./ft.^{2} with waterproofed-paper backing.
41. Mineral wood bats, 0.9 lb./ft.^{2}.
42. See wall design diagram below.



43. Duplicate specimen of W-4-W-7, tested simultaneously with W-4-W-7 in 18-foot test furnace.

TABLE 1.3.3
WOOD FRAME WALLS
6″ TO LESS THAN 8″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-6-W-1	$6^1/_4$″	2 × 4 stud wall; $^1/_2$″ thick, 1:2; 1:2 gypsum plaster on $^7/_8$″ flameproofed wood fiberboard weighing 2.8 lbs./ft.^{2} on both sides of wall.	See Note 3	1 hr.		1		1-3	1
W-6-W-2	$6^1/_2$″	2 × 4 stud wall; $^1/_2$″ thick, 1:3; 1:3 gypsum plaster on 1″ thick magnesium oxysulfate wood fiberboard on both sides of wall.	See Note 3	45 min.		1		1-3	$^3/_4$
W-7-W-3	$7^1/_4$″	Double row of 2 × 4 studs, $^1/_2$″ thick of 1:2; 1:2 gypsum plaster applied over $^3/_8$″ thick perforated gypsum lath on both sides of wall; mineral wool insulation.	N/A	1 hr.			43	2, 4, 5	1
W-7-W-4	$7^1/_2$″	Double row of 2 × 4 studs, $^5/_8$″ thick of 1:2; 1:2 gypsum plaster applied over $^3/_8$″ thick perforated gypsum lath over laid with 2″ × 2″, 16 gage wire fabric, on both sides of wall.	N/A	1 hr. 15 min.			43	2, 4	$1^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.

Notes:

1. Nominal 2-inch by 4-inch wood studs of No. 1 common or better lumber set edgewise. Two-inch by 4-inch plates at top and bottom and blocking at mid height of wall.
2. Mix proportions for plastered walls as follows: first ratio indicates scratch coat mix, weight of dry plaster: dry sand; second ratio indicates brown coat mix.
3. Load: 360 psi of net stud cross sectional area.
4. Nominal 2-inch by 4-inch studs of yellow pine of Douglas-fir spaced 16 inches in a double row, with studs in rows staggered.
5. Mineral wool bats, 0.19 lb./ft.^{2}

TABLE 1.4.1
MISCELLANEOUS MATERIALS WALLS
0″ TO LESS THAN 4″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-3-Mi-1	$3^7/_8$″	Glass brick wall: (bricks $5^3/_4$″ × $5^3/_4$″ × $3^7/_8$″) $^1/_4$″ mortar bed, cement/lime/sand; mounted in brick (9″) wall with mastic and $^1/_2$″ asbestos rope.	N/A	1 hr.			7	1, 2	1
W-3-Mi-2	3″	Core: 2″ magnesium oxysulfate wood-fiber blocks; laid in Portland cement-lime mortar; Facings: on both sides; see Note 3.	N/A	1 hr.		1		3	1
W-3-Mi-3	$3^7/_8$″	Core: 8″ × $4^7/_8$″ glass blocks $3^7/_8$″ thick weighing 4 lbs. each; laid in Portland cement-lime mortar; horizontal mortar joints reinforced with metal lath.	N/A	15 min.		1			$^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN.

Notes:

1. No failure reached at 1 hour.
2. These glass blocks are assumed to be solid based on other test data available for similar but hollow units which show significantly reduced fire endurance.
3. Minimum of $^1/_2$ inch of 1:3 sanded gypsum plaster required to develop this rating.

TABLE 1.4.2
MISCELLANEOUS MATERIALS WALLS
4″ TO LESS THAN 6″ THICK

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
W-4-Mi-1	4″	Core: 3″ magnesium oxysulfate wood-fiber blocks; laid in Portland cement mortar; Facings: both sides; see Note 1.	N/A	2 hrs.		1			2

For SI: 1 inch = 25.4 mm.

Notes:

1. One-half inch sanded gypsum plaster. Voids in hollow blocks to be not more than 30 percent.

FIGURE 1.5.1
FINISH RATINGS—INORGANIC MATERIALS

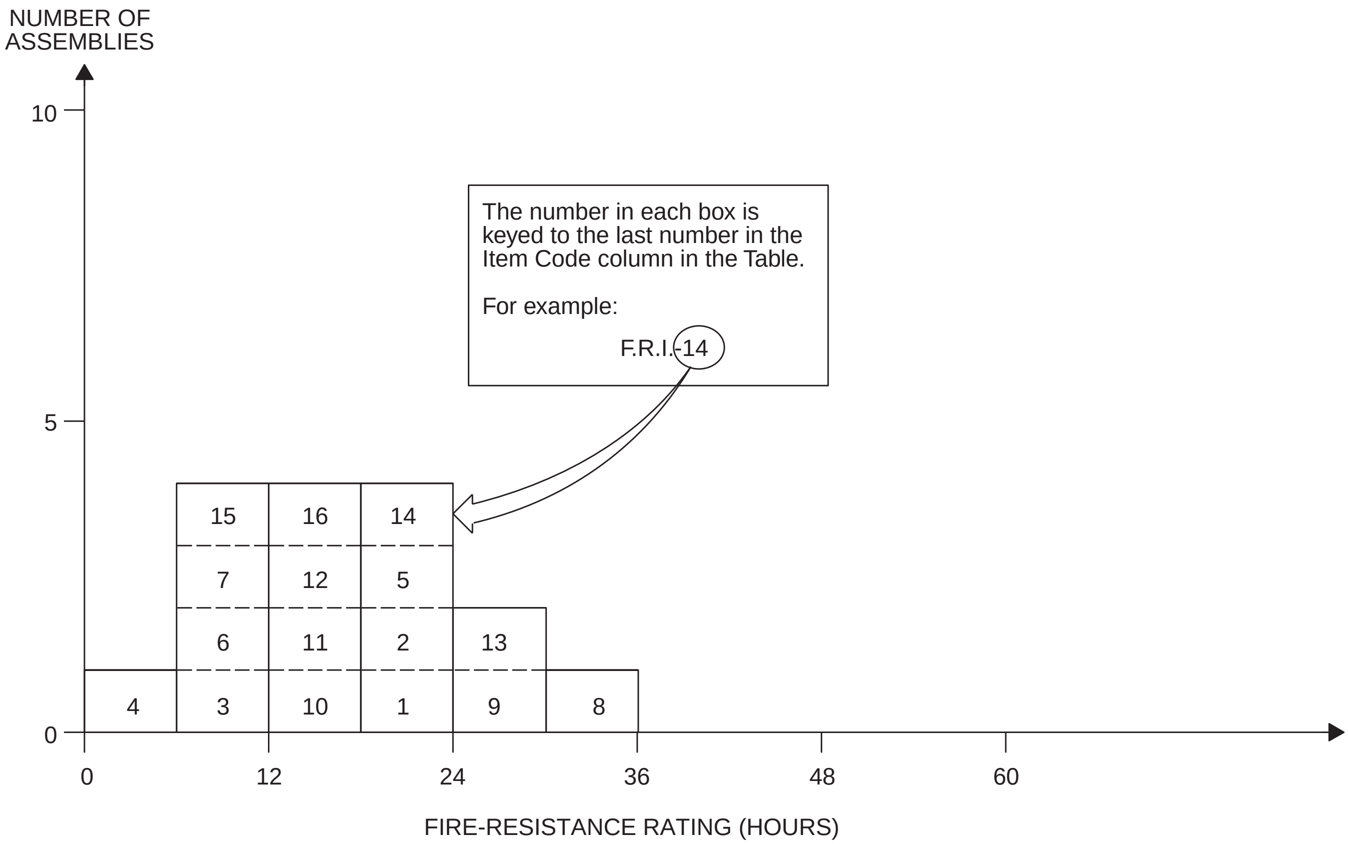


TABLE 1.5.1
FINISH RATINGS—INORGANIC MATERIALS

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE	REFERENCE NUMBER			NOTES	REC. F.R. (MIN.)
			FINISH RATING	PRE-BMS-92	BMS-92	POST-BMS-92		
F.R.-I-1	$^{9}/_{16}$″	$^{3}/_{8}$″ gypsum wallboard faced with $^{3}/_{16}$″ cement-asbestos board.	20 minutes		1		1, 2	15
F.R.-I-2	$^{11}/_{16}$″	$^{1}/_{2}$″ gypsum sheathing faced with $^{3}/_{16}$″ cement-asbestos board.	20 minutes		1		1, 2	20
F.R.-I-3	$^{3}/_{16}$″	$^{3}/_{16}$″ cement-asbestos board over uninsulated cavity.	10 minutes		1		1, 2	5
F.R.-I-4	$^{3}/_{16}$″	$^{3}/_{16}$″ cement-asbestos board over insulated cavities.	5 minutes		1		1, 2	5
F.R.-I-5	$^{3}/_{4}$″	$^{3}/_{4}$″ thick 1:2; 1:3 gypsum plaster over paper backed metal lath.	20 minutes		1		1, 2, 3	20
F.R.-I-6	$^{3}/_{4}$″	$^{3}/_{4}$″ thick Portland cement plaster on metal lath.	10 minutes		1		1, 2	10
F.R.-I-7	$^{3}/_{4}$″	$^{3}/_{4}$″ thick 1:5; 1:7.5 lime plaster on metal lath.	10 minutes		1		1, 2	10
F.R.-I-8	1″	1″ thick neat gypsum plaster on metal lath.	35 minutes		1		1, 2, 4	35
F.R.-I-9	$^{3}/_{4}$″	$^{3}/_{4}$″ thick neat gypsum plaster on metal lath.	30 minutes		1		1, 2, 4	30

(continued)

TABLE 1.5.1—continued
FINISH RATINGS—INORGANIC MATERIALS

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE	REFERENCE NUMBER			NOTES	REC. F.R. (MIN.)
			FINISH RATING	PRE-BMS-92	BMS-92	POST-BMS-92		
F.R.-I-10	$^3/_4''$	$^3/_4''$ thick 1:2; 1:2 gypsum plaster on metal lath.	15 minutes		1		1, 2, 3	15
F.R.-I-11	$^1/_2''$	Same as F.R.-1-7, except $^1/_2''$ thick on wood lath.	15 minutes		1		1, 2, 3	15
F.R.-I-12	$^1/_2''$	$^1/_2''$ thick 1:2; 1:3 gypsum plaster on wood lath.	15 minutes		1		1, 2, 3	15
F.R.-I-13	$^7/_8''$	$^1/_2''$ thick 1:2; 1:2 gypsum plaster on $^3/_8''$ perforated gypsum lath.	30 minutes		1		1, 2, 3	30
F.R.-I-14	$^7/_8''$	$^1/_2''$ thick 1:2; 1:2 gypsum plaster on $^3/_8''$ thick plain or indented gypsum plaster.	20 minutes		1		1, 2, 3	20
F.R.-I-15	$^3/_8''$	$^3/_8''$ gypsum wallboard.	10 minutes		1		1, 2	10
F.R.-I-16	$^1/_2''$	$^1/_2''$ gypsum wallboard.	15 minutes		1		1, 2	15

For SI: 1 inch = 25.4 mm, °C = [(°F) - 32]/1.8.

Notes:

1. The finish rating is the time required to obtain an average temperature rise of 250°F, or a single point rise of 325°F, at the interface between the material being rated and the substrate being protected.
2. Tested in accordance with the Standard Specifications for Fire Tests of Building Construction and Materials, ASA No. A2-1932.
3. Mix proportions for plasters as follows: first ratio, dry weight of plaster: dry weight of sand for scratch coat; second ratio, plaster: sand for brown coat.
4. Neat plaster means unsanded wood-fiber gypsum plaster.

General Note:

The finish rating of modern building materials can be found in the current literature.

TABLE 1.5.2
FINISH RATINGS—ORGANIC MATERIALS

ITEM CODE	THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE	REFERENCE NUMBER			NOTES	REC. F.R. (MIN.)
			FINISH RATING	PRE-BMS-92	BMS-92	POST-BMS-92		
F.R.-O-1	$^9/_{16}''$	$^7/_{16}''$ wood fiberboard faced with $^1/_8''$ cement-asbestos board.	15 minutes		1		1, 2	15
F.R.-O-2	$^{29}/_{32}''$	$^3/_4''$ wood sheathing, asbestos felt weighing 14 lbs./100 ft.^{2} and $^5/_{32}''$ cement-asbestos shingles.	20 minutes		1		1, 2	20
F.R.-O-3	$1^1/_2''$	1″ thick magnesium oxysulfate wood fiber-board faced with 1:3; 1:3 gypsum plaster, $^1/_2''$ thick.	20 minutes		1		1, 2, 3	20
F.R.-O-4	$^1/_2''$	$^1/_2''$ thick wood fiberboard.	5 minutes		1		1, 2	5
F.R.-O-5	$^1/_2''$	$^1/_2''$ thick flameproofed wood fiberboard.	10 minutes		1		1, 2	10
F.R.-O-6	1″	$^1/_2''$ thick wood fiberboard faced with $^1/_2''$ thick 1:2; 1:2 gypsum plaster.	15 minutes		1		1, 2, 3	30
F.R.-O-7	$1^3/_8''$	$^7/_8''$ thick flameproofed wood fiberboard faced with $^1/_2''$ thick 1:2; 1:2 gypsum plaster.	30 minutes		1		1, 2, 3	30
F.R.-O-8	$1^1/_4''$	$1^1/_4''$ thick plywood.	30 minutes			35		30

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square foot = 47.9 N/m^2, °C = [(°F) - 32]/1.8.

Notes:

1. The finish rating is the time required to obtain an average temperature rise of 250°F, or a single point rise of 325°F, at the interface between the material being rated and he substrate being protected.
2. Tested in accordance with the Standard Specifications for Fire Tests of Building Construction and Materials, ASA No. A2-1932.
3. Plaster ratios as follows: first ratio is for scratch coat, weight of dry plaster: weight of dry sand; second ratio is for the brown coat.

General Note:

The finish rating of thinner materials, particularly thinner woods, have not been listed because the possible effects of shrinkage, warpage and aging cannot be predicted.

SECTION II
COLUMNS

TABLE 2.1.1
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 0″ TO LESS THAN 6″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-6-RC-1	6″	6″ × 6″ square columns; gravel aggregate concrete (4030 psi); Reinforcement: vertical, four $^{7}/_{8}$″ rebars; horizontal, $^{5}/_{16}$″ ties at 6″ pitch; Cover: 1″.	34.7 tons	62 min.			7	1, 2	1
C-6-RC-2	6″	6″ × 6″ square columns; gravel aggregate concrete (4200 psi); Reinforcement: vertical, four $^{1}/_{2}$″ rebars; horizontal, $^{5}/_{16}$″ ties at 6″ pitch; Cover: 1″.	21 tons	69 min.			7	1, 2	1

Notes:

1. Collapse.
2. British test.

FIGURE 2.1.2
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

TABLE 2.1.2
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST- BMS-92		
C-10-RC-1	10″	10″ square columns; aggregate concrete (4260 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at 6″ pitch; Cover: $1^1/_4$″.	92.2 tons	1 hr. 2 min.			7	1	1
C-10-RC-2	10″	10″ square columns; aggregate concrete (2325 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	46.7 tons	1 hr. 52 min.			7	1	$1^3/_4$
C-10-RC-3	10″	10″ square columns; aggregate concrete (5370 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	46.5 tons	2 hrs.			7	2, 3, 11	2
C-10-RC-4	10″	10″ square columns; aggregate concrete (5206 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	46.5 tons	2 hrs.			7	2, 7	2
C-10-RC-5	10″	10″ square columns; aggregate concrete (5674 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	46.7 tons	2 hrs.			7	1	2

(continued)

TABLE 2.1.2—continued
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST- BMS-92		
C-10-RC-6	10″	10″ square columns; aggregate concrete (5150 psi); Reinforcement: vertical, four $1^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	66 tons	1 hr. 43 min.			7	1	$1^3/_4$
C-10-RC-7	10″	10″ square columns; aggregate concrete (5580 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: $1^1/_8$″.	62.5 tons	1 hr. 38 min.			7	1	$1^1/_2$
C-10-RC-8	10″	10″ square columns; aggregate concrete (4080 psi); Reinforcement: vertical, four $1^1/_8$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: $1^1/_8$″.	72.8 tons	1 hr. 48 min.			7	1	$1^3/_4$
C-10-RC-9	10″	10″ square columns; aggregate concrete (2510 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	51 tons	2 hrs. 16 min.			7	1	$2^1/_4$
C-10-RC-10	10″	10″ square columns; aggregate concrete (2170 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: 1″.	45 tons	2 hrs. 14 min.			7	12	$2^1/_4$
C-10-RC-11	10″	10″ square columns; gravel aggregate concrete (4015 psi); Reinforcement: vertical, four $^1/_2$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: $1^1/_8$″.	46.5 tons	2 hrs. 6 min.			7	1	2
C-11-RC-12	11″	11″ square columns; gravel aggregate concrete (4150 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; Cover: $1^1/_2$″.	61 tons	1 hr. 23 min.			7	1	$1^1/_4$
C-11-RC-13	11″	11″ square columns; gravel aggregate concrete (4380 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; Cover: $1^1/_2$″.	61 tons	1 hr. 26 min.			7	1	$1^1/_4$
C-11-RC-14	11″	11″ square columns; gravel aggregate concrete (4140 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; steel mesh around reinforcement; Cover: $1^1/_2$″.	61 tons	3 hrs. 9 min.			7	1	3
C-11-RC-15	11″	11″ square columns; slag aggregate concrete (3690 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; Cover: $1^1/_2$″.	91 tons	2 hrs.			7	2, 3, 4, 5	2
C-11-RC-16	11″	11″ square columns; limestone aggregate concrete (5230 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; Cover: $1^1/_2$″.	91.5 tons	3 hrs. 41 min.			7	1	$3^1/_2$
C-11-RC-17	11″	11″ square columns; limestone aggregate concrete (5530 psi); Reinforcement: vertical, four $1^1/_4$″ rebars; horizontal, $^3/_8$″ ties at $7^1/_2$″ pitch; Cover: $1^1/_2$″.	91.5 tons	3 hrs. 47 min.			7	1	$3^1/_2$

(continued)

TABLE 2.1.2—continued
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST- BMS-92		
C-11-RC-18	11″	11″ square columns; limestone aggregate concrete (5280 psi); Reinforcement: vertical, four 1$^1/_4$″ rebars; horizontal, $^3/_8$″ ties at 7$^1/_2$″ pitch; Cover: 1$^1/_2$″.	91.5 tons	2 hrs.			7	2, 3, 4, 6	2
C-11-RC-19	11″	11″ square columns; limestone aggregate concrete (4180 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	71.4 tons	2 hrs.			7	2, 7	2
C-11-RC-20	11″	11″ square columns; gravel concrete (4530 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″ with $^1/_2$″ plaster.	58.8 tons	2 hrs.			7	2, 3, 9	1$^1/_4$
C-11-RC-21	11″	11″ square columns; gravel concrete (3520 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	Vari-able	1 hr. 24 min.			7	1, 8	2
C-11-RC-22	11″	11″ square columns; aggregate concrete (3710 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	58.8 tons	2 hrs.			7	2, 3, 10	2
C-11-RC-23	11″	11″ square columns; aggregate concrete (3190 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	58.8 tons	2 hrs.			7	2, 3, 10	2
C-11-RC-24	11″	11″ square columns; aggregate concrete (4860 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	86.1 tons	1 hr. 20 min.			7	1	1$^1/_3$
C-11-RC-25	11″	11″ square columns; aggregate concrete (4850 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^3/_8$″ ties at 7″ pitch; Cover: 1$^1/_2$″.	58.8 tons	1 hr. 59 min.			7	1	1$^3/_4$
C-11-RC-26	11″	11″ square columns; aggregate concrete (3834 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^5/_{16}$″ ties at 4$^1/_2$″ pitch; Cover: 1$^1/_2$″.	71.4 tons	53 min.			7	1	$^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Passed 2 hour fire exposure.
3. Passed hose stream test.
4. Reloaded effectively after 48 hours but collapsed at load in excess of original test load.
5. Failing load was 150 tons.
6. Failing load was 112 tons.
7. Failed during hose stream test.
8. Range of load 58.8 tons (initial) to 92 tons (92 minutes) to 60 tons (80 minutes).
9. Collapsed at 44 tons in reload after 96 hours.
10. Withstood reload after 72 hours.
11. Collapsed on reload after 48 hours.

TABLE 2.1.3
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-RC-1	12″	12″ square columns; gravel aggregate concrete (2647 psi); Reinforcement: vertical, four $^5/_8$″ rebars; horizontal, $^5/_{16}$″ ties at $4^1/_2$″ pitch; Cover: 2″.	78.2 tons	38 min.		1	7	1	$^1/_2$
C-12-RC-2	12″	Reinforced columns with $1^1/_2$″ concrete outside of reinforced steel; Gross diameter or side of column: 12″ ; Group I, Column A.	—	6 hrs.		1		2, 3	6
C-12-RC-3	12″	Description as per C-12-RC-2; Group I, Column B.	—	4 hrs.		1		2, 3	4
C-12-RC-4	12″	Description as per C-12-RC-2; Group II, Column A.	—	4 hrs.		1		2, 3	4
C-12-RC-5	12″	Description as per C-12-RC-2; Group II, Column B.	—	2 hrs. 30 min.		1		2, 3	$2^1/_2$
C-12-RC-6	12″	Description as per C-12-RC-2; Group III, Column A.	—	3 hrs.		1		2, 3	3
C-12-RC-7	12″	Description as per C-12-RC-2; Group III, Column B.	—	2 hrs.		1		2, 3	2
C-12-RC-8	12″	Description as per C-12-RC-2; Group IV, Column A.	—	2 hrs.		1		2, 3	2
C-12-RC-9	12″	Description as per C-12-RC-2; Group IV, Column B.	—	1 hr. 30 min.		1		2, 3	$1^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2.

Notes:

1. Failure mode—unspecified structural.
2. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.
3. Groupings of aggregates and ties are the same as for structural steel columns protected solidly with concrete, the ties to be placed over the vertical reinforcing bars and the mesh where required, to be placed within 1 inch from the surface of the column.

   Column A: working loads are assumed as carried by the area of the column inside of the lines circumscribing the reinforcing steel.

   Column B: working loads are assumed as carried by the gross area of the column.

TABLE 2.1.4
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST- BMS-92		
C-14-RC-1	14″	14″ square columns; gravel aggregate concrete (4295 psi); Reinforcement: vertical four $^3/_4$″ rebars; horizontal: $^1/_4$″ ties at 9″ pitch; Cover: $1^1/_2$″	86 tons	1 hr. 22 min.			7	1	$1^1/_4$
C-14-RC-2	14″	Reinforced concrete columns with $1^1/_2$″ concrete outside reinforcing steel; Gross diameter or side of column: 12″ ; Group I, Column A.	—	7 hrs.		1		2, 3	7
C-14-RC-3	14″	Description as per C-14-RC-2; Group II, Column B.	—	5 hrs.		1		2, 3	5
C-14-RC-4	14″	Description as per C-14-RC-2; Group III, Column A.	—	5 hrs.		1		2, 3	5
C-14-RC-5	14″	Description as per C-14-RC-2; Group IV, Column B.	—	3 hrs. 30 min.		1		2, 3	$3^1/_2$
C-14-RC-6	14″	Description as per C-14-RC-2; Group III, Column A.	—	4 hrs.		1		2, 3	4
C-14-RC-7	14″	Description as per C-14-RC-2; Group III, Column B.	—	2 hrs. 30 min.		1		2, 3	$2^1/_2$
C-14-RC-8	14″	Description as per C-14-RC-2; Group IV, Column A.	—	2 hrs. 30 min.		1		2, 3	$2^1/_2$
C-14-RC-9	14″	Description as per C-14-RC-2; Group IV, Column B.	—	1 hr. 30 min.		1		2, 3	$1^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2.

Notes:

1. Failure mode—main rebars buckled between links at various points.
2. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.
3. Groupings of aggregates and ties are the same as for structural steel columns protected solidly with concrete, the ties to be placed over the vertical reinforcing bars and the mesh where required, to be placed within 1 inch from the surface of the column.

   Column A: working loads are assumed as carried by the area of the column inside of the lines circumscribing the reinforcing steel.

   Column B: working loads are assumed as carried by the gross area of the column.

FIGURE 2.1.5
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 16″ TO LESS THAN 18″

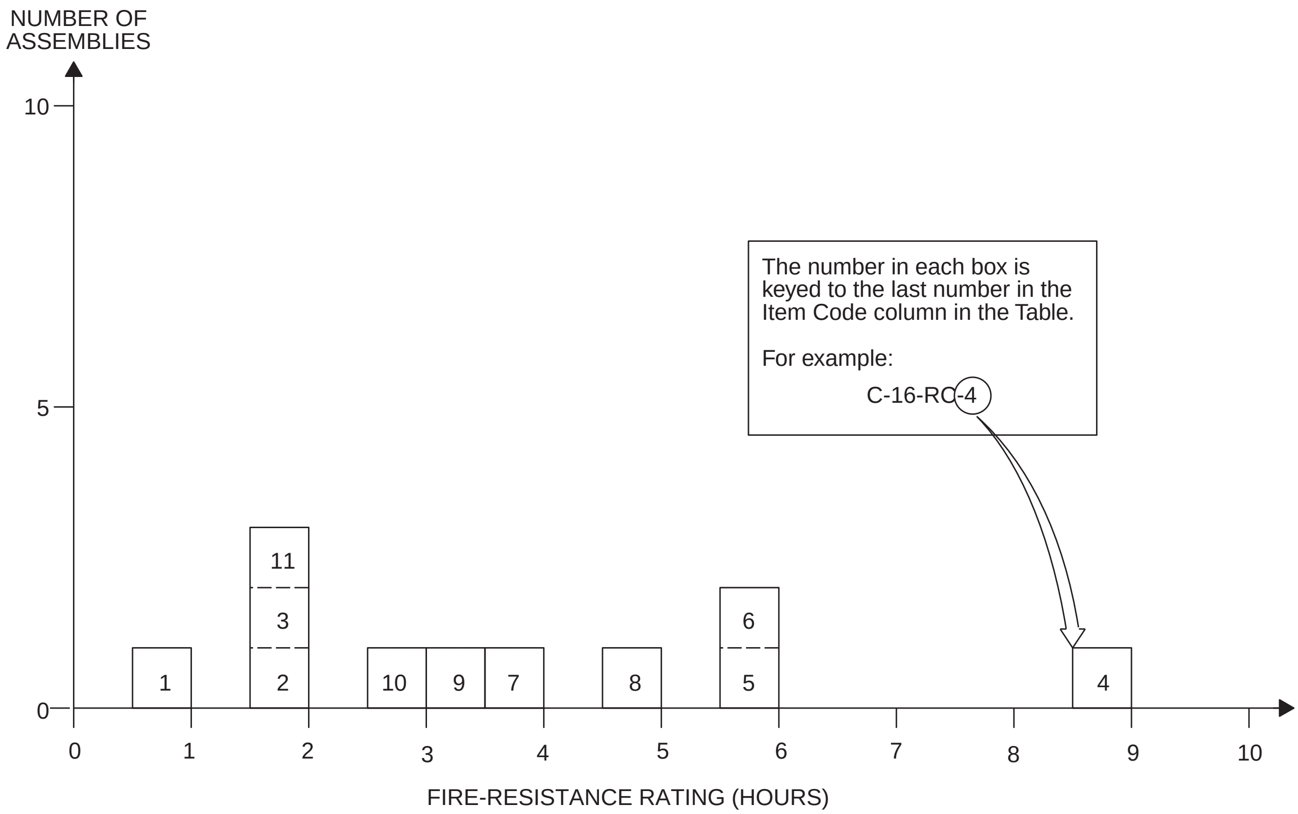


TABLE 2.1.5
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 16″ TO LESS THAN 18″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-16-RC-1	16″	16″ square columns; gravel aggregate concrete (4550 psi); Reinforcement: vertical, eight $1^3/_8$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch $1^3/_8$″ below column surface and $^5/_{16}$″ ties at 6″ pitch linking center rebars of each face forming a smaller square in column cross section.	237 tons	1 hr			7	1, 2, 3	1
C-16-RC-2	16″	16″ square columns; gravel aggregate concrete (3360 psi); Reinforcement: vertical, eight $1^3/_8$″ rebars; horizontal, $^5/_{16}$″ ties at 6″ pitch; Cover: $1^3/_8$″.	210 tons	2 hrs.			7	2, 4, 5, 6	2
C-16-RC-3	16″	16″ square columns; gravel aggregate concrete (3980 psi); Reinforcement: vertical, four $^7/_8$″ rebars; horizontal, $^3/_8$″ ties at 6″ pitch; Cover: 1″.	123.5 tons	2 hrs.			7	2, 4, 7	2
C-16-RC-4	16″	Reinforced concrete columns with $1^1/_2$″ concrete outside reinforcing steel; Gross diameter or side of column: 16″ ; Group I, Column A.	—	9 hrs.		1		8, 9	9
C-16-RC-5	16″	Description as per C-16-RC-4; Group I, Column B.	—	6 hrs.		1		8, 9	6
C-16-RC-6	16″	Description as per C-16-RC-4; Group II, Column A.	—	6 hrs.		1		8, 9	6

(continued)

TABLE 2.1.5—continued
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 16″ TO LESS THAN 18″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-16-RC-7	16″	Description as per C-16-RC-4; Group II, Column B.	—	4 hrs.		1		8, 9	4
C-16-RC-8	16″	Description as per C-16-RC-4; Group III, Column A.	—	5 hrs.		1		8, 9	5
C-16-RC-9	16″	Description as per C-16-RC-4; Group III, Column B.	—	3 hrs. 30 min.		1		8, 9	$3^1/_2$
C-16-RC-10	16″	Description as per C-16-RC-4; Group IV, Column A.	—	3 hrs.		1		8, 9	3
C-16-RC-11	16″	Description as per C-16-RC-4; Group IV, Column B.	—	2 hrs.		1		8, 9	2

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2.

Notes:

1. Column passed 1-hour fire test.
2. Column passed hose stream test.
3. No reload specified.
4. Column passed 2-hour fire test.
5. Column reloaded successfully after 24 hours.
6. Reinforcing details same as C-16-RC-1.
7. Column passed reload after 72 hours.
8. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.
9. Groupings of aggregates and ties are the same as for structural steel columns protected solidly with concrete, the ties to be placed over the vertical reinforcing bars and the mesh where required, to be placed within 1 inch from the surface of the column.

   Column A: working loads are assumed as carried by the area of the column inside of the lines circumscribing the reinforcing steel.

   Column B: working loads are assumed as carried by the gross area of the column.

TABLE 2.1.6
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 18″ TO LESS THAN 20″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST- BMS-92		
C-18-RC-1	18″	Reinforced concrete columns with $1^1/_2$″ concrete outside reinforced steel; Gross diameter or side of column: 18″ ; Group I, Column A.	—	11 hrs.		1		1, 2	11
C-18-RC-2	18″	Description as per C-18-RC-1; Group I, Column B.	—	8 hrs.		1		1, 2	8
C-18-RC-3	18″	Description as per C-18-RC-1; Group II, Column A.	—	7 hrs.		1		1, 2	7
C-18-RC-4	18″	Description as per C-18-RC-1; Group II, Column B.	—	5 hrs.		1		1, 2	5
C-18-RC-5	18″	Description as per C-18-RC-1; Group III, Column A.	—	6 hrs.		1		1, 2	6
C-18-RC-6	18″	Description as per C-18-RC-1; Group III, Column B.	—	4 hrs.		1		1, 2	4
C-18-RC-7	18″	Description as per C-18-RC-1; Group IV, Column A.	—	3 hrs. 30 min.		1		1, 2	$3^1/_2$
C-18-RC-8	18″	Description as per C-18-RC-1; Group IV, Column B.	—	2 hrs. 30 min.		1		1, 2	$2^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound per square yard = 5.3 N/m^2.

Notes:

1. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint and, tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

2. Groupings of aggregates and ties are the same as for structural steel columns protected solidly with concrete, the ties to be placed over the vertical reinforcing bars and the mesh where required, to be placed within 1 inch from the surface of the column.

   Column A: working loads are assumed as carried by the area of the column inside of the lines circumscribing the reinforcing steel.

   Column B: working loads are assumed as carried by the gross area of the column.

FIGURE 2.1.7
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 20″ TO LESS THAN 22″

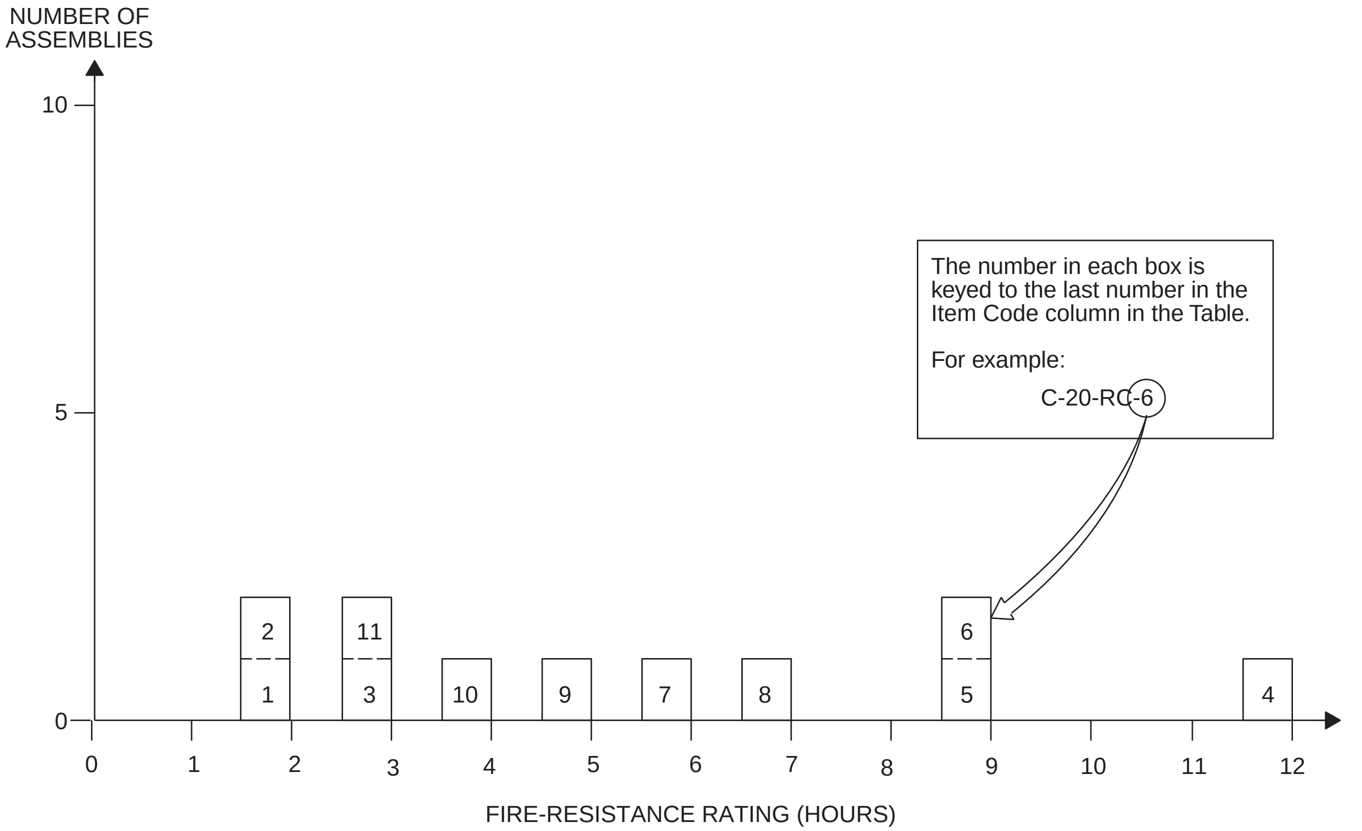


TABLE 2.1.7
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 20″ TO LESS THAN 22″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-20-RC-1	20″	20″ square columns; gravel aggregate concrete (6690 psi); Reinforcement: vertical, four $1^3/_4$″ rebars; horizontal, $^3/_8$″ wire at 6″ pitch; Cover $1^3/_4$″.	367 tons	2 hrs.			7	1, 2, 3	2
C-20-RC-2	20″	20″ square columns; gravel aggregate concrete (4330 psi); Reinforcement: vertical, four $1^3/_4$″ rebars; horizontal, $^3/_8$″ ties at 6″ pitch; Cover $1^3/_4$″.	327 tons	2 hrs.			7	1, 2, 4	2
C-20-RC-3	$20^1/_4$″	20″ square columns; gravel aggregate concrete (4230 psi); Reinforcement: vertical, four $1^1/_8$″ rebars; horizontal, $^3/_8$″ wire at 5″ pitch; Cover $1^1/_8$″.	199 tons	2 hrs. 56 min.			7	5	$2^3/_4$
C-20-RC-4	20″	Reinforced concrete columns with $1^1/_2$″ concrete outside of reinforcing steel; Gross diameter or side of column: 20″ ; Group I, Column A.	—	12 hrs.		1		6, 7	12
C-20-RC-5	20″	Description as per C-20-RC-4; Group I, Column B.	—	9 hrs.		1		6, 7	9

(continued)

TABLE 2.1.7—continued
REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 20″ TO LESS THAN 22″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-20-RC-6	20″	Description as per C-20-RC-4; Group II, Column A.	—	9 hrs.		1		6, 7	9
C-20-RC-7	20″	Description as per C-20-RC-4; Group II, Column B.	—	6 hrs.		1		6, 7	6
C-20-RC-8	20″	Description as per C-20-RC-4; Group III, Column A.	—	7 hrs.		1		6, 7	7
C-20-RC-9	20″	Description as per C-20-RC-4; Group III, Column B.	—	5 hrs.		1		6, 7	5
C-20-RC-10	20″	Description as per C-20-RC-4; Group IV, Column A.	—	4 hrs.		1		6, 7	4
C-20-RC-11	20″	Description as per C-20-RC-4; Group IV, Column B.	—	3 hrs.		1		6, 7	3

For SI: 1 inch = 25.4 mm, 1 pound per square yard = 5.3 N/m^2, 1 ton = 8.896 kN.

Notes:

1. Passed 2-hour fire test.
2. Passed hose stream test.
3. Failed during reload at 300 tons.
4. Passed reload after 72 hours.
5. Failure mode—collapse.
6. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.
   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.
   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.
   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.
7. Groupings of aggregates and ties are the same as for structural steel columns protected solidly with concrete, the ties to be placed over the vertical reinforcing bars and the mesh where required, to be placed within 1 inch from the surface of the column.
   Column A: working loads are assumed as carried by the area of the column inside of the lines circumscribing the reinforcing steel.
   Column B: working loads are assumed as carried by the gross area of the column.

TABLE 2.1.8
HEXAGONAL REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-HRC-1	12″	12″ hexagonal columns; gravel aggregate concrete (4420 psi); Reinforcement: vertical, eight $^1/_2$″ rebars; horizontal, $^5/_{16}$″ helical winding at $1^1/_2$″ pitch; Cover: $^1/_2$″.	88 tons	58 min.			7	1	$^3/_4$
C-12-HRC-2	12″	12″ hexagonal columns; gravel aggregate concrete (3460 psi); Reinforcement: vertical, eight $^1/_2$″ rebars; horizontal, $^5/_{16}$″ helical winding at $1^1/_2$″ pitch; Cover: $^1/_2$″.	78.7 tons	1 hr.			7	2	1

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Test stopped at 1 hour.

TABLE 2.1.9
HEXAGONAL REINFORCED CONCRETE COLUMNS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-14-HRC-1	14″	14″ hexagonal columns; gravel aggregate concrete (4970 psi); Reinforcement: vertical, eight $^1/_2$″ rebars; horizontal, $^5/_{16}$″ helical winding on 2″ pitch; Cover: $^1/_2$″.	90 tons	2 hrs.			7	1, 2, 3	2

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Withstood 2-hour fire test.
2. Withstood hose stream test.
3. Withstood reload after 48 hours.

TABLE 2.1.10
HEXAGONAL REINFORCED CONCRETE COLUMNS
DIAMETER—16″ TO LESS THAN 18″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST-BMS-92		
C-16-HRC-1	16″	16″ hexagonal columns; gravel concrete (6320 psi); Reinforcement: vertical, eight $^5/_8$″ rebars; horizontal, $^5/_{16}$″ helical winding on $^3/_4$″ pitch; Cover: $^1/_2$″.	140 tons	1 hr. 55 min.			7	1	$1^3/_4$
C-16-HRC-2	16″	16″ hexagonal columns; gravel aggregate concrete (5580 psi); Reinforcement: vertical, eight $^5/_8$″ rebars; horizontal, $^5/_{16}$″ helical winding on $1^3/_4$″ pitch; Cover: $^1/_2$″	124 tons	2 hrs.			7	2	2

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Failed on furnace removal.

TABLE 2.1.11
HEXAGONAL REINFORCED CONCRETE COLUMNS
DIAMETER—20″ TO LESS THAN 22″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST-BMS-92		
C-20-HRC-1	20″	20″ hexagonal columns; gravel concrete (6080 psi); Reinforcement: vertical, $^3/_4$″ rebars; horizontal, $^5/_6$″ helical winding on $1^3/_4$″ pitch; Cover: $^1/_2$″.	211 tons	2 hrs.			7	1	2
C-20-HRC-2	20″	20″ hexagonal columns; gravel concrete (5080 psi); Reinforcement: vertical, $^3/_4$″ rebars; horizontal, $^5/_{16}$″ wire on $1^3/_4$″ pitch; Cover: $^1/_2$″.	184 tons	2 hrs. 15 min.			7	2, 3, 4	$2^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Column collapsed on furnace removal.
2. Passed $2^1/_4$-hour fire test.
3. Passed hose stream test.
4. Withstood reload after 48 hours.

TABLE 2.2
ROUND CAST IRON COLUMNS

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-7-CI-1	7″ O.D.	Column: 0.6″ minimum metal thickness; unprotected.	—	30 min.		1			$^1/_2$
C-7-CI-2	7″ O.D.	Column: 0.6″ minimum metal thickness concrete filled, outside unprotected.	—	45 min.		1			$^3/_4$
C-11-CI-3	11″ O.D.	Column: 0.6″ minimum metal thickness; Protection: $1^1/_2$″ Portland cement plaster on high ribbed metal lath, $^1/_2$″ broken air space.	—	3 hrs.		1			3
C-11-CI-4	11″ O.D.	Column: 0.6″ minimum metal thickness; Protection: 2″ concrete other than siliceous aggregate.	—	2 hrs. 30 min.		1			$2^1/_2$
C-12-CI-5	12.5″ O.D.	Column: 7″ O.D. 0.6″ minimum metal thickness; Protection: 2″ porous hollow tile, $^3/_4$″ mortar between tile and column, outside wire ties.	—	3 hrs.		1			3
C-7-CI-6	7.6″ O.D.	Column: 7″ I.D., $^3/_{10}$″ minimum metal thickness, concrete filled unprotected.	—	30 min.		1			$^1/_2$
C-8-CI-7	8.6″ O.D.	Column: 8″ I.D., $^3/_{10}$″ minimum metal thickness; concrete filled reinforced with four $3^1/_2$″ × $^3/_8$″ angles, in fill; unprotected outside.	—	1 hr.		1			1

For SI: 1 inch = 25.4 mm.

FIGURE 2.3
STEEL COLUMNS—GYPSUM ENCASEMENTS

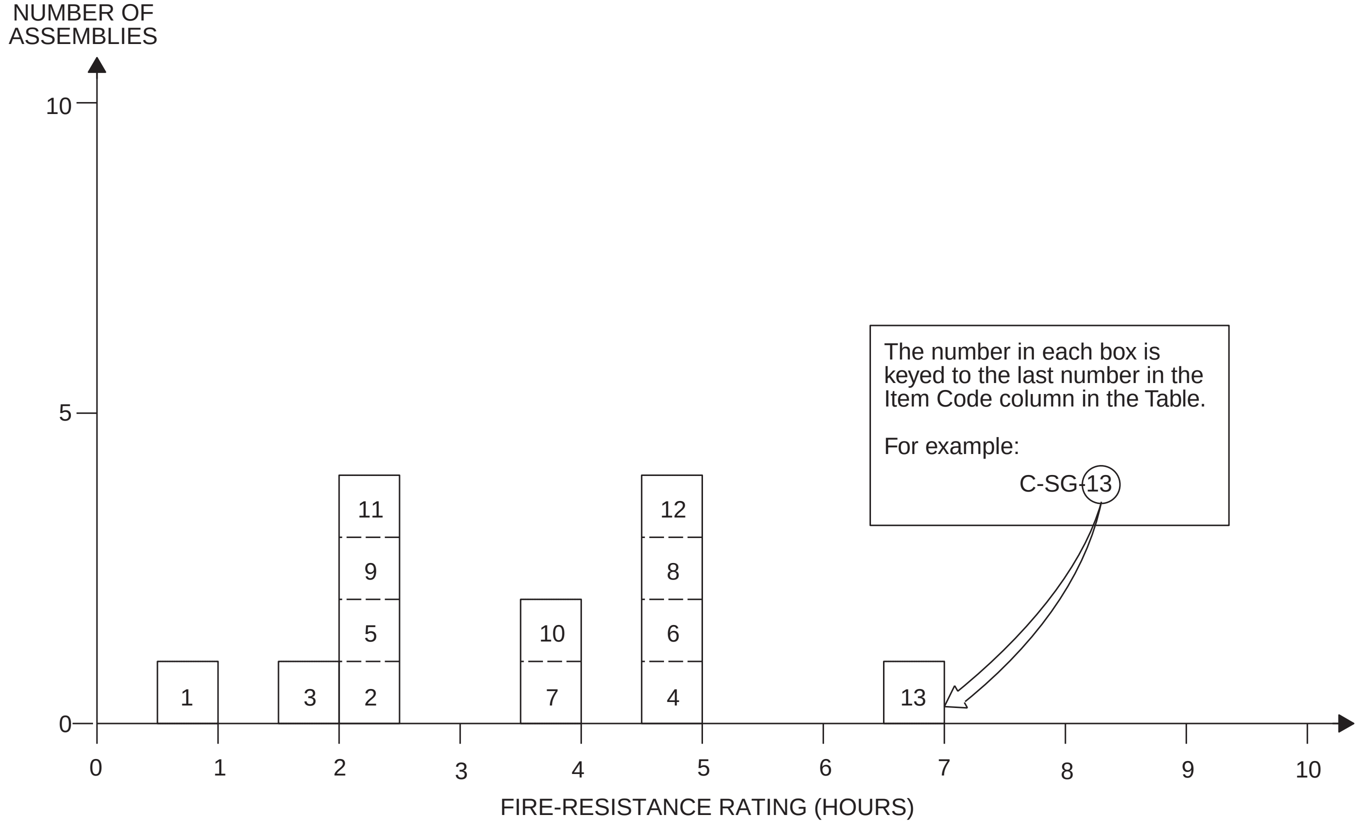


TABLE 2.3
STEEL COLUMNS—GYPSUM ENCASEMENTS

ITEM CODE	MINIMUM AREA OF SOLID MATERIAL	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-SG-1	—	Steel protected with $^3/_4''$ 1:3 sanded gypsum or 1″ 1:2$^1/_2$ Portland cement plaster on wire or lath; one layer.	—	1 hr.		1			1
C-SG-2	—	Same as C-SG-1; two layers.	—	2 hrs. 30 min.		1			2$^1/_2$
C-SG-3	130 in.^{2}	2″ solid blocks with wire mesh in horizontal joints; 1″ mortar on flange; reentrant space filled with block and mortar.	—	2 hrs.		1			2
C-SG-4	150 in.^{2}	Same as C-130-SG-3 with $^1/_2''$ sanded gypsum plaster.	—	5 hrs.		1			5
C-SG-5	130 in.^{2}	2″ solid blocks with wire mesh in horizontal joints; 1″ mortar on flange; reentrant space filled with gypsum concrete.	—	2 hrs. 30 min.		1			2$^1/_2$
C-SG-6	150 in.^{2}	Same as C-130-SG-5 with $^1/_2''$ sanded gypsum plaster.	—	5 hrs.		1			5
C-SG-7	300 in.^{2}	4″ solid blocks with wire mesh in horizontal joints; 1″ mortar on flange; reentrant space filled with block and mortar.	—	4 hrs.		1			4

(continued)

TABLE 2.3—continued
STEEL COLUMNS—GYPSUM ENCASEMENTS

ITEM CODE	MINIMUM AREA OF SOLID MATERIAL	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-SG-8	300 in.^{2}	Same as C-300-SG-7 with reentrant space filled with gypsum concrete.	—	5 hrs.		1			5
C-SG-9	85 in.^{2}	2″ solid blocks with cramps at horizontal joints; mortar on flange only at horizontal joints; reentrant space not filled.	—	2 hrs. 30 min.		1			$2^1/_2$
C-SG-10	105 in.^{2}	Same as C-85-SG-9 with $^1/_2$″ sanded gypsum plaster.	—	4 hrs.		1			4
C-SG-11	95 in.^{2}	3″ hollow blocks with cramps at horizontal joints; mortar on flange only at horizontal joints; reentrant space not filled.	—	2 hrs. 30 min.		1			$2^1/_2$
C-SG-12	120 in.^{2}	Same as C-95-SG-11 with $^1/_2$″ sanded gypsum plaster.	—	5 hrs.		1			5
C-SG-13	130 in.^{2}	2″ neat fibered gypsum reentrant space filled poured solid and reinforced with 4″ × 4″ wire mesh $^1/_2$″ sanded gypsum plaster.	—	7 hrs.		1			7

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

TABLE 2.4
TIMBER COLUMNS MINIMUM DIMENSION

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-11-TC-1	11″	With unprotected steel plate cap.	—	30 min.		1		1, 2	$^1/_2$
C-11-TC-2	11″	With unprotected cast iron cap and pintle.	—	45 min.		1		1, 2	$^3/_4$
C-11-TC-3	11″	With concrete or protected steel or cast iron cap.	—	1 hr. 15 min.		1		1, 2	$1^1/_4$
C-11-TC-4	11″	With $^3/_8$″ gypsum wallboard over column and over cast iron or steel cap.	—	1 hr. 15 min.		1		1, 2	$1^1/_4$
C-11-TC-5	11″	With 1″ Portland cement plaster on wire lath over column and over cast iron or steel cap; $^3/_4$″ air space.	—	2 hrs.		1		1, 2	2

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

Notes:

1. Minimum area: 120 square inches.
2. Type of wood: long leaf pine or Douglas fir.

TABLE 2.5.1.1
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION LESS THAN 6″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-5-SC-1	5″	5″ × 6″ outer dimensions; 4″ × 3″ × 10 lbs. "H" beam; Protection: gravel concrete (4900 psi) 6″ × 4″ - 13 SWG mesh.	12 tons	1 hr. 29 min.			7	1	$1^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.

TABLE 2.5.1.2
STEEL COLUMNS—CONCRETE ENCASEMENTS
6″ TO LESS THAN 8″ THICK

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-7-SC-1	7″	7″ × 8″ column; 4″ × 3″ × 10 lbs. “H” beam; Protection: brick filled concrete (6220 psi); 6″ × 4″ mesh - 13 SWG; 1″ below column surface.	12 tons	2 hrs. 46 min.			7	1	$2^3/_4$
C-7-SC-2	7″	7″ × 8″ column; 4″ × 3″ × 10 lbs. “H” beam; Protection: gravel concrete (5140 psi); 6″ × 4″ 13 SWG mesh 1″ below surface.	12 tons	3 hrs. 1 min.			7	1	3
C-7-SC-3	7″	7″ × 8″ column; 4″ × 3″ × 10 lbs. “H” beam; Protection: concrete (4540 psi); 6″ × 4″ - 13 SWG mesh; 1″ below column surface.	12 tons	3 hrs. 9 min.			7	1	3
C-7-SC-4	7″	7″ × 8″ column; 4″ × 3″ × 10 lbs. “H” beam; Protection: gravel concrete (5520 psi); 4″ × 4″ mesh; 16 SWG.	12 tons	2 hrs. 50 min.			7	1	$2^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.

FIGURE 2.5.1.3
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 8″ TO LESS THAN 10″

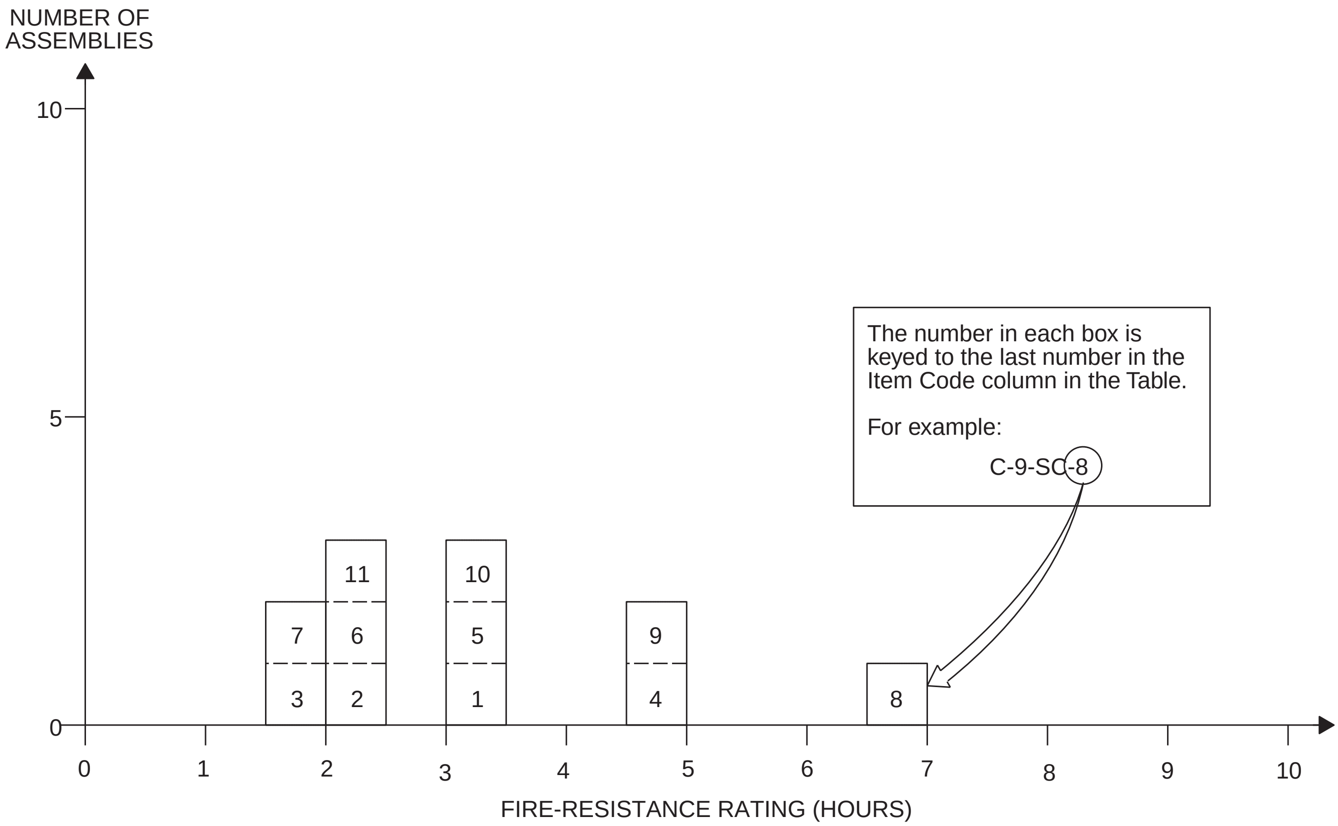


TABLE 2.5.1.3
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 8″ TO LESS THAN 10″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-8-SC-1	$8^1/_2$″	$8^1/_2$″ × 10″ column; 6″ × $4^1/_2$″ × 20 lbs. “H” beam; Protection: gravel concrete (5140 psi); 6″ × 4″ - 13 SWG mesh.	39 tons	3 hrs. 8 min.			7	1	3
C-8-SC-2	8″	8″ × 10″ column; 8″ × 6″ × 35 lbs. “I” beam; Protection: gravel concrete (4240 psi); 6″ × 4″ - 13 SWG mesh; $^1/_2$″ cover.	90 tons	2 hrs. 1 min.			7	1	2
C-8-SC-3	8″	8″ × 10″ concrete encased column; 8″ × 6″ × 35 lbs. “H” beam; protection: aggregate concrete (3750 psi); 4″ mesh - 16 SWG reinforcing $^1/_2$″ below column surface.	90 tons	1 hr. 58 min.			7	1	$1^3/_4$
C-8-SC-4	8″	6″ × 6″ steel column; 2″ outside protection; Group I.	—	5 hrs.		1		2	5
C-8-SC-5	8″	6″ × 6″ steel column; 2″ outside protection; Group II.	—	3 hrs. 30 min.		1		2	$3^1/_2$
C-8-SC-6	8″	6″ × 6″ steel column; 2″ outside protection; Group III.	—	2 hrs. 30 min.		1		2	$2^1/_2$

(continued)

TABLE 2.5.1.3—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 8″ TO LESS THAN 10″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-8-SC-7	8″	6″ × 6″ steel column; 2″ outside protection; Group IV.	—	1 hr. 45 min.		1		2	$1^3/_4$
C-9-SC-8	9″	6″ × 6″ steel column; 3″ outside protection; Group I.	—	7 hrs.		1		2	7
C-9-SC-9	9″	6″ × 6″ steel column; 3″ outside protection; Group II.	—	5 hrs.		1		2	5
C-9-SC-10	9″	6″ × 6″ steel column; 3″ outside protection; Group III.	—	3 hrs. 30 min.		1		2	$3^1/_2$
C-9-SC-11	9″	6″ × 6″ steel column; 3″ outside protection; Group IV.	—	2 hrs. 30 min.		1		2	$2^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

FIGURE 2.5.1.4
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

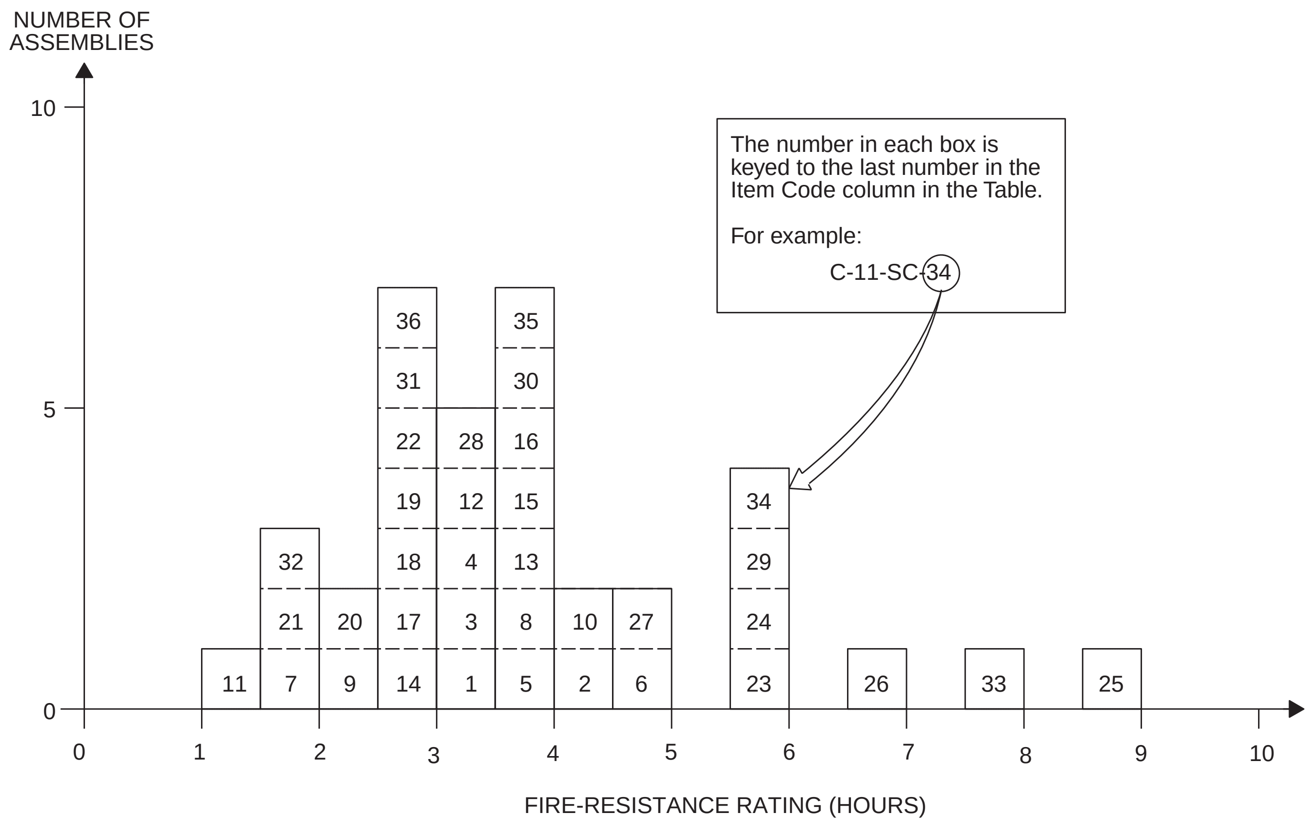


TABLE 2.5.1.4
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-10-SC-1	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: gravel aggregate concrete (3640 psi); Mesh 6″ × 4″ 13 SWG, 1″ below column surface.	90 tons	3 hrs. 7 min.			7	1,2	3
C-10-SC-2	10″	10″ × 16″ column; 8″ × 6″ × 35 lbs. “H” beam; Protection: clay brick concrete (3630 psi); 6″ × 4″ mesh; 13 SWG, 1″ below column surface.	90 tons	4 hrs. 6 min.			7	2	4
C-10-SC-3	10″	10″ × 12″ column; 8″ × 6″ × 35 lbs. “H” beam; Protection: crushed stone and sand concrete (3930 psi); 6″ × 4″ - 13 SWG mesh; 1″ below column surface.	90 tons	3 hrs. 17 min.			7	2	$3^1/_4$
C-10-SC-4	10″	10″ × 12″ column; 8″ × 6″ × 35 lbs. “H” beam; Protection: crushed basalt and sand concrete (4350 psi); 6″ × 4″ - 13 SWG mesh; 1″ below column surface.	90 tons	3 hrs. 22 min.			7	2	$3^1/_3$
C-10-SC-5	10″	10″ × 12″ column; 8″ × 6″ × 35 lbs. “H” beam; Protection: gravel aggregate concrete (5570 psi); 6″ × 4″ mesh; 13 SWG.	90 tons	3 hrs. 39 min.			7	2	$3^1/_2$
C-10-SC-6	10″	10″ × 16″ column; 8″ × 6″ × 35 lbs. “I” beam; Protection: gravel concrete (4950 psi); mesh; 6″ × 4″ 13 SWG 1″ below column surface.	90 tons	4 hrs. 32 min.			7	2	$4^1/_2$

(continued)

TABLE 2.5.1.4—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-10-SC-7	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (1370 psi); 6″ × 4″ mesh; 13 SWG reinforcing 1″ below column surface.	90 tons	2 hrs.			7	3, 4	2
C-10-SC-8	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” column; Protection: aggregate concrete (4000 psi); 13 SWG iron wire loosely around column at 6″ pitch about 2″ beneath column surface.	86 tons	3 hrs. 36 min.			7	2	$3^1/_2$
C-10-SC-9	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (3290 psi); 2″ cover minimum.	86 tons	2 hrs. 8 min.			7	2	2
C-10-SC-10	10″	10″ × 14″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” column; Protection: crushed brick filled concrete (5310 psi); 6″ × 4″ mesh; 13 SWG reinforcement 1″ below column surface.	90 tons	4 hrs. 28 min.			7	2	$4^1/_3$
C-10-SC-11	10″	10″ × 14″ concrete encased column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (342 psi); 6″ × 4″ mesh; 13 SWG reinforcement 1″ below surface.	90 tons	1 hr. 2 min.			7	2	1
C-10-SC-12	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (4480 psi); four $^3/_8$″ vertical bars at “H” beam edges with $^3/_{16}$″ spacers at beam surface at 3′ pitch and $^3/_{16}$″ binders at 10″ pitch; 2″ concrete cover.	90 tons	3 hrs. 2 min.			7	2	3
C-10-SC-13	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (5070 psi); 6″ × 4″ mesh; 13 SWG reinforcing at 6″ beam sides wrapped and held by wire ties across (open) 8″ beam face; reinforcements wrapped in 6″ × 4″ mesh; 13 SWG throughout; $^1/_2$″ cover to column surface.	90 tons	3 hrs. 59 min.			7	2	$3^3/_4$
C-10-SC-14	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (4410 psi); 6″ × 4″ mesh; 13 SWG reinforcement $1^1/_4$″ below column surface; $^1/_2$″ limestone cement plaster with $^3/_8$″ gypsum plaster finish.	90 tons	2 hrs. 50 min.			7	2	$2^3/_4$
C-10-SC-15	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: crushed clay brick filled concrete (4260 psi); 6″ × 4″ mesh; 13 SWG reinforcing 1″ below column surface.	90 tons	3 hrs. 54 min.			7	2	$3^3/_4$
C-10-SC-16	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: limestone aggregate concrete (4350 psi); 6″ × 4″ mesh; 13 SWG reinforcing 1″ below column surface.	90 tons	3 hrs. 54 min.			7	2	$3^3/_4$

(continued)

TABLE 2.5.1.4—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-10-SC-17	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: limestone aggregate concrete (5300 psi); 6″ × 4″; 13 SWG wire mesh 1″ below column surface.	90 tons	3 hrs.			7	4, 5	3
C-10-SC-18	10″	10″ × 12″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: limestone aggregate concrete (4800 psi) with 6″ × 4″; 13 SWG mesh reinforcement 1″ below surface.	90 tons	3 hrs.			7	4, 5	3
C-10-SC-19	10″	10″ × 14″ concrete encased steel column; 12″ × 8″ × 65 lbs. “H” beam; Protection: aggregate concrete (3900 psi); 4″ mesh; 16 SWG reinforcing $^1/_2$″ below column surface.	118 tons	2 hrs. 42 min.			7	2	2
C-10-SC-20	10″	10″ × 14″ concrete encased steel column; 12″ × 8″ × 65 lbs. “H” beam; Protection: aggregate concrete (4930 psi); 4″ mesh; 16 SWG reinforcing $^1/_2$″ below column surface.	177 tons	2 hrs. 8 min.			7	2	2
C-10-SC-21	$10^3/_8$″	$10^3/_8$″ × $12^3/_8$″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (835 psi) with 6″ × 4″ mesh; 13 SWG reinforcing $1^3/_{16}$″ below column surface; $^3/_{16}$″ gypsum plaster finish.	90 tons	2 hrs.			7	3, 4	2
C-11-SC-22	11″	11″ × 13″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: ″open texture″ brick filled concrete (890 psi) with 6″ × 4″ mesh; 13 SWG reinforcing $1^1/_2$″ below column surface; $^3/_8$″ lime cement plaster; $^1/_8$″ gypsum plaster finish.	90 tons	3 hrs.			7	6, 7	3
C-11-SC-23	11″	11″ × 12″ column; 4″ × 3″ × 10 lbs. “H” beam; gravel concrete (4550 psi); 6″ × 4″ - 13 SWG mesh reinforcing; 1″ below column surface.	12 tons	6 hrs.			7	7, 8	6
C-11-SC-24	11″	11″ × 12″ column; 4″ × 3″ × 10 lbs. “H” beam; Protection: gravel aggregate concrete (3830 psi); with 4″ × 4″ mesh; 16 SWG, 1″ below column surface.	16 tons	5 hrs. 32 min.			7	2	$5^1/_2$
C-10-SC-25	10″	6″ × 6″ steel column with 4″ outside protection; Group I.	—	9 hrs.		1		9	9
C-10-SC-26	10″	Description as per C-SC-25; Group II.	—	7 hrs.		1		9	7
C-10-SC-27	10″	Description as per C-10-SC-25; Group III.	—	5 hrs.		1		9	5
C-10-SC-28	10″	Description as per C-10-SC-25; Group IV.	—	3 hrs. 30 min.		1		9	$3^1/_2$
C-10-SC-29	10″	8″ × 8″ steel column with 2″ outside protection; Group I.	—	6 hrs.		1		9	6
C-10-SC-30	10″	Description as per C-10-SC-29; Group II.	—	4 hrs.		1		9	4
C-10-SC-31	10″	Description as per C-10-SC-29; Group III.	—	3 hrs.		1		9	3
C-10-SC-32	10″	Description as per C-10-SC-29; Group IV.	—	2 hrs.		1		9	2

(continued)

TABLE 2.5.1.4—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-11-SC-33	11″	8″ × 8″ steel column with 3″ outside protection; Group I.	—	8 hrs.		1		9	8
C-11-SC-34	11″	Description as per C-10-SC-33; Group II.	—	6 hrs.		1		9	6
C-11-SC-35	11″	Description as per C-10-SC-33; Group III.	—	4 hrs.		1		9	4
C-11-SC-36	11″	Description as per C-10-SC-33; Group IV.	—	3 hrs.		1		9	3

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2, 1 ton = 8.896 kN.

Notes:

1. Tested under total restraint load to prevent expansion—minimum load 90 tons.
2. Failure mode—collapse.
3. Passed 2-hour fire test (Grade “C,” British).
4. Passed hose stream test.
5. Column tested and passed 3-hour grade fire resistance (British).
6. Column passed 3-hour fire test.
7. Column collapsed during hose stream testing.
8. Column passed 6-hour fire test.
9. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

FIGURE 2.5.1.5
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

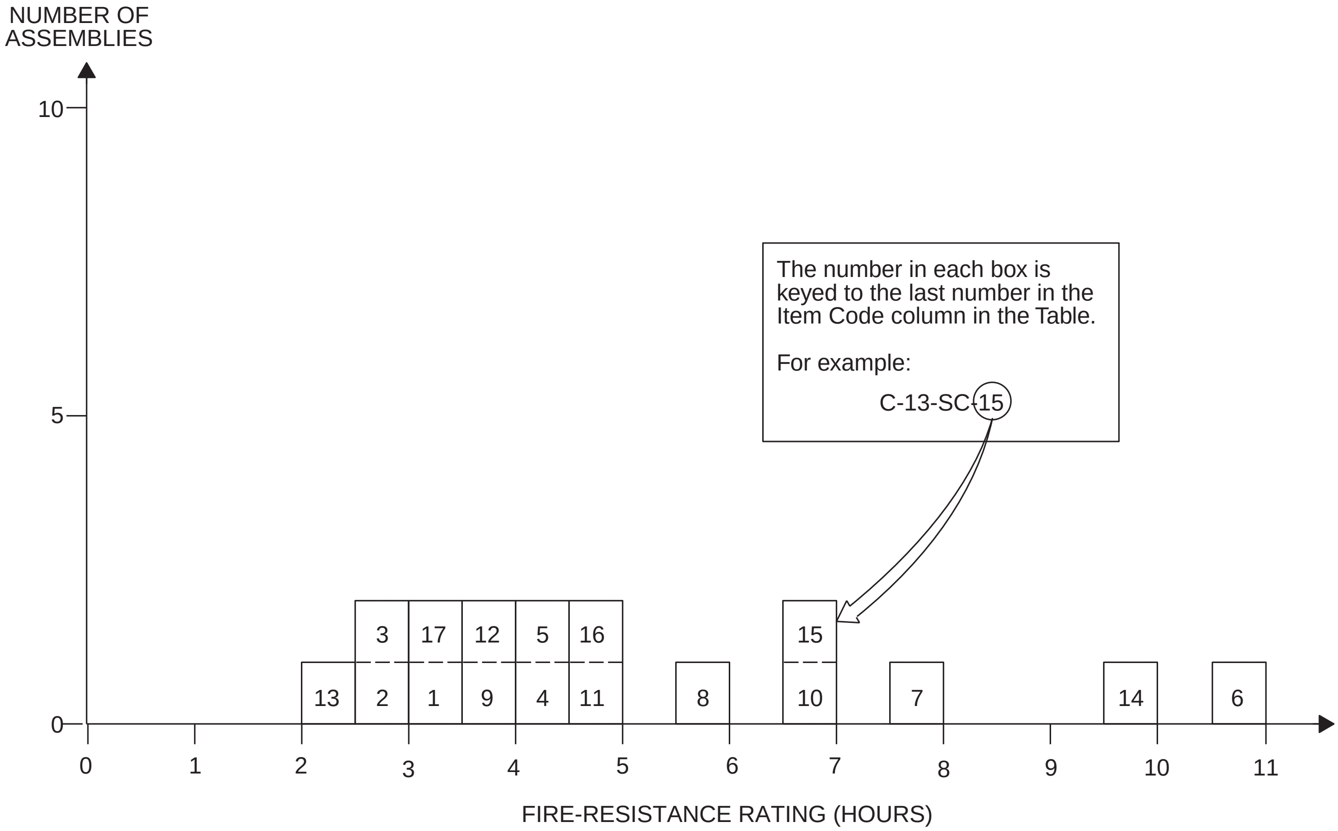


TABLE 2.5.1.5
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-SC-1	12″	12″ × 14″ concrete encased steel column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (4150 psi) with 4″ mesh; 16 SWG reinforcing 1″ below column surface.	120 tons	3 hrs. 24 min.			7	1	$3^1/_3$
C-12-SC-2	12″	12″ × 16″ concrete encased column; 8″ × 6″ × 35 lbs. “H” beam; Protection: aggregate concrete (4300 psi) with 4″ mesh; 16 SWG reinforcing 1″ below column surface.	90 tons	2 hrs. 52 min.			7	1	$2^3/_4$
C-12-SC-3	12″	12″ × 16″ concrete encased steel column; 12″ × 8″ × 65 lbs. “H” column; Protection: gravel aggregate concrete (3550 psi) with 4″ mesh; 16 SWG reinforcement 1″ below column surface.	177 tons	2 hrs. 31 min.			7	1	$2^1/_2$
C-12-SC-4	12″	12″ × 16″ concrete encased column; 12″ × 8″ × 65 lbs. “H” beam; Protection: aggregate concrete (3450 psi) with 4″ mesh; 16 SWG reinforcement 1″ below column surface.	118 tons	4 hrs. 4 min.			7	1	4

(continued)

TABLE 2.5.1.5—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-SC-5	12$^1/_2$″	12$^1/_2$″ × 14″ column; 6″ × 4$^1/_2$″ × 20 lbs. “H” beam; Protection: gravel aggregate concrete (3750 psi) with 4″ × 4″ mesh; 16 SWG reinforcing 1″ below column surface.	52 tons	4 hrs. 29 min.			7	1	4$^1/_3$
C-12-SC-6	12″	8″ × 8″ steel column; 2″ outside protection; Group I.	—	11 hrs.			1	2	11
C-12-SC-7	12″	Description as per C-12-SC-6; Group II.	—	8 hrs.		1		2	8
C-12-SC-8	12″	Description as per C-12-SC-6; Group III.	—	6 hrs.		1		2	6
C-12-SC-9	12″	Description as per C-12-SC-6; Group IV.	—	4 hrs.		1		2	4
C-12-SC-10	12″	10″ × 10″ steel column; 2″ outside protection; Group I.	—	7 hrs.		1		2	7
C-12-SC-11	12″	Description as per C-12-SC-10; Group II.	—	5 hrs.		1		2	5
C-12-SC-12	12″	Description as per C-12-SC-10; Group III.	—	4 hrs.		1		2	4
C-12-SC-13	12″	Description as per C-12-SC-10; Group IV.	—	2 hrs. 30 min.		1		2	2$^1/_2$
C-13-SC-14	13″	10″ × 10″ steel column; 3″ outside protection; Group I.	—	10 hrs.		1		2	10
C-13-SC-15	13″	Description as per C-12-SC-14; Group II.	—	7 hrs.		1		2	7
C-13-SC-16	13″	Description as per C-12-SC-14; Group III.	—	5 hrs.		1		2	5
C-13-SC-17	13″	Description as per C-12-SC-14; Group IV.	—	3 hrs. 30 min.		1		2	3$^1/_2$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

FIGURE 2.5.1.6
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

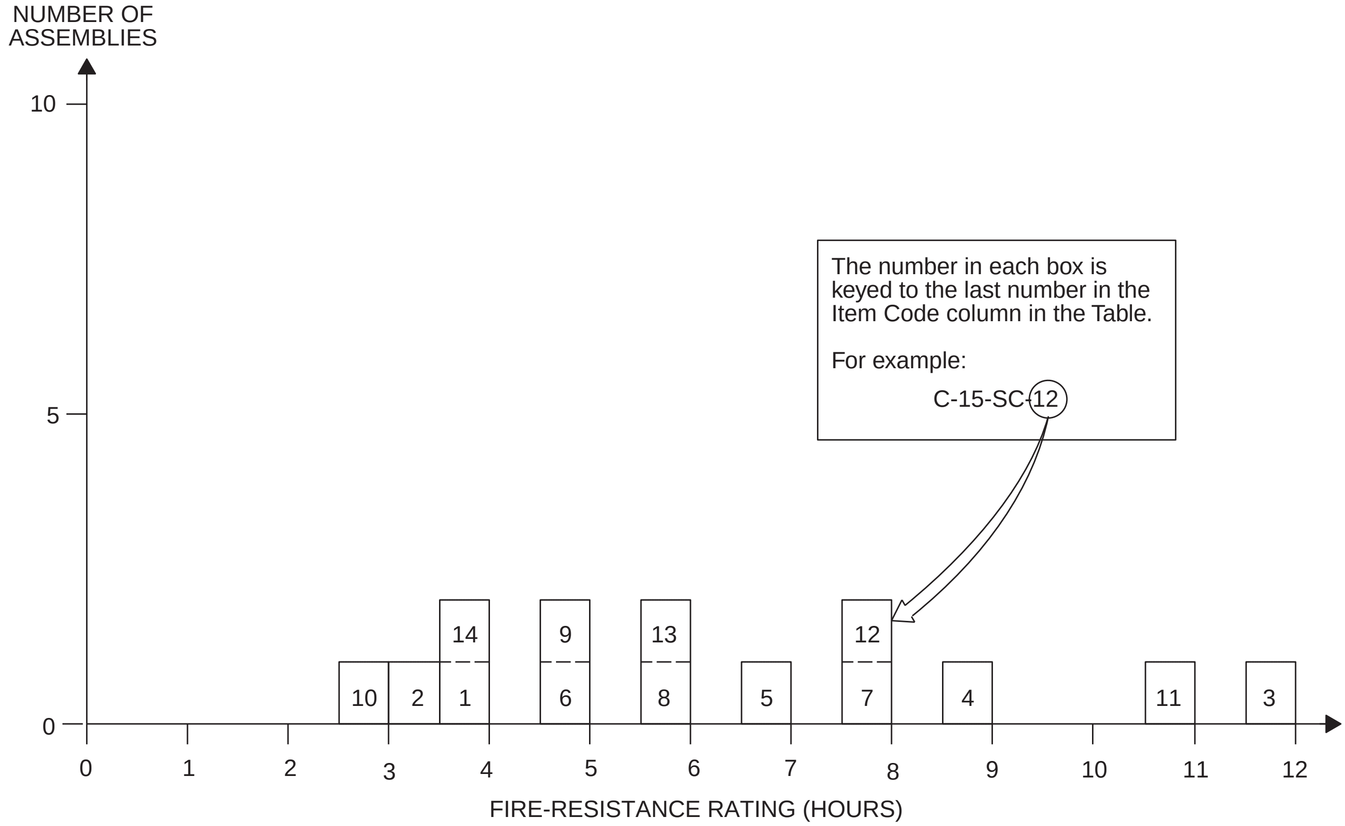


TABLE 2.5.1.6
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-14-SC-1	14″	24″ × 16″ concrete encased steel column; 8″ × 6″ × 35 lbs. "H" column; Protection: aggregate concrete (4240 psi); 4″ mesh - 16 SWG reinforcing 1″ below column surface.	90 tons	3 hrs. 40 min.			7	1	3
C-14-SC-2	14″	14″ × 18″ concrete encased steel column; 12″ × 8″ × 65 lbs. "H" beam; Protection: gravel aggregate concrete (4000 psi) with 4″ - 16 SWG wire mesh reinforcement 1″ below column surface.	177 tons	3 hrs. 20 min.			7	1	3
C-14-SC-3	14″	10″ × 10″ steel column; 4″ outside protection; Group I.	—	12 hrs.		1		2	12
C-14-SC-4	14″	Description as per C-14-SC-3; Group II.	—	9 hrs.		1		2	9
C-14-SC-1	14″	24″ × 16″ concrete encased steel column; 8″ × 6″ × 35 lbs. "H" column; Protection: aggregate concrete (4240 psi); 4″ mesh - 16 SWG reinforcing 1″ below column surface.	90 tons	3 hrs. 40 min.			7	1	3

(continued)

TABLE 2.5.1.6—continued
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-14-SC-2	14″	14″ × 18″ concrete encased steel column; 12″ × 8″ × 65 lbs. "H" beam; Protection: gravel aggregate concrete (4000 psi) with 4″-16 SWG wire mesh reinforcement 1″ below column surface.	177 tons	3 hrs. 20 min.			7	1	3
C-14-SC-3	14″	10″ × 10″ steel column; 4″ outside protection; Group I.	—	12 hrs.		1		2	12
C-14-SC-4	14″	Description as per C-14-SC-3; Group II.	—	9 hrs.		1		2	9
C-14-SC-5	14″	Description as per C-14-SC-3; Group III.	—	7 hrs.		1		2	7
C-14-SC-6	14″	Description as per C-14-SC-3; Group IV.	—	5 hrs.		1		2	5
C-14-SC-7	14″	12″ × 12″ steel column; 2″ outside protection; Group I.	—	8 hrs.		1		2	8
C-14-SC-8	14″	Description as per C-14-SC-7; Group II.	—	6 hrs.		1		2	6
C-14-SC-9	14″	Description as per C-14-SC-7; Group III.	—	5 hrs.		1		2	5
C-14-SC-10	14″	Description as per C-14-SC-7; Group IV	—	3 hrs.		1		2	3
C-15-SC-11	15″	12″ × 12″ steel column; 3″ outside protection; Group I.	—	11 hrs.		1		2	11
C-15-SC-12	15″	Description as per C-15-SC-11; Group II.	—	8 hrs.		1		2	8
C-15-SC-13	15″	Description as per C-15-SC-11; Group III.	—	6 hrs.		1		2	6
C-15-SC-14	15″	Description as per C-15-SC-11; Group IV.	—	4 hrs.		1		2	4

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 pound per square yard = 5.3 N/m^2, 1 ton = 8.896 kN.

Notes:

1. Collapse.
2. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.

   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.

   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

TABLE 2.5.1.7
STEEL COLUMNS—CONCRETE ENCASEMENTS
MINIMUM DIMENSION 16″ TO LESS THAN 18″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-16-SC-13	16″	12″ × 12″ steel column; 4″ outside protection; Group I.	—	14 hrs.		1		1	14
C-16-SC-2	16″	Description as per C-16-SC-1; Group II.	—	10 hrs.		1		1	10
C-16-SC-3	16″	Description as per C-16-SC-1; Group III.	—	8 hrs.		1		1	8
C-16-SC-4	16″	Description as per C-16-SC-1; Group IV.	—	5 hrs.		1		1	5

For SI: 1 inch = 25.4 mm.

Notes:

1. Group I: includes concrete having calcareous aggregate containing a combined total of not more than 10 percent of quartz, chert and flint for the coarse aggregate.
   Group II: includes concrete having trap-rock aggregate applied without metal ties and also concrete having cinder, sandstone or granite aggregate, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.
   Group III: includes concrete having cinder, sandstone or granite aggregate tied with No. 5 gage steel wire, wound spirally over the column section on a pitch of 8 inches, or equivalent ties, and concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, if held in place with wire mesh or expanded metal having not larger than 4-inch mesh, weighing not less than 1.7 lbs./yd.^{2}, placed not more than 1 inch from the surface of the concrete.
   Group IV: includes concrete having siliceous aggregates containing a combined total of 60 percent or more of quartz, chert and flint, and tied with No. 5 gage steel wire wound spirally over the column section on a pitch of 8 inches, or equivalent ties.

TABLE 2.5.2.1
STEEL COLUMNS—BRICK AND BLOCK ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-10-SB-1	10$^1/_2$″	10$^1/_2$″ × 13″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection. Fill of broken brick and mortar; 2″ brick on edge; joints broken in alternate courses; cement-sand grout; 13 SWG wire reinforcement in every third horizontal joint.	90 tons	3 hrs. 6 min.			7	1	3
C-10-SB-2	10$^1/_2$″	10$^1/_2$″ × 13″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 2″ brick; joints broken in alternate courses; cement-sand grout; 13 SWG iron wire reinforcement in alternate horizontal joints.	90 tons	2 hrs.			7	2, 3, 4	2
C-10-SB-3	10″	10″ × 12″ block encased columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 2″ foamed slag concrete blocks; 13 SWG wire at each horizontal joint; mortar at each joint.	90 tons	2 hrs.			7	5	2
C-10-SB-4	10$^1/_2$″	10$^1/_2$″ × 12″ block encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: gravel aggregate concrete fill (unconsolidated) 2″ thick hollow clay tiles with mortar at edges.	86 tons	56 min.			7	1	$^3/_4$
C-10-SB-5	10$^1/_2$″	10$^1/_2$″ × 12″ block encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 2″ hollow clay tiles with mortar at edges.	86 tons	22 min.			7	1	$^1/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.
2. Passed 2-hour fire test (Grade “C” - British).
3. Passed hose stream test.
4. Passed reload test.
5. Passed 2-hour fire exposure but collapsed immediately following hose stream test.

TABLE 2.5.2.2
STEEL COLUMNS—BRICK AND BLOCK ENCASEMENTS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-SB-1	12″	12″ × 15″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $2^5/_8$″ thick brick; joints broken in alternate courses; cement-sand grout; fill of broken brick and mortar.	90 tons	1 hr. 49 min.			7	1	$1^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Failure mode—collapse.

TABLE 2.5.2.3
STEEL COLUMNS—BRICK AND BLOCK ENCASEMENTS
MINIMUM DIMENSION 14″ TO LESS THAN 16″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-15-SB-1	15″	15″ × 17″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $4^1/_2$″ thick brick; joints broken in alternate courses; cement-sand grout; fill of broken brick and mortar.	45 tons	6 hrs.			7	1	6
C-15-SB-2	15″	15″ × 17″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection. Fill of broken brick and mortar; $4^1/_2$″ brick; joints broken in alternate courses; cement-sand grout.	86 tons	6 hrs.			7	2, 3, 4	6
C-15-SB-3	15″	15″ × 18″ brick encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $4^1/_2$″ brick work; joints alternating; cement-sand grout.	90 tons	4 hrs.			7	5, 6	4
C-15-SB-4	14″	14″ × 16″ block encased steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 4″ thick foam slag concrete blocks; 13 SWG wire reinforcement in each horizontal joint; mortar in joints.	90 tons	5 hrs. 52 min.			7	7	$4^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Only a nominal load was applied to specimen.
2. Passed 6-hour fire test (Grade “A” - British).
3. Passed (6 minute) hose stream test.
4. Reload not specified.
5. Passed 4-hour fire exposure.
6. Failed by collapse between first and second minute of hose stream exposure.
7. Mode of failure-collapse.

TABLE 2.5.3.1
STEEL COLUMNS—PLASTER ENCASEMENTS
MINIMUM DIMENSION 6″ TO LESS THAN 8″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-7-SP-1	$7^1/_2$″	$7^1/_2$″ × $9^1/_2$″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 24 SWG wire metal lath; $1^1/_4$″ lime plaster.	90 tons	57 min.			7	1	$^3/_4$
C-7-SP-2	$7^7/_8$″	$7^7/_8$″ × 10″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $^3/_8$″ gypsum board; wire wound with 16 SWG wire helically wound at 4″ pitch; $^1/_2$″ gypsum plaster.	90 tons	1 hr. 13 min.			7	1	1
C-7-SP-3	$7^1/_4$″	$7^1/_4$″ × $9^3/_8$″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $^3/_8$″ gypsum board; wire helically wound 16 SWG at 4″ pitch; $^1/_4$″ gypsum plaster finish.	90 tons	1 hr. 14 min.			7	1	1

Notes:
1. Failure mode—collapse.

TABLE 2.5.3.2
STEEL COLUMNS—PLASTER ENCASEMENTS
MINIMUM DIMENSION 8″ TO LESS THAN 10″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-8-SP-1	8″	8″ × 10″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 24 SWG wire lath; 1″ gypsum plaster.	86 tons	1 hr. 23 min.			7	1	$1^1/_4$
C-8-SP-2	$8^1/_2$″	$8^1/_2$″ × $10^1/_2$″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 24 SWG metal lath wrap; $1^1/_4$″ gypsum plaster.	90 tons	1 hr. 36 min.			7	1	$1^1/_2$
C-9-SP-3	9″	9″ × 11″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 24 SWG metal lath wrap; $^1/_8$″ M.S. ties at 12″ pitch wire netting $1^1/_2$″ × 22 SWG between first and second plaster coats; $1^1/_2$″ gypsum plaster.	90 tons	1 hr. 33 min.			7	1	$1^1/_2$
C-8-SP-4	$8^3/_4$″	$8^3/_4$″ × $10^3/_4$″ plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: $^3/_4$″ gypsum board; wire wound spirally (#16 SWG) at $1^1/_2$″ pitch; $^1/_2$″ gypsum plaster.	90 tons	2 hrs.			7	2, 3, 4	2

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:
1. Failure mode—collapse.
2. Passed 2 hour fire exposure test (Grade “C” - British).
3. Passed hose stream test.

TABLE 2.5.4.1
STEEL COLUMNS—MISCELLANEOUS ENCASEMENTS
MINIMUM DIMENSION 6″ TO LESS THAN 8″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-7-SM-1	$7^5/_8$″	$7^5/_8$″ × $9^1/_2$″ (asbestos plaster) protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 20 gage $^1/_2$″ metal lath; $^9/_{16}$″ asbestos plaster (minimum).	90 tons	1 hr. 52 min.			7	1	$1^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:
1. Failure mode—collapse.

TABLE 2.5.4.2
STEEL COLUMNS—MISCELLANEOUS ENCASEMENTS
MINIMUM DIMENSION 8″ TO LESS THAN 10″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-9-SM-1	9$^5/_8$″	9$^5/_8$″ × 11$^3/_8$″ asbestos slab and cement plaster protected columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: 1″ asbestos slab; wire wound; $^5/_8$″ plaster.	90 tons	2 hrs.			7	1, 2	2

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Passed 2 hour fire exposure test.
2. Collapsed during hose stream test.

TABLE 2.5.4.3
STEEL COLUMNS—MISCELLANEOUS ENCASEMENTS
MINIMUM DIMENSION 10″ TO LESS THAN 12″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-11-SM-1	11$^1/_2$″	11$^1/_2$″ × 13$^1/_2$″ wood wool and plaster protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: wood-wool-cement paste as fill and to 2″ cover over beam; $^3/_4$″ gypsum plaster finish.	90 tons	2 hrs.			7	1, 2, 3	2
C-10-SM-1	10″	10″ × 12″ asbestos protected steel columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: sprayed on asbestos paste to 2″ cover over column.	90 tons	4 hrs.			7	2, 3, 4	4

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Passed 2 hour fire exposure (Grade “C” - British).
2. Passed hose stream test.
3. Passed reload test.
4. Passed 4 hour fire exposure test.

TABLE 2.5.4.4
STEEL COLUMNS—MISCELLANEOUS ENCASEMENTS
MINIMUM DIMENSION 12″ TO LESS THAN 14″

ITEM CODE	MINIMUM DIMENSION	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
C-12-SM-1	12″	12″ × 14$^1/_4$″ cement and asbestos protected columns; 8″ × 6″ × 35 lbs. “H” beam; Protection: fill of asbestos packing pieces 1″ thick 1′3″ o.c.; cover of 2″ molded asbestos inner layer; 1″ molded asbestos outer layer; held in position by 16 SWG nichrome wire ties; wash of refractory cement on outer surface.	86 tons	4 hrs. 43 min.			7	1, 2, 3	4$^2/_3$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Passed 4 hour fire exposure (Grade “B” - British).
2. Passed hose stream test.
3. Passed reload test.

SECTION III
FLOOR/CEILING ASSEMBLIES

FIGURE 3.1
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

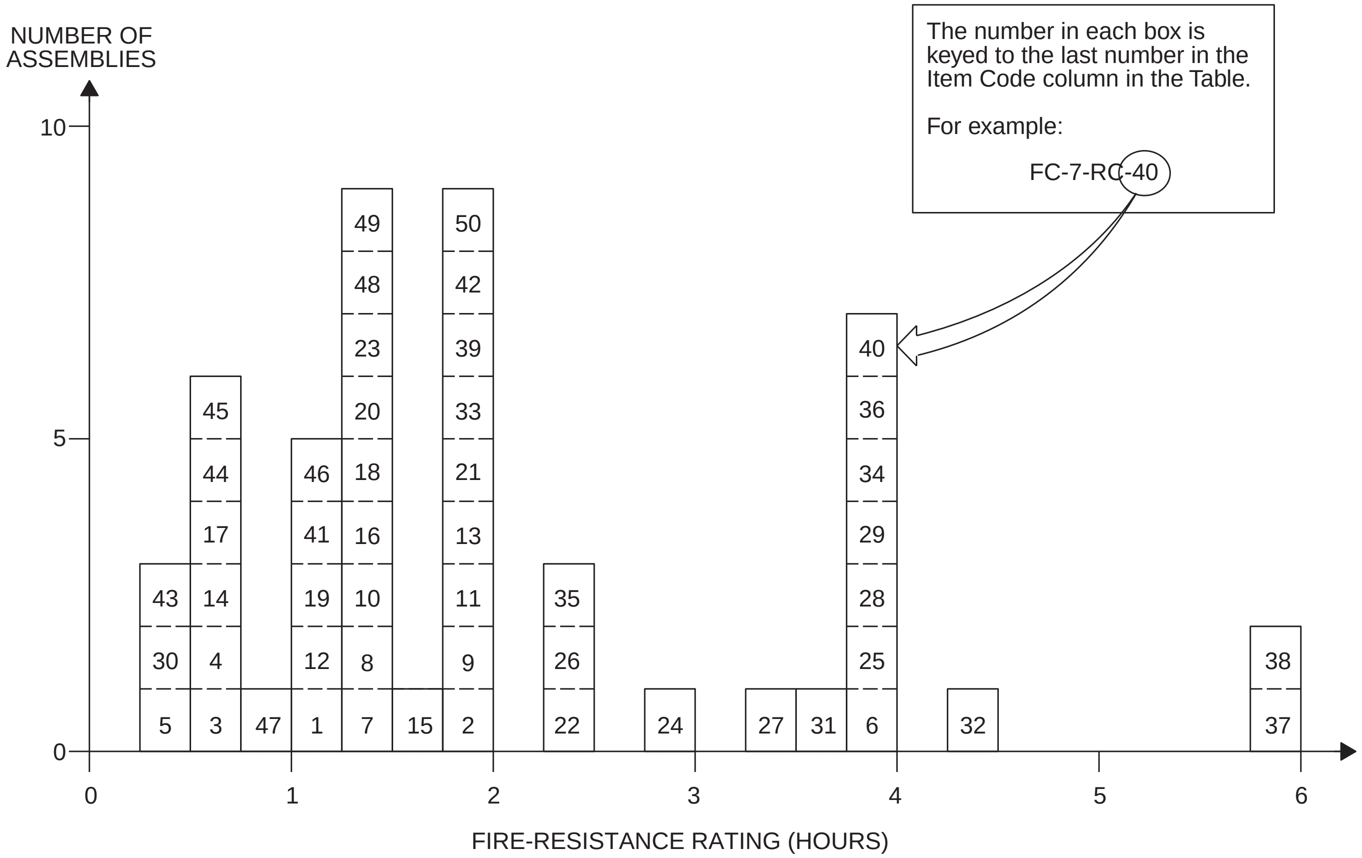


TABLE 3.1
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-3-RC-1	$3^3/_4''$	$3^3/_4''$ thick floor; $3^1/_4''$ (5475 psi) concrete deck; $^1/_2''$ plaster under deck; $^3/_8''$ main reinforcement bars at $5^1/_2''$ pitch with $^7/_8''$ concrete cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ concrete cover; 13′1″ span restrained.	195 psf	24 min.			7	1, 2	$^1/_3$
F/C-3-RC-2	$3^1/_4''$	$3^1/_4''$ deep (3540 psi) concrete deck; $^3/_8''$ main reinforcement bars at $5^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	195 psf	2 hrs.			7	1, 3, 4	2

(continued)

TABLE 3.1—continued
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-3-RC-3	$3^1/_4''$	$3^1/_4''$ deep (4175 psi) concrete deck; $^3/_8''$ main reinforcement bars at $5^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	195 psf	31 min.			7	1, 5	$^1/_2$
F/C-3-RC-4	$3^1/_4''$	$3^1/_4''$ deep (4355 psi) concrete deck; $^3/_8''$ main reinforcement bars at $5^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	195 psf	41 min.			7	1, 5, 6	$^1/_2$
F/C-3-RC-5	$3^1/_4''$	$3^1/_4''$ thick (3800 psi) concrete deck; $^3/_8''$ main reinforcement bars at $5^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	195 psf	1 hr. 5 min.			7	1, 5	1
F/C-4-RC-6	$4^1/_4''$	$4^1/_4''$ thick; $3^1/_4''$ (4000 psi) concrete deck; 1″ sprayed asbestos lower surface; $^3/_8''$ main reinforcement bars at $5^7/_8''$ pitch with $^7/_8''$ concrete cover; $^3/_8''$ main reinforcement bars at $4^1/_2''$ pitch perpendicular with $^1/_2''$ concrete cover; 13′1″ span restrained.	195 psf	4 hrs.			7	1, 7	4
F/C-4-RC-7	4″	4″ (5025 psi) concrete deck; $^1/_4''$ reinforcement bars at $7^1/_2''$ pitch with $^3/_4''$ cover; $^3/_8''$ main reinforcement bars at $3^3/_4''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	140 psf	1 hr. 16 min.			7	1, 2	$1^1/_4$
F/C-4-RC-8	4″	4″ thick (4905 psi) deck; $^1/_4''$ reinforcement bars at $7^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $3^3/_4''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	100 psf	1 hr. 23 min.			7	1, 2	$1^1/_3$
F/C-4-RC-9	4″	4″ deep (4370 psi);$^1/_4''$ reinforcement bars at 6″ pitch with $^3/_4''$ cover; $^1/_4''$ main reinforcement bars at 4″ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	150 psf	2 hrs.			7	1, 3	2
F/C-4-RC-10	4″	4″ thick (5140 psi) deck; $^1/_4''$ reinforcement bars at $7^1/_2''$ pitch with $^7/_8''$ cover; $^3/_8''$ main reinforcement bars at $3^3/_4''$ pitch perpendicular with $^1/_2''$ cover; 13′1″ span restrained.	140 psf	1 hr. 16 min.			7	1, 5	$1^1/_4$
F/C-4-RC-11	4″	4″ thick (4000 psi) concrete deck; 3″ × $1^1/_2''$ × 4 lbs. R.S.J.; 2′6″ C.R.S.; flush with top surface; 4″ × 6″ x 13 SWG mesh reinforcement 1″ from bottom of slab; 6′6″ span restrained.	150 psf	2 hrs.			7	1, 3	2

(continued)

TABLE 3.1—continued
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-4-RC-12	4″	4″ deep (2380 psi) concrete deck; 3″ × 1$^1/_2$″ × 4 lbs. R.S.J.; 2′6″ C.R.S.; flush with top surface; 4″ × 6″ x 13 SWG mesh reinforcement 1″ from bottom surface; 6′6″ span restrained.	150 psf	1 hr. 3 min.			7	1, 2	1
F/C-4-RC-13	4$^1/_2$″	4$^1/_2$″ thick (5200 psi) deck; $^1/_4$″ reinforcement bars at 7$^1/_4$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^3/_4$″ pitch perpendicular with $^1/_2$″ cover; 13′1″ span restrained.	140 psf	2 hrs.			7	1, 3	2
F/C-4-RC-14	4$^1/_2$″	4$^1/_2$″ deep (2525 psi) concrete deck; $^1/_4$″ reinforcement bars at 7$^1/_2$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^3/_8$″ pitch perpendicular with $^1/_2$″ cover; 13′1″ span restrained.	150 psf	42 min.			7	1, 5	$^2/_3$
F/C-4-RC-15	4$^1/_2$″	4$^1/_2$″ deep (4830 psi) concrete deck; 1$^1/_2$″ × No. 15 gauge wire mesh; $^3/_8$″ reinforcement bars at 15″ pitch with 1″ cover; $^1/_2$″ main reinforcement bars at 6″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	75 psf	1 hr. 32 min.			7	1, 8	1$^1/_2$
F/C-4-RC-16	4$^1/_2$″	4$^1/_2$″ deep (4595 psi) concrete deck; $^1/_4$″ reinforcement bars at 7$^1/_2$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^1/_2$″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	75 psf	1 hr. 20 min.			7	1, 8	1$^1/_3$
F/C-4-RC-17	4$^1/_2$″	4$^1/_2$″ deep (3625 psi) concrete deck; $^1/_4$″ reinforcement bars at 7$^1/_2$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^1/_2$″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	75 psf	35 min.			7	1, 8	$^1/_2$
F/C-4-RC-18	4$^1/_2$″	4$^1/_2$″ deep (4410 psi) concrete deck; $^1/_4$″ reinforcement bars at 7$^1/_2$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^1/_2$″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	85 psf	1 hr. 27 min.			7	1, 8	1$^1/_3$
F/C-4-RC-19	4$^1/_2$″	4$^1/_2$″ deep (4850 psi) deck; $^3/_8$″ reinforcement bars at 15″ pitch with 1″ cover; $^1/_2$″ main reinforcement bars at 6″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	75 psf	2 hrs. 15 min.			7	1, 9	1$^1/_4$
F/C-4-RC-20	4$^1/_2$″	4$^1/_2$″ deep (3610 psi) deck; $^1/_4$″ reinforcement bars at 7$^1/_2$″ pitch with $^7/_8$″ cover; $^3/_8$″ main reinforcement bars at 3$^1/_2$″ pitch perpendicular with $^1/_2$″ cover; 12′ span simply supported.	75 psf	1 hr. 22 min.			7	1, 8	1$^1/_3$

(continued)

TABLE 3.1—continued
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-5-RC-21	5″	5″ deep; $4^{1}/_{2}$″ (5830 psi) concrete deck; $^{1}/_{2}$″ plaster finish bottom of slab; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch with $^{7}/_{8}$″ cover; $^{3}/_{8}$″ main reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with $^{1}/_{2}$″ cover; 12′ span simply supported.	69 psf	2 hrs.			7	1, 3	2
F/C-5-RC-22	5″	$4^{1}/_{2}$″ (5290 psi) concrete deck; $^{1}/_{2}$″ plaster finish bottom of slab; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch with $^{7}/_{8}$″ cover; $^{3}/_{8}$″ main reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with $^{1}/_{2}$″ cover; 12′ span simply supported.	No load	2 hrs. 28 min.			7	1, 10, 11	$2^{1}/_{4}$
F/C-5-RC-23	5″	5″ (3020 psi) concrete deck; 3″ × $1^{1}/_{2}$″ × 4 lbs. R.S.J.; 2′ C.R.S. with 1″ cover on bottom and top flanges; 8′ span restrained.	172 psf	1 hr. 24 min.			7	1, 2, 12	$1^{1}/_{2}$
F/C-5-RC-24	$5^{1}/_{2}$″	5″ (5180 psi) concrete deck; $^{1}/_{2}$″ retarded plaster underneath slab; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch with $1^{3}/_{8}$″ cover; $^{3}/_{8}$″ main reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with 1″ cover; 12′ span simply supported.	60 psf	2 hrs. 48 min.			7	1, 10	$2^{3}/_{4}$
F/C-6-RC-25	6″	6″ deep (4800 psi) concrete deck; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch with $^{7}/_{8}$″ cover; $^{3}/_{8}$″ main reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with $^{7}/_{8}$″ cover; 13′1″ span restrained.	195 psf	4 hrs.			7	1, 7	4
F/C-6-RC-26	6″	6″ (4650 psi) concrete deck; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch with $^{7}/_{8}$″ cover; $^{3}/_{8}$″ main reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with $^{1}/_{2}$″ cover; 13′1″ span restrained.	195 psf	2 hrs. 23 min.			7	1, 2	$2^{1}/_{4}$
F/C-6-RC-27	6″	6″ deep (6050 psi) concrete deck; $^{1}/_{4}$″ reinforcement bars at $7^{1}/_{2}$″ pitch $^{7}/_{8}$″ cover; $^{3}/_{8}$″ reinforcement bars at $3^{1}/_{2}$″ pitch perpendicular with $^{1}/_{2}$″ cover; 13′1″ span restrained.	195 psf	3 hrs. 30 min.			7	1, 10	$3^{1}/_{2}$
F/C-6-RC-28	6″	6″ deep (5180 psi) concrete deck; $^{1}/_{4}$″ reinforcement bars at 8″ pitch $^{3}/_{4}$″ cover; $^{1}/_{4}$″ reinforcement bars at $5^{1}/_{2}$″ pitch perpendicular with $^{1}/_{2}$″ cover; 13′1″ span restrained.	150 psf	4 hrs.			7	1, 7	4
F/C-6-RC-29	6″	6″ thick (4180 psi) concrete deck; 4″ × 3″ × 10 lbs. R.S.J.; 2′ 6″ C.R.S. with 1″ cover on both top and bottom flanges; 13′1″ span restrained.	160 psf	3 hrs. 48 min.			7	1, 10	$3^{3}/_{4}$
F/C-6-RC-30	6″	6″ thick (3720 psi) concrete deck; 4″ × 3″ × 10 lbs. R.S.J.; 2′ 6″ C.R.S. with 1″ cover on both top and bottom flanges; 12′ span simply supported.	115 psf	29 min.			7	1, 5, 13	$^{1}/_{4}$

(continued)

TABLE 3.1—continued
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-6-RC-31	6″	6″ deep (3450 psi) concrete deck; 4″ × $1^3/_4$″ × 5 lbs. R.S.J.; 2′ 6″ C.R.S. with 1″ cover on both top and bottom flanges; 12′ span simply supported.	25 psf	3 hrs. 35 min.			7	1, 2	$3^1/_2$
F/C-6-RC-32	6″	6″ deep (4460 psi) concrete deck; 4″ × $1^3/_4$″ × 5 lbs. R.S.J.; 2′ C.R.S.; with 1″ cover on both top and bottom flanges; 12′ span simply supported.	60 psf	4 hrs. 30 min.			7	1, 10	$4^1/_2$
F/C-6-RC-33	6″	6″ deep (4360 psi) concrete deck; 4″ × $1^3/_4$″ × 5 lbs. R.S.J.; 2′ C.R.S.; with 1″ cover on both top and bottom flanges; 13′1″ span restrained.	60 psf	2 hrs.			7	1, 3	2
F/C-6-RC-34	$6^1/_4$″	$6^1/_4$″ thick; $4^3/_4$″ (5120 psi) concrete core; 1″ T&G board flooring; $^1/_2$″ plaster undercoat; 4″ × 3″ × 10 lbs. R.S.J.; 3′ C.R.S. flush with top surface concrete; 12′ span simply supported; 2″ × 1′3″ clinker concrete insert.	100 psf	4 hrs.			7	1, 7	4
F/C-6-RC-35	$6^1/_4$″	$4^3/_4$″ (3600 psi) concrete core; 1″ T&G board flooring; $^1/_2$″ plaster undercoat; 4″ × 3″ × 10 lbs. R.S.J.; 3′ C.R.S.; flush with top surface concrete; 12′ span simply supported; 2″ × 1′3″ clinker concrete insert.	100 psf	2 hrs. 30 min.			7	1, 5	$2^1/_2$
F/C-6-RC-36	$6^1/_4$″	$4^3/_4$″ (2800 psi) concrete core; 1″ T&G board flooring; $^1/_2$″ plaster undercoat; 4″ × 3″ × 10 lbs. R.S.J.; 3′ C.R.S.; flush with top surface concrete; 12″ span simply supported; 2″ × 1′3″ clinker concrete insert.	80 psf	4 hrs.			7	1, 7	4
F/C-7-RC-37	7″	(3640 psi) concrete deck; $^1/_4$″ reinforcement bars at 6″ pitch with $1^1/_2$″ cover; $^1/_4$″ reinforcement bars at 5″ pitch perpendicular with $1^1/_2$″ cover; 13′1″ span restrained.	169 psf	6 hrs.			7	1, 14	6
F/C-7-RC-38	7″	(4060 psi) concrete deck; 4″ × 3″ × 10 lbs. R.S.J.; 2′ 6″ C.R.S. with $1^1/_2$″ cover on both top and bottom flanges; 4″ × 6″ × 13 SWG mesh reinforcement $1^1/_2$″ from bottom of slab; 13′1″ span restrained.	175 psf	6 hrs.			7	1, 14	6
F/C-7-RC-39	$7^1/_4$″	$5^3/_4$″ (4010 psi) concrete core; 1″ T&G board flooring; $^1/_2$″ plaster undercoat; 4″ × 3″ × 10 lbs. R.S.J.; 2′ 6″ C.R.S.; 1″ down from top surface of concrete; 12′ simply supported span; 2″ × 1′ 3″ clinker concrete insert.	95 psf	2 hrs.			7	1, 3	2
F/C-7-RC-40	$7^1/_4$″	$5^3/_4$″ (3220 psi) concrete core; 1″ T&G flooring; $^1/_2$″ plaster undercoat; 4″ × 3″ × 10 lbs. R.S.J.; 2′6″ C.R.S.; 1″ down from top surface of concrete; 12′ simply supported span; 2″ × 1′3″ clinker concrete insert.	95 psf	4 hrs.			7	1, 7	4

(continued)

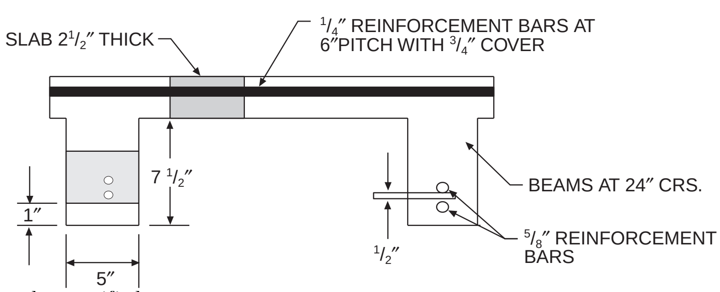
TABLE 3.1—continued
FLOOR/CEILING ASSEMBLIES—REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-7-RC-41	10″ ($2^1/_4$″ Slab)	Ribbed floor, see Note 15 for details; slab $2^1/_2$″ deep (3020 psi); $^1/_4$″ reinforcement bars at 6″ pitch with $^3/_4$″ cover; beams $7^1/_2$″ deep × 5″ wide; 24″ C.R.S.; $^5/_8$″ reinforcement bars two rows $^1/_2$″ vertically apart with 1″ cover; 13′1″ span restricted.	195 psf	1 hr. 4 min.			7	1, 2, 15	1
F/C-5-RC-42	$5^1/_2$″	Composite ribbed concrete slab assembly; see Note 17 for details.	See Note 16	2 hrs.			43	16, 17	2
F/C-3-RC-43	3″	2500 psi concrete; $^5/_8$″ cover; fully restrained at test.	See Note 16	30 min.			43	16	$^1/_2$
F/C-3-RC-44	3″	2000 psi concrete; $^5/_8$″ cover; free or partial restraint at test.	See Note 16	45 min.			43	16	$^3/_4$
F/C-4-RC-45	4″	2500 psi concrete; $^5/_8$″ cover; fully restrained at test.	See Note 16	40 min.			43	16	$^2/_3$
F/C-4-RC-46	4″	2000 psi concrete; $^3/_4$″ cover; free or partial restraint at test.	See Note 16	1 hr. 15 min.			43	16	$1^1/_4$
F/C-5-RC-47	5″	2500 psi concrete; $^3/_4$″ cover; fully restrained at test.	See Note 16	1 hr.			43	16	1
F/C-5-RC-48	5″	2000 psi concrete; $^3/_4$″ cover; free or partial restraint at test.	See Note 16	1 hr. 30 min.			43	16	$1^1/_2$
F/C-6-RC-49	6″	2500 psi concrete; 1″ cover; fully restrained at test.	See Note 16	1 hr. 30 min.			43	16	$1^1/_2$
F/C-6-RC-50	6″	2000 psi concrete; 1″ cover; free or partial restraint at test.	See Note 16	2 hrs.			43	16	2

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.

Notes :

1. British test.
2. Failure mode—local back face temperature rise.
3. Tested for Grade “C” (2 hour) fire resistance
4. Collapse imminent following hose stream.
5. Failure mode—flame thru.
6. Void formed with explosive force and report.
7. Achieved Grade “B” (4 hour) fire resistance (British).
8. Failure mode—collapse.
9. Test was run to 2 hours, but specimen was partially supported by the furnace at $1^1/_4$ hours.
10. Failure mode—average back face temperature.
11. Recommended endurance for nonload bearing performance only.
12. Floor maintained load bearing ability to 2 hours at which point test was terminated.
13. Test was run to 3 hours at which time failure mode 2 (above) was reached in spite of crack formation at 29 minutes.
14. Tested for Grade “A” (6 hour) fire resistance.
15.



16. Load unspecified.
17. Total assembly thickness $5^1/_2$ inches. Three-inch thick blocks of molded excelsior bonded with Portland cement used as inserts with $2^1/_2$-inch cover (concrete) above blocks and $^3/_4$-inch gypsum plaster below. Nine-inch wide ribs containing reinforcing steel of unspecified size interrupted 20-inch wide segments of slab composite (i.e., plaster, excelsior blocks, concrete cover).

FIGURE 3.2
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

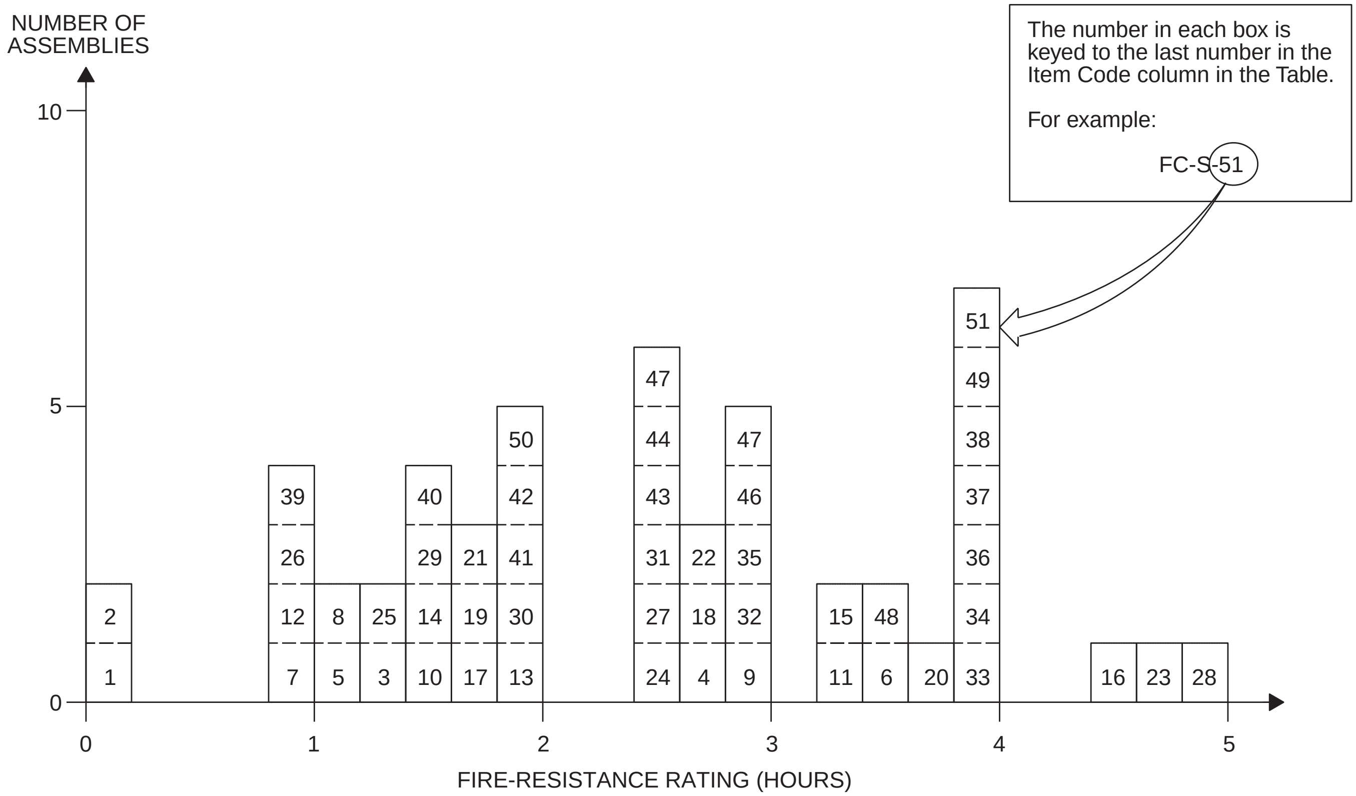


TABLE 3.2
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-S-1	0″	10′ × 13′6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete; Membrane: none.	145 psf	7 min.			3	1, 2, 3, 8	0
F/C-S-2	0″	10′ × 13′6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete; Membrane: none	145 psf	7 min.			3	1, 2, 3, 8	0
F/C-S-3	$^1/_2$″	10′ × 13′ 6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 12″ o.c.; Clips A, B, G; No extra reinforcement; $^1/_2$″ plaster - 1.5:2.5.	145 psf	1 hr. 15 min.			3	2, 3, 8	$1^1/_4$
F/C-S-4	$^1/_2$″	10′ × 13′ 6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 16″ o.c.; Clips D, E, F, G; Diagonal wire reinforcement; $^1/_2$″ plaster - 1.5:2.5.	145 psf	2 hrs. 46 min.			3	3, 8	$2^3/_4$
F/C-S-5	$^1/_2$″	10′ × 13′6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 16″ o.c.; Clips A, B, G; No extra reinforcement; $^1/_2$″ plaster - 1.5:2.5.	145 psf	1 hr. 4 min.			3	2, 3, 8	1
F/C-S-6	$^1/_2$″	10′ × 13′6″; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 16″ o.c.; Clips D, E, F, G; Hexagonal mesh reinforcement; $^1/_2$″ plaster.	145 psf	3 hrs. 28 min.			3	2, 3, 8	$2^1/_3$

(continued)

TABLE 3.2—continued
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-S-7	$^{1}/_{2}$″	10′ × 13′6″ ; S.J. 103 - 24″ o.c.; Deck: 4 lbs. rib lath; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck gravel concrete; Membrane: furring 16″ o.c.; Clips C, E; Reinforcement: none; $^{1}/_{2}$″ plaster - 1.5:2.5 mill mix.	N/A	55 min.			3	5, 8	$^{3}/_{4}$
F/C-S-8	$^{1}/_{2}$″	Spec. 9′ × 4′4″; S.J. 103 bar joists - 18″ o.c.; Deck: 4 lbs. rib lath base; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck 1:2:4 gravel concrete; Membrane: furring, $^{3}/_{4}$″ C.R.S., 16″ o.c.; Clips C, E; Reinforcement: none; $^{1}/_{2}$″ plaster - 1.5:2.5 mill mix.	300 psf	1 hr. 10 min.			3	2, 3, 8	1
F/C-S-9	$^{5}/_{8}$″	10′ × 13′6″; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 12″ o.c.; Clips A, B, G; Extra “A” clips reinforcement; $^{5}/_{8}$″ plaster - 1.5:2; 1.5:3.	145 psf	3 hrs.			3	6, 8	3
F/C-S-10	$^{5}/_{8}$″	18′ × 13′6″ ; Joists, S.J. 103 - 24″ o.c.; Deck: 4 lbs. rib lath; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck 1:2:3.5 gravel concrete; Membrane: furring, spacing 16″ o.c.; Clips C, E; Reinforcement: none; $^{5}/_{8}$″ plaster - 1.5:2.5 mill mix.	145 psf	1 hr. 25 min.			3	2, 3, 8	$1^{1}/_{3}$
F/C-S-11	$^{5}/_{8}$″	10′ × 13′6″; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 12″ o.c.; Clips D, E, F, G; Diagonal wire reinforcement; $^{5}/_{8}$″ plaster - 1.5:2; 0.5:3.	145 psf	3 hrs. 15 min.			3	2, 4, 8	$3^{1}/_{4}$
F/C-S-12	$^{5}/_{8}$″	10′ × 13′6″; Joists, S.J. 103 - 24″ o.c.; Deck: 3.4 lbs. rib lath; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck 1:2:4 gravel concrete; Membrane: furring 16″ o.c.; Clips D, E, F, G; Reinforcement: none; $^{5}/_{8}$″ plaster - 1.5:2.5.	145 psf	1 hr.			3	7, 8	1
F/C-S-13	$^{3}/_{4}$″	Spec. 9′ × 4′4″; S.J. 103 - 18″ o.c.; Deck: 4 lbs. rib lath; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck 1:2:4 gravel concrete; Membrane: furring, $^{3}/_{4}$″ C.R.S., 16″ o.c.; Clips C, E; Reinforcement: none; $^{3}/_{4}$″ plaster - 1.5:2.5 mill mix.	300 psf	1 hr. 56 min.			3	3, 8	$1^{3}/_{4}$
F/C-S-14	$^{7}/_{8}$″	Floor finish: 1″ concrete; plate cont. weld; 4″ - 7.7 lbs. “I” beams; Ceiling: $^{1}/_{4}$″ rods 12″ o.c.; $^{7}/_{8}$″ gypsum sand plaster.	105 psf	1 hr. 35 min.			6	2, 4, 9, 10	$1^{1}/_{2}$
F/C-S-15	1″	Floor finish: $1^{1}/_{2}$″ L.W. concrete; $^{1}/_{2}$″ limestone cement; plate cont. weld; 5″ - 10 lbs. “I” beams; Ceiling: $^{1}/_{4}$″ rods 12″ o.c. tack welded to beams metal lath; 1″ P. C. plaster.	165 psf	3 hrs. 20 min.			6	4, 9, 11	$3^{1}/_{3}$
F/C-S-16	1″	10′ × 13′6″ ; S.J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 12″ o.c.; Clips D, E, F, G; Hexagonal mesh reinforcement; 1″ thick plaster - 1.5:2; 1.5:3.	145 psf	4 hrs. 26 min.			3	2, 4, 8	$4^{1}/_{3}$
F/C-S-17	1″	10′ × 13′6″ ; Joists - S.J. 103 - 24″ o.c.; Deck: 3.4 lbs. rib lath; 6″ × 6″ - 10 × 10 ga. reinforcement; 2″ deck 1:2:4 gravel concrete; Membrane: furring 16″ o.c.; Clips D, E, F, G; 1″ plaster.	145 psf	1 hr. 42 min.			3	2, 4, 8	$1^{2}/_{3}$

(continued)

TABLE 3.2—continued
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-S-18	$1^1/_8''$	10′ × 13′6″ ; S. J. 103 - 24″ o.c.; Deck: 2″ concrete 1:2:4; Membrane: furring 12″ o.c.; Clips C, E, F, G; Diagonal wire reinforcement; $1^1/_8''$ plaster.	145 psf	2 hrs. 44 min.			3	2, 4, 8	$2^2/_3$
F/C-S-19	$1^1/_8''$	10′ × 13′6″ ; Joists - S.J. 103 - 24″ o.c.; Deck: $1^1/_2''$ gypsum concrete over; $^1/_2''$ gypsum board; Membrane: furring 12″ o.c.; Clips D, E, F, G; $1^1/_8''$ plaster - 1.5:2; 1.5:3.	145 psf	1 hr. 40 min.			3	2, 3, 8	$1^2/_3$
F/C-S-20	$1^1/_8''$	$2^1/_2''$ cinder concrete; $^1/_2''$ topping; plate 6″ welds 12″ o.c.; 5″ - 18.9 lbs. “H” center; 5″ - 10 lbs. “I” ends; 1″ channels 18″ o.c.; $1^1/_8''$ gypsum sand plaster.	150 psf	3 hrs. 43 min.			6	2, 4, 9, 11	$3^2/_3$
F/C-S-21	$1^1/_4''$	10′ × 13′6″ ; Joists - S.J. 103 - 24″ o.c.; Deck: $1^1/_2''$ gypsum concrete over; $^1/_2''$ gypsum board base; Membrane: furring 12″ o.c.; Clips D, E, F, G; $1^1/_4''$ plaster - 1.5:2; 1.5:3.	145 psf	1 hr. 48 min.			3	2, 3, 8	$1^2/_3$
F/C-S-22	$1^1/_4''$	Floor finish: $1^1/_2''$ limestone concrete; $^1/_2''$ sand cement topping; plate to beams $3^1/_2''$; 12″ o.c. welded; 5″ - 10 lbs. “I” beams; 1″ channels 18″ o.c.; $1^1/_4''$ wood fiber gypsum sand plaster on metal lath.	292 psf	2 hrs. 45 min.			6	2, 4, 9, 10	$2^3/_4$
F/C-S-23	$1^1/_2''$	$2^1/_2''$ L.W. (gas exp.) concrete; Deck: $^1/_2''$ topping; plate $6^1/_4''$ welds 12″ o.c.; Beams: 5″ - 18.9 lbs. “H” center; 5″ - 10 lbs. “I” ends; Membrane: 1″ channels 18″ o.c.; $1^1/_2''$ gypsum sand plaster.	150 psf	4 hrs. 42 min.			6	2, 4, 9	$4^2/_3$
F/C-S-24	$1^1/_2''$	Floor finish: $1^1/_2''$ limestone concrete; $^1/_2''$ cement topping; plate $3^1/_2''$ - 12″ o.c. welded; 5″ - 10 lbs. “I” beams; Ceiling: 1″ channels 18″ o.c.; $1^1/_2''$ gypsum plaster.	292 psf	2 hrs. 34 min.			6	2, 4, 9, 10	$2^1/_2$
F/C-S-25	$1^1/_2''$	Floor finish: $1^1/_2''$ gravel concrete on exp. metal; plate cont. weld; 4″ - 7.7 lbs. “I” beams; Ceiling: $^1/_4''$ rods 12″ o.c. welded to beams; $1^1/_2''$ fiber gypsum sand plaster.	70 psf	1 hr. 24 min.			6	2, 4, 9, 10	$1^1/_3$
F/C-S-26	$2^1/_2''$	Floor finish: bare plate; $6^1/_4''$ welding - 12″ o.c.; 5″ - 18.9 lbs. “H” girders (inner); 5″ - 10 lbs “I” girders (two outer); 1″ channels 18″ o.c.; 2″ reinforced gypsum tile; $^1/_2''$ gypsum sand plaster.	122 psf	1 hr.			6	7, 9, 11	1
F/C-S-27	$2^1/_2''$	Floor finish: 2″ gravel concrete; plate to beams $3^1/_2''$ - 12″ o.c. welded; 4″ - 7.7 lbs. “I” beams; 2″ gypsum ceiling tiles; $^1/_2''$ 1:3 gypsum sand plaster.	105 psf	2 hrs. 31 min.			6	2, 4, 9, 10	$2^1/_2$
F/C-S-28	$2^1/_2''$	Floor finish: $1^1/_2''$ gravel concrete; $^1/_2''$ gypsum asphalt; plate continuous weld; 4″ - 7.7 lbs. “I” beams; 12″ - 31.8 lbs. “I” beams - girder at 5′ from one end; 1″ channels 18″ o.c.; 2″ reinforcement gypsum tile; $^1/_2''$ 1:3 gypsum sand plaster.	200 psf	4 hrs. 55 min.			6	2, 4, 9, 11	$4^2/_3$

(continued)

TABLE 3.2—continued
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-S-29	$^3/_4''$	Floor: 2″ reinforced concrete or 2″ precast reinforced gypsum tile; Ceiling: $^3/_4''$ Portland cement-sand plaster 1:2 for scratch coat and 1:3 for brown coat with 15 lbs. hydrated lime and 3 lbs. of short asbestos fiber bag per cement or $^3/_4''$ sanded gypsum plaster 1:2 for scratch coat and 1:3 for brown coat.	See Note 12	1 hr. 30 min.		1		12, 13, 14	$1^1/_2$
F/C-S-30	$^3/_4''$	Floor: $2^1/_4''$ reinforced concrete or 2″ reinforced gypsum tile; the latter with $^1/_4''$ mortar finish; Ceiling: $^3/_4''$ sanded gypsum plaster; 1:2 for scratch coat and 1:3 for brown coat.	See Note 12	2 hrs.		1		12, 13, 14	2
F/C-S-31	$^3/_4''$	Floor: $2^1/_2''$ reinforced concrete or 2″ reinforced gypsum tile; the latter with $^1/_4''$ mortar finish; Ceiling: 1″ neat gypsum plaster or $^3/_4''$ gypsum-vermiculite plaster, ratio of gypsum to fine vermiculite 2:1 to 3:1.	See Note 12	2 hrs. 30 min.		1		12, 13, 14	$2^1/_2$
F/C-S-32	$^3/_4''$	Floor: $2^1/_2''$ reinforced concrete or 2″ reinforced gypsum tile; the latter with $^1/_2''$ mortar finish; Ceiling: 1″ neat gypsum plaster or $^3/_4''$ gypsum-vermiculite plaster, ratio of gypsum to fine vermiculite 2:1 to 3:1.	See Note 12	3 hrs.		1		12, 13, 14	3
F/C-S-33	1″	Floor: $2^1/_2''$ reinforced concrete or 2″ reinforced gypsum slabs; the latter with $^1/_2''$ mortar finish; Ceiling: 1″ gypsum-vermiculite plaster applied on metal lath and ratio 2:1 to 3:1 gypsum to vermiculite by weight.	See Note 12	4 hrs.		1		12, 13, 14	4
F/C-S-34	$2^1/_2''$	Floor: 2″ reinforced concrete or 2″ precast reinforced Portland cement concrete or gypsum slabs; precast slabs to be finished with $^1/_4''$ mortar top coat; Ceiling: 2″ precast reinforced gypsum tile, anchored into beams with metal ties or clips and covered with $^1/_2''$ 1:3 sanded gypsum plaster.	See Note 12	4 hrs.		1		12, 13, 14	4
F/C-S-35	1″	Floor: 1:3:6 Portland cement, sand and gravel concrete applied directly to the top of steel units and $1^1/_2''$ thick at top of cells, plus $^1/_2''$ $1:2^1/_2''$ cement-sand finish, total thickness at top of cells, 2″ ; Ceiling: 1″ neat gypsum plaster, back of lath 2″ or more from underside of cellular steel.	See Note 15	3 hrs.		1		15, 16, 17, 18	3
F/C-S-36	1″	Floor: same as F/C-S-35; Ceiling: 1″ gypsum-vermiculite plaster (ratio of gypsum to vermiculite 2:1 to 3:1), the back of lath 2″ or more from under-side of cellular steel.	See Note 15	4 hrs.		1		15, 16, 17, 18	4
F/C-S-37	1″	Floor: same as F/C-S-35; Ceiling: 1″ neat gypsum plaster; back of lath 9″ or more from underside of cellular steel.	See Note 15	4 hrs.		1		15, 16, 17, 18	4
F/C-S-38	1″	Floor: same as F/C-S-35; Ceiling: 1″ gypsum-vermiculite plaster (ratio of gypsum to vermiculite 2:1 to 3:1), the back of lath being 9″ or more from underside of cellular steel.	See Note 15	5 hrs.		1		15, 16, 17,18	5

(continued)

TABLE 3.2—continued
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-S-39	$^3/_4''$	Floor: asbestos paper 14 lbs./100 ft.^{2} cemented to steel deck with waterproof linoleum cement, wood screeds and $^7/_8''$ wood floor; Ceiling: $^3/_4''$ sanded gypsum plaster 1:2 for scratch coat and 1:3 for brown coat.	See Note 19	1 hr.		1		19, 20, 21, 22	1
F/C-S-40	$^3/_4''$	Floor: $1^1/_2''$, 1:2:4 Portland cement concrete; Ceiling: $^3/_4''$ sanded gypsum plaster 1:2 for scratch coat and 1:3 for brown coat.	See Note 19	1 hr. 30 min.		1		19, 20, 21, 22	$1^1/_2$
F/C-S-41	$^3/_4''$	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: $^3/_4''$ sanded gypsum plaster, 1:2 for scratch coat and 1:3 for brown coat.	See Note 19	2 hrs.		1		19, 20, 21, 22	2
F/C-S-42	1″	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: 1″ Portland cement-sand plaster with 10 lbs. of hydrated lime for @ bag of cement 1:2 for scratch coat and $1:2^1/_2''$ for brown coat.	See Note 19	2 hrs.		1		19, 20, 21, 22	2
F/C-S-43	$1^1/_2''$	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: $1^1/_2''$, 1:2 sanded gypsum plaster on ribbed metal lath.	See Note 19	2 hrs. 30 min.		1		19, 20, 21, 22	$2^1/_2$
F/C-S-44	$1^1/_8''$	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: $1^1/_8''$, 1:1 sanded gypsum plaster.	See Note 19	2 hrs. 30 min.		1		19, 20, 21, 22	$2^1/_2$
F/C-S-45	1″	Floor: $2^1/_2''$, 1:2:4 Portland cement concrete; Ceiling: 1″, 1:2 sanded gypsum plaster.	See Note 19	2 hrs. 30 min.		1		19, 20, 21, 22	$2^1/_2$
F/C-S-46	$^3/_4''$	Floor: $2^1/_2''$, 1:2:4 Portland cement concrete; Ceiling: 1″ neat gypsum plaster or $^3/_4''$ gypsum-vermiculite plaster, ratio of gypsum to vermiculite 2:1 to 3:1.	See Note 19	3 hrs.		1		19, 20, 21, 22	3
F/C-S-47	$1^1/_8''$	Floor: $2^1/_2''$, 1:2:4 Portland cement, sand and cinder concrete plus $^1/_2''$, $1:2^1/_2''$ cement-sand finish; total thickness 3″; Ceiling: $1^1/_8''$, 1:1 sanded gypsum plaster.	See Note 19	3 hrs.		1		19, 20, 21, 22	3
F/C-S-48	$1^1/_8''$	Floor: $2^1/_2''$, gas expanded Portland cement-sand concrete plus $^1/_2''$, 1:2.5 cement-sand finish; total thickness 3″; Ceiling: $1^1/_8''$, 1:1 sanded gypsum plaster.	See Note 19	3 hrs. 30 min.		1		19, 20, 21, 22	$3^1/_2$
F/C-S-49	1″	Floor: $2^1/_2''$, 1:2:4 Portland cement concrete; Ceiling: 1″ gypsum- vermiculite plaster; ratio of gypsum to vermiculite 2:1 to 3:1.	See Note 19	4 hrs.		1		19, 20, 21, 22	4
F/C-S-50	$2^1/_2''$	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: 2″ interlocking gypsum tile supported on upper face of lower flanges of beams, $^1/_2''$ 1:3 sanded gypsum plaster.	See Note 19	2 hrs.		1		19, 20, 21, 22	2
F/C-S-51	$2^1/_2''$	Floor: 2″, 1:2:4 Portland cement concrete; Ceiling: 2″ precast metal reinforced gypsum tile, $^1/_2''$ 1:3 sanded gypsum plaster (tile clipped to channels which are clipped to lower flanges of beams).	See Note 19	4 hrs.		1		19, 20, 21, 22	4

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.

Notes:

1. No protective membrane over structural steel.
2. Performance time indicates first endpoint reached only several tests were continued to points where other failures occurred.
3. Load failure.

(continued)

TABLE 3.2—continued
FLOOR/CEILING ASSEMBLIES—STEEL STRUCTURAL ELEMENTS

4. Thermal failure.
5. This is an estimated time to load bearing failure. The same joist and deck specimen was used for a later test with different membrane protection.
6. Test stopped at 3 hours to reuse specimen; no endpoint reached.
7. Test stopped at 1 hour to reuse specimen; no endpoint reached.
8. All plaster used = gypsum.
9. Specimen size - 18 feet by $13^1/_2$ inches. Floor deck - base material - $^1/_4$-inch by 18-foot steel plate welded to “I” beams.
10. “I” beams - 24 inches o.c.
11. “I” beams - 48 inches o.c.
12. Apply to open web joists, pressed steel joists or rolled steel beams, which are not stressed beyond 18,000 lbs./in.^{2} in flexure for open-web pressed or light rolled joists, and 20,000 lbs./in.^{2} for American standard or heavier rolled beams.
13. Ratio of weight of Portland cement to fine and coarse aggregates combined for floor slabs shall not be less than $1{:}6^1/_2$.
14. Plaster for ceiling shall be applied on metal lath which shall be tied to supports to give the equivalent of single No. 18 gage steel wires 5 inches o.c.
15. Load: maximum fiber stress in steel not to exceed 16,000 psi.
16. Prefabricated units 2 feet wide with length equal to the span, composed of two pieces of No. 18 gage formed steel welded together to give four longitudinal cells.
17. Depth not less than 3 inches and distance between cells no less than 2 inches.
18. Ceiling: metal lath tied to furring channels secured to runner channels hung from cellular steel.
19. Load: rolled steel supporting beams and steel plate base shall not be stressed beyond 20,000 psi in flexure. Formed steel (with wide upper flange) construction shall not be stressed beyond 16,000 psi.
20. Some type of expanded metal or woven wire shall be embedded to prevent cracking in concrete flooring.
21. Ceiling plaster shall be metal lath wired to rods or channels which are clipped or welded to steel construction. Lath shall be no smaller than 18 gage steel wire and not more than 7 inches o.c.
22. The securing rods or channels shall be at least as effective as single $^3/_{16}$-inch rods with 1-inch of their length bent over the lower flanges of beams with the rods or channels tied to this clip with 14 gage iron wire.

FIGURE 3.3
FLOOR/CEILING ASSEMBLIES—WOOD JOIST

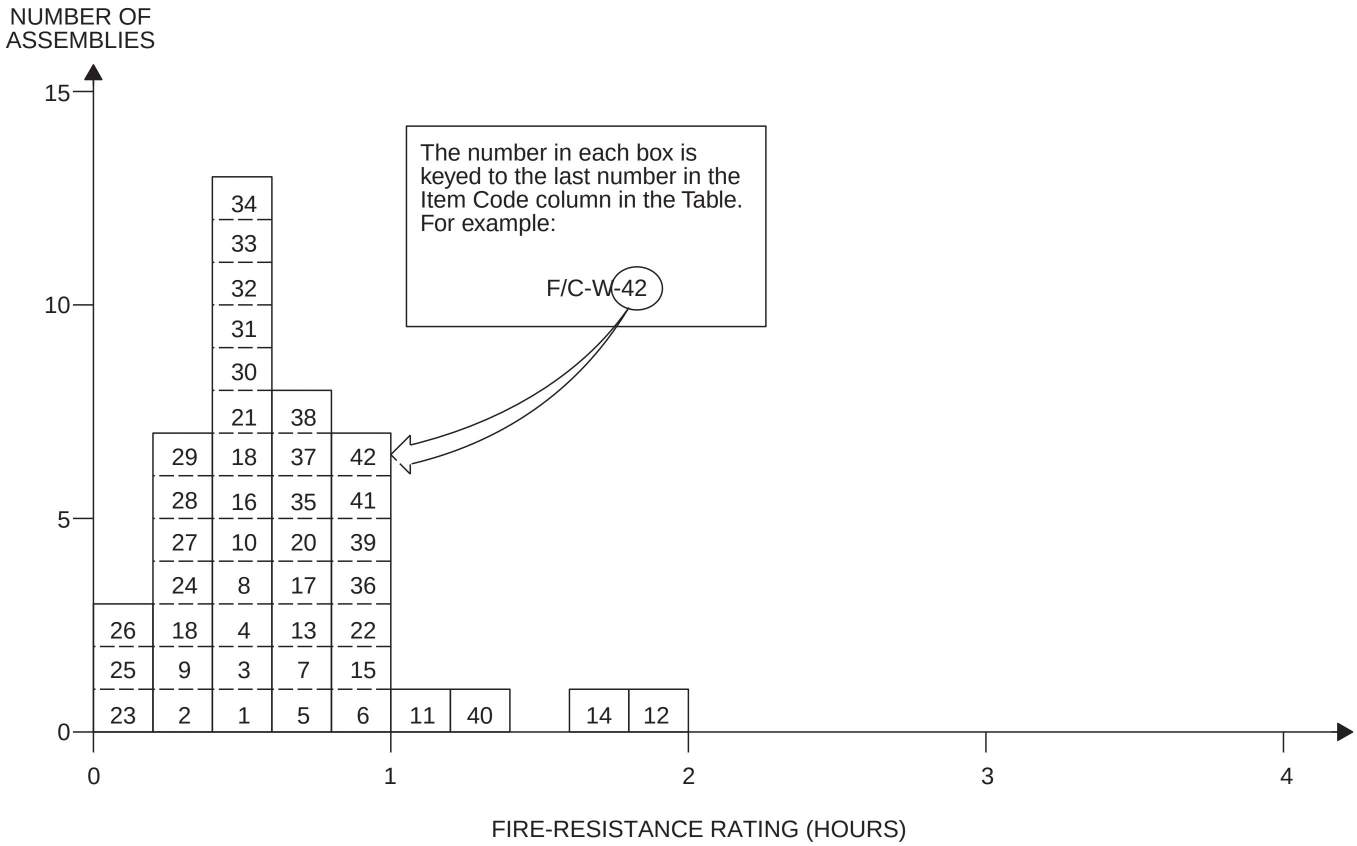


TABLE 3.3
FLOOR/CEILING ASSEMBLIES—WOOD JOIST

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-W-1	$^3/_8''$	12′ clear span - 2″ × 9″ wood joists; 18″ o.c.; Deck: 1″ T&G; Filler: 3″ of ashes on $^1/_2''$ boards nailed to joist sides 2″ from bottom; 2″ air space; Membrane: $^3/_8''$ gypsum board.	60 psf	36 min.			7	1, 2	$^1/_2$
F/C-W-2	$^1/_2''$	12′ clear span - 2″ × 7″ joists; 15″ o.c.; Deck: 1″ nominal lumber; Membrane: $^1/_2''$ fiber board.	60 psf	22 min.			7	1, 2, 3	$^1/_4$
F/C-W-3	$^1/_2''$	12′ clear span - 2″ × 7″ wood joists; 16″ o.c.; 2″ × 1$^1/_2''$ bridging at center; Deck: 1″ T&G; Membrane: $^1/_2''$ fiber board; 2 coats “distemper” paint.	30 psf	28 min.			7	1, 3, 15	$^1/_3$
F/C-W-4	$^3/_{16}''$	12′ clear span - 2″ × 7″ wood joists; 16″ o.c.; 2″ × 1$^1/_2''$ bridging at center span; Deck: 1″ nominal lumber; Membrane: $^1/_2''$ fiber board under $^3/_{16}''$ gypsum plaster.	30 psf	32 min.			7	1, 2	$^1/_2$
F/C-W-5	$^5/_8''$	As per previous F/C-W-4 except membrane is $^5/_8''$ lime plaster.	70 psf	48 min.			7	1, 2	$^3/_4$
F/C-W-6	$^5/_8''$	As per previous F/C-W-5 except membrane is $^5/_8''$ gypsum plaster on 22 gage $^3/_8''$ metal lath.	70 psf	49 min.			7	1, 2	$^3/_4$

(continued)

TABLE 3.3—continued
FLOOR/CEILING ASSEMBLIES—WOOD JOIST

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-W-7	$^1/_2''$	As per previous F/C-W-6 except membrane is $^1/_2''$ fiber board under $^1/_2''$ gypsum plaster.	60 psf	43 min.			7	1, 2, 3	$^2/_3$
F/C-W-8	$^1/_2''$	As per previous F/C-W-7 except membrane is $^1/_2''$ gypsum board.	60 psf	33 min.			7	1, 2, 3	$^1/_2$
F/C-W-9	$^9/_{16}''$	12′ clear span - 2″ × 7″ wood joists; 15″ o.c.; 2″ × $1^1/_2''$ bridging at center; Deck: 1″ nominal lumber; Membrane: $^3/_8''$ gypsum board; $^3/_{16}''$ gypsum plaster.	60 psf	24 min.			7	1, 2, 3	$^1/_3$
F/C-W-10	$^5/_8''$	As per F/C-W-9 except membrane is $^5/_8''$ gypsum plaster on wood lath.	60 psf	27 min.			7	1, 2, 3	$^1/_3$
F/C-W-11	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 15″ o.c.; 2″ × $1^1/_2''$ bridging at center span; Deck: 1″ T&G; Membrane: original ceiling joists have $^3/_8''$ plaster on wood lath; 4″ metal hangers attached below joists creating 15″ chases filled with mineral wool and closed with $^7/_8''$ plaster (gypsum) on $^3/_8''$ S.W.M. metal lath to form new ceiling surface.	75 psf	1 hr. 10 min.			7	1, 2	1
F/C-W-12	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 15″ o.c.; 2″ × $1^1/_2''$ bridging at center; Deck: 1″ T&G; Membrane: 3″ mineral wood below joists; 3″ hangers to channel below joists; $^7/_8''$ gypsum plaster on metal lath attached to channels.	75 psf	2 hrs.			7	1, 4	2
F/C-W-13	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 16″ o.c.; 2″ × $1^1/_2''$ bridging at center span; Deck: 1″ T&G on 1″ bottoms on $^3/_4''$ glass wool strips on $^3/_4''$ gypsum board nailed to joists; Membrane: $^3/_4''$ glass wool strips on joists; $^3/_8''$ perforated gypsum lath; $^1/_2''$ gypsum plaster.	60 psf	41 min.			7	1, 3	$^2/_3$
F/C-W-14	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 15″ o.c.; Deck: 1″ T&G; Membrane: 3″ foam concrete in cavity on $^1/_2''$ boards nailed to joists; wood lath nailed to 1″ × $1^1/_4''$ straps 14 o.c. across joists; $^7/_8''$ gypsum plaster.	60 psf	1 hr. 40 min.			7	1, 5	$1^2/_3$
F/C-W-15	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 18″ o.c.; Deck: 1″ T&G; Membrane: 2″ foam concrete on $^1/_2''$ boards nailed to joist sides 2″ from joist bottom; 2″ air space; 1″ × $1^1/_4''$ wood straps 14″ o.c. across joists; $^7/_8''$ lime plaster on wood lath.	60 psf	53 min.			7	1, 2	$^3/_4$
F/C-W-16	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; Deck: 1″ T&G; Membrane: 3″ ashes on $^1/_2''$ boards nailed to joist sides 2″ from joist bottom; 2″ air space; 1″ × $1^1/_4''$ wood straps 14″ o.c. ; $^7/_8''$ gypsum plaster on wood lath.	60 psf	28 min.			7	1, 2	$^1/_3$
F/C-W-17	$^7/_8''$	As per previous F/C-W-16 but with lime plaster mix.	60 psf	41 min.			7	1, 2	$^2/_3$
F/C-W-18	$^7/_8''$	12′ clear span - 2″ × 9″ wood joists; 18″ o.c.; 2″ × $1^1/_2''$ bridging at center; Deck: 1″ T&G; Membrane: $^7/_8''$ gypsum plaster on wood lath.	60 psf	36 min.			7	1, 2	$^1/_2$
F/C-W-19	$^7/_8''$	As per previous F/C-W-18 except with lime plaster membrane and deck is 1″ nominal boards (plain edge).	60 psf	19 min.			7	1, 2	$^1/_4$

(continued)

TABLE 3.3—continued
FLOOR/CEILING ASSEMBLIES—WOOD JOIST

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-W-20	$^{7}/_{8}$″	As per F/C-W-19, except deck is 1″ T&G boards.	60 psf	43 min.			7	1, 2	$^{2}/_{3}$
F/C-W-21	1″	12′ clear span - 2″ × 9″ wood joists; 16″ o.c.; 2″ × 1$^{1}/_{2}$″ bridging at center; Deck: 1″ T&G; Membrane: $^{3}/_{8}$″ gypsum base board; $^{5}/_{8}$″ gypsum plaster.	70 psf	29 min.			7	1, 2	$^{1}/_{3}$
F/C-W-22	1$^{1}/_{8}$″	12′ clear span - 2″ × 9″ wood joists; 16″ o.c.; 2″ × 2″ wood bridging at center; Deck: 1″ T&G; Membrane: hangers, channel with $^{3}/_{8}$″ gypsum baseboard affixed under $^{3}/_{4}$″ gypsum plaster.	60 psf	1 hr.			7	1, 2, 3	1
F/C-W-23	$^{3}/_{8}$″	Deck: 1″ nominal lumber; Joists: 2″ × 7″; 15″ o.c.; Membrane: $^{3}/_{8}$″ plasterboard with plaster skim coat.	60 psf	11$^{1}/_{2}$ min.			12	2, 6	$^{1}/_{6}$
F/C-W-24	$^{1}/_{2}$″	Deck: 1″ T&G lumber; Joists: 2″ × 9″; 16″ o.c.; Membrane: $^{1}/_{2}$″ plasterboard.	60 psf	18 min.			12	2, 7	$^{1}/_{4}$
F/C-W-25	$^{1}/_{2}$″	Deck: 1″ T&G lumber; Joists: 2″ × 7″; 16″ o.c.; Membrane: $^{1}/_{2}$″ fiber insulation board.	30 psf	8 min.			12	2, 8	$^{2}/_{15}$
F/C-W-26	$^{1}/_{2}$″	Deck: 1″ nominal lumber; Joists: 2″ × 7″; 15″ o.c.; Membrane: $^{1}/_{2}$″ fiber insulation board.	60 psf	8 min.			12	2, 9	$^{2}/_{15}$
F/C-W-27	$^{5}/_{8}$″	Deck: 1″ nominal lumber; Joists: 2″ × 7″; 15″ o.c.; Membrane: $^{5}/_{8}$″ gypsum plaster on wood lath.	60 psf	17 min.			12	2, 10	$^{1}/_{4}$
F/C-W-28	$^{5}/_{8}$″	Deck: 1″ T&G lumber; Joists: 2″ × 9″; 16″ o.c.; Membrane: $^{1}/_{2}$″ fiber insulation board; $^{1}/_{2}$″ plaster.	60 psf	20 min.			12	2, 11	$^{1}/_{3}$
F/C-W-29	No Membrane	Exposed wood joists.	See Note 13	15 min.		1		1, 12, 13, 14	$^{1}/_{4}$
F/C-W-30	$^{3}/_{8}$″	Gypsum wallboard: $^{3}/_{8}$″ or $^{1}/_{2}$″ with 1$^{1}/_{2}$″ No. 15 gage nails with $^{3}/_{16}$″ heads spaced 6″ centers with asbestos paper applied with paperhangers' paste and finished with casein paint.	See Note 13	25 min.		1		1, 12, 13, 14	$^{1}/_{2}$
F/C-W-31	$^{1}/_{2}$″	Gypsum wallboard: $^{1}/_{2}$″ with 1$^{3}/_{4}$″ No. 12 gage nails with $^{1}/_{2}$″ heads, 6″ o.c., and finished with casein paint.	See Note 13	25 min.		1		1, 12, 13, 14	$^{1}/_{2}$
F/C-W-32	$^{1}/_{2}$″	Gypsum wallboard: $^{1}/_{2}$″ with 1$^{1}/_{2}$″ No. 12 gage nails with $^{1}/_{2}$″ heads, 18″ o.c., with asbestos paper applied with paperhangers' paste and secured with 1$^{1}/_{2}$″ No. 15 gage nails with $^{3}/_{16}$″ heads and finished with casein paint; combined nail spacing 6″ o.c.	See Note 13	30 min.		1		1, 12, 13, 14	$^{1}/_{2}$
F/C-W-33	$^{3}/_{8}$″	Gypsum wallboard: two layers $^{3}/_{8}$″ secured with 1$^{1}/_{2}$″ No. 15 gage nails with $^{3}/_{8}$″ heads, 6″ o.c.	See Note 13	30 min.		1		1, 12, 13, 14	$^{1}/_{2}$
F/C-W-34	$^{1}/_{2}$″	Perforated gypsum lath: $^{3}/_{8}$″, plastered with 1$^{1}/_{8}$″ No. 13 gage nails with $^{5}/_{16}$″ heads, 4″ o.c.; $^{1}/_{2}$″ sanded gypsum plaster.	See Note 13	30 min.		1		1, 12, 13, 14	$^{1}/_{2}$
F/C-W-35	$^{1}/_{2}$″	Same as F/C-W-34, except with 1$^{1}/_{8}$″ No. 13 gage nails with $^{3}/_{8}$″ heads, 4″ o.c.	See Note 13	45 min.		1		1, 12, 13, 14	$^{3}/_{4}$

(continued)

TABLE 3.3—continued
FLOOR/CEILING ASSEMBLIES—WOOD JOIST

ITEM CODE	MEMBRANE THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-W-36	$^1/_2$″	Perforated gypsum lath: $^3/_8$″ , nailed with $1^1/_8$″ No. 13 gage nails with $^3/_8$″ heads, 4″ o.c.; joints covered with 3″ strips of metal lath with $1^3/_4$″ No. 12 nails with $^1/_2$″ heads, 5″ o.c.; $^1/_2$″ sanded gypsum plaster.	See Note 13	1 hr.		1		1, 12, 13, 14	1
F/C-W-37	$^1/_2$″	Gypsum lath: $^3/_8$″ and lower layer of $^3/_8$″ perforated gypsum lath nailed with $1^3/_4$″ No. 13 nails with $^5/_{16}$″ heads, 4″ o.c.; $^1/_2$″ sanded gypsum plaster or $^1/_2$″ Portland cement plaster.	See Note 13	45 min.		1		1, 12, 13, 14	$^3/_4$
F/C-W-38	$^3/_4$″	Metal lath: nailed with $1^1/_4$″ No. 11 nails with $^3/_8$″ heads or 6d common driven 1″ and bent over, 6″ o.c.; $^3/_4$″ sanded gypsum plaster.	See Note 13	45 min.		1		1, 12, 13, 14	$^3/_4$
F/C-W-39	$^3/_4$″	Same as F/C-W-38, except nailed with $1^1/_2$″ No. 11 barbed roof nails with $^7/_{16}$″ heads, 6″ o.c.	See Note 13	1 hr.		1		1, 12, 13, 14	1
F/C-W-40	$^3/_4$″	Same as F/C-W-38, except with lath nailed to joists with additional supports for lath 27″ o.c.; attached to alternate joists and consisting of two nails driven $1^1/_4$″, 2″ above bottom on opposite sides of the joists, one loop of No. 18 wire slipped over each nail; the ends twisted together below lath.	See Note 13	1 hr. 15 min.		1		1, 12, 13, 14	$1^1/_4$
F/C-W-41	$^3/_4$″	Metal lath: nailed with $1^1/_2$″ No. 11 barbed roof nails with $^7/_{16}$″ heads, 6 o.c., with $^3/_4$″ Portland cement plaster for scratch coat and 1:3 for brown coat, 3 lbs. of asbestos fiber and 15 lbs. of hydrated lime/94 lbs. bag of cement.	See Note 13	1 hr.		1		1, 12, 13, 14	1
F/C-W-42	$^3/_4$″	Metal lath: nailed with 8d, No. $11^1/_2$ gage barbed box nails, $2^1/_2$″ driven, $1^1/_4$″ on slant and bent over, 6″ o.c.; $^3/_4$″ sanded gypsum plaster, 1:2 for scratch coat and 1:3 for below coat.	See Note 13	1 hr.		1		1, 12, 13, 14	1

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.

Notes:

1. Thickness indicates thickness of first membrane protection on ceiling surface.
2. Failure mode—flame thru.
3. Failure mode—collapse.
4. No endpoint reached at termination of test.
5. Failure imminent—test terminated.
6. Joist failure—11.5 minutes; flame thru—13 minutes; collapse—24 minutes.
7. Joist failure—17 minutes; flame thru—18 minutes; collapse—33 minutes.
8. Joist failure—18 minutes; flame thru—8 minutes; collapse—30 minutes.
9. Joist failure—12 minutes; flame thru—8 minutes; collapse—22 minutes.
10. Joist failure—11 minutes; flame thru—17 minutes; collapse—27 minutes.
11. Joist failure—17 minutes; flame thru—20 minutes; collapse—43 minutes.
12. Joists: 2-inch by 10-inch southern pine or Douglas fir; No. 1 common or better. Subfloor: $^3/_4$-inch wood sheathing diaphragm of asbestos paper, and finish of tongue-and-groove wood flooring.
13. Loadings: not more than 1,000 psi maximum fiber stress in joists.
14. Perforations in gypsum lath are to be not less than $^3/_4$-inch diameter with one perforation for not more than 16/in.^{2} diameter.
15. “Distemper” is a British term for a water-based paint such as white wash or calcimine.

FIGURE 3.4
FLOOR/CEILING ASSEMBLIES—HOLLOW CLAY TILE WITH REINFORCED CONCRETE

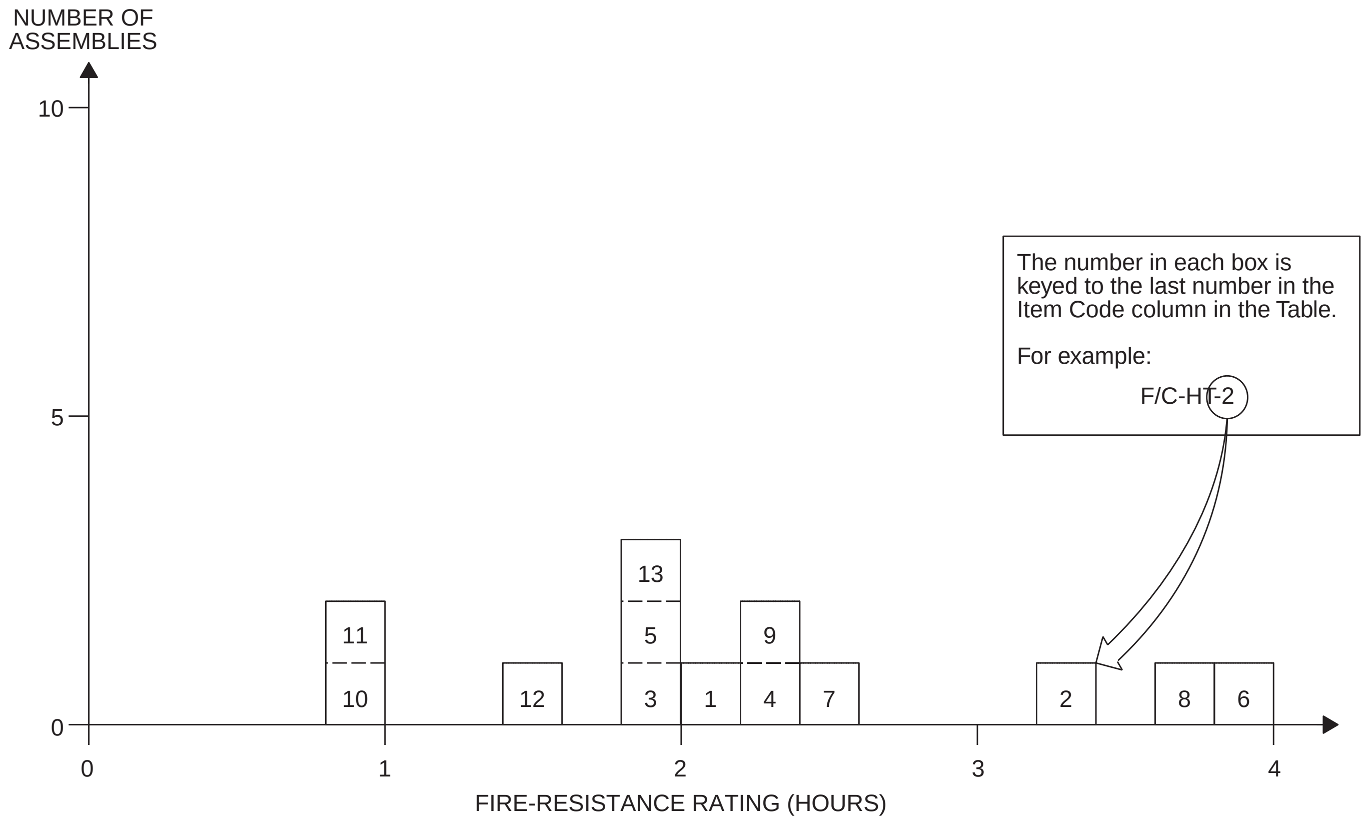


TABLE 3.4
FLOOR/CEILING ASSEMBLIES—HOLLOW CLAY TILE WITH REINFORCED CONCRETE

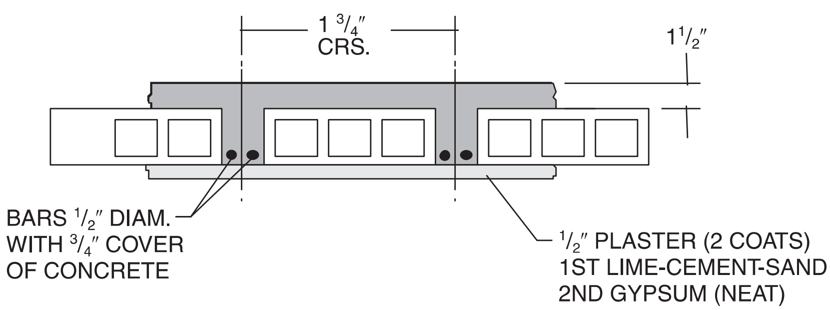
ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-HT-1	6″	Cover: $1^1/_2$″ concrete (6080 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; $3^1/_4$″ concrete between tiles including two $^1/_2$″ rebars with $^3/_4$″ concrete cover; $^1/_2$″ plaster cover, lower.	75 psf	2 hrs. 7 min.			7	1, 2, 3	2
F/C-HT-2	6″	Cover: $1^1/_2$″ concrete (5840 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; $3^1/_4$″ concrete between tiles including two $^1/_2$″ rebars each with $^1/_2$″ concrete cover and $^5/_8$″ filler tiles between hollow tiles; $^1/_2$″ plaster cover, lower.	61 psf	3 hrs. 23 min.			7	3, 4, 6	$3^1/_3$
F/C-HT-3	6″	Cover: $1^1/_2$″ concrete (6280 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; $3^1/_4$″ concrete between tiles including two $^1/_2$″ rebars with $^1/_2$″ cover; $^1/_2$″ plaster cover, lower.	122 psf	2 hrs.			7	1, 3, 5, 8	2
F/C-HT-4	6″	Cover: $1^1/_2$″ concrete (6280 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; $3^1/_4$″ concrete between tiles including two $^1/_2$″ rebars with $^3/_4$″ cover; $^1/_2$″ plaster cover, lower.	115 psf	2 hrs. 23 min.			7	1, 3, 7	$2^1/_3$
F/C-HT-5	6″	Cover: $1^1/_2$″ concrete (6470 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; $3^1/_4$″ concrete between tiles including two $^1/_2$″ rebars with $^1/_2$″ cover; $^1/_2$″ plaster cover, lower.	122 psf	2 hrs.			7	1, 3, 5, 8	2

(continued)

TABLE 3.4—continued
FLOOR/CEILING ASSEMBLIES—HOLLOW CLAY TILE WITH REINFORCED CONCRETE

ITEM CODE	ASSEMBLY THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
F/C-HT-6	8″	Floor cover: 1 1/2″ gravel cement (4300 psi); three cell, 12″ × 12″ × 6″ ; 3 1/2″ space between tiles including two 1/2″ rebars with 1″ cover from concrete bottom; 1/2″ plaster cover, lower.	165 psf	4 hrs.			7	1, 3, 9, 10	4
F/C-HT-7	9″ (nom.)	Deck: 7/8″ T&G on 2″ × 1 1/2″ bottoms (18″ o.c.) 1 1/2″ concrete cover (4600 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; 3″ concrete between tiles including one 3/4″ rebar 3/4″ from tile bottom; 3/4″ plaster cover.	95 psf	2 hrs. 26 min.			7	4, 11, 12, 13	2 1/3
F/C-HT-8	9″ (nom.)	Deck: 7/8″ T&G on 2″ × 1 1/2″ bottoms (18″ o.c.) 1 1/2″ concrete cover (3850 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; 3″ concrete between tiles including one 3/4″ rebar 3/4″ from tile bottoms; 1/2″ plaster cover.	95 psf	3 hrs. 28 min.			7	4, 11, 12, 13	
F/C-HT-9	9″ (nom.)	Deck: 7/8″ T&G on 2″ × 1 1/2″ bottoms (18″ o.c.) 1 1/2″ concrete cover (4200 psi); three cell hollow clay tiles, 12″ × 12″ × 4″; 3″ concrete between tiles including one 3/4″ rebar 3/4″ from tile bottoms; 1/2″ plaster cover.	95 psf	2 hrs. 14 min.			7	3, 5, 8, 11	
F/C-HT-10	5 1/2″	Fire clay tile (4″ thick); 1 1/2″ concrete cover; for general details, see Note 15.	See Note 14	1 hr.			43	15	1
F/C-HT-11	8″	Fire clay tile (6″ thick); 2″ cover.	See Note 14	1 hr.			43	15	1
F/C-HT-12	5 1/2″	Fire clay tile (4″ thick); 1 1/2″ cover; 5/8″ gypsum plaster, lower.	See Note 14	1 hr. 30 min.			43	15	1 1/2
F/C-HT-13	8″	Fire clay tile (6″ thick); 2″ cover; 5/8″ gypsum plaster, lower.	See Note 14	2 hrs.			43	15	1 1/2

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound per square inch = 0.00689 MPa, 1 pound per square foot = 47.9 N/m^2.



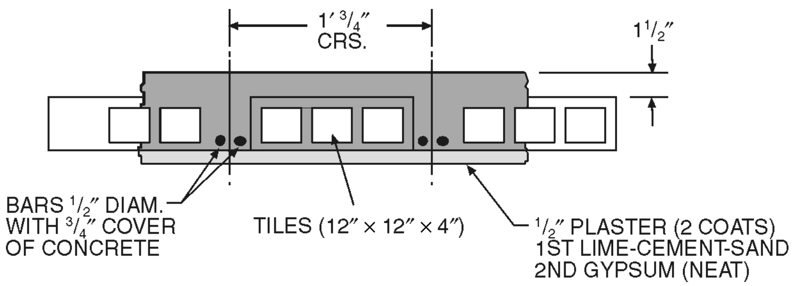
Notes:

1. A generalized cross section of this floor type follows:
2. Failure mode - structural.
3. Plaster: base coat—lime-cement-sand; top coat—gypsum (neat).

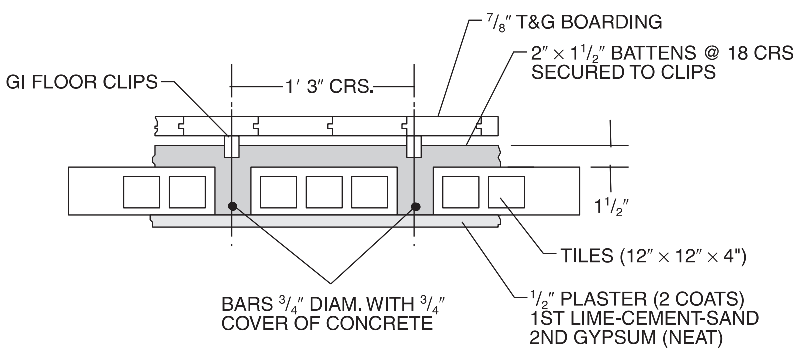
(continued)

TABLE 3.4—continued
FLOOR/CEILING ASSEMBLIES—HOLLOW CLAY TILE WITH REINFORCED CONCRETE

4. Failure mode—collapse.
5. Test stopped before any endpoints were reached.
6. A generalized cross section of this floor type follows:



7. Failure mode—thermal—back face temperature rise.
8. Passed hose stream test.
9. Failed hose stream test.



10. Test stopped at 4 hours before any endpoints were reached.
11. A generalized cross section of this floor type follows:
12. Plaster: base coat—retarded hemihydrate gypsum-sand; second coat—neat gypsum.
13. Concrete in Item 7 is P.C. based but with crushed brick aggregates while in Item 8 river sand and river gravels are used with the P.C.
14. Load - unspecified.
15. The 12-inch by 12-inch fire-clay tiles were laid end to end in rows spaced $2^1/_2$ inches or 4 inches apart. The reinforcing steel was placed between these rows and the concrete cast around them and over the tile to form the structural floor.

SECTION IV
BEAMS

TABLE 4.1.1
REINFORCED CONCRETE BEAMS
DEPTH 10″ TO LESS THAN 12″

ITEM CODE	DEPTH	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
B-11-RC-1	11″	24″ wide × 11″ deep reinforced concrete “T” beam (3290 psi); Details: see Note 5 figure.	8.8 tons	4 hrs. 2 min.			7	1, 2, 14	4
B-10-RC-2	10″	24″ wide × 10″ deep reinforced concrete “T” beam (4370 psi); Details: see Note 6 figure.	8.8 tons	1 hr. 53 min.			7	1, 3	$1^3/_4$
B-10-RC-3	$10^1/_2$″	24″ wide × $10^1/_2$″ deep reinforced concrete “T” beam (4450 psi); Details: see Note 7 figure.	8.8 tons	2 hrs. 40 min.			7	1, 3	$2^2/_3$
B-11-RC-4	11″	24″ wide × 11″ deep reinforced concrete “T” beam (2400 psi); Details: see Note 8 figure.	8.8 tons	3 hrs. 32 min.			7	1, 3, 14	$3^1/_2$
B-11-RC-5	11″	24″ wide × 11″ deep reinforced concrete “T” beam (4250 psi); Details: see Note 9 figure.	8.8 tons	3 hrs. 3 min.			7	1, 3, 14	3
B-11-RC-6	11″	Concrete flange: 4″ deep × 2' wide (4895 psi) concrete; Concrete beam: 7″ deep × $6^1/_2$″ wide beam; “I” beam reinforcement; 10″ × $4^1/_2$″ × 25 lbs. R.S.J.; 1″ cover on flanges; Flange reinforcement: $^3/_8$″ diameter bars at 6″ pitch parallel to “T”; $^1/_4$″ diameter bars perpendicular to “T”; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 11' restrained; Details: see Note 10 figure.	10 tons	6 hrs.			7	1, 4	6
B-11-RC-7	11″	Concrete flange: 6″ deep × 1' $6^1/_2$″ wide (3525 psi) concrete; Concrete beam: 5″ deep × 8″ wide precast concrete blocks $8^3/_4$″ long; “I” beam reinforcement; 7″ × 4″ × 16 lbs. R.S.J.; 2″ cover on bottom; $1^1/_2$″ cover on top; Flange reinforcement: two rows $^1/_2$″ diameter rods parallel to “T”; Beam reinforcement: $^1/_8$″ wire mesh perpendicular to 1″ ; Span: 1′ 3″ simply supported; Details: see Note 11 figure.	3.9 tons	4 hrs.			7	1, 2	4
B-11-RC-8	11″	Concrete flange: 4″ deep × 2' wide (3525 psi) concrete; Concrete beam 7″ deep × $4^1/_2$″ wide; (scaled from drawing); “I” beam reinforcement; 10″ × $4^1/_2$″ × 25 lbs. R.S.J.; no concrete cover on bottom; Flange reinforcement: $^3/_8$″ diameter bars at 6 pitch parallel to “T”; $^1/_4$″ diameter bars perpendicular to “T”; Span: 11′ restricted.	10 tons	4 hrs.			7	1, 2, 12	4
B-11-RC-9	$11^1/_2$″	24″ wide × $11^1/_2$″ deep reinforced concrete “T” beam (4390 psi); Details: see Note 12 figure.	8.8 tons	3 hrs. 24 min.			7	1, 3	$3^1/_3$

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

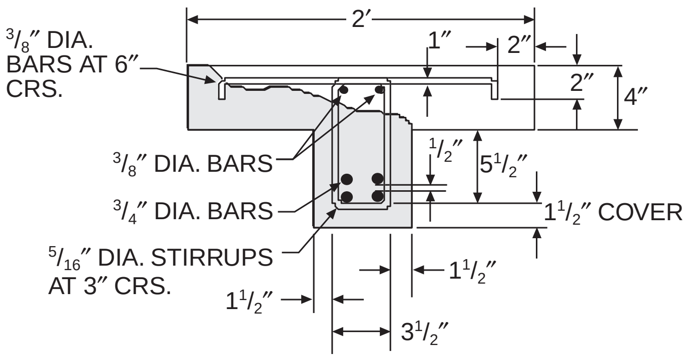
Notes:

1. Load concentrated at mid span.
2. Achieved 4 hour performance (Class “B,” British).
3. Failure mode—collapse.
4. Achieved 6 hour performance (Class “A,” British).

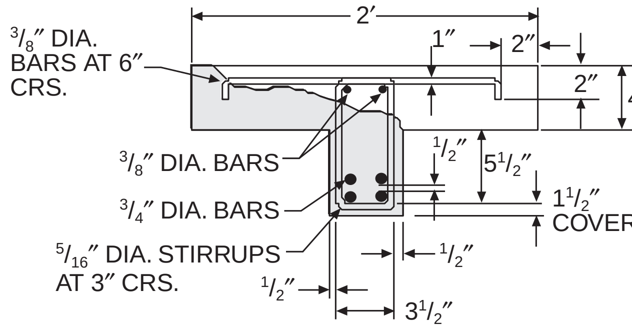
(continued)

TABLE 4.1.1—continued
REINFORCED CONCRETE BEAMS
DEPTH 10″ TO LESS THAN 12″

5.



6.



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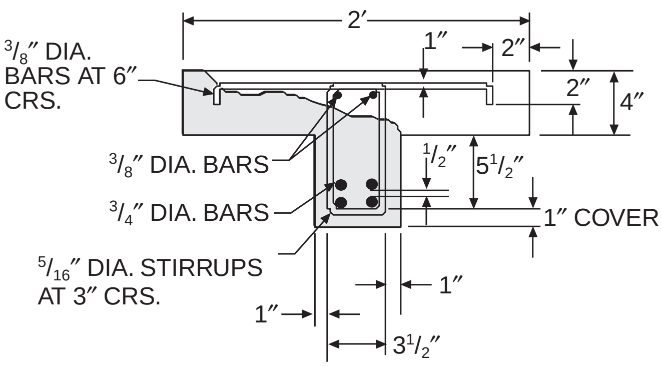

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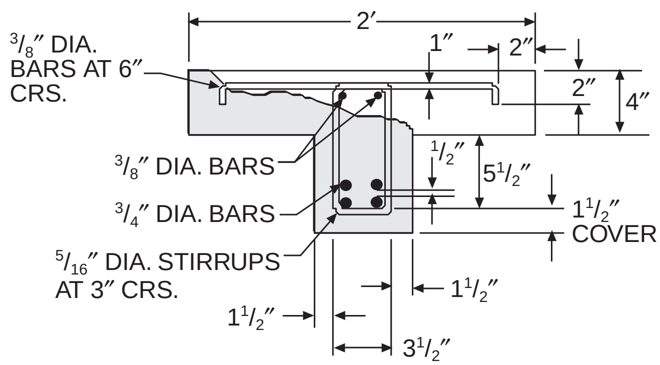

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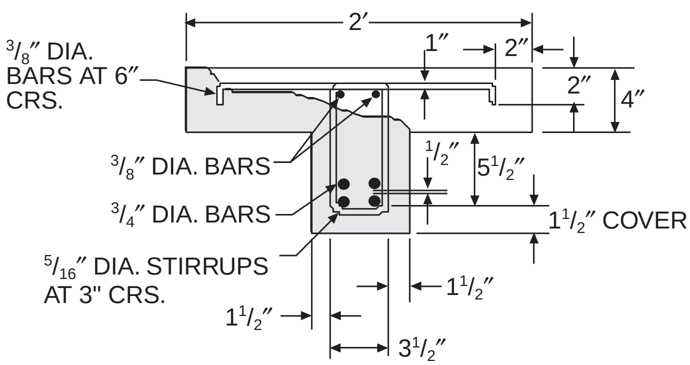

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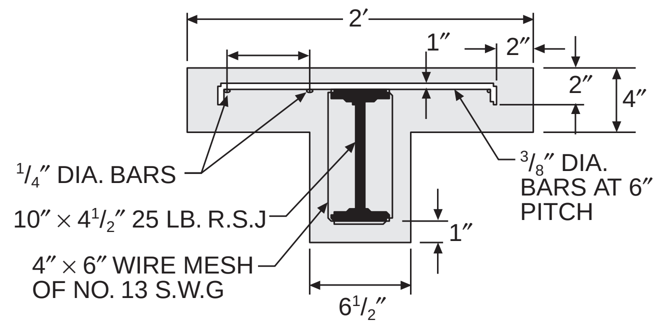

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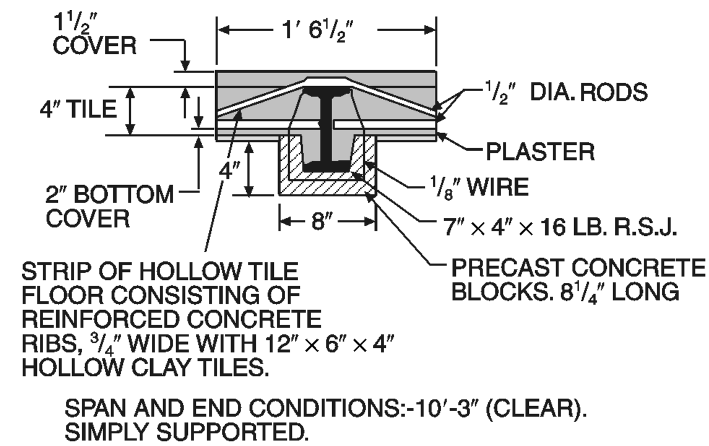
TABLE 4.1.1—continued
REINFORCED CONCRETE BEAMS
DEPTH 10″ TO LESS THAN 12″

11.



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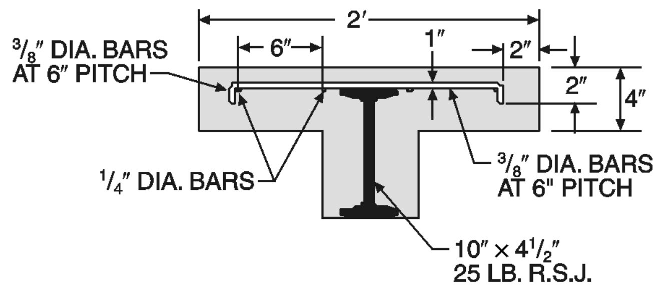

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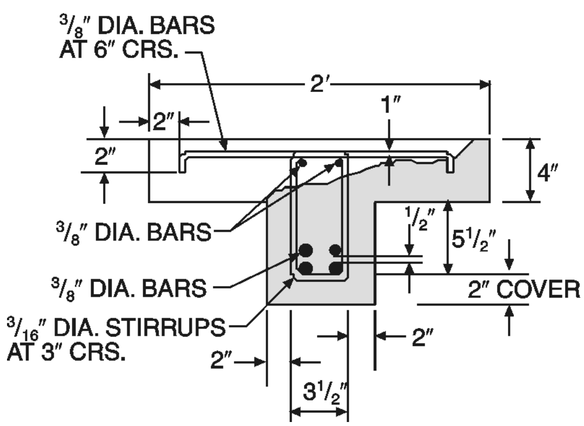


14. The different performances achieved by B-11-RC-1, B-11-RC-4 and B-11-RC-5 are attributable to differences in concrete aggregate compositions reported in the source document but unreported in this table. This demonstrates the significance of material composition in addition to other details.

TABLE 4.1.2
REINFORCED CONCRETE BEAMS
DEPTH 12″ TO LESS THAN 14″

ITEM CODE	DEPTH	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
B-12-RC-1	12″	12″ × 8″ section; 4160 psi aggregate concrete; Reinforcement: 4-$^7/_8$″ rebars at corners; 1″ below each surface; $^1/_4$″ stirrups 10″ o.c.	5.5 tons	2 hrs.			7	1	2
B-12-RC-2	12″	Concrete flange: 4″ deep × 2' wide (3045 psi) concrete at 35 days; Concrete beam: 8″ deep; "I" beam reinforcement: 10″ × 4$^1/_2$″ × 25 lbs. R.S.J.; 1″ cover on flanges; Flange reinforcement: $^3/_8$″ diameter bars at 6″ pitch parallel to "T"; $^1/_4$″ diameter bars perpendicular to "T"; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 10′ 3″ simply supported.	10 tons	4 hrs.			7	2, 3, 5	4
B-13-RC-3	13″	Concrete flange: 4″ deep × 2' wide (3825 psi) concrete at 46 days; Concrete beam: 9″ deep × 8$^1/_2$″ wide; (scaled from drawing); "I" beam reinforcement: 10″ × 4$^1/_2$″ × 25 lbs. R.S.J.; 3″ cover on bottom flange; 1″ cover on top flange; Flange reinforcement: $^3/_8$″ diameter bars at 6″ pitch parallel to "T"; $^1/_4$″ diameter bars perpendicular to "T"; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 11′ restrained.	10 tons	6 hrs.			7	2, 3, 6, 8, 9	4
B-12-RC-4	12″	Concrete flange: 4″ deep × 2' wide (3720 psi) concrete at 42 days; Concrete beam: 8″ deep × 8$^1/_2$″ wide; (scaled from drawing); "I" beam reinforcement: 10″ × 4$^1/_2$″ × 25 lbs. R.S.J.; 2″ cover bottom flange; 1″ cover top flange; Flange reinforcement: $^3/_8$″ diameter bars at 6″ pitch parallel to "T"; $^1/_4$″ diameter bars perpendicular to "T"; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 11′ restrained.	10 tons	6 hrs.			7	1, 3, 4, 7, 8, 9	4

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

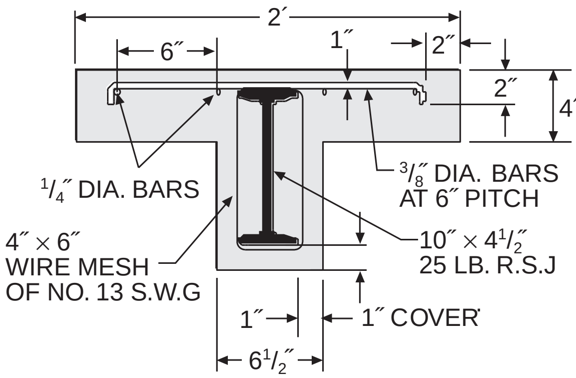
Notes:

1. Qualified for 2 hour use. (Grade "C," British) Test included hose stream and reload at 48 hours.
2. Load concentrated at mid span.
3. British test.
4. British test—qualified for 6 hour use (Grade "A").

(continued)

TABLE 4.1.2—continued
REINFORCED CONCRETE BEAMS
DEPTH 12″ TO LESS THAN 14″

5.



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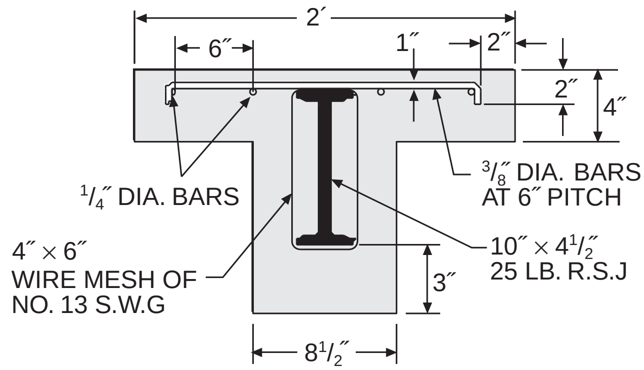

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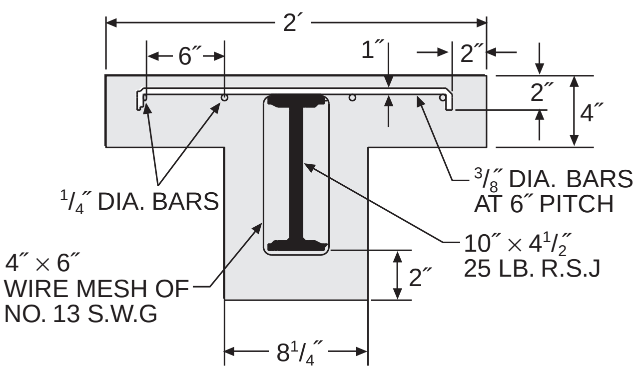


8. See Table 4.1.3, Note 5.

9. Hourly rating based upon B-12-RC-2 above.

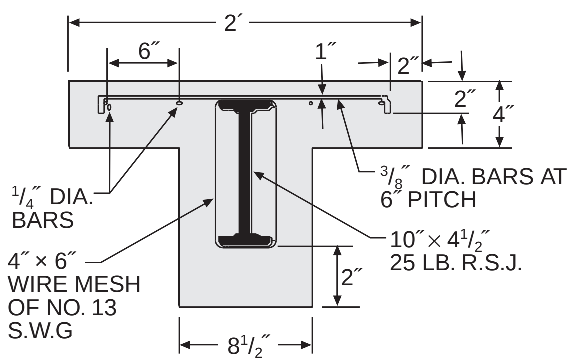
TABLE 4.1.3
REINFORCED CONCRETE BEAMS
DEPTH 14″ TO LESS THAN 16″

ITEM CODE	DEPTH	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE-BMS-92	BMS-92	POST-BMS-92		
B-15-RC-1	15″	Concrete flange: 4″ deep × 2' wide (3290 psi) concrete; Concrete beam: 10″ deep × 8$^{1}/_{2}$″ wide; “I” beam reinforcement: 10″ × 4$^{1}/_{2}$″ × 25 lbs. R.S.J.; 4″ cover on bottom flange; 1″ cover on top flange; Flange reinforcement: $^{3}/_{8}$″ diameter bars at 6″ pitch parallel to “T”; $^{1}/_{4}$″ diameter bars perpendicular to “T”; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 11′ restrained.	10 tons	6 hrs.			7	1, 2, 3 5, 6	4
B-15-RC-2	15″	Concrete flange: 4″ deep × 2' wide (4820 psi) concrete; Concrete beam: 10″ deep × 8$^{1}/_{2}$″ wide; “I” beam reinforcement: 10″ × 4$^{1}/_{2}$″ × 25 lbs. R.S.J.; 1″ cover over wire mesh on bottom flange; 1″ cover on top flange; Flange reinforcement: $^{3}/_{8}$″ diameter bars at 6″ pitch parallel to “T”; $^{1}/_{4}$″ diameter bars perpendicular to “T”; Beam reinforcement: 4″ × 6″ wire mesh No. 13 SWG; Span: 11′ restrained.	10 tons	6 hrs.			7	1, 2, 4, 5, 6	4

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Load concentrated at mid span.
2. Achieved 6 hour fire rating (Grade “A,” British).
3.



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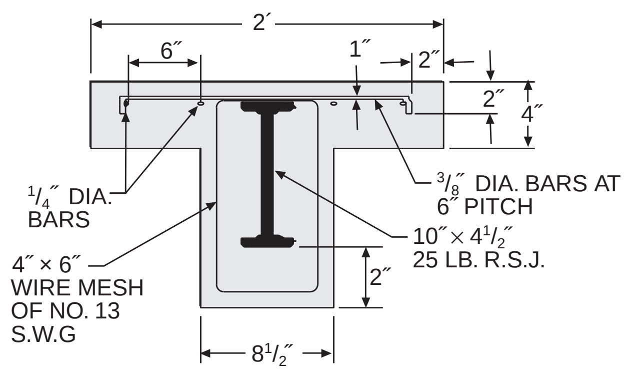

5. Section 43.147 of the 1979 edition of the *Uniform Building Code Standards* provides:

   “A restrained condition in fire tests, as used in this standard, is one in which expansion at the supports of a load-carrying element resulting from the effects of the fire is resisted by forces external to the element. An unrestrained condition is one in which the load-carrying element is free to expand and rotate at its support.”

   “Restraint in buildings is defined as follows: Floor and roof assemblies and individual beams in buildings shall be considered restrained when the surrounding or supporting structure is capable of resisting the thermal expansion throughout the range of anticipated elevated temperatures. Construction not complying . . . is assumed to be free to rotate and expand and shall be considered as unrestrained.”

   “Restraint may be provided by the lateral stiffness of supports for floor and roof assemblies and intermediate beams forming part of the assembly. In order to develop restraint, connections must adequately transfer thermal thrusts to such supports. The rigidity of adjoining panels or structures shall be considered in assessing the capability of a structure to resist therm expansion.”

   Because it is difficult to determine whether an existing building’s structural system is capable of providing the required restraint, the lower hourly ratings of a similar but unrestrained assembly have been recommended.
6. Hourly rating based upon Table 4.2.1, Item B-12-RC-2.

TABLE 4.2.1
REINFORCED CONCRETE BEAMS—UNPROTECTED DEPTH
10″ TO LESS THAN 12″

ITEM CODE	DEPTH	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST-BMS-92		
B-SU-1	10″	10″ × 4$^1/_2$″ × 25 lbs. “I” beam.	10 tons	39 min.			7	1	$^1/_3$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 ton = 8.896 kN.

Notes:

1. Concentrated at mid span.

TABLE 4.2.2
STEEL BEAMS—CONCRETE PROTECTION DEPTH
10″ TO LESS THAN 12″

ITEM CODE	DEPTH	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. HOURS
			LOAD	TIME	PRE- BMS-92	BMS-92	POST- BMS-92		
B-SC-1	10″	10″ × 8″ rectangle; aggregate concrete (4170 psi) with 1″ top cover and 2″ bottom cover; No. 13 SWG iron wire loosely wrapped at approximately 6″ pitch about 7″ × 4″ × 16 lbs. “I” beam.	3.9 tons	3 hrs. 46 min.			7	1, 2, 3	3$^3/_4$
B-SC-1	10″	10″ × 8″ rectangle; aggregate concrete (3630 psi) with 1″ top cover and 2″ bottom cover; No. 13 SWG iron wire loosely wrapped at approximately 6″ pitch about 7″ × 4″ × 16 lbs. “I” beam.	5.5 tons	5 hrs. 26 min.			7	1, 4, 5, 6, 7	3$^3/_4$

For SI: 1 inch = 25.4 mm, 1 pound = 0.004448 kN, 1 pound per square inch = 0.00689 MPa, 1 ton = 8.896 kN.

Notes:

1. Load concentrated at mid span.
2. Specimen 10-foot 3-inch clear span simply supported.
3. Passed Grade “C” fire resistance (British) including hose stream and reload.
4. Specimen 11-foot clear span—restrained.
5. Passed Grade “B” fire resistance (British) including hose stream and reload.
6. See Table 4.1.3, Note 5.
7. Hourly rating based upon B-SC-1 above.

SECTION V
DOORS

FIGURE 5.1
RESISTANCE OF DOORS TO FIRE EXPOSURE

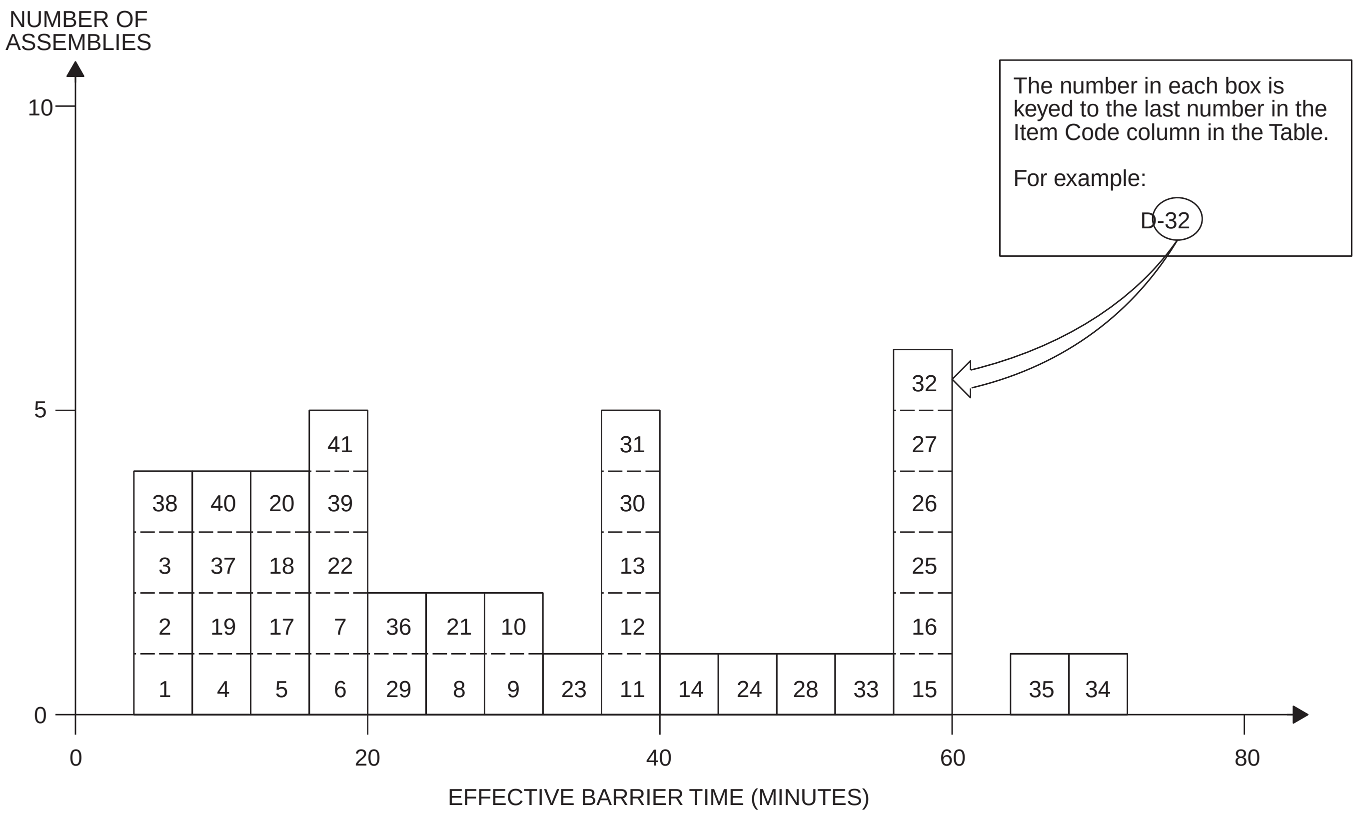

TABLE 5.1
RESISTANCE OF DOORS TO FIRE EXPOSURE

ITEM CODE	DOOR MINIMUM THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. (MIN.)
			EFFECTIVE BARRIER	EDGE FLAMING	PRE- BMS-92	BMS-92	POST- BMS-92		
D-1	$^3/_8''$	Panel door; pine perimeter ($1^3/_8''$); painted (enamel).	5 min. 10 sec.	N/A			90	1, 2	5
D-2	$^3/_8''$	As above, with two coats U.L. listed intumescent coating.	5 min. 30 sec.	5 min.			90	1, 2, 7	5
D-3	$^3/_8''$	As D-1, with standard primer and flat interior paint.	5 min. 55 sec.	N/A			90	1, 3, 4	5
D-4	$2^5/_8''$	As D-1, with panels covered each side with $^1/_2''$ plywood; edge grouted with sawdust filled plaster; door faced with $^1/_8''$ hardboard each side; paint see (5).	11 min. 15 sec.	3 min. 45 sec.			90	1, 2, 5, 7	10

(continued)

TABLE 5.1—continued
RESISTANCE OF DOORS TO FIRE EXPOSURE

ITEM CODE	DOOR MINIMUM THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. (MIN.)
			EFFECTIVE BARRIER	EDGE FLAMING	PRE- BMS-92	BMS-92	POST- BMS-92		
D-5	$^3/_8''$	As D-1, except surface protected with glass fiber reinforced intumescent fire retardant coating.	16 min.	N/A			90	1, 3, 4, 7	15
D-6	$1^5/_8''$	Door detail: As D-4, except with $^1/_8''$ cement asbestos board facings with aluminum foil; door edges protected by sheet metal.	17 min.	10 min. 15 sec.			90	1, 3, 4	15
D-7	$1^5/_8''$	Door detail with $^1/_8''$ hardboard cover each side as facings; glass fiber reinforced intumescent coating applied.	20 min.	N/A			90	1, 3, 4, 7	20
D-8	$1^5/_8''$	Door detail same as D-4; paint was glass reinforced epoxy intumescent.	26 min.	24 min. 45 sec.			90	1, 3, 4, 6, 7	25
D-9	$1^5/_8''$	Door detail same as D-4 with facings of $^1/_8''$ cement asbestos board.	29 min.	3 min. 15 sec.			90	1, 2	5
D-10	$1^5/_8''$	As per D-9.	31 min. 30 sec.	7 min. 20 sec.			90	1, 3, 4	6
D-11	$1^5/_8''$	As per D-7; painted with epoxy intumescent coating including glass fiber roving.	36 min. 25 sec.	N/A			90	1, 3, 4	35
D-12	$1^5/_8''$	As per D-4 with intumescent fire retardant paint.	37 min. 30 sec.	24 min. 40 sec.			90	1, 3, 4	30
D-13	$1^1/_2''$ (nom.)	As per D-4, except with 24 ga. galvanized sheet metal facings.	39 min.	39 min.			90	1, 3, 4	39
D-14	$1^5/_8''$	As per D-9.	41 min. 30 sec.	17 min. 20 sec.			90	1, 3, 4, 6	20
D-15	—	Class C steel fire door.	60 min.	58 min.			90	7, 8	60
D-16	—	Class B steel fire door.	60 min.	57 min.			90	7, 8	60
D-17	$1^3/_4''$	Solid core flush door; core staves laminated to facings but not each other; Birch plywood facings $^1/_2''$ rebate in door frame for door; $^3/_{32}''$ clearance between door and wood frame.	15 min.	13 min.			37	11	13

(continued)

TABLE 5.1—continued
RESISTANCE OF DOORS TO FIRE EXPOSURE

ITEM CODE	DOOR MINIMUM THICKNESS	CONSTRUCTION DETAILS	PERFORMANCE		REFERENCE NUMBER			NOTES	REC. (MIN.)
			EFFECTIVE BARRIER	EDGE FLAMING	PRE- BMS-92	BMS-92	POST- BMS-92		
D-18	$1^3/_4''$	As per D-17.	14 min.	13 min.			37	11	13
D-19	$1^3/_4''$	Door same as D-17, except with 16 ga. steel; $^3/_{32}''$ door frame clearance.	12 min.	—			37	9, 11	10
D-20	$1^3/_4''$	As per D-19.	16 min.	—			37	10, 11	10
D-21	$1^3/_4''$	Doors as per D-17; intumescent paint applied to top and side edges.	26 min.	—			37	11	25
D-22	$1^3/_4''$	Door as per D-17, except with $^1/_2'' \times {}^1/_8''$ steel strip set into edges of door at top and side facing stops; matching strip on stop.	18 min.	6 min.			37	11	18
D-23	$1^3/_4''$	Solid oak door.	36 min.	22 min.			15	13	25
D-24	$1^7/_8''$	Solid oak door.	45 min.	35 min.			15	13	35
D-25	$1^7/_8''$	Solid teak door.	58 min.	34 min.			15	13	35
D-26	$1^7/_8''$	Solid (pitch) pine door.	57 min.	36 min.			15	13	35
D-27	$1^7/_8''$	Solid deal (pine) door.	57 min.	30 min.			15	13	30
D-28	$1^7/_8''$	Solid mahogany door.	49 min.	40 min.			15	13	45
D-29	$1^7/_8''$	Solid poplar door.	24 min.	3 min.			15	13, 14	5
D-30	$1^7/_8''$	Solid oak door.	40 min.	33 min.			15	13	35
D-31	$1^7/_8''$	Solid walnut door.	40 min.	15 min.			15	13	20
D-32	$2^5/_8''$	Solid Quebec pine.	60 min.	60 min.			15	13	60
D-33	$2^5/_8''$	Solid pine door.	55 min.	39 min.			15	13	40
D-34	$2^5/_8''$	Solid oak door.	69 min.	60 min.			15	13	60
D-35	$2^5/_8''$	Solid teak door.	65 min.	17 min.			15	13	60
D-36	$1^1/_2''$	Solid softwood door.	23 min.	8.5 min.			15	13	10
D-37	$^3/_4''$	Panel door.	8 min.	7.5 min.			15	13	5
D-38	$^5/_{16}''$	Panel door.	5 min.	5 min.			15	13	5
D-39	$^3/_4''$	Panel door, fire retardant treated.	$17^1/_2$ min.	3 min.			15	13	8
D-40	$^3/_4''$	Panel door, fire retardant treated.	$8^1/_2$ min.	$8^1/_2$ min.			15	13	8
D-41	$^3/_4''$	Panel door, fire retardant treated.	$16^3/_4$ min.	$11^1/_2$ min.			15	13	8

For SI: 1 inch = 25.4 mm, 1 foot = 305 mm.

Notes:

1. All door frames were of standard lumber construction.
2. Wood door stop protected by asbestos millboard.
3. Wood door stop protected by sheet metal.
4. Door frame protected with sheet metal and weather strip.
5. Surface painted with intumescent coating.
6. Door edge sheet metal protected.
7. Door edge intumescent paint protected.
8. Formal steel frame and door stop.
9. Door opened into furnace at 12 feet.
10. Similar door opened into furnace at 12 feet.
11. The doors reported in these tests represent the type contemporaries used as 20-minute solid-core wood doors. The test results demonstrate the necessity of having wall anchored metal frames, minimum cleaners possible between door, frame and stops. They also indicate the utility of long throw latches and the possible use of intumescent paints to seal doors to frames in event of a fire.
12. Minimum working clearance and good latch closure are absolute necessities for effective containment for all such working door assemblies.
13. Based on British tests.
14. Failure at door-frame interface.

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HISTORY NOTE APPENDIX

2022 California Existing Building Code
California Code of Regulations, Title 24, Part 10

HISTORY:

For prior code history, see the History Note Appendix to the *California Existing Building Code*, 2019 Triennial Edition, effective January 1, 2020.

1. (BSC 09/21, DSA-SS 06/21, HCD 07/21, OSHPD 05/21, SFM 07/21) – Adoption by reference of the 2021 *International Existing Building Code* with necessary amendments to become the 2022 *California Existing Building Code*, and repeal of the 2018 edition of the *International Existing Building Code*; effective on January 1, 2023.

IMPORTANT NOTICE

Act now to keep your code up-to-date. The purchase of this code includes a free subscription for all State-issued supplements and errata. To receive these important updates through 2025, you **MUST** register online **www.iccsafe.org/CAL22**

2022 CALIFORNIA HISTORICAL BUILDING CODE

CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 8

California Building Standards Commission

Effective January 1, 2023

For Errata and Supplement effective dates see the History Note Appendix

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PREFACE

This document is the Part 8 of thirteen 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 Historical 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 generally be filed with the California Building Standards Commission (or other filing if indicated) 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:

California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833–2936

Phone: (916) 263–0916
Email: cbsc@dgs.ca.gov

Web page: www.dgs.ca.gov/bsc

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The 2022 *California Building Standards Code* (Code) was developed through the outstanding collaborative efforts of the Department of Housing and Community Development, Division of State Architect, Office of the State Fire Marshal, Office of Statewide Health Planning and Development, California Energy Commission, California Department of Public Health, California State Lands Commission, 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 Gavin Newsom

Members of the California Building Standards Commission

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Michael L. Nearman – Deputy Executive Director

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

CALIFORNIA CODE OF REGULATIONS, TITLE 24

California Agency Information Contact List

The following state agencies may propose building standards for publication in Title 24. Request notice of such activity with each agency of interest. See Sections 1.2 through 1.14 of the California Building Code (Part 2 of Title 24) for more detailed information on the regulatory jurisdiction of each state agency.

Board of State and Community Corrections

www.bscc.ca.gov .... (916) 445-5073

Local Adult and Juvenile Detention Facility Standards

California Building Standards Commission

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

State Buildings including UC and CSU Buildings, Parking Lot and Walkway Lighting, Green Building Standards for Non-residential Buildings

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

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Marine Oil Terminal Standards

California State Library

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Department of Consumer Affairs:

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

Office Standards

Board of Pharmacy
www.pharmacy.ca.gov .... (916) 518-3100

Pharmacy Standards

Bureau of Barbering and Cosmetology
www.barbercosmo.ca.gov .... (800) 952-5210

Barber and Beauty Shop, and College Standards

Bureau of Household Goods and Services
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Insulation Testing Standards

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Structural Standards

Veterinary Medical Board
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Veterinary Hospital Standards

Department of Food and Agriculture

www.cdfa.ca.gov

Meat & Poultry Packing Plant Standards
Rendering & Collection Center Standards................(916) 900-5004

Dairy Standards..(916) 900-5008

Department of Housing and Community Development

www.hcd.ca.gov...(800) 952-8356

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
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(800) 952-8356
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

Fire and Life Safety

Structural Safety

Public Schools Standards
Essential Services Building Standards
Community College Standards

State Historical Building Safety Board

Historical Rehabilitation, Preservation, Restoration or Relocation Standards

Office of Statewide Health Planning and Development AKA: California Department of Health Care Access and Information (HCAI)

www.hcai.ca.gov...(916) 440-8300

Hospital Standards
Skilled Nursing Facility Standards & Clinic Standards

Office of the State Fire Marshal

osfm.fire.ca.gov...(916) 568-3800

Code Development and Analysis
Fire Safety Standards

HOW TO DETERMINE WHERE CHANGES HAVE BEEN MADE

Symbols in the margins indicate where changes have been made or language has been deleted.

| This symbol indicates that a change has been made.

> This symbol indicates deletion of language.

PART 8 CONTAINS ALTERNATIVE REGULATIONS FOR QUALIFIED HISTORICAL BUILDINGS

The *California Historical Building Code* (CHBC) is unique among state regulations. The authoring of the original CHBC required state agencies promulgating regulations for building construction to work in harmony with representatives of other design and construction disciplines. The result was a totally new approach to building codes for historical structures, which maintains currently acceptable life–safety standards.

These regulations are also unique in that they are performance oriented rather than prescriptive. The provisions of the CHBC are to be applied by the enforcing authority of every city, county, city and county, or state agency in permitting repairs, alterations and additions necessary for the preservation, rehabilitation, relocation, related construction, change of use or continued use of a qualified historical building.

The authority for use of the CHBC is vested in Sections 18950 through 18961 of the Health and Safety Code. Section 18954 states, "The building department of every city or county shall apply the provisions of alternative building standards and building regulations adopted by the CHBC Board pursuant to Section 18959.5 in permitting repairs, alterations and additions necessary for the preservation, restoration, rehabilitation, moving or continued use of an historical building or structure. A state agency shall apply the alternative building regulations adopted by the CHBC Board pursuant to Section 18959.5 in permitting repairs, alterations and additions necessary for the preservation, restoration, rehabilitation, moving or continued use of an historical building or structure."

However, be aware that in order to use the CHBC, the structure under consideration must be qualified by being designated as an historical building or structure. Section 18955 states, "For the purposes of this part, a qualified historical building or structure is any structure or collection of structures, and their associated sites deemed of importance to the history, architecture or culture of an area by an appropriate local or state governmental jurisdiction. This shall include structures on existing or future national, state or local historical registers or official inventories, such as the National Register of Historic Places, State Historical Landmarks, State Points of Historical Interest, and city or county registers or inventories of historical or architecturally significant sites, places, historic districts or landmarks."

The regulations of the CHBC have the same authority as state law and are to be considered as such. Liability is the same as for prevailing law.

The intent of the CHBC is to save California's architectural heritage by recognizing the unique construction problems inherent in historical buildings and by providing a code to deal with these problems.

HISTORICAL PREFACE

The background of the *California Historical Building Code* can be traced to December 1973, when the State Department of Parks and Recreation published the California History Plan, Volume I, in which Recommendation No. 11 was proposed by the then California Landmarks Advisory Committee (later to become The State Historical Resources Commission). This proposal expressed a need for a new building code to meet the intent of protecting the public health and safety and also retain "enough flexibility to allow restoration of a Historic feature while still retaining its Historic integrity." No. 11 of this History Plan supported this need by stating that ". . . restoration . . . is frequently made difficult by unnecessarily rigid interpretation of building . . . codes."

In March of 1974, the Landmarks Committee by resolution recommended that the Director of the State Department of Parks and Recreation and the State Architect initiate a study to develop this needed code. These two officials accepted this concept and jointly called a statewide meeting in Sacramento on May 14th of that year. Attending were representatives from both the public and private sectors, such as members of the building industry, design professions, local and state building officials, and others interested in this problem.

Out of this open conference, a steering committee was formed to explore in depth the ways and means of implementing the new historical building code concept. This ad hoc committee was chaired by a representative from the California Council, American Institute of Architects and composed of a comprehensive cross section of the professional organizations and government agencies concerned with design and code enforcement.

Meetings began late in 1974 and continued into early 1975. By April of that year, a legislative subcommittee of the ad hoc group drafted a sample bill for the proposed code and requested that it be carried by Senator James R. Mills, President Pro Tempore of the Senate. After further development and refinement, the enacting legislation to create the authority for the code and an advisory board to prepare regulations to implement it (SB 927, Mills) was supported by both the legislature and the public. It was signed by the governor in September 1975, and became effective January 1, 1976.

The members of the advisory board, which were required by law to include local and state building officials, individuals from the building industry and design professions, as well as representatives from city and county governments, were appointed and held their first session in Sacramento, February 24, 1976. This Board's duties included the preparation of code regulations and the review of specific historic building cases, when officially requested by governing bodies.

Several of the Board's members were a part of the original ad hoc steering committee and thus provided a continuity and smooth transition from the inception of the code's philosophy to its pragmatic implementation in these performance–oriented regulations.

The first comprehensive regulations were codified in August and October 1979, after years of careful deliberation. Those regulations allowed all jurisdictions to utilize them at their discretion in replacing or modifying details of prevailing prescriptive codes.

Changes made in law in 1984 and 1991, and to the code, make the application of the *California Historical Building Code* statutes and regulations applicable for all agencies and at the discretion of the owner for local jurisdictions when dealing with qualified historical buildings.

These current performance regulations were adopted by the Board on June 23, 1998, and approved by the California Building Standards Commission on December 12, 2013.

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CHAPTER 8-1

ADMINISTRATION

Note: The *California Historical Building Code,* Part 8 of Title 24, governs for all qualified historical buildings or properties in the State of California.

SECTION 8-101
TITLE, PURPOSE AND INTENT

8-101.1 Title. These regulations shall be known as the *California Historical Building Code* and will be referred to herein as "the CHBC."

8-101.2 Purpose. The purpose of the CHBC is to provide regulations for the preservation, restoration, rehabilitation, relocation or reconstruction of buildings or properties designated as qualified historical buildings or properties (Chapter 8-2). The CHBC is intended to provide solutions for the preservation of qualified historical buildings or properties, to promote sustainability, to provide access for persons with disabilities, to provide a cost-effective approach to preservation, and to provide for the reasonable safety of the occupants or users. The CHBC requires enforcing agencies to accept solutions that are reasonably equivalent to the regular code (as defined in Chapter 8-2) when dealing with qualified historical buildings or properties.

8-101.3 Intent. The intent of the CHBC is to facilitate the preservation and continuing use of qualified historical buildings or properties while providing reasonable safety for the building occupants and access for persons with disabilities.

SECTION 8-102
APPLICATION

8-102.1 Application. The CHBC is applicable to all issues regarding code compliance for qualified historical buildings or properties. The CHBC may be used in conjunction with the regular code to provide solutions to facilitate the preservation of qualified historical buildings or properties. The CHBC shall be used by any agency with jurisdiction and whenever compliance with the code is required for qualified historical buildings or properties.

1. The state or local enforcing agency shall apply the provisions of the CHBC in permitting repairs, alterations and additions necessary for the preservation, restoration, reconstruction, rehabilitation, relocation or continued use of a qualified historical building or property when so elected by the private property owner.
2. **State agencies.** All state agencies shall apply the provisions of the CHBC in permitting repairs, alterations and additions necessary for the preservation, restoration, rehabilitation, safety, relocation, reconstruction or continued use of qualified historical buildings or properties.

8-102.1.1 Additions, alterations and repairs. It is the intent of the CHBC to allow nonhistorical expansion or addition to a qualified historical building or property, provided nonhistorical additions shall conform to the requirements of the regular code. See Chapter 8-2.

8-102.1.2 Relocation. Relocated qualified historical buildings or properties shall be sited to comply with the regular code or with the solutions listed in the CHBC. Nonhistorical new construction related to relocation shall comply with the regular code. Reconstruction and restoration related to relocation is permitted to comply with the provisions in the CHBC.

8-102.1.3 Change of occupancy. For change of use or occupancy, see Chapter 8-3, Use and Occupancy.

8-102.1.4 Continued use. Qualified historical buildings or properties may have their existing use or occupancy continued if such use or occupancy conformed to the code or to the standards of construction in effect at the time of construction, and such use or occupancty does not constitute a distinct hazard to life safety as defined in the CHBC.

8-102.1.5 Unsafe buildings or properties. When a qualified historical building or property is determined to be unsafe as defined in the regular code, the requirements of the CHBC are applicable to the work necessary to correct the unsafe conditions. Work to remediate the buildings or properties need only address the correction of the unsafe conditions, and it shall not be required to bring the entire qualified historical building or property into compliance with regular code.

8-102.1.6 Additional work. Qualified historical buildings or properties shall not be subject to additional work required by the regular code, regulation or ordinance beyond that required to complete the work undertaken. Certain exceptions for accessibility and for distinct hazards exist by mandate and may require specific action, within the parameters of the CHBC.

SECTION 8-103
ORGANIZATION AND ENFORCEMENT

8-103.1 Authority. The state or local enforcing agency, pursuant to authority provided under Section 18954 of the Health and Safety Code, shall administer and enforce the provisions of the CHBC in permitting repairs, alterations and additions necessary for the preservation, restoration, reconstruction, rehabilitation, relocation or continued use of a qualified historical building or property.

8-103.2 State enforcement. All state agencies pursuant to authority provided under Section 18954 and Section 18961 of the Health and Safety Code shall administer and enforce the CHBC with respect to qualified historical buildings or properties under their respective jurisdiction.

8-103.3 Liability. Prevailing law regarding immunity of building officials is unaffected by the use and enforcement of the CHBC.

SECTION 8-104
REVIEW AND APPEALS

8-104.1 State Historical Building Safety Board (SHBSB). In order to provide for interpretation of the provisions of the CHBC and to hear appeals, the SHBSB shall act as an appeal and review body to state and local agencies or any affected party.

8-104.2 SHBSB review. When a proposed design, material or method of construction is being considered by the enforcing agency, the agency chief, the building official or the local board of appeals may file a written request for opinion to the SHBSB for its consideration, advice or findings. In considering such request, the SHBSB may seek the advice of other appropriate private or public boards, individuals, or state or local agencies. The SHBSB shall, after considering all of the facts presented, including any recommendation of other appropriate boards, agencies or other parties, determine if, for the purpose intended, the proposal is reasonably equivalent to that allowed by these regulations in proposed design, material or method of construction, and it shall transmit such findings and its decision to the enforcing agency for its application. The Board may recover the costs of such reviews and shall report the decision in printed form, copied to the California Building Standards Commission.

8-104.2.1 State agencies. All state agencies with ownership of, or that act on behalf of state agency owners of, qualified historical buildings or properties, shall consult and obtain SHBSB review prior to taking action or making decisions or appeals that affect qualified historical buildings or properties, per Section 18961 of the Health and Safety Code.

8-104.2.2 Imminent threat. Where an emergency is declared and a qualified historical building or property is declared an imminent threat to life and safety, the state agency assessing such a threat shall consult with the SHBSB before any demolition is undertaken, per Section 18961 of the Health and Safety Code.

8-104.3 SHBC appeals. If any local agency administering and enforcing the CHBC or any person adversely affected by any regulation, rule, omission, interpretation, decision or practice of the agency enforcing the CHBC wishes to appeal the issue for resolution to the SHBSB, either of these parties may appeal directly to the Board. The Board may accept the appeal only if it determines that issues involved are of statewide significance. The Board may recover the costs of such reviews and shall make available copies of decisions in printed form at cost, copied to the California Building Standards Commission.

8-104.4 Local agency fees. Local agencies, when actively involved in the appeal, may also charge affected persons reasonable fees not to exceed the cost of obtaining reviews and appeals from the Board.

SECTION 8-105
CONSTRUCTION METHODS AND MATERIALS

8-105.1 Repairs. Repairs to any portion of a qualified historical building or property may be made in-kind with historical materials and the use of original or existing historical methods of construction, subject to conditions of the CHBC. (See Chapter 8-8.)

8-105.2 Solutions to the *California Historical Building Code*. Solutions provided in the CHBC, or any other acceptable regulation or methodology of design or construction and used in whole or in part, with the regular code, or with any combination of the regular code and the CHBC, shall be allowed. The CHBC does not preclude the use of any proposed alternative or method of design or construction not specifically prescribed or otherwise allowed by these regulations. Any alternative may be submitted for evaluation to the appropriate enforcing agency for review and acceptance. The enforcing agency may request that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding such solutions. Any alternative offered in lieu of that prescribed or allowed in the CHBC shall be reasonably equivalent in quality, strength, effectiveness, durability and safety to that of the CHBC.

SECTION 8-106
SHBSB RULINGS

8-106.1 General. Rulings of the SHBSB (i.e., formal appeals, case decisions, code interpretations and administrative resolutions, etc.) that are issues of statewide application are required to be submitted to the California Building Standards Commission in printed form. These rulings may be used to provide guidance for similar cases or issues.

CHAPTER 8-2

DEFINITIONS

SECTION 8-201 DEFINITIONS

For the purpose of the CHBC, certain terms and phrases, words and their derivatives shall be construed as specified in this chapter. Additional definitions and/or terms may appear in the various other chapters relative to terms or phrases primarily applicable thereto. Any reference to "authority having jurisdiction" does not necessarily preclude the appellate process of Section 8-104.3.

ADDITION. A nonhistorical extension or increase in floor area or height of a building or property.

ALTERATION. A modification to a qualified historical building or property that affects the usability of the building or property, or part thereof. Alterations include, but are not limited to, remodeling, renovation, rehabilitation, reconstruction, historical restoration, changes or rearrangement of the structural parts or elements, and changes or rearrangements in the plan configuration of walls and full-height partitions.

BUILDING STANDARD. Any guideline, regulation or code that may be applied to a qualified historical building or property.

CHARACTER-DEFINING FEATURE. Those visual aspects and physical elements that comprise the appearance of a historical building or property, and that are significant to its historical, architectural and cultural values, including the overall shape of the historical building or property, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment.

CULTURAL RESOURCE. Building, site, property, object or district evaluated as having significance in prehistory or history.

DISTINCT HAZARD. Any clear and evident condition that exists as an immediate danger to the safety of the occupants or public right of way. Conditions that do not meet the requirements of current regular codes and ordinances do *not*, of themselves, constitute a distinct hazard. Section 8-104.3, SHBC appeals, remains applicable.

ENFORCING AGENCY, Authority Having Jurisdiction, Local Agency with Jurisdiction. An entity with the responsibility for regulating, enforcing, reviewing or otherwise that exerts control of or administration over the process of granting permits, approvals, decisions, variances, appeals for qualified historical buildings or properties.

EXIT LADDER DEVICE. An exit ladder device is a permanently installed, fixed, folding, retractable or hinged ladder intended for use as a means of emergency egress from areas of the second or third stories. Unless approved specifically for a longer length, the ladder shall be limited to 25 feet (7620 mm) in length. Exit ladders are permitted where the area served by the ladder has an occupant load less than 10 persons.

FIRE HAZARD. Any condition which increases or may contribute to an increase in the hazard or menace of fire to a greater degree than customarily recognized by the authority having jurisdiction, or any condition or act which could obstruct, delay, hinder or interfere with the operations of firefighting personnel or the egress of occupants in the event of fire. Section 8-104.3, SHBC appeals, remains applicable.

HISTORICAL FABRIC OR MATERIALS. Original and later-added historically significant construction materials, architectural finishes or elements in a particular pattern or configuration which form a qualified historical property, as determined by the authority having jurisdiction.

HISTORICAL SIGNIFICANCE. Importance for which a property has been evaluated and found to be historical, as determined by the authority having jurisdiction.

IMMINENT THREAT. Any condition within or affecting a qualified historical building or property which, in the opinion of the authority having jurisdiction, would qualify a building or property as dangerous to the extent that the life, health, property or safety of the public, its occupants or those performing necessary repair, stabilization or shoring work are in immediate peril due to conditions affecting the building or property. Potential hazards to persons using, or improvements within, the right-of-way may not be construed to be "imminent threats" solely for that reason if the hazard can be mitigated by shoring, stabilization, barricades or temporary fences.

INTEGRITY. Authenticity of a building or property's historical identity, evidenced by the survival of physical characteristics that existed during the property's historical or prehistorical period of significance.

LIFE-SAFETY EVALUATION. An evaluation of the life-safety hazards of a qualified historical building or property based on procedures similar to those contained in NFPA 909, *Standard for the Protection of Cultural Resources, Appendix B, Fire Risk Assessment in Heritage Premises.*

LIFE SAFETY HAZARD. See Distinct Hazard.

PERIOD OF SIGNIFICANCE. The period of time when a qualified historical building or property was associated with important events, activities or persons, or attained the characteristics for its listing or registration.

PRESERVATION. The act or process of applying measures necessary to sustain the existing form, integrity and materials of a qualified historical building or property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-related work to make properties functional is appropriate within a preservation project.

QUALIFIED HISTORICAL BUILDING OR PROPERTY. As defined in Health and Safety Code Section 18955 as "Qualified Historical Building or Property." Any building, site, object, place, location, district or collection of structures, and their associated sites, deemed of importance to the history, architecture or culture of an area by an appropriate local, state or federal governmental jurisdiction. This shall include historical buildings or properties on, or determined eligible for, national, state or local historical registers or inventories, such as the National Register of Historic Places, California Register of Historical Resources, State Historical Landmarks, State Points of Historical Interest, and city or county registers, inventories or surveys of historical or architecturally significant sites, places or landmarks.

RECONSTRUCTION. The act or process of depicting, by means of new construction, the form, features and detailing of a nonsurviving site, landscape, building, property or object for the purpose of replicating its appearance at a specific period of time.

REGULAR CODE. The adopted regulations that govern the design and construction or alteration of nonhistorical buildings and properties within the jurisdiction of the enforcing agency.

REHABILITATION. The act or process of making possible a compatible use for qualified historical building or property through repair, alterations and additions while preserving those portions or features which convey its qualified historical, cultural or architectural values.

RELOCATION. The act or process of moving any qualified historical building or property or a portion of a qualified historical building or property to a new site, or a different location on the same site.

REPAIR. Renewal, reconstruction or renovation of any portion of an existing property, site or building for the purpose of its continued use.

RESTORATION. The act or process of accurately depicting the form, features and character of a qualified building or property as it appeared at a particular period of time by the means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

STRUCTURE. That which is built or constructed, an edifice or a building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

TREATMENT. An act of work to carry out preservation, restoration, stabilization, rehabilitation or reconstruction.

CHAPTER 8-3

USE AND OCCUPANCY

SECTION 8-301
PURPOSE AND SCOPE

8-301.1 Purpose. The purpose of the CHBC is to provide regulations for the determination of occupancy classifications and conditions of use for qualified historical buildings or properties.

8-301.2 Scope. Every qualified historical building or property for which a permit or approval has been requested shall be classified prior to permit issuance according to its use or the character of its occupancy in accordance with the regular code and applicable provisions of this chapter.

SECTION 8-302
GENERAL

8-302.1 Existing use. The use or character of occupancy of a qualified historical building or property, or portion thereof, shall be permitted to continue in use regardless of any period of time in which it may have remained unoccupied or in other uses, provided such building or property otherwise conforms to all applicable requirements of the CHBC.

8-302.2 Change in occupancy. The use or character of the occupancy of a qualified historical building or property may be changed from or returned to its historical use or character, provided the qualified historical building or property conforms to the requirements applicable to the new use or character of occupancy as set forth in the CHBC. Such change in occupancy shall not mandate conformance with new construction requirements as set forth in regular code.

8-302.3 Occupancy separations. Required occupancy separations of more than one hour may be reduced to one-hour fire-resistive construction with all openings protected by not less than three-fourths-hour fire-resistive assemblies of the self-closing or automatic-closing type when the building is provided with an automatic sprinkler system throughout the entire building in accordance with Section 8-410.2. Doors equipped with automatic-closing devices shall be of a type which will function upon activation of a device which responds to products of combustion other than heat.

Required occupancy separations of one hour may be omitted when the building is provided with an automatic sprinkler system throughout.

8-302.4 Maximum floor area. Regardless of the use or character of occupancy, the area of a one-story qualified historical building or property may have, but shall not exceed, a floor area of 15,000 square feet (1393.5 m^2) unless such an increase is otherwise permitted in regular code. Multistory qualified historical buildings (including basements and cellars) shall be in accordance with regular code requirements.

Exception: Historical buildings may be unlimited in floor area without fire-resistive area separation walls:

1. When provided with an automatic sprinkler, or
2. Residential occupancies of two stories or less when provided with a complete fire alarm and annunciation system and where the exiting system conforms to regular code.

8-302.5 Maximum height. The maximum height and number of stories of a qualified historical building or property shall not be limited because of construction type, provided such height or number of stories does not exceed that of its historical design.

8-302.5.1 High-rise buildings. Occupancies B, F-1, F-2 or S in high-rise buildings with floors located more than 75 feet above the lowest floor level having building access may be permitted with only the stories over 75 feet provided with an automatic fire sprinkler system if:

1. The building construction type and the exits conform to regular code, and
2. A complete building fire alarm and annunciation system is installed, and
3. A fire barrier is provided between the sprinklered and nonsprinklered floors.

8-302.6 Fire-resistive construction. See Chapter 8-4.

8-302.7 Light and ventilation. Existing provisions for light and ventilation which do not, in the opinion of the enforcing agency, constitute a safety hazard may remain. See Section 8-303.6 for residential requirements. See Section 8-503 for Escape or Rescue Windows and Doors.

SECTION 8-303
RESIDENTIAL OCCUPANCIES

8-303.1 Purpose. The purpose of this section is to provide regulations for those buildings designated as qualified historical buildings or properties and classified as residential occupancies. The CHBC requires enforcing agencies to accept any reasonably equivalent alternative to the regular code when dealing with qualified historical buildings and properties.

8-303.2 Intent. The intent of the CHBC is to preserve the integrity of qualified historical buildings and properties while maintaining a reasonable degree of protection of life, health and safety for the occupants.

8-303.3 Application and scope. The provisions of this section shall apply to all qualified historical buildings used for human habitation. Those dwelling units intended only for display, or public use with no residential use involved, need not comply with the requirements of this section.

8-303.4 Fire escapes. See Chapter 8-5.

8-303.5 Room dimensions. Rooms used for sleeping purposes may contain a minimum of 50 square feet (4.6 m^2) floor area, provided there is maintained an average ceiling height of 7 feet (2134 mm). Other habitable rooms need only be of adequate size to be functional for the purpose intended.

8-303.6 Light and ventilation. Windows in habitable rooms shall have an area of 6 percent of the floor area, or 6 square feet (0.56 m^2), whichever is greater. Windows in sleeping rooms shall be openable (see Section 8-503). Residential occupancies need not be provided with electrical lighting.

8-303.7 Alteration and repair. The alteration and repair of qualified historical buildings or properties may permit the replacement, retention and extension of original materials and the continued use of original methods of construction, provided a life-safety hazard is not created or continued. Alterations and repairs shall be consistent with the CHBC.

The amount of alterations and repairs is not limited, provided there is no nonhistorical increase in floor area, volume or size of the building or property.

8-303.8 Exiting. See Chapter 8-5.

CHAPTER 8-4

FIRE PROTECTION

SECTION 8-401 PURPOSE, INTENT AND SCOPE

8-401.1 Purpose. The purpose of this chapter is to provide regulations for fire protection of qualified historical buildings or properties. The CHBC requires enforcing agencies to accept any reasonably equivalent alternatives to the regular code when dealing with qualified historical buildings or properties.

8-401.2 Intent. The intent of the CHBC is to preserve the integrity of qualified historical buildings or properties while maintaining a reasonable degree of fire protection based primarily on the life safety of the occupants and firefighting personnel.

8-401.3 Scope. This chapter shall apply when required by the provisions of Section 8-102.

SECTION 8-402 FIRE-RESISTIVE CONSTRUCTION

8-402.1 Exterior wall construction. The fire-resistance requirement for existing exterior walls and existing opening protection may be satisfied when an automatic sprinkler system designed for exposure protection is installed per the CHBC. The automatic sprinklers may be installed on the exterior with at least one sprinkler located over each opening required to be protected. Additional sprinklers shall also be distributed along combustible walls under the roof lines that do not meet the fire-resistive requirement due to relationship to property lines as required by regular code. Such sprinkler systems may be connected to the domestic water supply on the supply-main side of the building shut-off valve. A shut-off valve may be installed for the sprinkler system, provided it is locked in an open position.

8-402.2 One-hour construction. Upgrading an existing qualified historical building or property to one-hour fire-resistive construction and one-hour fire-resistive corridors shall not be required regardless of construction or occupancy when one of the following is provided:

1. An automatic sprinkler system throughout. See Section 8-410 for automatic sprinkler systems.
2. An approved life-safety evaluation.
3. Other alternative measures as approved by the enforcing agency.

8-402.3 Openings in fire-rated systems. Historical glazing materials and solid wood unrated doors in interior walls required to have one-hour fire rating may be approved when operable windows and doors are provided with appropriate smoke seals and when the area affected is provided with an automatic sprinkler system. See Section 8-410 for automatic sprinkler systems.

SECTION 8-403 INTERIOR FINISH MATERIALS

New non-historical interior wall and ceiling finishes shall conform to the provisions of the regular code. Existing nonconforming materials used in interior walls and finishes may be surfaced with an approved fire-retardant to increase the rating of the natural finish to within reasonable proximity of the required rating. For wood lath and plaster walls, see Section 8-404.

> **Exception:** When an automatic sprinkler system is provided throughout the building, existing finishes shall be approved.

SECTION 8-404 WOOD LATH AND PLASTER

Wood lath and plaster walls may be considered in accordance with codes, standards and listings published prior to 1943 whereby a wood stud wall assembly with gypsum or lime plaster on hand split or sawn wooden lath obtains a one-half-hour fire-resistive rating. This rating may be increased for interior walls to as much as one hour by filling the wall with mineral fiber or glass fiber.

SECTION 8-405 OCCUPANCY SEPARATION

See Chapter 8-3.

SECTION 8-406 MAXIMUM FLOOR AREA

See Chapter 8-3.

SECTION 8-407 VERTICAL SHAFTS

Vertical shafts need not be enclosed when such shafts are blocked at every floor level by the installation of not less than 2 full inches (51 mm) of solid wood or equivalent construction to prevent the initial passage of smoke and flame. Automatic sprinkler systems or other solutions may be considered on a case-by-case basis, in lieu of enclosure of vertical shafts and stairwells.

SECTION 8-408 ROOF COVERING

Existing or original roofing materials may be repaired or reconstructed subject to the following requirements:

1. The original or historical roofing system shall be detailed or modified as necessary in order to be capable

of providing shelter while preserving the historical materials and appearance of the roof.

2. Wooden roof materials may be utilized where fire resistance is required, provided they are treated with fire-retardant treatments to achieve a Class "B" roof covering rating. Wood roofing in state designated Urban Wildland and High Fire Zones shall be permitted when installed in class "A" assemblies.

3. Jurisdictions that prohibit wood roofing materials for application as roof coverings and roof assemblies shall submit documentation for the adoption. Express Terms, statement of reasons and minutes of the action by the adopting authority Health and Safety Code, Section 18959(f).

SECTION 8-409
FIRE ALARM SYSTEMS

Every qualified historical building or property shall be provided with fire alarm systems as required for the use or occupancy by the regular code or other approved alternative.

SECTION 8-410
AUTOMATIC SPRINKLER SYSTEMS

8-410.1 Every qualified historical building or property which cannot be made to conform to the construction requirements specified in the regular code for the occupancy or use, and which constitutes a distinct fire hazard (for definition of "distinct hazard," see Chapter 8-2), shall be deemed to be in compliance if provided with an automatic sprinkler system or a life-safety system or other technologies as approved by the enforcing agency. ("Automatic" is defined in the regular code. Sprinkler System is defined in this section.)

8-410.2 When required by the CHBC, an automatic sprinkler system is defined by the following standards as adopted by the State Fire Marshal (for nonhazardous occupancies).

1. Buildings of four stories or less: NFPA 13R.
2. For floors above the fourth, NFPA 13.
3. Buildings with floors above 75 feet, NFPA 13.
4. When the building is free standing or with property line separation, two floors and 1500 sf per floor or less, NFPA 13D.
5. For exterior wall and opening protection. As required by this chapter.

Exception: When the automatic sprinkler systems are used to reach compliance using this code, in three or more occasions, NFPA 13D standard shall be increased to NFPA 13R standard, or NFPA 13R standard shall be increased to a NFPA 13 standard.

8-410.3 Automatic sprinkler systems shall not be used to substitute for or act as an alternate to the required number of exits from any facility. (See Chapter 8-5 for exiting requirements.)

8-410.4 An automatic sprinkler system shall be provided in all detention facilities.

SECTION 8-411
OTHER TECHNOLOGIES

Fire alarm systems, smoke and heat detection systems, occupant notification and annunciation systems, smoke control systems and fire modeling, timed egress analysis and modeling, as well as other engineering methods and technologies may be accepted by the enforcing agency to address areas of nonconformance.

SECTION 8-412
HIGH-RISE BUILDINGS

Qualified historical buildings having floors for human occupancy located more than 75 feet above the lowest floor level having building access shall conform to the provisions of the regular code for existing high-rise buildings as amended by the CHBC.

CHAPTER 8-5

MEANS OF EGRESS

SECTION 8-501
PURPOSE, INTENT AND SCOPE

8-501.1 Purpose. The purpose of this chapter is to establish minimum means of egress regulations for qualified historical buildings or properties. The CHBC requires enforcing agencies to accept reasonably equivalent alternatives to the means of egress requirements in the regular code.

8-501.2 Intent. The intent of these regulations is to provide an adequate means of egress.

8-501.3 Scope. Every qualified historical building or portion thereof shall be provided with exits as required by the CHBC when required by the provisions of Section 8-102.

SECTION 8-502
GENERAL

8-502.1 General. The enforcing agency shall grant reasonable exceptions to the specific provisions of applicable egress regulations where such exceptions will not adversely affect life safety.

8-502.2. Existing door openings and corridor widths of less than dimensions required by regular code shall be permitted where there is sufficient width and height for the occupants to pass through the opening or traverse the exit.

8-502.3 Stairs. Existing stairs having risers and treads or width at variance with the regular code are allowed if determined by the enforcing agency to not constitute a distinct hazard. Handrails with nonconforming grip size or extensions are allowed if determined by the enforcing agency to not constitute a distinct hazard.

8-502.4 Main entry doors. The front or main entry doors need not be rehung to swing in the direction of exit travel, provided other means or conditions of exiting, as necessary to serve the total occupant load, are provided.

8-502.5 Existing fire escapes. Existing previously approved fire escapes and fire escape ladders shall be acceptable as one of the required means of egress, provided they extend to the ground and are easily negotiated, adequately signed and in good working order. Access shall be by an opening having a minimum width of 29 inches (737 mm) when open with a sill no more than 30 inches (762 mm) above the adjacent floor, landing or approved step.

8-502.6 New fire escapes and fire escape ladders. New fire escapes and fire escape ladders which comply with this section shall be acceptable as one of the required means of egress. New fire escapes and new fire escape ladders shall comply with the following:

1. Access from a corridor shall not be through an intervening room.
2. All openings within 10 feet (3048 mm) shall be protected by three-fourths-hour fire assemblies. When located within a recess or vestibule, adjacent enclosure walls shall be of not less than one-hour fire-resistive construction.
3. Egress from the building shall be by a clear opening having a minimum dimension of not less than 29 inches (737 mm). Such openings shall be openable from the inside without the use of a key or special knowledge or effort. The sill of an opening giving access shall not be more than 30 inches (737 mm) above the floor, step or landing of the building or balcony.
4. Fire escape stairways and balconies shall support the dead load plus a live load of not less than 100 pounds per square foot (4.79 kN/m^2) and shall be provided with a top and intermediate handrail on each side. The pitch of the stairway shall not exceed 72 degrees with a minimum width of 18 inches (457 mm). Treads shall not be less than 4 inches (102 mm) in width, and the rise between treads shall not exceed 10 inches (254 mm). All stair and balcony railings shall support a horizontal force of not less than 50 pounds per lineal foot (729.5 N/m^2) of railing.
5. Balconies shall not be less than 44 inches (1118 mm) in width with no floor opening other than the stairway opening greater than $^5/_8$ inch (15.9 mm) in width. Stairway openings in such balconies shall not be less than 22 inches by 44 inches (559 by 1118 mm). The balustrade of each balcony shall not be less than 36 inches (914 mm) high with not more than 9 inches (287 mm) between balusters.
6. Fire escapes shall extend to the roof or provide an approved gooseneck ladder between the top floor landing and the roof when serving buildings four or more stories in height having roofs with less than 4 units vertical in 12 units horizontal (33.3 percent slope). Fire escape ladders shall be designed and connected to the building to withstand a horizontal force of 100 pounds (445 N) placed anywhere on the rung. All ladders shall be at least 15 inches (381 mm) wide, located within 12 inches (305 mm) of the building. Ladder rungs shall be $^3/_4$ inch (19.1 mm) in diameter and shall be located 12 inches (305 mm) on center. Openings for roof access ladders through cornices and similar projections shall have minimum dimensions of 30 inches by 33 inches (762 by 838 mm).

   The length of fire escapes and exit ladder devices shall be limited to that approved by the building official based on products listed by a recognized testing laboratory.
7. The lowest balcony shall not be more than 18 feet (5486 mm) from the ground. Fire escapes shall extend to the ground or be provided with counterbalanced stairs reaching to the ground.

8. Fire escapes shall not take the place of stairways required by the codes under which the building was constructed.
9. Fire escapes shall be kept clear and unobstructed at all times and maintained in good working order.

SECTION 8-503
ESCAPE OR RESCUE WINDOWS AND DOORS

Basements in dwelling units and every sleeping room below the fourth floor shall have at least one openable window or door approved for emergency escape which shall open directly into a public street, public way, yard or exit court. Escape or rescue windows or doors shall have a minimum clear area of 3.3 square feet (0.31 m^2) and a minimum width or height dimension of 18 inches (457 mm) and be operable from the inside to provide a full, clear opening without the use of special tools.

SECTION 8-504
RAILINGS AND GUARDRAILS

The height of railings and guard railings and the spacing of balusters may continue in their historical height and spacing unless a distinct hazard has been identified or created by a change in use or occupancy.

CHAPTER 8-6

ACCESSIBILITY

SECTION 8-601
PURPOSE, INTENT AND SCOPE

8-601.1 Purpose. The purpose of the CHBC is to provide alternative regulations to facilitate access and use by persons with disabilities to and throughout facilities designated as qualified historical buildings or properties. These regulations require enforcing agencies to accept alternatives to regular code when dealing with qualified historical buildings or properties.

8-601.2 Intent. The intent of this chapter is to preserve the integrity of qualified historical buildings and properties while providing access to and use by persons with disabilities.

8-601.3 Scope. The CHBC shall apply to every qualified historical building or property that is required to provide access to persons with disabilities.

1. Provisions of this chapter do not apply to new construction or reconstruction/replicas of historical buildings.
2. Where provisions of this chapter apply to alteration of qualified historical buildings or properties, alteration is defined in *California Building Code* (CBC), Chapter 2, Definitions and Abbreviations. 202 – A. Alter or Alteration.

8-601.4 General application. The provisions in the CHBC apply to local, state and federal governments (Title II entities); alteration of commercial facilities and places of public accommodation (Title III entities); and barrier removal in commercial facilities and places of public accommodation (Title III entities). Except as noted in this chapter.

SECTION 8-602
BASIC PROVISIONS

8-602.1 Regular code. The regular code for access for people with disabilities (Title 24, Part 2, Vol. 1, Chapter 11B) shall be applied to qualified historical buildings or properties unless strict compliance with the regular code will threaten or destroy the historical significance or character-defining features of the building or property.

8-602.2 Alternative provisions. If the historical significance or character-defining features are threatened, alternative provisions for access may be applied pursuant to this chapter, provided the following conditions are met:

1. These provisions shall be applied only on an item-by-item or a case-by-case basis.
2. Documentation is provided, including meeting minutes or letters, stating the reasons for the application of the alternative provisions. Such documentation shall be retained in the permanent file of the enforcing agency.

SECTION 8-603
ALTERNATIVES

8-603.1 Alternative minimum standards. The alternative minimum standards for alterations of qualified historical buildings or facilities are referenced in Section 202.5 of the 2010 ADA Standards for Accessible Design, as incorporated and set forth in federal regulation 28 CFR Pt. 36.

8-603.2 Entry. These alternatives do not allow exceptions for the requirement of level landings in front of doors, except as provided in Section 8-603.4.

1. Access to any entrance used by the general public and no further than 200 feet (60 960 mm) from the primary entrance.
2. Access at any entrance not used by the general public but open and unlocked with directional signs at the primary entrance and as close as possible to, but no further than 200 feet (60 960 mm) from, the primary entrance.
3. The accessible entrance shall have a notification system. Where security is a problem, remote monitoring may be used.

8-603.3 Doors. Alternatives listed in order of priority are:

1. Single-leaf door which provides a minimum 30 inches (762 mm) of clear opening.
2. Single-leaf door which provides a minimum $29^1/_2$ inches (749 mm) clear opening
3. Double door, one leaf of which provides a minimum $29^1/_2$ inches (749 mm) clear opening.
4. Double doors operable with a power-assist device to provide a minimum $29^1/_2$ inches (749 mm) clear opening when both doors are in the open position.

8-603.4 Power-assisted doors. Power-assisted door or doors may be considered an equivalent alternative to level landings, strikeside clearance and door-opening forces required by the regular code.

8-603.5 Toilet rooms. In lieu of separate-gender toilet facilities as required in the regular code, an accessible unisex toilet facility may be designated.

8-603.6 Exterior and interior ramps and lifts. Alternatives listed in order of priority are:

1. A lift or a ramp of greater than standard slope but no greater than 1:10, for horizontal distances not to exceed 5 feet (1525 mm). Signs shall be posted at upper and lower levels to indicate steepness of the slope.
2. Access by ramps of 1:6 slope for horizontal distance not to exceed 13 inches (330 mm). Signs shall be posted at upper and lower levels to indicate steepness of the slope.

SECTION 8-604
EQUIVALENT FACILITATION

Use of other designs and technologies, or deviation from particular technical and scoping requirements, are permitted if the application of the alternative provisions contained in Section 8-603 would threaten or destroy the historical significance or character-defining features of the historical building or property.

1. Such alternatives shall be applied only on an item-by-item or a case-by-case basis.
2. Access provided by experiences, services, functions, materials and resources through methods including, but not limited to, maps, plans, videos, virtual reality and related equipment, at accessible levels. The alternative design and/or technologies used will provide substantially equivalent or greater accessibility to, and usability of, the facility.
3. The official charged with the enforcement of the standards shall document the reasons for the application of the design and/or technologies and their effect on the historical significance or character-defining features. Such documentation shall be in accordance with Section 8-602.2, Item 2, and shall include the opinion and comments of state or local accessibility officials, and the opinion and comments of representative local groups of people with disabilities. Such documentation shall be retained in the permanent file of the enforcing agency. Copies of the required documentation should be available at the facility upon request.

   Note: For commercial facilities and places of public accommodation (Title III entities).

Equivalent facilitation for an element of a building or property when applied as a waiver of an ADA accessibility requirement will not be entitled to the Federal Department of Justice certification of this code as rebuttable evidence of compliance for that element.

CHAPTER 8-7

STRUCTURAL REGULATIONS

SECTION 8-701 PURPOSE, INTENT AND SCOPE

8-701.1 Purpose. The purpose of the CHBC is to provide alternative regulations to the regular code for the structural safety of buildings designated as qualified historical buildings or properties. The CHBC requires enforcing agencies to accept any reasonably equivalent alternatives to the regular code when dealing with qualified historical buildings or properties.

8-701.2 Intent. The intent of this chapter is to encourage the preservation of qualified historical buildings or structures while providing standards for a minimum level of building performance with the objective of preventing partial or total structural collapse such that the overall risk of life-threatening injury as a result of structural collapse is low.

8-701.3 Application. The alternative structural regulations provided by Section 8-705 are to be applied in conjunction with the regular code whenever a structural upgrade or reconstruction is undertaken for qualified historical buildings or properties.

SECTION 8-702 GENERAL

8-702.1 The CHBC shall not be construed to allow the enforcing agency to approve or permit a lower level of safety of structural design and construction than that which is reasonably equivalent to the regular code provisions in occupancies which are critical to the safety and welfare of the public at large, including, but not limited to, public and private schools, hospitals, municipal police and fire stations and essential services facilities.

8-702.2 Nothing in these regulations shall prevent voluntary and partial seismic upgrades when it is demonstrated that such upgrades will improve life safety and when a full upgrade would not otherwise be required.

SECTION 8-703 STRUCTURAL SURVEY

8-703.1 Scope. When a structure or portion of a structure is to be evaluated for structural capacity under the CHBC, it shall be surveyed for structural conditions by an architect or engineer knowledgeable in historical structures. The survey shall evaluate deterioration or signs of distress. The survey shall determine the details of the structural framing and the system for resistance of gravity and lateral loads. Details, reinforcement and anchorage of structural systems and veneers shall be determined and documented where these members are relied on for seismic lateral resistance.

8-703.2 The results of the survey shall be utilized for evaluating the structural capacity and for designing modifications to the structural system to reach compliance with this code.

8-703.3 Historical records. Past historical records of the structure or similar structures may be used in the evaluation, including the effects of subsequent alterations.

SECTION 8-704 NONHISTORICAL ADDITIONS AND NONHISTORICAL ALTERATIONS

8-704.1 New nonhistorical additions and nonhistorical alterations which are structurally separated from an existing historical building or structure shall comply with regular code requirements.

8-704.2 New nonhistorical additions which impose vertical or lateral loads on an existing structure shall not be permitted unless the affected part of the supporting structure is evaluated and strengthened, if necessary, to meet regular code requirements.

Note: For use of archaic materials, see Chapter 8-8.

SECTION 8-705 STRUCTURAL REGULATIONS

8-705.1 Gravity loads. The capacity of the structure to resist gravity loads shall be evaluated and the structure strengthened as necessary. The evaluation shall include all parts of the load path. Where no distress is evident, and a complete load path is present, the structure may be assumed adequate by having withstood the test of time if anticipated dead and live loads will not exceed those historically present.

8-705.2 Wind and seismic loads. The ability of the structure to resist wind and seismic loads shall be evaluated. Wind loads shall be considered when appropriate, but need not exceed 75% of the wind loads prescribed by the regular code. The evaluation shall be based on the requirements of Section 8-706.

8.705.2.1 Any unsafe conditions in the lateral-load-resisting system shall be corrected, or alternative resistance shall be provided. When strengthening is required, additional resistance shall be provided to meet the minimum requirements of the CHBC. The strengthening measures shall be selected with the intent of meeting the performance objectives set forth in Sectio 8-701.2. The evaluation of structural members and structural systems for seismic loads shall consider the inelastic performance of structural members and their ability to maintain load-carrying capacity during the seismic loadings prescribed by the regular code.

8.705.2.2 The architect or engineer shall consider additional measures with minimal loss of, and impact to, historical materials which will reduce damage and needed repairs in future earthquakes to better preserve the historical structure in perpetuity. These additional measures shall be presented to the owner for consideration as part of the rehabilitation or restoration.

SECTION 8-706 LATERAL LOAD REGULATIONS

8-706.1 Seismic forces. Strength-level seismic forces used to evaluate the structure for resistance to seismic loads shall be based on the *R*-values tabulated in the regular code for similar lateral-force-resisting systems including consideration of the structural detailing of the members where such *R*-values exist. Where such *R*-values do not exist, an appropriate *R*-value shall be rationally assigned considering the structural detailing of the members.

Exceptions:

1. The forces need not exceed 0.75 times the seismic forces prescribed by the regular code requirements.
2. For Risk Category I, II or III structures, near-fault increases in ground motion (maximum considered earthquake ground motion of 0.2 second spectral response greater than 150 percent at 5 percent damping) need not be considered when the fundamental period of the building is 0.5 seconds in the direction under consideration.
3. For Risk Category I or II structures, the seismic base shear need not exceed 0.30W.
4. For Risk Category III or IV structures, the seismic base shear need not exceed 0.40W.

8-706.1.1 When a building is to be strengthened with the addition of a new lateral force resisting system, the R value of the new system can be used when the new lateral force resisting system resists at least 75 percent of the building's base shear regardless of its relative rigidity.

8-706.1.2 Evaluation and seismic improvement of unreinforced masonry bearing wall buildings shall comply with the *California Existing Building Code* (CEBC), Appendix Chapter A1 2013 Edition, and as modified by the CHBC.

Exceptions:

1. Alternative standards may be used on a case-by-case basis when approved by the authority having jurisdiction. It shall be permitted to exceed the strength limitation of 100 psi in Section A108.2 of the CEBC when test data and building configuration supports higher values subject to the approval of the authority having jurisdiction.
2. CEBC Section A102.2 shall not apply to Qualified Historical Buildings in Risk Category III buildings and other structures whose primary occupancies are public assembly with an occupancy load greater than 300.

8-706.1.3 All deviations from the detailing provisions of the lateral-force-resisting systems shall be evaluated for stability and the ability to maintain load-carrying capacity at the expected inelastic deformations.

8-706.2 Existing building performance. The seismic resistance may be based upon the ultimate capacity of the structure to perform, giving due consideration to ductility and reserve strength of the lateral-force-resisting system and materials while maintaining a reasonable factor of safety. Broad judgment may be exercised regarding the strength and performance of materials not recognized by regular code requirements. (See Chapter 8-8, Archaic Materials and Methods of Construction.)

8-706.2.1 All structural materials or members that do not comply with detailing and proportioning requirements of the regular code shall be evaluated for potential seismic performance and the consequence of non-compliance. All members that would be reasonably expected to fail and lead to collapse or life threatening injury when subjected to seismic demands shall be judged unacceptable, and appropriate structural strengthening shall be developed.

8-706.3 Load path. A complete and continuous load path, including connections, from every part or portion of the structure to the ground shall be provided for the required forces. It shall be verified that the structure is adequately tied together to perform as a unit when subjected to earthquake forces.

8-706.4 Parapets. Parapets and exterior decoration shall be investigated for conformance with regular code requirements for anchorage and ability to resist prescribed seismic forces.

An exception to regular code requirements shall be permitted for those parapets and decorations which are judged not to be a hazard to life safety.

8-706.5 Nonstructural features. Nonstructural features of historical structure, such as exterior veneer, cornices and decorations, which might fall and create a life-safety hazard in an earthquake, shall be evaluated. Their ability to resist seismic forces shall be verified, or the feature shall be strengthened with improved anchorage when appropriate.

8-706.5.1 Partitions and ceilings of corridors and stairways serving an occupant load of 30 or more shall be investigated to determine their ability to remain in place when the building is subjected to earthquake forces.

8-706.5.2 Seismic forces used to evaluate and improve nonstructural components and their anchorage, where required, shall comply with ASCE 41 or need not exceed 0.75 times the seismic forces prescribed by the requirements of the regular code.

CHAPTER 8-8

ARCHAIC MATERIALS AND METHODS OF CONSTRUCTION

SECTION 8-801 PURPOSE, INTENT AND SCOPE

8-801.1 Purpose. The purpose of the CHBC is to provide regulations for the use of historical methods and materials of construction that are at variance with regular code requirements or are not otherwise codified, in buildings or structures designated as qualified historical buildings or properties. The CHBC require enforcing agencies to accept any reasonably equivalent alternatives to the regular code when dealing with qualified historical buildings or properties.

8-801.2 Intent. It is the intent of the CHBC to provide for the use of historical methods and materials of construction that are at variance with specific code requirements or are not otherwise codified.

8-801.3 Scope. Any construction type or material that is, or was, part of the historical fabric of a structure is covered by this chapter. Archaic materials and methods of construction present in a historical structure may remain or be reinstalled or be installed with new materials of the same class to match existing conditions.

SECTION 8-802 GENERAL ENGINEERING APPROACHES

Strength values for archaic materials shall be assigned based upon similar conventional codified materials, or on tests as hereinafter indicated. The archaic materials and methods of construction shall be thoroughly investigated for their details of construction in accordance with Section 8-703. Testing shall be performed when applicable to evaluate existing conditions. The architect or structural engineer in responsible charge of the project shall assign allowable stresses or strength levels to archaic materials. Such assigned strength values shall not be greater than those provided for in the following sections without adequate testing, and shall be subject to the concurrence of the enforcing agency.

SECTION 8-803 NONSTRUCTURAL ARCHAIC MATERIALS

Where nonstructural historical materials exist in uses which do not meet the requirements of the regular code, their continued use is allowed by this code, provided that any public health and life-safety hazards are mitigated subject to the concurrence of the enforcing agency.

SECTION 8-804 ALLOWABLE CONDITIONS FOR SPECIFIC MATERIALS

Archaic materials which exist and are to remain in qualified historical buildings or structures shall be evaluated for their condition and for loads required by this code. The structural survey required in Section 8-703 of the CHBC shall document existing conditions, reinforcement, anchorage, deterioration and other factors pertinent to establishing allowable stresses, strength levels and adequacy of the archaic materials. The remaining portion of this chapter provides additional specific requirements for commonly encountered archaic materials.

SECTION 8-805 MASONRY

For adobe, see Section 8-806.

8-805.1 Existing solid masonry. Existing solid masonry walls of any type, except adobe, may be allowed, without testing, a maximum ultimate strength of nine pounds per square inch (62.1 kPa) in shear where there is a qualifying statement by the architect or engineer that an inspection has been made, that mortar joints are filled and that both brick and mortar are reasonably good. The shear stress above applies to unreinforced masonry, except adobe, where the maximum ratio of unsupported height or length to thickness does not exceed 13, and where minimum quality mortar is used or exists. Wall height or length is measured to supporting or resisting elements that are at least twice as stiff as the tributary wall. Stiffness is based on the gross section. Shear stress may be increased by the addition of 10 percent of the axial direct stress due to the weight of the wall directly above. Higher-quality mortar may provide a greater shear value and shall be tested in accordance with Appendix A, Chapter A1 of the *California Existing Building Code* (CEBC) 2010 edition, and as modified by the CHBC.

8-805.2 Stone masonry.

8-805.2.1 Solid-backed stone masonry. Stone masonry solidly backed with brick masonry shall be treated as solid brick masonry as described in Section 8-805.1 and in the 2009 IEBC, provided representative testing and inspection verifies solid collar joints between stone and brick and that a reasonable number of stones lap with the brick wythes as headers or that steel anchors are present. Solid stone masonry where the wythes of stone effectively overlap to provide the equivalent header courses may also be treated as solid brick masonry.

8-805.2.2 Independent wythe stone masonry. Stone masonry with independent face wythes may be treated as solid brick masonry as described in Section 8-805.1 and the CEBC, provided representative testing and inspection verify that the core is essentially solid in the masonry wall and that steel ties are epoxied in drilled holes between outer stone wythes at floors, roof and not to exceed 4 feet (1219 mm) on center in each direction, between floors and roof. A reinforcing element shall exist or be provided at or near the top of all stone masonry walls.

8-805.2.3 Testing of stone masonry. Testing of stone masonry shall be similar to the 2010 CEBC requirements for brick masonry, except that representative stones which are not interlocked shall be pulled outward from the wall and shear area appropriately calculated after the test.

8-805.3 Reconstructed walls. Totally reconstructed walls utilizing original brick or masonry, constructed similar to original, shall be constructed in accordance with the regular code. Repairs or infills may be constructed in a similar manner to the original walls without conforming to the regular code.

SECTION 8-806 ADOBE

8-806.1 General. Unburned clay masonry may be constructed, reconstructed, stabilized or rehabilitated subject to this chapter. Alternative approaches which provide an equivalent or greater level of safety may be used, subject to the concurrence of the enforcing agency.

8-806.2 Moisture protection. Provisions shall be in-place to protect adobe structures from deterioration due to moisture penetration. Adobe shall be maintained in reasonably good condition. Particular attention shall be given to moisture content of adobe walls. Unmaintained walls or ruins shall be evaluated for safety based on their condition and stability. Additional protection measures may be appropriate subject to the concurrence of the enforcing agency.

8-806.3 Height to thickness ratio. Unreinforced new or existing adobe walls meeting these criteria need not be evaluated for out of plane failure. Where existing dimensions do not meet these conditions, additional strengthening measures, such as a bond beam, may be appropriate. Existing sod or rammed earth walls shall be considered similar to the extent these provisions apply.

1. One-story adobe load-bearing walls shall not exceed a height-to-thickness ratio of 6.
2. Two-story adobe buildings or structures' height- to-thickness wall ratio shall not exceed 6 at the ground floor and 5 at the second floor, and shall be measured at floor-to-floor height when the second floor and attic ceiling/roof are connected to the wall as described below.

8-806.4 Nonload-bearing adobe. Nonload-bearing adobe partitions and gable end walls shall be evaluated for stability and anchored against out-of-plane failure if necessary.

8-806.5 Bond beam. Where provided, a bond beam or equivalent structural element shall be located at the top of all adobe walls, and at the second floor for two-story buildings or structures. The size and configuration of the structural element shall be sufficient to provide an effective brace for the wall, to tie the building together and to connect the wall to the floor or roof.

8-806.6 Repair or reconstruction. Repair or reconstruction of wall area may utilize unstabilized brick or adobe masonry designed to be compatible with the constituents of the existing adobe materials.

8-806.7 Shear values. Existing adobe may be allowed a maximum strength level of twelve pounds per square inch (82.7 kPa) for shear.

8-806.8 Mortar. Mortar may be of the same soil composition as that used in the existing wall, or in new walls as necessary to be compatible with the adobe brick.

SECTION 8-807 WOOD

8-807.1 Existing wood diaphragms or walls. Existing wood diaphragms or walls of straight or diagonal sheathing shall be assigned shear resistance values appropriate with the fasteners and materials functioning in conjunction with the sheathing. The structural survey shall determine fastener details and spacings and verify a load path through floor construction. Shear values of Tables 8-8-A and 8-8-B.

8-807.2 Wood lath and plaster. Wood lath and plaster walls and ceilings may be utilized using the shear values referenced in Section 8-807.1.

8-807.3 Existing wood framing. Existing wood framing members may be assigned allowable stresses consistent with codes in effect at the time of construction. Existing or new replacement wood framing may be of archaic types originally used if properly researched, such as balloon and single wall. Wood joints such as dovetail and mortise and tenon types may be used structurally, provided they are well made. Lumber selected for use and type need not bear grade marks, and greater or lesser species such as low-level pine and fir, boxwood and indigenous hardwoods and other variations may be used for specific conditions where they were or would have been used.

Wood fasteners such as square or cut nails may be used with a maximum increase of 50 percent over wire nails for shear.

SECTION 8-808 CONCRETE

8-808.1 Materials. Natural cement concrete, unreinforced rubble concrete and similar materials may be utilized wherever that material is used historically. Concrete of low strength and with less reinforcement than required by the regular code may remain in place. The architect or engineer shall assign appropriate values of strength based on testing of samples of the materials. Bond and development lengths shall be determined based on historical information or tests.

8-808.2 Detailing. The architect or engineer shall carefully evaluate all detailing provisions of the regular code which are not met and shall consider the implications of these variations on the ultimate performance of the structure, giving due consideration to ductility and reserve strength.

SECTION 8-809 STEEL AND IRON

The hand-built, untested use of wrought or black iron, the use of cast iron or grey iron, and the myriad of joining methods that are not specifically allowed by code may be used wherever applicable and wherever they have proven their worth under the considerable span of years involved with most qualified historical buildings or structures. Uplift capacity should be evaluated and strengthened where necessary. Fixed conditions or midheight lateral loads on cast iron columns that could cause failure should be taken into account. Existing structural wrought, forged steel or grey iron may be assigned the maximum working stress prevalent at the time of original construction.

SECTION 8-810
HOLLOW CLAY TILE

The historical performance of hollow clay tile in past earthquakes shall be carefully considered in evaluating walls of hollow clay tile construction. Hollow clay tile bearing walls shall be evaluated and strengthened as appropriate for lateral loads and their ability to maintain support of gravity loads. Suitable protective measures shall be provided to prevent blockage of exit stairways, stairway enclosures, exit ways and public ways as a result of an earthquake.

SECTION 8-811
VENEERS

8-811.1 Terra cotta and stone. Terra cotta, cast stone and natural stone veneers shall be investigated for the presence of suitable anchorage. Steel anchors shall be investigated for deterioration or corrosion. New or supplemental anchorage shall be provided as appropriate.

8-811.2 Anchorage. Brick veneer with mechanical anchorage at spacings greater than required by the regular code may remain, provided the anchorages have not corroded. Nail strength in withdrawal in wood sheathing may be utilized to its capacity in accordance with code values.

SECTION 8-812
GLASS AND GLAZING

8-812.1 Glazing subject to human impact. Historical glazing material located in areas subject to human impact may be approved subject to the concurrence of the enforcing agency when alternative protective measures are provided. These measures may include, but not be limited to, additional glazing panels, protective film, protective guards or systems, and devices or signs which would provide adequate public safety.

8-812.2 Glazing in fire-rated systems. See Section 8-402.3.

TABLE8-8A
STRENGTH VALUES FOR EXISTING MATERIALS

EXISTING MATERIALS OR CONFIGURATIONS OF MATERIALS[1]	STRENGTH LEVEL CAPACITY x14.594 for N/m
1. Horizontal diaphragms[2]	
1.1 Roofs with straight sheathing and roofing applied directly to the sheathing	300 lbs per foot for seismic shear
1.2 Roofs with diagonal sheathing and roofing applied directly to the sheathing	750 lbs per foot for seismic shear
1.3 Floors with straight tongue-and-groove sheathing	300 lbs per foot for seismic shear
1.4 Floors with straight sheathing and finished wood flooring with board edges offset or perpendicular	1,500 lbs per foot for seismic shear
1.5 Floors with diagonal sheathing and finished	1,800 lbs per foot for seismic shear
2. Crosswalls[2,3]	
2.1 Plaster on wood or metal lath	Per side: 600 lbs per foot for seismic shear
2.2 Plaster on gypsum lath	550 lbs per foot for seismic shear
2.3 Gypsum wallboard, unblocked edges	200 lbs per foot for seismic shear
2.4 Gypsum wallboard, blocked edges	400 lbs per foot for seismic shear
3. Existing footings, wood framing, structural steel and reinforcing steel	
3.1 Plain concrete footings	f'_c = 1,500 psi (10.34 MPa) unless otherwise shown by tests[3]
3.2 Douglas fir wood	Allowable stress same as D.F. No. 1[3]
3.3 Reinforcing steel	f_t = 40,000 lbs per square inch (124.1 N/mm^2) maximum
3.4 Structural steel	f_t = 33,000 lbs per square inch (137.9 N/mm^2) maximum

1 Material must be sound and in good condition.
2 Shear values of these materials may be combined, except the total combined value shall not exceed 900 pounds per foot (13,140 N/m).
3 Stresses given may be increased for combinations of loads as specified in the regular code.

TABLE 8-8B
STRENGTH VALUES OF NEW MATERIALS USED IN CONNECTION WITH EXISTING CONSTRUCTION

NEW MATERIALS OR CONFIGURATIONS OF MATERIALS	STRENGTH LEVEL CAPACITY[1]
1. Horizontal diaphragms[2]	
1.1 $^{15}/_{32}$ inch minimum plywood sheathing fastened directly over existing straight sheathing with edges of plywood located on center of individual sheathing boards and fastened with minimum #8x $1^1/_4$ inch wood screws or nails with helical threads 0.13 inch min. diameter and $1^1/_4$ inch min. length at 4 inch centers all panel edges and 12 inch centers each way in field.	1,500 lbs per foot
1.2 Same plywood and attachments as 1.1 fastened directly over existing diagonal sheathing.	1,800 lbs per foot
1.3 $^3/_8$ inch plywood sheathing fastened directly over existing straight or diagonal sheathing with ends and edges on centers of individual sheathing boards and fastened with #6 wood screws or nails with helical threads 0.13 inch minimum diameter and $1^1/_4$ inch min. length at 6 inch centers tall panel edges and 12 inch centers each way in field.	900 lbs per foot
2. Shear walls: Plywood sheathing applied directly over wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing	100 percent of the value specified in the regular code for shear walls
3. Crosswalls: (special procedure only)	133 percent of the value specified in the regular code for shear walls
3.1 Plywood sheathing applied directly over wood studs. No value shall be given to plywood applied over existing plaster or wood sheathing	
3.2 Drywall or plaster applied directly over wood studs	100 percent of the values in the regular code
3.3 Drywall or plaster applied to sheathing over existing wood studs	50 percent of the values specified in the regular code
4. Tension bolts	
a. Bolts extending entirely through unreinforced masonry walls secured with bearing plates on far side of a three-wythe- minimum wall with at least 30 square inches (19 350 mm^2) of area[4,5]	5,400 lbs (24,010 N) per bolt[6] 2,700 lbs (12,009 N) per bolt for two-wythe walls[6]
b. All thread rod extending to the exterior face of the wall installed in adhesive[9]	3,600 lbs (16,014 N) per bolt
5. Shear bolts: Bolts embedded a minimum of 8 inches (203 mm) into unreinforced masonry walls and centered in a $2^1/_2$-inch-diameter (63.5 mm) hole filled with dry-pack or nonshrink grout. Through bolts with first 8 inches (203 mm) as noted above and embedded all thread rod as noted in Item 4.b[5,7,9]	$^1/_2$ inch (12.7 mm) diameter = 1050 lbs (4671 N)[6] $^5/_8$ inch (15.9 mm) diameter = 1500 lbs (6672 N)[6] $^3/_4$ inch (19 mm) diameter = 2250 lbs (10,008 N)[6]
6. Infilled walls: Reinforced masonry infilled openings in existing unreinforced masonry walls. Provide keys or dowels to match reinforcing.	Same as values specified for unreinforced masonry walls
7. Reinforced masonry: Masonry piers and walls reinforced per the regular code	Same as values specified in the regular code[8]
8. Reinforced concrete: Concrete footings, walls and piers reinforced as specified in the regular code and designed for tributary loads	Same as values specified in the regular code[8]

1 Values are for strength level loads as defined in regular code standards.
2 Values may be adjusted for other fasteners when approved by the enforcing authority.
3 In addition to existing sheathing value.
4 Bolts to be $^1/_2$-inch (12.7 mm) minimum diameter.
5 Other bolt sizes, values and installation methods may be used provided a testing program is conducted in accordance with regular code standards. Bolt spacing shall not exceed 6 feet. (1830 mm) on center and shall not be less than 12 inches (305) mm) on center.
6 Other masonry based on tests or other substantiated data.
7 Embedded bolts to be tested as specified in regular code standards.
8 Stresses given may be increased for combinations of loads as specified in the regular code.
9 Adhesives shall be approved by the enforcing agency and installed in accordance with the manufacturer's recommendations. All drilling dust shall be removed from drilled holes prior to installation.

CHAPTER 8-9

MECHANICAL, PLUMBING AND ELECTRICAL REQUIREMENTS

SECTION 8-901
PURPOSE, INTENT AND SCOPE

8-901.1 Purpose. The purpose of the CHBC is to provide regulations for the mechanical, plumbing and electrical systems of buildings designated as qualified historical buildings or properties. The CHBC requires enforcing agencies to accept any reasonable equivalent solutions to the regular code when dealing with qualified historical buildings or properties.

8-901.2 Intent. The intent of the CHBC is to preserve the integrity of qualified historical buildings or properties while providing a reasonable level of protection from fire, health and life-safety hazards (hereinafter referred to as safety hazards) for the building occupants.

8-901.3 Scope. The CHBC shall be applied in conjunction with the regular code whenever compliance with the regular code is required for qualified historical buildings or properties.

8-901.4 Safety hazard. No person shall permit any safety hazard to exist on premises under their control, or fail to take immediate action to abate such hazard. Existing systems which constitute a safety hazard when operational may remain in place, provided they are completely and permanently rendered inoperative. Safety hazards created by inoperative systems shall not be permitted to exist. Requirements of the regular code concerning general regulations shall be complied with, except that the enforcing agency shall accept solutions which do not cause a safety hazard.

8-901.5 Energy conservation. Qualified historical buildings or properties covered by this part are exempted from compliance with energy conservation standards. When new nonhistorical lighting and space conditioning system components, devices, appliances and equipment are installed, they shall comply with the requirements of Title 24, Part 6, *The California Energy Code*, except where the historical significance or character-defining features are threatened.

SECTION 8-902
MECHANICAL

8-902.1 General. Mechanical systems shall comply with the regular code unless otherwise modified by this chapter.

8-902.1.1 The provisions of the CHBC shall apply to the acceptance, location, installation, alteration, repair, relocation, replacement or addition of any heating, ventilating, air conditioning, domestic incinerators, kilns or miscellaneous heat-producing appliances or equipment within or attached to a historical building.

8-902.1.2 Existing systems which do not, in the opinion of the enforcing agency, constitute a safety hazard may remain in use.

8-902.1.3 The enforcing agency may approve any alternative to the CHBC which would achieve equivalent life safety.

8-902.2 Heating facilities. All dwelling-type occupancies covered under this chapter shall be provided with heating facilities. Wood-burning or pellet stoves or fireplaces may be acceptable as heating facilities.

8-902.3 Fuel oil piping and tanks. Fuel oil piping and tanks shall comply with regular code requirements except that the enforcing agency may waive such requirements where the lack of compliance does not create a safety or environmental hazard.

8-902.4 Heat-producing and cooling equipment. Heat-producing and cooling equipment shall comply with the regular code requirements governing equipment safety, except that the enforcing agency may accept alternatives which do not create a safety hazard.

8-902.5 Combustion air.

8-902.5.1 All fuel-burning appliances and equipment shall be provided a sufficient supply of air for proper fuel combustion, ventilation and draft hood dilution.

8-902.5.2 The enforcing agency may require operational tests for combustion air systems which do not comply with applicable requirements of the regular code.

8-902.6 Venting of appliances.

8-902.6.1 Every appliance required to be vented shall be connected to an approved venting system. Venting systems shall develop a positive flow adequate to convey all combustion products to the outside atmosphere.

8-902.6.2 Masonry chimneys in structurally sound condition may remain in use for all fuel-burning appliances, provided the flue is evaluated and documentation provided that the masonry and grout are in good condition. Terra cotta chimneys and Type C metallic vents installed in concealed spaces shall not remain in use unless otherwise mitigated and approved on a case-by-case basis.

8-902.6.3 The enforcing agency may require operational tests for venting systems which do not comply with applicable requirements of the regular code.

8-902.7 Ducts.

8-902.7.1 New ducts shall be constructed and installed in accordance with applicable requirements of the regular code.

8-902.7.2 Existing duct systems which do not comply with applicable requirements of the regular code and do not, in the opinion of the enforcing agency, constitute a safety or health hazard may remain in use.

8-902.8 Ventilating systems.

8-902.8.1 Ventilating systems shall be installed so that no safety hazard is created.

8-902.8.2 Grease hoods and grease hood exhaust systems shall be furnished and installed in accordance with applicable requirements of the regular code. Existing systems which are altered shall comply with the regular code.

8-902.9 Miscellaneous equipment requirements.

8-902.9.1 The following appliances and equipment shall be installed so that no safety hazard is created: warm air furnaces, space heating equipment, vented decorative appliances, floor furnaces, vented wall furnaces, unit heaters, room heaters, absorption units, refrigeration equipment, duct furnaces, infrared radiant heaters, domestic incinerators, miscellaneous heat-producing appliances and water heaters.

8-902.9.2 Storage-type water heaters shall be equipped with a temperature- and pressure-relief valve in accordance with applicable requirements of the regular code.

SECTION 8-903
PLUMBING

8-903.1 General. Plumbing systems shall comply with the regular code unless otherwise noted.

8-903.1.1 The provisions of the CHBC shall apply to the acceptance, location, installation, alteration, repair, relocation, replacement or addition of any plumbing system or equipment within or attached to a historical building.

8-903.1.2 Existing systems which do not, in the opinion of the enforcing agency, constitute a safety hazard may remain in use.

8-903.1.3 The enforcing agency may approve any alternative to these regulations which achieves reasonably equivalent life safety.

8-903.2 Residential occupancies.

8-903.2.1 Where toilet facilities are provided, alternative sewage disposal methods may be acceptable if approved by the local health department. In hotels, where private facilities are not provided, water closets at the ratio of one for each 15 rooms may be acceptable.

8-903.2.2 Toilet facilities are not required to be on the same floor or in the same building as sleeping rooms. Water-flush toilets may be located in a building immediately adjacent to the sleeping rooms. When alternative sewage disposal methods are utilized, they shall be located a minimum distance from the sleeping rooms or other locations as approved by the local health department.

8-903.2.3 Kitchen sinks shall be provided in all kitchens. The sink and countertop may be of any smooth nonabsorbent finish which can be maintained in a sanitary condition.

8-903.2.4 Hand washing facilities shall be provided for each dwelling unit and each hotel guest room. A basin and pitcher may be acceptable as adequate hand washing facilities.

8-903.2.5 Hot or cold running water is not required for each plumbing fixture, provided a sufficient amount of water is supplied to permit the fixture's normal operation.

8-903.2.6 Bathtubs and lavatories with filler spouts less than 1 inch (25.4 mm) above the fixture rim may remain in use, provided there is an acceptable overflow below the rim.

8-903.2.7 Original or salvage water closets, urinals and flushometer valves shall be permitted in qualified historical buildings or properties. Historically accurate reproduction, nonlow-consumption water closets, urinals and flushometer valves shall be permitted except where historically accurate fixtures that comply with the regular code are available.

8-903.3 Materials. New nonhistorical materials shall comply with the regular code requirements. The enforcing agency shall accept alternative materials which do not create a safety hazard where their use is necessary to maintain the historical integrity of the building.

8-903.4 Drainage and vent systems. Plumbing fixtures shall be connected to an adequate drainage and vent system. The enforcing agency may require operational tests for drainage and vent systems which do not comply with applicable requirements of the regular code. Vent terminations may be installed in any location which, in the opinion of the enforcing agency, does not create a safety hazard.

8-903.5 Indirect and special wastes. Indirect and special waste systems shall be installed so that no safety hazard is created. Chemical or industrial liquid wastes which may detrimentally affect the sanitary sewer system shall be pretreated to render them safe prior to discharge.

8-903.6 Traps and interceptors. Traps and interceptors shall comply with the regular code requirements except that the enforcing agency shall accept solutions which do not increase the safety hazard. Properly maintained "S" and drum traps may remain in use.

8-903.7 Joints and connections.

8-903.7.1 Joints and connections in new plumbing systems shall comply with applicable requirements of the regular code.

8-903.7.2 Joints and connections in existing or restored systems may be of any type that does not create a safety hazard.

8-903.8 Water distribution. Plumbing fixtures shall be connected to an adequate water distribution system. The enforcing agency may require operational tests for water distribution systems which do not comply with applicable requirements of regular code. Prohibited (unlawful) connections and cross connections shall not be permitted.

8-903.9 Building sewers and private sewage disposal systems. New building sewers and new private sewage disposal systems shall comply with applicable requirements of the regular code.

8-903.10 Fuel-gas piping. Fuel-gas piping shall comply with the regular code requirements except that the enforcing agency shall accept solutions which do not increase the safety hazard.

SECTION 8-904
ELECTRICAL

8-904.1 General. Electrical systems shall comply with the regular code unless otherwise permitted by this code, or approved by the authority having jurisdiction.

8-904.1.1 The provisions of the CHBC shall apply to the acceptance, location, installation, alteration, repair, relocation, replacement or addition of any electrical system or portion thereof, the premise wiring, or equipment fixed in place as related to restoration within or attached to a qualified historical building or property.

8-904.1.2 Existing systems, wiring methods and electrical equipment which do not, in the opinion of the enforcing agency, constitute a safety hazard may remain in use.

8-904.1.3 The enforcing agency may approve any alternative to the CHBC which achieves equivalent safety.

8-904.1.4 Archaic methods that do not appear in present codes may remain and may be extended if, in the opinion of the enforcing agency, they constitute a safe installation.

8-904.2 Wiring methods.

8-904.2.1 Where existing branch circuits do not include an equipment grounding conductor and, in the opinion of the enforcing agency, it is impracticable to connect an equipment grounding conductor to the grounding electrode system, receptacle convenience outlets may remain the nongrounding type.

8-904.2.2 Ground fault circuit interrupter (GFCI) protected receptacles shall be installed where replacements are made at receptacle outlets that are required to be so protected by the regular code in effect at the time of replacement. Metallic face plates shall either be grounded to the grounded metal outlet box or be grounded to the grounding-type device when used with devices supplied by branch circuits without equipment grounding conductors.

8-904.2.3 Grounding-type receptacles shall not be used without a grounding means in an existing receptacle outlet unless GFCI protected. Existing nongrounding receptacles shall be permitted to be replaced with nongrounding or grounding-type receptacles where supplied through a ground fault circuit interrupter.

8-904.2.4 Extensions of existing branch circuits without equipment-grounding conductors shall be permitted to supply grounding-type devices only when the equipment grounding conductor of the new extension is grounded to any accessible point on the grounding electrode system.

8-904.2.5 Receptacle outlet spacing and other related distance requirements shall be waived or modified if determined to be impracticable by the enforcing agency.

8-904.2.6 For the replacement of lighting fixtures on an existing nongrounded lighting outlet, or when extending an existing nongrounding lighting outlet, the following shall apply:

1. The exposed conductive parts of lighting fixtures shall be connected to any acceptable point on the grounding electrode system, or
2. The lighting fixtures shall be made of insulating material and shall have no exposed conductive parts.

   Exception: Lighting fixtures mounted on electrically nonconductive ceilings or walls where located not less than either 8 feet (2438 mm) vertically or 5 feet (1524 mm) horizontally from grounded surfaces.

8-904.2.7 Lighting load calculations for services and feeders may be based on actual loads as installed in lieu of the "watts per square foot" method.

8-904.2.8 Determination of existing loads may be based on maximum demand recordings in lieu of calculations, provided all of the following are met:

1. Recordings are provided by the serving agency.
2. The maximum demand data is available for a one-year period.

   Exception: If maximum demand data for a one-year period is not available, the maximum demand data shall be permitted to be based on the actual amperes continuously recorded over a minimum 30-day period by a recording ammeter connected to the highest loaded phase of the feeder or service. The recording should reflect the maximum demand when the building or space is occupied and include the measured or calculated load at the peak time of the year, including the larger of the heating or cooling equipment load.

3. There has been no change in occupancy or character of load during the previous 12 months.
4. The anticipated load will not change, or the existing demand load at 125 percent plus the new load does not exceed the ampacity of the feeder or rating of the service.

CHAPTER 8-10

QUALIFIED HISTORICAL DISTRICTS, SITES AND OPEN SPACES

SECTION 8-1001
PURPOSE AND SCOPE

8-1001.1 Purpose. The purpose of this chapter is to provide regulations for the preservation, rehabilitation, restoration and reconstruction of associated historical features of qualified historical buildings, properties or districts (as defined in Chapter 8-2), and for which Chapters 8-3 through 8-9 of the CHBC may not apply.

8-1001.2 Scope. This chapter applies to the associated historical features of qualified historical buildings or properties such as historical districts that are beyond the buildings themselves which include, but are not limited to, natural features and designed site and landscape plans with natural and man-made landscape elements that support their function and aesthetics. This may include, but will not be limited to:

1. Site plan layout configurations and relationships (pedestrian, equestrian and vehicular site circulation, topographical grades and drainage, and use areas).
2. Landscape elements (plant materials, site structures other than the qualified historical building, bridges and their associated structures, lighting, water features, art ornamentation, and pedestrian, equestrian and vehicular surfaces).
3. Functional elements (utility placement, erosion control and environmental mitigation measures).

SECTION 8-1002
APPLICATION

8-1002.1 The CHBC shall apply to all sites and districts and their features associated with qualified historical buildings or qualified historical districts as outlined in 8-1001.2 Scope.

8-1002.2 Where the application of regular code may impact the associated features of qualified historical properties beyond their footprints, by work performed secondarily, those impacts shall also be covered by the CHBC.

8-1002.3 This chapter shall be applied for all issues regarding code compliance or other standard or regulation as they affect the purpose of this chapter.

8-1002.4 The application of any code or building standard shall not unduly restrict the use of a qualified historical building or property that is otherwise permitted pursuant to Chapter 8-3 and the intent of the *State Historical Building Code,* Section 18956.

SECTION 8-1003
SITE RELATIONS

The relationship between a building or property and its site, or the associated features of a district (including qualified historical landscape), site, objects and their features are critical components that may be one of the criteria for these buildings and properties to be qualified under the CHBC. The CHBC recognizes the importance of these relationships. This chapter shall be used to provide context sensitive solutions for treatment of qualified historical buildings, properties, district or their associated historical features, or when work to be performed secondarily impacts the associated historical features of a qualified historical building or property.

APPENDIX A

CHAPTER 8-6

TABLE 1—PROVISION APPLICABILITY

	Title II Public Entities	Title III Private Entities	Title III Barrier Removal
SECTION 8-601 PURPOSE, INTENT, SCOPE **8-601.1 Purpose.** The purpose of the CHBC is to provide alternative regulations to facilitate access and use by persons with disabilities to and throughout facilities designated as qualified historical buildings or properties. These regulations require enforcing agencies to accept alternatives to regular code when dealing with qualified historical buildings or properties. **8-601.2 Intent.** The intent of this chapter is to preserve the integrity of qualified historical buildings and properties while providing access to and use by persons with disabilities. **8-601.3 Scope.** The CHBC shall apply to every qualified historical building or property that is required to provide access to persons with disabilities. 1. Provisions of this chapter do not apply to new construction or reconstruction/replicas of historical buildings. 2. Where provisions of this chapter apply to alteration of qualified historical buildings or properties, alteration is defined in *California Building Code* (CBC), Chapter 2, Definitions and Abbreviations. 202 – A. Alter or Alteration. **8-601.4 General application.** The provisions in the CHBC apply to local, state and federal governments (Title II entities); alteration of commercial facilities and places of public accommodation (Title III entities); and barrier removal in commercial facilities and places of public accommodation (Title III entities). Except as noted in this chapter.	Applies	Applies	Applies
SECTION 8-602 — BASIC PROVISIONS **8-602.1 Regular code.** The regular code for access for people with disabilities (Title 24, Part 2, Vol.1, Chapter 11B) shall be applied to qualified historical buildings or properties unless strict compliance with the regular code will threaten or destroy the historical significance or character-defining features of the building or property. **8-602.2 Alternative provisions.** If the historical significance or character-defining features are threatened, alternative provisions for access may be applied pursuant to this chapter, provided the following conditions are met: 1. These provisions shall be applied only on an item-by-item or case-by-case basis. 2. Documentation is provided, including meeting minutes or letters, stating the reasons for the application of the alternative provisions. Such documentation shall be retained in the permanent file of the enforcing agency.	Applies	Applies	Applies
Section 8-603 — ALTERNATIVES **8-603.1 Alternative minimum standards.** The alternative minimum standards for alterations of qualified historical buildings or facilities are referenced in Section 202.5 of the 2010 ADA Standards for Accessible Design, as incorporated and set forth in federal regulation 28 CFR Pt. 36.	Applies	Applies	Applies
8-603.2 Entry. These alternatives do not allow exceptions for the requirement of level landings in front of doors, except as provided in Section 8-603.4. 1. Access to any entrance used by the general public and no further than 200 feet (60 960 mm) from the primary entrance. 2. Access at any entrance not used by general public but open and unlocked with directional signs at the primary entrance and as close as possible to, but no further than 200 feet (60 960 mm) from, the primary entrance. 3. The accessible entrance shall have a notification system. Where security is a problem, remote monitoring may be used.	Applies	Applies	Applies

(continued)

TABLE 1—PROVISION APPLICABILITY—continued

	Title II Public Entities	Title III Private Entities	Title III Barrier Removal
8-603.3 Doors. Alternatives listed in order of priority are: 1. Single-leaf door which provides a minimum 30 inches (762 mm) of clear opening. 2. Single-leaf door which provides a minimum $29^1/_2$ inches (749 mm) clear opening. 3. Double door, one leaf of which provides a minimum $29^1/_2$ inches (749 mm) clear opening. 4. Double doors operable with a power-assist device to provide a minimum $29^1/_2$ inches (749 mm) clear opening when both doors are in the open position. **Exception:** Alternatives in this section do not apply to alteration of commercial facilities and places of public accommodation (Title III entities).	Does not apply	Does not apply	Applies
8-603.4 Power-assisted doors. Power-assisted door or doors may be considered an equivalent alternative to level landings, strikeside clearance and door-opening forces required by regular code.	Applies	Applies	Applies
8-603.5 Toilet rooms. In lieu of separate-gender toilet facilities as required in the regular code, an accessible unisex toilet may be designated.	Applies	Applies	Applies
8-603.6 Exterior and interior ramps and lifts. Alternatives listed in order of priority are: 1. A lift or a ramp of greater than standard slope but no greater than 1:10, for horizontal distances not to exceed 5 feet (1525 mm). Signs shall be posted at upper and lower levels to indicate steepness of the slope. 2. Access by ramps of 1:6 slope for horizontal distance not to exceed 13 inches (330 mm). Signs shall be posted at upper and lower levels to indicate steepness of the slope.	Applies	Applies	Applies
SECTION 8-604 — EQUIVALENT FACILITATION Use of other designs and technologies, or deviation from particular technical and scoping requirements, are permitted if the application of the alternative provisions contained in Section 8-603 would threaten or destroy the historical significance or character-defining features of the qualified historical building or property. 1. Such alternatives shall be applied only on an item-by-item or case-by-case basis. 2. Access provided by experiences, services, functions, materials and resources through methods including, but not limited to, maps, plans, videos, virtual reality and related equipment, at accessible levels. The alternative design and/or technologies used will provide substantially equivalent or greater accessibility to, and usability of, the facility. 3. The official charged with the enforcement of the standards shall document the reasons for the application of the design and/or technologies and their effect on the historical significance or character-defining features. Such documentation shall be in accordance with Section 8-602.2, Item 2, and shall include the opinion and comments of state or local accessibility officials, and the opinion and comments of representative local groups of people with disabilities. Such documentation shall be retained in the permanent file of the enforcing agency. Copies of the required documentation should be available at the facility upon request. **Note:** For commercial facilities and places of public accommodation (Title III entities). Equivalent facilitation for an element of a building or property when applied as a waiver of an ADA accessibility requirement will not be entitled to the Federal Department of Justice certification of this code as rebuttable evidence of compliance for that element.	Applies	**Waivers** If a builder applies for a waiver of an ADA accessibility requirement for an element of a building, he or she will not be entitled to certification's rebuttable evidence of compliance for that element. This limitation on the certification determination should be noted in any publication of Chapter 8-6 if certification is granted.	Applies

Notes: The regular code for Chapter 8-6 is contained in Title 24, Part 2, Vol.1, Chapter 11B, which contain standards for new construction. Provisions of this chapter may be used in conjunction with all other provisions of the regular code and ADA regulations.

HISTORY NOTE APPENDIX

2022 California Historical Building Code
California Code of Regulations, Title 24, Part 8

HISTORY:

For prior history, see the History Note Appendix to the *California Historical Building Code*, 2019 Triennial Edition, effective January 1, 2020.

1. (SHBSB 01/21) Adoption of the 2022 *California Historical Building Code,* CCR Title 24, Part 8, carrying forward existing amendments from the 2019 edition, effective January 1, 2023.

IMPORTANT NOTICE

Act now to keep your code up-to-date. The purchase of this code includes a free subscription for all State-issued supplements and errata. To receive these important updates through 2025, you **MUST** register online **www.iccsafe.org/CAL22**

2022 CALIFORNIA REFERENCED STANDARDS CODE

CALIFORNIA CODE OF REGULATIONS TITLE 24, PART 12

California Building Standards Commission

Effective January 1, 2023

For Errata and Supplement effective dates see the History Note Appendix

2022 California Referenced Standards Code
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PREFACE

This document is the Part 12 of thirteen 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 Referenced Standards 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 generally be filed with the California Building Standards Commission (or other filing if indicated) 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.

The referenced standards contained in Part 12 are developed by the state agencies listed herein. The Part 12 Cross Reference Table herein identifies the state agency to which the standard applies, the subject of the standard, and the provisions in other parts of Title 24 where the application of the standard is required.

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:

California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833–2936

Phone: (916) 263–0916
Email: cbsc@dgs.ca.gov

Web page: www.dgs.ca.gov/bsc

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The 2022 *California Building Standards Code* (Code) was developed through the outstanding collaborative efforts of the Department of Housing and Community Development, Division of State Architect, Office of the State Fire Marshal, Office of Statewide Health Planning and Development, California Energy Commission, California Department of Public Health, California State Lands Commission, 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 Gavin Newsom

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Kent Sasaki

Mia Marvelli – Executive Director
Michael L. Nearman – Deputy Executive Director

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

CALIFORNIA CODE OF REGULATIONS, TITLE 24

California Agency Information Contact List

The following state agencies may propose building standards for publication in Title 24. Request notice of such activity with each agency of interest. See Sections 1.2 through 1.14 of the California Building Code (Part 2 of Title 24) for more detailed information on the regulatory jurisdiction of each state agency.

Board of State and Community Corrections

www.bscc.ca.gov .... (916) 445-5073

Local Adult and Juvenile Detention Facility Standards

California Building Standards Commission

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

State Buildings including UC and CSU Buildings, Parking Lot and Walkway Lighting, Green Building Standards for Non-residential Buildings

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 Terminal Standards

California State Library

www.library.ca.gov .... (916) 323-9843

Department of Consumer Affairs:

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

Office Standards

Board of Pharmacy
www.pharmacy.ca.gov .... (916) 518-3100

Pharmacy Standards

Bureau of Barbering and Cosmetology
www.barbercosmo.ca.gov .... (800) 952-5210

Barber and Beauty Shop, and College Standards

Bureau of Household Goods and Services
www.bhgs.dca.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) 515-5220

Veterinary Hospital Standards

Department of Food and Agriculture

www.cdfa.ca.gov

Meat & Poultry Packing Plant Standards
Rendering & Collection Center Standards................(916) 900-5004

Dairy Standards..(916) 900-5008

Department of Housing and Community Development

www.hcd.ca.gov ....(800) 952-8356

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

(916) 445-3338
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Fire Safety Standards

HOW TO DETERMINE WHERE CHANGES HAVE BEEN MADE

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|| This symbol indicates that a change has been made.

> This symbol indicates deletion of language.

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CHAPTER 12-1

ADMINISTRATION

Reserved

CHAPTER 12-3

RELEASING SYSTEMS FOR SECURITY BARS IN DWELLINGS

(This standard includes provisions of Underwriters Laboratories Subject 2326, Appendix B, dated December 17, 1999, reprinted with their permission.)

INTRODUCTION

SECTION 12-3-1 SCOPE

12-3-1.1 These requirements cover releasing systems for bars, grilles, mesh, glazing or other items intended to provide security at doors and windows required for emergency escape from dwelling units. When actuated by the occupant, the system allows the obstructions over the door or window to be moved so occupants can escape in the event of an emergency.

12-3-1.2 These requirements only cover the ability of the releasing system to be manually activated from the interior of a dwelling unit by an occupant to affect an escape through the protected opening.

12-3-1.3 These requirements cover releasing systems intended for use on the interior side of doors or windows in all climatic locations.

12-3-1.4 These requirements do not evaluate the ability of the releasing system or obstructions to resist an external forced entry attack.

12-3-1.5 These requirements do not evaluate the ability of the releasing system or obstructions to be opened or removed from the exterior of the residential dwelling unit by emergency response personnel during rescue operations.

12-3-1.6 Products covered by these requirements are intended for installation in dwelling units to protect door and window openings that are designated by the *California Building Standards Code* to be used as the secondary means of escape from the living area.

12-3-1.7 Products covered by these requirements are not intended to be used to protect doors in means of egress path for nonresidential occupancies, the common egress path of multifamily residential dwelling units or the primary means of egress path in a single-family dwelling unit.

12-3-1.8 These requirements do not cover window guards or fall prevention devices that are intended to prevent falls from upper story windows.

12-3-1.9 These requirements do not apply to storm doors and windows or light duty screens used for insect control.

12-3-1.10 A product that contains features, characteristics, components or materials new or different from those covered by these requirements, and that involve a risk of fire, electric shock or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain an acceptable level of safety.

SECTION 12-3-2 GENERAL

12-3-2.1 Components.

12-3-2.1.1 Except as indicated in Section 12-3-2.1.2, a component of a product covered shall comply with the requirements for that component.

12-3-2.1.2 A component need not comply with a specific requirement that:

(a) Involves a feature or characteristic not needed in the application of the component in the product covered by these requirements, or

(b) Is superseded by these requirements.

12-3-2.1.3 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

12-3-2.1.4 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specific limits, and shall be used only under those specific conditions for which they have been recognized.

12-3-2.2 Units of measurement.

12-3-2.2.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

12-3-2.3 Installation instructions.

12-3-2.3.1 A copy of the operating and installation instructions or equivalent information is to be furnished with the samples submitted for investigation for use as a guide in the examination and test of the mechanism. For this purpose, a printed edition is not required.

12-3-2.4 Definitions.

12-3-2.4.1 Dwelling unit. A single unit, providing complete, independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

12-3-2.4.2 Escape. For the purposes of these requirements, escape refers to movement of occupants from the interior of a residential dwelling unit to a safe point outside of the dwelling unit during an emergency fire condition.

12-3-2.4.3 Emergency means of escape. A passage independent of and remote from the primary means of escape that provides a means of travel from living and sleeping spaces inside a dwelling unit to the outside.

12-3-2.4.4 Means of escape. A concept included in building codes that, in most cases, requires sleeping rooms and living areas in dwelling units to be provided with at least one primary means of escape and one secondary means of escape to the outside.

12-3-2.4.5 Primary means of escape. A door, stairway or ramp providing a means of unobstructed travel from living spaces inside a dwelling unit to the outside at street or ground level.

12-3-2.4.6 Security bars. For the purposes of these requirements, the term “security bars” includes “burglar bars” and refers to metal and other bars, grilles, grates and other barriers that are designed to provide security for doors and windows in dwelling units. The purpose of security bars, by their mere presence on a building, is to deter a potential forced entry into the dwelling.

CONSTRUCTION

SECTION 12-3-3 ASSEMBLY

12-3-3.1 Security bar releasing systems consist of the security bars, latches, manual actuators, cables, connectors, hinges and mounting hardware. The entire system shall be packaged in a single container. Standard mounting hardware including screws, bolts and washers are allowed to be provided separately.

Exception: The security bars shall be allowed to be provided separately if the instruction manual complies with Section 12-3-13.2.

12-3-3.2 The system shall be of a type capable of being readily maintained in proper operating condition.

12-3-3.3 The system shall be designed to immediately unlatch the security bars when actuated. It shall be able to be operated from the inside of a building by the occupants without the use of tools, keys, or special knowledge or effort.

12-3-3.4 The manual actuator used to release the security bars shall be designed to be mounted inside the dwelling unit for operation by the occupants. Covers or other barriers that can obstruct access to actuators shall not be provided if they inhibit the proper operation of the system.

12-3-3.5 The release mechanism shall not depend on springs to release the latch, although springs are allowed to be provided to assist in the operation.

12-3-3.6 The system shall be designed to prevent it from being locked in a closed position with a pad lock or similar device.

12-3-3.7 Systems provided with an automatic actuating mechanism shall also include a manual release system that complies with these requirements. The automatic actuation portion of the system, even in the event of its failure, shall not inhibit operation of the manual releasing system.

12-3-3.8 Manual actuation of the system shall release the security bars quickly and with simple, easily understood and intuitive motions. The system shall be capable of being operated in all lighting conditions.

12-3-3.9 Manual actuation of the system shall not require two different forces to be applied at the same time, such as applying force to the actuator while also pushing on the bars.

12-3-3.10 When fully opened, the assembly shall provide a minimum clear opening of not less than 5.7 square feet (0.53 m^2) with the width not less than 20 inches (508 mm) and the height not less than 24 inches (610 mm), measured parallel to the plane of the opening.

12-3-3.11 Security bars shall be constructed so that they do not swing up to open. They shall not include projections that can easily snag the clothing of those escaping through the opening.

12-3-3.12 Security bars shall have been constructed such that a sphere 4 inches (102 mm) in diameter shall not pass through any opening and shall not create other potential head entrapment hazards.

SECTION 12-3-4 MATERIALS

12-3-4.1 The materials employed shall have adequate mechanical strength to perform their expected function.

12-3-4.2 O-rings, gaskets and seals shall comply with UL Standard 157, 1996 Edition. Polymeric materials shall comply with UL Standard 746C, 1995 Edition, Section 25-27.

Exception: O-rings, gaskets, seals and polymeric materials that are used as decorative parts, or whose failure will not affect the ability of the system to comply with these requirements.

12-3-4.3 Components constructed of dissimilar metals shall not be used in applications where contact between them is likely to cause galvanic corrosion. The materials employed shall reduce the likelihood of the release mechanism becoming inoperative due to corrosion.

12-3-4.4 Ferrous metal parts shall be 300 series stainless steel or protected against corrosion using minimum G60 or A60 hot-dipped mil galvanization, 0.0104 mm thick zinc coating, 0.0127 mm thick cadmium coating or two coats of organic outdoor paint.

12-3-4.5 Manual actuators.

12-3-4.5.1 Security bar releasing assembly mechanisms shall include a manual actuation mechanism that is capable of unlatching the security bars so that they can be opened by the occupants. The actuating force shall be applied in one of the following manners:

Finger actuated: Pushing with the index finger or pulling a loop with the index finger in a curled position.

Hand actuated: Pulling, pushing, twisting, rotating or turning a lever, knob, handle, rod or similar actuator with the hand or multiple fingers.

Foot actuated: Kicking, depressing or stepping on an actuating pedal, lever, stirrup or similar actuator.

12-3-4.5.2 On foot-actuated systems, only a single foot motion shall be used to disengage the bar assembly from the latch. On finger- and hand-actuated systems, one or two distinct hand or finger motions shall be used to disengage the bar assembly from the latch.

12-3-4.5.3 Releasing the actuator after the latch has been disengaged from the bar assembly shall not reengage the bar assembly.

12-3-4.5.4 No features or methods shall be provided or referenced in the instruction manual to inhibit the operation of the releasing mechanism.

12-3-4.6 Cables and connectors.

12-3-4.6.1 Cables connecting actuators to latches and release mechanisms shall only be used in applications where the force transmitted by them during normal operation is less than $^{1}/_{10}$ the manufacturer's rated working tension or compression.

12-3-4.6.2 Cables and connectors shall not be damaged, or have wire strands frayed during normal installation or use, and shall not contact sharp objects when installed as intended.

12-3-4.6.3 The means used to secure cables or connectors to latches, release mechanisms and actuators shall provide a tight, reliable nonslip connection.

12-3-4.7 Hinges.

12-3-4.7.1 Hinges shall operate smoothly and reliably, and shall not be susceptible to rust or corrosion.

PERFORMANCE

SECTION 12-3-5
TEST SETUP AND SAMPLE PREPARATION

12-3-5.1 Sample selection.

12-3-5.1.1 Representative samples of the releasing system shall be assembled to a test fixture as described in the installation instructions, unless otherwise noted in specific tests. The assembly shall include the mounting, hardware, releasing mechanisms and fasteners recommended in the instructions.

12-3-5.1.2 Samples to be tested shall include each type and sizes of releasing system shown in the installation instructions. Each type of releasing mechanism shall be subjected to the complete test program, unless it can be shown that tests on one type of mechanism are representative of the worst case testing on another mechanism. The sample shall be tested with mounting hardware and security bars that represent the worst case conditions of use. This shall be considered to be the security bars with the heaviest weight, greatest dimensions, and systems that create the greatest torque, moment and frictional forces on the hinges and releasing mechanism.

12-3-5.1.3 The test report shall document the systems tested, along with the basis for sample selection.

12-3-5.2 Test fixture.

12-3-5.2.1 The test fixture in which the assembly is mounted shall consist of the wood stud construction described in Section 12-3-5.2.2. Systems that require a specific mounting arrangement not represented by these test fixtures, such as masonry or brick, shall be mounted in a fixture of equivalent dimensions and rigidity, as described in the installation instructions. If agreeable to the testing laboratory and manufacturer, the wood stud fixture shall be representative of all mounting structures, provided the system is securely held in place in the fixture during all tests.

12-3-5.2.2 The entire test fixture shall be constructed of commercially available two by four trade size vertical wood studs [nominal 1.5 inches by 3.5 inches (38.1 mm by 89 mm)], spaced on maximum 16 inch (406 mm) centers. The opening shall be framed with two by four plates and minimum two layers of two by four for headers. For window openings, a minimum of two layers of two by four shall be used for the sill and cripple studs shall be provided. The frame shall be secured in place so it does not move when the system is subjected to the test forces noted below. The frame shall extend a minimum of 12 inches (305 mm) above and on each side of the opening.

12-3-5.2.3 Actual doors and windows or their frames shall not be required to be mounted in the opening unless the presence of such doors, windows or frames affects the operation of the system, or unless part of the system is mounted on the door or window frame.

12-3-5.2.4 The exterior side of the assembly shall be covered by $^{3}/_{4}$-inch (19 mm) thick trade size CDX plywood, secured with minimum $1^{1}/_{2}$-inch (38 mm) nails or screws, secured at least every 12 inches (305 mm) to each stud, sill and header. The interior side of the assembly shall be covered with a layer of $^{1}/_{2}$-inch (13 mm) gypsum wallboard, secured with minimum $1^{1}/_{4}$-inch (32 mm) nails or screws at least every 12 inches (305 mm) to each stud, sill and header.

12-3-5.2.5 Openings in the test fixture shall be sized to accommodate the size of the assembly under test, as described in the installation instructions. Opening size shall be allowed to vary if the size used is judged to not affect the results of any test performed.

12-3-5.3 Sample assembly.

12-3-5.3.1 Samples of the releasing system shall arrive at the test site in the packaging anticipated for distribution and sale, and accompanied by the installation instructions. The samples are to be installed on the test fixture by a representative of the certification organization, using common hand and power tools as recommended by the instruction manual. Any specialty tools required for assembly shall be so identified in the instructions.

12-3-5.3.2 When multiple tests are required on an assembly, they are allowed to be performed on the same test fixture, provided that new hole or openings are used for mounting. Portions of the test fixture shall be allowed to be replaced to accommodate new mounting holes or brackets.

12-3-5.3.3 Samples that include grease, graphite, silicon or other lubricants shall also be tested with the lubricant removed or not applied.

12-3-5.3.4 When assembled in accordance with the installation instructions the system shall be securely held in place in the test fixture and shall operate consistently in the intended fashion.

SECTION 12-3-6
SECURE ATTACHMENT TEST

12-3-6.1 Two samples of the system shall be subjected to the following test sequence.

12-3-6.2 The system, when in the closed position, shall resist 50-pound (22 N) force without opening, loosening in the test fixture or damaging the releasing assembly. The force shall be applied on the exterior side of the test fixture in a location that is most likely to move or damage the system. The force shall be gradually applied perpendicular to the opening and held for a period of 1 minute. A $^{3}/_{8}$-inch (10 mm) diameter rope looped through the security bars, or similar arrangement, shall be used to apply the force.

SECTION 12-3-7
OPERATION TEST

12-3-7.1 Following the Secure Attachment Test, each of the two samples of the system shall unlatch immediately without intentional delay during each of 10 attempts to operate the system, and the security bars shall be fully opened to create the opening specified in Section 12-3-3.10. During each attempt, the actuating mechanism shall be operated as intended, using a finger, hand or foot movement as described in the operating instructions provided to unlatch the security bars. The security bars shall then be opened to the full open position, and the system shall then be reset to the closed position. An examination shall be performed to verify that the security bars are completely reset prior to the next attempt.

12-3-7.2 Springs provided in the latch or on the security bars that are intended to move the security bars from the latched position shall be removed or disabled prior to the test.

12-3-7.3 Prior to the test, the assembly shall be operated and reset a number of times to acquaint the operator with the system and its opening and reselling operation. On some systems, it may be necessary to slam, tap or otherwise carefully align the security bars in the latch to successfully reset the system into the closed position.

12-3-7.4 In the event that the actuating mechanism or assembly does not operate as intended during each of the 10 attempts, the test assembly, mounting method, actuating motion and system resetting procedure shall be reviewed to determine a potential cause of failure. After correcting any identified problems, the set of 10 operations shall be repeated with no unsuccessful attempts.

SECTION 12-3-8
MANUAL ACTUATION TEST

12-3-8.1 Following the Operation Test, each of the two sample assemblies shall be operated five times, and the forces required to unlatch the system shall be measured and recorded. These forces shall not exceed the values indicated in Sections 12-3-8.2 through 12-3-8.4.

12-3-8.2 A force gauge shall be used to apply the actuating force. The force shall be applied in the orientation anticipated by the design, using an appropriate force gauge and attachments, such as hooks, loops or probes. The gauge shall be capable of measuring the maximum force applied on each attempt. The force shall be applied in a location and fashion that is most likely to unlatch the actuator, and shall be allowed to range from a slow gradual application of force to a faster application of force of not less than 1 second in duration.

12-3-8.2.1 The average force required to unlatch finger-actuated systems shall not exceed 5 pounds (22 N) over the five attempts. The force required to unlatch the system during any of the attempts shall not exceed 10 pounds (44 N).

12-3-8.2.2 The average force required to unlatch hand-actuated systems shall not exceed 5 pounds (22 N) over the five attempts. The force required to unlatch the system during any of the attempts shall not exceed 10 pounds (44 N).

12-3-8.2.3 The average force required to unlatch foot-actuated systems shall not exceed 15 pounds (66 N) over the five attempts. The force required to unlatch the system during any of the attempts shall not exceed 30 pounds (132 N).

12-3-8.3 In lieu of complying with Section 12-3-8.2, foot-actuated systems designed to be operated by a kick shall successfully unlatch and disengage the latching mechanism each of five times when subjected to the following impact. The impact shall be applied by swinging a 25-pound (11.4 kg) weight on a 4-foot (1.2 m) pendulum from 10 inches (254 mm) away, measured horizontally. The point of impact on the foot actuator shall be at the bottom of the pendulum swing.

12-3-8.4 Once the system is unlatched, a maximum force required to set the security bars in motion shall not exceed 30 pounds (132 N), and the maximum force required to open the security bars to the minimum required width shall not exceed 15 pounds (66 N).

SECTION 12-3-9
ENDURANCE TEST

12-3-9.1 A sample of the security bar releasing system shall function as intended during 250 cycles of operation without failure or excessive wear of the parts, including serving or fraying of individual cable wires. Following the cycling, the system shall be subjected to the Operation Test.

12-3-9.2 The system shall be operated and reset as described in the manufacturer's operating instructions. As part of the cycling, it is only necessary to unlatch, disengage and reset the system, and not open the security bars to the full open position. The cycling rate shall not exceed 30 cycles per minute.

SECTION 12-3-10
ENVIRONMENTAL EXPOSURE TEST

12-3-10.1 After each of the following exposures, test assemblies shall be subjected to the Manual Actuation Test. The test shall be performed while the test assemblies are in the test chambers, or immediately after their removal from the test chamber. Opening forces after these conditionings shall not exceed the values shown in Section 12-3-8.2 or 12-3-8.3. A single sample shall be subjected to each exposure. The same sample, or different sample, shall be allowed to be used for each exposure condition.

12-3-10.2 Elevated ambient. Samples shall be conditioned in a 120°F (49°C) environment for 24 hours.

12-3-10.3 Low ambient. Samples shall be conditioned in a 32°F (0°C) environment for 24 hours.

12-3-10.4 Humidity test. Samples shall be conditioned for 24 hours in moist air having a relative humidity of 85 +/– 5 percent at a temperature of 90°F +/– 5°F (32 +/– 2°C).

SECTION 12-3-11
ABUSE TEST

12-3-11.1 A sample shall comply with the Manual Actuation Test requirements in Sections 12-3-8.2 and 12-3-8.3 after being subjected to the simulated abuse provided in Section 12-3-11.2.

12-3-11.2 The sample shall be subject to six impacts of 5 feet-pounds (6.8 N · m) each applied with a 2-inch diameter (51 mm) steel ball on portions of the release system that are most likely to adversely affect the operation of the system.

MARKINGS AND INSTRUCTIONS

SECTION 12-3-12
MARKINGS

12-3-12.1 Security bars and the latching mechanism shall be permanently marked with the company name, model number and date of manufacture. When a manufacturer produces assemblies at more than one factory, each such assembly shall have a distinctive marking to identify it as the product of a particular factory.

12-3-12.2 Symbols or diagrams shall be marked on the manual actuator to identify how to manually release the security bars. The diagram or symbols shall be readily visible to occupants when the assembly is mounted as intended.

12-3-12.3 Security bars and the latching mechanism shall be marked with the name or logo of the testing agency certifying to compliance of the products with this standard, and identification of the standard as SFM SB-2000.

12-3-12.4 Adhesive-backed labels used to provide required markings shall be suitable for the application and shall comply with UL Standard 969, 1995 Edition.

SECTION 12-3-13
INSTRUCTION MANUAL

12-3-13.1 Installation and operating instructions shall be provided with each system. Installation instructions shall describe how to install and initially test the system, and provide periodic testing and maintenance. Operating instructions shall be provided that include diagrams, drawing and symbols describing how to operate the system and escape in the event of a fire or other emergency.

12-3-13.2 When the releasing mechanism assembly is provided separately from the security bar assembly in accordance with Section 12-3-3.1, the instruction manual shall describe the compatible security bars that have been investigated and found suitable for use with the releasing assembly. Security bars shall be identified by the manufacturer's name and model number and maximum dimensions.

12-3-13.3 The installation instructions shall include directions on mounting the actuator inside the room at a height not exceeding 48 inches (1.2 m) from the finished floor.

CHAPTER 12-4A

LABORATORY ANIMAL QUARTERS STANDARDS

STANDARD 12-4A-1

Department of Health Services

Authority: Sections 102, 208 and 25811.
Reference: Sections 102, 208 and 436.5.

Laboratory Animal Quarters

Sec. 12-4A-101. Laboratory animal quarters shall comply with Chapter IV, “Guide for Care and Use of Laboratory Animals,” U.S. Department of Health, Education and Welfare, Publication Number 85-23, Revised 1985.

CHAPTER 12-4-1

STAGE AND PLATFORMS

SMOKE OR HEAT VENTILATORS
STANDARD 12-4-1

STATE FIRE MARSHAL

SMOKE OR HEAT VENTILATORS

Sec. 12-4-100.

(a) **Application.** The minimum design, construction and performance standard set forth herein for stage and platform smoke or heat ventilators are those deemed necessary to establish conformance to the provisions of these regulations.

(b) **Scope.** This standard covers ventilators and shutters designed to open under conditions of excessive smoke or heat to provide openings for the release to the atmosphere of accumulated smoke or heat.

A smoke or heat ventilator covered by this standard consists of a prefabricated frame of metal or other noncombustible materials; a cover of noncombustible or plastic materials; an automatic releasing device; and the control rigging. The control rigging may include electrically operated units for normal opening and closing.

(c) **Tested and listed component parts.** Component parts, devices, combinations of devices and electrical equipment which have been tested and listed by an approved testing agency for the intended purpose need not be individually retested. Such individually tested and listed component parts, devices and equipment shall be subjected to the performance standard tests to determine their suitability for use in the smoke or heat ventilator.

(d) **Alternate constructions.** Ventilators having materials or forms of construction differing from this standard may be investigated and tested in accordance with these regulations, and if found to be substantially equivalent in performance may be given recognition for approval.

(e) **Marking.** Units shall be provided with a manufacturers label or other permanent markings clearly identifying the manufacturer and model numbers. Plastics in dome-type ventilators shall be identified by brandmarkings, imprint or other markings acceptable to the State Fire Marshal.

(f) **Framing design.** The unit and cover shall be so formed and assembled that they will have the strength and rigidity necessary to resist the abuses to which they are liable to be subject without adversely affecting their performance, and without operational failure due to partial collapse with the resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

(g) **Curb design.** The ventilator design shall include provisions for mounting on roof curbs or shall in themselves incorporate a design to provide the equivalent of roof curbs.

(h) **Corrosion resistant.** Ventilators shall be constructed of corrosion-resistant materials. Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating or other equivalent means. This includes all parts upon which proper mechanical operation may depend. Bearings and hinge points shall be corrosion resistant or of such material and design as to ensure against binding due to corrosion.

Ventilators designed and constructed in accordance with the above may be accepted without additional tests establishing the effects of frost, expansion by heat or warping of the framework.

(i) **Plastic covers.** Plastic covers shall be of the dome type having a continuous curvature with the center not less in height than 10 percent of the span having the least dimension but not less than 5 inches (127 mm).

(j) **Area.** The minimum dimension for an effective vent opening should not be less than 4 feet (1219 mm) in any direction. The effective venting area is the minimum cross-sectional area through which smoke and gases must pass in route to the atmosphere. The effective venting area of monitors shall be the cross-sectional area of the throat or the area of the side lights on one side of the monitor, whichever is the lesser.

Ventilators having plastic covers shall not exceed 100 square feet (9.3 m^2) in area.

(k) **Fail-safe design.** The ventilator cover, lid, sidelight or shutter shall be designed to fail safe in the event of fire and shall not fall back over the opening. It shall require a manual operation to reclose the cover, lid, sidelight or shutter.

(l) **Opening counterforce.**

1. Gravity-type ventilators shall have securely attached weights to provide a continuous excess counter-weight of not less than 30 pounds throughout the opening arc of the lid or sidelight.
2. Devices used to open ventilators shall be designed to exert a continuous opening force, at all times normal to the lid of not less than 30 pounds. When springs are used they shall not be stressed to more than 50 percent of their capacity when the lid is in a closed position.
3. Louvered-type shutters intended for installation in gables shall be of the gravity type. The excess counter-weight shall be not less than 2 pounds per square foot of gross shutter area.

(m) Automatic heat or smoke detectors shall be placed in the underside of the ventilator at or above the roof line.

(n) **Test procedure.**

1. Ventilators and shutters shall be mounted for the tests in a manner simulating their intended use. The lid, cover or sidelight shall be held in a closed position by a fusible link, or an automatic heat or smoke actuated detector or combination thereof, and the fusible link or detector controls.
2. The opening counterforce shall be measured at the geometric center of the lid, cover or sidelight. The automatic detector shall be released and measurements of the counterforce taken at various points throughout the opening arc but at not less than at 30 inches (762 mm) and at 60 inches (1524 mm) from the plane of the lid when in a closed position, and at a point past 90 inches (2286 mm) from the horizontal.
3. The opening force of gable-type shutter ventilators shall be measured from the top of the operating bar.

(o) **Test report.** The test report shall include but is not limited to the following:

1. A detailed description of the unit and its intended operation.
2. Engineering data and shop drawings. Shop drawings shall bear the seal or stamp of a registered or licensed engineer or architect attesting to the structural integrity of the ventilator as it relates to the provisions of Section 12-4-100 (f).
3. Photographs [4 inches by 5 inches (101 mm by 127 mm) or larger] of the unit with markings identifying component parts of the unit.
4. Description and results of the tests performed.

CHAPTER 12-7-1

FIRE-RESISTIVE STANDARDS

FIRE TESTS OF BUILDING CONSTRUCTION AND MATERIALS STANDARD 12-7-1

STATE FIRE MARSHAL SCOPE

Sec. 12-7-100.

(a) This standard for fire tests contains methods that are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including bearing and other walls and partitions, columns, girders, beams, slabs and composite slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building.

(b) It is the intent that classifications shall register performance during the period of exposure and shall not be construed as having determined suitability for use after exposure.

FIRE TESTING FURNACES AND CONTROL

Sec. 12-7-101. Fire testing furnaces and their control shall conform to SFM 12-7-1, Fire Testing Furnaces.

UNEXPOSED SURFACE TEMPERATURES

Sec. 12-7-102.

(a) **Thermocouples.** Temperatures of unexposed surfaces shall be measured with thermocouples placed under flexible, oven-dry, felted asbestos pads, 6 inches square (645 mm^2), 0.4 inch (10 mm) in thickness, and weighing not less than 1.0 nor more than 1.4 pounds per square foot. The pads shall be sufficiently soft so that, without breaking, they may be shaped to contact over the whole surface against which they are placed. The wire leads of the thermocouple shall have an immersion under the pad and be in contact with the unexposed surface for not less than $3^1/_2$ inches (89 mm). The hot junction of the thermocouple shall be placed approximately under the center of the pad. The outside diameter of protecting or insulating tubes shall not be more than $^5/_{16}$ inch (8 mm). The pad shall be held firmly against the surface and shall fit closely about the thermocouples. The wires for the thermocouple in the length covered by the pad shall be not heavier than No. 18 B.&S. gage [0.04 inch (1 mm)] and shall be electrically insulated and heat- and moisture-resistant coatings.

Note: In tests of assemblies with roof coverings, the thermocouples and pads shall be placed on top of the roof covering.

(b) **Ceiling-floor, ceiling-roof assemblies.** Temperature readings shall be taken in the center of the plenum, on the bottom side of the floor or roof deck, and on the structural members in fire-endurance tests of ceiling-floor and ceiling-roof assemblies. Thermocouples shall be located on structural steel as specified in Section 12-7-110 (c). In combustible assemblies five or more thermocouples shall be located on the bottom of soffit of joists or beams. Thermocouples shall be placed in representative locations such as at midspan, over joints in the ceiling, over light fixtures, over air-outlet openings or similar locations.

(c) **Thermocouple locations on unexposed side.** Temperature readings shall be taken at not less than nine points on the surface of the unexposed side. Five of these shall be symmetrically disposed, one to be approximately at the center of the specimen and four at approximately the center of its quarter sections. The other four shall be located at the discretion of the testing authority to obtain representative information on the performance of the construction under test. None of the thermocouples shall be located nearer than $1^1/_2$ times the thickness of the construction, or nearer than 12 inches (305 mm) to the edges. An exception shall be made in those cases where there is an element of the construction at the edges which is not otherwise represented in the remainder of the construction. Also, none of the thermocouples shall be located opposite or on top of beams, girders, pilasters or other structural members if temperatures at such points will obviously be lower than at other more representative locations.

(d) **Temperature intervals.** Temperature readings shall be taken at intervals not exceeding 15 minutes until a reading exceeding 212°F (100°C) has been obtained at any one point. Thereafter the readings may be taken more frequently at the discretion of the testing body, but the intervals need not be less than 5 minutes.

(e) **Maximum unexposed temperature rise.** Where the conditions of acceptance place a limitation on the rise of temperature of the unexposed surface, the temperature end point of the fire endurance period shall be determined by the average of the measurements taken at individual points; except that if a temperature rise 30 percent in excess of the specified limit occurs at any one of these points, the remainder shall be ignored and the fire endurance period judged as ended.

CLASSIFICATION AS DETERMINED BY TEST

Sec. 12-7-103.

(a) **Fire exposure report.** Results shall be reported in accordance with the performance tests prescribed in these methods. They shall be expressed in time periods of resistance, to the nearest integral minute. Reports shall include observations of significant details of behavior of the material or construction during the test and after the furnace fire is cut off, including information on deformation, spalling, cracking, burning of the specimen or its component parts, continuance of flaming and production of smoke. The form and contents of reports shall be in accordance with Section 12-7-115.

(b) **Structural fire report.** Reports of tests involving wall, ceiling-floor, ceiling-roof or beam constructions in which restraint is provided against expansion, contraction or rotation of the construction shall describe the method used to provide this restraint and include details of the restraining frame as well as information recorded during the test concerning the forces imposed on that structure by the test specimen.

TEST SPECIMEN

Sec. 12-7-104.

(a) **Representative specimen.** The test specimen shall be truly representative of the construction for which classification is desired, as to materials, workmanship and details such as dimensions of parts, and shall be built under conditions representative of those obtaining as practically applied in building construction and operations. The physical properties of the materials and ingredients used in the test specimen shall be determined and recorded. When necessary for evaluation of test reports, the sponsor shall furnish them to the enforcing agency.

(b) **Specimen size.** The size and dimensions of the test specimen specified herein are intended to apply for rating constructions of dimensions within the usual general range employed in buildings. If the conditions of use limit the construction to smaller dimensions, a proportionate reduction may be made in the dimensions of the specimens for a test qualifying them for such restricted use.

DURATION AND CONDUCT OF TESTS

Sec. 12-7-105.

(a) **Fire endurance.** The fire endurance test on the specimen with its applied load, if any, shall be continued until failure occurs, or until the specimen has withstood the test conditions for a period equal to that herein specified in the conditions of acceptance for the given type of construction.

(b) **Hose stream test.** Where required by the conditions of acceptance, a duplicate sample shall be subjected to a fire exposure test for a period equal to one-half of that indicated as the resistance period in the fire endurance test, but not for more than 1 hour, immediately after which the sample shall be subjected to the impact, erosion and cooling effects of a hose stream directed first at the middle and then at all parts of the exposed face, changes in direction being made slowly.

(c) **Exemption.** The hose stream shall not be required in the case of constructions having a resistance period, indicated in the fire endurance test, of less than 1 hour.

(d) **Optional program.** The submitter may elect, with the advice and consent of the testing body, to have the hose stream test made on the sample subjected to the fire endurance test and immediately following the expiration of the fire endurance test.

(e) **Stream equipment and details.** The stream shall be delivered through $2^1/_2$-inch (63.5 mm) hose, discharging through a National Standard Play Pipe of corresponding size equipped with a $1^1/_8$-inch (22 mm) discharge tip of the standard-taper, smooth-bore pattern without shoulder at the orifice. The water pressure and duration of application shall be as specified in Table SFM 12-7-1A.

(f) **Nozzle distance.** The nozzle orifice shall be 20 feet (6096 mm) from the center of the exposed surface of the test sample if the nozzle is so located that, when directed at the center, its axis is normal to the surface of the test sample. If otherwise located, its distance from the center shall be less than 20 feet (6096 mm) by an amount equal to 1 foot (305 mm) for each 10 degrees of deviation from the normal.

(g) **Protection and conditioning of test specimen.** The test specimen shall be protected during and after fabrication to ensure normality of its quality and condition at the time of test. It shall not be tested until a large portion of its final strength has been attained, and if it contains moisture, until the excess has been removed to achieve an air-dry condition in accordance with the requirements given in Items 1 through 3. The testing equipment and sample undergoing the fire test shall be protected from any condition of wind or weather that might lead to abnormal results. The ambient air temperature at the beginning of the test shall be within the range of 50 to 90°F (10 to 32°C). The velocity of air across the unexposed surface of the sample, measured just before the test begins, shall not exceed 4.4 feet per second, as determined by an anemometer placed at right angles to the unexposed surface. If mechanical ventilation is employed during the test, an air stream shall not be directed across the surface of the specimen.

1. Prior to the fire test, constructions shall be conditioned with the objective of providing, within a reasonable time, a moisture condition within the specimen approximately representative of that likely to exist in similar constructions in buildings. For purposes of standardization, this condition is to be considered as that which would be established at equilibrium resulting from drying in an ambient atmosphere of 50 percent relative humidity at 73°F (23°C). However, with some constructions, it may be difficult or impossible to achieve such uniformity within a reasonable period of time. Accordingly, where this is the case, specimens may be tested when the dampest portion of the structure, the portion at 6-inch (152 mm) depth below the surface of massive constructions, has achieved a moisture content corresponding to drying to equilibrium with air in the range of 50 to 75 percent relative humidity at 73 ± 5°F. In the event that specimens dried in a heated building fail to meet these requirements after a 12-month conditioning period, or in the event that the nature of the construction is such that it is evident that drying of the specimen interior will be prevented by hermetic sealing, these requirements may be waived, except as to attainment of a large portion of final strength, and in the specimen tested in the condition in which it then exists.

2. Specimens shall be exposed to the controlled conditions outlined in Item 1 until the interior or dampest section of the assembly attains a relative humidity of 75 percent or less. If during the conditioning of the specimen it appears desirable or is necessary to use accelerated drying techniques, it is the responsibility of the

laboratory conducting the test to avoid procedures which will significantly alter the structural or fire endurance characteristics of the specimen or both from those produced as the result of drying in accordance with procedures given in Item 1.

3. Within 72 hours prior to the fire test, information on the actual moisture content and distribution within the specimen shall be obtained. This information shall be included in the test report.

TESTS OF BEARING WALLS AND PARTITIONS

Sec. 12-7-106.

(a) **Size of sample.** The area exposed to fire shall be not less than 100 square feet (9.3 m^2) with neither dimension less than 9 feet (2743 mm). The test specimen shall not be restrained on its vertical edges. The fire testing furnace, its arrangement and control during fire tests shall conform to SFM 12-7-3, Section 12-7-301 (a), Vertical Large-scale Wall Furnace.

(b) **Loading.** During the fire endurance test, and fire and hose stream test, a superimposed lead shall be applied to the construction in a manner calculated to develop theoretically, as nearly as practicable, the working stresses contemplated by the design.

(c) **Conditions of acceptance.** The test shall be regarded as successful if the following conditions are met:

1. The wall or partition shall have sustained the applied load during the fire endurance test without passage of flame or gases hot enough to ignite conditioned cotton waste, for a period equal to that for which classification is desired.

   Note: Cotton waste shall be conditioned by drying in an oven at a temperature of 120°F (49°C) for a period of not less than 1 hour prior to the test.

2. The wall or partition shall have sustained the applied load during the fire and hose stream test as specified in Section 12-7-105, without passage of flame, of gases hot enough to ignite cotton waste, or passage of the hose stream, and after cooling but within 72 hours after its completion shall sustain the dead lead of the test construction plus twice the superimposed load specified above.
3. Transmission of heat through the wall or partition during the fire endurance test shall not have been such as to raise the temperature on its unexposed surface more than 250°F (139°C) above its initial temperature.
4. Deflection of the wall or partition during the fire endurance test shall not exceed 6 inches (152 mm). The deflection of specimens varying from the dimensions given in Section 12-7-106 (a) shall be determined proportionately.

TESTS OF NONBEARING WALLS AND PARTITIONS

Sec. 12-7-107.

(a) **Size of sample.** The area exposed to fire shall be not less than 100 square feet (9.3 m^2), with neither dimension less than 9 feet (2743 mm). The test specimen shall be restrained on all four edges. The fire testing furnace, its arrangement and control during fire tests shall conform to SFM 12-7-3, Section 12-7-301 (a), Vertical Large-scale Wall Furnace.

(b) **Conditions of acceptance.** The test shall be regarded as successful if the following conditions are met:

1. The wall or partition shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite conditioned cotton waste, for a period equal to that for which classification is desired.

   Note: Cotton waste shall be conditioned by drying in an oven at a temperature of 120°F (49°C) for a period of not less than 1 hour prior to the test.

2. The wall or partition shall have withstood the fire and hose stream test as specified in Section 12-7-105 without passage of flame, of gases hot enough to ignite cotton waste, or passage of the hose stream.
3. Transmission of heat through the wall or partition during the fire endurance test shall not have been such as to raise the temperature on its unexposed surface more than 250°F (139°C) above its initial temperature.
4. Deflection of the wall or partition during the fire endurance test shall not exceed 6 inches (152 mm). The deflection of specimens varying from the dimensions given in Section 12-7-107 (a) shall be determined proportionately.

TEST OF COLUMNS

Sec. 12-7-108.

(a) **Size of sample.** The length of the column exposed to fire shall, when practicable, approximate the maximum clear length contemplated by the design, and for building columns shall be not less than 9 feet (2743 mm). The contemplated details of connections and their protection, if any, shall be applied according to the methods of acceptable field practice.

(b) **Loading.**

1. During the fire endurance test, the column shall be exposed to fire on all sides and shall be loaded in a manner calculated to develop theoretically, as nearly as practicable, the working stresses contemplated by the design. Provision shall be made for transmitting the load to the exposed portion of the column without unduly increasing the effective column length.
2. If the submitter and the testing body jointly so decide, the column may be subjected to $1^3/_4$ times its designed working load before the fire endurance test is undertaken. The fact that such a test has been made shall not be construed as having had a deleterious effect on the fire endurance test performance.

(c) **Condition of acceptance.** The test shall be regarded as successful if the column sustains the applied load during the fire endurance test for a period equal to that for which classification is desired.

ALTERNATE TEST OF PROTECTION FOR STRUCTURAL STEEL COLUMNS

Sec. 12-7-109.

(a) **Application.** This test procedure does not require column loading at any time and may be used at the discretion of the testing laboratory to evaluate steel column protections that are not required by design to carry any of the column load.

(b) **Size and character of sample.**

1. The size of the steel column used shall be such as to provide a test specimen that is truly representative of the design, materials and workmanship for which classification is desired. The protection shall be applied according to the methods of acceptable field practice. The length of the protected column shall be at least 8 feet (2438 mm). The column shall be vertical during application of the protection and during the fire exposure. The rating of performance shall not be applicable to sizes of columns smaller than those tested.

2. The applied protection shall be restrained against longitudinal temperature expansion greater than that of the steel column by rigid steel plates or reinforced concrete attached to the ends of the steel column before the protection is applied. The size of the plates or amount of concrete shall be adequate to provide direct bearing for the entire transverse area of the protection.

3. The ends of the specimen, including the means for restraint, shall be given sufficient thermal insulation to prevent appreciable direct heat transfer from the furnace.

(c) **Temperature measurement.** The temperature of the steel in the column shall be measured by at least three thermocouples located at each of four levels. The upper and lower levels shall be 2 feet (609 mm) from the ends of the steel column, and the other two intermediate levels shall be equally spaced. The thermocouples at each level shall be so placed as to measure significant temperatures of the component elements of the steel section.

(d) **Exposure to fire.** During the fire endurance test, the specimen shall be exposed to fire on all sides for its full length.

(e) **Conditions of acceptance.** The test shall be regarded as successful if the transmission of heat through the protection during the period of fire exposure for which classification is desired does not raise the average (arithmetical) temperature of the thermocouples at any one of the four levels above 1000°F (537.8°C), or does not raise the temperature above 1200°F (648.8°C) at any one of the measured points.

TESTS OF FLOORS AND ROOFS

Sec. 12-7-110. (The following is applicable to floors and roofs with or without attached, furred or suspended ceilings, and requires application of fire exposure to the underside of the construction.)

(a) **Size and construction of sample.**

1. The area exposed to fire shall be not less than 180 square feet (16.7 m^2), with neither dimension less than 12 feet (3657 mm). Structural members, if a part of the construction under test, shall lie within the combustion chamber and have a clearance of not less than 8 inches (203 mm) from its walls. No individual classification shall be made of structural members which have a clearance of less than 24 inches (609 mm) from its walls. The fire testing furnace, its arrangement and control during fire tests shall conform to the provisions of SFM 12-7-3, Section 12-7-301 (c), for Horizontal Large-scale Floor Furnace.

2. Structural members forming a part of the assembly shall be supported in accordance with the recommended fabrication procedures for the type of construction. Assemblies representing forms of construction that restrain structural elements and top deck shall be supported by a restraining frame, incorporated in or attachable to the furnace structure in such a manner that comparable restraint shall occur during the test.

(b) **Loading.** Throughout the fire endurance test, a superimposed load shall be applied to the test specimen. This load, together with the weight of the specimen, shall be as nearly as practicable the maximum theoretical dead and live loads permitted by nationally recognized design standards.

(c) **Temperature measurement.** The temperature of the steel in structural members shall be measured by thermocouples at three or more sections equally spaced along the length of the members with one section located at mid-span; alternately when thermocouples are placed at four sections, they may be at the quarter points provided no thermocouples shall be placed within 24 inches (609 mm) of the furnace walls; except that in cases where the cover thickness is not uniform along the specimen length, at least one of these sections shall include the point of minimum cover. For solid section steel beams, there shall be four thermocouples at each section: one at the center on the exposed face of the bottom flange, one on the edge of the bottom flange, one on the web at the center and one on the bottom at the edge of the top flange. For reinforced or prestressed concrete structural members, thermocouples shall be located on each of the tension reinforcing elements unless there are more than eight elements, in which case thermocouples shall be placed on eight elements of selected in such a manner as to obtain representative temperatures of all the elements. For designs employing trusses or open-web steel joists, four thermocouples shall preferably be placed at mid-span of each truss or joist, two on the bottom chord, one at the middle of the web element and one on the bottom of the top chord with locations selected in such a manner as to obtain representative temperatures of all the elements, provided, however, that no more than four joists need to be so instrumented. For designs employing combustible framing, three or more thermocouples shall be placed approximately at mid-span on three or more framing members and so located as to obtain representative temperatures on the soffits of the framing members.

(d) **Conditions of acceptance.** In obtaining an assembly classification, the following conditions shall be met:

1. The construction shall have sustained the applied load during the fire endurance test without passage of flame or gases hot enough to ignite conditioned cotton waste for a period at least equal to that for which classification is desired.

    Note: Cotton waste shall be conditioned by drying in an oven at a temperature of 120°F (49°C) for a period of not less than 1 hour prior to the test.

2. The transmission of heat through the construction during the fire endurance test shall not have been such as to raise the average temperature of the thermocouples on its unexposed surface more than 150°F (139°C) above its initial temperature.
3. Structural failure, deflection or sagging of the structural elements of the test specimen or any portion of the structural elements in excess of 12 inches (305 mm) shall be judged as the end of the fire endurance period.
4. For assemblies employing steel structural members, including decks designed as structural diaphragms the transmission of heat through the protection during the period of fire endurance for which classification is desired does not raise the temperature at any location on the member above 1200°F (649°C), nor the average of the thermocouples at any section above 1000°F (538°C).
5. For assemblies employing multiple open web steel joists [spaced less than 48 inches (1219 mm) on center], the transmission of heat through the protection during the period of fire endurance for which classification is desired does not raise the average of all thermocouples in all joists above 1000°F (538°C).
6. For assemblies employing concrete structural members, the transmission of heat through the cover to the steel during the period for which classification is desired does not raise the average temperature of the thermocouples at any section on the steel above 800°F (426°C) for cold drawn prestressing steel or 1000°F (538°C) for reinforcing steel.

(e) **Reports of results.** The fire endurance shall be reported for the floor or roof assembly as tested, and a different fire endurance classification from that of the assembly for structural members shall not be recorded without reference to Section 12-7-110 (f) and (g).

(f) **Alternate classification procedure for loaded structural frame members.** Fire endurance classifications may be developed for structural frame members tested as part of a floor or roof assembly as described in Section 12-7-110 (a) through (c) using the conditions of acceptance described in Section 12-7-110 (g). The fire endurance classification so derived shall be applicable to the structural frame member when used with any floor or roof construction which has a comparable or greater thermal capacity for heat dissipation from the beam, and equal or greater compressive strength than the floor or roof with which it was tested. The fire-resistance classification developed by this method shall not be applicable to sizes of structural frame members smaller than those tested.

(g) **Structural frame members, conditions of acceptance.**

1. The construction shall have sustained the applied load during the fire endurance test for a period equal to that for which classification is desired.
2. For assemblies employing solid steel beams the transmission of heat through the protection during the period of fire endurance for which classification is desired does not raise the temperature at any location on the member above 1200°F (649°C), nor the average temperature recorded by four thermocouples at any section above 1000°F (538°C).
3. For assemblies employing open-web steel joists or steel trusses spaced 4 feet (1219 mm) or more on centers, the transmission of heat through the protection on the steel joists or trusses during the period of fire endurance for which classification is desired does not raise the average temperature of all joists or truss thermocouples above 1000°F (538°C).
4. For assemblies employing concrete structural members the transmission of heat through the cover to the steel during the period for which classification is desired does not raise the average temperature of the thermocouples at any section on the steel above 800°F (426°C) for cold drawn prestressing steel or 1000°F (538°C) for reinforcing steel.

TESTS OF LOADED RESTRAINED STRUCTURAL FRAME MEMBERS

Sec. 12-7-111.

(a) **Application.** An individual classification of a structural frame member (beams, girders, joists, etc.) may be developed by this test procedure. The structural frame member may be tested with a representative floor or roof section; and the fire endurance classification so derived shall be applicable to the structural frame member when used with any floor or roof construction which has a comparable or greater thermal capacity for heat dissipation from the beam than the floor or roof with which it was tested. The fire endurance classification developed by this method shall not be applicable to sizes of structural frame members smaller than those tested.

(b) **Size and construction of specimen.** The structural frame member shall be such as to provide a test specimen that is representative of the design, materials and workmanship for which classification is desired. Any protection shall be applied according to the methods of acceptable field practice. The length of the structural frame member exposed to the fire shall be not less than 12 feet (3657 mm), and the member shall be tested in a horizontal position. Specimens representing forms of construction in which restraint due to thermal expansion occurs shall be supported by a restraining frame in such a manner that comparable restraint shall occur during the test. A section of a representative floor or roof construction not less than 5 feet (1524 mm) wide, symmetrically located with reference to the structural frame member and extending its full length may be included in the test assembly and exposed to fire from below. The floor or roof construction shall not be supported or restrained along its span length or ends.

(c) **Furnace.** The fire testing furnace, its arrangement and control during fire tests shall conform to SFM 12-7-3, Fire Testing Furnaces, Section 12-7-301, for the Horizontal Large-scale Floor Furnace, or the Horizontal Large-scale Beam Furnace.

(d) **Loading.** Throughout the fire endurance test, a superimposed load shall be applied to the test specimen. This load, together with the weight of the specimen, shall be as nearly as practicable the maximum theoretical dead and live loads permitted by nationally recognized design standards.

(e) **Temperature measurements.** The temperature of the steel in structural members shall be measured by thermocouples at three or more sections spaced along the length of the members with one section located at the mid-span, except that in cases where the cover thickness is not uniform along the structural frame member length at least one of these sections shall include the point of minimum cover. For solid steel beams there shall be four thermocouples at each section: one shall be located at the center on the exposed face of the bottom flange: one on the edge of the bottom flange, one on the web at the center and one on the bottom of the top flange. For open-web steel joists there shall be four thermocouples at each section: two on the bottom of the lower chord, one at the middle of the web and one on the bottom of the top chord. For trusses there shall be not less than four thermocouples at each section: one on the bottom of the top chord, one at the middle of the nearest diagonal or vertical member and two on the bottom of the lower chord. For reinforced or prestressed concrete structural members, thermocouples shall be located on each of the tension reinforcing elements, unless there are more than eight such elements, in which case thermocouples shall be placed on eight elements selected in such a manner as to obtain representative temperature on all the elements.

(f) **Conditions of acceptance.** In deriving a structural frame member classification, the following conditions shall be met:

1. The structural frame member shall have sustained the applied load during the fire endurance test for a period at least equal to that for which classification is desired.
2. For structural steel members, the transmission of heat through the protection during the period of fire endurance for which classification is desired does not raise the temperature of the thermocouple at any location on the structural steel member above 1200°F (649°C) nor the average of the thermocouples at any section above 1000°F (538°C).
3. For concrete beams, the transmission of heat through the cover to the steel during the period of fire endurance for which classification is desired does not raise the average temperature of the thermocouples at any section on the steel above 800°F (426°C) for cold drawn prestressing steel or 1000°F (538°C) for reinforcing steel.

Sec. 12-7-112.

(a) **Application.** Where the size and construction of the sample, or the loading specified in Sections 12-7-110 (a) and (b) is not feasible by design or dimensions, this alternate test procedure may be used to evaluate the protection for steel beams, girders and trusses without application of design load, provided that the protection is not required by design to function structurally in resisting applied loads. The furnace and its control during fire tests shall conform to SFM 12-7-3, Fire Testing Furnaces, Section 12-7-301, for the Horizontal Small-scale Beam Furnace, the Horizontal Large-scale Beam Furnace or the Horizontal Large-scale Floor Furnace.

(b) **Size and character of sample.**

1. The size of the steel beam, girder or truss shall be such as to provide a test specimen that is representative of the design, materials and workmanship for which classification is desired. The protection shall be applied according to the methods of acceptable field practice, and the projection below the ceiling, if any, shall be representative of the conditions of intended use. The length of the beam, girder or truss exposed to the fire shall be not less than 7 feet (2133 mm), and the member shall be tested in a horizontal position. A section of a representative floor or roof construction not less than 5 feet (1524 mm) wide, symmetrically located with reference to the beam, girder or truss and extending its full length, may be included in the test assembly and exposed to fire from below.

   The rating of performance shall not be applicable to sizes of solid structural members or elements of built-up structural members, such as trusses, smaller than those tested.
2. The applied protection shall be restrained against longitudinal expansion greater than that of the steel beam, girder or truss by rigid steel plates or reinforced concrete attached to the ends of the member before the protection is applied. The ends of the member, including the means for restraint, shall be given sufficient thermal insulation to prevent appreciable direct heat transfer from the furnace to the unexposed ends of the member or from the ends of the member to the outside of the furnace.

(c) **Temperature measurement.** The temperature of the steel in the beam, girder or truss shall be measured with not less than four thermocouples at each of not less than three sections equally spaced along the length of the beam, girder or truss, symmetrically disposed and not nearer than 2 feet (609 mm) from the inside face of the walls of the furnace. The thermocouples at each section shall be symmetrically placed so as to measure significant temperatures of all component elements of the steel section.

(d) **Conditions of acceptance.** The test shall be regarded as successful if the transmission of heat through the protection during the period of fire exposure for which classification is desired does not raise the average (arithmetical) temperature of the thermocouples at one of the sections above 100°F (38°C), or does not raise the temperature above 1200°F (649°C) at any one of the measured points. The fire-resistance classification so derived shall be applicable to the beam, girder or truss when used with any floor or roof construction which has an equal or greater thermal capacity for heat dissipation from the beam than the floor or roof with which it was tested.

TESTS OF CEILING CONSTRUCTIONS

Sec. 12-7-113.

(a) **Application.** This test procedure is to be used for classification of ceilings that are not an integral part of a floor construction and where 36 inches (914 mm) or more space is provided above the top of the joists or beams supporting and protected by the ceiling.

(b) **Size of sample.** The area exposed to fire shall be not less than 180 square feet (16.7 m^2), with neither dimension less than 12 feet (3657 mm), and the ceiling surface at its edges shall be in contact with the test furnace structure.

(c) **Test construction and enclosure.** The test ceiling construction shall include all structural members and details including hangers, if any, but not walkways. Above the ceiling during the test, there shall be provided a tight flat-topped enclosure, the underside of the covering material of which shall be 36 inches (914 mm) above the top of the joists or beams supporting and protected by the ceiling. The top of the enclosure shall be made of cement-asbestos board $^1/_4$ inch (6 mm) in thickness under asbestos millboard $^1/_2$ inch (13 mm) in thickness, and the side walls of 8-inch (203 mm) common brick, or it shall be of a construction having equivalent heat conductivity and heat capacity. Where use of the ceiling under a combustible construction is contemplated, at least five 15-inch (381 mm) square panels of 1-inch (25 mm) pine boards shall be attached to the underside of the top of the enclosure. The temperatures on the bottom surface of these panels shall be measured.

(d) **Conditions of acceptance.** The test shall be regarded as successful if the following conditions are met:

1. The ceiling shall have withstood the fire endurance test without the passage of flame or ignition of combustible members or materials forming part of the construction above the ceilings as evidenced by glow or flame.
2. Transmission of heat through the ceiling during the fire endurance test shall not have been such as to raise the average temperature above the test ceiling more than indicated in Items A, B and C. The limiting temperatures shall be the average of those taken at not less than five points, one of which shall be approximately at the center, and four at approximately the centers of the quarter sections.
   - A. With combustible supports or other combustible material in contact with the ceiling, the temperature increase at the points of contact shall not exceed 250°F (121°C).
   - B. With combustible supports or other combustible material not in contact with the ceiling, the temperature increase on the surface of any combustible members, pine panels, or combustible material adjacent to the ceiling shall not exceed 250°F (121°C). The temperature on the exposed surface of combustible members not in contact with the ceiling shall be measured under a sheet of mica approximately 0.002 inch (0.05 mm) in thickness.
   - C. With no combustible material above the ceiling construction, the average temperature measured on the lower surface of the main structural supporting members (beams or slabs) shall not exceed 1200°F (649°C) and the average temperature of the top and bottom of the beams, when used, shall not exceed 1000°F (538°C).

TESTS OF PROTECTION FOR COMBUSTIBLE FRAMING, OR FOR COMBUSTIBLE FACINGS ON THE UNEXPOSED SIDE OF WALLS, PARTITIONS AND FLOORS

Sec. 12-7-114.

(a) **Character of sample.** Test panels carrying wall, partition or floor protection shall be finished with the protections which are the subject of the test, except that where the finish on the unexposed side is not the subject of the test and is not specifically indicated, the testing laboratory shall apply a finish judged suitable for the purpose. In case a floor construction, as installed for actual use, is to have no finish on the unexposed side, it shall be so tested.

(b) **Size of sample.** The area exposed to fire shall be, for tests of wall and partition protection, not less than 100 square feet (9.3 m^2) with neither dimension less than 9 feet (2743 mm); for tests of floor protection, not less than 180 square feet (16.7 m^2) with neither dimension less than 12 feet (3657 mm).

(c) **Conditions of acceptance.** The test shall be regarded as successful if the following conditions are met:

1. The protection shall have withstood the fire endurance test, without ignition of the materials protected, for a period equal to that for which classification is desired.
2. Transmission of heat through the protection during the fire endurance test shall not have been such as to raise the temperatures at its contact with the protected structural members or facings of the test panel more than 250°F (130°C) above the initial temperatures at these points, except that for members closely embedded on three sides in masonry, concrete or similar noncombustible materials the permissible temperature rise may be 325°F (181°C).

STANDARD FIRE ENDURANCE TEST REPORT FORM

Sec. 12-7-115. Reports of fire endurance tests specified in Section 12-7-103 shall include all data and in the form prescribed in this section.

(a) **Cover page.** Cover page shall include: Laboratory, Laboratory Project Number, Sponsor and Date Tested.

(b) **Title page.** Title page shall include: Table of Contents, Summary of Construction and Fire Endurance Time. The signature of the fire-protection engineer responsible for the conduct of the test may be on the title page or at the conclusion of the report.

(c) **Test facility.** A complete description and details of the furnace and recording equipment shall be provided. This may be in an appendix to the report.

1. Describe details of end conditions (wedges, bearing, means to prevent rotation), describe details of the

restraining frame, degree of restraint or reactive forces opposing expansion and the method used to provide this restraint.

2. If construction is tested under load, indicate how load is applied and controlled (include loading diagram).
3. If construction is tested as nonload bearing indicate whether frame is rigid or moves in test.

(d) **Description of materials.** Type, size, class, strength, densities, trade name and any additional data necessary to fully define and identify materials. The testing laboratory shall indicate whether materials meet ASTM standards by markings, or by statement of sponsor, or by physical or chemical test by the testing laboratory. The sponsor shall authorize the testing laboratory to provide all data to the enforcing agency as may be necessary for evaluation.

(e) **Description of test assembly.**

1. Give size of test specimen including dimensions of all parts.
2. Give details of structural design, including safety factor of all structural members in the test assembly.
3. Include plan, elevation, principal cross section, plus other sections as needed for clarity. Detailed drawing of complete assembly.
4. Give details of attachment of test panel in frame.
5. Give location of thermocouples, deflection points and other items for test.
6. Describe general ambient conditions at:
   A. Time of construction;
   B. During curing (time from construction to test); and
   C. Time of test.
7. Record air movement across unexposed face of test specimen.
8. Report relative humidity in specimen.

(f) **Description of test.**

1. Except as provided in Section 12-7-102 (d), report temperatures at beginning and every 5 minutes. If charts are included in report, clearly indicate time and Fahrenheit temperature:
   A. In furnace space.
   B. On unexposed face for each thermocouple.
   C. On protected framing members as stipulated in test method. In combustible assemblies indicate temperatures on framing back of protection, soffit of joists or other framing members.
   D. On request of the enforcement agency, furnish the temperatures in the plenum at mid-depth of ceiling-floor assemblies and underside of floor.
2. Report deflections every 5 minutes for first 15 minutes and last hour of test. Every 10 minutes in between.
3. Report appearance of exposed face:
   A. Every 15 minutes;
   B. At any noticeable development, give details and time, i.e., cracks, buckling, twisting, expansion of supports, flaming, smoke, loss of material, etc.; and
   C. At end of test include amount of drop out, condition of fasteners, sag, etc.
4. Report appearance of the unexposed face:
   A. Every 15 minutes;
   B. At any noticeable development including cracking, smoking, buckling, giving details and time; and
   C. At end of test.
5. Report time of failure by:
   A. Temperature rise;
   B. Failure to carry load; and
   C. Passage of flame-heat-smoke.
6. If hose stream is required, repeat necessary parts of Items 3 and 5. If failure occurs in hose stream test, describe.

(g) **Comments by testing engineer.**

1. Included shall be a statement concerning construction being representative of field construction. If construction does not represent typical field construction, all deviations shall be noted.
2. If construction is unsymmetrical, clearly indicate face exposed to fire.
3. Fire test.

(h) **Summary of results.** Shall include:

1. Endurance time.
2. Nature of failure.
3. Hose stream results.

(i) **Pictures.** Pictures shall be provided as necessary to clarify and show what cannot be covered in the report. Pictures shall include:

1. Assembly in construction with closeups of details supplementing the report.
2. Exposed face prior to test.
3. Unexposed face at start of endurance test.
4. Unexposed face at end of fire endurance test.
5. Exposed face at end of fire endurance test.
6. If hose stream test is required, repeat Items 1 through 5.

TABLE SFM 12-7-1A
CONDITIONS FOR HOSE STREAM TEST

	WATER PRESSURE AT BASE OF NOZZLE (POUNDS PER SQUARE INCH)	DURATION OF APPLICATION, MINUTES PER 100 SQUARE FEET OF EXPOSED AREA
4 hours and over	45	5
2 hours and over, if less than 4	30	$2^1/_2$
$1^1/_2$ hours and over, if less than 2	30	$1^1/_2$
1 hour and over, if less than $1^1/_2$	30	1
Less than 1 hour, if desired	30	1

For SI: 1 square foot = 92 903 mm^2

CHAPTER 12-7-2

FIRE-RESISTIVE STANDARDS

Reserved

CHAPTER 12-7-3

FIRE-RESISTIVE STANDARDS

FIRE TESTING FURNACES
STANDARD 12-7-3

STATE FIRE MARSHAL
SCOPE

Sec. 12-7-300. This standard sets forth the general requirements for the design and control of fire testing furnaces intended for fire exposure testing and assignment of fire endurance ratings of building materials, assemblies of building materials, equipment and devices.

Furnace design and dimensions

Sec. 12-7-301. Furnaces shall consist of a furnace chamber and an insulated specimen frame. The furnace chamber walls and floor shall consist of insulating fire brick or equivalent heat-reflective materials. Furnace dimensions shall be not less than shown in the following:

(a) **Vertical large-scale wall furnace.** The furnace exposure panel or door shall consist of an insulated steel restraining frame having an available opening for the test sample of not less than 200 square feet (18.6 m^2) in area with neither dimension less than 9 feet (2743 mm).

(b) **Vertical half-scale wall furnace.** The furnace exposure panel or door shall consist of an insulated steel restraining frame having an available opening of not less than 50 square feet (4.6 m^2) for the test sample. Neither dimension of the furnace opening shall be less than 7 feet (2133 mm).

(c) **Horizontal large-scale floor furnace.** The furnace exposure panel shall consist of an insulated steel restraining frame having an available opening of not less than 180 square feet (16.7 m^2) for the test sample. Neither dimension of the furnace opening shall be less than 12 feet (3657 mm).

(d) **Horizontal small-scale furnace.** The furnace exposure panel shall consist of an insulated frame having an available opening of not less than 35 square feet (3 m^2) for the test sample. Neither dimension of the furnace opening shall be less than 5 feet (1524 mm).

(e) **Horizontal large-scale beam furnace.** The furnace exposure panel shall consist of an insulated steel restraining frame having an available opening of not less than 180 square feet (16.7 m^2) for the test sample. Neither dimension of the furnace opening shall be less than 5 feet (1524 mm).

(f) **Horizontal small-scale beam furnace.** The furnace exposure panel for the "Alternate Test of Protection for Structural Steel Beams, Girders and Trusses" shall consist of an insulated steel frame having an available opening of not less than 35 square feet (3 m^2) for the test sample. Neither dimension of the furnace opening shall be less than 5 feet (1524 mm).

(g) **Column furnace.** The column furnace shall be of such dimensions as to provide an opening for column sections not less than 8 feet (2438 mm) in clear length.

(h) **Protection of equipment and test specimen.** The testing furnaces, equipment and test specimen undergoing the fire test shall be protected from any condition of wind or weather, that might lead to abnormal results. The ambient air temperature of the testing room at the beginning of the test shall be within the range of 50°F to 90°F (10°C to 32°C). Velocity of air across the unexposed face of the test specimen shall not exceed 4.4 feet per second, as determined by an anemometer placed at right angles to the unexposed surface, measured before or during the test. If mechanical ventilation is employed during the test, an airstream shall not be directed across the surface of the specimen.

BURNERS AND FUEL

Sec. 12-7-302.

(a) **Burners.**

1. In vertical furnaces, burners shall be placed in the back wall of the furnace. The location of the burners and provisions for combustion air shall be such as to provide an even flame exposure to the entire exposed face of the test specimen. Combustion air openings shall be provided in such a manner as to normally prevent induction of combustion air through any opening in the test specimen.
2. In horizontal furnaces, burners shall be placed in the floor or side walls. Burrs and the provisions for combustion air shall be so arranged as to provide a uniform exposure to the entire exposed face of the test specimen.
3. In column furnaces, burners shall be placed in the four walls to provide an even luminous flame exposure to all sides of the test sample.

(b) **Fuel.** Furnaces shall be supplied with natural, manufactured or bottled gas.

TIME-TEMPERATURE CURVE

Sec. 12-7-303. The conduct of fire tests of materials, assemblies, methods of construction, equipment and devices shall be controlled to conform to the applicable portion of the standard time-temperature curve shown in Figure 12-7-3-1. The points on the curve that determine its character are:

1000°F (538°C)	. . . . at	5 minutes
1300°F (704°C)	. . . . at	10 minutes
1500°F (843°C)	. . . . at	30 minutes
1700°F (927°C)	. . . . at	1 hour

1792°F (978°C)	at	$1^1/_2$ hours
1850°F (1010°C)	at	2 hours
1925°F (1052°C)	at	3 hours
2000°F (1093°C)	at	4 hours

For a closer definition of the time-temperature curve, see Table 12-7-3A.

FURNACE CONTROL

Sec. 12-7-304.

(a) **Thermocouples.**

1. Furnace thermocouples shall be protected by sealed porcelain tubes having $^3/_4$-inch (19 mm) outside diameter and $^1/_8$-inch (3 mm) wall thickness, or as an alternate, in the case of base-metal thermocouples, shall be protected by $^1/_2$-inch (13 mm) wrought steel or wrought iron pipe of standard weight or equivalent protection of approved type. The exposed length of the pyrometer tube and thermocouple in the furnace chamber shall be not less than 12 inches (305 mm).
2. In the large-scale horizontal floor and vertical wall furnaces, the temperature of the fire test exposure shall be deemed to be the average temperature obtained from the readings of not less than nine thermocouples symmetrically disposed and distributed to show the temperature near all parts of the test specimen. In the vertical half scale and horizontal small-scale furnaces, the number of thermocouples shall be proportioned to those of the large-scale furnaces, but shall in no case be less than four thermocouples.
3. In the column furnace, the temperature of the fire test exposure shall be deemed to be the average temperature obtained from the readings of not less than eight thermocouples symmetrically disposed at two levels to show the temperature near all parts of the test specimen. The two levels shall be located approximately 2 feet (609 mm) from the top and bottom of an 8-foot (2438 mm) clear height furnace.
4. In the vertical wall furnaces, the junction of the thermocouples shall be placed 6 inches (152 mm) from the exposed face of the test specimen at the beginning of the test. The junction of the thermocouples shall, during the fire test and as a result of deflection, be maintained at 6 inches (152 mm) from the exposed face of the test specimen.
5. In horizontal beam, floor and roof furnaces having a furnace chamber not less than 180 square feet (16.7 m^2) in area, the junction of the thermocouples shall be 12 inches (305 mm) from the exposed face of the test specimen at the beginning of the test, and shall not touch the test specimen during the test as a result of its deflection.
6. In horizontal beam, floor and roof furnaces having a furnace chamber less than 180 square feet (16.7 m^2) in area, the junction of the thermocouples shall be placed 6 inches (152 mm) from the exposed face of the test specimen at the beginning of the test and, during the test, shall not touch the test specimen as a result of its deflection.

(b) **Temperature recording.** The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first 2 hours, and thereafter the intervals may be increased to not more than 10 minutes.

(c) **Furnace control accuracy.** The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the thermocouple readings, is within 10 percent of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5 percent for those over 1 hour and not more than 2 hours, and within 5 percent for tests exceeding 2 hours in duration. Individual thermocouple readings shall not exceed or fall below the standard time-temperature curve by more than 15 percent.

(d) **Furnace correction.** When the indicated resistance period is $^1/_2$ hour or over, determined by the average or maximum temperature rise on the unexposed surface or within the test sample, or by failure under load, a correction shall be applied for variation of the furnace exposure from that prescribed, where it will affect the classification, by multiplying the indicated period by two-thirds of the difference in area between the curve of average furnace temperature and the standard curve for the first three-fourths of the period and dividing the product by the area between the standard curve and a base line of 60°F (20°C) for the same part of the indicated period, the latter area increased by 54 Fahr-hour or 30 Cent-hour (3240 Fahr-minutes or 1800 Cent-minutes) to compensate for the thermal lag of the furnace thermocouples during the first part of the test. For fire exposure in the test higher than standard, the indicated resistance period shall be increased by the amount of the correction and be similarly decreased for fire exposure below standard.

Note: The correction can be expressed by the following formula:

$$C = \frac{21(A - AS)}{3(AS + L)}$$

where:

C = correction in the same units as 1

1 = indicated fire endurance period

A = area under the curve of indicated average furnace temperature for the first three-fourths of the indicated period

AS = area under the standard furnace curve for the same part of the indicated period

L = lag correction in the same units as A and AS (54 Fahr-hour or 30 Cent-hour (3240 Fahr-minutes or 1800 Cent-minutes)

(e) **Furnace pressure.** The pressure in the furnace chamber during the fire test shall be maintained as nearly equal to atmospheric pressure as possible. Horizontal furnaces may be operated at a slight negative pressure sufficient to reduce haze permitting visual observation. Furnace stacks shall be equipped with dampers to facilitate maintenance of furnace pressure.

CORRELATION

Sec. 12-7-305. Tests of specific assemblies of materials shall be conducted for correlation (or correlation factor) of furnace exposure by comparison with tests of identical assemblies and materials conducted in furnaces of "Approved Listing Agencies" which furnaces are deemed as conforming to the design and operating requirements of this standard.

Correlation tests of wall furnaces shall include tests of two assemblies, one combustible and one noncombustible.

Correlation tests of horizontal furnaces dependent on intended test specimens shall include at least one test for each type of assembly such as combustible ceiling-floor assembly, noncombustible assembly having a high thermal capacity floor for heat dissipation, noncombustible assembly having an insulating concrete floor or other type of design.

Comparison of test results shall provide evidence of equivalent exposure based on transmitted temperatures on the unexposed side, on structural framing members, on the underside of floor or roof decks, and in the plenum space.

TABLE 12-7-3A
STANDARD TIME-TEMPERATURE CURVE FOR CONTROL OF FIRE TESTS

TIME	AREA ABOVE 68°F BASE						AREA ABOVE 20°C BASE					
	TEMPERATURE											
hr.: min.	°Fahr.		°Fahr. min.		°Fahr. hr.		°Cent.		°Cent. min.		°Cent. hr.	
0;00		68		00		0		20		00		0
0;05	1	000	2	330		39		538	1	290		22
0:10	1	300	7	740		129		704	4	300		72
0:15	1	399	14	150		236		760	7	860		131
0:20	1	462	20	970		350		795	11	650		194
0:25	1	510	28	050		468		821	15	590		260
0:30	1	550	35	360		589		843	19	650		328
0:35	1	584	42	860		714		862	23	810		397
0:40	1	613	50	510		842		878	28	060		468
0:45	1	638	58	300		971		892	32	390		540
0:50	1	661	66	200	1	103		905	36	780		613
0:55	1	681	74	220	1	237		916	41	230		687
1:00	1	700	82	330	1	372		927	45	740		762
1:05	1	718	90	540	1	509		937	50	300		838
1:10	1	735	98	830	1	647		946	54	910		915
1:15	1	750	107	200	1	787		955	59	560		993
1:20	1	765	115	650	1	928		963	64	250		071
1:25	1	779	124	180	2	070		971	68	990	1	150
1:30	1	792	132	760	2	213		978	73	760	1	229
1:35	1	804	141	420	2	357		985	78	560	1	309
1:40	1	815	150	120	2	502		991	83	400	1	390
1:45	1	826	158	890	2	648		996	88	280	1	471
1:50	1	835	167	700	2	795	1	001	93	170	1	553
1:55	1	843	176	550	2	942	1	006	98	080	1	635
2:00	1	850	185	440	2	091	1	010	103	020	1	717

(continued)

TABLE 12-7-3A—continued
STANDARD TIME-TEMPERATURE CURVE FOR CONTROL OF FIRE TESTS

TIME	AREA ABOVE 68°F BASE						AREA ABOVE 20°C BASE					
	TEMPERATURE											
hr.: min.	°Fahr.		°Fahr. min.		°Fahr. hr.		°Cent.		°Cent. min.		°Cent. hr.	
2:10	1	862	203	330	3	389	1	017	112	960	1	882
2:20	1	875	221	330	3	689	1	024	122	960	2	049
2:30	1	888	239	400	3	991	1	031	133	040	2	217
2:40	1	900	257	720	4	295	1	038	143	180	2	386
2:50	1	912	276	110	4	602	1	045	153	390	2	556
3:00	1	925	294	610	4	910	1	052	163	670	2	728
3:10	1	938	313	250	5	221	1	059	174	030	2	900
3:20	1	950	332	000	5	533	1	066	184	450	3	074
3:30	1	962	350	890	5	848	1	072	194	940	3	249
3:40	1	975	369	890	6	165	1	079	205	500	3	425
3:50	1	988	389	030	6	484	1	086	216	130	3	602
4:00	2	000	408	280	6	805	1	093	226	820	3	780
4:10	2	012	427	670	7	128	1	100	237	590	3	960
4:20	2	025	447	180	7	453	1	107	248	430	4	140
4:30	2	038	466	810	7	780	1	114	259	340	4	322
4:40	2	050	486	560	8	110	1	121	270	310	4	505
4:50	2	062	506	450	8	441	1	128	281	360	4	689
5:00	2	075	526	450	8	774	1	135	292	470	4	874
5:10	2	088	546	580	9	110	1	142	303	660	5	061
5:20	2	100	566	840	9	447	1	149	315	910	5	248
5:30	2	112	587	220	9	787	1	156	326	240	5	437
5:40	2	125	607	730	10	129	1	163	337	630	5	627
5:50	2	138	628	360	10	473	1	170	349	930	5	818
6:00	2	150	649	120	10	819	1	177	360	620	6	010
6:10	2	162	670	000	11	167	1	184	372	230	6	204
6:20	2	175	691	010	11	517	1	191	383	900	6	398
6:30	2	188	712	140	11	869	1	198	395	640	6	594
6:40	2	200	733	400	12	223	1	204	407	450	6	791
6:50	2	212	754	780	12	580	1	211	419	330	6	989
7:00	2	225	776	290	12	938	1	218	431	270	7	188
7:10	2	238	797	920	13	299	1	225	443	290	7	388
7:20	2	250	819	680	13	661	1	232	455	380	7	590
7:30	2	262	841	560	14	026	1	239	467	540	7	792
7:40	2	275	863	570	14	393	1	246	479	760	7	996
7:50	2	288	885	700	14	762	1	253	492	060	8	201
8:00	2	300	907	960	15	133	1	260	504	420	8	407

For SI: °C = [(°F) – 32]/1.8.

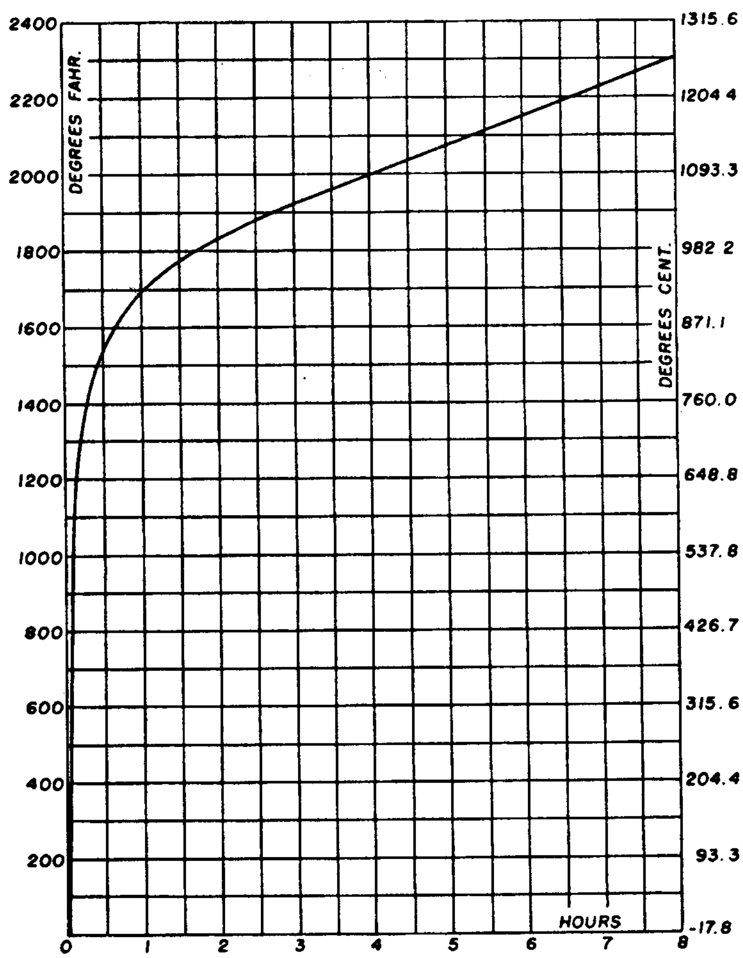


FIGURE 12-7-3-1—TIME-TEMPERATURE CURVE

CHAPTER 12-7-4

FIRE-RESISTIVE STANDARDS

FIRE DOOR ASSEMBLY TESTS
STANDARD 12-7-4

STATE FIRE MARSHAL
SCOPE

Sec. 12-7-400.

(a) **Application.** These methods of fire tests are applicable to door assemblies of various materials and types of construction for use in wall openings to retard the passage of fire (flame, heat and smoke).

(b) **Performance.** Tests made in conformity with these test methods will register performance during the test exposure, but such tests shall not be construed as determining suitability for use after exposure to fire.

(c) **Suitability of assemblies.** It is the intent that tests made in conformity with these test methods will develop data to enable enforcing agencies to determine the suitability of door assemblies for use in locations where fire resistance of a specified duration is required.

FIRE TESTING FURNACES AND CONTROL

Sec. 12-7-401.

(a) **Furnaces.** Fire testing furnaces and their control shall conform to SFM 12-7-3, Fire Testing Furnaces, Section 12-7-301 (a), Vertical Large-scale Wall Furnaces.

(b) **Half scale.** If the proposed conditions of use limit the construction to smaller dimensions, and for the evaluation of hardware intended for use on doors not exceeding 4 feet (1219 mm) in width by 7 feet 2 inches (2184 mm) in height, fire testing furnaces conforming to Section 12-7-301 (b), Vertical Half-scale Wall Furnace, may be utilized. Constructions and hardware for ceiling access doors intended for use in fire-endurance rated ceiling-floor assemblies shall be tested in furnaces conforming to SFM 12-7-3, Section 12-7-301 (b), (d) or (f).

UNEXPOSED SURFACE TEMPERATURES

Sec. 12-7-402.

(a) **Temperatures recorded.** The unexposed surface temperatures of all fire door assemblies shall be recorded. The unexposed surface temperature shall be determined in the manner specified in Sections 12-7-402 (b), (c) and (d).

(b) **Surface temperature locations.** Unexposed surface temperatures shall be taken at not less than three points, with at least one thermocouple in each 16 square foot (1.5 m^2) area of the door(s). Thermocouples shall not be located over reinforcements extending through the door, over glass panels or nearer than 12 inches (305 mm) from the edge of the door.

(c) **Thermocouples.** Unexposed surface temperatures shall be measured with thermocouples placed under flexible, oven-dry, felted asbestos pads of the following approximate dimensions and weight: 6 inches square (3871 mm^2), 0.40 inch (10 mm) in thickness, and weighing 0.026 pound. The pads shall be held firmly against the surface of the door(s) and shall fit closely about the thermocouples without breaking. The thermocouple leads shall be immersed under the pad for distance of not less than $3^1/_2$ inches (88.9 mm), with the hot junction under the center of the pad. The thermocouple leads under the pads shall be not heavier than No. 18 B.&S. gage [0.04 inch (1 mm)] and shall be electrically insulated with heat-resistant and moisture-resistant coatings.

(d) **Recording interval.** Unexposed surface temperatures shall be read at the same intervals as used for the furnace temperatures, Section 12-7-304 (b).

TEST ASSEMBLIES

Sec. 12-7-403.

(a) **Construction and size.**

1. The construction and size of the test fire door assembly, consisting of single doors, doors in pairs, special purpose doors (such as Dutch doors, double egress doors, etc.) or multisection doors shall be representative of that for which classification or rating is desired. The materials and construction of the door and frame, and the details of the installation, hardware, hangers, guides, trim, finish and clearance or lap shall be recorded to ensure positive identification or duplication in all respects.

2. A floor structure shall be provided as part of the opening to be protected, except where such floor interferes with the operation of the door. The floor segment shall be of noncombustible material and shall project into the furnace approximately twice the thickness of the test door.

(b) **Mounting of doors for test purposes.**

1. Swinging doors shall be mounted so as to open into the furnace chamber, except doors in pairs swinging in opposite directions shall be mounted so as to have one door leaf open into and one door leaf open away from the furnace chamber.

2. Sliding and rolling doors, except passenger elevator shaft doors, shall be mounted on the exposed side of the opening in the wall closing the furnace chamber.

3. Passenger elevator shaft doors shall be mounted on the unexposed side of the opening in the wall closing the furnace chamber.
4. Access-type door and chute-type door and frame assemblies shall be mounted so as to have one assembly open into the furnace chamber and another assembly open away from the furnace chamber. Ceiling access doors and frame assemblies shall be mounted in a representative ceiling with the room side of the access door opening into the furnace chamber.
5. Dumbwaiter and service counter door and frame assemblies shall be mounted on the exposed side of the opening in the wall.
6. Door frames shall be evaluated when mounted so as to have the doors open either away from or into the furnace chamber at the discretion of the enforcing agency to obtain representative information on the performance of the construction under test.
7. Surface-mounted hardware (fire exit devices) for use on fire doors shall be evaluated by being installed on one door assembly swinging into the furnace chamber and another door assembly swinging away from the furnace chamber.
8. The mounting of all doors shall be such that they fit snugly within the frame, against the wall surfaces, or in guides, but such mounting shall not prevent free and easy operation of the test door.
9. Clearances for swinging doors shall be [with a minus $^{1}/_{16}$-inch (1.6 mm) tolerance] as follows: $^{1}/_{8}$ inch (3.2 mm) along the meeting edge of doors in pairs, $^{3}/_{8}$ inch (9.5 mm) at the bottom edge of single swing doors and $^{1}/_{4}$ inch (6.35 mm) at the bottom edge of a pair of doors.
10. Clearances for horizontal sliding doors not mounted within guides [with a minus $^{1}/_{8}$-inch (3.2 mm) tolerance] shall be as follows: $^{1}/_{2}$ inch (13 mm) between door and wall surfaces, $^{3}/_{8}$ inch (9.5 mm) between door and floor structure and $^{1}/_{4}$ inch (6.35 mm) between the meeting edges of center parting doors. A minimum lap of 4 inches (102 mm) of the door over the wall opening at sides and top shall be provided.
11. Clearances for vertical sliding doors moving within guides [with a minus $^{1}/_{8}$-inch (3.2 mm) tolerance] shall be as follows: $^{1}/_{2}$ inch (13 mm) between door and wall surfaces along the top and/or bottom door edges with guides mounted directly to the wall surface, and $^{3}/_{16}$ inch (4.8 mm) between meeting edges of biparting doors or $^{3}/_{16}$ inch (4.8 mm) between door and floor structure or sill.
12. Clearances for passenger elevator sliding doors [with a minus $^{1}/_{8}$-inch (3.2 mm) tolerance] shall be as follows: $^{3}/_{8}$ inch (9.5 mm) between door and wall surfaces and $^{3}/_{8}$ inch (9.5 mm) between multisection door panels. Multisection door panels shall overlap $^{3}/_{4}$ inch (19 mm). Door panels shall lap the wall opening $^{3}/_{4}$ inch (19 mm) at the sides and top.

CONDUCT OF TESTS

Sec. 12-7-404.

(a) **Time of testing.** Masonry settings shall be allowed to dry at least 3 days before tests are made.

(b) **Fire endurance test.**

1. The pressure in the furnace chamber shall be maintained as nearly equal to the atmospheric pressure as possible.
2. The test shall be continued until the exposure period of the desired classification or rating is reached, unless the conditions of acceptance set forth in the appropriate paragraphs are exceeded in a shorter period.

(c) **Hose stream test.**

1. Immediately following the fire endurance test, the test assembly shall be subjected to the impact, erosion and cooling effects of a hose stream directed first at the middle and then at all parts of the exposed surface, changes in direction being made slowly.
2. The hose stream shall be delivered through a $2^{1}/_{2}$-inch (63.5 mm) hose discharging through a national standard play-pipe of corresponding size equipped with a $1^{1}/_{8}$-inch (22 mm) discharge tip of the standard-taper smooth-bore pattern without shoulder at the orifice. The water pressure at the base of the nozzle and duration of the application in seconds per square feet of exposed area shall be as given in Table 12-7-4A.
3. The tip of the nozzle shall be located 20 feet (6096 mm) from and on a line normal to the center of the test door. If impossible to be so located, the nozzle may be on a line deviating not more than 30 degrees from the line normal to the center of the test door. When so located the distance from the center shall be less than 20 feet (6096 mm) by an amount equal to 1 foot (305 mm) for each 10 degrees of deviation from the normal.

TABLE 12-7-4A
HOSE STREAM TEST

DESIRED RATING	WATER PRESSURE AT BASE OF NOZZLE, POUNDS PER SQUARE INCH	DURATION OF APPLICATION, SECONDS PER SQUARE FOOT EXPOSED AREA
3 hours	45	3
$1^{1}/_{2}$ hours and over if less than 3 hours	30	1.5
1 hour and over if less than $1^{1}/_{2}$ hours	30	0.9
Less than 1 hour	30	0.6

REPORT

Sec. 12-7-405.

1. The report shall record the construction and mounting details of the door(s) as provided in Section 12-7-403. Drawings and photographs of construction and mounting details shall be provided.
2. The results shall be reported in accordance with the performance in tests prescribed in these test methods. The report shall show the performance under the desired exposure period chosen from the following: 20 minutes, 30 minutes, 45 minutes, 1 hour, $1^1/_2$ hours or 3 hours. The report shall include the temperature measurements of the furnace, and if determined, of the unexposed side of the test assembly. It shall also contain a record of all observations having a bearing on the performance of the test assembly.

CONDITIONS OF ACCEPTANCE

Sec. 12-7-406.

(a) **General.**

1. A door assembly shall be considered as meeting the requirements for acceptable performance when it remains in the opening during the tests specified in this standard within the limitations contained in this section for the desired endurance rating.
2. The test assembly shall have withstood the fire endurance test and hose stream test without developing openings anywhere through the assembly, except that dislodging of small fragments from the central area of the glass light shall be disregarded. The edges of the individual glass light shall remain in place.

   Exception: The hose stream test shall not be required for opposite swing double egress exit doors, and for doors of fire endurance rating of less than 45 minutes with or without approved wired glass lights.

3. Flaming on the unexposed surface of a door assembly shall not be permitted during the first 30 minutes of the classification periods. Some intermittent light flames [tongues of flame not exceeding approximately 6 inches (152 mm) in length] for periods not exceeding 5-minute intervals are permissible along the edges of door after 30 minutes. During the last 15 minutes of the classification period the unexposed surface area of the door covered by light flaming or charring shall be contained within a distance of $1^1/_2$ inches (38 mm) from a vertical door edge and within 3 inches (76 mm) from the top edge of the door.

   Exception: On doors not subjected to the hose stream test, finished with surface veneers or crossbands and veneers, surface flaming on the unexposed surface shall not burn or char crossbands or surface veneer along the hinge or latch jamb and shall not burn or char crossbands or surface veneer down more than $^1/_2$ inch (13 mm) from the top edge, except that light browning without any flaming may occur at throughbolts and the latch rose.

(b) **Hardware.** When hardware is to be evaluated for use on fire doors, it shall hold the door closed under the conditions of acceptance for an exposure period of 3 hours, and the latch bolts shall remain projected and shall be intact after the test. Builders fire door hardware shall not be equipped with any dogging device, set screw or other arrangement which can be used to prevent projection and latching of the latch bolt, locking device or locking bolt upon closing of the door(s). The hardware need not be operable after the test. All parts essential to the latching or unlatching of fire exit hardware devices shall be constructed of materials having a solidus temperature of not less than 1000°F (358°C).

(c) **Swing doors.**

1. The movement of swing doors shall not permit any portion of the edges to move from the original position in a direction perpendicular to the plane of the door more than the thickness of the door during the first half of the classification period, nor more than $2^7/_8$ inches (73 mm) during the entire classification period and as a result of the hose stream.
2. The movement of swing doors mounted in pairs shall not permit any portion of the meeting edges to move more than the thickness of the door away from the adjacent door edge in a direction perpendicular to the plane of the doors during the entire classification period and as a result of the hose stream.
3. An assembly consisting of a pair of swinging doors, incorporating an astragal shall not separate in a direction parallel to the plane of the doors more than $^3/_4$ inch (19 mm) not equal to the throw of the latch bolt along the meeting edges.
4. An assembly consisting of a pair of swinging doors, without an overlapping astragal, for a fire and hose stream exposure of $1^1/_2$ hours or less, shall not separate along the meeting edges more than $^3/_8$ inch (9.5 mm), including the initial clearance between doors.
5. An assembly consisting of a single swinging door shall not separate more than $^1/_2$ inch (13 mm) at the latch location.
6. Door frames to be evaluated with doors shall remain securely fastened to the wall on all sides and shall not cause through openings between frame and doors or between frame and adjacent wall.

(d) **Sliding doors.**

1. Doors mounted on the face of the wall shall not move from the wall sufficiently to develop a separation of more than $2^1/_8$ inches (54 mm) at the point of separation during the entire classification period and as a result of the hose stream.
2. Doors mounted in guides shall not release from guides and guides shall not loosen from fastenings.
3. The bottom bar of rolling steel doors shall not separate from the floor structure more than $^3/_4$ inch

(19 mm) during the entire classification period and as a result of the hose stream.

4. The meeting edge of centerparting horizontal sliding doors and biparting vertical sliding doors shall not separate more than the door thickness in a direction perpendicular to the plane of the doors.
5. The meeting edges of centerparting horizontal sliding doors and biparting vertical sliding doors without an overlapping astragal for a fire and hose stream exposure of $1^1/_2$ hours or less shall not separate along the meeting edges more than $^3/_8$ inch (9.5 mm), including the initial clearance between doors.
6. The meeting edges of centerparting horizontal sliding doors incorporating an astragal shall not separate in a direction parallel to the plane of the doors more than $^3/_4$ inch (19 mm) nor equal to the throw of the latch bolt along the meeting edges.
7. The bottom edge of service counter doors or single slide dumbwaiter doors shall not separate from the sill more than $^3/_8$ inch (9.5 mm).
8. A resilient astragal when required for life-safety purposes shall not deteriorate sufficiently to cause through openings during the fire endurance part of the test, but small portions may be dislodged during the hose stream part of the test.
9. The lap edges of passenger elevator doors, including the lap edges of multisection doors, shall not move from the wall or adjacent panel surfaces sufficiently to develop a separation of more than $2^7/_8$ inches (73 mm) at the point of separation during the entire classification period and as a result of the hose stream.
10. The meeting edges of centerparting passenger elevator door assemblies, for a fire and hose stream exposure of $1^1/_2$ hours or less, shall not move apart more than $1^1/_4$ inches (32 mm) as measured in any horizontal plane during the entire classification period and as a result of the hose stream.

MARKING

Sec. 12-7-407.

(a) **Label.** Fire assemblies shall bear a label issued by an approved listing agency or a label approved by the State Fire Marshal showing the fire-protection rating of the assembly.

(b) **Label markings.** The markings on the labels approved by the State Fire Marshal shall include the following:

1. Name and address of the listee.
2. Model number or identification of the assembly.
3. Serial number assigned by the listing agency or file number assigned by the State Fire Marshal.
4. Rating of 3, $1^1/_3$, 1, $^3/_4$, $^1/_2$ or $^1/_3$ hour indicating duration of exposure to fire.
5. Letter A, B, C, D or E following the hourly rating designating the location for which the assembly is designed.
6. Temperature rise on the unexposed fact at the end of 30 minutes. Temperature rise classification shall be 250°F (121°C) max., 450°F (232°C) max., 650°F (343°C) max. or no reference on the label to temperature rise denoting a temperature rise on the unexposed surface in excess of 650°F (343°C) at the end of 30 minutes.

(c) **Glass lights.** All doors with glass vision panels of 100 square inches (64 516 m^2) or less in area carry the same temperature rating as the door without glass lights. All doors with glass lights in excess of 100 square inches (64 516 mm^2) are rated as having a surface temperature in excess of 650°F (343°C) max., at the end of 30 minutes.

CHAPTER 12-7-5

FIRE-RESISTIVE STANDARDS

Interior Finish of Decorative Material STANDARD 12-7-5

STATE FIRE MARSHAL SCOPE

Sec. 12-7-500. These requirements and methods of test apply to unframed and framed rigid construction.

TEST SETUP AND PERFORMANCE

Section 12-7-501

(a) **Unframed Rigid Combustible Decorative Material.** Rigid combustible decorative material and assemblies of materials not more than $^1/_4$ inch (6 mm) in thickness used for folding doors, room dividers, decorative screens and similar applications, which do not create concealed spaces and which are installed with exposed edges, shall be flame resistant in accordance with the following:

1. Test specimen shall be 12 inches (305 mm) wide and 24 inches (609 mm) long. Four specimens shall be tested, two in each direction of the material.
2. The specimen shall be suspended vertically with its lower edge 2 inches (51 mm) above the top of a $^3/_8$ inch (9.5 mm) diameter Bunsen Burner. The test shall be performed in a draft-free area.
3. The flames from the burner shall be 4 inches (101 mm) long and shall be adjusted with sufficient air supply to eliminate any yellow flame tips but without any distinct inner blue cone.
4. The specimen shall be exposed to the flame at each corner and at not less than one other point along the lower edge. Each exposure shall be of sufficient duration to determine if the material will ignite and continue to burn, but shall be not less than 20 seconds.
5. The criteria for acceptance shall be as follows:
   (A) There shall be not more than intermittent flaming appreciably beyond the area exposed to the test flame.
   (B) Flame shall not reach the top of the specimen.
   (C) On removing the test flame there shall be not more than 1 second of after flaming except there may be nonprogressive flaming of short duration in areas of accumulated char which were directly exposed to the test flame.

Section 12-7-502

(a) **Framed Rigid Combustible Decorative Material.** Rigid combustible decorative material and assemblies of materials not more than $^1/_4$ inch (6 mm) in thickness used for folding doors, room dividers, decorative screens and similar applications, and which are installed with all edges protected, shall conform to the following:

1. All exposed edges shall be protected with frames of metal or other noncombustible material, or solid wood of minimum $^1/_4$-inch (6 mm) dimension.
2. The total square foot area of the material shall not exceed ten percent of that of the floor area of the room in which the material is installed.
3. When tested as follows, flames shall not reach the top edge of the specimen.

   The test shall be conducted in a draft free area, on a specimen of the material 12 inches by 12 inches (305 mm by 305 mm) suspended at a 45-degree angle from the horizontal with the upper and lower edges in a horizontal plane. The test flame shall be 3 inches (76 mm) long from a Bunsen burner of approximately $^1/_2$-inch (13 mm) inside diameter with the air supply completely shut off. The burner shall be positioned so that its top is 1 inch (25 mm) vertically below a point on the lower surface of the test specimen, 1 inch (25 mm) up from its lower horizontal edge and midway between the inclined edges. The exposure to the test flame and the duration of test shall be for a period of 2 minutes.

CHAPTER 12-7A

MATERIALS AND CONSTRUCTION METHODS FOR EXTERIOR WILDFIRE EXPOSURE

EXTERIOR WALL SIDING AND SHEATHING SFM STANDARD 12-7A-1

12-7A-1.1 Application. The minimum design, construction and performance standards set forth herein for exterior wall siding and sheathing are those deemed necessary to establish conformance to the provisions of these regulations. Materials and assemblies that meet the performance criteria of this standard are acceptable for use as defined in *California Building Standards Code.*

12-7A-1.2 Scope. This standard evaluates the performance of exterior walls of structures when exposed to direct flames.

12-7A-1.3 Referenced documents.

1. ASTM E2257, Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies.
2. ASTM D4442, Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
3. ASTM D4444, Test Methods for Use and Calibration of Hand-Held Moisture Meters.
4. *California Building Code*, Chapter 7A.

12-7A-1.4 Definitions.

1. **Siding (cladding).** Any material that constitutes the exposed exterior covering of an exterior wall and is applied over sheathing or is directly attached to the wall structural system.
2. **Sheathing.** The material placed on an exterior wall beneath cladding or siding and is directly attached to the wall structural system.

12-7A-1.5 Summary of test method.

1. **Direct flame exposure.** This test method provides for the direct flame exposure of a wall specimen to a flame source centered at the base of a 4-foot by 8-foot (1220 mm by 2440 mm) test assembly.
2. **Gas burner.** The method employs a gas burner to produce a diffusion flame in contact with the test wall assembly.
3. **Heat output.** The gas burner produces a prescribed net rate of heat output of 8535 Btu/min (150 kW) for a period of 10 minutes, after which the flame exposure is terminated.
4. **Resistance to fire penetration.** The test method measures the ability of the wall system to resist fire penetration from the exterior to the unexposed side of the test assembly under the conditions of exposure. Observations are made for the appearance of sustained flaming or glow on the unexposed side and/or sustained glowing on the unexposed side at the end of a 60-minute observation period.

12-7A-1.6 Equipment. Unless otherwise noted, dimensions in the following descriptions shall be followed with a tolerance of ± 0.5 inch (13 mm).

1. **Wall assembly holding fixture.** The test specimen support assembly shown in Figure 1 is designed to permit rapid installation and removal of wall assemblies, and to prevent edge penetration of fire at the margins of the wall assembly. It includes a sturdy frame assembly to hold the specimen and a simulated soffit that is noncombustible. The frame assembly permits a 4-foot by 8-foot (1220 mm by 2440 mm) prefabricated wall section to be inserted and to be sealed in such a way that protects the edges from fire. Side shields are situated near the vertical edges and to within 12 inches (304 mm) of the top of the test wall assembly as shown in Figure 1 to aid in minimizing extraneous drafts to the surface of the assembly.
2. **Burner.**

   2.1. **Burner details.** The ignition source for the test shall be a gas diffusion burner with a nominal 4-inch-wide by 39-inch-long (100 mm wide by 1000 mm long) porous top surface of a refractory material, as shown in Figure 2. With the exception of top surface dimensions, the essential configuration of the burner is comparable to the burner design described in ASTM E2257. The burner enclosure shall be positioned so that it is centered relative to the width of the test wall. The distance from the bottom of the test specimen to the top surface of the burner shall be 12 inches ± 2 inches (300 mm ± 50 mm). The bottom of the test specimen shall be protected from burner fire exposure by the placement of a 4-foot-wide (1220-mm) thermal barrier consisting of nominal 0.75 inch (19 mm) cement board (or equivalent) between the burner enclosure and the test specimen. The burner enclosure shall be in contact with the protective barrier. The thermal barrier shall be positioned so that the top edge extends 3 inch ± 1 inch (76 mm ± 25 mm) above the top edge of the burner, and fastened to the base of the wall in such a manner to prevent obstruction of the burner flame caused by distortion away from the surface of the wall. Any gaps between the top edge of the thermal barrier and the test wall surface shall be filled with ceramic wool, or equivalent, prior to the test.

Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 8535 ± 454 Btu/min (150 ± 8 kW) throughout the flame exposure.

The burner shall be ignited by a pilot burner or a remotely controlled spark igniter.

2.2. **Burner output verification.** The gas supply to the burner shall be the same as used for testing.

1. Without a test specimen in the apparatus, place the gas burner in the configuration to be used for testing and obtain a heat release rate value of 150 kW.
2. Take measurements at least once every 6 seconds and start 1 minute prior to ignition of the burner. Determine the average heat output over a period of at least 1 minute by the oxygen consumption method, or calculate the heat output from the gas mass flow and the net heat of combustion.
3. Perform verification prior to each day of testing.

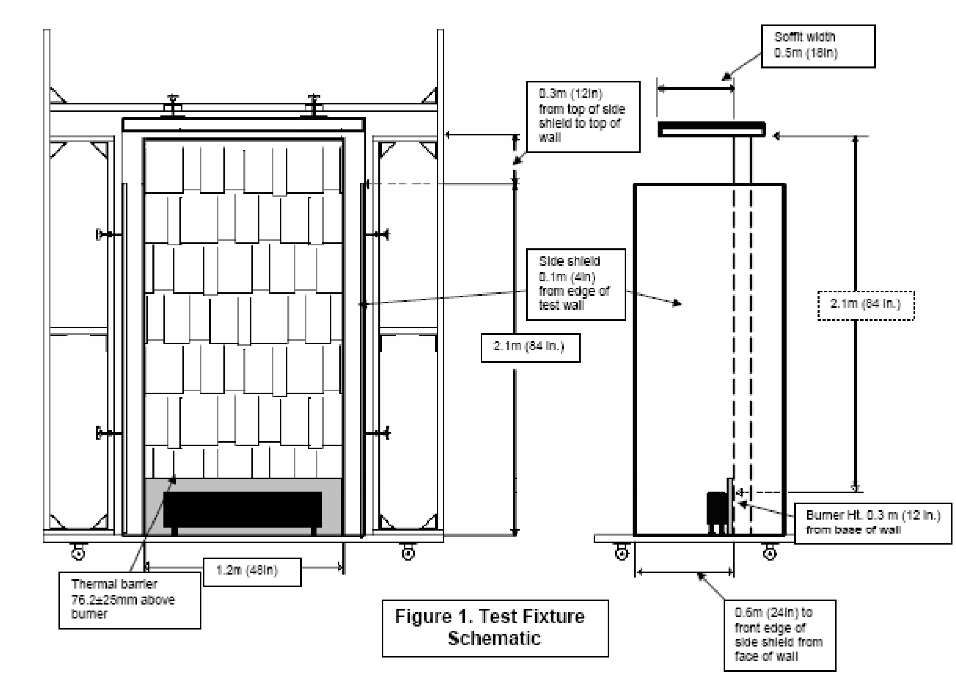


FIGURE 1. TEST FIGURE SCHEMATIC

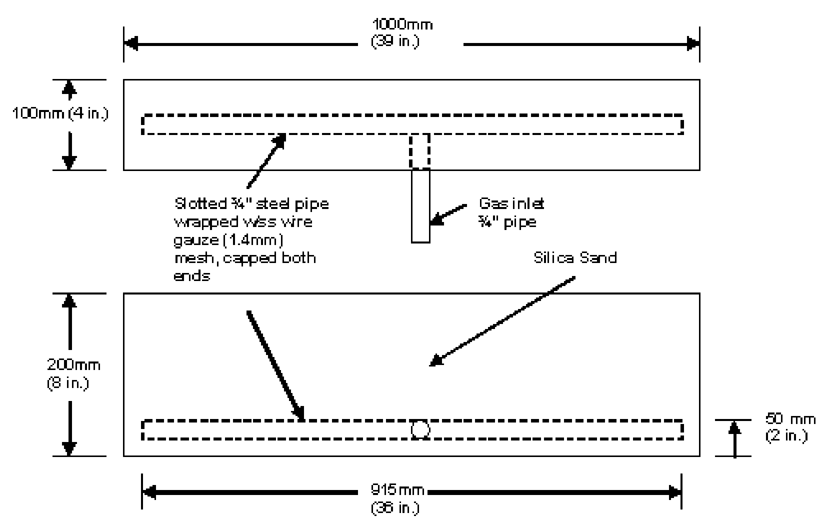


FIGURE 2. GAS BURNER IGNITION SOURCE

12-7A-1.7 Test assembly.

1. **Dimensions.** The test specimen's dimensions shall be 4 feet wide by 8 feet high (1220 mm by 2440 mm). The test specimen shall be representative of the end-use wall assembly except as specified in Items 3 and 4. The test specimen shall be mounted in the steel frame holding fixture assembly as shown in Figure 1.
2. **Joint details.** The test specimen shall incorporate joint detail(s) representative of actual installation.
3. **Wall assemblies without internal cavity spaces.** For wall assemblies without internal cavity spaces, the entire wall assembly shall constitute the test specimen to be tested. The wall assembly shall be constructed in accordance with manufacturer's specifications and/or building code requirements, where applicable. Other components of the wall assembly, such as building felt and sheathing, are employed to conform to the manufacturer's specifications and/or building codes.
4. **Wall assemblies with internal cavity spaces.** For wall assemblies with internal cavity spaces, the materials on what would be considered the interior (unexposed) side of the wall assembly shall be omitted from the test specimen. Materials such as insulation normally installed within the cavity space shall be omitted from the test specimen. The wall assembly used as the test specimen shall include the structural support elements and any sheathing, weather barrier and cladding attached to the exterior surface of the structural support elements.
5. **Layered materials.** For wall assemblies composed of layered materials, such as sheathing, siding (cladding) and underlayment, the installation of such layered materials shall be in accordance with the manufacturer's instructions, or in the absence of such instructions, applicable building code requirements. In the absence of manufacturer's specifications, the wall assembly shall include the following minimum components: nominal 2 x 4 studs spaced 16 inches (410 mm) on center, and the desired exterior siding material. If sheathing is used, tests shall be run on typical $^{7}/_{16}$-inch (11 mm) oriented strandboard (OSB) of Exposure 1 rating. Where specified by the manufacturer, sheathing material and installation shall be in accordance with the manufacturer's instructions. The sheathing shall have one vertical seam on a selected stud with a 0.125 inch (3 mm) gap.
6. **Edge protection.** Protect the vertical and horizontal edges of the test specimen with 12-mm-thick ceramic wool blanket (or equivalent) to eliminate the gap between the holder and the test specimen and prevent unwanted edge effects caused by heat transfer to the edges of the test specimen through the sample holder.
7. **Replicates.** Three matched test specimen assemblies shall be tested.
8. **Pre-test conditioning of test specimens.** The completed test specimens are to be stored indoors at temperatures not lower than 60°F (16°C) nor higher than 90°F (32°C) for the period of time necessary to cure or condition the assembly components. Test specimens are to be stored so that each will be surrounded by freely circulating air. Pieces of any hygroscopic materials from the same stock from which the test specimen was constructed shall be tacked to the specimen during construction in such a manner that they are easily removed. These pieces shall be conditioned with the completed specimens. Prior to testing, the pieces of hygroscopic materials shall be tested for moisture content.

   8.1. Make the moisture determination on two samples from each piece and report the average. For lumber and other wood-based materials, use Test Methods D 4442. Use of an appropriately calibrated moisture meter, as described in Test Methods D 4444, to determine the moisture content of wood or wood products is also permitted. For other hygroscopic materials, use test methods appropriate for those materials.

   8.2. For lumber used in the construction of the supporting wall structure, the moisture content shall not be more than 12 percent. For wood sheathing, the moisture content shall not exceed 8 percent. For other hygroscopic materials, the moisture shall be within ranges specified by the manufacturer before the assembly is constructed. These specified ranges shall be typical for exposure at 77 ± 9°F [25 ± 5°C] and 55 ± 10% relative humidity.

12-7A-1.8 Weathering. Weathering of materials shall be in accordance with California Building Code Section 703A Standards of Quality.

12-7A-1.9 Conduct of tests.

1. **Test room environment.** The ambient temperature in the test room shall be above 60°F (15°C) and the relative humidity shall be less than 75 percent. The test room shall be draft-protected and equipped with an exhaust hood system for removal of products of combustion during testing.
2. **Airflow.** The horizontal airflow, measured at a horizontal distance of 20 inches (0.5 m) from the edge of the wall assembly, shall not exceed 1.64 ft/s (0.5 m/s).
3. **Placement of test frame.** Prior to testing, and without the test specimen in place, position the frame assembly under the exhaust hood and set the gas burner for the prescribed level of output.
4. **Placement of specimen.** Once the burner output is verified, position the specimen holder assembly at the desired test location under the collection hood.
5. **Test specimen.** Insert the test specimen into the frame assembly, sealing all edges with ceramic wool.
6. **Ignition.** Simultaneously ignite the gas burner and start the timer marking the beginning of the test. Control the burner to a constant 150 ± 8 kW output. Control the hood duct flow to collect all products of combustion.

7. **Flame exposure.** Continue the flame exposure until flame penetration of the test specimen and sustained flaming on the unexposed side occurs or for a period of 10 minutes, then extinguish the burner.
8. **Observation.** If sustained flaming on the unexposed side of the test specimen has not occurred, observe the unexposed side of the test specimen for an additional 60 minutes for evidence of sustained flaming or glowing combustion on the unexposed side. Terminate the observation prior to the completion of the 60-minute observation period if all evidence of flame, glow and smoke has disappeared.

   Note: An infrared thermometer has been found to be useful to detect the increase of temperature on the unexposed side of the test assembly.
9. **Documentation.** Perform photographic and/or video documentation before, during and after each test.

12-7A-1.10 Report. The report shall include the following:

1. Name and address of the testing laboratory.
2. Name and address of test sponsor.
3. Description of the test specimen including construction details of the wall system, including details of individual components (such as type, thickness and installation method of any sheathing) and the manufacturer's installation details and limitations as applicable.
4. Number of specimens tested.
5. Description of weathering, as applicable.
6. Moisture content of hygroscopic elements of wall system construction at the time of testing.
7. Details of the burner verification, including heat supply rate.
8. Date of test, test identification number and date of report.
9. The test results shall include:
   - 9.1. A notation of the time and location of sustained flaming on the unexposed side of the test specimen during the test, along with the sequence number of the test specimen.
   - 9.2. A determination of the presence of glow on the unexposed side of the test specimen at the end of the 60-minute observation period.
   - 9.3. Observations of the burning characteristics of the exposed surface of the test wall during and after the flame exposure.

12-7A-1.11 Conditions of Acceptance. Should one of the three replicates fail to meet the Conditions of Acceptance, three additional tests may be run. All of the additional tests must meet the Conditions of Acceptance.

1. Absence of flame penetration through the wall assembly at any time.
2. Absence of evidence of glowing combustion on the interior surface of the assembly at the end of the 70-minute test.

EXTERIOR WINDOWS
SFM STANDARD 12-7A-2

12-7A-2.1 Application. Exterior window assemblies that meet the performance criteria of this standard are acceptable for use as defined in the *California Building Standards Code.*

12-7A-2.2 Scope. This standard evaluates the performance of exterior windows used in structures when exposed to direct flames.

12-7A-2.3 Referenced documents.

1. AAMA (for definitions) Training Manual, Residential & Light Commercial Window and Door Installation Training and Registration Program.
2. CAWM 400-95, Standard Practice for Installation of Windows with Integral Mounting Flange in Wood Frame Construction.

12-7A-2.4 Definitions.

1. **Frame (Jambs).** This usually consists of two vertical members (side jambs) and two horizontal members (head and sill) that hold the sash. Frames and sash are typically made of steel, aluminum, vinyl, fiberglass, wood or a combination of these materials.
2. **Glazing.** The glass in a window. It may include layers of plastic as well as glass.
3. **Sash.** The fixed or movable parts of the window in which the panes of glass are set.

12-7A-2.5 Test apparatus.

1. **Wall assembly test module.** The module is designed to permit rapid installation and removal of window/ wall assemblies, and is designed to prevent edge penetration of fire at the margins. It includes two noncombustible side walls attached to a wall frame assembly, and a simulated soffit that is also noncombustible. The assembly permits a prefabricated 4 × 8 ft (1.2 × 2.4 m) wall section containing the test window to be inserted from the rear and sealed in such a way that the edges are protected from fire (see Figure 1).
2. **Burner.** A 4 × 39 inch (100 × 1000 mm) diffusion burner shall be used. Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 150 ± 4 kW throughout the flame exposure. Burner output can be determined from HRR or calculated from the gas flow rate, temperature and pressure.
3. **Burner location.** The burner shall be positioned so that it is centered relative to the width of the wall assembly and against the wall. The distance from the floor to the top of the burner shall be 12 inches (300 mm).

12-7A-2.6 Test assembly.

1. **Window.** The window width cannot exceed 3 feet (900 mm) due to the limitations of the test fixture. The burner's flame shall cover the full width of the window sill. The distance from top of the burner to bottom of window will be 8 inches (200 mm).

   Note: Larger windows may be tested by expanding the size of the rear wall of the Wall Assembly Test Module.

2. **Materials.** In the absence of the window manufacturer's specifications, the wall assembly shall include the following minimum components:

   2.1. 2 by 4 inch studs spaced 16 inches (410 mm) on center, framed out to incorporate a rough opening sized to receive the test window such that the window is centered relative to the width of the wall;

   2.2. Gypsum board for mounting around the window once it is installed;

   2.3. Pieces of gypsum cut into narrow strips for use as trim around the window;

   2.4. Caulk to be used as per the window manufacturer's instructions.

3. **Wall assembly.** A noncombustible wall shall be used with a manufacturer or code-specified opening for the particular window. Install window in framed rough opening following manufacturer guidelines. Apply manufacturer-recommended caulk to nailing flange prior to installation. Use narrow strips of gypsum board as trim around window, covering the nail flange of the window. Any type of framing material may be tested.

   3.1. Fit the window test assembly into the rear wall of the Wall Assembly Test Module, sealing all edges, including the soffit-to-wall joint. Ceramic wool or comparable material shall be used for sealing.

12-7A-2.7 Conduct of tests.

1. **Burner output verification.** Without the window in place, set the burner for 150 kW output. Conduct a verification run of 3 minutes to assure the heat release rate, and then turn off the burner.
2. **Test.** Place the burner against the wall assembly at the center. Ignite the burner at the 150 kW output and control during the test for constant and uniform output. Optional radiometers can be placed behind the Wall Assembly Test Module to measure heat flux through the window glass.
3. **Duration and observations.** The test shall be continued until flame-through occurs at the window. Flame-through can occur at the glass (glazing) and/or in the frame. At this point, the burner shall be extinguished and the assembly monitored for sustained combustion. Note the time elapsed and location of penetration if it occurs.
4. **Report.** Report a description of the window unit, including the types of frames, cladding and panes being tested and details of the installation. Record when and how the glass breaks or flame-through occurs in the framing materials or sash, and/or if the framing material deforms or otherwise suffers a loss of integrity such

that the glass cannot be held in place, and a record of the time at which any of these events occur.

12-7A-2.8 Conditions of Acceptance.

1. **Duration of direct flame exposure.** To pass this test standard, the window and window assembly shall withstand 8 minutes of direct flame exposure with the absence of flame penetration through the window frame or pane, or structural failure of the window frame or pane.
2. **Flame penetration or structural failure.** Flame penetration or structural failure of the flame or pane anytime during the test constitutes failure of this test standard.

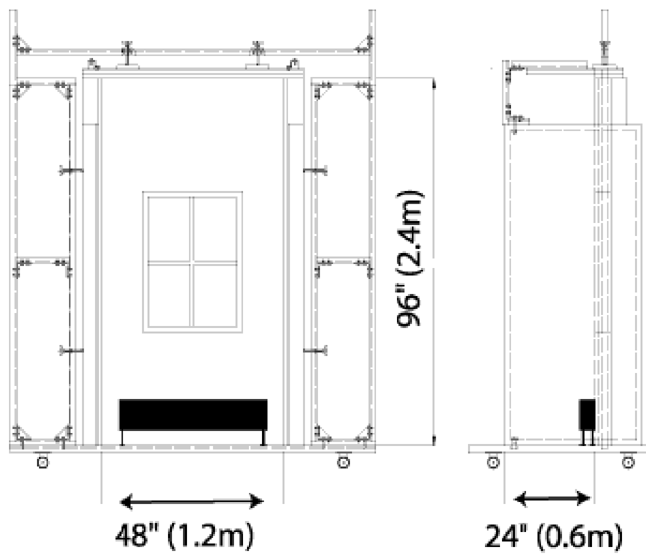


FIGURE 1. SCHEMATIC OF THE WALL ASSEMBLY
Test Module used for evaluating the fire performance of a window.

HORIZONTAL PROJECTION UNDERSIDE
SFM STANDARD 12-7A-3

12-7A-3.1 Application. The minimum design, construction and performance standards set forth herein for the exposed underside of horizontal projections such as the horizontal soffits of roof eaves, floor projections and exposed underfloor areas are those deemed necessary to establish conformance to the provisions of these regulations. Materials and assemblies that meet the performance criteria of this standard are acceptable for use as defined in the *California Building Standards Code.*

12-7A-3.2 Scope. This standard evaluates the fire-resistive performance of horizontal projection assemblies including the horizontal soffits of roof eaves, floor projections and exposed underfloor areas when subjected to direct flame exposure to the underside of a horizontal projection.

12-7A-3.3 Referenced documents.

1. ASTM D4442, Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
2. ASTM D4444, Test Methods for Use and Calibration of Hand-Held Moisture Meters.
3. *California Building Code*, Chapter 7A.

12-7A-3.4 Definitions.

1. **Eaves.** A projecting edge of a roof that extends beyond the supporting wall as in CBC 702A “Roof Eave” or similar horizontal projection assembly.
2. **Soffit.** The enclosed underside of any exterior overhanging section of a roof eave or similar horizontal projection assembly (see CBC 702A “Roof Eave Soffit”).

12-7A-3.5 Equipment.

1. **Burner.** A 12 by 12-inch (300 by 300 mm) diffusion burner shall be used. Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 300 ± 15 kW throughout the flame exposure. Burner output can be determined from HRR or calculated from the gas flow rate, temperature and pressure.
2. **Infrared temperature analyzer** (optional). Intended for monitoring the temperature change of the inside of the eaves.
3. **Moisture content.** Prior to testing, all materials (lumber and soffit material) shall be conditioned to a constant weight or for a minimum of 30 days at 73 ± 4ºF (23 ± 2ºC) and 50 ± 5% relative humidity, whichever occurs first. Constant weight shall be defined as occurring when the change in test material weight is less than or equal to 2 percent in a 24-hour period. Lumber moisture content shall be between 8 and 12 percent (oven-dry basis) and sheathing shall not exceed 8 percent (oven-dry basis).

12-7A-3.6 Materials.

1. **Framing.** The materials used shall be representative of the grades that would be typical of eave construction and installed in the eave’s subassembly as per accepted construction practices.
2. **Soffit.** Material selected for the test.

12-7A-3.7 Test system preparation (Figure 1).

1. **Eaves fabrication.** The 4-foot-wide by 2-foot (1.2 m by 0.6 m) test specimen shall be constructed to fit into a 4-foot-wide (1.2 m) space at the top of the test assembly described in SFM 12-7A-1. Normal eave framing, joints in soffit material and other typical features present in the constructed assembly shall be present in the test specimen.
2. **Test Fixture.** The test fixture shall be as described in SFM 12-7A-1, with the exception that the top soffit projection of the wall assembly fixture is modified to facilitate installation and removal of eave assemblies. Gypsum board (or equivalent) is used to create a noncombustible wall surface in the 4 x 8 ft. opening in the wall test fixture.
3. **Eaves assembly.** Fit the eave assembly into the test module so that the horizontal surface of the assembly is 84 inches (2.1 m) from the top of the burner.
4. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D4444), and for sheathing products, by methods outlined in ASTM D4442.
5. **Sealing.** Seal the edges and ends with ceramic wool or comparable material to prevent flame penetration in these locations of the eave assembly.

12-7A-3.8 Conduct of Tests.

1. **Airflow.** The wall test shall be conducted under conditions of ambient airflow.
2. **Number of tests.** Conduct the tests on three replicate eaves assemblies.
3. **Burner output verification.** Without the eaves assembly in place, adjust the burner for 300 ± 15 kW output. Extinguish the burner.
4. **Burner positioning.** Center the burner with respect to the width of the eaves wall assembly and 0.75 inch (20 mm) from the wall. The distance from the floor to the top of the burner shall be 12 inches (300 mm).
5. **Procedure.**

   5.1 **Ignition.** Ignite the burner, controlling for a constant 300 ± 15 kW output.

   5.2 **Flame exposure.** Continue the exposure until flame penetration of the eaves occurs or for a 10-minute period.

5.3 **Continued combustion.** If penetration does not occur, continue observation for an additional 30 minutes or until all combustion has ceased.

Note: An infrared thermometer has been found to be useful to detect the increase of temperature on the back side of the eaves and as an aid to identify the areas of potential combustion.

6. **Observations.** Note the time, location and nature of flame penetration.

12-7A-3.9 Report. The report shall include a description of the eaves material, details of the construction of the eaves, moisture content of the framing and wood-based soffit elements as applicable, and point of flame penetration. Provide details on the time and reasons for early termination of the test.

12-7A-3.10 Conditions of Acceptance. Should one of the three replicates fail to meet the Conditions of Acceptance, three additional tests may be run. All of the additional tests must meet the Conditions of Acceptance.

1. Absence of flame penetration of the eaves or horizontal projection assembly at any time.
2. Absence of structural failure of the eaves or horizontal projection subassembly at any time.
3. Absence of sustained combustion of any kind at the conclusion of the 40-minute test.

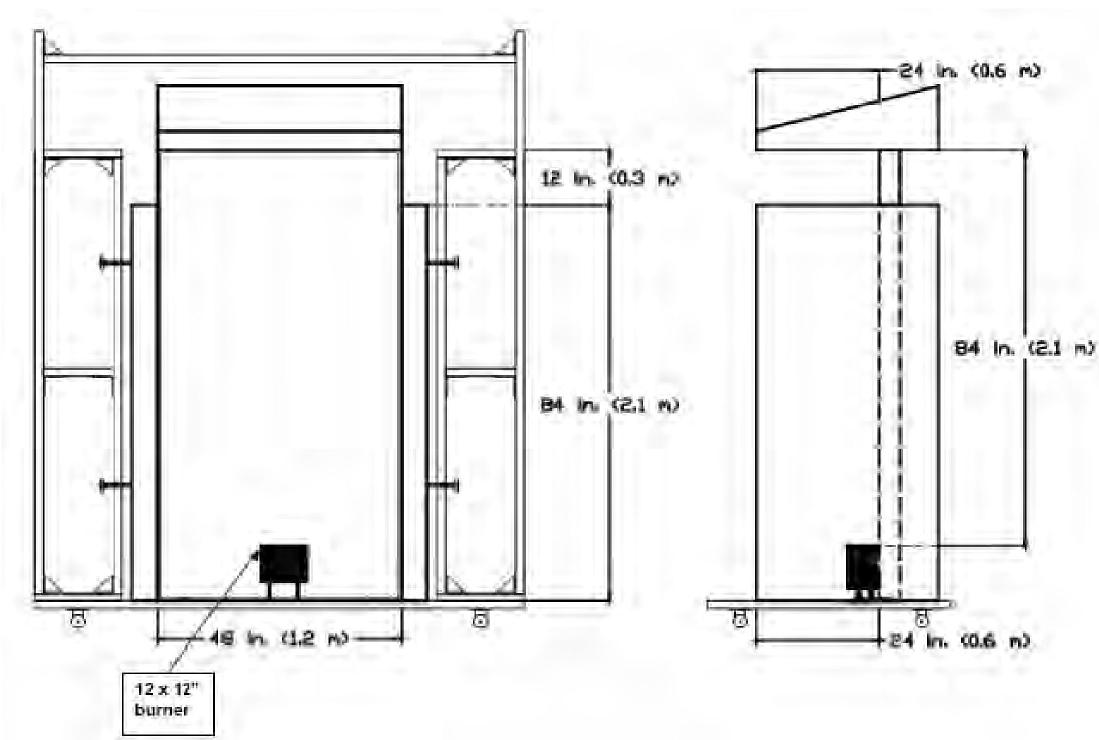


FIGURE 1. EAVES TEST ASSEMBLY

DECKING
SFM STANDARD 12-7A-4

12-7A-4.1 Application. The minimum design, construction and performance standards set forth herein for unloaded decks are those deemed necessary to establish conformance to the provisions of these regulations. Materials and assemblies that meet the performance criteria of this standard are acceptable for use as defined in *California Building Standards Code.*

12-7A-4.2 Scope. This standard evaluates the performance of decks (or other horizontal ancillary structures in close proximity to primary structures) when exposed to direct flames and brands. The under-deck flame exposure test is intended to determine the heat release rate (HRR) and degradation modes of deck or other horizontal boards when exposed to a burner flame simulating combustibles beneath a deck. The burning brand exposure test is intended to determine the degradation modes of deck or other horizontal boards when exposed to a burning brand on the upper surface.

12-7A-4.3 Referenced document.

1. ASTM D4444, Test Methods for Use and Calibration of Hand-Held Moisture Meters.
2. ASTM E108, Test Methods for Fire Tests of Roof Coverings.
3. *California Building Code,* Chapter 7A.
4. UL 790, Standard Test Methods for Fire Tests of Roof Coverings.

12-7A-4.4 Definitions.

1. **Deck boards.** Horizontal members that constitute the exposed surface of the ancillary structure.
2. **Deck surface area.** The test specimen area defined by the overall specimen length and width after assembly.
3. **Heat release rate.** The net rate of energy release as measured by oxygen depletion calorimetry.

12-7A-4.5 Test assembly.

1. **Size.** The overall size of the test deck shall be nominally 24 x 24 inches (610 x 610 mm) unless width variation of deck boards requires an increase in overall deck width (i.e., the direction of joists) in order to meet the overall dimensions. The length of individual deck boards shall be 24 inches (610 mm).
2. **Joists.** The deck is supported by two nominal 2 x 6 Douglas-fir joists running perpendicular to the deck boards, and constructed with a 16-inch (406 mm) center-to-center spacing. A comparable species that may be more commonly used for structural framing of decks in a given region can be substituted for Douglas-fir.
3. **Deck board spacing and fastening.** Edge-to-edge spacing and method of attachment shall conform to the manufacturer's installation recommendations. The front deck board shall be flush with the ends of the joists, and the rear deck board shall overhang the end of the joists by 1 inch (25 mm).
   3.1. In the absence of recommended installation guidance, the edge-to-edge spacing shall be $^{3}/_{16}$ inch (5 mm) with boards mechanically attached to the joists using deck screws.
   3.2. If nominal 6-inch-wide (152 mm) deck boards are used, a total of 5 boards shall be used for each deck. Changing the board width could change the number of deck boards.

12-7A-4.6 Materials.

1. **Cross-sectional dimension.** All deck board materials are to have cross-sectional dimensions equivalent to use in service.
2. **Description.** The material under test should be described as completely as possible (unit weight, thickness, width and general information regarding composition).
3. **Condition of test material.** Prior to testing, all materials (deck boards and joist material) shall be conditioned to a constant weight or for a minimum of 30 days at 73 ± 4ºF (23 ± 2ºC) and 50 ± 5% relative humidity, whichever occurs first. Constant weight shall be defined as occurring when the change in test material weight is less than or equal to 2 percent in a 24-hour period.

12-7A-4.7 PART A. Under-deck flame test.

12-7A-4.7.1 Equipment.

1. **Burner.** A 12 x 12 inch (300 x 300 mm) sand diffusion burner shall be used. Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 80 ± 4 kW throughout the flame exposure. Burner output can be determined from HRR or calculated from the gas flow rate, temperature and pressure.
2. **Oxygen depletion calorimeter.** The equipment shall include a hood, associated ducting and instrumentation to provide HRR data by oxygen depletion calorimetry.

12-7A-4.7.2 Test system preparation. See Figure No. 1.

1. **Deck support assembly.** The assembly that holds the test deck over the burner.
2. **Baffle panels and joist support.** Horizontal metal plates to support the deck joists along their full length, and also to confine burner flames to the underside of the deck boards located between the support joists.
3. **Back wall.** Ceramic fiber board or another noncombustible panel product for the back wall material. Total height of the back wall shall be 8 feet (2.4 m).
4. **Ledger board.** A 4-foot-long (1.2 m) simulated 2 x 6 ledger board shall be constructed of layers of ceramic fiber board (or other noncombustible panel product) and attached to the wall at a height slightly below the overhang of the rear deck board of the test deck.

12-7A-4.7.3 Conduct of tests.

1. **Airflow.** The test shall be conducted under conditions of ambient airflow.
2. **Number of tests.** Conduct the test on three replicate assemblies.
3. **Burner output verification.** Without a deck in the apparatus, set the output of the burner to 80 ± 4 kW. Conduct a verification run of 3 minutes to ensure the heat release rate, and then turn off the burner.
4. **Measurement of heat release rate.** HRR is measured during the tests with a properly calibrated oxygen depletion calorimeter. Since HRR is typically a post-test analysis, this criterion for Acceptance may be determined at the end of the test.
5. **Burner positioning.** Center the burner directly under the middle deck board, midway between the joists. The distance from the top of the burner to the bottom of the deck boards shall be 27 inches (690 mm).
6. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D4444).
7. **Procedure.**
   7.1. **Ignition.** Ignite the burner, controlling for a constant 80 ± 4 kW output.
   7.2. **Flame exposure.** Continue the exposure for a 3-minute period. Extinguish the burner.
   7.3. **Continued combustion.** Continue observation for an additional 40 minutes or until all combustion has ceased.
8. **Observations.** Note physical changes of the deck boards during the test, including structural failure of any deck board, location of flaming and glowing ignition, and loss of material (i.e., flaming drops of particles falling from the deck). It is desirable to capture the entire test with a video recorder to allow review of the details of performance.

12-7A-4.7.4 Report. The report shall include a description of the deck board material and the time of any degradation (effective net peak heat release rate, structural failure, flaming drops or particles falling from the deck) during the test.

1. **Calculated rate of heat release.** The effective net peak heat release rate (HRR) shall be calculated as follows:
   1.1. During the first 5 minutes of the test (the 3 minutes during which the ignition source burner is operating and the immediately following 2 minutes) the effective net peak HRR of the test assembly shall be reported as: effective net peak HRR = (peak heat release rate – 80 kW) / (deck surface area).
   1.2. During the remaining test duration the effective net peak heat release rate of the test assembly shall be reported as: effective net peak HRR = (peak heat release rate) / (deck surface area).

12-7A-4.7.5 Conditions of Acceptance. Should one of the three replicates fail to meet the Conditions of Acceptance, three additional tests may be run. All of the additional tests must meet the Conditions of Acceptance.

1. Effective net peak heat release rate of less than or equal to 25 kW/ft^2 (269 kW/m^2).
2. Absence of sustained flaming or glowing combustion of any kind at the conclusion of the 40-minute observation period.
3. Absence of falling particles that are still burning when reaching the burner or floor.

12-7A-4.8 PART B. Burning brand exposure.

12-7A-4.8.1 Equipment.

1. **Wind tunnel.** The wind tunnel shall have the capability of providing 12 mph (5.4 m/s) airflow over the deck assembly.
2. **Anemometer.** Device for measuring airflow across the deck.
3. **Burner.** Gas-fueled burner for brand ignition.

12-7A-4.8.2 Test system preparation. See Figure 2. The ASTM E108 "A" brand roof test apparatus is to be used, with the following modifications:

1. **Deck support.** The deck shall be supported horizontally with the center 60 inches (150 mm) from the front opening of the wind tunnel and the joists parallel to the airflow and resting on two transverse metal supports. The top surfaces of these supports, no more than 3 inches (75 mm) wide, are at the same height as the floor of the wind tunnel.
2. **Fragments.** Burning fragments shall be free to fall to the floor of the room.

12-7A-4.8.3 Conduct of tests.

1. **Number of tests.** Conduct the test on three replicate assemblies.
2. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D4444).
3. **Procedure.** Adhere to ASTM E108 "Standard Test Methods for Fire Tests of Roof Coverings" (burning brand test, "A" brand), with apparatus modified as described above in "Test system preparation" and the following procedure:
   3.1. The air velocity shall be calibrated using the 60-inch (1.5 m) framework spacing, with a smooth noncombustible calibration deck at a 5-inch (127 mm) per 12-inch (305 mm) horizontal incline positioned 60 inches (1.5 m) from the front opening of the wind tunnel. All other measurement details shall be followed as specified in Sections 4.4.2, 4.4.3 and 4.4.4 of ASTM E108. Although ASTM E108 specifies calibration to be conducted with the 33-inch (840-mm) framework spacing used for the intermittent flame test set up, tests have shown that at the nominal 12 mph setting, there was not difference in measured velocity between the 33- and 60-inch (838 mm and 1524 mm) framework spacing.

3.2. Mount the test specimen at a zero horizontal incline positioned 60 inches (1.5 m) from the front opening of the wind tunnel.

3.3. Ignite the "A" brands as specified in Section 9.4 of ASTM E108 as reprinted here:

1. Each 12- x 12-inch (300 x 300 mm) face for 30 seconds.
2. Each 2.25- x 12-inch (57 x 300 mm) edge for 45 seconds.
3. Each 12- x 12-inch (300 x 300 mm) face again for 30 seconds.

3.4. Center the burning brand laterally on the deck with the front edge 2.5 inches (64 mm) from the entering air edge of the deck.

3.5. Continue the exposure for a 40-minute period or until all combustion of the deck boards ceases. The test shall be terminated immediately if flaming combustion accelerates uncontrollably (runaway combustion) or structural failure of any deck board occurs.

Heat Release Rate is not monitored because of the impracticability with the specified airflow.

4. **Observations.** Note physical changes of the deck boards during the test, including deformation from the horizontal plane, location of flaming and glowing combustion, and loss of material (i.e., flaming drops of particles falling from the deck). It is desirable to capture the entire test with a video recorder to allow review of the details of performance.

12-7A-4.8.4 Report. The report shall include description of the deck board material, and the time of any degradation (accelerated combustion, board collapse, flaming drops or particles falling from the deck).

12-7A-4.8.5 Conditions of Acceptance. Should one of the three replicates fail to meet the Conditions of Acceptance, three additional tests may be run. All of the additional tests must meet the Conditions of Acceptance:

1. Absence of sustained flaming or glowing combustion of any kind at the conclusion of the 40-minute observation period.
2. Absence of falling particles that are still burning when reaching the burner or floor.

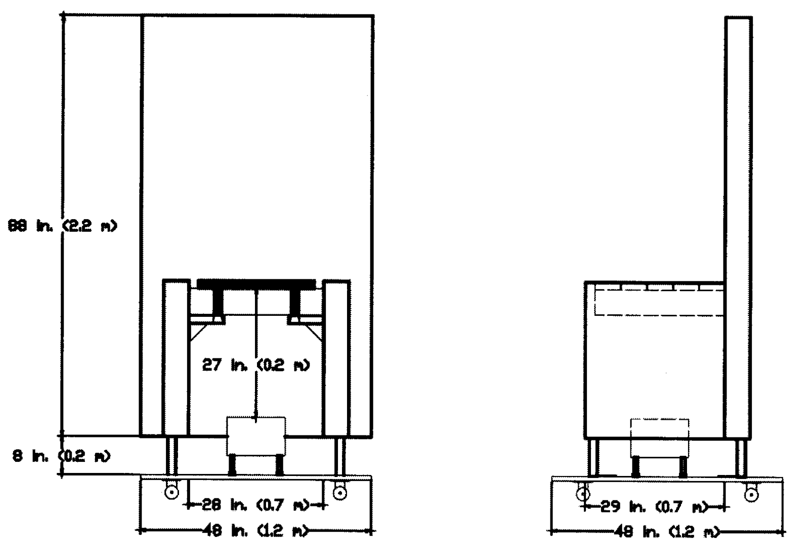


FIGURE 1. DECK TEST ASSEMBLY (UNDER DECK-FLAME)

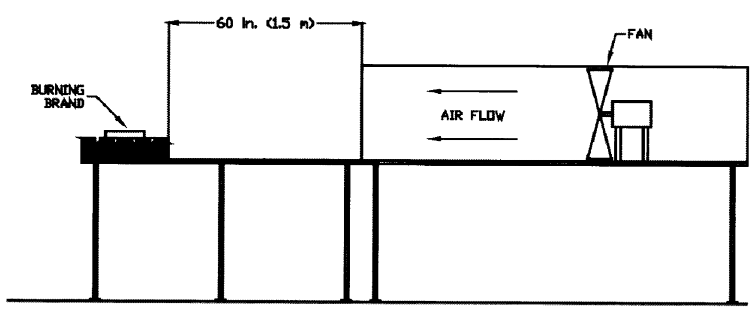


FIGURE 2. DECK TEST ASSEMBLY (BURNING-BRAND)

DECKING ALTERNATE METHOD A
SFM STANDARD 12-7A-4A

12-7A-4A.1 Application. The minimum design, construction and performance standards set forth herein for unloaded decks are those deemed necessary to establish conformance to the provisions of these regulations. Materials and assemblies that meet the performance criteria of this standard are acceptable for use as defined in the *California Building Standards Code.*

12-7A-4A.2 Scope. This standard evaluates the performance of decks (or other horizontal ancillary structures in close proximity to primary structures) when exposed to direct flames and brands. The under-deck flame exposure test is intended to determine the heat release rate (HRR) and degradation modes of deck or other horizontal boards when exposed to a burner flame simulating combustibles beneath a deck. The burning brand exposure test is intended to determine the degradation modes of deck or other horizontal boards when exposed to a burning brand on the upper surface.

12-7A-4A.3 Referenced document.

1. ASTM E108. Standard Test Methods for Fire Tests of Roof Coverings.
2. *California Building Code*, Chapter 7A.

12-7A-4A.4 Definitions.

1. **Deck boards.** Horizontal members that constitute the exposed surface of the ancillary structure.
2. **Heat release rate.** The net rate of energy release as measured by oxygen depletion calorimetry.

12-7A-4A.5 Test assembly.

1. **Size.** The overall size of the test deck shall be nominally 24 x 24 inches (610 x 610 mm) unless width variation of deck boards requires an increase in overall deck width (i.e., the direction of joists) in order to meet the overall dimensions. The length of individual deck boards shall be 24 inches (610 mm).
2. **Joists.** The deck is supported by two nominal 2 x 6 Douglas-fir joists running perpendicular to the deck boards, and constructed with a 16-inch (406 mm) center-to-center spacing. A comparable species that may be more commonly used for structural framing of decks in a given region can be substituted for Douglas-fir.
3. **Deck board spacing and fastening.** Edge-to-edge spacing and method of attachment shall conform to the manufacturer's installation recommendations. The front deck board shall be flush with the ends of the joists, and the rear deck board shall overhang the end of the joists by 1 inch (25 mm).
   - 3.1. In the absence of recommended installation guidance, the edge-to-edge spacing shall be $^{3}/_{16}$ inch (5 mm) with boards mechanically attached to the joists using deck screws.
   - 3.2. If nominal 6-inch-wide (152 mm) deck boards are used, a total of five boards shall be used for each deck. Changing the board width could change the number of deck boards.

12-7A-4A.6 Materials.

1. **Cross-sectional dimension.** All deck board materials are to have cross-sectional dimensions equivalent to use in service.
2. **Description.** The material under test should be described as completely as possible (unit weight, thickness, width and general information regarding composition).
3. **Condition of test material.** Prior to testing, all materials (deck boards and joist material) shall be conditioned to a constant weight or for a minimum of 30 days at 73 ± 4ºF (23 ± 2ºC) and 50 ± 5 percent relative humidity, whichever occurs first. Constant weight shall be defined as occurring when the change in test material weight is less than or equal to 2 percent in a 24-hour period.

   Note: The moisture content of joists shall be between 8- and 10-percent moisture content.

12-7A-4A.7 Under-deck flame test.

12-7A-4A.7.1 Equipment.

1. **Burner.** A 12- x 12-inch (300 x 300 mm) diffusion burner shall be used. Natural gas, methane or propane shall be supplied to the burner through a metered control system. The gas supply to the burner shall produce a net heat output of 80 ± 4 kW throughout the flame exposure. Burner output can be determined from HRR or calculated from the gas flow rate, temperature and pressure.
2. **Oxygen depletion calorimeter.** The equipment shall include a hood, associated ducting and instrumentation to provide HRR data by oxygen depletion calorimetry.

12-7A-4A.7.2 Test system preparation. See 12-7A-4 Figure No. 1.

1. **Deck support assembly.** Assembly that holds the test deck over the burner.
2. **Baffle panels and joist support.** Horizontal metal plates to support the deck joists along their full length, and also to confine burner flames to the underside of the deck boards located between the support joists.
3. **Back wall.** Ceramic fiber board or another noncombustible panel product for the back wall material. Total height of the back wall is 8 feet (2.4 m).
4. **Ledger board.** A 4-foot-long (1.2 m) simulated 2 x 6 ledger board shall be constructed of layers of ceramic fiber board (or other noncombustible panel product) and attached to the wall at a height slightly below the overhang of the rear deck board of the test deck.

12-7A-4A.7.3 Conduct of tests.

1. **Airflow.** The test is conducted under conditions of ambient airflow.
2. **Number of tests.** Conduct the test on three replicate assemblies.
3. **Burner output verification.** Without a deck in the apparatus, set the output of the burner to 80 ± 4 kW. Conduct a verification run of 3 minutes to ensure the heat release rate, and then turn off the burner.
4. **Measurement of heat release rate.** HRR is measured during the tests with a properly calibrated oxygen depletion calorimeter. Since HRR is typically a post-test analysis, this criterion for Acceptance may be determined at the end of the test.
5. **Burner positioning.** Center the burner directly under the middle deck board, midway between the joists. The distance from the top of the burner to the bottom of the deck boards shall be 27 inches (690 mm).
6. **Moisture content.** Measure the moisture content of the wooden members of the assembly using a moisture meter (ASTM D4444).
7. **Procedure.**

   7.1. **Ignition.** Ignite the burner, controlling for a constant 80 ± 4 kW output.

   7.2. **Flame exposure.** Continue the exposure for a 3-minute period. Extinguish the burner.

   7.3. **Continued combustion.** Continue observation for an additional 40 minutes or until all combustion has ceased. The test shall be terminated immediately if flaming combustion accelerates uncontrollably (runaway combustion) or structural failure of any deck board occurs.

8. **Observations.** Note physical changes of the deck boards during the test, including structural failure of any deck board, location of flaming and glowing ignition, and loss of material (i.e., flaming drops of particles falling from the deck). It is desirable to capture the entire test with a video recorder to allow review of the details of performance.

12-7A-4A.7.4 Report. The report shall include a description of the deck board material and the time of any degradation (effective net peak heat release rate) during the test.

12-7A-4A.7.5 Conditions of acceptance. Should one of the three replicates fail to meet the Condition of Acceptance, three additional tests may be run. All of the additional tests must meet the Condition of Acceptance with an effective peak heat release rate of less than or equal to 25 kW/ft^2 (269 kW/m^2).

CHAPTER 12-8-1

FIRE-RESISTIVE STANDARDS FOR FIRE PROTECTION

STANDARD 12-8-100

ROOM FIRE TEST FOR WALL AND CEILING MATERIALS
(*See Chapter 35, California Building Code.*)

STATE FIRE MARSHAL

Authority: Sections 13143, 13146.1, Health and Safety Code
Reference: Sections 13108, 13143, 13146.1, Health and Safety Code

SCOPE

Sec. 12-8-101.

(a) **Basic.** This standard is intended to evaluate, under a specified fire exposure condition, the contribution to room fire growth provided by wall ceiling and/or floor materials or assemblies. This standard is not intended to evaluate the fire endurance or flamespread of material or assemblies.

Note: See State Fire Marshal (SFM) 7-1 and *Uniform Building Code* (UBC) Standard 8-1.

This standard can be used to evaluate the effectiveness of thermal barriers in restricting the contribution of combustible materials in the wall and floor assemblies to fire growth in a padded safety cell. This standard shall be used in conjunction with ASTM E603-77, "Standard Guide for Room Fire Experiments," which covers instrumentation, safety precautions and the general effect of various parameters.

(b) **Tests and listings by approved testing agency.** Test data for wall and/or ceiling materials or assemblies investigated and tested in accordance with the Standard for Safety established by Underwriters Laboratories, Inc., UL 723C, "Investigation for the Classification of Wall and Ceiling Interior Finish Materials and Assemblies Using a Room Fire Test," will be acceptable for evaluation against this standard, provided all instrumentation data required by this standard is incorporated in the test and report.

(c) **Test simulation.** The test simulates a fire in the comer of an 8-foot by 12-foot (2438 mm by 3657 mm) compartment containing a single open doorway; this can be used to evaluate the relative performance of specific wall, ceiling and floor materials or assemblies when they are used together in the same relationship within an enclosure, in addition to simulating the manner in which they will be used.

(d) **Materials considered.** The test may be used for evaluating wall, ceiling and flooring finish materials and assemblies, including panels, tiles, boards, sprayed or brushed coatings, etc.

FIRE AND SMOKE MEASUREMENTS AND PHOTOGRAPHIC RECORD

Sec. 12-8-102.

(a) **Significance.** This fire test is applicable to a description of certain fire performance characteristics in appraising wall, ceiling and flooring materials, products or systems under specified fire exposure conditions in an enclosure. The test indicates the maximum extent of fire growth in an enclosure, the rate of heat release, and if they occur, the time to flashover and the time to flame extension beyond the doorway following flashover. Time to flashover is either the time when the radiant flux onto the floor reaches 20 kW/m^2 or the average temperature of the upper air reaches 1100°F (593°C). A crumpled up single sheet of newspaper may be placed on the floor 3 feet (914 mm) out from the center of the front wall.

The spontaneous ignition of this newspaper will provide a visual indication of flashover. It determines both the extent to which the wall and ceiling materials or assemblies may contribute to fire growth in a compartment and the potential for fire spread beyond the compartment under the particular conditions simulated. It does not measure the contribution of the furnishing materials.

(b) **Fire measurements.** The potential for the spread of fire to other objects in the enclosure interior, remote from the ignition source, is evaluated by measurements of:

1. The total heat flux incident at the center of the floor.
2. A characteristic upper level gas temperature in the test compartment.

(c) **Fire spread potential.** The potential for the spread of fire to objects outside the compartment of origin is evaluated by the measurement of the total rate of heat release of the fire.

(d) **Smoke measurements.** Measurements of the rate of production of carbon monoxide and visible smoke are taken.

(e) **Photographic record.** The overall performance of the test specimen is to be visually documented by full color photographic records. Videotaping of the complete fire test may be done as an alternate to the continuous photographic record. Such records may show when each area of the test specimen becomes involved in the fire.

(f) **Photographic Specification.** Photographic equipment shall be used to continuously record the fire spread in the room and the fire projection from the door of the room. The location of the camera must avoid interference with the air inflow.

Note: A window, cut 2-0 above the floor wall facing the gas burner, fitted with heat-resistant, impact-resistant glazing provides useful photographic access. Flood lights should not raise the ambient temperature in the room above that specified in Section 12-8-110. The interior wall surfaces of the test room, adjacent to the corner in which the burner is located, shall be clearly marked with a 12-inch (305 mm) grid. A clock shall appear in all photographic records, giving the time to the nearest second (or 0.01 minute) from the start of the test. This clock shall be accurately synchronized with all other measurements, or other provisions shall be made to correlate the photographic record with time. Color slides shall also be taken at 15-second intervals for the first 3 minutes of the test and at a minimum of 30-second intervals thereafter for the duration of the test.

REPORT

Sec. 12-8-103. The report shall include the following items:

1. **Material description.** The name, thickness, density and size of the material shall be listed, along with other identifying characteristics or labels.
2. Materials mounting and conditioning.
3. Layout of specimens and attachments in test room.
4. Relative humidity and temperature of the room and the test building prior to and during the test.
5. The fuel gas flow to the ignition burner and its calculated rate of gross heat output.
6. The total incident heat flux at the center of the floor shall be reported for each heat flux gage as a function of time starting 1 minute prior to the test.
7. The temperature of gases in the room, the doorway, and in the exhaust duct shall be reported for each thermocouple as a function of time starting 1 minute prior to the test. The temperature recorded by the thermocouple in the duct will be used in the required calculation.
8. The volumetric flow rate of the gas in the duct shall be calculated from Equation 12 in Appendix 12-8-1A and reported as a function of time starting 1 minute prior to the test.
9. The oxygen concentration in the analyzer shall be reported as a function of time starting 1 minute prior to the test.
10. The carbon dioxide concentration, if measured in the analyzer, shall be reported as a function of time starting 1 minute prior to the test.

    Note: Separate reporting of the volumetric flow rate, temperature, oxygen and carbon dioxide and/or carbon monoxide concentrations provide diagnostic information on the performance of the exhaust gas collection system and provide a check on the heat production calculations.

11. The total rate of heat production shall be calculated from the measured oxygen and carbon dioxide and/or carbon monoxide concentrations, and the temperature and volumetric flow rate of the gas in the duct.
12. The product of the volumetric flow rate of the gas in the duct and the carbon monoxide concentration at the specified location in the combustion hood system shall be reported as a function of time after the start of the test.
13. The product of the volumetric flow rate of the gas in the duct at the duct gas temperature and the optical density per foot at the specified smoke meter location in the duct shall be reported as a function of time after the start of the test.

    Note: If this product is multiplied by 1.55×10^{-3}, for English units, it gives the smoke units produced per second, where a smoke unit is defined as the quantity of smoke which, when distributed uniformly over a cubic meter, would have an optical density of unity over a path length of 1 meter. (This is the definition used in the Proposed ASTM Test for Heat and Visible Smoke Release Rates for Materials and Products.)

14. A transcription of the visual, photographic, audio and written records of the fire test shall be provided. The records shall indicate the time of ignition of the wall and ceiling finishes, the approximate location of the flame front most distant from the ignition source, at intervals not exceeding 15 seconds during the fire test, the time of flashover, and the time at which flames extend outside the doorway. In addition, still photographs taken at intervals not exceeding 15 seconds for the first 3 minutes, beginning at the start of the test and at every 30 seconds for the remainder of the test shall be supplied. Photographs showing the extent of the damage of the materials after the test shall also be supplied. The camera settings, film speed and lighting used shall be described.
15. A report on the pretest calibration conducted in Section 12-8-113.
16. Report on the barometric pressure at time of test.
17. A complete discussion of the criteria. This shall include all calculations and references to other data used to satisfy the criteria presented in Section 12-8-115.

TEST SAMPLES

Sec. 12-8-104. Samples of the test material, both in its original (untested) and post-tested conditions, shall be retained by the testing agency. All samples shall be retained by the testing agency for a minimum period of three years from the date of the test. All samples shall measure 4 inches by 4 inches (101 mm by 101 mm) by the sample thickness. Two samples of the material in its original pretest condition shall be retained. These samples shall be taken from the same material lot used for the test samples. Post-test samples from the test shall include one each, from the geometric center of each wall panel and the ceiling panel, and one each from the following locations:

1. The top, mid-height and bottom of each wall along the vertical centerline of each wall panel.

2. The quarter points of the ceiling, in those cases in which the test material was applied to the ceiling.

All samples shall be clearly identified as to the material, test date and their location within the room.

SUMMARY OF METHOD AND HEAT SOURCE

Sec. 12-8-105.

(a) **Summary of method.** The test involves an ignition source exposure of the wall, ceiling and/or floor lining materials or assemblies as they would be incorporated in actual safety cell installation.

(b) **Heat source.** This method uses a gas burner to produce a diffusion flame in contact with the walls and ceiling in the corner of an 8-foot by 12-foot by 8-foot-high (2438 mm by 3657 mm by 2438 mm) compartment. The burner produces a prescribed gross rate of heat output as given in Table 12-8-1A and Figure 12-8-1.

The contribution of the wall, ceiling and flooring materials or assemblies to fire growth is measured in terms of the time history of the incident heat flux at the center of the floor, the time history of the temperature of the gases in the upper part of the compartment, the time to flashover and the rate of heat release. The test is conducted with natural ventilation to the test compartment provided through a single doorway 30 inches by 80 inches (762 mm by 2032 mm) in width and height. The combustion products are collected in a hood feeding into a plenum connected to an exhaust duct in which measurements are made of the gas velocity, temperature and concentrations.

IGNITION SOURCE AND LOCATION

Sec. 12-8-106.

(a) **Ignition source.** The ignition source for the test shall be a gas burner with a nominal 12 inches by 12 inches (305 mm by 305 mm) porous top surface of a refractory material.

> **Note:** A burner may be constructed with a 1-inch (25 mm) porous ceramic-fiber board over a 6-inch (152 mm) plenum; or alternatively a minimum 4-inch (101 mm) layer of Ottowa sand can be used to provide the horizontal surface through which the gas is supplied. The sand burner may be preferable for dripping materials. This type of burner is shown in Figure 12-8-7.

(b) **Burner location.** The top surface of the burner through which the gas is supplied shall be located horizontally, 12 inches (305 mm) off the floor, and the burner enclosure shall be in contact with both walls in a corner of the room opposite from the door. The edge of the diffusion surface shall be within 1 inch (25 mm) of the wall.

(c) **Gas supply.** The gas supply to the burner shall be propane and shall produce a heat source as outlined in Section 12-8-105 (b). The flow rate shall be metered throughout the test. The burner shall be so designed that it can be set at the flow rates required to produce the gross rates of heat release as specified in Section 12-8-105 (b).

(d) **Ignition.** The burner may be ignited by a pilot burner or a remote controlled spark igniter.

COMPARTMENT DIMENSIONS AND CONSTRUCTION

Sec. 12-8-107.

(a) **Compartment geometry and construction.** The interior dimensions of the floor of the fire room when the specimens are in place, shall measure 8 feet (2438 mm) ± 1 inch (25 mm) × 12 feet (3657 mm) ± 1 inch (25 mm). The finished ceiling shall be 8 feet (2438 mm) ± 0.5 inch (13 mm) above the floor. There shall be four walls at right angles defining the compartment.

> **Note:** The experimental choices for the sizes of compartment fire experiments are discussed in Section 5 of ASTM E603. The compartment size defined in this section has been chosen to make it convenient to utilize standard sized 4-foot by 8-foot (1219 mm by 2438 mm) building materials or panels.

(b) **Doorway.** There shall be a 30-inch (762 mm) ± 0.25-inch (6 mm) × 80-inch (2032 mm) ± 0.25-inch (6 mm) doorway in the center of one of the 8-foot by 8-foot (2438 mm by 2438 mm) walls, and no other wall or ceiling openings that will allow ventilation.

(c) **Wall construction.** The wall containing the door shall be of calcium silicate board of 46 pcf density and 0.5 inch (13 mm) nominal thickness. As an alternative to the calcium silicate board, 0.5-inch (13 mm) thick gypsum wallboard may be used. The door frame shall be constructed to remain unchanged during the test period to a tolerance of ± 1 percent in height and width.

(d) **Compartment construction.** The test compartment may be a framed structure or a concrete block structure. If self-supporting panels are tested, a separate exterior frame or block compartment may not be required.

(e) **Floor materials.** The floor of the test compartment shall be noncombustible as defined by ASTM E136.

SPECIMEN MOUNTING AND TEST MATERIAL SIZE

Sec. 12-8-108.

(a) **Specimen mounting.** The specimens (e.g., the ceiling and wall materials whose condition is being tested) shall be mounted on a framing or support system comparable to that intended for their field use, using backing materials, insulation or air gaps, as appropriate to the intended application and representing a typical value of thermal resistance for the wall system.

(b) **Test material size.** In the test, the ceiling material shall cover the entire ceiling if such an end use application is anticipated and the wall material shall cover three of the side walls, but not the wall containing the door. The wall and ceiling materials shall be mounted in the same wall-ceiling relationship in which they are intended for use, and it therefore may be necessary to actually construct a section of a prototype padded safety cell.

FIRE COMPARTMENT ENVIRONMENT

Sec. 12-8-109. The test building in which the fire compartment is located shall have vents for the discharge of combustion products and have provisions for fresh air intake, so that no oxygen deficient air shall be introduced into the fire compartment during the test. Prior to initiation of the test the ambient air at the mid-height entrance to the compartment shall have a velocity in any direction of less than 100 feet per minute. The building shall be of adequate size so that there shall be no smoke accumulation in the building below the level of the top of the fire compartment.

AMBIENT CONDITIONS IN TEST BUILDING AND FIRE COMPARTMENT

Sec. 12-8-110.

(a) **Ambient conditions in test building.** The ambient temperature in the test building at any location outside the fire compartment shall be above 40°F (4°C), and the relative humidity shall be less than 75 percent for the duration of the test.

(b) **Ambient conditions in fire compartment.** The ambient temperature in the fire compartment measured by one of the thermocouples specified in Section 12-8-112, Item 2., D., shall be within the range of 65°F to 75°F (18°C to 24°C) for at least 16 hours prior to the test.

(c) **Humidity.** The ambient relative humidity in the fire compartment for 16 hours prior to the test shall be within the range of 50 ± 5 percent. This may require the use of a humidifier or dehumidifier.

SPECIMEN CONDITIONING

Sec. 12-8-111. The specimens shall be conditioned prior to mounting at a temperature of 70°F ± 5°F, and at a relative humidity of 50 ± 5 percent until they reach a rate of weight change of less than 0.1 percent per day.

INSTRUMENTATION

Sec. 12-8-112. The following are the minimum requirements for instrumentation for this test:

Note: Added instrumentation may be desirable for further information.

1. **Total heat flux gages.**

   A. **Location.** Two gages shall be mounted within 5 inches (127 mm) of each other and within a distance of 2 inches (51 mm) above the floor surface upward in the geometric center of the floor.

   Note: See Figure 12-8-2.

   One additional gage shall be mounted in the wall adjacent to the ignition burner during calibration tests only.

   Note: See Section 12-8-113, Item 2.

   It shall be 6 feet (1829 mm) above the floor, and 6 inches (152 mm) from the corner where the burner is located, along the wall opposite the doorway. The front surface of the calibration gage shall be flush with the wall surface, within 0.04 inch (1 mm).

   B. **Specification.** The gages shall be of the Gardon type, with a flat black surface and a 180° view angle, and shall be maintained at a constant temperature, within ± 1.8°F above the dew point by water supplied at a temperature of 120°F to 150°F (49°C to 65°C). This will normally require a flow rate of at least 0.1 gpm. The full-scale output range shall be 5 Btu/ft.^{2}/sec. for the floor gage and 10 Btu/ft.^{2}/sec. for the wall gage.

   Note: A suitable Gardon-type heat flux gage, manufactured by the Medtherm Corporation in Huntsville, Alabama, is listed under model 64-5-18 for the 5 Btu/ft.^{2}/sec. range and under model 64-10-18 for the 10 Btu/ft.^{2}/sec. range. See R. Gardon, "An Instrument for the Direct Measurement of Intense Thermal Radiation," Review of Scientific Instruments, Vol. 24, No. 5, May 1953, pp. 36-70, for further information.

2. **Gas temperature thermocouples.**

   A. **Specification.** Twenty-mil-diameter bare chromel-alumel thermocouple wire within 0.5 inch (13 mm) of the bead should be run along expected isotherms to minimize conduction errors. The insulation between the chromel and alumel wires must be stable to at least 2000°F (1093°C) or the wires must be separated.

   Note: Metal clad ceramic powder will work satisfactorily. The commonly used silicone-impregnated glass insulation will break down above 1500°F (815°C).

   B. **Location for doorway.** A thermocouple shall be located in the interior plane of the door opening on the door centerline, 1 inch (25 mm) down from the top.

   Note: See Figure 12-8-3.

   C. **Locations for room.** Thermocouples shall be located 4 inches (101 mm) down from the center of the ceiling and from the center of each of the four ceiling quadrants, and one shall be directly over the center of the ignition burner, 4 inches (101 mm) below the ceiling. The thermocouples shall be mounted on supports, with their junctions at least 4 inches (101 mm) away from a solid surface. There shall be no attachments to the test specimens.

   Note: See Figure 12-8-3.

   D. **Location in canopy hood and duct systems.** One pair of thermocouples shall be placed 11 feet (3353 mm) downstream to the entrance to the horizontal duct. The pair of thermocouples shall straddle the center of the duct and be separated by 2 inches (51 mm) from each other.

   Note: See Figure 12-8-4.

3. **Canopy hood and exhaust duct location and design.** A hood shall be installed immediately adjacent to the door of the fire room. The bottom of the

hood shall be level with the top surface of the room. The face dimensions of the hood shall be minimum 8 feet by 8 feet (2438 mm by 2438 mm) and the depth shall be 3.5 feet (1067 mm). The hood shall feed into a plenum having a 3-foot by 3-foot (914 mm by 914 mm) cross section.

Note: See Figure 12-8-4.

The plenum shall have a minimum height of 3 feet (914 mm). The height can be increased up to a maximum of 6 feet (1829 mm) to satisfy building constraints. The exhaust duct connected to the plenum shall be 16 inches (406 mm) in diameter, horizontal, and shall have a circular aperture of 12 inches (305 mm) at its entrance.

The hood shall have sufficient draft to collect all the combustion products leaving the room. This draft should be capable of moving up to 5,000 standard cubic feet per minute (scfm) during the test. Provisions shall be made to vary the draft so that it can operate at either 1,000 or 5,000 scfm. Mixing vanes may also be required in the duct if concentration gradients are found to exist.

An alternate exhaust system design may be used if it has been shown to produce equivalent results. Equivalency may be shown by meeting the requirements of Section 12-8-113, Item 5.

4. **Duct gas velocity specification.** A bidirectional probe or equivalent measuring system shall be used to measure gas velocity in the duct.

   Note: See B. J. McCaffrey and G. Heskjestad, Combustion and Flame, 26, 125-127 (1976).

   The probe shown in Figure 12-8-6 consists of a short stainless steel cylinder 1.75-inch (44 mm) long and 0.975-inch (25 mm) inside diameter with a solid diaphragm in the center. The pressure taps on either side of the diaphragm support the probe. The axis of the probe shall be along the centerline of the duct 11 feet (3353 mm) downstream from the entrance. The taps shall be connected to a pressure transducer which shall be able to resolve pressure differences of 0.0001-inch (0.002 mm) of water.

   Notes:

   1. Capacitance-type transducers have been found to be the most stable for this application.
   2. The bidirectional probe is specified rather than the pilot-static tube in order to avoid problems of clogging with soot.

5. **Duct oxygen concentration specification.** A stainless steel gas sampling tube shall be located 13 feet (3962 mm) downstream from the entrance to the duct, to obtain a continuously flowing sample for determining the oxygen concentration of the exhaust gas as a function of time. A suitable filter and cold trap shall be placed in the line to remove particulates and water. The oxygen analyzer shall be of the paramagnetic or polarographic type and shall be capable of measuring the reduction in oxygen concentration over the range of 0.21 down to 0.15 with an accuracy of ± 2 percent in this concentration range. The signal from the oxygen analyzer must be within 5 percent of its final value in 30 seconds after introducing a step change in composition of the gas stream flowing past the inlet to the sampling tube.

6. **Duct carbon dioxide concentration specification.** The gas sampling tube defined in Section 12-8-112, Item 5, or an alternate tube in the same location, shall provide a continuous sample for the measurement of the carbon dioxide concentration with an analyzer which has a range of 0 to 20 percent and a maximum error of 2 percent of full-scale. The total system response time between the sampling inlet and the meter shall be no greater than 30 seconds.

7. **Duct carbon monoxide concentration specification.** The gas sampling tube defined in Section 12-8-112, Item 5, or an alternate tube in the same location, shall provide a continuous sample for the measurement of the carbon monoxide concentration with an analyzer which has a range of 0 to 10 percent and a maximum error of 2 percent of full-scale.

8. **Optical density of smoke in duct specification (supplementary measurement).** A meter shall be installed to measure the optical density of the exhaust gases in a vertical path across the width of a horizontal duct, 1 foot (105 mm) downstream of the duct velocity probe. A horizontal path should be used with a vertical duct.

   A suitable design for the meter is as follows:

   Use as a light source a number 1810 lamp which is rated at 6.3 volts, 0.40 amps, and 1.5 candela and is operated at 5 volts d.c. The lamp is mounted at the focal point of a + 20 diopter and 50 mm diameter double convex collimating lens. At the other side of the duct the collimated beam is intercepted by a + 10 diopter 50 mm diameter plane convex lens and concentrated onto the cathode of a 1P39 phototube. A Corning CS3-132 type 3304 filter (available from the Swift Glass Company, Box 890, Elmira Heights, NY 14903) is used in front of the phototube to correct its spectral response to the standard photopic curve of the human eye.

   The lens, filter and phototube are mounted inside of a light-tight housing which is blackened inside to minimize internal reflections. The phototube is connected to a linear operational power amplifier with an adjustable gain of 10^6 which in turn is connected to a commercially available log ratio amplifier to produce an output voltage proportional to the optical density. A smoke meter meeting the above requirements is described in a report by R. W. Bukowski, “Smoke Measurements in Large- and Small-scale Fire Testing,” NBSIR 78-1502, October 1978. Alternate systems can be used, but the color temperature of the light source must match that of the 1810 lamp under the specified operating conditions, and the light receiver, including the photo detector, must match the standard photopic curve of the eye.

The optical density shall be continuously recorded over the duration of the test. After completion of the test, the optical density reading must be less than 0.02 (transmission higher than 95 percent).

CALIBRATION AND DOCUMENTATION OF IGNITION SOURCE AND TEST EQUIPMENT

Sec. 12-8-113. A calibration test shall be performed prior to and within 30 days of any fire test. The calibration test, to last for 15 minutes, shall use the standard ignition source with inert wall and ceiling materials (calcium silicate board of 46 pcf density and 0.5-inch (13 mm) thickness. The following quantities shall be reported:

1. Once the burner is activated, the output of all instruments normally used in the test is to be measured and data recorded as a function of time.
2. The time history of the total heat flux at the wall location.
3. The maximum extension of the burner flame as recorded by still color photographs of 0.1 second exposure time taken at a minimum of 30-second intervals, or more often if it is changing rapidly. These shall be taken with a camera operating in the "operative mode" with the camera set to the standard ASA ratings of the film.
4. The temperature and velocity profiles across the duct cross-section at the location of the bidirectional probe if one is used. These profiles shall be used to determine the factor "k" in Equation 12, Appendix 12-8-1A.
5. The total rate of heat production is determined both by the oxygen consumption calculation and by the metered gas input. These must agree within 5 percent.

   Note: The net heat of combustion is 2,283 Btu/ft^3 for propane at 68°F (20°C) and 14.7 psi. This value should be used in this calculation.

TEST PROCEDURE

Sec. 12-8-114. The following paragraphs describe the steps in the test procedure:

1. Establish an initial volumetric flow rate of 1,000 cfm through the duct if a forced ventilation system is used. If a forced ventilation system is used, increase the volume flow rate through the duct to 5,000 cfm when the oxygen content falls below18 percent.
2. Turn on all sampling and recording devices and establish steady state baseline readings for at least 1 minute.
3. Ignite the gas burner and start the clock simultaneously. Increase gas flow rate in steps as indicated in Section 12-8-106 (c).
4. Take 35 mm color slides at 15-second intervals during the first 3 minutes and at 30-second intervals thereafter to photographically document the growth of the fire.
5. Provide a continuous voice or written record of the fire, which will give times of all significant events such as flame attachment to the wall, flames out of the doorway, flashover, etc.
6. The ignition burner shall be shut off at 15 minutes after initiation of the test and the test terminated at that time unless safety considerations dictate an earlier termination.
7. Photograph and verbally describe the damage after the test.

FLASHOVER AND SMOKE

Sec. 12-8-115.

(a) **Flashover.** The criterion for acceptable performance shall be that the compartment never reaches flashover at any time during the 15-minute period of ignition source burner operation. Flashover shall be considered to have occurred if one or more of the following conditions occur during the test:

1. The average ceiling gas temperature, as determined by averaging the temperature at the center and quarter point thermocouples, reaches or exceeds 1112°F (600°C).
2. The total heat flux at the floor, as determined by either of the total heat flux meters mounted in the geometric center of the floor, reaches or exceeds a value of 1.761 Btu/ft.^{2}/sec.
3. Visible flaming extends from the doorway of the test compartment.

(b) **Smoke.** Materials meeting the acceptance criteria of this standard shall have a smoke density rating no greater than 75 when tested in the thickness intended for use by UBC Standard 26-5, or when tested in accordance with UBC Standard 8-1.

MARKINGS

Sec. 12-8-116. All materials shall be provided with a manufacturer's label or other permanent marking clearly identifying the manufacturer label or other permanent marking clearly identifying the manufacturer, the product and model numbers (or brand name). Materials approved and listed by the State Fire Marshal shall be marked as required by Section 1.58, Title 19, C.A.C.

TABLE 12-8-1A
IGNITION SOURCE RATE OF HEAT RELEASE PROGRAM FOR TESTS OF SAFETY CELL PADDING MATERIALS

ELAPSED TEST TIME (Min)	BURNER GROSS RATE OF HEAT RELEASE (KW)
0	44
1	88
2	132
3	132
4	88
5-15	44

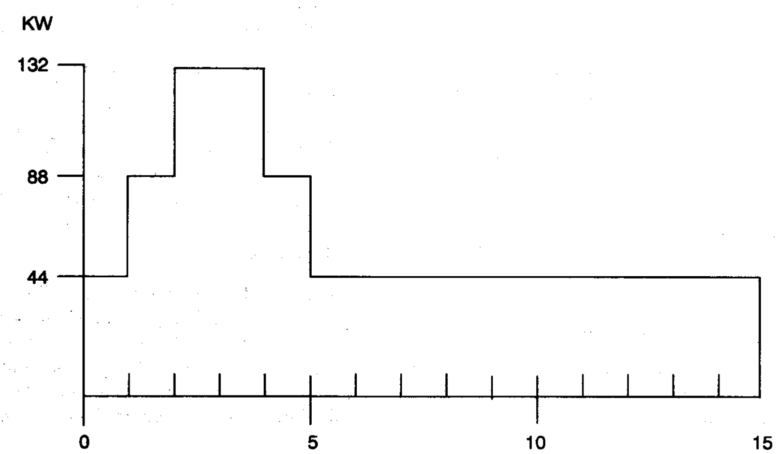


FIGURE 12-8-1—TIME—MINUTES

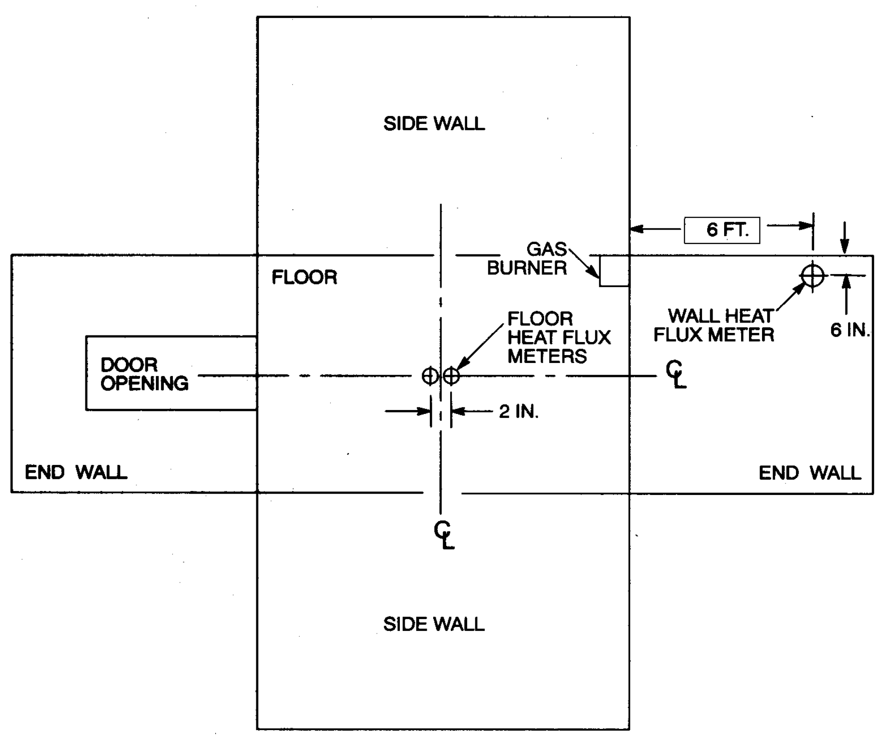


FIGURE 12-8-2—LOCATION OF HEAT FLUX METERS

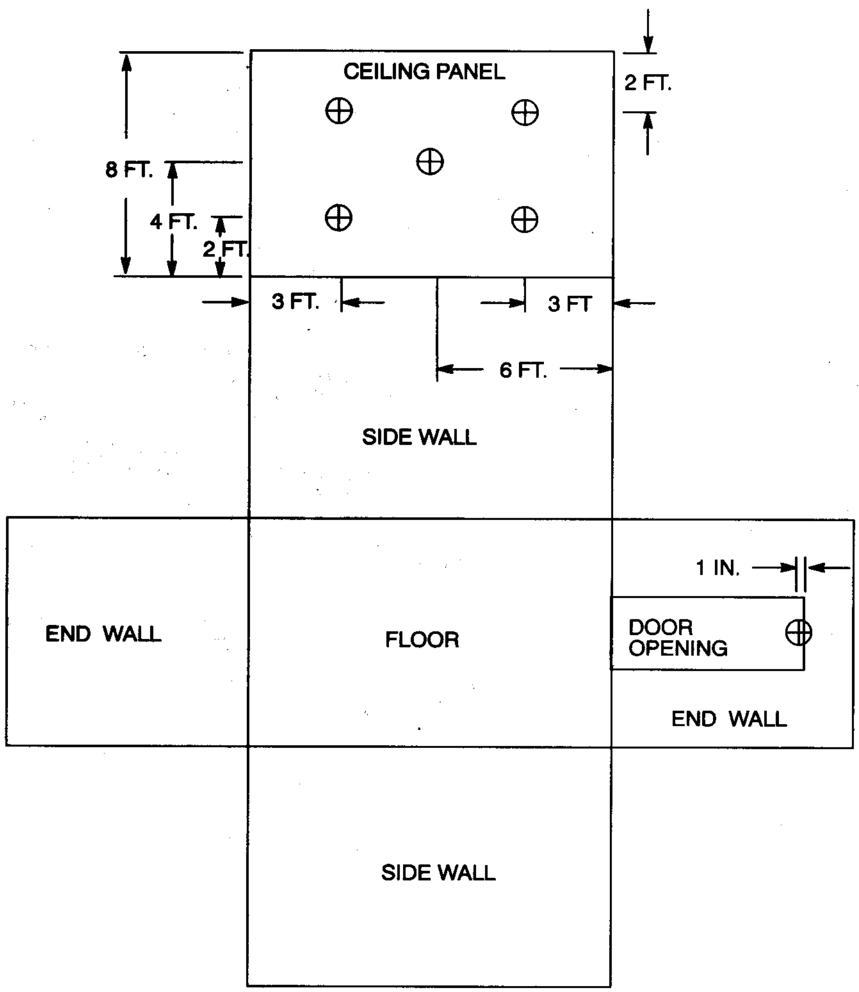
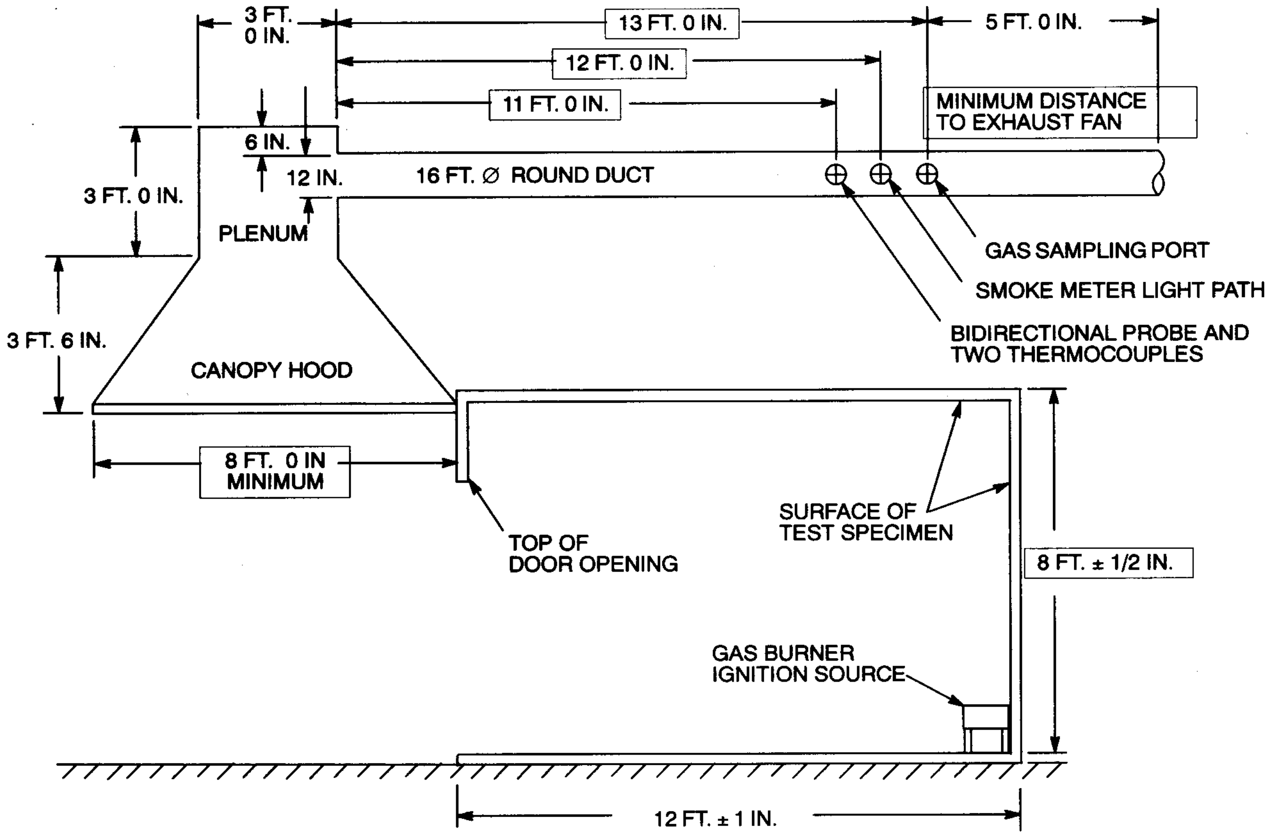


FIGURE 12-8-3—ROOM THERMOCOUPLE LOCATIONS

Note: Two 0.20 mil. Type K thermocouples at each location.



NOTES:

1. PLENUM HEIGHT MAY BE INCREASED UP TO 6 FT. TO ADJUST FOR BUILDING CONSTRAINTS.
2. SUPPORT FOR HOOD MUST NOT INTERFERE WITH AIR INFLOW TO ROOM.
3. THE EXHAUST SYSTEM MUST BE CAPABLE OF EXHAUSTING AT LEAST 5,000 SCFM. THIS MAY RESULT IN A FLOW OF UP TO 12,000 ACFM, DEPENDING ON DUCT GAS TEMPERATURE.

FIGURE 12-8-4—SECTION VIEW OF ROOM TEST APPARATUS

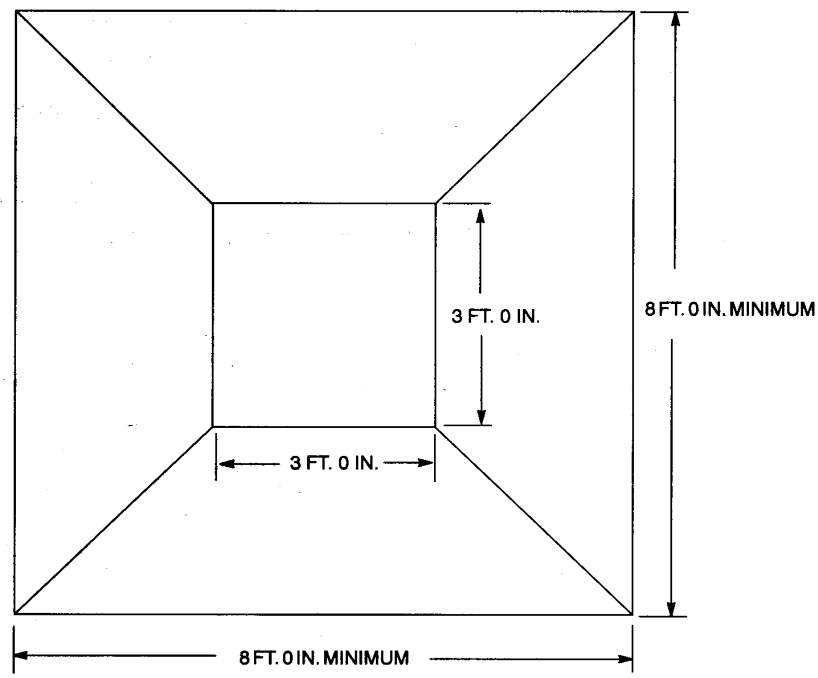


FIGURE 12-8-5—PLAN VIEW OF CANOPY HOOD

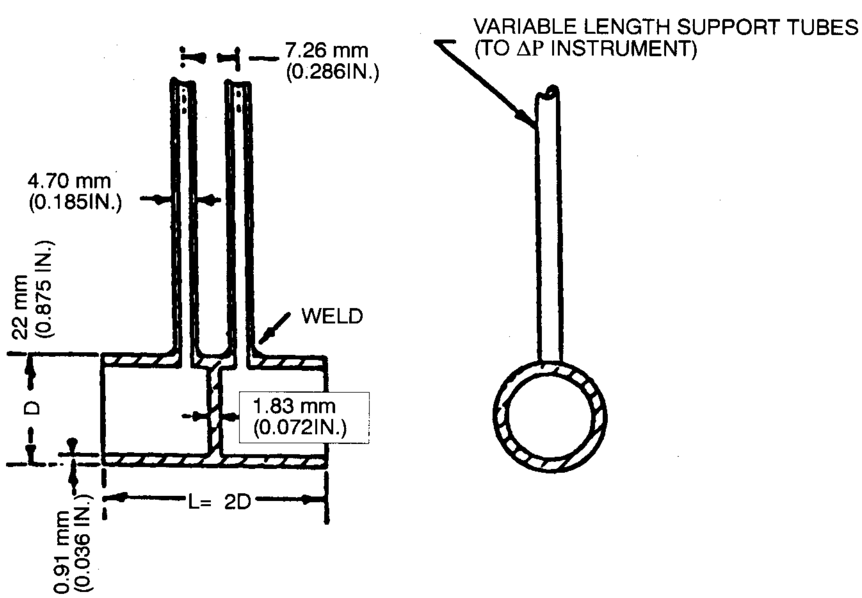


FIGURE 12-8-6—BIDIRECTIONAL PROBE

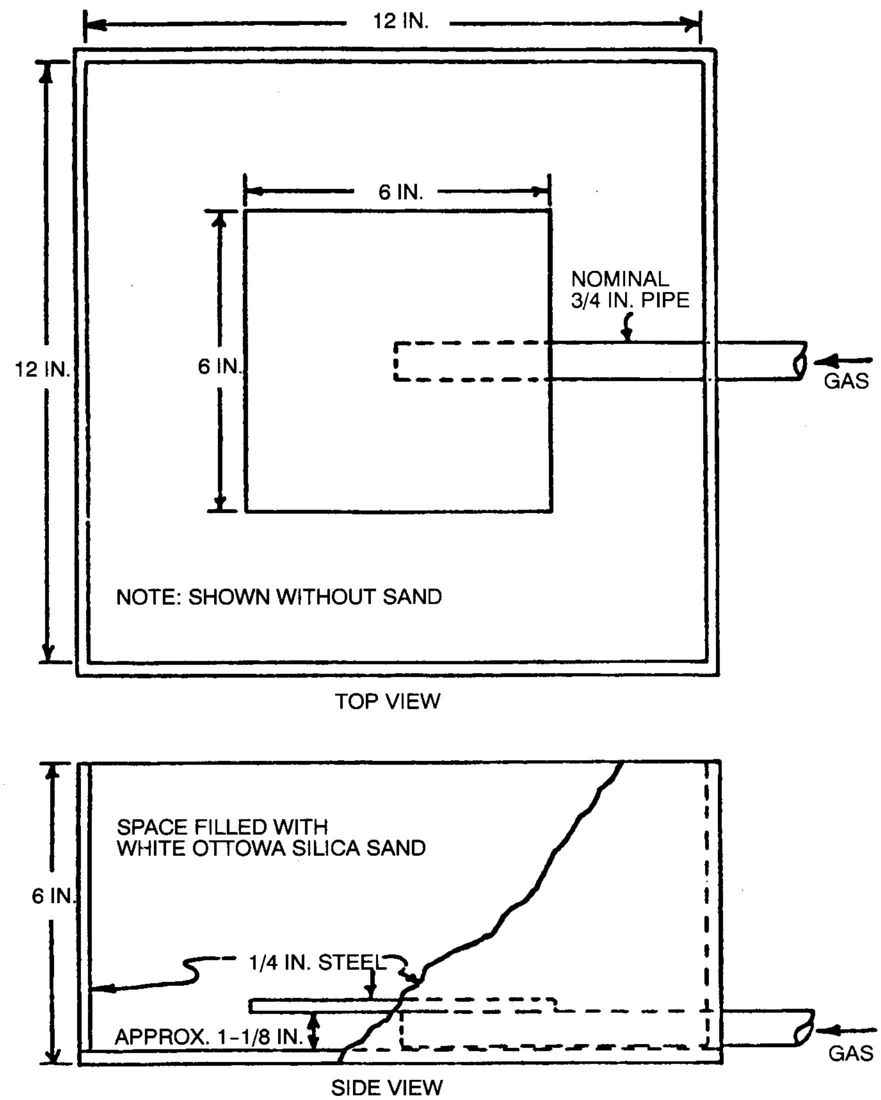


FIGURE 12-8-7—GAS BURNER

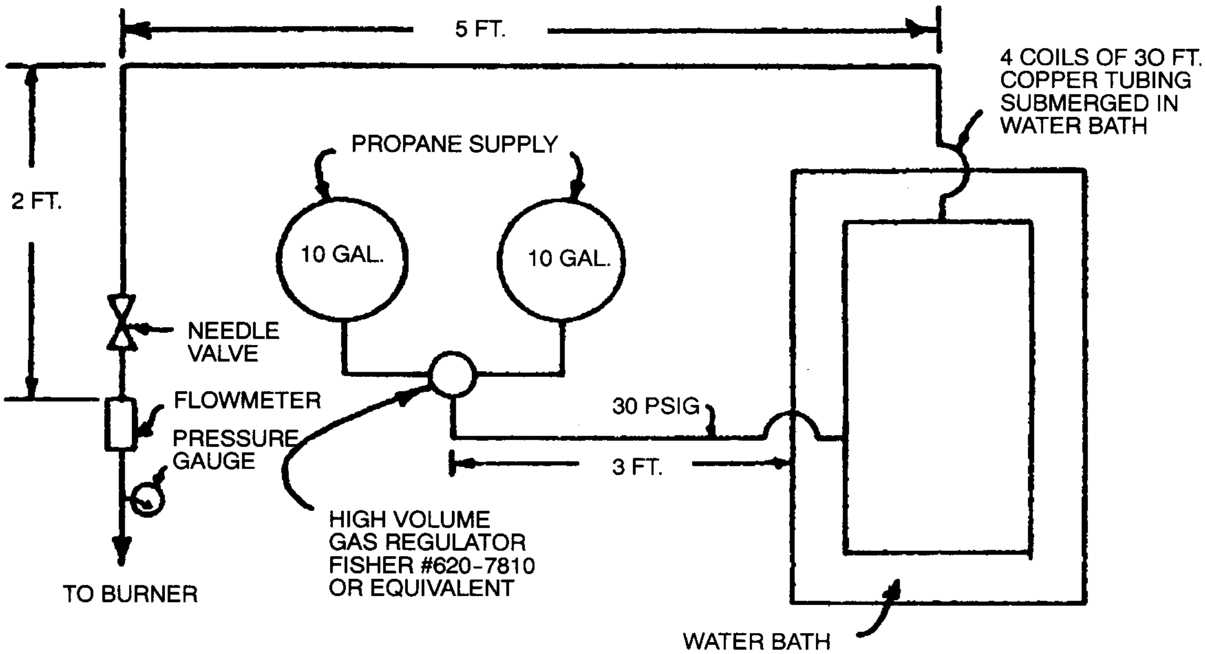


FIGURE 12-8-8—BURNER GAS FLOW CONTROL AND MEASUREMENT

APPENDIX 12-8-1A

CALCULATION OF THE TOTAL RATE OF HEAT AND CARBON MONOXIDE OR CARBON DIOXIDE PRODUCTION

The total rate of heat production is given by

$$\dot{Q} = E\phi X^0 o_2 \, V_A \tag{1}$$

where:

E = the heat release per volume of oxygen consumed, 467 Btu/ft.^{3}

ϕ = the fraction of the oxygen consumed

$X^0 o_2$ = the ambient molar concentration of oxygen

V_A = the volume flow rate of air into the system corrected to 36°F (including that which enters the room and that which passes directly into the exhaust duct).

The oxygen depletion is given by

$$\phi = \frac{M^0_{o_2} - M_{o_2}}{M^0_{o_2}} \tag{2}$$

where:

$M^0_{o_2}$ =the molar flow rate of oxygen into the system.

M_{o_2} =the molar flow rate of oxygen in the exhaust duct.

The concentrations of oxygen and carbon dioxide in the analyzers are given by

$$X_{o_2} = \frac{M_{o_2}}{M^0_{N_2} + M_{o_2} + M_{co_2}} \tag{3}$$

$$X_{co_2} = \frac{M_{co_2}}{M^0_{N_2} + M_{o_2} + M_{co_2}} \tag{4}$$

where:

$M^0_{N_2}$ = the molar flow rate of nitrogen into the system.

M_{co_2} = the molar flow rate of carbon dioxide in the exhaust duct.

It is assumed that all the water is trapped out and that the only gases passing through the analyzers are nitrogen, oxygen and carbon dioxide.

Combining Equations 3 and 4 to get

$$M_{co_2} = \frac{X_{co_2} M_{o_2}}{X_{o_2}}$$

and noting that

$$X^0{}_{o_2} = \frac{M^0{}_{o_2}}{M^0{}_{N_2} + M^0{}_{o_2}}$$

Equation 3 can be solved for M_{o_2},

$$M_{o_2} = \frac{M^0{}_{o_2}[(X_{o_2}/X^0{}_{o_2}) - X_{o_2}]}{1 - X_{o_2} - X_{co_2}} \tag{5}$$

which, when substituted into Equation 2, yields

$$\phi = \frac{X^0{}_{o_2} - X_{o_2}/(1 - X_{co_2})}{X^0{}_{o_2}[1 - X_{o_2}/(1 - X_{co_2})]} \tag{6}$$

The volumetric flow rate in the exhaust duct is given by

$$V_S = (1 - \phi)\, V_A + \phi V_A \tag{7}$$

where:

V_S = referred to standard conditions 68°F.

V_A = referred to standard conditions 68°F.

= the expansion factor, due to chemical reaction, of the air that is depleted of its oxygen.

$$= X^0{}_{N_2} + bX^0{}_{o_2} = 0.79 + 0.21b \tag{8}$$

where b is the ratio of the moles of combustion products formed to the moles of oxygen consumed. The value of ranges from 1.000 for carbon to 1.175 for cellulose with the plastics having values in between. In order to reduce the error incurred when unknown products are burning is taken to have an intermediate value of 1.084 which is exact for propane, the burner gas.

From Equation 7, the volumetric flow rate of air entering the system is

$$V_A = V_S / [1 + (-1)\phi] \tag{9}$$

Setting: = 1.084

E = 467 Btu/ft^3

$X^0{}_{o_2}$ = 0.21

Equation 1 becomes

$$\dot{Q} = \frac{E\phi X^0_{o_2} V_s}{1 + (-1)\phi} = \frac{98.1\phi V_s}{1 + 0.084\phi} \text{ Btu/min.} \tag{10}$$

if V_S is in cfm referred to 68°F.

Setting E = 17.4 MJ/m^3

$$\dot{Q} = \frac{3.65\phi V_s}{1 + 0.084\phi} MW \tag{11}$$

where:

V_S = in m^3/sec, and is determined from the flow measurement in the exhaust duct

ϕ = the oxygen depletion, which is obtained from Equation 6.

When the velocity is measured with a bidirectional probe and the Reynolds number correction is taken into account, the volumetric flow rate in m^3/sec. in the duct under standard conditions is given by

$$V_S = 0.926kA\,[(2\rho/_O)\,(T_O/T)]\,^1/_2 = 20.1kA\sqrt{\rho/T} \quad (12)$$

where:

0.926 = a suitable calibration factor for air velocities in excess of 3 ft./sec. in a 16-inch (406 mm) duct

k = the ratio of the average duct gas mass flow per unit area, as determined by measuring the velocity and temperature profiles across the stack, and the velocity and temperature at the center line where the bidirectional probe is located during the test

A = the cross-sectional area of the duct in m^2 at the location of the probe

ρ = the differential pressure measured with the probe in Pa

o = the density of air in kg/m^3 at the reference temperature T_O in K

T = the duct gas temperature in K

The volumetric flow rate can be expressed in standard cubic feet per minute (scfm) at 60°F using common engineering units by

$$V_S = 8.38 \times 10^4 kA\,[\rho/(t + 459)]^1/_2 \text{ scfm} \quad (13)$$

where:

A = given in ft^2 and in. of water

ρ = given in ft^2 and in. of water

t = the duct gas temperature in °F.

The volume flow rate of CO in m^3/sec. through the duct can be found from the formula

$$V_{co} = \frac{0.79 V_s X_{co}}{(1 + 0.084\phi)(1 - X_{o_2} - X_{co_2} - X_{co})} \quad (14)$$

where:

X_{CO} = the concentration of carbon monoxide measured in the analyzer.

This can be derived as follows

$$\frac{V_{co}}{V_A} = \frac{M_{co}}{M_{AIR}} = \frac{M_{co}}{M_{o_2}} = \frac{M_{o_2}}{M^0_{o_2}}\,\frac{M^0_{o_2}}{M_A} = \frac{X_{co}M_{o_2}}{X_{o_2}M^0_{o_2}}\,X^0_{o_2} \quad (15)$$

where:

M_{CO} and M_A = the molar flow rates of carbon dioxide in the duct and of the air into the system including that flowing into the room and that entering the exhaust duct directly.

The ratio of the CO and O_2 concentration in the duct are the same as in the analyzer so that

$$\frac{M_{co}}{M_{o_2}} = \frac{X_{co}}{X_{o_2}} \quad (16)$$

When CO is present in the sampling line, Equation 5 becomes

$$M_{o_2} = M^0_{o_2}\,\frac{(X_{o_2}/X^0_{o_2}) - X_{o_2}}{1 - X_{o_2} - X_{co_2} - X_{co}} \quad (17)$$

Equation 14 is obtained by combining equations 15, 16 and 17, letting

$$1 - X^0_{o_2} = 0.79\text{, and letting}$$

$$V_A = \frac{V_s}{1 - 0.084\phi}$$

When CO is not measured, but is removed from the sample line and CO is measured, ϕ and $\dot{Q}$ are calculated as follows

$$\phi = \frac{X^0{}_{o_2} - (X_{o_2}/1 - X_{co})}{X^0{}_{o_2}(X_{o_2}1 - X_{co})} \quad (18)$$

$$\dot{Q} = [\phi - ((E'' - E')/E')((1 - \phi)/2)(X_{co}X_{o_2})]$$

$$E'X_{o_2}V_A(MW) \quad (19)$$

where:

E'' = 23.4 MJ/m^3

E' = 17.4 MJ/m^3

V_A = m^3/sec.

referred to a 68°F base. Thus, $\dot{Q}$ becomes

$$\dot{Q} = [\phi - 0.345((1 - \phi)2)/(X_{co}/X_{o_2})]$$

$$17.4X^0_{o_2}V_A(MW) \quad (20)$$

When Equations 18 through 20 are used to calculate the rate of heat release, $\dot{Q}$, the carbon dioxide must be removed from the sample streams flowing through the oxygen and carbon monoxide analyzers. The removal of carbon dioxide can be accomplished by passing the sample stream through a filter of either ascarite or an aqueous solution of sodium hydroxide.

APPENDIX 12-8-1B

GUIDE TO MOUNTING TECHNIQUES FOR WALL AND CEILING INTERIOR FINISH MATERIAL

GENERAL

Sec. 12-8-1B.1.

(a) **Basic.** This guide is intended as an aid in determining the method of mounting various building materials in the standard fire test room. These mountings are described for test method uniformity and good laboratory practice; they are not meant to imply restriction in the specific details of field installation. They are intended to be used for general material testing where the specific details of the field installation either have not been established or are so broad that any single installation method may not be representative of the full range of installation possibilities.

(b) **Mounting methods.** The suggested mounting methods are grouped according to building materials to be tested which are broadly described either by usage or by form of the material. For some building materials, none of the methods described may be applicable. In such cases, other means of attachment may have to be devised. Wherever possible, these specimens shall be mounted using the same method of attachment as that contemplated in the field installation.

(c) All backing materials, when used, shall be supported on a framed support system. A typical supporting framework is shown in Figure 12-8-1B-1.

(d) Whenever calcium silicate board or gypsum wallboard is specified as a backing substrate in subsequent paragraphs, the material shall be 0.5-inch-thick (13 mm) calcium silicate board supplied in 4 feet by 8 feet (1219 mm by 2438 mm) sheets with a density of 46 lb/ft^3, or 0.625-inch-thick (16 mm) gypsum wallboard "Type X" supplied in 4 feet by 8 feet (1219 mm by 2438 mm) sheets with a density of 42.2 lb/ft^3, and they shall be uncoated. Where metal screws in combination with washers and wing nuts are specified for fastening, they shall be standard 0.25-inch (6 mm) by 20 TPl round head steel machine screws, 0.25-inch (6 mm) by 20 TPI steel wing nuts and 2 inch (51 mm) O.D. by 0.044-inch-thick (1 mm) flat steel washers with a 0.281-inch (7 mm) I.D. hole. Fastening screws shall be installed as shown in Figure 12-8-1B-2. The fastening pattern is shown in Figure 12-8-1B-3 for rigid wall materials and Figure 12-8-1B-4 for flexible wall materials. The fastening pattern for all ceiling materials is shown in Figure 12-8-1B-5.

ACOUSTICAL MATERIALS AND OTHER BOARD MATERIALS

Sec. 12-8-1B.2.

(a) Depending on the type of field mounting required by the acoustical product, either wood furring strips or metal runners are to be used to support acoustical material.

(b) Wood furring strips for mounting acoustical materials and other board materials are to be nominal 1-inch by 2-inch (25 mm by 51 mm) wood furring strips and attached to a gypsum wall board substrate to approximately the field installation.

(c) Metal runners for mounting are to be attached to the 0.625-inch (16 mm) gypsum wallboard substrate to approximate the field suspension systems application.

BATT OR BLANKET-TYPE INSULATING AND OTHER FLEXIBLE MATERIALS

Sec. 12-8-1B.3. Batt or blanket and other flexible materials which do not have sufficient rigidity or strength to support themselves are to be supported by round head machine screws in combination with wing nuts and flat washers, as specified in Section 12-8-1B.1 (d), which are inserted through the material in such a way as to fasten the material to a substrate board.

BUILDING UNITS

Sec. 12-8-1B.4. Materials falling within this category include organic and/or inorganic materials formed or laminated into blocks, boards, planks, slabs or sheets of various sizes, thicknesses or shapes. If building units have sufficient structural integrity to support themselves, no additional mounting to a substrate board support is required. If the building units are of such construction as to require individual components and are not self-supporting, the component is to be fastened to the substrate board as specified in Section 12-8-1B.1 (d).

COATINGS OR SPRAY APPLIED MATERIALS

Sec. 12-8-1B.5.

(a) Coating materials, such as cementitious mixtures, mastic coatings, sprayed fibers, etc., are to be mixed and applied to the substrate board as specified in the manufacturer's instructions at the thickness, coverage rate or density recommended by the manufacturer.

(b) Materials intended for application to a wood surface are to be applied to a substrate made of 1 inch by 4 inches (25 mm by 101 mm) nominal "C" and better VG Douglas fir flooring (FSC 70 to 90) or to other species for which the surface burning characteristic is to be measured.

(c) Coating materials intended for application to particular combustible surfaces, but not wood, are to be applied to the specific surface for which they are intended. The coating material and combustible material are to be attached to the substrate board as specified in Section 12-8-1B.1 (d).

(d) Coating materials intended only for field applications to nonflammable surfaces are to be applied to 0.5 in calcium silicate board.

WALL COVERING MATERIAL

Sec. 12-8-1B.6. Wall coverings such as vinyl coatings, wallpaper, etc., of various types are to be mounted on 0.625-inch (16 mm) gypsum wallboard or on the actual substrate to which they are to be applied, using the adhesive and application technique specified by the manufacturer.

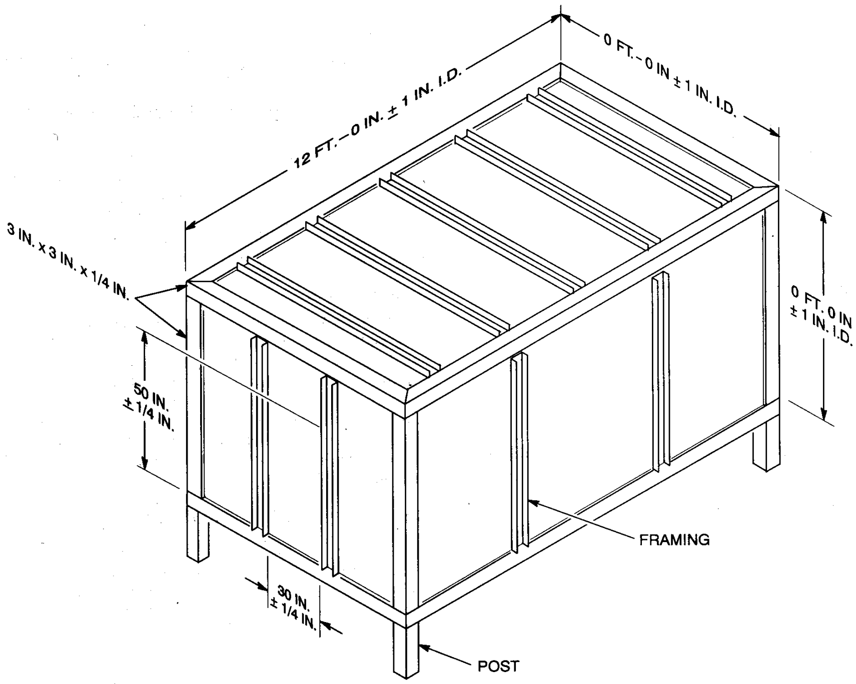


FIGURE 12-8-1B-1—TYPICAL STEEL FRAME SUPPORT SYSTEM

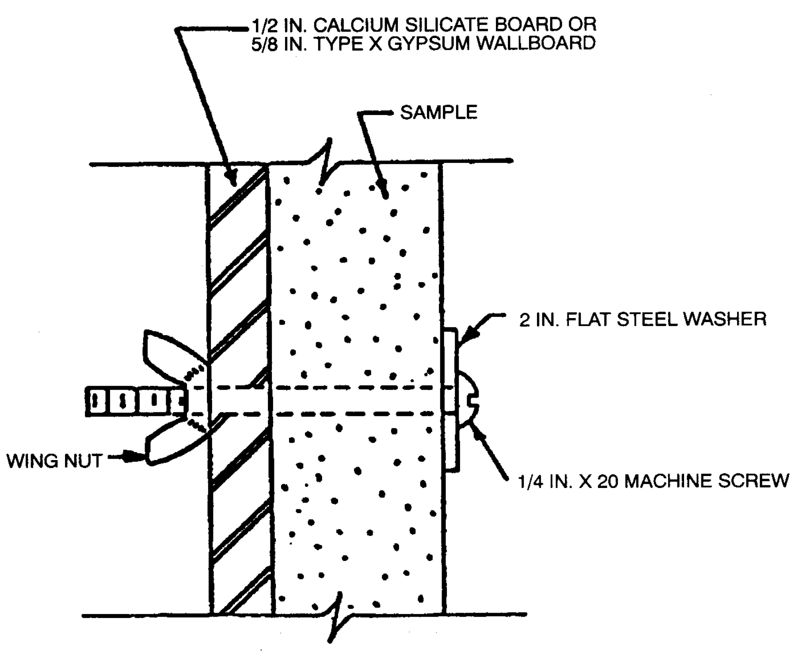


FIGURE 12-8-1B-2—MATERIAL FASTENING TECHNIQUE

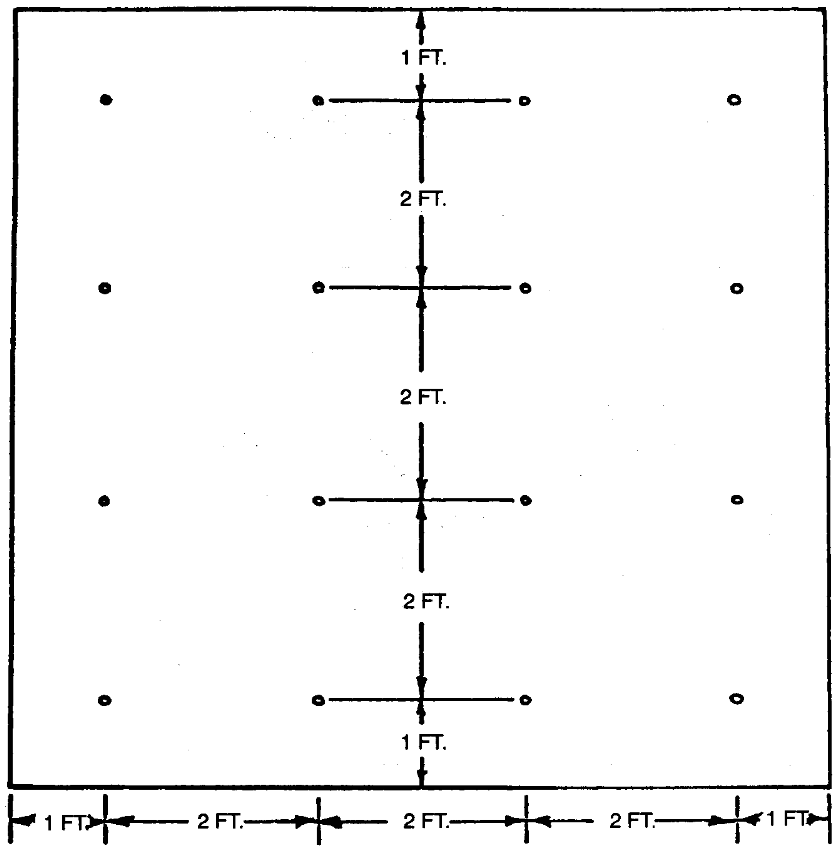


FIGURE 12-8-1B-3—TYPICAL MOUNTING TECHNIQUE FOR RIGID WALL MATERIALS

Note: When required, additional fasteners may be used to hold up the specimen flush to the wall.

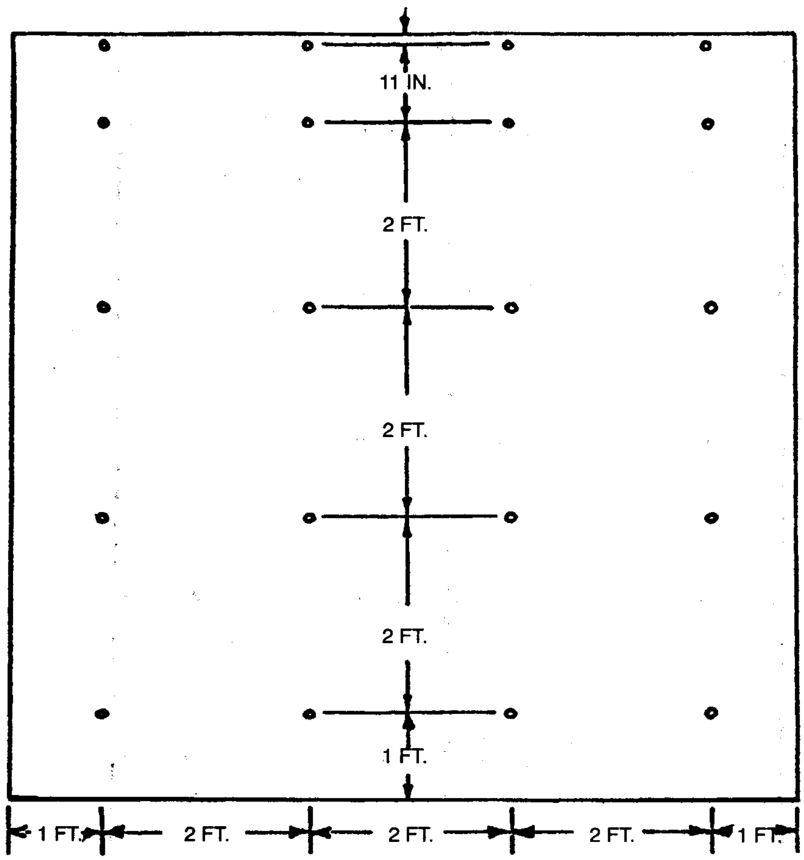


FIGURE 12-8-1B-4—TYPICAL MOUNTING TECHNIQUE FOR FLEXIBLE WALL MATERIALS

Note: When required, additional fasteners may be used to hold up the specimen flush to the wall.

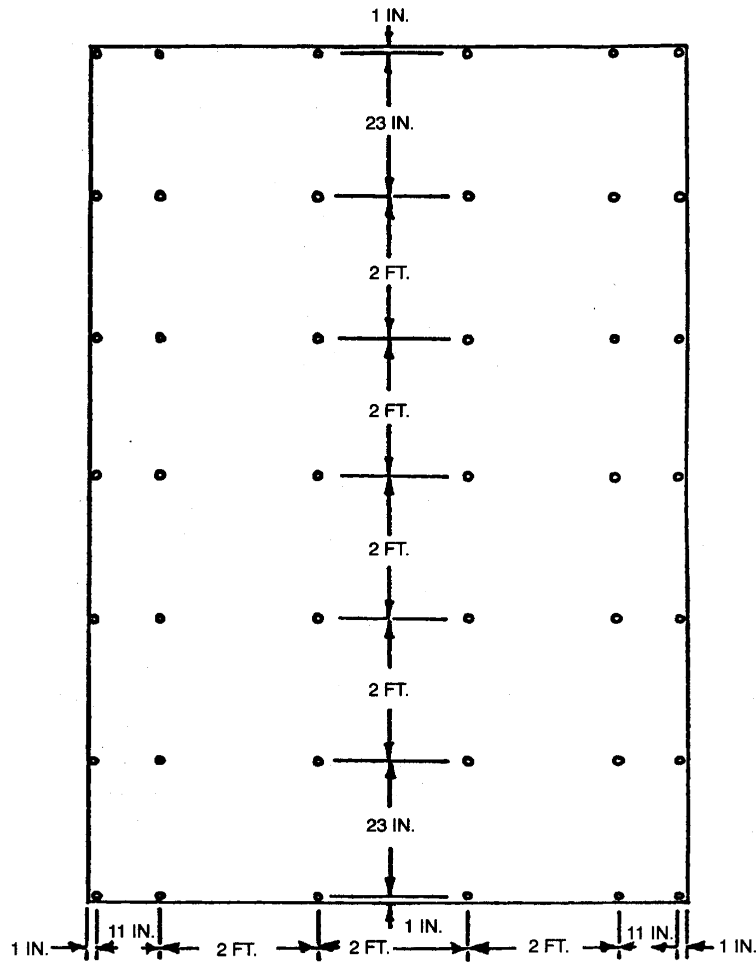


FIGURE 12-8-1B-5—TYPICAL MOUNTING TECHNIQUE FOR CEILING MATERIALS

CHAPTER 12-10-1

EXITS

POWER-OPERATED EXIT DOORS
STANDARD 12-10-1

STATE FIRE MARSHAL
SCOPE

Sec. 12-10-100.

(a) **General.** These requirements and methods of test apply to power operated: swinging doors, and combination sliding and swinging doors intended for installation in locations where conforming exits are required by Title 24, California Code of Regulations, Part 2, Chapter 10.

(b) Power-operated doors described in (a) may be provided with air, hydraulic or electric operators actuated from a floor, activating carpet, photoelectric device or other approved signaling device.

(c) **Alternates.** A product employing materials or having forms of construction differing from those described in this procedure may be examined and tested in accordance with the intent of these testing procedures and, if found to be substantially equivalent, may be recognized for listing.

(d) **Application.** The minimum design, construction and testing procedures set forth herein are those deemed as the minimum necessary to establish conformance to the regulations of the State Fire Marshal contained in Title 24, California Code of Regulations.

(e) **Fire door assemblies.** Power-operated doors intended for installation in openings where listed fire door assemblies are required, shall in addition to the requirements of this standard, be tested in accordance with the Fire Door Assembly Tests, SFM 12-7-4.

GENERAL

Sec. 12-10-101.

(a) **Panic hardware.** Power-operated doors intended for installation in openings where panic hardware is required shall be tested with listed panic hardware on the doors.

(b) **Glazed doors.** Glazing of doors shall conform to Title 24, California Code of Regulations, Part 2, Chapter 7.

(c) **Opening degree.** Where manually operated in the direction of egress, leaves of swinging doors or swing-out sections of sliding doors shall swing open to not less than 90 degrees from the closed position.

(d) **Locking mechanisms.** Locking mechanisms on doors intended for locations which do not require panic hardware shall be of a type readily identified as locked, and the doors shall be posted with durable, permanent signs reading "THESE DOORS TO REMAIN UNLOCKED WHENEVER THE PUBLIC IS PRESENT." Signs shall be 1-inch-high (25 mm) block letters on a contrasting background. Signs shall be located on the header framing.

(e) **Swinging and sliding doors.** Each swing-out leaf of swinging or sliding doors with swinging sections shall be provided with durable signs in not less than 1-inch (25 mm) block letters on contrasting background wording, "IN EMERGENCY, PUSH TO OPEN," or other approved wording. The sign shall be located at the closing edge of the door not less than 36 inches (914 mm) or more than 60 inches (1524 mm) above the floor. The sign shall read horizontally and be in two lines.

Illuminated exit signs when required by other provisions of the basic building regulations shall be installed above the header. Wiring and circuit arrangement shall conform to the provisions of the *California Electrical Code.*

(f) **Electrical wiring and devices.** Electrical wiring, electrical devices and controls shall be of a type tested and listed in conformance with the standards established by the *California Electrical Code*, or shall be tested for conformance with the testing procedures approved by the State Fire Marshal.

(g) **Testing.** Doors with power operators shall be examined and tested by a testing laboratory approved by the State Fire Marshal, or tests shall be conducted by a qualified independent fire protection engineer, acceptable to the State Fire Marshal.

(h) **Test report.** The test report shall contain engineering data and drawings; size and weight of door tested; wiring diagrams of electrical control systems; schematic drawings of mechanical controls; and operating manuals. The report shall describe the mechanical operation of the power operator in sequence as the door(s) open and close under normal and emergency conditions. The report shall set forth the tests performed in accordance with the provisions of this standard and the results thereof. The report shall additionally contain an analysis comparing each feature of the design against the performance test procedures contained herein.

(i) **Simulated installation and test equipment.** Doors with power operators shall be installed in a simulated wall and door framing assembly in accordance with the manufacturer's instructions. The test specimen shall be not less than 3 feet (914 mm) wide by 7 feet (2133 mm) high. A motor-driven or suitable mechanism shall be used to actuate the activating carpet. The rate of operation or number of cycles shall be 3 to 5 per minutes. On sliding doors with a swing-out section additional operating endurance tests shall be conducted. A motor-driven mechanism or other approved means shall be used to push the swinging door section open and pull the swinging section closed at a rate of 3 to 5 cycles per minute, so that the latching mechanism and disconnect switches operate as in service. During the test the door specimen shall have only the lubrication which is provided by the manufacturer at the factory, or as may be recommended by the manufacturer in his installation instructions.

(j) **Endurance tests.** The power operator shall function as intended to open and close the door(s) for 100,000 cycles of operation without failure or excessive wear of parts. The release mechanism and disconnect switches of the swinging section in sliding doors shall function as intended for 250 cycles of operation without failure or excessive wear of parts. The opening and closing forces, and the speed of opening and closing shall be recorded at the start of the endurance tests, and shall again be recorded at the end of the endurance tests. Opening and closing forces at the beginning and at the end of the endurance test shall not exceed the maximum forces prescribed in these procedures.

HISTORY:

1. Editorial correction (Register 71, No. 52 errata sheets).

SWINGING DOORS

Sec. 12-10-102.

(a) Each door opening when the door(s) is in the 90-degree open position, shall provide a clear opening width of not less than 28 inches (711 mm), with no single leaf less than 24 inches (609 mm) in width.

(b) **Doors in pairs.** Doors in pairs shall be equipped with a separate operator for each leaf unless tests with a tandem operator with one leaf jammed in a closed and in a partially open position indicates that the second leaf continues to operate or is free to swing into the open position without exceeding the maximum permitted manual opening pressures. On doors with mechanical controls, one mechanism shall be subjected to fault conditions; during the fault condition the second leaf shall be openable manually without exceeding the maximum permitted opening pressure.

(c) **Closing mechanism.** Normal closing of doors shall be by spring action, pressure-operated mechanism or electrically driven mechanism. The closing force measured at the closing stile shall not exceed 40 pounds at any point in the closing arc. The final 10 degrees of closing shall be not less than $1^1/_2$ seconds.

(d) Each possible fault condition that affects the power supply shall be introduced into the door and power-operator assembly. Under each fault condition, single doors and each leaf of doors in pairs shall open to the 90-degree position with an applied pressure at the normal location at the push plate not exceeding 40 pounds.

(e) **In-swinging doors.** Power-operated in-swinging doors are not recognized in determining exit width opening required to swing in the direction of egress.

(f) **Activating carpets and safety mats.**

1. When carpets are used as the activating device, they shall have a width[1] not less than 10 inches (254 mm) less than the clear width of the door opening with the centerline of the carpet in the centerline of the door opening.
2. The length[2] of activating carpets shall be not less than 42 inches (1067 mm). The length of activating carpets for doors exceeding 42 inches (1067 mm) in width shall be not less than 56 inches (1422 mm).
3. Doors serving one-way traffic only shall be provided with a safety mat[3] having a length not less than the width of the widest leaf.
4. Doors serving both egress and ingress shall have a series of joined carpets on the swing side of the door arranged as follows:
   A. One safety carpet or mat nearest to the door at least as long as the width of the door leaf;
   B. One or more activating carpets to provide a total carpet length on the swing side of not less than $2^1/_2$ times the width of the widest door leaf.

HISTORY:

1. Editorial correction (Register 71, No. 52 errata sheets).

SLIDING DOORS

Sec. 12-10-103.

(a) **General.**

1. Sliding leaves of sliding doors shall be provided with swinging sections arranged to swing in the direction of egress when pressure is applied at the location of normal push plates or on the crossbar of panic hardware on doors where panic hardware is required.
2. Operation of the swinging section shall disconnect the sliding door power operator.
3. Permanent stops shall be provided to prevent double swing.
4. Location of the breakway tension adjustment, opening and closing speed adjustment, opening and closing snub speed adjustments, opening and closing power pressure adjustments, and similar controls shall be concealed and not readily accessible where they may be subject to tampering.
5. Doors shall be suspended from overhead track. Operators, control levers or mechanisms shall be guarded.

(b) **Closing mechanism.** The closing force of sliding doors at 24 inches (609 mm) of opening shall not exceed 30 pounds with a closing speed not in excess of 1.5 feet per second.

1 Width: Shall be measured between the exposed edges of the carpet tread surface excluding molded edge bevels or aluminum edge trim.
2 Length: Shall be measured from the centerline of the doors pivot to the exposed edge of the carpet tread surface excluding molded edge bevels or aluminum edge trim.
3 Safety Mat: A safety mat is one that will prevent the door from opening if there is pressure on the safety mat before pressure is applied to the activating mat, and one that will prevent the door from closing following normal door actuation until pressure on the safety mat is removed.

(c) **Opening width.** The minimum clear width of the door opening with the swinging section, or sections in the 90-degree open position shall be not less than 28 inches (711 mm) with no single leaf less than 24 inches (609 mm) in width.

(d) **Opening forces.** The swinging section in sliding doors shall swing open into the full open position when an opening force not exceeding 40 pounds is applied at the normal push plate location or on the crossbar of panic hardware.

(e) **Fault condition introduced.** Under each possible fault condition that affects the power supply with the sliding leaf or leaves retracted one-half the leaf width into its or their pocket(s) each swinging section shall open to the 90-degree position with an applied pressure at the normal location of the push plate not exceeding 40 pounds.

(f) **Sliding doors without swing-out section.** Power-operated sliding doors which are not provided with a swing-out section may be evaluated for conformance to the mechanical requirements and endurance tests provided in this standard. Power-operated sliding doors which are not provided with a swing-out section shall not be listed for use in locations where required exits are specified in Part 2, Title 24, California Code of Regulations.

(g) **Activating carpets, safety mats.** Activating carpets and safety mats shall conform to Section 12-10-102 (f).

MARKING

Sec. 12-10-104. The name of the manufacturer, or trademark by which the manufacturer can be readily identified, shall be legibly marked on the operating equipment where it can be seen after installation. The type, model number or letter designation identifying the product as a listed device shall be provided on a label attached in a location as indicated in its listing.

CHAPTER 12-10-2

EXITS

SINGLE-POINT LATCHING OR LOCKING DEVICES

STANDARD 12-10-2

STATE FIRE MARSHAL SCOPE

Sec. 12-10-200.

(a) **Builders hardware, exit doors.** These design requirements and testing procedures apply to builders hardware, single-point latches and locks, intended for use on required means of egress doors in other than Group R and M Occupancies with an occupant load of 10 or less. It is the intent that devices designed and tested in accordance with these procedures will develop data to enable the State Fire Marshal to determine the suitability of latches and locks on means of egress doors. Alternate designs and materials may be submitted with substantiating test data. If, after evaluation, devices are found to comply with the intent of these procedures, they may also be recognized for approval and listing by the State Fire Marshal.

(b) **Fire doors.** Builders hardware single-point latches and locks intended for use on doors bearing a fire-retardant classification shall also conform to the construction standards and performance tests specified in Fire Door Assembly Tests, SFM 12-7-4, Section 12-7-400.

(c) **Listing by approved listing agency.** Listing by an approved listing agency shall not be construed as necessarily indicating compliance in all respects with the requirements of these design requirements and test procedures for single-point latching or locking devices. The test report of the approved listing agency may be filed for review and after evaluation, if it is found to provide evidence of conformance, the single-point latching or locking device may be recognized for approval and listing.

(d) **Definitions.**

1. **Inside knob.** Inside knob means the knob, lever, bar or paddle on the side of the door which must be turned or depressed to unlatch or unlock the door to permit egress.
2. **Outside knob.** Outside knob means the knob on the corridor side of room to corridor doors, or the knob on the exterior side of a door leading to the exterior.

INSTRUCTIONS

Sec. 12-10-201. Approved installation instructions shall be provided by the manufacturer. Instructions shall be illustrated and shall include directions and information adequate to ensure proper and safe installation of the device.

DESIGN

Sec. 12-10-202.

(a) **Finish.** Builders hardware shall have a smooth finish with no sharp or burred edges. Knobs may be knurled or have an abrasive finish for ease of turning or identification as may be required. Strikes shall be plain with curved lip. Strike and lip extending beyond jamb have rounded corners.

(b) **Knob, lever or "T" handle actuated.** Single-point latch bolts and/or dead bolts shall be retracted from the strike to release the door by a knob, lever or "T" handle with not to exceed $^1/_4$ turn. A thumb piece or thumb turn is not acceptable for this purpose.

(c) **Tested design.** Builders hardware single-point latching or locking devices shall be designed to retract the latch bolt and/or dead bolt after application of the horizontal forces and the endurance tests without exceeding the releasing torque specified in 12-10-204 (h).

(d) **Knobs.** Knobs shall have a minimum diameter of 2 inches (51 mm) and a maximum diameter of $2^3/_4$ inches (70 mm).

(e) **"T" handle.** "T" handles shall be oval-shaped and have minimum dimensions of $1^3/_4$ inch by 1 inch (44 mm by 25 mm) at center portion with $1^1/_4$ inch (32 mm) projection.

(f) **Levers.** The lever of lever actuated latches or locks shall be curved with a return to within $^1/_2$ inch (13 mm) of the door to prevent catching on the clothing of persons during egress.

(g) **Self-releasing knob.** The inside knob shall be free at all times. Any locking, stopworks or shut-out mechanism shall not prevent retracting the latch bolt or dead bolt to release the door by turning of the inside knob, or "T" handle, or depressing the inside lever, bar or paddle.

(h) **Dead bolt operation.** Operation of the inside knob shall retract both latch bolt and dead bolt simultaneously. The opening in the strike shall be of such dimensions that when the flat of the latch bolt is forced against the edge of the latch hole there shall be no pressure against the side of the dead bolt.

(i) **Springs.** Retraction of the latch bolt and/or dead bolt shall not depend on springs.

(j) **Backset.** Backset shall be not less than $2^3/_4$ inches (70 mm) or more than 5 inches (127 mm).

(k) **Throw.** Latches shall have a minimum latch throw of $^1/_2$ inch (13 mm). Latches intended for use on fire endurance rated doors shall also conform to the requirements of SFM 12-7-4, Section 12-7-400, Fire Door Assembly Tests.

(l) **Roller latches.** Roller latches intended for use on room to corridor doors shall have a minimum projection of $^3/_8$ inch (9.5 mm) excluding any coating or sound deadening material. Stops or staking shall be provided to provide a minimum projection of $^1/_8$ inch (3 mm). Spring design shall be such as will require an opening force of 20 pounds when the roller projects $3^1/_6$ inch (72 mm) in a door and frame with $^1/_8$-inch (3 mm) jamb clearance. Adjustment of the roller projection shall not be possible from the front of face plate.

CONSTRUCTION MATERIALS

Sec. 12-10-203.

(a) **Cases, interior working parts.** Cases, latch or lock enclosures, and interior working parts shall be of brass, bronze, steel, monel, stainless steel or of materials equivalent in mechanical strength to brass or bronze. Cases of mortise locks may be of cast iron.

(b) **Latch bolts, strikes.** Latch bolts and strikes shall be of brass, bronze, monel, stainless steel or materials equivalent in mechanical strength having corrosion resistance equivalent to brass or bronze.

(c) **Corrosion resistance.** Cases, enclosures and internal working parts shall have corrosion resistance equivalent to cadmium plating not less than 0.00015 inch (0.004 mm) thick or zinc plating not less than 0.0004 inch (0.01 mm) thick, or processed to give equal corrosion resistance as determined by comparison in salt fog atmosphere per ASTM Method B-117.

(d) **Nonmetallic materials.** Nonmetallic materials may be used as coatings or for wearing surfaces, rollers and finishes, and antifriction inserts, or for similar purpose if the material otherwise conforms to these requirements.

(e) **Springs.** Component springs used in the assembly of a latch or lock shall be of material having spring properties equivalent to stainless steel conforming to ASTM A313.67.

ENDURANCE AND PERFORMANCE TEST PROCEDURES

Sec. 12-10-204.

(a) **Testing laboratory.** Tests shall be conducted at a testing laboratory approved by the State Fire Marshal, or tests shall be conducted by a qualified independent fire protection engineer, acceptable to the State Fire Marshal, in testing facilities acceptable to the State Fire Marshal.

(b) **Report.** The test report shall include a detailed description of the latch or lock and its intended function; engineering data, shop drawings and photographs; identification of materials as to source, composition, strength and corrosion resistance; the physical or chemical tests including dimensions of parts before and after the endurance tests establishing conformance of materials. The report shall include the manufacturer's installation instructions. The report shall be verified by the laboratory or fire protection engineer responsible for the conduct of the test. The test report and evidence of listing by an approved listing agency may be provided for the applicable portions of these endurance and performance test procedures. Test reports prepared for other governmental agencies may be utilized to the extent that the test procedures contained herein have been duplicated.

(c) **Test latches or locks.**

1. **Samples.** Samples of the test latch or lock shall be selected by the testing agency or fire protection engineer at random from the manufacturer's current production runs. The types tested shall be considered to represent, for purposes of approval and listing, all lock types of a series, except that when there are variations of basic mechanical design and/or materials for mechanical parts, each variation shall be tested for compliance with the minimum performance test procedures.
2. **Modifications in design or test procedure.** Devices involving dead-locking bolts, lever handles, shear pins in the outside know or other variations in design may require modifications in the test procedure in order to simulate the intended in-service conditions. Requests for modifications in the design and test procedures shall be filed for evaluation and approval by the State Fire Marshal before proceeding with the test.

(d) **Test equipment.**

1. **Static loading.** The static loading apparatus used for the torque loading, axial load, vertical load and releasing torque tests shall consist of frame, test door and test block as detailed in Figure 12-10-2-1. Except as shown, materials shall be of steel, welded or bolted. The test apparatus may be of alternate design and construction having equivalent or greater rigidity.
2. **Endurance test.** Apparatus for the endurance test shall consist of frame and test door as shown in Figure 12-10-2-2. An alternate design having equivalent or greater rigidity may be utilized. Alternate designs utilizing components of greater dimensions or greater rigidity may affect details of the approval and listing.
3. **Test equipment.** Torque wrenches, spring scales, hydraulic or pneumatic pressure scales, or other instruments shall be calibrated in an approved manner.

(e) **Torque loading test.** Each latch or lock shall be installed in a $1^3/_4$-inch (44 mm) thick test block in accordance with the manufacturer's installation instructions. The test block shall be installed in the static loading test fixture. The torque load shall be applied to the inside door knob or lever. The knob or lever shall be turned or depressed to fully retract the latch bolt or dead bolt before application of the torque load. The applied torque load shall be 300 inch-pounds. After removal of the torque load the latch shall automatically return to its latch position, the dead bolt shall be extended to its locked position.

Subsequent hand turning of the knob or depressing the lever shall retract the latch or dead bolt. Three representative latches and/or locks shall be tested and there shall be no failures.

(f) **Axial load.** Each latch or lock shall be installed as described in Section 12-10-204 (e). A hydraulic loading device or load dynamometer shall be applied first to the outside knob and then to the inside knob or lever so that the force applied to the knob or lever is in line with the axis of the spindle. The axial load applied alternately to the outside knob and inside knob or lever shall be 500 pounds. Neither knob nor lever shall pull off under the axial load. Three representative latches and/or locks shall be tested and there shall be no failures.

(g) **Vertical load test.** Each latch or lock shall be installed as described in Section 12-10-204 (e). Each latch or lock shall be subjected to a vertical downward force applied perpendicular to the spindle axis through a sling which shall conform to the knob shape. A vertical downward force of 350 pounds shall be applied first to the outside knob and then to the inside knob or lever. Neither knob nor lever shall break off under the downward force. Three latches or locks shall be tested and there shall be no failures.

(h) **Releasing torque test.** A latch or lock set shall be installed as described in Section 12-10-204 (e). A hydraulic or pneumatic loading device shall be used to apply a horizontal force of 50 pounds against the latching edge of the test block 3 inches (76 mm) above and in the vertical center of the latch or lock spindle in such a direction that the flat of the latch bolt is forced against the edge of the latch hole in the strike. After not less than 25 unlatchings under the above-prescribed load not more than 30 inch-pounds of torque on the inside knob in either direction or 15 pounds of downward pressure on an inside lever shall be required to retract the latch bolt. After 100,000 cycles of the endurance test as described in Section 12-10-204 (i), the torque or downward pressure necessary to retract the latch bolt shall not exceed the above-prescribed limits.

(i) **Endurance test.** Five latches or locks shall be subjected to an accelerated endurance test as provided in this subsection. The locks shall be installed in the door of the endurance testing apparatus in accordance with the manufacturer's installation instructions. The latch or lock shall be operated to retract the latch, open the door, and close the door at a rate of approximately 10 cycles per minute. A cycle shall consist of the following:

1. Turn the inside knob to retract the latch bolt.
2. Open the door after the latch bolt is restricted to clear the strike.
3. Release the knob allowing the latch bolt to return to its extended position by action of its own spring.

After insertion of the latches or locks in the test door the torque in inch-pounds necessary to fully retract the latch bolts shall be recorded. The torque shall be the average recorded for the five latches or locks. Each sample shall be subjected to 800,000 operating cycles as described above. Each latch shall continue to extend itself per cycle 3 above throughout the test. At the end of the endurance test the torque to retract the latch bolts of any four latch bolts shall not exceed two times the initial average torque. If two latches fail to operate successfully at the end of the test or the torque of any four latches exceeds two times the initial average torque, an additional five latches or locks shall be subjected to the endurance test and the torque of any seven latches shall not exceed two times the initial average torque.

(j) **Roller latches.**

1. **Fire test.** Roller latches shall be installed in a composite test fire door in accordance with the manufacturer's installation instructions and subjected to the fire test as described in SFM 12-7-4, for a period of 30 minutes. The latch shall be adjusted to an opening pressure of 20 pounds applied to the closing edge immediately above the latch. Throughout the test the latch shall require an applied pressure of 20 pounds to open the door.
2. **Endurance test.** Five samples of the roller latch shall be subjected to the endurance test as described in Section 12-10-204 (i). The latch shall continue to extend the roller throughout the test without any failure. The opening pressure at the end of the test shall not be less than 15 pounds.
3. **Installation.** Doors utilizing roller latches shall be installed in doors hung in steel frames only. Frame jambs shall be anchored to the floor to prevent spreading of the jambs. In other than concrete fill floors the jambs shall be anchored to a steel sill or steel floor plate extending between the jambs to prevent spreading of the frame. Horizontal bracing shall be provided in the wall in back of the strike.

THICKNESS OF COATINGS TESTS

Sec. 12-10-205. The thickness of cadmium, zinc or bronze plated coatings applied for corrosion resistance may be determined by either of the following methods:

1. Cross sections of coated samples cut at 90 exposed edges polished and thickness measured with a suitable microscope and scale.
2. Dropping test of a suitable reagent at a definite rate until coating is penetrated. The thickness is calculated from the known characteristics of the reagent at the observed temperature and time required for the end point to appear.

Thickness testing shall not apply to other processes having equal corrosion resistance; acceptance shall be determined by comparison in salt fog atmosphere per ASTM Method B-117.

MARKING

Sec. 12-10-206. The name of the manufacturer, or trademark by which the manufacturer can be readily identified, shall be legibly marked on the latch or lock where it can be seen after installation. When the manufacturer produces similar devices, the type, model number or letter designation identifying the listed product shall be legibly marked on the latch or case. Such identification may be an approved marking or label on the case.

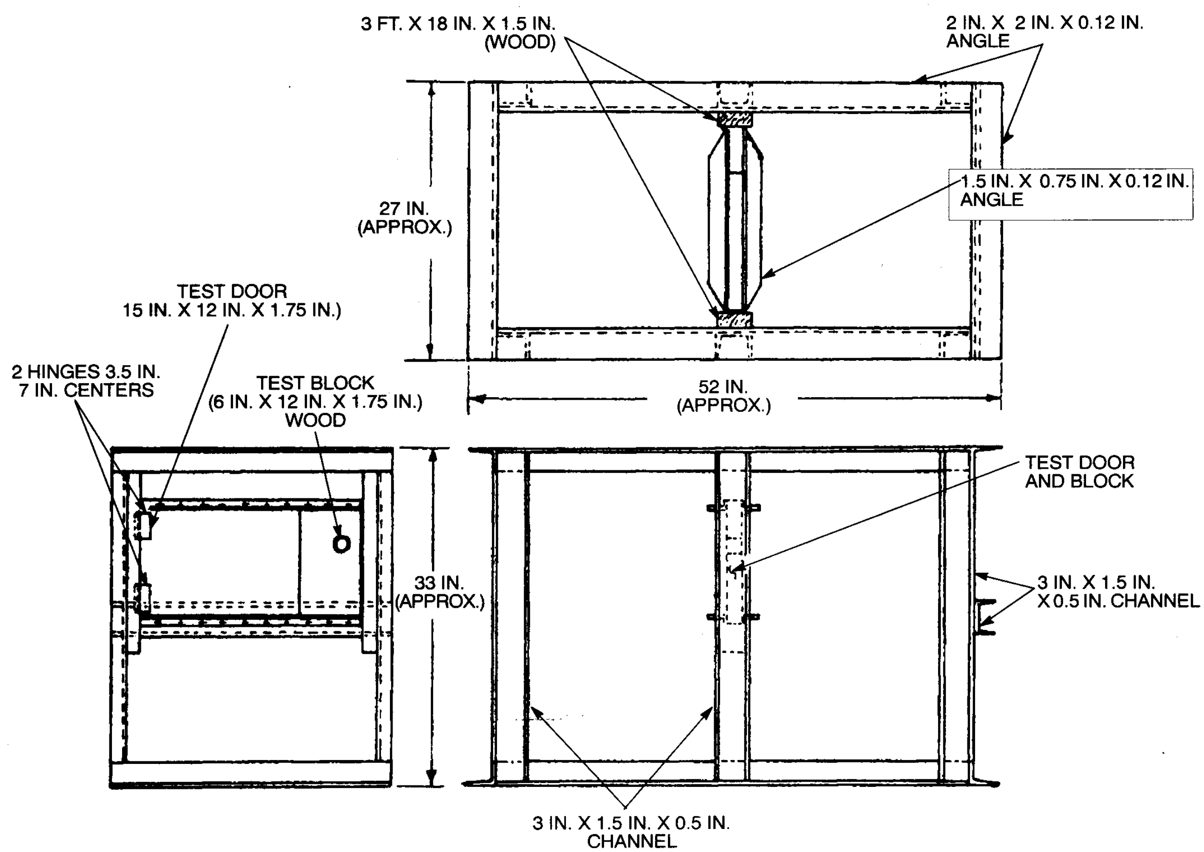


FIGURE 12-10-2-1—STATIC LOADING FIXTURE

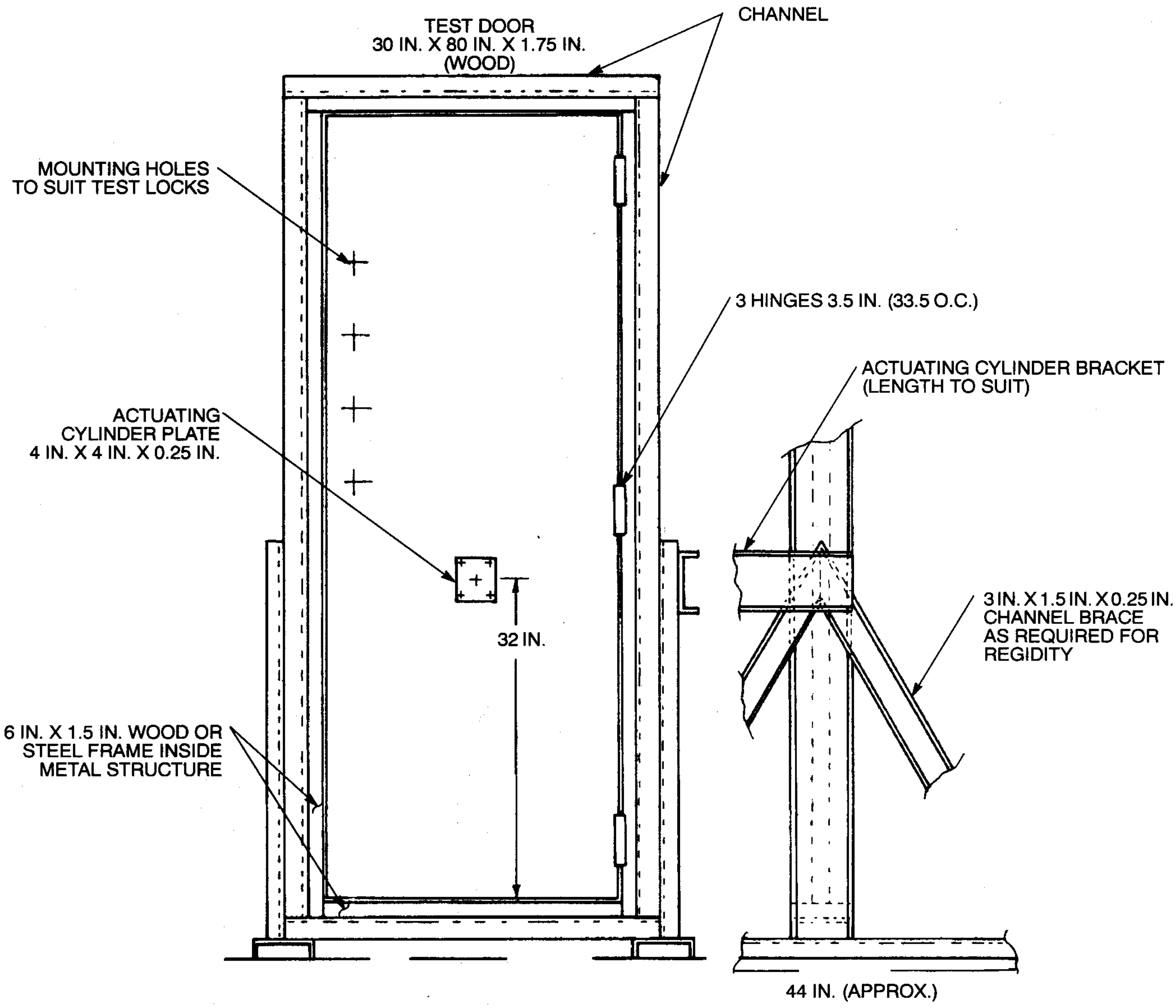


FIGURE 12-10-2-2—ENDURANCE LIFE TESTING APPARATUS

CHAPTER 12-10-3

EXITS

EMERGENCY EXIT AND PANIC HARDWARE
STANDARD 12-10-3

STATE FIRE MARSHAL
SCOPE

Sec. 12-10-300.

(a) **Exit door hardware.** These requirements and methods of test apply to releasing devices actuated by a crossbar for outward-opening doors intended for use on exit doors.

(b) **Fire-exit hardware.** Releasing devices intended for use on doors bearing a fire-retardant classification shall also conform to the construction standards and performance tests specified in Fire Door Assembly Tests, SFM 12-7-4, Section 12-7-400.

(c) **Listing by approved listing agency.** Listing by an approved listing agency shall not be construed as necessarily indicating compliance in all respects with the requirements of these Construction Standards and Performance Tests for Emergency Exit and Panic Hardware. The test report of the listing agency may be filed for review and after evaluation, if it is found to provide evidence of conformance, the releasing device assembly may be recognized for approval and listing.

INSTRUCTIONS

Sec. 12-10-301. Approved installation instructions shall be provided by the manufacturer. Instructions shall be illustrated and shall include directions and information adequate for obtaining proper and safe installation of the equipment.

DESIGN

Sec. 12-10-302.

(a) **Releasing pressure.** Exit panic hardware mechanisms shall be designed to release the door latch or latches when pressure not to exceed 15 pounds is applied at any point along the cross-bar perpendicular to the door in the direction of exit travel. The cross-bar shall extend across not less than one-half the width of the door.

(b) **Locking device.** A locking device employed as part of the mechanism shall not prevent release of the door latch or latches when pressure of not to exceed 15 pounds is applied to the cross-bar in the direction of exit travel.

(c) **Dead locking bolt.** A dead locking bolt shall not be provided as a part of the mechanism unless it is released and retracted, and does not prevent release of the door latch or latches, or release of the door to swing outward when pressure not to exceed 15 pounds is applied to the cross-bar in the direction of exit travel.

(d) **Cross bar.** The ends of the cross-bar shall be curved, guarded or otherwise designed to prevent catching on the clothing of persons during egress.

(e) **Springs.** The release mechanism shall not depend on springs to release or retract the door latch or latches, locking mechanism, dead bolt or vertical rods.

(f) **Dogging devices.** Exit panic hardware mechanisms shall not be equipped with any locking or dogging device, set screw or other arrangement which can be used to prevent release of the door latch or latches, locking device or dead locking bolt when pressure is applied to the cross-bar.

CONSTRUCTION MATERIALS

Sec. 12-10-303.

(a) **Strength.** The materials used in the assembly of a releasing mechanism shall have mechanical strength equivalent to brass or bronze to perform their intended function.

(b) **Springs.** Component springs used in the assembly of a releasing mechanism shall be of material having spring properties equivalent to stainless steel conforming to ASTM A313-67.

(c) **Corrosion resistance of moving parts.** Moving parts in the releasing mechanism assembly shall have corrosion resistance equivalent to 300 series stainless steel, or shall show no visual signs of corrosion after being subjected to a salt fog atmosphere per ASTM B117 for a period of 120 hours.

(d) **Nonmoving parts.** Nonmoving parts, cases and similar parts shall be of materials, or shall be coated to provide corrosion protection equivalent to 0.0005-inch-thick (0.01 mm) cadmium coated steel as determined by comparison in salt fog atmosphere per ASTM B117 for a period of not less than 16 hours.

(e) **Galvanic action.** Coated or uncoated metals used in the assembly of releasing mechanisms shall not be used in combination such as to cause detrimental galvanic action which may adversely affect the function of any part of the assembly.

(f) **Nonmetallic materials.** Nonmetallic materials may be used as coatings for wearing surfaces, rollers, finishes or for similar purposes if the materials otherwise conform to these requirements.

ENDURANCE AND PERFORMANCE TESTS

Sec. 12-10-304.

(a) **Testing laboratory.** Tests shall be conducted at a testing laboratory approved by the State Fire Marshal, or tests shall be conducted by a qualified independent fire protection engineer, acceptable to the State Fire Marshal in test facilities acceptable to the State Fire Marshal.

(b) **Report.** The test report shall include a detailed description of the releasing mechanism and its intended function; engineering data, shop drawings and photographs; identification of materials as to source, composition, strength and corrosion resistance; the physical or chemical tests including dimension of parts before and after the endurance tests establishing conformance of materials. The report shall include copies of the manufacturer's installation instructions. The report shall be verified by the laboratory or fire protection engineer responsible for the conduct of the test. The test report and evidence of listing by an approved listing agency may be provided for the applicable portions of these endurance and performance tests.

(c) **Test equipment.** The releasing mechanism shall be applied on a suitable door hung on heavy duty ball bearing butts or pivots installed in a suitable metal frame in accordance with the manufacturer's instructions. A motor-driven mechanism shall be used to actuate the cross-bar so as to release the latches or dead-locking bolts, push the door open and jerk the door shut so that the latches or dead-locking bolts operate as in service. The rate of operation or number of cycles shall be approximately ten per minute. For the test the assembly is to have only the lubrication which is provided at the factory or as recommended by the manufacturer in his installation instructions.

> **Note:** Mechanisms involving dead-locking bolts may require modification in the test procedure in order to simulate the intended in-service condition. Modifications in the test procedure shall be filed for evaluation and approval before proceeding with the test.

(d) **Releasing pressure.** The motor-driven mechanism shall be arranged to apply not to exceed 15 pounds pressure against the cross-bar to release the door latch(es) or dead-locking bolts before the door is pushed open.

(e) **Cycle test.** The release mechanism and latches or dead-locking bolts shall function as intended for 100,000 cycles of operation without failure or excessive wear of the parts.

EMERGENCY OPERATION TEST

Sec. 12-10-305.

(a) **Releasing pressure.** The release mechanism shall be so designed that a horizontal force of 50 pounds or less will actuate the release bar and latches or dead-locking bolt when the latched or locked door is subjected to outward pressure as described in Sections 12-10-305 (c) and (d). The horizontal force shall be applied at any point along the cross-bar perpendicular to the door in the direction of swing.

(b) **Test specimen.** The test specimen for the emergency operation test shall be the sample which has been previously subjected to the cycle test specified in Section 12-10-304.

(c) **Testing instrument.** The horizontal force applied to the cross-bar shall be measured with a calibrated spring scale or other approved means.

(d) **Outward pressure, single door.** A hydraulic loading device or load dynamometer shall be used to apply a horizontal force of 250 pounds against the latching edge in the direction in which the door opens. The thrust load shall be applied to the stile immediately above the latching mechanism.

(e) **Outward pressure, double doors.** A hydraulic loading device or load dynamometer shall be used to apply a horizontal force of 250 pounds against the lock stile of each door of doors in pairs 2 inches (51 mm) in from the edge at midpoint between top and bottom of each door leaf in the direction of door swing.

(f) **Release bar deformation.** The cross-bar on a 36-inch (914 mm) wide door shall not be permanently set or deformed in excess of $^1/_4$ inch (6 mm), by the test; a spacing of at least 1 inch (25 mm) is to be provided and maintained between the cross-bar and the face of the door when the horizontal force is applied against the cross-bar.

MARKING

Sec. 12-10-306. The listee's name (or approved symbol), type or model designation shall be plainly marked on the releasing assembly. Devices and assemblies which are not listed by an approved listing agency for the intended purpose shall bear a label or other identifying markings as approved by the State Fire Marshal.

CHAPTERS 12-11A AND 12-11B

BUILDING AND FACILITY ACCESS SPECIFICATIONS

Detectable warning products and directional surfaces installed after January 1, 2001, shall be evaluated by an independent entity, selected by the Department of General Services, Division of the State Architect-Access Compliance, for all occupancies, including transportation and other outdoor environments, except that when products and surfaces are for use in residential housing evaluation shall be in consultation with the Department of Housing and Community Development. See Government Code Section 4460.

PRODUCT APPROVAL FOR DETECTABLE WARNING PRODUCTS AND DIRECTIONAL SURFACES

SCOPE

Sections 12-11A.202 and 12-11B.202. These requirements and test methods apply to detectable warning products and directional surfaces.

DETECTABLE WARNING PRODUCTS

Sections 12-11A.203 and 12-11B.203. Must comply with the California Code of Regulations, Title 24.

DIRECTIONAL SURFACES

Sections 12-11A.204 and 12-11B.204. Must comply with the California Code of Regulations, Title 24.

INDEPENDENT ENTITY

Sections 12-11A.205 and 12-11B.205. Evaluation by an independent entity to confirm the prescriptive and performance standard of detectable warning products or direction surfaces installed after January 1, 2001. An independent entity is a not-for-profit product safety testing and certification organization, dedicated to testing for public safety. An independent entity would operate for the testing, certification and quality assessment of products, systems and services.

TWO-YEAR APPROVAL

Sections 12-11A.206 and 12-11B.206. Detectable warning products and directional surfaces are to be recertified every two years without exception or waiver.

FEE

Sections 12-11A.207 and 12-11B.207. The Division of the State Architect-Access Compliance may impose a fee on manufacturers of the specified products, to cover the cost of detectable warning products and directional surfaces.

DISABILITY ACCESS ACCOUNT

Sections 12-11A.208 and 12-11B.208. The fees received from manufacturers will be placed in the Disability Access Account.

DETECTABLE WARNING PRODUCTS AND DIRECTIONAL SURFACES

Sections 12-11A.209 and 12-11B.209. Detectable Warning Products and Directional Surfaces must ensure consistency and uniformity:

(a) Shape,

(b) Color fastness,

(c) Conformation,

(d) Sound-on-cane acoustic quality,

(e) Resilience, and

(f) Attachment will not degrade significantly for at least five years.

SIGNIFICANT DEGRADATION

Sections 12-11A.210 and 12-11B.210. Significant degradation means that the product maintains at least 90 percent of its approved design characteristics.

SELECTION OF INDEPENDENT ENTITY

Sections 12-11A.211 and 12-11B.211. The independent entity selected by the Division of the State Architect-Access Compliance shall be recognized as having appropriate expertise in determining whether products comply with the California Code of Regulations, Title 24.

Authority: Government Code Sections 4450, 4460 and Health & Safety Code Section 18949.1.

Reference: Government Code Section 4460.

CHAPTER 12-12

RESERVED

CHAPTER 12-13

STANDARDS FOR INSULATING MATERIAL

(See Part 6, Title 24, CCR)

DEPARTMENT OF CONSUMER AFFAIRS
Bureau of Home Furnishings and Thermal Insulation

Article 3. Standards for Insulating Material

APPLICATION AND SCOPE

Sec. 12-13-1551.

(a) This article establishes standards governing the quality of insulation sold within the state after September 22, 1981, including those properties which affect the safety and thermal performance of insulation during application and in the use intended.

(b) The provisions of this article shall apply only to the following types of insulating material:

1. Aluminum foil (reflective foil);
2. Cellular glass (board form);
3. Cellulose fiber (loose fill and spray applied);
4. Mineral aggregate (board form);
5. Mineral fiber (blankets, board form, loose fill);
6. Perlite (loose fill);
7. Polystyrene (board form, molded and extruded);
8. Polyurethane (board form and field applied);
9. Polyisocyanurate (board form and field applied);
10. Urea formaldehyde foam (field applied);
11. Vermiculite (loose fill).

(c) The provisions of this article shall apply to the sale of insulating material within the state. The provisions of this article shall not apply to insulating material manufactured in California, but sold outside the state, nor to insulating material manufactured outside California and sold wholesale in California for final retail sale outside the state. For the purpose of this article, the sale of a building or an appliance which contains installed insulating material is not considered the sale of the insulating material.

(d) Any type of insulating material not listed in subsection (b) may be sold within California notwithstanding any other provision of this article.

Authority: Sections 25920 and 25922, Public Resources Code.

Reference: Sections 25910, 25920, 25921 and 25922, Public Resources Code.

HISTORY:

1. Repealer of Article 3 (Sections 1551-1561) filed 8-11-78; effective thirtieth day thereafter (Register 78, No. 32). For prior history, see Registers 76, No. 16; 78, Nos. 2 and 26.
2. New Article 3 (Sections 1551-1565) filed 1-16-79; effective thirtieth day thereafter (Register 79, No. 3).
3. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

DEFINITIONS

Sec. 12-13-1552. For purposes of this article, the following definitions shall apply:

(a) **"Approved laboratory"** means any testing facility including a facility owned or operated by a manufacturer which has been approved pursuant to Section 1554 of this article.

(b) **"ANSI"** means the American National Standards Institute.

(c) **"ASTM"** means ASTM International.

(d) **"Building materials"** means materials used in walls, ceilings, roofs and floors of buildings.

(e) **"Exposed application"** means any interior application of the product in which it is not used in a construction assembly imposing a material which meets the requirements of Chapter 8 of the *California Building Code* in substantial contact with the facing or membrane surface.

(f) **"Installed design density"** means the proven density for loose fill insulation other than cellulose which has been determined by the manufacturer to constitute the density whereby settlement of no more than 2 percent shall occur over the first three years, or no more than 4 percent over the first 15 years of installation.

(g) **"Insulating material" or "insulation"** means any material listed in Section 1551 (b) of this article and placed within or contiguous to a wall, ceiling, roof or floor of a room or building, or contiguous to the surface of any appliance or its intake or outtake mechanism, for the purpose of reducing heat transfer or reducing adverse temperature fluctuations of the building room or appliance.

(h) **"Manufacturer"** means any person who either:

1. Produces insulating material in the final composition either for use in the form sold or to be further dimensionally modified; or
2. In the case of polyurethane, polyisocyanurate and urea formaldehyde foam formed at the installation site, produces the primary components of the material.

"Manufacturer" shall not include any building contractor or any other person whose sole activity is to install insulation at the installation site.

(i) **"Quality assurance program." (Reserved)**

(j) **"Recommended wall density"** means the density used for pressure fill retrofit wall applications to prevent settling.

(k) **"Representative sample"** means a sample of insulating material with the same characteristics (other than thickness) and using the same facing imposed on the insulating material manufactured for final use.

(l) **“Representative thickness”** means a thickness of insulating material at which the change in thermal performance per inch will vary no more than plus or minus 2 percent with increases in thickness.

(m) **“TAPPI”** means Technical Association of Pulp and Paper Industry.

(n) **“Thermal performance”** means the tested thermal conductivity, thermal conductance or thermal resistance (*R*-value), as appropriate, of an insulating material.

(o) **“Urea formaldehyde foam”** means a cellular plastic insulation material generated in a continuous stream by mixing the components which are a urea formaldehyde resin, air and a foaming agent.

Authority: Sections 25920 and 25922, Public Resources Code.

Reference: Sections 25915 (a), 25920, 25921 and 25922, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

QUALITY STANDARDS

Sec. 12-13-1553. The manufacturer shall cause the testing of samples of insulating material for conformity with the quality standards described in this section.

(a) **General testing provisions.** In testing any material pursuant to this section, the following general procedures shall be used.

1. All tests with the exception of the ANSI/ASTM E84-79 test shall be conducted using representative samples at the representative thickness of the insulation, except that when the final use of an insulating material entails a thickness less than the representative thickness, then the insulating material will be tested at the lesser thickness.
2. Where uniformity of product ensures consistency of test results across a product grouping, test results for one may be used for certification of other products within that product group. The manufacturer shall provide sufficient documentation to establish a valid basis for applying a particular test result to other products within the group.

   The Executive Director shall determine whether a valid basis exists for grouping products for testing pursuant to this subsection. If it is determined that a valid basis does not exist, individual tests shall be required. A manufacturer may appeal the Executive Director’s determination to the full Commission.
3. Thermal performance of building insulations shall be stated in *R* value. Other insulations shall use thermal conductivity, conductance or *R* value as appropriate.
4. All thermal performance tests shall be conducted on materials which have been conditioned at 73.4° ± 3.6°F and a relative humidity of 50 ± 5 percent for 24 hours immediately preceding the tests. The average testing temperature shall be 75° ± 2°F with at least a 40°F (4°C) temperature difference.
5. Aluminum foil insulation shall be tested according to ANSI/ASTM C236-66 to determine the thermal performance in horizontal, upward and downward directions. The tested thermal performance in the heat-flow direction or directions of the intended application shall be labeled on the material. The manufacturer shall test once in each direction of intended application, except that for products labeled with only one heat-flow direction, the manufacturer shall test two samples in that direction.
6. Insulation (other than aluminum foil insulation materials) for which additional value is claimed for facings and air spaces shall be tested for thermal performance as a material without the air space pursuant to this article. The manufacturer may elect to report additional thermal performance values of a given construction tested according to ANSI/ASTM C236-66 for that construction as long as full details of that construction are also disclosed in the certification statement and pursuant to Section 1557 (c) of this article. If a manufacturer elects to report a thermal performance value for a material plus an air space (as supplemental information to the required material thermal performance), but not necessarily for a full construction, the manufacturer must also disclose the conditions of the test and the limitations to the attainment of that result.
7. Except as provided in Items 5 and 6, the thermal performance test results certified under Section 1555 of this article shall be the average of the values obtained from at least three tests.
8. The average measured thermal performance of the tests required by Items 5, 6 and 7 shall not be more than 5 percent below the value specified on the product. In addition, all insulation material sold within the state after September 22, 1981, shall have a measured thermal performance not more than 10 percent below the value specified on the product.
9. All numbered test descriptions shall be contained in the document “Test Descriptions for Insulating Material” dated February 27, 1981.
10. Facings on representative samples may be removed or modified by slitting for the ANSI/ASTM C177-76 and ANSI/ASTM C518-76 tests.
11. All thermal performance testing equipment used for testing insulating materials shall be calibrated with samples referenced to the United States National Bureau of Standards.
12. Manufacturers of loose fill insulations for which no settled density test is required by this section shall be required to include the installed design density in the identifying information described in Section 1557. The manufacturer shall provide suf-

ficient documentation to establish a valid basis for the determination of installed design density.

The Executive Director shall determine whether a valid basis exists for the installed design density claimed by the manufacturer. If it is determined that a valid basis does not exist, the director may assign an appropriate installed design density or may require an appropriate test to determine the installed design density. The manufacturer may appeal the Executive Director's determination to the full Commission.

13. Within 180 days after the availability of appropriate representative thickness calibration samples from the National Bureau of Standards, all insulating materials thicker than 1 inch (25 mm), which have not previously been tested at the representative thickness of a representative sample, shall be tested at representative thickness and recertified. Test results and a revised certification statement will be submitted to the Executive Director. The Executive Director shall determine if and when an appropriate representative thickness calibration sample is available from the National Bureau of Standards and shall publish a list of available representative thickness calibration samples. The manufacturer may appeal the Executive Director's determination to the full Commission.

14. All products which may be used for pressure fill retrofit wall application shall be separately tested for thermal performance using a sample prepared at the manufacturer's recommended wall density for such applications.

15. All water heater insulation kits and nonpreformed pipe insulation shall be tested for thermal performance at the installed compressed thickness of a typical application. Installed compressed thickness shall be determined according to Test Description Number 6. All nonpreformed duct insulation shall be labeled, in accordance with Section 1557(c), with an installed *R*-value equal to the *R*-value of the uncompressed insulation times 0.75.

(b) **Aluminum foil.**

1. **Composition.** The insulation shall have uniform flat surfaces and shall not be crumpled, torn or punctured. Aluminum foil shall contain not less than 99 percent aluminum. Kraft paper and flangeboard shall meet the requirements of ANSI/TAPPI T400 0S75. Flangeboard used for more than two insulation layers shall be of 28 point grade minimum, if single sheet flangeboard is used or 14 point grade minimum if double sheet flangeboard is used.

   Adhesive used in bonding shall be waterproof and shall show no sign of bleeding when tested in accordance with the following test procedure. Bleeding at cut edges may be disregarded.

   Specimens for tests shall consist of pieces of insulation cut to approximately 3 by 6 inches (76 mm by 152 mm), suspended in a vertical position and heated to a temperature of 180°F ± 5°F for at least 5 hours. At the end of heating period, examine the reflective surfaces to determine whether the adhesive has bled or extruded through the surface, or delamination has occurred.

2. **Thermal performance.** Thermal performance shall be determined according to ANSI/ASTM C236-66. The test panel shall consist of a panel utilizing a wooden frame of 2 by 6 inches (51 mm by 152 mm) construction covered with $^{3}/_{4}$-inch (19 mm) plywood on both sides. The resultant thermal performance shall be based on the insulation only.

3. **Size.** Layers of insulation composed of unsupported foil that is exposed shall have a minimum thickness of 0.0004 inch (0.01 mm). Unsupported foil that is sandwiched in a multilayer sheet shall have a minimum thickness of 0.00035 inch (0.009 mm). Foil bonded to kraft paper shall have a minimum thickness of 0.00025 inch (0.006 mm). Minimum space between layers of a multilayer sheet shall conform with the United States General Services Administration insulation standard HH-I-1252B dated August 18, 1976.

4. **Resistance to combustion.** Surface-burning characteristics shall be determined according to the ANSI/ASTM E84-79, and shall not exceed the following values:

   Flame spread 25
   Smoke developed 50

5. **Pliability.** Foil shall be folded and the folded edge smoothed using a light finger pressure. The finished insulation shall not crack when folded to 180° bend at a temperature of 70° ± 2°F and a relative humidity of 50 ± 5 percent.

(c) **Cellular glass in board form.**

1. **Composition.** The material shall consist of a glass composition which has been foamed or cellulated under molten conditions, annealed and set to form a rigid material with hermetically sealed cells.

2. **Thermal performance.** Determination of the thermal performance shall be based on a representative sample and shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.

3. **Resistance to combustion.** Surface-burning characteristics shall be determined according to ANSI/ASTM E84-79, and shall not exceed the following values:

   Flame spread 25
   Smoke developed 50

(d) **Cellulose fiber in loose fill form.**

1. **Composition.** The basic material shall consist of virgin or recycled wood-based cellulosic fiber and may be made from related paper or paperboard stock, excluding contaminated materials and extraneous foreign materials such as metals and glass which may reasonably be expected to be retained in

the finished product. Suitable chemicals may be introduced to improve flame resistance, processing and handling characteristics. The particles shall not be so fine as to create a dust hazard, and the added chemicals shall not create a health hazard. The materials used must be capable of proper adhesion to the additive chemicals.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ ASTM C518-76 at the manufacturer's option.

3. **Density.** The density shall be determined according to the United States General Services Administration insulation standard HH-I-515D dated June 15, 1978, or as amended October 11, 1979, at the manufacturer's option. Cellulose insulation made from newsprint may use a 13 percent settling percentage along with the drop box procedure in place of the humidity cycling procedure described in HH-I-515D dated June 15, 1978. All other tests for loose fill cellulose fiber insulation prescribed by this section shall be conducted at the settled density as determined herein.

4. **Resistance to combustion.** Flammability characteristics shall comply with the standard for flammability and smoldering combustion in 44 Fed. Reg. pages 39966-39973.

5. **Resistance to fungi.** Resistance to fungi shall be determined according to Method 508 of the March 10, 1975, edition of the Military Standard for Environmental Test Methods known as MIL-STD-810C, except the spore suspensions shall be prepared using distilled water. The core of gypsum wall board shall be used as the control. After the test exposure, the test samples shall show no more fungal growth than the control material when examined at 40 times magnification.

6. **Corrosiveness.** The product shall comply with the standard for corrosiveness set forth in 44 Fed. Reg. pages 39966-39973.

7. **Odor emission.** Odor emission shall be determined according to Test Description Number 3. A detectable odor of objectionable nature observed by two or more of the panel members shall be cause for rejection.

8. **Identification.** Each insulation container shall be marked with the type (pouring or pneumatic), net weight and the manufacturer's recommendations for installation including minimum thickness, maximum coverage and settled density to provide the levels of thermal performance shown. Manufacturer's installation recommendations shall include precautions according to the *California Electrical Code* Section 410-66.

Insulation which may be used for pressure fill retrofit wall application shall be marked with the recommended wall density to prevent settling and separately marked with the tested thermal performance for such applications.

(e) **Cellulose fiber spray applied.**

1. **Composition.** The basic material shall consist of virgin or recycled wood-based cellulosic fiber and may be made from related paper or paperboard stock, excluding contaminated materials and extraneous foreign materials such as metals and glass which may reasonably be expected to be retained in the finished product. Suitable chemicals may be introduced to improve flame resistance, processing, adhesive and cohesive qualities, and handling characteristics. The added chemicals shall not create a health hazard.

   The basic material shall be processed into a form suitable for installation by pneumatic conveying equipment and simultaneous mixing with water and/or adhesive at the spray nozzle.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.

3. **Resistance to combustion.** Flammability characteristics shall comply with the standard for flammability and smoldering combustion in 44 Fed. Reg. pages 39966-39973.

4. **Corrosiveness.** The product shall comply with the standard for corrosiveness set forth in 44 Fed. Reg. pages 39966-39973.

5. **Bond strength.** The bond strength shall be determined by Test Description Number 3 and the bond shall support a force five times the weight of the sample for 1 minute.

6. **Bond deflection.** The bond deflection shall be determined by Test Description Number 4 and shall be greater than $^{1}/_{60}$th of the length of the sample.

7. **Air erosion.** The air erosion shall be determined by Test Description Number 5 and shall withstand an air velocity of 800 ft/min.

8. **Odor emission.** Odor emissions shall be determined by Test Description Number 1. A detectable odor of objectionable nature observed by two or more panel members shall be cause for rejection.

9. **Fungi resistance.** Resistance to fungi shall be determined according to Method 508 of the March 10, 1975, edition of the Military Standard for Environmental Test Methods known as MIL-STD-810C, except the spore suspensions shall be prepared using distilled water, and observations shall be made at 7-day intervals during the 28-day cycle to determine the minimum length of time required for fungal growth to appear. Viability of the spore organisms shall be determined by injecting or inoculating a separate bottle of culture medium with

the spore preparation for each organism and observing for growth and individual viability. The back side of $^1/_2$-inch (13 mm) standard commercial grade gypsum wall board grayback paper surface shall be used as the control. After the test exposure, the test samples shall be examined at 40 times magnification for evidence of fungal growth. The material shall show no more fungal growth than the control material.

10. Test procedures described in Items 5, 6 and 7 are not required of products which are installed in such a manner that physical restrictions imposed by the construction elements preclude any possibility of subsequent delamination, erosion or dusting and the product is identified only for such installations.

(f) **Mineral aggregate in board form.**

1. **Composition.** The basic material shall be mineral in nature, crushed, dried and graded to the proper particle size and expanded by the application of heat to form a spherical, cellular type of aggregate. It shall be composed of spherical cellular beads of expanded aggregate and fibers formed into rigid, flat, rectangular units and shall have an integral water proofing treatment. It shall be clean, dry and free of extraneous material. Fibers shall be evenly distributed and insulation and facings shall be sufficiently coherent to be unaffected by handling and installation.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.

3. **Resistance to combustion.** Surface-burning characteristics of materials with facings and membranes intended for exposed applications shall be determined according to ANSI/ASTM E84-79 and shall not exceed the following values:

   Flame spread 25
   Smoke developed 450

   Facings and membranes of materials intended for exposed applications shall be exposed to the flame during the ANSI/ASTM E84-79 test.

   Insulation boards exclusive of facings and membranes shall not exceed the following values:

   Flame spread 25
   Smoke developed 50

(g) **Mineral fiber in blanket form.**

1. **Composition.** The basic material shall be fibers made from mineral substances such as rock, slag or glass processes from a molten state into fibrous form.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.

3. **Size.** The thickness shall be determined according to ANSI/ASTM C167-64.

4. **Resistance to combustion.** Surface-burning characteristics of materials with facings and membranes intended for exposed applications shall be determined according to ANSI/ASTM E84-79 and shall not exceed the following values:

   Flame spread 25
   Smoke developed 450

   Facings and membranes of materials intended for exposed applications shall be exposed to the flame during the ANSI/ASTM E84-79 test.

   Insulation blankets not intended for exposed applications shall comply with the United States General Services Administration insulation standard HH-I-521F dated September 4, 1980, for flammability and smoldering combustion testing.

5. **Corrosiveness.** Corrosiveness shall be determined according to Test Description Number 2. The steel test plate in contact with the insulation shall show no greater corrosion than a steel plate in contact with sterile cotton.

6. **Resistance to fungi.** Resistance to fungi shall be determined according to Method 508 of the March 10, 1975, edition of the Military Standard for Environmental Test Methods known as MIL-STD-810C except the spore suspensions shall be prepared using distilled water. The core of gypsum wall board shall be used as the control. After the test exposure, the test samples shall show no more fungal growth than the control material when examined at 40 times magnification.

7. **Odor emission.** Odor emission shall be determined according to Test Description Number 1. A detectable odor of objectionable nature observed by two or more of the panel members shall be cause for rejection.

(h) **Mineral fiber in board form.**

1. **Composition.** The basic material shall be made from mineral substances such as rock, slag or glass processed from a molten state into a fibrous form. Insulation shall be composed of mineral fibers with water resistant binder added and formed into flat, rectangular units. Insulation boards shall be uniform in quality, free from defects, such as broken edges, splits or loose materials which would impair its intended use.

   Roof insulation boards shall have either integral waterproofing treatment or a waterproof coating on one surface. The coating shall be flush with the edges of the sides and may be flush with or extend over both ends.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.

3. **Resistance to combustion.** Surface-burning characteristics of materials with facings and membranes

intended for exposed applications shall be determined according to ANSI/ASTM E84-79 and shall not exceed the following values:

Flame spread. 25
Smoke developed 450

Facings and membranes of materials intended for exposed applications shall be exposed to the flame during the ANSI/ASTM E84-79 test.

Insulation boards exclusive of facings and membranes shall not exceed the following values:

Flame spread. 25
Smoke developed 50

(i) **Mineral fiber in loose fill form.**

1. **Composition.** Mineral fiber insulation shall be made from mineral substances such as rock, slag or glass processed from a molten state into fibrous form. The insulation shall be mechanically processed to produce a mineral fiber suitable for pneumatic or poured application.
2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.
3. **Density.** The density shall be determined according to installed design density. All tests shall be conducted at the installed design density.
4. **Resistance to combustion.** Loose fill insulation shall comply with the United States General Services Administration insulation standard HH-I-1030B dated August 12, 1980, for flammability and smoldering combustion testing.
5. **Corrosiveness.** Corrosiveness shall be determined according to Test Description Number 2. The steel plate in contact with the insulation shall show no greater corrosion than a steel plate in contact with sterile cotton.
6. **Resistance to fungi.** Resistance to fungi shall be determined according to Method 508 of the March 10, 1975, edition of the Military Standard for Environmental Test Methods known as MIL-STD-810C, except the spore suspensions shall be prepared using distilled water. The core of gypsum wall board shall be used as the control. After the test exposure, the test samples shall show no more fungal growth than the control material when examined at 40 times magnification.
7. **Odor emission.** Odor emission shall be determined according to Test Description Number 1. A detectable odor of objectionable nature observed by two or more of the panel members shall be cause for rejection.
8. **Identification.** Each insulation container shall be marked with the type (pouring or pneumatic), the net weight and the manufacturer's recommendations for installation including minimum thickness, maximum coverage and installed design density to provide the levels of thermal performance shown. Manufacturer's installation recommendations shall include precautions according to the *California Electrical Code* Section 410-66.

Products which may be used for pressure fill retrofit wall application shall be marked with the recommended wall density to prevent settling and separately marked with the tested thermal performance for such applications.

(j) **Perlite in loose fill form.**

1. **Composition.** Expanded perlite loose fill insulation shall be produced by the expanding of natural perlite or by heating.
2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option.
3. **Density.** Density shall be determined according to installed design density. All tests except the ANSI/ASTM E84-79 test shall be conducted at the installed design density.
4. **Resistance to combustion.** Resistance to combustion shall be determined by the use of the Attic Floor Radiant Panel Test, as described in the United States General Services Administration insulation standard HH-I-515D Section 3.1.9 as amended October 11, 1979.
5. **Identification.** Each insulation container shall be marked with the type (pouring or pneumatic), the net weight and the manufacturer's recommendations for installation including minimum thickness, maximum coverage and installed design density to provide the levels of thermal performance shown. Manufacturer's installation recommendations shall include precautions according to the 1993 *National Electrical Code* Section 410-66.

Products which may be used for pressure fill retrofit wall application shall be marked with the recommended wall density to prevent settling and separately marked with the tested thermal performance for such applications.

(k) **Polystyrene in board form.**

1. **Composition.** Insulation board shall be formed by the expansion of polystyrene resin beads or granules in a mold or the insulation board shall be formed by the expansion of polystyrene base resin in an extrusion process. The insulation shall be uniformly fused, homogeneous and essentially unicellular. Insulation board shall be uniform in physical properties and reasonably free of voids or accumulations of unexpanded material, foreign inclusions, broken corners and broken edges.
2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option. All foam insulation materials using materials other than air or pentane as an expanding agent shall either sep-

arately condition samples at 73.4° ± 3.6°F and a relative humidity of 50 ± 5 percent, and at 140°F dry heat and test at 30-, 60- and 90-day intervals or shall test samples certified by an approved testing laboratory to have been aged while exposed to free air in a well ventilated room for at least two years at 70° ± 10°F, provided, however, that until $2^1/_2$ years after the adoption of these quality standards by the Commission, test samples may be aged for six months for certification of the material.

Notwithstanding any other provision of this article, this thermal performance standard shall not take effect until 250 days after adoption. If the certification statement submitted pursuant to Section 1555 of this article does not include test results for thermal performance, the manufacturer shall submit a new certification statement which includes such test results prior to 250 days after adoption. If the latest certification statement is based on the six-month aging test, a new statement, based upon the two-year aging test or the accelerated aging test shall be submitted by $2^1/_2$ years after the adoption date.

3. A. **Resistance to combustion.** The material shall be tested to meet the requirements of Sections 2603.2 and 2603.3 of the *California Building Code*, with the additional provision that the surface-burning characteristics shall be determined according to ANSI/ASTM E84-79 and shall not exceed the following values:

   Flame spread 75
   Smoke developed. 450

   Exception: Polystyrene foam insulation boards with a maximum thickness of 2 inches (51 mm) when installed below a minimum 3.5-inch-thick (89 mm) concrete slab on grade.

   B. This subsection shall not apply to any product recognized by the International Conference of Building Officials, as of the date of adoption of these regulations, as complying with Sections 2602.1-2602.6 of the 1994 *Uniform Building Code* based solely upon diversified testing. The manufacturer of any product which is recognized by the International Conference of Building Officials, subsequent to the date of approval of these regulations, as complying with Sections 2602.1-2602.6 of the 1994 *Uniform Building Code* based solely upon diversified testing, may petition the Commission for an exemption of that product from the provisions of this subsection.

4. **Dimensional stability.** All foamed polystyrene insulation materials which are factory formed shall be tested for dimensional stability in accordance with Procedures E and G of ASTM D2126-75 with the following exceptions: (a) sample size shall be 12 inches by 12 inches (305 mm by 305 mm) ± 1 inch (25 mm), and (b) samples shall be tested as manufactured with or without facers.

The average percent change in length or width shall not exceed ± 2 percent in 24 hours or ± 4 percent in 7 days. The average percent change in thickness shall not exceed ± 10 percent in 7 days. Samples shall be regarded as failing if: (1) delamination area of "faced" samples exceeds 25 percent or (2) warping or cupping exceeds $^1/_4$ inch (6 mm) when checked by a straight edge across raised diagonal corners.

(l) **Polyurethane and polyisocyanurate in board form and field applied.**

1. **Composition.** The manufacture of the insulation shall be based mainly on the reaction of an organic polyisocyanate with a polyol resin.

   Board shall be of uniform texture, reasonably free from accumulation of unexpanded material and foreign inclusions, and reasonably free of broken edges and corners. It shall be reasonably free from holes, voids, depressions and objectionable odor. Laminated composite boards shall be included in this quality standard. The faces of laminated boards shall adhere firmly throughout to the foam, and shall show no excessive amounts of slits, voids or depressions.

2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C518-76 at the manufacturer's option. All foam insulation materials using materials other than air or pentane as an expanding agent shall either separately condition samples at 73.4° ± 3.6°F and a relative humidity of 50 ± 5 percent, and at 140°F (60°C) dry heat and test at 30-, 60- and 90-day intervals or shall test samples certified by an approved testing laboratory to have been aged while exposed to free air in a well ventilated room for at least two years at 70° ± 10°F, provided, however, that until $2^1/_2$ years after the adoption of these quality standards by the Commission, test samples may be aged for six months for certification of the material.

   Notwithstanding any other provision of this article, this thermal performance standard shall not take effect until 250 days after adoption. If the certification statement submitted pursuant to Section 1555 of these regulations does not include test results for thermal performance, the manufacturer shall submit a new certification statement which includes such test results prior to 250 days after adoption. If the latest certification statement is based on the six-month aging test, a new statement, based upon the two-year aging test or the accelerated aging test shall be submitted by $2^1/_2$ years after the adoption date.

3. **Dimensional stability.** All foamed polyurethane and polyisocyanurate insulation materials which are factory formed shall be tested for dimensional stability in accordance with Procedures E and G of ASTM D2126-75 with the following exceptions: (a) sample size shall be 12 inches by 12 inches (305 mm by 305 mm) ± 1 inch (25 mm) and (b) samples shall be tested as manufactured with or without facers.

   The average percent change in length or width shall not exceed ± 2 percent in 24 hours or ± 4 percent in 7 days. The average percent change in thickness shall not exceed ± 10 percent in 7 days. Samples shall be regarded as failing if: (1) delamination area of "faced" samples exceeds 25 percent or (2) warping or cupping exceeds $^1/_4$ inch (6 mm) when checked by a straight edge across raised diagonal corners.

4. **Resistance to combustion.**

A. The material shall be tested to meet the requirements of Sections 2602.1-2602.6 of the 1994 *Uniform Building Code*, with the additional provision that the surface-burning characteristics shall be determined according to ANSI/ASTM E84-79 and shall not exceed the following values:

Flame spread 75
Smoke developed. 450

B. This subsection shall not apply to any product recognized by the International Conference of Building Officials, as of the date of adoption of this article, as complying with Sections 2602.1-2602.6 of the 1994 *Uniform Building Code* based solely upon diversified testing. The manufacturer of any product which is recognized by the International Conference of Building Officials, subsequent to the date of approval of these regulations, as complying with Sections 2602.1-2602.6 of the 1994 *Uniform Building Code* based solely upon diversified testing, may petition the Commission for an exemption of that product from the provisions of this subsection.

5. **Identification.** Foam containers shall state the conditions of proper storage.

(m) **Urea formaldehyde foam field applied.**

1. **Limitation on sale.** Urea formaldehyde foam is unsafe for use as insulation. Sale within the State of California of urea formaldehyde foam insulation is prohibited.

2. **Exemption.** Notwithstanding any other provision of this article, a manufacturer of the primary components of urea formaldehyde foam insulation may apply for certification as provided in Section 1555 of this article. Such certification statement shall indicate compliance with the following standards:

A. **Composition.** The material shall consist of cellular plastic generated in a continuous stream by mixing the components which are a urea formaldehyde resin, air and a foaming agent. The material shall be suitable for filling closed cavities through small holes and suitable also for filling open cavities by trowelling during foaming prior to enclosure.

B. **Thermal performance.** The effective thermal performance, incorporating a derating value, shall be determined according to the method described in 42 Fed. Reg. pages 55143-55148.

C. **Resistance to combustion.** Surface-burning characteristics shall be determined according to the ANSI/ASTM E84-79 and shall not exceed the following values:

Flame spread 25
Smoke developed 450

Test specimens shall be aged for 45 days at 70°F ± 5°F and 35 to 40 percent relative humidity before testing.

D. **Free formaldehyde content of dry foam.** The free formaldehyde content of the dry foam shall be less than 0.01 percent formaldehyde by weight when tested as specified in paragraph (f) (8), published in 45 Fed. Reg. page 63801, except that the specimens to be tested shall also be aged for 56 days at 24 ± 5°C (75 ± 10°F) and 50 ± 10 percent relative humidity in an uncovered beaker.

E. **Corrosiveness.** The material shall be tested and shall meet the criteria for corrosiveness as specified in 45 Fed. Reg. pages 63786-63810.

F. **Density.** The material shall be tested and shall meet the criteria for density as specified in 45 Fed. Reg. pages 63786-63810.

G. **Shrinkage.** The material shall be tested and meet the criteria for shrinkage as specified in 45 Fed. Reg. pages 63786-63810, except that the material shall not shrink more than 2.0 percent in any direction.

H. **Volume resistivity.** The material shall be tested and meet the criteria for volume resistivity as specified in 45 Fed. Reg. pages 63786-63810.

I. **Identification.** Resin and foaming agent containers shall be marked with conditions of proper storage and the derated *R*-value and shrinkage of the prepared foam as certified by the manufacturer.

J. **Safety information.** Installers of urea formaldehyde foam insulation shall present the following safety notice to the purchasers of the foam prior to the signing of the contract for installation. The notice shall be printed in a minimum of 8-point type size. One copy of the notice signed by the purchaser shall be immediately given to the purchaser, one copy shall be retained by the installer and one copy shall be mailed by the installer to the Executive Director of the Energy Commission within 48 hours after installation of the insulation is completed.

Manufacturers shall make all sales of urea foam insulation components expressly subject to the application restrictions listed in the notice described below.

UREA FORMALDEHYDE FOAM INSULATION SAFETY NOTICE

The Federal Panel on Formaldehyde has concluded that formaldehyde should be presumed to pose a carcinogenic (cancer) risk for humans. Formaldehyde gas may also cause eye, nose, and throat irritation, coughing, shortness of breath, skin irritation, nausea, headaches and dizziness. People with respiratory problems or allergies may suffer more serious reactions, especially people allergic to formaldehyde. Women who are pregnant or planning to become pregnant should not be exposed to this product.

The symptoms may appear immediately or not until months after installation.

This product may release formaldehyde gas into your home or building over a long period of time. In some instances the formaldehyde gas cannot be controlled by ventilation or other means.

Application of this product is restricted to exterior sidewalls in both residential and commercial/industrial buildings. A 4-mil thickness plastic polyethylene vapor barrier, or equivalent plastic sheeting vapor barrier, shall be installed between the urea formaldehyde foam insulation and the interior space of the home or building in all applications.

If you have health concerns, call your doctor. Also, call the installer or manufacturer of the material.

(PLEASE PRINT OR WRITE LEGIBLY)

PURCHASER NAME OR NAMES____________________

PURCHASER ADDRESS________________CITY_______ZIP_______

PURCHASER PHONE NUMBER: Home ( )_________Work ( )_________

LOCATION OF INSTALLATION IF DIFFERENT FROM ABOVE

LOCATION ADDRESS________________CITY_______ZIP_______

The Purchaser acknowledges he or she has read and understands this notice.

Signed X________________Date_________

Signed X________________Date_________

THE FOLLOWING INFORMATION IS TO BE COMPLETED BY THE INSTALLING CONTRACTOR

CONTRACTOR'S NAME____________________

CONTRACTOR'S ADDRESS________________CITY_______ZIP_______

CONTRACTOR'S STATE LICENSE NUMBER________________

NAME OF MANUFACTURER____________________

MANUFACTURER'S ADDRESS________________CITY_______ZIP_______

MANUFACTURER'S PHONE NUMBER ( )________________

TEMPERATURE OF OUTSIDE AIR AT START OF INSTALLATION_________°F

	BATCH NUMBER	EXPIRATION DATE	TEMPERATURE (START OF INSTALLATION)
RESIN	______	______	______°F
FOAMING AGENT	______	______	______°F

STEPS THE INSTALLING CONTRACTOR MUST FOLLOW

1. The installing contractor is responsible for mailing this completed notice to the following address within 48 hours after completion of installation. Mail one copy to:

   Executive Director
   Energy Resources, Conservation and Development Commission
   1516 9th Street
   Sacramento, CA 95814

2. Give one copy to the Purchaser.
3. The installing contractor shall keep one copy of this completed notice for a period of not less than three years.

3. **Severability of provisions.** If any provision of Section 1553 (m) (1) or (2), or the application thereof to any person or circumstances, is held invalid, the remaining provisions, or the application of such provisions to other persons or circumstances, shall not be affected thereby.

(n) **Vermiculite in loose fill form.**

1. **Composition.** Vermiculite loose fill insulation shall be produced by the expanding or exfoliating of natural vermiculate or by grading and heating.
2. **Thermal performance.** Determination of the thermal performance shall be in accordance with ANSI/ASTM C177-76, ANSI/ASTM C236-66 or ANSI/ASTM C615-76 at the manufacturer's option.
3. **Density.** Density shall be determined according to installed design density. All tests except the ANSI/ASTM E84-79 test shall be conducted at the installed design density.
4. **Resistance to combustion.** Resistance to combustion shall be determined by the use of the Attic Floor Radiant Panel Test, as described in the United States General Services Administration insulation standard HH-I-515D as amended October 11, 1979.
5. **Identification.** Containers of vermiculite shall be marked with the type (pouring or pneumatic), the net weight and the manufacturer's recommendations for installation including minimum thickness, maximum coverage and installed design density to provide the levels of thermal performance shown. Manufacturer's installation recommendations shall include precautions according to the *California Electric Code* Section 410-66.

Products which may be used for pressure fill retrofit wall application shall be marked with the recommended wall density to prevent settling and separately marked with the tested thermal performance for such applications.

Authority: Sections 25402(a) and 25920, Public Resources Code.

Reference: Sections 25920-25922, Public Resources Code.

HISTORY:

1. Amendment of subsection (a) (9) filed 4-2-79; effective thirtieth day thereafter (Register 79, No. 14).
2. Editorial correction of subsection designations with subsection (l) (4) (Register 79, No. 17).
3. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).
4. New subsection (m) (2) (J) filed 9-11-81; effective thirtieth day thereafter (Register 81, No. 37).
5. Editorial correction of subsection (k) (3) (B) filed 1-13-82 (Register 82, No. 3).
6. Amendment of subsections (a) (5) and (a) (8) filed 5-5-82; effective thirtieth day thereafter (Register 82, No. 19).
7. Editorial correction of subsection (m) printing error (Register 82, No. 44).

APPROVAL OF TESTING LABORATORIES

Sec. 12-13-1554.

(a) Except as provided in subsection (b), laboratories shall be approved using the procedures described in the Criteria for the Approval of Testing Laboratories, dated October 27, 1978. The Executive Director shall approve any laboratory that meets the standards described in the Criteria for the Approval of Testing Laboratories, dated October 27, 1978. A testing laboratory shall have the right to appeal to the full Commission any denial of approval by the Executive Director.

(b) Up to and including September 30, 1982, laboratories shall be approved either upon accreditation by the United States Department of Commerce National Voluntary Laboratory Accreditation Program or as stated in the preceding paragraph, at the manufacturer's option. After September 30, 1982, laboratories shall only be approved upon accreditation by the United States Department of Commerce National Voluntary Laboratory Accreditation Program.

Authority: Section 25218(e), Public Resources Code.

Reference: Sections 25915(a) and 25921, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81, designated effective 9-22-81 (Register 81, No. 33).

CERTIFICATION

Sec. 12-13-1555.

(a) No insulating material shall be sold or installed in California on or after September 22, 1981, unless the manufacturer has certified that the material complies with the provisions of this article.

(b) The manufacturer shall submit a certification statement to the Executive Director for each type of insulating material. Such statement shall contain the following information:

1. Name of the manufacturer.
2. A description of the type of insulating material being certified in sufficient detail to permit its identification. The description may include information sheets, brochures, a sample label for the product or similar information.
3. Test results from an approved laboratory.
4. A description of the basis for ensuring that all the insulating material of the type being certified complies with the requirements of this article. Such description shall include, but not be limited to a description of the frequency of testing of the material, the quality assurance program, and any third-party inspections or testing used by the manufacturer.
5. A declaration that the insulating material complies with the requirements of this article.
6. The wording of the certification seal, if such seal consists of a statement pursuant to Section 1557 (b) (2) of this article.

(c) Every certification statement shall be dated and signed by the manufacturer attesting to its truth and accuracy. Where the manufacturer is either a corporation or a business association, the certification statement shall be dated, signed and attested to by a responsible official thereof.

(d) Within 45 days after receipt of a certification statement, the Executive Director shall forward, to the manufacturer, an acknowledgment that the statement has been received and that it is complete and accurate on its face.

(e) Certification of the insulation material shall be deemed to occur upon forwarding of the acknowledgement by the Executive Director. If acknowledgment is not forwarded in a timely manner, certification shall be deemed to occur on the 45th day after receipt of the certification statement.

(f) The statement of test results required in the certification may be based upon tests conducted prior to the adoptive date of this article if: (1) the same test was conducted within two years of the date of adoption, (2) the laboratory at which the tests were conducted has been approved for those tests as of the date of the certification statement, and (3) the laboratory certifies that the test and product are the same as the test and product referred to in the statement of test results.

Authority: Section 25218(e), Public Resources Code.

Reference: Sections 25921 and 25921.1, Public Resources Code.

HISTORY:

1. Amendment of subsections (a), (b) (4), (b) (6) and (f) filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

QUALITY ASSURANCE (Reserved)

Sec. 12-13-1556.

Authority: Section 25218 (e), Public Resources Code.

Reference: Section 25921.1, Public Resources Code.

HISTORY:

1. Repealer filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

IDENTIFICATION

Sec. 12-13-1557.

(a) Except as specified in subsection (b), Item 3, of this section, no insulation shall be sold in California on or after September 22, 1981, unless the insulating material, container, bundle or similar packaging material bears a visible Commission approved statement certifying that a representative sample of the insulation material has been tested and approved by an approved laboratory and complies with the requirements of this article.

(b) The Commission-approved statement shall consist of either:

1. A design or statement approved by the Executive Director, or
2. An identification of the manufacturer and any statement that the material meets the quality standards of the State of California.
3. A statement that the material meets the quality standards of the State of California included in the bill of lading shall meet the requirements of this section only if the product is being shipped in bulk, or the container or product is not otherwise labeled by the manufacturer and the product is being sold to its ultimate user.

(c) Any representation of thermal performance which appear on any label, literature, advertising or any other writing intended for the public shall be consistent with the certification testing results and derating required by this article.

(d) Any insulation with facings and membranes for which the flame spread exceeds 25 when tested with facings and membranes exposed to the flame during the ANSI/ASTM E84-79 test must be clearly labeled with a statement that the product may be highly combustible if used in an exposed application. This subsection shall not apply to any product meeting the requirements of Sections 2602.1-2602.6 of the 1994 *Uniform Building Code.*

Authority: Section 25218(e), Public Resources Code.

Reference: Section 25921, Public Resources Code.

HISTORY:

1. Amendment of subsections (a) and (c) filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

INSPECTIONS

Sec. 12-13-1558.

After September 22, 1981, the Commission may, upon the consent of the owner or lessee, or upon securing a search warrant, have access, during normal working hours, to the premises of manufacturers, distributors and retailers of insulating material sold for installation within the state for the purpose of determining compliance with the standards promulgated pursuant to Chapter 10.5 of the *California Public Resources Code*. Such access shall be for the purposes of obtaining representative samples of subject insulation and inspecting records and documents pertaining to tests by approved testing labs.

Authority: Section 25218 (e), Public Resources Code.

Reference: Section 25926, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

PERFORMANCE TESTS

Sec. 12-13-1559.

The Commission may conduct, or may contract with others to conduct, independent performance tests of representative samples of insulation sold in the state to determine compliance with standards adopted pursuant to Chapter 10.5 of the *California Public Resources Code*. Such tests shall form the basis for instituting enforcement proceedings.

Authority: Section 25218 (e), Public Resources Code.

Reference: Section 25926, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

COSTS OF INSPECTION AND TESTING (Reserved)

Sec. 12-13-1560.

Authority: Section 25218 (e), Public Resources Code.

Reference: Section 25926, Public Resources Code.

HISTORY:

1. Repealer filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

ENFORCEMENT (Reserved)

Sec. 12-13-1561.

Authority: Section 25218 (e), Public Resources Code.

Reference: Section 25931, Public Resources Code.

HISTORY:

1. Repealer filed 6-26-79; effective thirtieth day thereafter (Register 79, No. 26).

RELEASE OF INFORMATION

Sec. 12-13-1562.

Persons submitting information to the Commission who wish information to be kept confidential shall comply with the provisions of Sections 2501-2511 of the Public Resources Code.

Authority: Section 25218(e), Public Resources Code.

Reference: Sections 25223 and 25921.1, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

LIABILITY

Sec. 12-13-1563.

Nothing in this article shall be construed as imposing responsibility on manufacturers for misuse of properly labeled insulation.

Authority: Section 25218(e), Public Resources Code.

Reference: Sections 25926 and 25931, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

INSULATING EXISTING BUILDINGS

Sec. 12-13-1564.

(a) On or after March 25, 1982, if insulating material is installed in an existing building, in any of the applications specified in California Code of Regulations, Title 24, Part 6, Section 118, the installing contractor shall certify that the amount of insulation installed meets or exceeds the requirements of Part 6, Section 118 for that application. Such certification shall be made on completion of the installation by posting in a conspicuous location a certificate signed under penalty of perjury. The certificate shall state the manufacturer's name and material identification, the thermal resistance (*R*-value) of the newly installed insulation, the estimated *R*-value of the original insulation, the total *R*-value, and (in application of loose fill insulation) the minimum contractor installed weight per square foot. This installed weight per square foot shall conform with the manufacturer's installed design density per square foot at the manufacturer's labeled *R*-value.

(b) **Water heater insulation kits.** No water heater insulation kit shall be sold, on or after March 25, 1982, unless it has a thermal resistance of at least R-6 and is so identified.

Each water heater insulation kit sold shall include instructions which are equivalent to the Department of Energy standard practice for the installation of insulation on gas-fired, oil-fired and electric resistance water heaters, 44 Fed. Reg. pages 64703-64705.

Authority: Section 25922, Public Resources Code.

Reference: Section 25922, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).
2. Editorial correction of subsection (a) filed 1-13-82 (Register 82, No. 2).

INTERPRETATION

Sec. 12-13-1565.

The General Counsel of the Commission shall make a determination as to the application or interpretation of any provision of this article to any person requesting such a determination. Any such request shall be submitted in writing to the Commission. The Commission shall make written replies to such inquiries and shall widely publish interpretations that have broad application or interest.

Authority: Section 25218 (e), Public Resources Code.

Reference: Sections 25920 and 25922, Public Resources Code.

HISTORY:

1. Amendment filed 8-10-81; designated effective 9-22-81 (Register 81, No. 33).

CHAPTER 12-16-1

ENGINEERING REGULATIONS—QUALITY AND DESIGN OF THE MATERIALS OF CONSTRUCTION

STANDARD 12-16-1
CALIFORNIA STANDARD FOR EARTHQUAKE-ACTUATED AUTOMATIC GAS SHUTOFF SYSTEMS
(See CCR Title 24, Part 2, Chapters 16 and 16A, and CCR Title 24, Part 5, Chapter 12)

DIVISION OF THE STATE ARCHITECT

Authority: Sections 19180–19183, Health and Safety Code.

Reference: Section 19182, Health and Safety Code.

Division 1—CONSTRUCTION
SCOPE

Sec. 12-16-101. The American Society of Civil Engineers (ASCE) requirements for "Earthquake-Actuated Automatic Gas Shutoff Devices," ANSI/ASCE/SEI 25-16 (copyright 2016 by ASCE), shall be the applicable standard used by the Division of the State Architect for the certification of these devices.

Sec. 12-16-101.1. Each installation of a customer-owned device that satisfies this standard shall be in accordance with the *California Plumbing Code (CCR Title 24, Part 5).*

CHAPTER 12-16-2

ENGINEERING REGULATIONS—QUALITY AND DESIGN OF THE MATERIALS OF CONSTRUCTION

STANDARD 12-16-2
CALIFORNIA STANDARD FOR RESIDENTIAL EXCESS FLOW ACTUATED AUTOMATIC GAS SHUTOFF VALVES
(See CCR Title 24, Part 5, Chapter 12)

DIVISION OF THE STATE ARCHITECT

Authority: Sections 19200–19204, Health and Safety Code.

Reference: Sections 19201.5 and 19202, Health and Safety Code.

Division 1—CONSTRUCTION
SCOPE

Sec. 12-16-201. The American Society for Testing and Materials (ASTM) F2138-12(2017) Standard Specification for Excess Flow Valves for Natural Gas Service, and the American National Standards Institute (ANSI) Z21.93-2017/CSA 6.30-2017 Excess Flow Valves for Natural and LP Gas with Pressure up to 5 psig, shall be the applicable standards used by the Division of the State Architect for certification of these devices.

Sec. 12-16-201.1. Each installation of a customer-owned device that satisfies this standard shall be in accordance with the *California Plumbing Code (CCR Title 24, Part 5).*

CHAPTER 12-31C

RADIATION SHIELDING STANDARDS

STANDARD 12-31C-1

DEPARTMENT OF HEALTH SERVICES

Authority: Sections 102, 208 and 25811.
Reference: Sections 102, 208 and 436.5.

ALL HEALING ARTS X-RAY INSTALLATIONS

Sec. 12-31C-101. All radiation shielding barriers in rooms and enclosures housing radiation machines shall comply with the mandatory standards and appendices in Report No. 35, "DentalX-RAY Protection"; Report 49, "Structural Shielding Design and Evaluation for Medical use of X-rays and Gamma Rays of Energies up to 10 MeV"; and Report No. 51, "Radiation Protection Design Guidelines for 0.1-100 MeV Particle Accelerator Facilities." Published by the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, Maryland 20814.

CHAPTER 12-71

AIR FILTERS

AIR FILTERS
STANDARD 12-71-1

STATE FIRE MARSHAL

DESCRIPTION OF TEST APPARATUS, METHOD AND CLASSIFICATION REQUIREMENTS FOR AIR FILTERS

Sec. 12-71-100.

(a) **Test apparatus.**

1. The test duct, made of M.S. gage galvanized sheet metal reinforced with angle irons, is 21 inches square (13 548 mm^2) and $13^1/_2$ feet (4114 mm) long.
2. One end of the duct is tapered to the discharge of a variable-speed blower and the other end is open to discharge. A metal filter frame is provided near the middle of the length of the duct to receive one 20 by 20 inches (508 mm by 508 mm) (nominal) filter unit. Two tightfitting doors, located to permit access to the filter frame, are each provided with a mica window to permit observation of both faces of the filter and conditions in the duct downstream from the filter.
3. Two 1-inch (25 mm) pipe elbows, about 18 inches (457 mm) from the base of the test filter, form gas burner outlets adjusted to provide yellow, wavering flames. The burners consume approximately 4 cubic feet (approximately 1,000 Btu/cubic feet) of gas per minute.
4. With the filter in place the air velocity is adjusted to approximately 200 linear feet per minute as measured at the discharge end of the duct by an Alnor Velometer Anemometer.

(b) **Test method.**

1. Filters are tested clean, that is, unused. The flames are applied for 3 minutes during which time observations are made of both faces of the filter as to the downstream travel of flame or sparks and the density, duration and character of the products of combustion.
2. Smoke density is measured as the drop in light intensity on a microammeter by means of photoelectric cell mounted a few inches below and about 12 inches (305 mm) inside the discharge end of the duct. The light source, stabilized for light intensity, is mounted 1 inch (25 mm) above the duct directly above the photoelectric cell. The microammeter readings are recorded every 5 seconds for the first minute and every 10 seconds for the next 2 minutes.
3. The differences between these readings and the readings taken before the test are plotted against time (the scale being 40 μA and 40 seconds to the inch) with the resulting area under the curve being measured by use of a planimeter or calculated mathematically. This area is a measure of the smoke density produced during the test.

(c) **Classification.** As a result of the tests, air filter units are classified as Class 1 or 2 as indicated below:

1. Class 1 air filter units are those which, when clean, do not produce flames or sparks when attacked by flame and which develop areas under the smoke density curves that are less than 1.5 square inches (967 mm^2).
2. Class 2 air filter units are those which, when clean, burn moderately when attacked by flame or emit moderate amounts of smoke or both. These units, although they may be consumed to some extent, do not project flames or extensive sparks that would ignite adjacent combustible materials beyond the discharge end of the duct during the test and do not develop areas under the smoke density curves that are more than 6.0 square inches (3871 mm^2).

(d) **Adhesive coatings.** Liquid-adhesive coatings used on filters shall have a flash point of 325°F (163°C) Cleveland open cup tester, or higher.

CHAPTER 12-72-1

PROTECTIVE SIGNALING SYSTEMS

PROTECTIVE SIGNALING SYSTEMS, STANDARD TEST PROCEDURES STANDARD 12-72-1

STATE FIRE MARSHAL SCOPE

Sec. 12-72-100.

(a) **Basic.** This standard represents the minimum basic requirements for the construction and performance of the protective signaling systems to be listed under this classification. The minimum design, construction and performance standards set forth herein are those deemed as minimum necessary to establish conformance to the regulations of the State Fire Marshal as set forth in the *California Electrical Code*, and when applicable shall be reported on in their entirety by the approved testing laboratory.

(b) **Systems.** This standard covers electrically operated devices and control units designed to transmit and sound alarms, supervisory and trouble signals to be employed in ordinary indoor locations in accordance with the Standards of the National Fire Protection Association for the Installation, Maintenance and Use of Proprietary, Auxiliary and Local Protective Signaling Systems, Remote Station, Nos. 72A, 72B, 72C and 72D, and the *California Electrical Code.* This includes combination protective signaling systems employing nonsupervised sounding circuits; combination fire alarm-communication, -program and -clock systems (hereinafter referred to as combination signaling systems); and audible devices used for both alarm and program or communication purposes.

(c) **Control unit.** A control unit covered by this standard consists of a unit assembly of electrical parts having provisions for the connection of power-supply circuits routed through the control unit equipment by a prescribed scheme of circuitry; signal initiating circuits extended to separate devices by which the operating parts of the control unit are actuated for signals, and to incorporated or separate devices by which the signals are transmitted or indicated to form a coordinated combination system for definite signaling service.

TEST REPORTS

Sec. 12-72-101.

(a) **Test report contents.** The report shall include engineering data, and an analysis comparing the design against Section 12-72-102 (a) through (u); it shall include wiring, diagrams, operating manuals and photographs as set forth in Section 12-72-102 (a), Items 5 and 6; it shall set forth the tests performed in accordance with Sections 12-72-103 (a) through (g) and the results thereof; and shall verify the correctness of the electrical rating required by Section 12-72-107.

(b) **Listed devices.** Electrical wiring, material, devices, combination of devices, fittings, appliances and equipment which have been tested and listed by an approved listing agency for the intended purpose and use need not be individually retested.

The report shall include the catalog number or other readily identifiable marking, the name of the approved listing agency, the laboratory test report number and date. Such individually tested and listed component parts and devices when installed in combination with other devices in a control unit or in a circuit extended from such control unit shall be subjected to the performance standard tests to determine its suitability for use in combination with other component parts, devices, circuits or equipment.

(c) **Listed control units.** Control units which by their design are intended to fully comply with the Standard for the Installation, Maintenance and Use of Proprietary, Auxiliary, Remote Station and Local Protective Association may be investigated and tested in accordance with the Standards for Safety established by Underwriters' Laboratories, Inc., U.L. 864, provided such investigation, test and report incorporates the provisions of the *California Electrical Code.*

(d) **Rejection for cause.** Compliance with these standards will not necessarily mean approval and listing, if, when examined and tested, it is found to have other features which may impair the result intended by these regulations. Unusual constructions may require application of additional performance tests. The State Fire Marshal may refuse to approve any item for cause.

(e) **Systems only.** The standard applies to protective signaling systems as defined in the *California Electrical Code*, and systems or systems components for which application for approval and listing has been filed under the provisions of the *California Electrical Code.*

This standard does not cover manual stations, automatic detectors, automatic transmitters or other actuating devices; nor does it cover separately listed bells, registers or other indicating devices which are not provided as a part of the control unit or matched against the output of sound-reproducing equipment.

(f) **Differing constructions.** A control unit having materials or forms of construction differing from this standard may be investigated and tested according to the intent of this standard, and if found to be substantially equivalent may be given recognition for approval and listing. The office of the State Fire Marshal shall be consulted for general requirements and performance standards.

GENERAL

Sec. 12-72-102.

(a) **Investigation—Report.**

1. A control unit or combination signaling system shall be so designed and constructed as to be practical, reliable and sufficiently durable for its intended installation and use. It shall be suitable for use with acceptable actuating and indicating devices which have been found by investigation to be suitable for use with the control unit or combination signaling system. It shall permit its application in conformity with the regulations set forth in the *California Electrical Code.*

2. The scheme of electrical or electronic circuiting of a control unit or combination signaling system shall provide for the degree of electrical supervision required by the *California Electrical Code*, and when required, shall ensure emergency operation in the presence of a fault condition.

3. Attachment plugs, bells, circuit-breakers, cords, fuse-holders, fuses, lampholders, receptacles, transformers, switches, wires, etc., provided as a part of a control unit or combination signaling system shall be investigated and judged under the requirements established by the *California Electrical Code*, for such devices and also with respect to their suitability for the particular application.

4. Amplifiers used in the fire-protective signaling circuits of combination systems shall be tested in accordance with UL, Inc. Standard 813 (Second Edition 1954, amended 1966 and 1967), Sound Recording and Reproducing Equipment.

   The exchange or replacement of amplifiers from those originally tested with a combination system shall be tested in accordance with UL, Inc. Standard 813 and evaluated in accordance with this standard to determine their suitability for use with the combination system.

5. The report of investigation shall include schematic wiring diagrams tracing the electrical or electronic circuits in their normally supervised and operating condition. Contacts of operating devices shall be shown in the normally supervised position with operating and supervisory power supplied to the equipment.

6. The report of investigation shall include photographs of the equipment with markings identifying the component parts. Operating and maintenance manuals shall be included with each control unit or combination signaling system and shall be attached to the test report and certification.

7. The report of investigation shall include an itemized list of optional equipment that has, by test, been determined as not required to provide a fire alarm signal transmission. The report of investigation shall include routing of circuits for any equipment or devices which are not necessary for the transmission of a fire alarm signal.

(b) **Marking.**

1. Control units and combination signaling systems shall be plainly and permanently marked with a nameplate bearing the manufacturer's name, model number and electrical rating. Enclosures and castings shall have die stamped or cast identifying numbers or other readily identifiable markings. Component parts shall be fully described or identified by manufacturer's name and model number.

2. A wiring diagram of the control unit or combination signaling system shall be attached inside the control cabinet or metalware enclosure.

3. An audible alarm silencing switch when provided, shall be marked to indicate its normal position unless it is of the automatically restoring type. A permanently attached metal or equivalent sign shall bear the following words, "Do not operate the audible alarm silencing switch until the fire department has been notified." The trouble signal silencing switch, unless of the automatically restoring type, shall be marked to indicate its normal on position.

4. Terminal connections for the power supply shall be marked or identified as required by the *California Electrical Code.*

5. Installation wiring terminals or leads shall be marked or otherwise plainly evident.

6. A control unit designed for use with automatic detectors shall be marked for use with nonrestoring types of detectors only, unless the control unit provides signal lock-in performance required by Section 12-72-103 (b), Item 14.

7. A control unit designed for use with limited-energy circuits shall be marked to identify the particular circuits in which the energy is limited.

8. The maximum impedance of each actuating circuit shall be marked when the value for successful operation is less than 100 ohms.

9. A control unit designed to limit the duration of an alarm signal by means of a time-limit cutout shall be marked to indicate the time for which it is to be adjusted; nonadjustable time-limit cutouts shall be marked to indicate time at which it will operate. [See Sections 12-72-103 (l), Items 1 and 2.]

10. Equipment required to be mounted in a definite position in order to function properly shall be marked to indicate correct mounting position.

(c) **Frame, enclosure and metalware.**

1. Control units and combination signaling systems shall be installed in locked substantial cabinets or metalware enclosures and shall be of a type expressly designed for the service for which they are used. Control unit cabinets and combination signaling system metalware enclosures enclosing alarm

signaling circuits shall be provided with integral key locks.

2. Control unit cabinets and combination signaling system metalware enclosures shall be so formed and assembled that they will have the strength and rigidity necessary to resist the abuses to which they are liable to be subjected, without adversely affecting their performance, and without increasing fire hazard due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.
3. Electrical parts of a control unit or combination signaling system shall be so located or enclosed that suitable protection against accidental contact with uninsulated hazardous live parts will be provided.
4. Operating parts, such as gear mechanisms, relays and similar devices, shall be protected against fouling by dust, insects or by other material which might impair their operation, by means of individual protection or dust-tight cabinets.
5. The thickness of cast metal for an enclosure shall be as indicated in Table 12-72-1A; except that cast metal of lesser thickness may be used if upon investigation it is shown that it has the equivalent mechanical strength.
6. Sheet metal enclosures for a control unit or combination signaling system shall be investigated and listed by a nationally recognized testing laboratory for its intended purpose or use, or shall be not less than indicated in Table 12-72-1B.
7. An enclosure shall have suitable means for mounting, accessible without disassembling any operating part except removal of a completely assembled panel such as a relay panel.
8. An enclosure cover shall be hinged if it gives access to fuses or any other overload-protective device, the normal functioning of which requires renewal, or if it is necessary to open the cover in connection with the normal operation of the control unit or combination signaling system.
9. Enclosure covers accessible for service only may be unhinged if, upon investigation, they are found to be suitable for the purpose. Unhinged covers shall be securely held in place by screws or equivalent fastening devices requiring the use of a tool for its removal.
10. Cabinets or compartments for housing of primary batteries shall be key locked with provisions for protection against moisture or movement. Metal cabinets shall be of approved design constructed of sheet iron or steel not less than No. 14 manufacturer’s standard gage.
11. Compartments for storage batteries shall have a total volume not less than twice the volume occupied by the batteries. Ventilating openings shall be provided, and so located to permit dispersion of gas while the battery is being charged at the highest rate permitted by the means incorporated in the unit.
12. The interior of the storage battery compartment shall be protected against detrimental action by the electrolyte. The compartment shall be so located or enclosed that the equipment of the signaling system will not be adversely affected by battery gases.
13. Ventilating openings shall be screened with wire screening having wires of not less than No. 16 AWG, expanded metal mesh or perforated metal of not less than 0.042 inch (1 mm) in thickness. No opening in wire screening, metal mesh or perforated metal shall exceed $^{1}/_{2}$ square inch (322 mm^2) in area.
14. A compartment enclosing electrical parts shall not be open to the floor or other support on which the equipment rests.

(d) **Protection against corrosion.** Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating or other equivalent means. This includes all parts upon which proper mechanical operation may depend. It does not apply to bolts, screws, washers or similar parts, if corrosion will not impair operation of the equipment. Stainless steel, polished or treated, does not require additional protection. Bearings shall be of such design and material to ensure against binding due to corrosion.

(e) **Insulating materials.**

1. Base for support of live-metal parts shall be of noncombustible, moisture-resistant, insulating material commonly recognized as suitable for support of live-metal parts. A base shall withstand the most severe conditions liable to be met in service.
2. Bases mounted on metal surfaces shall be provided with an insulating barrier from the mounting surfaces unless all live-metal parts are staked, upset, sealed or otherwise prevented from loosening to prevent parts and ends of terminal screws from coming in contact with the supporting surface.
3. Countersunk, sealed parts of control units shall be covered to a depth of not less than $^{1}/_{8}$ inch (3 mm) with a waterproof insulating compound which will not melt at a temperature 15°C higher than the normal operating temperature of the assembly. In no case shall such insulating compound melt at less than 65°C.

(f) **Mounting parts.**

1. All parts of control equipment shall be securely mounted in position to prevent loosening or turning if such motion may adversely affect normal operation of the control equipment. A switch, lampholder, attachment-plug receptacle or plug connector shall be mounted securely and, except as noted in Item 3, shall be prevented from turning. See Item 4.
2. The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

   A. The switch is to be of a plunger or other type that does not tend to rotate when operated (a toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch).

B. The means of mounting the switch is to make it unlikely that operation of the switch will loosen the switch.

C. The spacings are not to be reduced below the minimum acceptable values if the switch does rotate.

D. Normal operation of the switch is to be by mechanical means rather than by direct contact by persons.

3. A lampholder of a type in which the lamp cannot be replaced (such as a neon pilot or indicator light in which the lamp is sealed in by a nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

4. The means for preventing the turning mentioned in Section 12-72-103 (f) is to consist of more than friction between surfaces—e.g., a suitable lockwasher, properly applied, is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

5. Uninsulated live-metal parts, including terminals, shall be secured by methods other than friction between surfaces, to prevent turning or shifting that may result in reduction of any required spacings. Contact assemblies shall be so secured that alignment of contacts will be ensured.

(g) **Grounding.** Cabinets, metalware enclosures and noncurrent carrying metal parts shall be grounded as required by the *California Electrical Code*. Equipment grounded by a multiple-conductor cord shall have a fixed contacting member in the attachment plug for connection of the grounding conductor. The grounding conductor shall be green-identified and shall not be used as a circuit conductor.

(h) **Operating mechanisms.**

1. Parts and motors shall be suitable for the particular applications and shall be of sufficient mechanical strength and capacity to withstand the stresses to which they will be subjected in operation without introducing any hazard.

2. Cams, signaling wheels and similar parts shall be fastened to prevent loosening or independent turning. Adjustable parts and adjusting screws shall have provisions to prevent loosening under conditions of use.

3. Electromagnetic devices shall be designed to provide positive electrical and mechanical performance under all conditions of use.

(i) **Current-carrying parts.**

1. Current-carrying parts shall be of nonferrous metal recognized as suitable and of sufficient mechanical strength for the particular application.

2. Except for grounded signaling wheels, bearings, hinges, etc., shall not be used for carrying current between interrelated fixed and moving parts.

(j) **Supply connections.** Control units and combination signaling systems shall be provided with wiring terminals for the connection of conductors of at least the size required by the *California Electrical Code,* for the electrical rating of the equipment.

(k) **Terminal connections.**

1. Wiring terminals shall ensure thorough connections under hard usage. Terminals shall be a suitable pressure wire connector, firmly bolted or held by a screw, except that for No. 8 AWG and smaller wires, a wire binding screw having upturned lugs or the equivalent may be used. Alternate: Binding screws without upturned lugs may be recognized when conductors are fitted with mechanically and electrical secure ring connectors.

2. Wire-binding screws not less than 8-32 may be used at terminal strips, except that a 6-32 screw may be used for No. 14 AWG and smaller wires. Terminal plates shall be not less than 0.050 inch (1 mm) in thickness to provide not less than two full threads in the metal. Terminal plates of less thickness may be recognized when the resistance to stripping of the threads is equal to or greater than two full threads in 0.050-inch-thick (1 mm) terminal plates.

(l) **Raceways and power-supply cord.**

1. Control units shall have provisions for connection of armored cable or conduit. Combination signaling systems may be provided with a flexible cord and attachment cap. The power-supply cord serving the fire alarm signal generator or tone oscillator shall be Type SJ or equivalent. Strain relief shall be provided so that mechanical stress on a flexible cord will not be transmitted to terminals, splices or interior wiring. Power-supply for the signal generator or tone oscillator provided by a cord shall have an attachment cap with a device to prevent its easy removal from the receptacle.

2. Power-supply for clock, communication or program systems shall not be supplied from the fire alarm control unit.

(m) **Internal wiring.**

1. Internal wiring of a control unit or combination signaling system shall consist of suitably insulated conductors for the voltage and temperature attained, and of adequate current-carrying capacity for the service.

2. All conductors in an enclosure or raceway shall be insulated for the maximum voltage of any conductor in the enclosure or raceway.

3. Wireways shall be smooth and free from sharp edges, burrs, fins and moving parts. Holes in sheet metal partitions shall be provided with smooth bushings or shall have smooth well-rounded surfaces.

4. All joints and connections shall be mechanically secure and shall provide a reliable electrical contact without strain on connections and terminals. Stranded conductors clamped under wiring-binding screws or similar parts shall have the individual strands soldered together or equivalent arrangement to ensure reliable connections.

5. Wire shall be neatly arranged and routed, and shall be held in place with clamps, string ties or equivalent unless of sufficient rigidity to retain a shaped form, placed in spaces affording protection against damage during servicing.

(n) **Interconnection of units.**

1. Control units and combination signaling systems shall be interconnected by metallic raceway enclosures or armored cable suitable for the purpose.

2. Cords and wires used to interconnect units within the overall enclosure shall be securely fastened to the enclosure walls by means of clamps or shall be cabled assemblies with strain relief.

3. In combination signaling systems, the control unit audible alarm circuit shall form the alarm signal interconnection. The audible alarm circuit shall be continuous to the terminals of the relay approved for alarm signaling service for the control unit, except that contacts of a combination signaling system power-supply supervisory relay may be included in the circuit.

4. The alarm signal relay shall be firmly attached to the enclosure and shall be a component part of the combination signaling system unit.

5. The interconnection between control units having nonsupervised audible alarm circuits and the combination signaling system shall be in duplicate, connected alternately to two or more signal relays wired in parallel to the oscillator or tone signal relays.

6. Portions of alarm circuits in combination signaling system control panels which are not supervised from the contacts of the audible alarm signal relay to the oscillator or tone signal alarm relays shall not exceed 24 inches (609 mm) in length. They shall be of 600V insulated wire held in place by clamps or equivalent and so located that they will not be subject to handling during use or servicing.

(o) **Capacitors.** Capacitors shall be of materials suitable for their intended use. A paper capacitor shall be impregnated or suitably enclosed to exclude moisture. It shall not be injuriously affected by the temperature attained under the most severe conditions of use. The removal of a capacitor of the plug-in type shall require the use of a tool.

(p) **Coil windings—transformers.**

1. The insulation of coil windings of relays, transformers, etc., shall be impregnated or otherwise designed to exclude moisture.

2. Transformers connected across a power-supply circuit shall be individually housed in noncombustible material.

3. Transformers shall be of the two-coil or insulated type except that an autotransformer may be employed provided the terminal common to both input and output circuits is connected to the grounded supply terminal.

(q) **Overcurrent protection.**

1. Storage batteries provided as part of a control unit, other than primary batteries, shall be protected by overcurrent devices having a rating of not less than 150 percent and not more than 200 percent of the maximum operating load on the battery.

2. System control units and combination signaling system control units shall be protected on the current supply side by overcurrent devices having a rating not more than 150 percent of the maximum normal operating current.

3. Transformers shall be protected on either the primary or secondary side by overcurrent devices having a rating not greater than the continuous duty rating of the transformer unless the current is limited to the same value by other acceptable means.

(r) **Rectifiers.**

1. Rectifiers used direct shall be approved for the purpose and of adequate capacity to maintain voltage regulation between 100 percent of rated voltage at maximum load and 130 percent of rated voltage at no load.

2. A control unit incorporating a battery-charging rectifier shall be provided with meters as part of the assembly or with readily accessible terminal connections for portable meters for determination of battery voltage and charging current.

(s) **Storage batteries.**

1. Storage batteries provided as part of a control unit shall have sealed cells with spray-trap vents. Normal charging shall be by a trickle-charge rectifier. The mounting arrangement shall prevent terminals from contacting terminals of adjacent cells or parts of the battery enclosure. The cells shall permit ready access for checking the specific gravity of the electrolyte.

2. The conditioning charge shall be so limited that with the maximum charge which can be obtained, the battery gases will not adversely affect the control unit.

(t) **Spacings.**

1. A control unit or combination signaling system shall provide reliably maintained spacings between uninsulated live-metal parts, and between uninsulated live-metal parts and dead-metal or noncurrent carrying metal parts not less than those indicated in Table 12-72-1C and Section 12-72-102 (t), Items 3 and 4.

2. The spaces within devices or assemblies which have been individually or as assemblies tested and listed by a nationally recognized testing agency for the intended use need not comply with the provisions of Table 12-72-1C and Section 12-72-102 (t), Items 3 and 4. The report shall note such devices and assemblies by reference to the test report.

3. If a short circuit between uninsulated live-metal parts of the same polarity would prevent the normal signaling operation of the control unit without simultaneously producing a trouble signal, the spacings between such parts shall be not less than those indicated for “other parts” in Table 12-72-1C except in the case of the special devices mentioned in Footnote 2 to the table, the spacing between uninsulated live-metal parts of the same polarity, for any potential of 0-300 volts, shall be not less than $^{1}/_{32}$ inch (0.8 mm) through air, and the spacing over surface shall be not less than $^{1}/_{16}$ inch (1.6 mm) unless the smaller over-surface spacings permitted in Footnotes 3 and 4 of Table 12-72-1C.

4. Spacings may be reduced provided a barrier or liner of suitable moisture-resistant insulating material of sufficient mechanical strength to withstand operation of equipment and arcing is used, and is reliably held in place.

(u) **Speakers—sound equipment.** Speakers shall be of an approved type and designed with current capabilities for the intended function and purposes.

PERFORMANCE

Sec. 12-72-103.

(a) **General.**

1. The performance of a control unit or combination signaling system shall be investigated by subjecting a representative sample in commercial form to tests described in Sections 12-72-103 (b) through (q). Insofar as possible tests are to be made in the order indicated by the following test headings.

2. A control unit shall be tested in the position in which it is designed to be installed for proper function.

3. A combination signaling system console or rack is to be placed in a position simulating an actual installation against a vertical wood wall unless by its design, it is obviously intended for installation in the open. If ventilation openings are provided on the rear surfaces, it is to be spaced out 1 inch (25 mm) from the wall.

4. Tests shall be made at rated frequency and voltage. The rated voltage for test purposes is considered to be 120 volts for units marked 110–125 volts, or 240 volts if marked 220–250 volts.

5. Control units intended to be energized by trickle-charged batteries shall be tested at the rated trickle - charge of the battery except for over-and under-voltage tests.

(b) **Normal operation.**

1. A control unit or combination signaling system shall operate reliably and uniformly for all conditions of its intended performance when employed in conjunction with actuating devices, indicating devices and power supplies to form a combination type indicated by the wiring diagram and supplementary information supplied with it.

2. To determine compliance, actuating devices, indicating devices optional equipment not necessary for transmission of a fire alarm signal, and power supplies are to be connected to the control unit to form a typical combination, and the control unit operated for each condition of its intended performance.

3. A combination signaling system shall be connected to the intended signal initiating control units and devices, optional equipment or devices not necessary for the transmission of a fire alarm signal, signal indicating devices (in sound-reproducing equipment the output impedance and matching load combination which produced the maximum input in the power- input test is to be used), and power supplies, and the equipment operated for each condition of its intended performance.

4. Actuating and indicating devices used for testing are to be those specified by the wiring diagram of the equipment, except that substitute devices may be used if the actuating switching contacts produce equivalent actuation, and if the indicating devices produce equivalent signal indication and circuit loading. Acceptable substitute load devices are those found by investigation to produce the same load conditions as the devices intended to be used with the equipment.

5. The control unit or combination signaling system shall be in the normal circuit supervisory condition prepared for normal signaling operation by being connected to the devices and circuits indicated in Sections 12-72-103 (b), Items 1 through 3.

6. The operation of any actuating device shall cause the equipment to operate the related indicating devices to produce a clearly defined signal of the type for which the combination is designed.

7. A coded fire alarm signal shall consist of not less than three complete rounds of the number transmitted.

8. Fire alarm signals in schools emitted by devices not distinctive in tone or used for other purposes shall be intermittent or continuous sounding signals. The signal, herein referred to as the *California Uniform Fire Code* Signal, shall be given for a period of 10 full seconds followed by a silence of 5 full seconds before the signal is repeated. The signal shall be given for a period of not less than 1 minute. Conformance requires signal duration in excess of 1 minute.

9. Control units or combination signaling systems shall have provisions to disconnect time and program signal circuits upon initiation of an alarm signal. Restoration of time, recall or program circuits shall require manual operation of a resetting device in the control unit or combination signaling system console. The resetting device shall be located inside the locked control panel or console, or shall be key-operated. A metal sign having the following words shall be attached adjacent to the switch "Reset switch shall not be operated until building has been determined safe from fire." The wiring diagram required by Section 12-72-103 (b), Item 2, shall include the circuit arrangement.
10. Combination signaling systems designed for use with a coded fire alarm control unit (control unit of type other than continuous ringing) shall be provided with an audible alarm signal relay of the lock-in type. This may be a latching-type relay or an electrical holding circuit.
11. Combination signaling systems designed for use with a continuous ringing fire alarm control unit shall be provided with a *California Fire Code* Signal coding device actuated by the audible alarm signal relay.
12. Combination signaling system using sound-reproducing equipment designed to provide an alarm signal of distinctive tone used for no other purpose is not required to provide a coding device. To be considered as distinctive in tone, the frequency should be not less than 300 cycles higher or lower than any other signal (such as a classroom or program signal) and shall be an undulating tone swinging not less than approximately 100 cycles each side of the mean frequency with a pulse rate of not less than 30 per minute.
13. Combination signaling systems which are so designed that they may have the power supply circuit disconnected or alarm signal output discontinued without a trouble signal shall have provisions to instantly and automatically restore power supply, signal generation and signal output upon actuation of a fire alarm initiating device.
14. The signal indicating resulting from the operation of a noncode fire alarm control unit by automatic detectors having self-restoring contacts shall be maintained automatically by the control unit until a resetting device in the control unit is manually operated.
15. Combination signaling systems designed to have the audible alarm circuit routed through a clock- cross-connect or pin board shall not, on removal or relocation of any pin, cause interruption of interference with the fire alarm signal. The circuit arrangement shall be shown on the wiring diagram required by Section 12-72-103 (b), Item 2.
16. Normal operation of fire alarm signaling equipment shall not depend upon a ground connection.
17. A switch and circuit provided for silencing alarm sounding devices shall conform to the following:
    A. Switching to the off-normal position shall automatically transfer the alarm signal to visual warning signal lights which shall not be extinguished until the system is manually restored to normal.
    B. With the system in normal supervisory condition, switching to the off-normal position shall result in an audible trouble signal.
    C. Restoration of the alarm initiating circuit to normal supervisory condition shall result in a trouble signal, unless the silencing switch and its related control circuit is of the automatically restoring type.
    D. The switch shall be located inside of the locked control unit enclosure.
18. Circuits and all related devices of a combination system may have their output regulated providing the minimum setting will allow satisfactory compliance to the *California Electrical Code*, for the total number of sound reproducers that may be served by the system.

(c) **Power input-sound reproducing equipment.**

1. The current or wattage consumption of a combination signaling system utilizing sound reproducing equipment shall not exceed the marked input rating by more than 5 percent when the equipment is operated under normal conditions while connected to a supply circuit of rated frequency and voltage corresponding to the mean of the marked primary voltage rating.
2. For the test specified in Section 12-72-103 (c), Item 1, the audio-input connections of each amplifier of the system are to be connected to an oscillator adjusted to supply a 1,000-cycle signal. All volume and tone controls are to be at their maximum settings, and normal operating condition is considered to be operational with the audio-input-signal potential adjusted to produce audio-output rating of the amplifier. The tests are to be conducted throughout the range of impedance taps with load impedance of the amplifier.

(d) **Fire alarm signal precedence.**

1. Control units designed to serve more than one type of alarm-initiating device or to utilize the audible alarm devices for more than one type of signaling service shall provide priority for manual box signals, and for fire alarm signals in combination signaling systems.
2. A coded system control unit shall be actuated by one or more initiating devices other than a manual box and by a manual box simultaneously. The manual box signal shall take precedence over other signals.
3. Combination signaling system shall be actuated to transmit a program or sound signal. A fire alarm initiating device shall be actuated while the program or

sound signal is being transmitted. The fire alarm signal shall take priority without any interference or garbling of the alarm signal. Each separate type of program, or sound signal, including all-call or individual room signals shall be actuated without interfering with the fire alarm signal.

4. Fault conditions shall be introduced in each piece of optional equipment or device and during such fault conditions a fire alarm initiating device shall be actuated. The fire alarm signal shall be transmitted without interference or garbling of the alarm signal.

(e) **Electrical supervision.**

1. Unless otherwise provided, the circuits formed by conductors extended from the terminals of the control unit or combination signaling system shall be so electrically supervised that a trouble signal will be promptly indicated upon the occurrence of a signal break or ground fault condition of its circuits which would prevent normal operation of the combination, control unit, actuating devices and indicating devices. Electrical supervision of the main operating power, power supply to the oscillator or tone generator shall be provided under the conditions set forth in Sections 12-72-103 (e), Items 2 through 4. The above requirements do not apply to the following type of circuits:

   A. The audible alarm signaling circuits of combination signaling system of the clock-bell program or sound reproducing type, provided all portions of the circuits are used for normal program or signaling purposes not less than once each hour.

   B. Local system circuits intended for use only with sprinkler waterflow alarm or sprinkler-supervisory circuits.

   C. Current and circuits for trouble signals.

   D. Current for alternate operation when source of main power supply is interrupted.

   E. Current supply and circuits for supplementary signal devices, or optional equipment not necessary for the transmission of a fire alarm signal, provided that a break or ground fault will not affect operation of the system for required fire alarm signals.

   F. Circuit for register or indicating device provided as a part of the control unit.

   G. Audible alarm circuits, provided there are suitable terminal facilities for the connection of either multiple circuits, so that a break or ground fault prevents operation of only one of the circuits; or a return loop circuit so that a break or ground fault does not prevent operation of any alarm signal sounding device or appliance with means provided for testing the continuity of the circuit conductors.

   H. Circuit for an alarm-indicating device in the same room as the control unit, provided the circuit conductors are installed in a metallic raceway or equivalent to prevent mechanical injury or tampering.

2. Electrical supervision of the main source of operating power. Supervision of a control unit using a rectifier for battery charging shall include supervision of the power supply to the rectifier and the fuse in the load circuit of the battery.

3. Electrical supervision of the power supply to the oscillator or tone generator of a combination signaling system when the signal and its related amplifiers are used for normal room signaling service. The supervisory circuit may be so arranged as to sound the fire alarm control unit trouble signal.

4. Electrical supervision of the signal output of a combination signaling system when the alarm signal oscillator or tone generator and its related amplification devices and circuits are not used for normal signaling.

5. A single break or ground fault in an alarm initiating or indicating circuit, or failure and restoration of the power supply to the control unit, shall not cause transmission of an alarm signal.

6. To determine conformance of a control unit or combination signaling system with the performance and tests requirements of Items 1 through 5, the investigation is to start with the representative system combination in the normal supervisory condition indicated in Section 12-72-103 (b), Item 5; each type of fault to be detected shall be separately introduced in each circuit conductor.

7. If the off-normal position of any normally preset mechanism or any similar part of the control unit or control equipment requires manual restoration to normal position for proper signaling operation of the control equipment, such off-normal position shall be indicated by a trouble signal. Compliance is to be determined by observation during the normal operation test.

8. While the control unit or control equipment is in the supervisory condition, any operation of any manual-switching part that may interfere with normal operation of the equipment of transmission of an alarm signal shall be indicated by a trouble signal. The control unit or equipment shall be operated for transmission of signals in each position of the manual-switching parts.

(f) **Trouble signals.** Trouble signals shall be distinctive from alarm signals, or other communication or warning signals. They shall be indicated by the continuous sound of an audible trouble signaling device or appliance. The audible signal sounding device or appliance may be common to more than one supervised circuit. Trouble signal sounding circuits may be provided with time limit cut-off devices to provide for intermittent operation of the trouble signal device or appliance. The time limit device or appliance shall provide for the continuous sounding of the trouble signal sounding device or appliance for a period of not less than 10 minutes followed by a period of silence not to exceed 5 minutes.

(g) **Trouble signal silencing switch.** A trouble signal silencing switch shall be provided. Upon operation of the trouble signal silencing switch, the trouble indication shall be transferred to a trouble lamp or other approved visual indicator located adjacent to the silencing switch. Operation of the trouble signal silencing switch shall also remove the time limit cutout from the circuit. The visual indicator shall remain in operation until the silencing switch is restored to its normal position unless the audible trouble signal will be obtained when a fault occurs without restoring the switch to normal position. The silencing switch and its related control circuit may be of the automatically restoring type.

(h) **Control unit input and output current and voltage.**

1. The input or output current of each circuit of a control unit shall not exceed the marked rating of the control unit by more than 10 percent when the unit is operated under conditions of normal use.
2. A limited-energy detector circuit shall conform to the following:
   A. The open-circuit voltage between any two wiring terminals and between any terminal and a grounded circuit part or noncurrent carrying metal part shall not exceed 50 volts when the control unit is connected to a power supply source of rated voltage and frequency.

   B. Overcurrent protection not in excess of 2 amperes shall be provided in such manner that each limited-energy circuit is protected. Current-limiting transformers may be substituted, provided that under condition of short circuit, current flow at the terminals will not exceed 2 amperes.

(i) **Jarring.** The control unit or control equipment installed or supported in the position of its normal use connected to a power supply and in supervisory condition shall withstand jarring from impact or vibration such as may be experienced in service by striking the enclosure. Striking the enclosure shall not cause signaling operation of any part nor adversely affect any subsequent normal operation.

(j) **Temperature.**

1. Materials employed in the construction of a control unit or combination signaling system which have not been investigated and reported on by a nationally recognized testing laboratory as an assembly in the form intended for use shall be investigated and tested to determine temperature rises that may adversely affect the materials of construction, normal signaling operation of the equipment and fire hazard to building materials.
2. A control unit shall be mounted on a wood panel representative of its manner of installation in service. It shall be connected to a power supply as indicated in Section 12-72-103 (a), Item 4, and operated under representative normal conditions liable to produce the highest temperatures.
3. A combination signaling system shall be set up representative of normal service conditions against a wood panel wall as specified in Section 12-72-103 (a), Item 3, connected to a supply circuit as indicated in Section 12-72-103 (c), Item 1, and operated under representative normal conditions liable to produce the highest temperatures.
4. In control units equipped with time-limit cutouts which are not intended to limit the time of alarm-signal operation, the time-limit cutout shall be shunted out of the circuit for the duration of the test.
5. A control unit or combination signaling system intended to provide impulse signals shall be operated by a testing device to provide one impulse per second, except that if the signal impulses are normally produced by a device which is a part of the control unit or equipment assembly, the test impulses are to be at the rate of normal operation of the device.
6. Circuits shall be loaded representative of maximum load under normal service conditions. Resistors shall be adjusted for maximum wattage dissipation possible under conditions of normal service.
7. Except for coils, temperature readings are to be preferably obtained by means of thermocouples. Temperatures are to be considered as constant when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5 minute intervals, indicate no change. Temperature rise on coils may be determined by the resistance method or mercury thermometers.
8. Horizontal screened or ventilation openings subject to accumulation of dust and lint shall be covered with loose cotton.
9. Materials of construction and fire hazard to buildings shall be considered to be adversely affected if the temperature rise exceeds the limits shown in the following, based on an assumed ambient temperature of 25°C:
   A. 65°C on wood panels or other combustible material or surfaces adjacent to or upon which a control unit may be mounted in service.

   B. 35°C on rubber or thermoplastic insulation.

   C. 60°C on varnished cloth insulation.

   D. 65°C on surface of coil winding of impregnated organic insulation.

   E. 125°C on phenolic insulation.

   F. 65°C on a transformer enclosure.

   G. 65°C on fiber insulation.

   H. 30°C at any point on a copper-oxide rectifier.

   I. 50°C at any point on a selenium rectifier.

   J. 15°C less than melting point of a sealing compound.

K. Rated temperature limit of a capacitor.

L. 65°C on fuses.

M. 350°C on embedded resistor.

10. The test-operating condition shall be continued for a period of not less than:

A. Operation under a normal supervisory condition until constant temperatures are attained.

B. Operation for 1 hour during normal signaling condition of local system control equipment designed for actuation by automatic devices. Includes control units producing a continuous signal until actuating device is restored to normal or until a circuit-resetting device is manually operated.

C. Operation for 15 minutes during normal signaling condition of a local system control unit intended to be actuated by coded manual fire alarm boxes.

D. Operation of a rectifier at its maximum rated output until constant temperatures are attained.

(k) **Over- and under-voltage operation.**

1. The design of a signaling system shall provide that the system will perform its intended function at 85 percent and at 110 percent of rated voltage. The operating parts of control equipment shall withstand 110 percent of its rated voltage continuously without injury during the normal supervisory condition.

2. To determine compliance with the higher voltage specified in Item 1, the signaling system is to be subjected to the increased voltage while in its normal supervisory condition until a constant temperature of all of its parts attained but in no case less than 3 hours and then tested for all signaling conditions. The unit shall not fail to transmit any required signal.

3. To determine compliance with the under-voltage specified in Item 1, the signaling system is to be operated in the normal supervisory condition until constant temperatures of all its parts are attained and then immediately tested for all signaling conditions at the reduced voltage. Reduced voltage is to be achieved by a means that maintains a stable potential of the required value under the most severe conditions of normal loading.

4. Circuits extended from the control unit in which the maximum impedance for successful operation is less than 100 ohms shall have the maximum impedance connected to its circuits during the under-voltage test.

(l) **Time limit cutout.**

1. A time limit cutout arranged to control the duration of a continuous alarm signal shall operate within the range of the time marked for the control unit when tested at an ambient temperature of 25°C ± 2°C. A common coded signal shall complete not less than three complete rounds and a system control unit intended for schools not less than 1 full minute of signal transmission as specified in Section 12-72-103 (b), Item 8, before operation of the time limit cutout.

2. Except as specified in Item 1, a bell circuit time-limit-cutout shall operate in not less than 3 minutes nor more than 10 minutes when energized continuously at the maximum rated current value of the circuit to which it is connected, tested at an ambient temperature of 25°C ± 2°C.

(m) **Overload.**

1. Under the conditions specified in Items 2 through 4, a current-interrupting device provided as part of, or intended for use with, a signaling system control unit or equipment shall perform in an acceptable manner during an overload test consisting of not less than 50 make and break operations. There shall be no electrical or mechanical failure of the device, nor shall there be any undue arcing, burning, pitting or welding of contacts.

2. A control unit or equipment normally supplied from a grounded circuit shall be tested with all normally grounded parts and the enclosure connected through a 15 ampere fuse to the grounded conductor of the supply circuit.

3. Current-interrupting devices controlling devices on the load side of control equipment power supply terminals shall be tested at 115 percent of rated voltage with a test load equivalent to that which the device is intended to control.

4. Overcurrent devices in control equipment which includes motor-driven devices or intended to include motors on any of its circuits shall be tested under stalled rotor conditions of the motor.

(n) **Endurance.** An operating device included as part of a control unit or combination signaling system shall perform acceptably when tested at the rate and for the number of cycles specified in Table 12-72-1D. When the device controls an electrical load the contacts shall make and break the normal current the device is intended to control for the number of cycles specified. There shall not be any electrical or mechanical failure of the device, nor shall there by any undue arcing, burning, pitting or welding of the contacts. The device shall be tested in conjunction with its related components in the assembly by operating the primary actuating device to produce the signals.

(o) **Dielectric tests.**

1. Except for motors rated at $^1/_2$ hp or less, and 250 volts or less, signaling system control units or equipment shall withstand, without breakdown, the application of a 60-cycle alternating potential of twice rated voltage plus 1,000 volts for a period of 1 full minute. The test potential shall be applied to the following parts:

A. Between all normally ungrounded current-carrying parts and the enclosure.

B. Between all metal current-carrying parts and exposed noncurrent-carrying parts.

C. Between all current-carrying metal parts of circuits, including transformer windings, operating at different frequencies of potentials.

2. Motors rated less than $^{1}/_{2}$ hp and 250 volts shall withstand for 1 minute without breakdown, the application of a 60-cycle a.c. potential of 900 volts between the frame and winding.

(p) **Abnormal operation.**

1. A control unit shall be capable of operating under abnormal conditions without emission of flame, molten metal or other manifestation of a fire hazard. Excessive temperatures or burnout is indicative of failure.

2. A control unit connected to a supply circuit of rated voltage shall have its alarm initiating and audible alarm circuits short-circuited until a constant temperature is attained, or burnout occurs, unless the fault results in operation of an overcurrent device which is an integral component part of the unit.

(q) **Burnout tests.**

1. A continuous-duty resistor shall not burn out or be adversely affected while carrying the maximum normal load continuously. An intermittent duty resistor shall carry its maximum rated current on any step for the maximum length of time permitted by limiting devices of the unit.

2. A transformer operated continuously, at the rated voltage and frequency specified by Section 12-72-103 (a), Item 4, with the enclosure grounded and having a load of three times maximum normal load current connected to its output terminals shall not be adversely affected by injury to the enclosure, nor shall any emission of flame or molten metal occur.

3. The testing circuit shall be protected by overcurrent devices having a rating of at least ten times the primary current rating of the transformer. Output terminals of the transformer shall be short-circuited, if such a condition results in less than three times the maximum normal load current being drawn from the secondary. Tests shall be continued until constant temperatures are attained or a burnout occurs. Blowing of the fuse on the primary side of the transformer is not considered to be a failure.

4. If the circuit designs of a control unit or combination signaling system incorporate a time limit cutout or a mercury tube switch wired into the system circuit in such a manner that a short circuit or a ground fault causes the device to carry current in excess of its maximum normal load, it shall withstand the test specified in Items 5 through 7, without introducing a fire hazard.

5. The device is to be tested in the control equipment as it is intended to be normally used and in series with a protective fuse of the marked maximum rating indicated by the markings on the control unit. All openings in the enclosure of the control equipment shall be covered with surgical cotton, and the enclosure is to be connected to ground through a fuse of the same rating as the protective fuse mentioned above.

6. The open circuit voltage of the test circuit is to be within 5 percent of the rated voltage; see Sections 12-72-103 (a), Item 4, and 12-72-103 (c), Item 1, of the control equipment circuit in which the device is installed, except that a higher voltage may be used if agreeable to those concerned. The source of current and the test circuit should have sufficient capacity to deliver 1,000 amperes when the system is short-circuited at the testing terminals.

7. Ignition of the cotton, or of insulation on circuit conductors, emission of flame or molten metal from the enclosure, blowing of the fuse in the grounding conductor, damage to other parts of the control equipment, or any evidence of a fire hazard is to be deemed as failure. Burnout of pigtail leads or a thermal element, or welding of contacts, is not to be considered as a failure.

PRINTED WIRING BOARDS

Sec. 12-72-104.

(a) **General.**

1. These requirements cover printed wiring boards that are intended for use in fire protective signaling equipment. The acceptability of the combination of the printed wiring board and the electric equipment is to be determined by the State Fire Marshal.

2. Printed wiring boards conforming to ASTM Grade FR-5 when tested in accordance with ASTM Designation D-1867, may be used in protective signaling equipment.

3. Throughout these requirements, the term “printed wiring” is used to designate a pattern of conductive material formed in a predetermined design on the surface or surfaces of a common insulating base, and intended primarily to provide point to point electrical connections, shielding or to form inductors. The term “printed wiring board” is used to designate the combination of a printed writing pattern and the common insulating base completely processed as far as the printed portion is concerned. The term “printed wiring assembly” is used to designate a printed wiring board on which separate components have been added.

4. Printed wiring boards which do not conform to Item 3, shall be tested in accordance with the procedures set forth in Sections 12-72-104 (b) through (d).

(b) **Insulating material.** Insulating material on which printed wiring is applied shall be suitable for the sole support of uninsulated live parts and for the temperature involved, and shall have suitable mechanical strength.

(c) **Conductors.**

1. Current-carrying parts of printed wiring shall be of copper, copper-alloy, aluminum, silver or other material having similar corrosion-resisting properties.
2. Conductor surfaces shall be substantially free of wrinkles, pits, blisters, corrosion or other imperfections before and after being subjected to the conditions described in Item 6.
3. Printed wiring shall be so applied to the insulating material that the average strength of the bond between the printed wiring and the insulating base for each individual strip of conductor will not be less than 1 pound per inch of width of the printed wiring when samples are tested under the conditions described in Items 4 through 7.
4. The samples of printed wiring boards are to be without components (capacitors, resistors, etc.) and, except at points where connections are to be made, the conductors are to be free from solder. If the normal production soldering operation results in a coating of solder on the conductors, the samples are to be subjected to a simulated soldering operation, using a material other than solder, at the normal soldering temperature, or an equivalent arrangement, in order to obtain the same thermal effect on the conductors.
5. A uniform width of the printed wiring is to be peeled from the insulating material for a distance of $^1/_4$ inch (6 mm) at a uniform rate of approximately 12 inches (305 mm) per minute, with the angle between the printed conductor and the insulating material at not less than 85 degrees, and the force required to separate the conductor from the insulating material measured. Three determinations are to be made on each of six samples, and the average strength of the bond for each individual strip or conductor determined.
6. Following the test described in the preceding paragraph, three of the samples are to be placed in an air oven maintained at the temperature determined by the following expression for 1,344 consecutive hours:

   T = 1.02 (R + 15 + 273) – 273, where

   T = oven temperature in °C.

   R = temperature in °C for which the printed material is to be recognized (75°, 90°, 105° or 125°C).

   The remaining three samples are to be placed first in the air oven for 168 hours and then in a moist air chamber having a relative humidity of 83.5–86.5 percent at a temperature of 30.5°–33.5°C, for 168 hours, and the cycle repeated for a total of 1,344 hours (four 168-hour periods in the air oven alternating with four 168-hour periods in the moist air).
7. After 1,344 hours under the conditions described in the preceding paragraph, the six samples are to be allowed to cool to room temperature and then subjected to the test described in Item 5 and the average strength of the bond determined for each sample.
8. The use of coatings over printed wiring will be given special consideration with respect to their effect on the strength of the bond between the printed wiring and the insulating material.

(d) **Dielectric strength.**

1. The average dielectric breakdown potential for six samples of printed wiring boards that have been conditioned in an air oven for 1,344 hours at the temperature determined by the formula in Section 12-72-104 (c), Item 6, shall be not less than 80 percent of the average dielectric breakdown potential for six samples of printed wiring boards that have not been subjected to such conditioning.
2. The 12 samples may be provided without components (capacitors, sockets, resistors, etc.) but are to be samples that have been subjected to the complete production soldering process. The test potential is to be obtained from a suitable transformer, the output voltage of which can be regulated. The potential is to be increased gradually from zero, at the rate, of approximate 75 volts per second, until dielectric breakdown occurs. Three different locations on each sample, with different spacings between conductors, if possible, are to be tested. The locations selected are to be the same for all samples. The average dielectric breakdown potentials for each group of six samples for each location is to be determined. The average value for each location for the samples that have been conditioned is to be not less than 80 percent of the average value for the corresponding location for the samples that have not been conditioned.

RELAYS FOR PROTECTIVE SIGNALING SERVICE

Sec. 12-72-105.

(a) **Test conditions.** Relays which have not been qualified as approved for use with protective signaling systems by investigation and report from an approved listing agency shall have its suitability for use in a protective signaling system evidenced by an investigation and report by an approved testing laboratory which shall include certification that the relay conforms to the minimum requirements of the *California Electrical Code.* The test report shall include, but is not limited to:

1. Over- and under-voltage operation per the *California Electrical Code.*
2. The insulation of coil windings of relays shall be such as to resist the absorption of moisture.
3. Temperature readings on the coil and insulation under normal operation at a constant temperature (temperature may be considered constant when three succeeding readings at not less than 5 minute intervals indicate no change in temperature).

4. Overload test consisting of 50 operations at 115 percent of rated voltage with a test load being that which the relay is to handle.
5. Endurance test consisting of 40,000 cycles of coded or noncoded signal impulses at rated load and voltage.
6. Dielectric strength test without breakdown by application of 60 cycle a.c. at twice rated voltage plus 1,000 volts for a period not less than 1 minute.

(b) **Acceptance criteria.** There shall be no electrical or mechanical failure, nor any undue pitting, burning or welding of contact during any test.

SEMICONDUCTOR TESTS

Sec. 12-72-106.

(a) **General.** Semiconductors shall be investigated to determine their suitability for application under all the environmental conditions to which they will be exposed in service.

The performance tests of the complete device are intended to show the effects of these conditions. The prescribed tests may be supplemented where conditions exceeding those represented by the tests indicated herein may be encountered.

(b) **Test procedure.**

1. **Temperature.** The system combination is to be connected as in the normal operation test and operated in an oven at 85°C. It is then to be operated in a refrigerator at 0°C. After temperature equilibrium has been maintained in both cases, the unit shall operate as in the normal operation test.
2. **Humidity.** The system combination is to be connected as in the normal operation test, and placed in a humidity cabinet maintained at 85 percent humidity, 32°C, for a period of 48 hours. At the end of this time, the unit shall operate as in the normal operation test.
3. **Transient voltage.** The system combination shall be subjected to the transient voltages caused by the collapse of the field of a 2-kilovolt-ampere transformer switched on and off on a random basis for 500 cycles.
4. **Acceptance criteria.** There shall be no adverse effects on the system combination and the unit shall operate as intended.

(c) **Temperature.** A semiconductor shall be operated so as to obtain not more than 75 percent of its rated operating temperature during the normal supervisory condition indicated in Section 12-72-103 (b), Item 5. The rated operating temperature of a semiconductor shall not be exceeded under any condition of operation of the complete unit which produces the maximum temperature dissipation of its components, including the over-voltage test described in Section 12-72-103 (k), Items 1 and 2, and the variable ambient temperature test described in Section 12-72-106 (b), Item 1.

ELECTRICAL RATING

Sec. 12-72-107. The electrical rating of a control unit or combination signaling system shall be marked as provided in Section 12-72-102 (b). The following ratings shall be marked on the nameplate or may be marked on supplemental labels at the terminal strips:

(a) Each power supply circuit—the voltage, frequency and maximum input in amperes or watts.

(b) Each alarm initiating circuit—maximum current output and maximum open-circuit voltage if different than the power supply circuit.

(c) Each control unit audible alarm or indicating circuit—maximum current output and the maximum open-circuit voltage if different than the power supply circuit.

(d) Each combination signaling system sound reproducing control audible alarm circuit-output rating in watts.

(e) Supplementary—device circuit—maximum current load that may be connected, and the voltage and frequency of supply power other than that of the control unit.

(f) Fuses—maximum ampere rating of the fuse that may be installed in each fuseholder provided as part of the control unit or combination signaling system.

TABLE 12-72-1A—CAST-METAL ENCLOSURES

DIMENSION OF AREA	MINIMUM THICKNESS IN INCHES	
	Die-cast metal	Castings other than die-cast
24 square inches or less, no dimension greater than 6 inches	$^{5}/_{64}$*	$^{1}/_{2}$
More than 24 square inches or any dimension exceeding 6 inches	$^{3}/_{32}$	$^{1}/_{2}$
Threaded conduit opening	$^{1}/_{4}$	$^{1}/_{4}$
Unthreaded conduit opening	$^{1}/_{8}$	$^{1}/_{9}$

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

* Suitable reinforcing ribs may subdivide larger areas.

TABLE 12-72-1B—SHEET-METAL ENCLOSURES

MAXIMUM DIMENSIONS		MINIMUM THICKNESS IN INCHES*		
		Steel		
Linear dimension	Surface area in square inches	Zinc coated	Uncoated	Copper, brass or aluminum
24	360	0.057 (16)	0.054 (16)	0.075 (12)
48	1,200	0.071 (14)	0.067 (14)	0.095 (10)
60	1,500	0.098 (12)	0.095 (12)	0.122 (8)
Over 60	Over 1,500	0.127 (10)	0.124 (10)	0.153 (6)

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

Note: Numbers in parentheses are the galvanized sheet gage for zinc-coated steel, manufacturer's standard gage for uncoated steel, American wire gage for nonferrous metal.

* At areas where armored cable or conduit is to be attached, sheet metal shall be of such thickness or so formed or reinforced that it will have the stiffness equivalent to uncoated flat sheet steel 0.054 inch thickness; when a supporting frame or equivalent reinforcing by forming or flanging is provided, thicknesses may be reduced by two gage numbers.

TABLE 12-72-1C—MINIMUM ACCEPTABLE SPACINGS IN INCHES[1, 2]

POTENTIAL INVOLVED IN VOLTS	AT INSTALLATION-WIRING TERMINALS		AT OTHER PARTS	
	Through the air	Over the surface of insulating material	Through the air	Over the surface of insulating material
0-150	$^1/_4$[3]	$^1/_4$[3]	$^1/_8$[4]	$^1/_4$[4]
151-300	$^1/_8$[3, 5]	$^1/_8$[3]	$^1/_4$[4]	$^3/_8$[4]
	$^1/_4$[3]			

For SI: 1 inch = 25.4 mm.

1. Measurements are to be made while wire with adequate capacity for the applied load is connected to each terminal as it would be in actual installation. In no case is the wire to be smaller than No. 14 AWG.
2. At fixed parts of rigidly clamped special assemblies of live parts and insulating separators (such as contact springs on relays or cam switches) that are wired at the factory, the spacings may be less than those indicated, but not less than $^1/_{16}$ inch for 0-150 volts, and not less than $^3/_{32}$ inch for 151-300 volts, through air and over surface, except as noted in the following footnotes.
3. Nor less than $^3/_{64}$ inch through air and over surface for 250 volts or less if the equipment which the component part controls does not consume more than 375 volt-amperes or more than 5 amperes.
4. Not less than $^1/_{32}$ inch through air and over surface for a circuit involving a potential or not more than 30 volts and supplied by a primary battery or by a standard Class 2 transformer or by a suitable combination of transformer and fixed impedance having output characteristics in compliance with what is required for a Class 2 transformer.
5. The spacing through air at installation-wiring terminals may be less than $^1/_4$ inch but not less than $^1/_8$ inch if the terminals are recessed in insulating material or have insulating barriers so as to confine loose strands of conductors sufficiently to make it unlikely that the terminals will be grounded or short-circuited.

TABLE 12-72-1D—ENDURANCE TEST

NORMAL SIGNALING PERFORMANCE OF DEVICE	TOTAL NUMBER OF CYCLES DEVICE TO BE TESTED	CYCLES PER MINUTE
Continuous noncode signal for each operation of alarm signal initiating device	6,000	6
A number of coded or noncode impulses for each operation of alarm signal initiating device	40,000	60
Preliminary coded or noncode signal impulses followed by continuous signal impulses after each operation of alarm signal initiating device	40,000 resetting of device after each group of 40 impulses	— 60
Relays	40,000	60

CHAPTER 12-72-2

PROTECTIVE SIGNALING SYSTEMS

SINGLE- AND MULTIPLE-STATION FIRE ALARM DEVICES MECHANICALLY OPERATED TYPE STANDARD 12-72-2

STATE FIRE MARSHAL SCOPE

Sec. 12-72-200.

(a) **Basic.** This standard represents the minimum basic requirements for the construction and performance of single- and multiple-station fire alarm devices intended for indoor installation, and to be listed under this classification. The minimum design, construction and performance standards set forth herein are those deemed as minimum necessary to establish conformance to the regulations of the State Fire Marshal.

(b) **Definitions.** For the purpose of this standard, the following definitions shall apply:

1. **Fire alarm device, multiple station.** Two or more gas-operated single station units interconnected by metal tubing to one or more remote alarm-sounding devices.
2. **Fire alarm device, single station.** A self-contained fire alarm system comprising a heat detector, an alarm- sounding device and a stored energy source incorporated in one integral package. The basic types are gas- operated units and spring-wound units.
3. **Gas-operated type.** A device having a temperature-sensitive eutectic element; compressed gas, usually in a liquid state in a cylinder; and a sounding means, such as a horn or whistle. When the eutectic element melts, the compressed gas is released in a gaseous state through the alarm-sounding device.
4. **Spring-wound type.** A device having a temperature-sensitive bimetal or eutectic element and a spring-wound type mechanism with clapper mounted within a bell housing. The snap action of the bimetal or melting of the eutectic element releases the spring mechanism resulting in a bell-type sound.

TEST REPORTS

Sec. 12-72-201.

(a) **Test Report contents.** The report shall include engineering data, and an analysis comparing the design against Sections 12-72-201(b) through 12-72-202(g); it shall include operating manuals and photographs. The report shall set forth the tests performed in accordance with this standard and the results thereof.

(b) **Instructions and drawings.** A copy of the operating and installation instructions and any related drawings is to be furnished with the sample submitted for investigation to be used as a guide in the examination and test of the unit and for this purpose they need not be in final printed form.

The instructions and drawings shall include such directions and information as deemed by the manufacturer to be adequate for attaining proper and safe installation, operation and maintenance.

(c) **Rejection for cause.** Compliance with these standards will not necessarily mean approval and listing, if, when examined and tested, it is found to have other features which may impair the result intended by these regulations. Unusual constructions may require application of additional performance tests. The State Fire Marshal may refuse to approve any item for cause. (See the *California Electrical Code.*)

(d) **Devices covered.** This standard does not cover electrically operated single- or multiple-station fire alarm devices actuated by heat, smoke or combustion products.

(e) **Temperature classification.** The temperature sensitive elements of single- and multiple-station fire alarm devices are to be identified as to their temperature of operation as follows:

TEMPERATURE CLASSIFICATION	RATING RANGE, °F (°C)	MAXIMUM CEILING TEMPERATURE, °F (°C)
Ordinary	135-174 (57-79)	100 (38)
Intermediate	175-225 (79-107)	150 (66)

The maximum rating of a fire alarm device is to be not more than 225°F (107°C).

(f) **Differing constructions.** A control unit having materials or forms of construction differing from this standard may be investigated and tested according to the intent of this standard, and if found to be substantially equivalent may be given recognition for approval and listing. The office of the State Fire Marshal shall be consulted for general requirements and performance standards.

GENERAL

Sec. 12-72-202.

(a) **Construction.**

1. Unless otherwise indicated, the term “fire alarm device” as used in this standard refers to single- and multiple-station mechanically operated type fire alarm devices.

2. A fire alarm device shall be so constructed that it will be reliable and durable for the intended installation and use.

(b) **Mounting.**

1. A fire alarm device shall be provided with a means for mounting either to a ceiling or wall.
2. The means for mounting shall not result in any distortion of the fire alarm device so as to alter its operating characteristics.

(c) **Calibration.**

1. Any means for calibration or adjustment shall be guarded or sealed to prevent manipulation by hand or ordinary tools. A thermal responsive element adjustment, if provided as part of a unit, shall not be capable of being readjusted after shipment from the factory.
2. A calibration means considered to be not accessible or apparent is one not exposed to manipulation by tools, or one not readily replaceable. The complete concealment of tool-engagement means in a screw, such as a slot, recessed head, etc., by the use of solder or brazing material is considered adequate for the purpose of preventing manipulation or replacement.

(d) **Materials.**

1. A part shall be constructed of materials that are acceptable for the intended application and shall be of adequate mechanical strength.
2. Diaphragms and spring parts shall be made of nonferrous material, such as phosphor bronze, nickel, silver, etc., or of ferrous materials. If ferrous materials are employed, they shall be hermetically sealed or plated so as not to be affected adversely by corrosion.
3. A eutectic element, if used as the operating member of a fire alarm device, shall be constructed so as not to be affected adversely by conditions to which it is likely to be exposed in service, as represented by the tests described in Section 12-72-203.
4. All exposed parts likely to be affected adversely by corrosion shall be protected by enameling, galvanizing, sherardizing, plating or equivalent means.

(e) **Operating mechanisms.**

1. The moving parts of a fire alarm device shall have sufficient play at bearing surfaces to prevent binding.
2. The manually operated parts of a fire alarm device shall have sufficient strength to withstand the stresses to which they will be subjected in service.
3. A gear train driving spring shall be reliably anchored at each end. The spring winding means shall be provided with a positive stop to limit the winding or shall withstand the maximum force likely to be applied without affecting the operation of the mechanism adversely.

(f) **Mechanical assembly.**

1. Any servicing or restoration operations intended to be made by the user shall be simple and capable of being accomplished with ordinary tools.
2. A device shall be so constructed that parts will not become displaced during or after installation.
3. An obstruction means, such as a wire mesh screen, shall be provided to prevent the entry of foreign bodies or materials into sounding devices which could prevent their operation.

(g) **Power supervisory feature.** A means shall be provided on a unit to automatically indicate that operating power is not available. The indication may be in the form of a flag, target, sight glass, change in mounting position of the fire alarm device or equivalent. A fire alarm device shall be capable of producing an alarm signal for not less than 4 minutes at the point where the loss of operating power is indicated initially. See Section 12-72-203 (l).

(h) **Operating gas.**

1. The operating gas employed in a fire alarm device shall be noncombustible and shall be of a degree of toxicity that will not produce death or serious injury to guinea pigs during a 2-hour exposure to the gas at a concentration of $2^1/_2$ percent by volume of air.
2. Refrigerants 12 and 22 are commonly used gases which comply with this requirement.

PERFORMANCE

Sec. 12-72-203.

(a) **General.**

1. Representative samples of units in commercial form shall be subjected to the following applicable tests.
2. If a device(s) is required to be mounted in a definite position in order to function properly, it shall be tested in that position.
3. If a device is normally intended to be connected to tubing to function, it shall be connected to the maximum length of tubing specified by the manufacturer unless the length of tubing would not have a bearing on its operation.

(b) **Determination of spacings.**

1. The sensitivity of a fire alarm device is to be expressed in terms of spacing limitations. Spacing limitations refer to the maximum distance permitted between devices mounted on smooth ceilings.
2. Installation spacing limitations of a fire alarm device are developed by an oven test [15-foot (4572 mm) spacing only] or by a fire test. See Sections 12-72-203 (c) and (d).
3. Determination of spacings is obtained by the testing of ordinary degree ratings. Devices shall be sufficiently sensitive to qualify for at least a 15-foot (4572 mm) spacing limitation.

4. An ordinary-degree rating, with a spacing of 15 feet (4572 mm), may be tested for sensitivity by being subjected to the oven test. See Section 12-72-203 (c), Item 1. If the device does not operate within 2 minutes, a fire test shall be conducted.

5. A fire alarm device is not acceptable if it fails to qualify for at least a 15-foot (4572 mm) spacing, i.e., does not operate within 2 minutes in the oven test, and does not operate when subjected to the fire test.

(c) **Oven test.**

1. A fire alarm device shall operate in a normal and uniform manner when tested to the time-temperature curve illustrated in Figure 12-72-2-1. A sample shall be uniform in operation when mounted in the same position inside the oven. Operation is considered uniform if the device operates within a tolerance of 15°F (8.3°C) for an ordinary rated unit and 20°F (11°C) for an intermediate rated unit. A fire alarm device which operates within 2 minutes or less is suitable for a 15-foot (4572 mm) spacing allocation.

2. The test apparatus consists of a full draft circulating air oven capable of producing the time-temperature curve illustrated in Figure 12-72-2-1. Air is to be moved past the sample at a velocity of 230 to 245 feet per minute. The temperature in the oven is recorded by means of a thermocouple and calibrated potentiometer.

3. The device under test is to be installed in the test oven with its temperature-sensitive element located in the air streams and positioned so that there is no obstruction of the moving air to the sensing element.

4. After installation in the oven, the device is to be subjected to the time-temperature conditions illustrated by Figure 12-72-2-1. The time of actuation is to be recorded at the instant the unit goes into alarm.

5. To determine that the performance of a fire alarm device is uniform, five samples are to be tested, using a different sample for each test, but each of the five samples is to be installed inside the chamber in the same position.

(d) **Fire test.**

1. A fire alarm device, installed at the intended spacing, shall operate prior to the 160°F (71.1°C) rated sprinklers installed on a 10-foot (3048 mm) spacing schedule when both are simultaneously exposed to a control fire condition.

2. The test room is to be equipped with automatic sprinkler piping arranged to receive automatic sprinklers on a 10-by-10-foot (3048 mm by 3048 mm) spacing schedule. Sprinklers of the standard upright spray type are to be installed with the deflectors approximately 7 inches (178 mm) below the ceiling, which is normal for sprinkler piping installation. For each test, new automatic sprinklers of the same make and ratings are to be installed in the sprinkler piping. The devices under test are to be installed at their designated spacing, minimum 15 feet (4572 mm), in line with the sprinkler and fire test plan. See Figure 12-72-2-2 for layout.

3. This test is to be conducted in a room having a smooth ceiling with no physical obstructions between the fire source and devices under test and with minimum air movement. The room is to be provided for maintaining the room temperature ambient, if necessary. The heaters are to be shut off during a test trial.

4. The room shall be of sufficient cross-sectional area so that the devices under test are located in accordance with the spacing layout illustrated by Figure 12-72-2-2. The reflection of heated air is to be prevented from returning to the devices under test from adjacent wall surfaces during the course of the fire test. The room height shall be such that the vertical distance from the base of the fire to the ceiling is approximately 12 feet (3657 mm).

5. Fire tests are to be produced by burning denatured alcohol consisting of 190 proof ethanol to which 5 percent methanol has been added as a denaturant, in steel pans of a size necessary to produce a temperature rise sufficient to operate the automatic sprinklers in 2 minutes, ± 10 seconds, when installed on a 10-by-10-foot (3048 mm by 3048 mm) spacing schedule. Since temperature conditions in the test room may vary throughout the year, it is necessary to utilize different pan sizes in order to obtain the proper temperature-rise condition. This test condition develops a time-temperature curve similar to that shown in Figure 12-72-2-1.

6. The fire tests are to be conducted to compare the operating time of the fire alarm devices when installed at their recommended spacing schedule as compared with the operating time of automatic sprinklers installed on the standard 10-by-10-foot (3048 mm by 3048 mm) spacing schedule. Operation of the devices prior to the sprinkler will qualify the device for a spacing on which it is installed. Since automatic sprinklers vary in their sensitivity, the particular sprinkler utilized in these tests is to be one which has average operating response under uniform temperature-rise conditions.

7. Four units shall be subjected simultaneously to the fire test condition and all four units are required to respond prior to the sprinkler.

8. For units which may be mounted on a side wall, the device under test shall be mounted in a vertical position so that the distance between the top of the unit and the ceiling is 6 inches (152 mm). The front of the units shall face the fire source and any surfaces on which the units are mounted shall be of a configuration to prevent reflection of heat onto the detector element.

9. If a fire alarm device is intended to be mounted on the ceiling, the unit shall be so installed for this test.

10. If a device is intended to be employed with an enclosure, such as used in mounting, it shall be subjected

to the fire test using the enclosure representative of normal installation.

(e) **High-temperature exposure test.**

1. A fire alarm device shall not operate when subjected for 30 days to the test ambient temperature indicated in Table 12-72-2A. Following the exposure, the response of the units shall not show a variation of more than 10 percent from the value obtained in the Oven Test on as-received samples. There shall be no change in the sound intensity when tested following the exposure. There shall be no evidence of eutectic flow as a result of this test.

2. Devices capable of repeated operation are to be subjected to the Oven Test before and after exposure to the test temperature ambient. Where devices are not capable of repeated operation the response data after exposure is to be compared to the response of identical as-received samples.

3. A fire alarm device shall withstand the high-temperature exposure without false operation and there shall be no visible deformation or change in the temperature sensitive element or any other part of the unit as a result of the test.

4. Five samples of each temperature rating are to be tested for their normal operating temperature after which they are to be placed in a circulating air oven maintained at the test temperature.

5. The units are to be removed from the oven after the 30-day period, allowed to remain at room temperature for at least 24 hours and then subjected to the oven test.

(f) **Corrosion tests.**

1. The response of a fire alarm device, after being subjected to corrosive atmospheres, shall not show a variation of more than 50 percent from the value obtained in the oven test on as-received samples. No false alarms shall occur during the exposure and there shall be no change in the sound intensity when the units are subjected to the oven test.

2. Devices capable of repeated operations are to be subjected to the oven test before and after exposure to the corrosive atmospheres. Where devices are not capable of repeated operation, the response data obtained from the oven test is to be compared to the response of identical as-received samples.

3. Two samples are to be exposed for 10 days to an atmosphere containing approximately 1 percent hydrogen sulfide by volume in air saturated with water vapor at room temperature.

4. Two samples are to be exposed for 10 days to an atmosphere containing approximately 1 percent sulphur dioxide in 1 percent carbon dioxide by volume in air saturated with water vapor at room temperature.

5. After exposure to the corrosive atmospheres, the samples are to be removed from the test chamber, allowed to remain in a normal atmosphere at room temperature for at least 24 hours and then subjected to the oven test.

6. This test is to be conducted only on devices of the ordinary degree rating unless there is reason to anticipate different behavior of other ratings.

(g) **Operating temperature test.**

1. A fire alarm device shall operate in a normal manner and within the operating temperature limits and tolerances included in Table 12-72-2B, when subjected to an operating temperature test in heated water, oil or air bath.

2. Five samples of each temperature rating are to be subjected to this test. Depending on their particular design, the devices are to be suspended in a circulating water, oil or air bath, and the temperature gradually increased at the rate of 1°F (0.6°C) per minute until operation takes place. The temperature of the bath at the instant of operation is to be recorded.

(h) **Vibration test.**

1. A fire alarm device shall be capable of withstanding vibration without false operation, without breakage or damage to parts or any leakage at fittings. Following the vibration test the response of a unit shall not show a variation of more than 50 percent from the value obtained in the oven test on as-received samples. There shall be no change in the sound intensity following the vibration.

2. Two samples are to be secured in the position of normal use on a mounting board and the board, in turn, securely fastened to a variable speed vibration machine having an amplitude of 0.01 inch (0.2 mm). The frequency of vibration is to be varied from 10 to 35 cycles per second (cps) in increments of 5 cps until a resonant frequency is obtained. The samples are then to be vibrated at the maximum resonant frequency for a period of 4 hours. If no resonant frequency is obtained, the samples are to be vibrated at 35 cycles per second for a period of 120 hours.

3. For these tests, amplitude is defined as the maximum displacement of sinusoidal motion from a position of rest or one-half of the total table displacement. Resonance is defined as the maximum magnification of the applied vibration.

4. Devices capable of repeated operation are to be subjected to the oven test before and after the vibration test. Where devices are not capable of repeated operation, the response data obtained from the oven test is to be compared to the response of identical as-received samples.

5. This test is generally to be conducted only on devices of the ordinary degree rating unless there is a reason to anticipate different behavior of other ratings. For multiple station fire alarm devices, the units shall be interconnected with a 10-foot (3048 mm) length of tubing between units and between the units and any sounding appliance with which it is intended to be employed.

(i) **Humidity test.**

1. A fire alarm device shall be capable of operating in a normal manner and comply with the requirements of the oven test following exposure for 24 hours to moist air having a relative humidity of 85 ± 5 percent at a temperature of 30 ± 2°C (86 ± 3.6°F). The units shall be tested within 5 minutes after removal from the humid environment.
2. Two samples are to be subjected to this test. This test is to be conducted on devices having an ordinary degree rating only, unless different behavior of other ratings is anticipated.

(j) **Low-temperature exposure test.**

1. A fire alarm device shall be capable of operating in a normal manner and comply with the requirements of the oven test following exposure for 24 hours to a temperature of minus 30 ± 2°C (minus 34.4 ± 3.6°F). The units shall be tested within 5 minutes after removal from the low temperature chamber. There shall be no false operation, damage to parts or leakage at fittings.
2. Two samples are to be subjected to this test. This test is to be conducted on devices having an ordinary degree rating only, unless different behavior of other ratings is anticipated.
3. For a multiple station fire alarm device the maximum length of tubing specified by the manufacturer [see Section 12-72-203 (a), Item 2] is to be connected between the unit and any alarm sounding device with which it is intended to be used prior to conducting the test.

(k) **Endurance test.**

1. There shall be no mechanical failure of a spring wound-type fire alarm device and the unit shall be capable of operating in a normal manner and comply with the requirements of the oven test following 100 cycles of operation at a rate of not less than once per hour.
2. Two samples of any rating shall be subjected to this test. Each cycle shall consist of a complete rundown and rewinding operation. Following the 100 cycles, the units shall be subjected to the oven test.

(l) **Audibility test.**

1. The audible alarm generated by a fire alarm device shall be distinctive in sound from other customary sounds, continue for at least 4 full minutes at full intensity and be not less than 83 decibels when measured in an ambient temperature of 23 ± 3°C (73 ± 5.4°F) with a relative humidity of 60 ± 20 percent and a barometric pressure of approximately 700 mm mercury.
2. The measurement of sound level is to be made with a sound level meter employing the C weighting network and fast response characteristics. The measurement is to be made in a room having the approximate dimensions of 20- by 10- by 10-feet (6096 mm by 3048 mm by 3048 mm) high or larger with sound absorbing panels on walls and ceiling having a Noise Reduction Coefficient (NRC) of 0.95 or higher for the walls and 0.64 or higher for the ceiling. The ambient noise level shall be not greater than 55 decibels. The device is to be mounted in a position of normal use, approximately 5 feet (1524 mm) above the floor in the center of the room. The microphone is to be located at a 10-foot (3048 mm) distance from the device and in a position to receive the maximum sound level produced by the device.
3. Alternately, the measurement may be made in a free field condition to minimize the effect of reflected sound energy. The ambient noise level is to be at least 10 decibels below the measured level produced by the signal device. Free field conditions may be simulated by mounting the device not less than 10 feet (3048 mm) from the ground and with the microphone located 10 feet (3048 mm) from the device and conducting the test outdoors on a clear day with a wind velocity of not more than 5 miles per hour and an ambient temperature of 15–25°C (50–77°F).
4. Alternatively, an anechoic chamber of not less than 1,000 cubic feet (28 m^3), with no dimension less than 7 feet (2133 mm), and with an absorption factor of 0.99 or greater from 100 Hertz (Hz) to 10 kilo-Hertz (kHz) for all surfaces may be used for this measurement.

(m) **Hydrostatic strength test.**

1. The storage cylinder of a gas operated-type detector shall be capable of withstanding, without failure, an internal hydrostatic pressure of five times the pressure of the stored gas at the operating temperature of the device.
2. In conducting the hydrostatic strength test, the storage cylinder is to be tested to the specified pressure after the shell has been completely filled with water or oil. Care should be exercised to expel all air from the test specimen before the pressure is applied.
3. The apparatus for this test is to consist of a hand- or motor-operated hydraulic pump capable of producing the required test pressure, a substantial test cage capable of containing the shell and its parts in the event of failure, the necessary valves and fittings for attachment to the test sample, a calibrated pressure gage graduated in at least 20 pounds per square inch (psi) increments to at least 200 psi more than the test pressure, and the necessary valves, fittings, etc., for regulating and maintaining the specified test pressure.
4. The pressure should be increased at a rate of approximately 300 psi per minute until the test pressure is obtained. The ultimate test pressure is to be held for 1 minute.
5. Five cylinders are to be subjected to this test. None of the cylinders shall rupture or show evidence of leakage. Deformation of a cylinder is not considered a failure.

INSTRUCTIONS

Sec. 12-72-204.

(a) **General.** Each fire alarm device shall be provided with the following installation, operating and maintenance instructions:

1. Typical installation layout for the unit(s) indicating recommended locations.
2. Description of the operation, testing (if provided), and proper maintenance procedures of the unit(s).
3. Information on establishing a household emergency evacuation plan in the event of a fire.
4. An indication that the local fire authority shall be notified of the installation.

(b) The instructions may be incorporated on the outside of the unit, on a separate sheet, or as part of a manual. If not included directly on the device, the instructions or manual shall be referenced in the marking information on the unit.

MARKING

Sec. 12-72-205.

(a) **General.** A fire alarm device shall be clearly and permanently marked where it will be visible after installation with the following information. Removal of a unit from an installed position by removing not more than one screw to view the marking is considered as meeting the requirement regarding visibility after installation.

1. Name or identifying symbol of manufacturer or vendor.
2. Model number or equivalent.
3. Temperature rating of the fire alarm device.
4. Reference to the State Fire Marshal Regulations for Household Fire Warning Equipment.
5. The statement: "Do Not Paint" or equivalent to prevent painting of the temperature sensitive element and the markings. The letters shall be a minimum of $^1/_8$ inch (3 mm) in height.
6. The following information is required on gas operated units. The letters shall be a minimum of $^1/_8$ inch (3 mm) in height.

   CAUTION—Pressurized Container—Do Not Puncture or Incinerate—Explosion Hazard May Result

7. The following or equivalent wording:

   Operation—Responds To A Heat Producing Fire Only. Unit Will Actuate When The Temperature Of The Surrounding Air Reaches The Marked Temperature Rating (Plus Or Minus A Few Degrees) Provided The Air Temperature Increase Is 1°F (0.56°C) Per Minute Or Less. At Faster Rates Of Temperature Rise, The Surrounding Air Temperature At Which The Unit Will Actuate Will Be Above The Marked Rating, The Temperature Differential Depending On The Rate Of Rise Of Temperature Produced By A Fire. This Temperature Differential Results From the Time Lag Before The Temperature Element Absorbs The Necessary Heat From the Surrounding Air to Actuate.

8. Instructions for setting or rewinding of a spring wound fire alarm device to be included on the device.
9. For gas-operated fire alarm devices information to return the unit to the factory for servicing shall be provided.
10. State Fire Marshal listing file number if required by Article 1.5.

(b) If a manufacturer has more than one temperature rating for an alarm device, where the thermally sensitive element is renewable and must be replaced after operation, the renewable element shall bear the manufacturer's name or equivalent identification and the temperature rating.

(c) If a manufacturer produces units at more than one factory, each unit shall have a distinctive marking to identify it as the product of a particular factory.

TESTING OVEN

Sec. 12-72-206.

(a) **General.** The testing oven shall be constructed and operated in accordance with this section and the following:

1. A typical test oven consists of an oval shaped stainless steel box approximately 31 by 10 by 16 inches (787 mm by 254 mm by 406 mm) high, made of No. 11 M.S.G. material. One of the curved end sections is hinged. See Figure 12-72-2-3.
2. A section 6 by 6 inches (152 mm by 152 mm) at the top is fitted with a removable wooden cover.
3. Two glass windows, 4 by 6 inches (101 mm by 152 mm) in size, are provided in the sides of the oven for observation of the samples under test.
4. The interior of the oven is divided horizontally by a baffle over the heater chamber located in the central lower section. One end of the horizontal baffle is joined to a guide vane extending upward at an angle of 72 degrees into the oven chamber. The vane directs the air currents to ensure greater uniformity of temperature in the oven.
5. Eight 1,000-watt heating elements, threaded into screw shell lampholders, furnish the heat. They are so connected that six of the heating elements are controlled by means of two manually adjusted autotransformers. An auxiliary switch controls the other two heating elements for supplying additional heat when necessary.
6. An air current through the bank of heaters is created by means of a four blade 5-inch (127 mm) diameter fan located behind the heating elements and connected to a shaft which extends to the outside of the oven. A variable speed motor is mounted on a bracket inside the lower cabinet and operates the fan

through a pulley and belt arrangement. The speed of the motor is adjusted and the pitch of the fan blade is such that the velocity of the air current is 230 to 245 feet per minute over the sample under test.

7. Temperatures are measured by means of two No. 30 AWG wire thermocouples inserted through copper tubes extending to the inside of the test chamber and are located adjacent to the device under test and in the heating chamber. The air velocity is measured by a velometer installed in the oven.
8. A control board is mounted on the cabinet adjacent to the testing oven. The control board incorporates five toggle switches and four indicating lights for operating the heating elements, air flow fan and a cooling fan. A toggle switch is used for turning on the temperature recorder and another is used for checking the temperatures in either the upper or lower portion of the oven.
9. Two manually adjusted autotransformers are mounted on the control panel for controlling the heat developed by the heating coils. An air flow indicator gage is incorporated on the control board for continuous indication of the air flow during the test run. In the event that the air flow tends to change during a test run, the speed of the fan is adjusted to keep the air velocity within the specified range.

(b) **Test method.**

1. The preparation for test consists of mounting the device on the small removable screen base of $^1/_4$-inch (6 mm) hardware cloth formed to a height where the temperature sensing element is midway between the top of the chamber and the guide vane. The sample under test is positioned in the air stream so that there is no obstruction between the guide vane and sensing element. A spring wound device is mounted with the sensing element in a horizontal position. The test sample shall remain in the oven at least 5 minutes prior to starting each test run.
2. The heating coils are permitted to preheat for 10 to 20 seconds prior to starting the test. The fan controlling the air flow is turned on and its speed adjusted to produce the required velocity. The temperatures are read every 10 seconds. The two autotransformers are adjusted as needed to obtain the desired rate of temperature rise. Normal oven temperatures at the start of the test are to be 85–90°F (29.4–32.2°C).
3. Upon operation of the device, the current applied to the bank of heaters is cut-off and the oven is cooled to normal room temperature by means of the cooling fan.

TABLE 12-72-2A—TEMPERATURE CLASSIFICATIONS

TEMPERATURE CLASSIFICATION	RATING RANGE °F (°C)	TEST TEMPERATURE °F (°C)
Ordinary	135-174 (57-74)	125 (51.7)
Intermediate	175-225 (79-107)	150 (66)

TABLE 12-72-2B—TEMPERATURE CLASSIFICATIONS

TEMPERATURE CLASSIFICATION	OPERATING TEMPERATURE LIMITS	OPERATION	
	Minimum °F (°C)	Maximum °F (°C)	Tolerance, °F (°C)
Ordinary	128 (53.3)	165 (73.9)	10 (5.6)
Intermediate	166 (74.4)	225 (107)	15 (8.3)

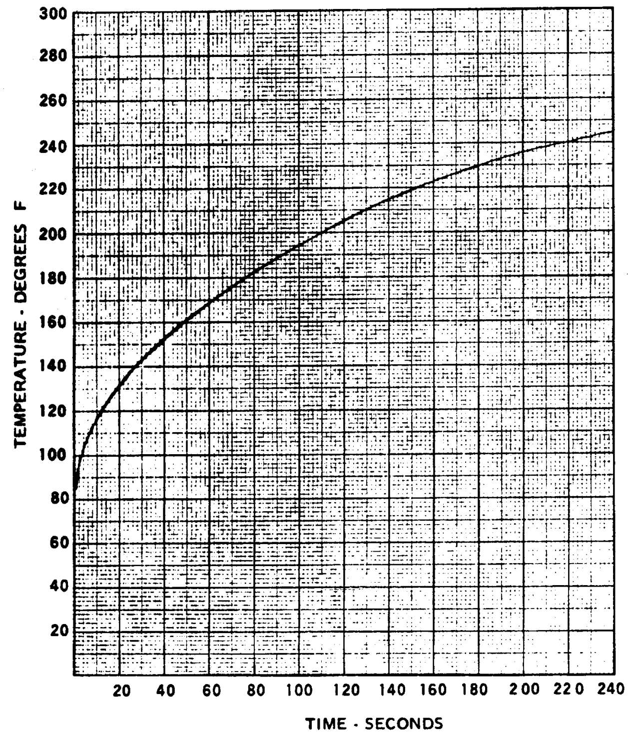
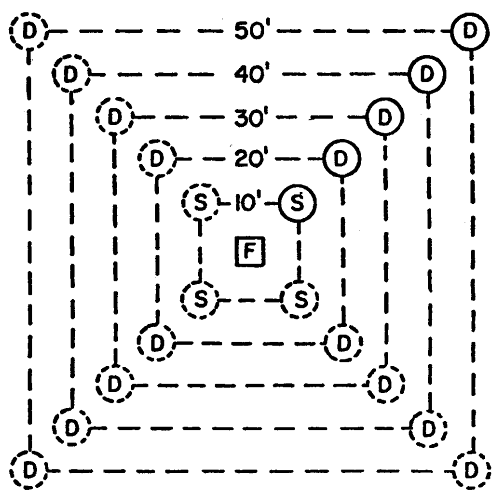


FIGURE 12-72-2-1—TIME-TEMPERATURE CURVE—15-FOOT SPACINGS



Legend:

F — TEST FIRE, DENATURED ALCOHOL, 190-PROOF. PAN LOCATED APPROXIMATELY 3 FEET ABOVE FLOOR.

S (dashed circle) — INDICATES NORMAL SPRINKLER SPACINGS ON 10-FOOT SCHEDULES.

S (solid circle) — SPRINKLER INSTALLED DURING FIRE TEST. RATED 160° F (71.1° C), STANDARD UPRIGHT SPRAY TYPE. DEFLECTORS APPROXIMATELY 7 INCHES BELOW CEILING.

D (dashed circle) — INDICATES NORMAL FIRE ALARM DEVICE SPACING ON VARIOUS SPACING SCHEDULES.

D (solid circle) — FIRE ALARM DEVICE UNDER TEST. EMPLOYED TO DETERMINE MAXIMUM ALLOWABLE SPACING.

FIGURE 12-72-2-2—FIRE-TEST LAYOUT

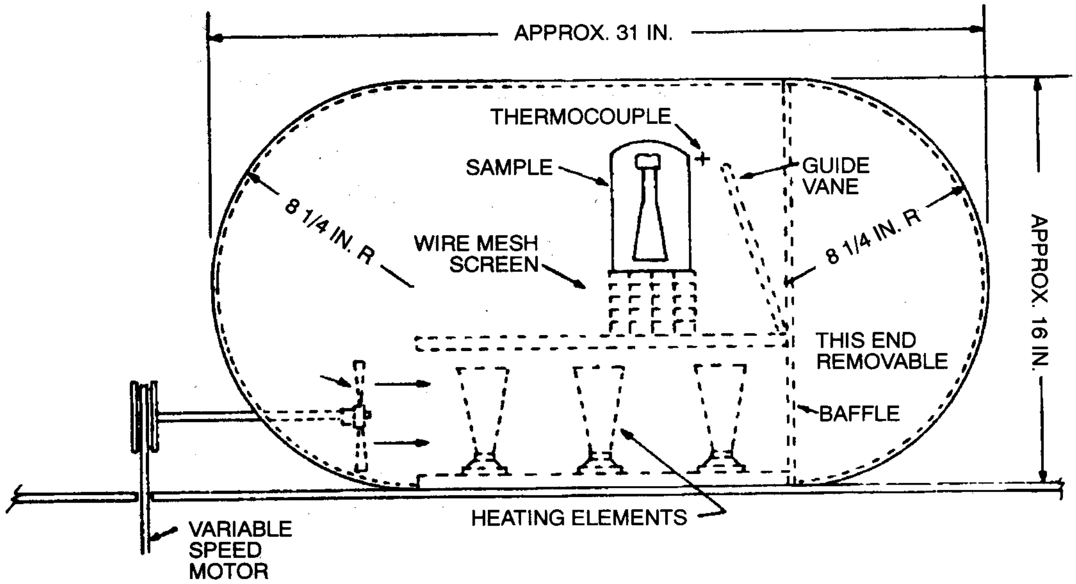


FIGURE 12-72-2-3—TEST OVEN

CHAPTER 12-72-3

PROTECTIVE SIGNALING SYSTEMS

SMOKE DETECTORS, COMBUSTION PRODUCTS TYPE
STANDARD 12-72-3

STATE FIRE MARSHAL
SCOPE

Sec. 12-72-300.

(a) **Basic.** This standard represents the minimum basic requirements for the construction and performance of combustion products detectors of other than the photoelectric type to be employed in ordinary indoor locations and to be listed under this classification. The minimum design, construction and performance standards set forth herein are those deemed as minimum necessary to establish conformance to the regulations of the State Fire Marshal.

(b) **Definitions.** For the purpose of this standard, the following definitions shall apply:

1. **Alarm signal.** A signal intended to indicate an emergency fire condition.
2. **Annunciator.** Integrally mounted or remotely connected visual indicating device intended to indicate an alarm or trouble condition.
3. **Ionization type detector.** A device in which the presence of small combustion practices, often invisible to the eye, interfere with the normal ionization current resulting from radiation produced by a radioactive source in the detection chamber. A second chamber, employing a similar ionization source, may also be used to compensate for normal environmental ambient changes.
4. **Ionization-resistance bridge type detector.** Employs both ionization and resistance bridge principles in one unit. Additive response from both detector elements is required for detector operation.
5. **Resistance-bridge type detector.** Responds to an abnormal rate of increase of combustion products which change the impedance of second similar plate may be employed to compensate for normal ambient changes.
6. **Sensitivity.** Relative degree of response of a detector. A high sensitivity denotes response to a lower concentration of combustion than a low sensitivity under identical fire test conditions.
7. **Trouble signal.** A visual or audible signal intended to indicate a fault or trouble condition, such as an open or ground fault, occurring in the device or connected wiring.
8. **Voltage classification.**

   A. **Low voltage.** A circuit classified as low voltage is one involving a potential of not more than 30 volts alternating current (42.4 peak) or direct current, and supplied from a circuit whose power is limited to a maximum of 100 volt amperes.

   B. **High voltage.** A circuit classified as high voltage is one having circuit characteristics in excess of those of a low-voltage circuit.

TEST REPORTS

Sec. 12-72-301.

(a) The report shall include engineering data, and an analysis comparing the design against Sections 12-72-302 (a) through 12-72-302 (t); it shall include wiring diagrams, operating manuals and photographs; it shall set forth the tests performed in accordance with this standard and the results thereof and shall verify the correctness of the electrical rating.

(b) **Listed components.** Electrical wiring, material, devices, combination of devices, fittings, appliances and equipment which have been tested and listed by an approved listing agency for the intended purpose and use need not be individually retested.

The report shall include the catalog number or other readily identifiable marking; the name of the approved listing agency, the laboratory test report number and date. Such individually tested and listed component parts and devices shall be subjected to the performance standard tests to determine its suitability for use in combination with other component parts, devices, circuits or equipment.

(c) **Listed detectors.** Detectors which have been tested to any other acceptable test standard may be evaluated provided such test incorporates all features of this standard.

(d) **Rejection for cause.** Compliance with these standards will not necessarily mean approval and listing, if when examined and tested, it is found to have other features which may impair the result intended by these regulations. Unusual constructions may require application of additional performance tests. The State Fire Marshal may refuse to approve any item for cause. (See the *California Electrical Code*.)

(e) **Smoke detectors only.**

1. A combustion products detector, as covered by these requirements consists of an assembly of electrical components arranged to detect one or more products of combustion. The products of combustion may consist of but are not necessarily limited to gaseous combustion products, water vapor and visible as well as invisible smoke particles. The detector includes provision for the connection to a source of

power, signaling and optional remote control circuits.

2. These requirements cover the following types of detectors:

   A. Detectors intended for open area protection, intended for connection to a compatible power supply or control unit for operation as part of a fire alarm system.

   B. Detectors intended solely for control of releasing devices such as electromagnetic door holders, fire dampers, etc.

   C. Detectors suitable for Items A and B above.

3. This standard does not cover the following:

   A. Detectors for monitoring the smoke density within flues or stacks.

   B. Duct detectors.

   C. Power supplies and control units to which the detectors are intended to be connected. These are covered under the Standard Test Procedures for Protective Signaling Systems, SFM 12-72-1.

   D. Smoke detectors of the photoelectric type which are covered by the Standard for Smoke Detectors, Photoelectric Type, for Fire-Protective Signaling Systems, UL 168.

4. The manufacture, importation, distribution and disposal of smoke detectors containing radioactive material are subject to the safety requirements of state radiation control agencies and/or the U.S. Atomic Energy Commission.

5. Verification of an acceptable evaluation by the regulating agency involved is required prior to the investigation of the smoke detector to ensure compliance with this standard.

(f) **Differing constructions.** A detector having materials or forms of construction differing from this standard may be investigated and tested according to the intent of this standard, and if found to be substantially equivalent may be given recognition for approval and listing. The office of the State Fire Marshal shall be consulted for general requirements and performance standards.

(g) **Operating and installation instructions.**

1. A copy of the operating and installation instructions and related schematic wiring diagrams and installation drawings are to be furnished with the sample submitted for investigation to be used as a guide in the examination and test of the detector and for this purpose need not be in final printed form. The information may be included in a manual or technical bulletin.

2. The instructions and drawings should include such directions and information as deemed by the manufacturer to be adequate for attaining proper and safe installation, maintenance and operation of the detector. See Section 12-72-302 (b).

GENERAL

12-72-302.

(a) **Construction.**

1. A detector shall be so constructed that it will be reliable and sufficiently durable for its intended installation and use.

2. A component of a detector shall comply with the requirements for that component, except that such requirements may be modified if appropriate for the particular application.

3. Except where specifically indicated otherwise, the construction requirements specified for a detector shall also apply for any remote accessories with which it is to be employed.

4. Each detector is to be provided with a means for monitoring the relative sensitivity of the unit after it has been installed.

5. The monitoring means may be by means of a jack or terminals for connection of a meter, or by a visual means which would be visible with the unit installed, or equivalent.

6. The use of a plug-in type detector assembly, which may be removed readily for insertion of an adapter connected to metering equipment, would be acceptable.

(b) **Marking.**

1. A detector shall be permanently marked with the following information, except where it is indicated that the information may appear on an installation wiring diagram.

   A. Name or identifying symbol of the manufacturer or vendor.

   B. Model number or equivalent and serial number or equivalent.

   C. Electrical rating, in volts, amperes or watts, and frequency for each circuit. May appear on the installation wiring diagram.

   D. Sensitivity setting and reference to the region of sensitivity such as maximum, nominal or intermediate or minimum. If a detector is intended to be adjusted in the field, the range of sensitivity is to be indicated. The sensitivity shall be indicated as an instrument reading. A sensitivity indication other than an instrument reading may be employed if it provides an equivalent indication of the sensitivity of the detector. May appear on the installation wiring diagram.

   E. Correct mounting position if a unit is intended to be mounted in a definite position. This information may appear on the installation wiring diagram.

   F. Identification of lights, switches, meters, etc., regarding their function, unless their operation is obvious.

G. Maximum rating of fuse in each fuseholder. Located adjacent to the fuseholder.

H. Reference to an installation wiring diagram, if not attached to the detector, by drawing number and issue number of date.

I. For a detector which employs a radioactive material, the following information shall be indicated directly on the unit: type, amount, radiation symbol (optional), safe disposal and a caution notice which shall read as follows:

CAUTION—Contains Radioactive Material, or its equivalent wording.

J. A reference to the Technical Bulletin. May appear on the installation wiring diagram.

K. Reference to a specific model number or description of the instrument to be used for checking the sensitivity of the detector. May appear on the installation wiring diagram.

L. A detector intended for permanent connection only to a wiring system other than metal-clad cable or conduit shall be marked to indicate the system or systems for which it is suitable. The marking shall be so located that it will be visible when power-supply connections to the detector are made or may appear on the installation wiring diagram.

M. The State Fire Marshal's listing label if required by Article 1.5.

N. A detector which is not intended to be painted in the field shall be marked on the outside "DO NOT PAINT."

2. An installation wiring diagram shall be provided with each detector illustrating the field connections to be made. The drawing may be attached to the unit or, if separate, shall be referenced in the marking attached to the unit with the drawing number and issue number and/or date.

3. The drawing shall show a pictorial view of the installation terminals or leads to which field connections are made as they would appear when viewed during an installation and the minimum internal dimensions of a back box, if not provided with the detector, shall be specified. The terminal numbers on the detector shall agree with the numbers on the drawing. A drawing not attached to the detector unit shall be marked with the name or identifying symbol of the manufacturer's or vendor's drawing number, and an issue number and/or date.

4. The following marking information is required to appear on the detector or the installation wiring diagram for the applicable circuits to which field connections are made. Where an electrical rating is indicated, it may be omitted if reference is made for connection to a specific control unit or equivalent.

A. **Supply circuit.** Voltage, current or watts, and frequency.

B. **Initiating device circuit connections.** For detectors intended to be connected only to the initiating device circuit of a fire alarm system control unit, at least two detectors shall be shown connected to a typical initiating device circuit. For a detector intended only for releasing device service, a typical connection shall be shown. For a detector suitable for both application, typical connections representing both types of connections shall be illustrated.

C. **Supplementary circuits.** Voltage, current or watts, and frequency rating.

5. **Technical bulletin.** A technical bulletin shall be provided by the manufacturer for each installation to be used as a reference by the installer. The bulletin shall include the manufacturer's recommendations regarding typical detector locations. The information shall include guidelines on detector location, spacings, maintenance, servicing tests, etc., under various environmental conditions and physical configurations. Some conditions for which guidelines are required are:

A. Temperature

B. Humidity

C. Corrosive atmospheres

D. Air movement (ventilating and air-conditioning systems)

E. High ceilings

F. Sloped ceilings

G. Girder ceiling construction

H. Small and large bays

I. Open joist construction

J. High stock piling

K. Conditions produced by manufacturing processes

6. Detailed information shall be provided regarding the use of the facilities provided on the detector to monitor the sensitivity. Typical information that shall be provided includes:

A. Nominal reading under clear condition

B. Nominal reading when close to alarm

C. Nominal reading at alarm condition

D. Guidelines on instrument use for an engineering survey, installation and maintenance

7. Information regarding locations where not to install detectors shall also be provided to minimize the possibility of false alarms.

8. Reference to the bulletin number and date is required either on the detector nameplate marking or on the installation drawing. If the installation drawing is included as part of the technical bulletin, reference to the bulletin is required to be indicated on the detector.

(c) **Frame, enclosure and metalware.**

1. A detector enclosure shall be so formed and assembled that it has the strength and rigidity necessary to resist the abuses to which it is likely to be subjected in service without adversely affecting its performance and without introducing a fire, shock or accident hazard due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts or other defects.
2. Except as noted, all electrical parts of a detector shall be enclosed to provide protection against contact with uninsulated live parts. A separate enclosure for field wiring terminals that will be enclosed by a back box is not required.
3. A detector shall have a suitable means for mounting, which shall be accessible without disassembling any operating part of the unit. Removal of a completely assembled panel or equivalent to mount the detector is not considered to be disassembly of an operating part.
4. An assembled part intended to be removed during installation shall be protected against damage from handling.
5. An enclosure shall have provision for the connection of metal-clad cable or conduit. An enclosure without provision for the connection of metal-clad cable or conduit may be acceptable if there are furnished with it definite instructions indicating the sections of the unit which are intended to be drilled in the field for the connection of raceways, or if the unit is intended for mounting on an outlet box.
6. The thickness of cast metal for an enclosure shall be as indicated in Table 12-72-3A. Except that cast metal having a thickness $^{1}/_{32}$ inch (0.8 mm) less than that indicated in the table may be employed if the surface under consideration is curved, ribbed or otherwise reinforced, or if the shape and/or size of the surface is such that equivalent mechanical strength is provided.
7. If threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or if an equivalent construction is employed, there shall be not less than three and one-half nor more than five threads in the metal, and the construction shall be such that a standard conduit bushing can be properly attached.
8. If threads for the connection of conduit are tapped only part of the way through a hole in an enclosure wall, there shall be not less than three and one-half full threads in the metal, and there shall be a smooth, rounded inlet hole for the conductors which shall afford protection to the conductors equivalent to that provided by a standard conduit bushing.
9. **Sheet metal enclosures.** The thickness of sheet metal employed for the enclosure of a detector shall be not less than that indicated in Table 12-72-3B, except that sheet metal of two gauge sizes lesser thickness may be employed if the surface under consideration is curved, ribbed or otherwise reinforced, or if the shape and/or size of the surface is such that equivalent mechanical strength is provided.
10. At any point where conduit or metal-clad cable is to be attached, sheet metal shall be of such thickness or shall be so formed or reinforced that it will have a stiffness at least equivalent to that of an uncoated flat sheet steel having a minimum thickness of 0.053 inch (1.3 mm) (No. 16 MSG).
11. A plate or plug closure for an unused conduit opening or other hole in the enclosure shall have a thickness not less than:

    A. 0.014 inch (0.3 mm) for steel or 0.019 inch (0.5 mm) for nonferrous metal for a hole having a $^{1}/_{4}$-inch (6 mm) maximum dimension.

    B. 0.027-inch (0.7 mm) steel or 0.032-inch (0.8 mm) nonferrous metal for a hole having a $1^{3}/_{8}$-inch (35 mm) maximum dimension.
12. A closure for a hole larger than $1^{3}/_{8}$-inch (35 mm) diameter shall have a thickness equal to that required for the enclosure of the device or a standard knockout seal shall be used. Such plates or plugs shall be securely mounted.
13. A knockout in a sheet metal enclosure shall be reliably secured but shall be capable of being removed without undue deformation of the enclosure.
14. A knockout shall be provided with a surrounding surface adequate for proper seating of a conduit bushing, and shall be so located that installation of a bushing at any knockout likely to be used during installation will not result in spacings between uninsulated live parts and the bushing of less than those indicated under spacings.

    The figures in parentheses are the galvanized sheet gage numbers (GSG) (for zinc-coated steel), the manufacturers' standard gage numbers (MSG) (for uncoated steel), and the American wire gage numbers (AWG) (for a nonferrous metal) which provide the required minimum thickness of metal.
15. An enclosure or parts of an enclosure of nonmetallic material shall have the mechanical strength and durability and be so formed that parts will be protected against damage. The mechanical strength of an enclosure shall be at least equivalent to a sheet metal enclosure of the minimum thickness specified in Table 12-72-3B. See Section 12-72-205 for performance tests on plastic materials and enclosures.
16. (No requirements.)
17. The continuity of the grounding system shall not rely on the dimensional integrity of the nonmetallic material.
18. Ventilating openings in an enclosure, including perforated holes, louvers and openings protected by means of wire screening, expanded metal or perforated covers, shall be of such size or shape that no

opening will permit passage of a rod having a diameter of $3^3/_{64}$ inch (77 mm). An enclosure for fuses or other overload protective device and provided with ventilating openings shall afford adequate protection against the emission of flame or molten metal. The opening shall be designed to permit cleaning without damage to functional enclosed parts.

19. Except as noted in the following paragraph, perforated sheet metal and sheet metal employed for expanded metal mesh shall be not less than 0.042 inch (1 mm) in average thickness, 0.046 inch (1.1 mm) if zinc coated.

20. If the indentation of a guard or enclosure will not alter the clearance between uninsulated live parts and dead metal parts so as to affect performance adversely or reduce spacings below the minimum values given under spacings, 0.021 inch (0.5 mm) expanded metal mesh [0.024 inch (0.6 mm) if zinc coated] may be employed, provided that (1) the exposed mesh on any one side or surface of the device so protected has an area of not more than 72 square inches (46 451 mm^2) and has no dimension greater than 12 inches (305 mm), or (2) the width of an opening so protected is not greater than $3^1/_2$ inches (89 mm).

21. The wires forming a screen protecting current carrying parts shall be not smaller than No. 16 AWG and the screen openings shall be not greater than $^1/_2$ square inch (322 mm^2) in area.

22. An enclosure cover shall be hinged, sliding, pivoted or similarly attached if (1) it provides ready access to fuses or any other overcurrent protective device the normal functioning of which requires renewal, or (2) it is necessary to open the cover in connection with the normal operation of the unit.

23. With reference to the requirement of Item 22, normal operation is considered to be operation of a switch for testing or for silencing an audible signal appliance or operation of any other component of a unit which requires such action in connection with its intended performance.

24. A hinged cover is not required where the only fuse(s) enclosed is intended to provide protection to portions of internal circuits, such as may be employed on a separate printed wiring board or circuit subassembly, to prevent excessive circuit damage resulting from a fault. The use of such a fuse(s) is acceptable if the following or equivalent marking is indicated on the cover of units employing high voltage circuits: Circuit Fuse(s) Inside—Disconnect Power Prior to Servicing.

25. A hinged cover shall be provided with a latch, screw or catch to hold it closed. An unhinged cover shall be securely held in place by screws or the equivalent.

26. Glass covering an observation opening shall be held securely in place so that it cannot be readily displaced in service and shall provide adequate mechanical protection of the enclosed parts. The thickness of a glass cover shall be not less than that indicated in Table 12-72-3C.

27. A glass panel for an opening having an area of more than 144 square inches (92 903 mm^2) or having any dimension greater than 12 inches (305 mm), shall be supported by a continuous groove not less than $^3/_{16}$ inch (4.7 mm) deep along all four edges of the panel.

28. A transparent material other than glass employed as a cover over an opening in an enclosure shall have mechanical strength equivalent to that of glass, not become a fire hazard or distort, or not become less transparent at the temperature to which it may be subjected under normal or abnormal service conditions.

(d) **Protection against corrosion.**

1. Except as indicated herein, iron and steel parts shall be suitably protected against corrosion by enameling, galvanizing, sheradizing, plating or other equivalent means.

2. These requirements apply to all enclosures whether of sheet steel or cast iron, and to all springs and other parts upon which proper mechanical operation may depend. It does not apply to minor parts such as washers, screws, bolts and the like, if the failure of such unprotected parts would not be liable to result in a hazardous condition or adversely affect the operation of the unit. Parts made of stainless steel (properly polished or treated if necessary) do not require additional protection against corrosion. Bearing surfaces should be of such materials and design as to ensure against binding due to corrosion.

(e) **Insulating materials.**

1. Material for the mounting of current-carrying parts shall be porcelain, phenolic composition, cold-molded composition or material which is suitable for the particular application.

2. Vulcanized fiber may be used for insulating bushings, washers, separators and barriers, but not as the sole support for uninsulated current-carrying parts of other than low-voltage circuits. Plastic materials may be used for the sole support of uninsulated live parts, if found to have adequate mechanical strength and rigidity, dielectric withstand, resistance to heat, flame propagation, arcing, creep and moisture, and other properties suitable for the application, without displaying a loss of these properties beyond the minimum acceptable level as a result of aging.

3. Metal parts as described below need not comply with the requirement of Section 12-72-302 (d), Item 2.

   A. Adhesive attached metal foil markings, screws, handles, etc., which are located on the outside of the detector enclosure and isolated from electrical components or wiring by grounded metal parts so that they are not liable to become energized.

4. A terminal block mounted on a metal surface which may be grounded shall be provided with an insulating barrier between the mounting surface and all live parts on the underside of the base which are not staked, upset, sealed or equivalently prevented from loosening so as to prevent such parts and the ends of replaceable terminal screws from coming in contact with the supporting surface.

5. A countersunk part shall be covered with a waterproof insulating compound which will not melt at a temperature 15°C (27°F) higher than the maximum normal operating temperature of the assembly, and at not less than 65°C (149°F) in any case. The depth or thickness of sealing compound shall be not less than $^{1}/_{8}$ inch (3 mm).

(f) **Mounting parts.**

1. All parts of a detector shall be securely mounted in position and prevented from loosening or turning if such motion may affect adversely the normal performance of the unit, or may affect the fire and accident hazard incident to the operation of the detector.

2. A switch, lampholder, attachment-plug receptacle, plug connector or similar electrical component, shall be mounted securely and, except as noted in Items 3 and 4, shall be prevented from turning.

3. The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

   A. The switch is to be of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch.

   B. Isolated metal parts, such as small assembly screws, etc., which are positively separated from wiring and uninsulated live parts.

   C. Panels and covers which do not enclose uninsulated live parts if wiring is positively separated from the panel or cover so that it is not liable to become energized.

   D. Panels and covers which are insulated from electrical components and wiring by an insulating barrier of vulcanized fiber, varnished cloth, phenolic composition or similar material not less than $^{1}/_{32}$-inch (0.8 mm) thick and reliably secured in place.

4. A bonding conductor shall be of material suitable for use as an electrical conductor. If of ferrous metal, it shall be protected against corrosion by painting, plating or the equivalent. The conductor shall be not smaller than the maximum size wire employed in the circuit wiring of the component or part. A separate bonding conductor or strap shall be installed in such a manner that it is protected from mechanical damage.

5. The bonding shall be by a positive means, such as by clamping, riveting, bolted or screwed connection, brazing or welding. The bonding connection shall reliably penetrate nonconductive coatings such as paint. Bonding around a resilient mount shall not depend on the clamping action of rubber or similar material.

6. A bolted or screwed connection that incorporates a star washer under the screw head, is considered acceptable for penetrating nonconductive coatings.

7. Where the bonding means depends upon screw threads, two or more screws or two fall threads of a single screw engaging metal is considered acceptable.

8. Metal-to-metal hinge-bearing members for doors or covers may be considered as a means for bonding the door or cover for grounding providing a multiple-bearing, pin-type hinge is employed.

9. Splices shall not be employed in conductors used to bond electrical enclosures or components.

(g) **Deleted.**

(h) **Motors.**

1. All motors shall be protected by thermal or by overcurrent protective devices, or a combination thereof.

2. A motor employing thermal protection which complies with the Standard for Thermal Protectors for Motors, UL 547, is considered to comply with the requirement of Item 1.

3. Motors, such as direct-drive fan motors, which are not normally subjected to overloads, and which are determined to be adequately protected against overheating due to locked-rotor current by a thermal or overcurrent protective device may be accepted under this requirement, provided it is determined that the motor will not overheat under the performance requirements of this standard.

4. Impedance protection may be accepted for motors which are determined to be adequately protected against overheating due to locked-rotor current, provided it is determined that the motor will not overheat under the performance requirements of this standard.

(i) **Current-carrying parts.**

1. A current-carrying part shall have adequate mechanical strength and current carrying capacity for the service, and shall be a metal such as silver, copper or copper alloy, or other material which will provide equivalent performance.

2. Bearings, hinges, etc., are not acceptable for carrying current between interrelated fixed and moving parts.

3. The insulation of coil windings of relays, transformers, etc., shall be such as to resist the absorption of moisture.

4. Enameled wire is not required to be given additional treatment to prevent moisture absorption.

(j) **Supply connections.** A detector shall be provided with wiring terminals or leads for the connection of conductors of at least the size required by the *California Electrical Code*, corresponding to the rating of the unit.

(k) **Terminal connections and leads.**

1. The parts to which wiring connections are made are to consist of binding screws with terminal plates having upturned lugs or the equivalent to hold the wires in position. Other terminal connections may be provided if found to be equivalent.
2. If a wire binding screw is employed at a field wiring terminal, the screw shall be not smaller than No. 8, except that a No. 6 screw may be used for the connection of a No. 14 AWG or smaller conductor.
3. Except as noted in the following paragraph, a terminal plate tapped for a wire binding screw shall be of metal not less than 0.050 inch (1.27 mm) in thickness for a No. 8 or larger screw, and not less than 0.030 inch (0.7 mm) in thickness for a No. 8 screw, and shall have not less than two full threads in the metal.
4. A terminal plate may have the metal extruded at the tapped hole for the binding screw so as to provide two full threads. Other constructions may be employed if they provide equivalent security.
5. Leads provided for field connections shall be not less than 6 inches (152 mm) long, provided with strain relief, shall be not smaller than No. 18 AWG, and the insulation, if of rubber or thermoplastic, shall be not less than $^{1}/_{32}$ inch (0.8 mm) in thickness.
6. The leads specified in Item 5 may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead might result in a hazard.
7. In a detector intended for connection to a high- voltage source of supply by means of other than a metal-enclosed wiring system, such as nonmetallic sheathed cable:
   A. An equipment-grounding terminal or lead shall be provided.
   B. A marking shall be provided to indicate the system or systems for which it is suitable. (See Item 1, L of Section 12-72-302 (b).
   C. The grounding means shall be reliably connected to all exposed dead metal parts which are liable to become energized and all dead metal parts within the enclosure which are exposed to contact during servicing and maintenance.
8. The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green, with or without one or more yellow stripes and no other leads visible to the installer, other than grounding conductors, shall be so identified.
9. A field-wiring terminal intended for connection of an equipment-grounding conductor shall be plainly identified, such as being marked G, GR, Ground, Grounding, or the equivalent, or by a suitable marking on a wiring diagram provided on the detector. The field-wiring diagram is provided on the detector. The field-wiring terminal shall be so located that it is unlikely to be removed during normal servicing of the detector.
10. A field-wiring terminal for the connection of a grounded supply conductor shall be identified by means of a metallic plated coating substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of the terminal for the connection of the grounded conductor shall be clearly shown in some other manner, such as on an attached wiring diagram.
11. A field-wiring lead provided for connection of a grounded supply conductor shall be finished to show a white or natural gray color and shall be readily distinguishable from other leads and no other leads, other than grounded conductors, shall be so identified.
12. A terminal or lead identified for the connection of the grounded supply conductor shall not be electrically connected to a single-pole manual switching device which has an off position or to a single-pole overcurrent (not thermal) protective device.

(l) **Field-wiring compartment.**

1. The field-wiring compartment area of a detector to which connections are to be made is to be of sufficient size for completing all wiring connections as specified by the installation wiring diagram.
2. Protection for the internal components and wire insulation from sharp edges shall be provided by insulating or metal barriers having smoothly rounded edges or by the following or equivalent instructions located in the wiring area: "CAUTION—When making installation route field wiring away from sharp projections, corners and internal components."
3. The location of an outlet box or compartment in which field-wiring connections are to be made shall be such that these connections may be inspected after the detector is installed as intended. The removal of not more than two mounting screws, or an equivalent arrangement, to view the field connections, is considered as meeting the intent of this paragraph.

(m) **Internal wiring.**

1. The internal wiring of a unit shall consist of conductors of at least the size required by the Basic Electrical Regulations, corresponding to the current rating of the unit, and having insulation rated for the potential involved and the temperatures to which it may be subjected. The wiring shall be routed away from moving parts and sharp projections and held in place with clamps, string ties or equivalent, unless of sufficient rigidity to retain a shaped form.
2. Leads or a cable assembly connected to parts mounted on a hinged cover shall be of sufficient length to permit the full opening of the cover with-

out applying stress to the leads or their connections. The leads shall be secured or equivalently arranged to prevent abrasion of insulation and jamming between parts of the enclosure.

3. If the use of a short length of insulated conductor is not feasible, e.g., a short coil lead or the like, electrical insulating tubing may be employed. The tubing is not to be subjected to sharp bends, tension, compression or repeated flexing, and is not to contact sharp edges, projections or corners. The wall thickness of the tubing is to conform to the requirements for such tubing, except that the wall thickness at any point for polyvinyl chloride tubing of $^3/_8$-inch (9.5 mm) diameter or less, is to be not less than 0.017 inch (0.4 mm). For insulating tubing of other types, the wall thickness is to be not less than required to at least equal the mechanical strength, dielectric properties, heat and moisture resistant characteristics, etc. of polyvinyl chloride tubing having a wall thickness of 0.017 inch (0.4 mm).
4. Internal wiring of circuits which operate at different potentials shall be reliably separated by barriers or shall be segregated, unless the conductors of the circuits of lower voltage are provided with insulation equivalent to that required for the highest voltage involved. Segregation of insulated conductors may be accomplished by clamping, routing or equivalent means which ensures permanent separation. See Item 10.
5. Stranded conductors clamped under wire-binding screws or similar parts shall have the individual strands soldered together or be equivalently arranged to ensure reliable connections.
6. Wireways shall be smooth and free from sharp edges, burrs, fins, moving parts, etc., which may cause abrasion of the conductor insulation.
7. All splices and connections shall be mechanically secured and bonded electrically.
8. A splice shall be provided with insulation equivalent to that of the wires involved if permanence of electrical spacing between the splice and uninsulated metal parts is not assured.
9. Splices shall be located, enclosed and supported so that they are not subject to damage from flexing, motion or vibration.
10. A metal barrier shall have a thickness at least equal to that required by Table 12-72-3B, based on the size of the barrier. A barrier of insulation material shall be not less than 0.028 inch (0.7 mm) in thickness and shall be of greater thickness if its deformation may be readily accomplished so as to defeat its purpose. Any clearance between the edge of a barrier and a compartment wall shall be not more than $^1/_{16}$ inch (1.6 mm).
11. Where a lead or wire harness passes through an opening in a wall, barrier or enclosing case, there shall be a metal or insulating type bushing, or the equivalent, which shall be substantial, reliably secured in place, and shall have a smooth rounded surface against which the wire may bear.
12. If the opening is in a phenolic composition or other suitable nonconducting material or in metal of thickness greater than 0.042 inch (1 mm), a smooth surface having rounded edges is considered to be the equivalent of a bushing.
13. Ceramic materials and some molded compositions are considered to be acceptable for insulating bushings, but separate buildings of wood and of hot-molded shellac are not acceptable.
14. Fiber may be employed where it will not be subjected to a temperature higher than 90°C (194°F) under normal operating conditions, the bushing is not less than $^1/_{16}$ inch (1.6 mm) in thickness with a minus tolerance of $^1/_{64}$ inch (0.4 mm) for manufacturing variations, and it is so formed and secured in place that it will not be affected adversely by ordinary ambient conditions of humidity.
15. If a soft-rubber bushing is employed in a hole in metal, the hole shall be free from sharp edges, burrs, projections, etc., which would be likely to cut into the rubber.
16. An insulating metal grommet may be considered acceptable in lieu of an insulating bushing, provided that the insulating material used is not less than $^1/_{32}$ inch (0.8 mm) in thickness and fills completely the space between the grommet and the metal in which it is mounted.
17. A strain relief means shall be provided for the field supply leads, and all internally connected wires or cords which are subject to movement in conjunction with the installation, operation or normal servicing of a detector to prevent any mechanical stress from being transmitted to terminals and internal connections. Inward movement of the cord or leads provided with a ring-type strain relief means shall not damage internal connections or components, or result in a reduction of electrical spacings.
18. Each lead employed for field connections or an internal lead subjected to movement or handling during installation and normal servicing shall be capable of withstanding for 1 minute a pull of 10 pounds without any evidence of damage or of transmitting the stress to internal connections.

(n) **Lampholders and lamps.**

1. Lampholders and lamps shall be rated for the circuit in which they are employed when the detector is operated under any condition of normal service.
2. A lampholder employing a screw shell shall be so wired that the screw shell will be connected to an identified (grounded circuit) conductor.
3. If more than one screw shell-type lampholder is provided, the screw shells of all such lampholders shall be connected to the same conductor unless there is

no shock hazard present (30 volts RMS or less) when replacing the lamps.

4. A lampholder shall be installed so that uninsulated live parts will not be exposed to contact by persons removing or replacing lamps in normal service.

(o) **Operating components.**

1. Operating components and assemblies, such as switches, relays and similar devices, shall be adequately protected by individual protection or dust-tight cabinets, against fouling by dust or by other material which may affect their normal operation.
2. Moving parts shall have sufficient play at bearing surfaces to prevent binding.
3. Provision shall be made to prevent adjusting screws and similar adjustable parts from loosening under the conditions of actual use.
4. Manually operated parts shall have sufficient strength to withstand the stresses to which they will be subjected in operation.
5. An electromagnetic device shall ensure reliable and positive electrical and mechanical performance under all conditions of normal operation.

(p) **Switches.**

1. A switch provided as part of a unit shall have a current and voltage rating not less than that of the circuit which it controls when the device is operated under any condition of normal service.
2. If a reset switch is provided, it shall be of a self-restoring type.

(q) **Over-current protection.** Fuseholders, fuses and circuit breakers provided on a detector unit shall be rated for the application.

(r) **Printed wiring boards.** Printed wiring boards shall be acceptable for the application. The securing of components to the board shall be made in a reliable manner and the spacings between circuits shall comply with the spacings requirements. The board shall be reliably mounted so that deflection of the board during servicing shall not result in damage to the board or in a fire or shock hazard. (See SFM 12-72-1.)

(s) **Service and maintenance protection.**

1. An uninsulated live part and hazardous moving parts within the enclosure shall be located, guarded or enclosed so as to minimize the likelihood of accidental contact by persons performing service functions which may have to be performed with the equipment energized.
2. Manual-switching devices may be located or oriented with respect to uninsulated live parts or hazardous moving parts so that manipulation of the mechanism can be accomplished in the normal direction of access if uninsulated live parts or hazardous moving parts are not located in front (in the direction of access) of the mechanism and are not located within 6 inches (152 mm) on any side or behind the mechanism, unless guarded.
3. In determining compliance with Item 2, only uninsulated live parts in high-voltage circuits are to be considered.
4. An electrical control component which may require examination, adjustment, servicing or maintenance while energized (excluding voltage measurements except for jacks or terminals specifically intended for that purpose) shall be located and mounted with respect to other components and with respect to grounded metal parts so that it is accessible for electrical service functions without subjecting persons to the likelihood of shock hazard from adjacent uninsulated live parts or to accident hazard from adjacent hazardous moving parts.
5. Other arrangements of location of components and/or guarding are also acceptable where electrical components are accessible for service as indicated by Item 4.
6. The following are not considered to be uninsulated live parts: (1) coils of controllers, relays and solenoids, and transformer windings, if the coils and windings are provided with suitable insulating overwraps, (2) enclosed motor windings, (3) terminals and (4) splices with suitable insulation and insulated wire.

(t) **Spacings.**

1. A detector shall provide reliably maintained spacings between uninsulated live parts and dead metal parts and between uninsulated live parts of opposite polarity. The spacings shall be not less than those indicated in Table 12-72-3E.
2. The spacing between an uninsulated live part and a wall or cover of a metal enclosure, a fitting for conduit or metal-clad cable, and any dead-metal part shall be not less than that indicated in Table 12-72-3E.
3. The through air and over surface spacings at an individual component part are to be judged on the basis of the volt-amperes used and controlled by the individual component. However, the spacing from one component to another, and from any component to the enclosure or to other uninsulated dead metal parts excluding the component mounting surface, shall be judged on the basis of the maximum voltage and total volt-ampere rating of all components in the enclosure.
4. The spacing requirements in Table 12-72-3E do not apply to the inherent spacings inside motors, except at wiring terminals, or to the inherent spacings of a component which is provided as part of the detector. Such spacings are judged on the basis of the requirements for the component. The electrical clearance resulting from the assembly of a component into the complete device, including clearances to dead metal or enclosures, shall be those indicated in Table 12-72-3E.

5. The “to walls of enclosure” spacings are not to be applied to an individual enclosure of a component part within an outer enclosure.
6. An insulating liner or barrier of vulcanized fiber, varnished cloth, mica, phenolic composition or similar material employed where spacings would otherwise be insufficient, shall be not less than 0.028 inch (0.7 mm) in thickness, except that a liner or barrier not less than 0.013 inch (0.3 mm) in thickness may be used in conjunction with an air spacing of not less than one-half of the through air spacing required. The liner shall be located so that it will not be affected adversely by arcing.
7. Insulating material having a thickness less than that specified in Item 6 may be used, if upon investigation, it is found to be adequate for the particular application.
8. Enamel-insulated wire is considered to be a bare current-carrying part in determining compliance of a device with the spacing requirements, but enamel is acceptable as turn-to-turn insulation in coils.

PERFORMANCE

Sec. 12-72-303.

(a) **General.**

1. Unless otherwise specified, detectors representative of production are to be used for each of the following tests.
2. The devices employed for testing are to be those specified by the wiring diagram of the detector, except that substitute devices may be used if they produce functions and load conditions equivalent to those obtained with the devices intended to be used with the detector in service.
3. Data on detector components, e.g., capacitors, resistors (other than carbon or wire wound), solid state devices, etc., shall be provided by the manufacturer for evaluation of the reliability of the components for the intended application. If a Mil-Spec. is referenced, a copy of the specification is to be provided for review. A failure rate of 0.5 failure per million hours for nonsupervised components would be acceptable.
4. The data required in the preceding paragraph shall include the following:

   A. **Component fault analysis.** Effect of failure, open and short, particularly of capacitors, on operation of a detector.

   B. A description of any component screening and burn-in test, if available.

   C. Amount of derating of components under normal standby and alarm conditions. A derating of 50 percent or more is acceptable for all components except for electrolytic capacitors. See also Table 12-72-3F.

   D. **Component failure rate data at rated values and derated values.** This may be in the form of a reference to a Mil-Spec. handbook or equivalent.

   E. Maximum ratings for components.

   F. Any other data, not included above, which will provide an equivalent reliability analysis.

DETECTOR RATED VOLTAGE, NAMEPLATE	TEST VOLTAGE
110 to 120	120
220 to 240	240
Other	Marked Rating

5. Unless specifically specified otherwise, the test voltage for each test of a detector shall be as follows at rated frequency:
6. The following samples are used to perform the tests of this standard:

   A. At least 20 assembled detectors fully representative of production units.

   B. One additional unassembled detector fully representative of production units.

   C. Five additional samples of detectors employing a radioactive source. These may be partial assemblies illustrating the radioactive source installation.

   D. Three control units and/or power supplies if the detectors are intended specifically to be employed with a specific unit or power supply.

   E. The monitoring instrument or reference to a commonly available meter intended to monitor sensitivity of a detector.

(b) **Normal operation.**

1. A detector shall be capable of operating for all conditions of its intended performance at all sensitivity settings when employed in conjunction with any related power supply or control unit with which it is intended to be employed and indicating devices to form the system combination covered by the installation wiring diagram and any supplementary information provided.
2. The test voltage shall be in accordance with Section 12-72-303 (a), Item 5, and the combustion products detector shall be in the normal circuit supervisory standby condition and prepared for normal signaling operation when it is connected to related devices and circuits.
3. The introduction of combustion products into the detector chamber such as produced by a smoldering cotton lamp wick, rope or equivalent, shall result in the operation of the detector in its intended manner. Section 12-72-303 (p), Item 2.

(c) **Power input and output.** The input or output current of each circuit of a combustion products detector shall not exceed the marked rating by more than 10 percent when the detector is operated under the conditions of normal use and with the detector connected to a source of supply in accordance with Section 12-72-303 (a), Item 5.

(d) **Electrical supervision.**

1. All nonreliable components such as electronic tube heaters, blower motors, capacitors, functional heating elements, etc., the failure of which may result in an open or shorted condition shall be electrically supervised. See Sections 12-72-302 (e); 12-72-303 (a), Item 3; 12-72-303 (e) and 12-72-303 (s).
2. All electrical circuits formed by conductors extending from the installation wiring connections for interconnecting to a power supply or system control units the failure of which may result in an open or ground fault shall be electrically supervised either at the detector or at the control unit to which a detector would be connected. See Section 12-72-302 (e).
3. The requirements of Sections 12-72-392 (d), Items 1 and 2, do not apply to the following:

   A. Trouble indicating circuits.

   B. The circuits of a detector employed only for releasing device service if the fault results in the same operation of the unit as that obtained by detection of combustion products.

   C. A circuit for a supplementary signal annunciator, signal sounding appliance, motor controller or similar appliance provided that a break or a ground fault in no way affects the normal operation of the unit except for omission of the supplementary feature.

(e) **Electrical supervision test.**

1. The electrical circuits formed by conductors extending from the installation wiring connections of a detector for interconnection to a power supply source or system control unit initiating device circuit shall be electrically supervised so that the detector trouble signal or circuit is energized under any of the following fault conditions if the fault prevents normal operation of the detector for fire alarm signals.

   A. Single open or single ground fault of the connecting field wiring.

   B. Failure of a nonreliable component. See Sections 12-72-303 (d), Item 1; 12-72-303 (a), Item 3; and 12-72-303 (s).

2. A motor included in a detector, such as a blower motor which is required to operate continuously during normal operation, shall be supervised to indicate stalling or burnout.
3. The heaters of all electronic tubes or other functional heating elements employed in a detector shall be electrically supervised to indicate an open circuit fault by an audible trouble signal if the fault prevents normal operation of the unit.
4. Internal shorts between any two elements of an electronic tube shall be indicated by either a trouble signal or an alarm signal if such failure prevents normal operation of the unit. Such a failure shall not result in a fire hazard.
5. Interruption and restoration of any source of electrical power connected to a detector unit shall not cause an alarm signal.
6. The operation of any manual switching part of a detector unit to other than its normal position while the detector unit is in the normal standby condition shall be indicated by a trouble signal, if the off-normal position of the switch interferes with normal operation of the detector unit.
7. To determine if a detector unit complies with the requirements for electrical supervision, see Section 12-72-303 (d). The detector is to be tested with the representative system combination in its normal supervisory condition, and the type of fault to be detected is then to be introduced. Each fault shall be applied separately, the results noted and the fault removed. The system combination is then to be restored to its normal supervisory condition prior to establishing the next fault.

(f) **Sensitivity test.**

1. A combustion products detector shall operate within the limits specified below when subjected to a smoldering smoke condition using the combustion products and test equipment described in the following paragraphs. If the detector employs a variable sensitivity setting, test measurements are to be made at maximum, minimum and nominal settings.

   A. Visible Smoke Obscuration Limits—

   0.0 percent per foot maximum (0.013)[1]

   0.2 percent per foot minimum (0.001)[1]

   B. Relative Combustion Products Measurement Limits—

   9.0 volts maximum

   1.0 volt minimum

   C. Monitoring Means—

   Within 25 percent of the operating limits of the detector rating.

2. **Combustion products.** A mercerized cotton lamp wick, nominally $^{7}/_{8}$ inch (22 mm) wide by $^{1}/_{8}$ inch (3 mm) in cross section and secured by an alligator type clip 3 inches (76 mm) below a removable cover assembly is to be employed as the source of combustion products. The wick end is to be cut square and smoldering initiated by momentarily placing the wick end over a horizontally mounted resistive heater element energized to a dull red color. Smoldering may be promoted by passing a slow current of air over the wick end. The smoldering end is to be cut away

1. Figure in parentheses denotes optical density per foot.
2. A meter suitable for this purpose is Weston Instrument Model 622 in conjunction with a Model 594 RR Photronic Cell.

approximately $^{1}/_{4}$ inch (6 mm) above the charred section prior to conducting a succeeding trial. The smoldering rate of the wick is to be such that the visible smoke obscuration increases at an approximate uniform rate of 1.5 ± 0.2 percent per foot (0.0329 0.001 optical density per foot).

(g) **Test equipment and methods.**

1. The visible smoke obscuration (optical density) in the test compartment is to be measured by means of a direct current (DC) type microammeter having a maximum internal resistance of 100 ohms used with a barrier type selenium photovoltaic cell, enclosed in a hermetically sealed case. The meter and cell are used in conjunction with the light produced by a tungsten filament automotive type lamp rated 6 volts and energized from a regulated supply to provide a light beam of uniform flux density. The photoelectric cell and lamp are to be spaced 5 feet (1524 mm) apart. The following equations are to be used:

A. At any distance, the percent obscuration per foot will be:

$$O_u = [1 - (T_s / T_c)^{1/d}]\ 100$$

where:

O_u = Percent obscuration per foot.

T_s = Smoke density meter reading with smoke.

T_c = Smoke density meter reading with clear air.

d = Distance in feet (m × 3.33).

B. The percent obscuration of light for the full length beam at any distance will be:

$$O_d = [1 - (T_s / T_c)]\ 100$$

where:

O_d = Percent obscuration at distance d.

T_s = Smoke density meter reading with smoke.

T_c = Smoke density meter reading with clean air.

C. When the percent obscuration per foot is known, the percent obscuration for the full length of any longer beam can be determined by the following:

$$O_d = [1 - [1 - (O_u / 100)]^d]\ 100$$

where:

O_d = Percent obscuration at distance d.

O_u = Percent obscuration per foot.

d = Distance in feet (m × 3.33).

D. At any distance, the total optical density will be:

$$OD_t = \mathrm{Logo}_{10} (T_c / T_s)$$

where:

OD_t = Optical density.

T_c = Smoke density meter reading with clear air.

T_s = Smoke density meter reading with smoke.

E. At any distance, the optical density per foot will be:

$$OD_f = [\mathrm{Logo}_{10} (T_c / T_s)]/d$$

where:

OD_f = Optical density per foot.

T_c = Smoke density meter reading with clear air.

T_s = Smoke density meter reading with smoke.

d = Distance in feet (m × 3.33).

2. A meter[3] calibrated in volts is to be used to measure the relative buildup of primarily invisible products of combustion. The meter, used with an ionization detecting monitoring head without an alarm indicating circuit, has Americium 241 as the radioactive element. The monitoring head is to be located in the test chamber adjacent to the sample under test

3. **Test chamber.** The following items refer to Figure 12-72-3-1.

A. **Cabinet.** Plywood, $^{3}/_{4}$ inch (19 mm) thick, except for $^{1}/_{4}$ inch (6 mm) thick clear plastic front panel. Overall dimensions approximately $69^{1}/_{2}$ inches (1765 mm) long, 18 inches (457 mm) high, 11 inches (279 mm) deep. A center divider forms two equal 8 inches (203 mm) high by 10 inches (254 mm) deep interior compartments. Inside of lower left side of plastic front panel, as well as all interior surfaces of the cabinet are to be painted flat black. Plastic front assembled with rubber gasket.

B. **Combustible.** Cotton wick. See Section 12-72-303 (f), Item 2. Secured by alligator type clip to removable cap which covers a $3^{1}/_{4}$-inch (82 mm) diameter hole in top of compartment. Cap measures approximately 4 inches square (2580 mm^2). Center of hole located approximately 16 inches (406 mm) from left end.

C. **Air dispersing medium.** Three-fourths inch (19 mm) nominal diameter solid glass beads to fill to capacity an expanded metal container, approximately 4 inches (101 mm) wide, 8 inches (203 mm) high, 10 inches (254 mm) deep. Any space between top surface of beads and compartment ceiling to be filled with foam plastic. Provides uniform flow of air and combustion products. Center of unit approximately 22 inches (559 mm) from right-hand side of compartment.

D. **Air circulating fan.** Motor mounted on $^{1}/_{4}$-inch (6 mm) plastic support which fits into slots of compartment and fills completely the upper chamber. Employs 5 inch (100 cfm) diameter fan.

E. **Opening.** Rectangular hole, approximately 6 by 4 inches (152 mm by 101 mm), center of opening 4 inches (101 mm) from end of cabinet.

1 Figure in parentheses denotes optical density per foot.

2 A meter suitable for this purpose is Weston Instrument Model 622 in conjunction with a Model 594 RR Photronic Cell.

3 A meter suitable for this purpose is a Pyrotronics, Inc., Type CPM-2 with monitoring head.

F. **Exhaust fan.** Same as Item D. Mounted in end wall of compartment.

G. **Exhaust fan cover.** Plastic, approximately $5^3/_4$ inches (146 mm) wide, 10 inches (254 mm) long, by $^3/_{16}$ inch (4.7 mm) thick. Fitted in slots.

H. **Lamp.** Low voltage automobile-type lamp. See Section 12-72-303 (g), Item 1.

I. **Monitoring head.** Ionization detector mounted on back wall in test area. See Section 12-72-303 (g), Item 2. Employed with Item M.

J. **Photovoltaic cell.** See Section 12-72-303 (g), Item 1. Mounted on Item K. Has a linear response up to 800 microamperes at 200 footcandles.

K. **Air dispersing medium.** Same as Item C, except 3 inches (76 mm) wide.

L. **Opening.** Rectangular, approximately 6 by 2 inches (152 mm by 51 mm), center of opening 3 inches (76 mm) from left end. Covered with perforated metal having approximately 50 percent openings.

M. **Combustion products meter.** See Section 12-72-303 (g), Item 2. Meter is to have a 0–10 volts scale. Employed with ionization head (Item I). Provides indication of relative build-up of combustion products in test chamber.

N. **Control equipment.** Includes fan and switch controls, lamp voltage control and terminals for connection of microammeter.

O. **Obscuration equipment meter.** See Section 12-72-303 (g), Item 1. Meter is to have 0–100 or 0–200 microamperes full scale.

P. **Access door for test sample.** Plastic, approximately $11^1/_2$ by $7^1/_2$ by $^1/_4$ inch (292 mm by 190 mm by 6 mm) thick. Secured by hinges and spring catch to front section. Center of door approximately 30 inches (762 mm) from right-hand side of cabinet. Fitted with rubber gasket to prevent air loss.

4. **Test method.** The test is to be conducted in an ambient temperature of 23 ± 3°C (73.4 ± 5°F) at a relative humidity between 30–50 percent and a barometric pressure of not less than 700 millimeters of mercury. A minimum of 12 samples of the detector, previously energized for at least 16 hours or as recommended by the manufacturer from a source of supply in accordance with Section 12-72-303 (a), Item 5, are to be subjected to this test. The samples shall be momentarily disconnected from the source of supply, placed in the center of the lower section of the test chamber with the signaling contacts connected to an indicating circuit and re-energized from the specified source of supply.

5. With the air velocity in the test compartment maintained at 30 to 35 feet per minute (fpm), as measured in the sample area, the wick is to be inserted into the upper chamber with the smoldering end facing downward. The air flow is to be parallel to the $^1/_8$-inch (3 mm) thick end of the wick and the wick end is to be approximately 3 inches (76 mm) below the compartment roof. See Section 12-72-303 (r), Item 2. Operation is to be continued until the detector is actuated in an alarm condition. Five test trials shall be conducted on each sample with at least a 5-minute interval between each trial. The following readings are to be recorded for each trial at the moment of actuation: (1) visible smoke obscuration, (2) combustion products meter reading, (3) elapsed time of test trial and (4) the monitoring means. If a detector has a variable sensitivity setting, five trials are to be made at the maximum, minimum and nominal sensitivity settings.

6. The detector shall be uniform in operation so that the average of the readings of the smoke density and combustion products meters of the mean three of five trials (highest and lowest not included) of one detector shall be within 50 percent of the mean average of all detectors. If a detector has a variable sensitivity setting, the requirement applies to each setting tested.

7. There shall be no false alarms or effect on operation of a detector set at the maximum sensitivity setting when two representative samples are subjected to the following test conditions:

   A. Operation for three months in an ambient room temperature of approximately 25 ± 3°C (77 ± 5°F) and relative humidity of 30–50 percent, having a relatively clean atmosphere with minimum air movement.

   B. Operation for three months in a relatively clean atmosphere in laminal air stream having a velocity of 300 ± 25 fpm. in an ambient room temperature of approximately 25 ± 3°C (77 ± 5°F) and relative humidity of 30–50 percent.

   C. Ten cycles of humidity variation between 20 and 90 ± 5 percent at room temperature.

   D. Ten cycles of temperature variation between 17.8°C and 66°C (0°F and 150°F).

   E. Ten cycles of rapid change of air velocity from 0 to 300 ± 25 fpm.

   F. Ten cycles of a 2-inch (51 mm) drop of air pressure starting from 29-31 ± 0.5 inch (13 mm) of mercury.

   G. Fifty cycles of momentary interruption of the detector power supply at a rate of not more than 6 cycles per minute.

8. Two detectors, employing a maximum sensitivity setting are to be mounted in a position of normal use, energized from a source of supply in accordance with Section 12-72-303 (a), Item 5, and subjected to each of the above test conditions.

9. For tests, C, D and F of Section 12-72-303 (g), Item 5, the time of cycling from one extreme to the other shall be a maximum of 1 hour and a minimum of 5 minutes. For test E the air velocity is to be turned on and off abruptly with a maximum of 1 hour between applications. For test F the time of change from one

pressure to the other is approximately one-half minute. The cycling is conducted at a rate not faster than once per 10 seconds. Each cycle is to start at one test condition, changing to the other extreme and returning to the original test condition.

10. The test samples subjected to tests A-G of Section 12-72-303 (g), Item 5, are to be tested for sensitivity, see Sections 12-72-303 (f) following the completion of the test. The response of the detectors, when tested in accordance with the sensitivity test, shall not vary more than 50 percent from the value obtained prior to the test.

(h) **Deleted.**

(i) **Fire test.**

1. At least two of the four detectors subjected to each of the following combustible tests shall operate for alarm when installed on 30-foot (9144 mm) spacings and exposed to the following four types of controlled test fires. The maximum response time shall be 2 minutes for tests A, B and C, and 4 minutes for test D.

   A. **Paper.** Combustible is to be $^1/_2$ pound of shredded newsprint type paper, strips to be $^1/_4$ to $^3/_8$ inch (6 mm to 9 mm) wide, 6 to 24 inches (152 mm to 609 mm) long placed in a receptacle formed of $^1/_4$-inch (6 mm) mesh hardware cloth. The receptacle is to be approximately 12 inches (305 mm) in diameter by 24 inches (609 mm) high with a hardware cloth bottom 6 inches (152 mm) above the base. The combustible is to be ignited at the bottom center. Paper is to be dried prior to test.

   B. **Polystyrene.** Combustible is to be 2 ounces of typical foam polystyrene type packing material, with no flame inhibitor, each piece $^1/_4$ to $^3/_8$ inch (6 mm to 9 mm) diameter, 3 to 10 inches (76 mm to 254 mm) long placed in the same type of receptacle as used for test A. Alternate shape of combustible is cylindrical, $^3/_4$ inch (19 mm) diameter by $^1/_2$ inch (13 mm) high having a $^3/_8$-inch (9 mm) diameter hole. The combustible is to be ignited at the bottom center.

   C. **Gasoline.** Combustible is to be 200 cubic centimeters (cc) of regular leaded gasoline placed in a 9-inch (228 mm) diameter steel pan container $1^1/_2$ inches (38 mm) deep.

   D. **Wood brand (Class A).** Combustible is to be three layers of kiln dried fir strips, each strip $^3/_4$ inch (19 mm) in cross section, 12 inches (305 mm) long with 12 strips in each layer. Strips are to be nailed or stapled together with adjacent layers at right angles to each other. Overall dimensions of wood brand is approximately 12 by 12 by $2^1/_4$ inches (305 mm by 305 mm by 57 mm) high. The brand is to be ignited by burning 100 cc of denatured alcohol consisting of 190 proof (95 percent) ethanol to which 5 percent methanol is added as a denaturant. The alcohol is placed in the same type of container as used for test C.

2. The fire tests are to be conducted in a room having a smooth ceiling with no physical obstructions between the fire source and detectors and with minimum air movement. The room is to be provided with means for the removal of combustion products, such as vents or exhaust fans. Heaters are to be provided for maintaining the room temperature ambient, if necessary. The heaters are to be shut off during a test trial. The room shall be of sufficient cross-sectional area so that the detectors can be located in accordance with the spacing layout illustrated by Figure 12-72-3-2 and any reflection of combustion products is prevented from returning to the detectors from adjacent walls during the course of the test. The room height shall be such that the vertical distance from the base of the combustible to the ceiling is approximately 12 feet (3657 mm).

3. The tests are to be conducted in an ambient temperature between 15.6°C and 26.7°C (60°F and 80°F) and a relative humidity of 50 ± 20 percent. The test samples are to be energized from a source of supply in accordance with Section 12-72-303 (a), Item 5.

4. Four samples, each adjusted to their minimum sensitivity setting, are to be installed on the ceiling at a 30-foot (9144 mm) spacing schedule with relation to the test fire [21.2-foot (6462 mm) linear distance measured along the ceiling to a point directly over the center of the test fire]. See Figure 12-72-3-2. The time starts at the moment of ignition. At least two trials shall be conducted for each combustible. Each detector shall respond at least once to each of the four combustibles employed.

5. Sensitivity monitoring instruments are to be employed to determine that the test room area is free of products of combustion prior to conducting a test.

(j) **Temperature test.**

1. The materials or components employed in a detector shall not be affected adversely by the temperatures attained under any condition of normal operation.

2. A material or component will be considered as being adversely affected if it is subject to a temperature rise greater than that indicated in Table 12-72-3F.

3. The classes of material used for electrical insulation referred to in Items 8 and 9 of Table 12-72-3F include the following:

   Class A (Class 105) — Impregnated cotton, paper and similar organic materials when impregnated, and enamel as applied to coil windings.

   Class B (Class 130) — Inorganic materials, such as mica and impregnated asbestos.

4. All values for temperature rises apply to equipment intended for use in ambient temperatures normally prevailing which usually are not higher than 25°C (77°F). If equipment is intended specifically for use with a prevailing ambient temperature constantly more than 25°C (77°F), the test of the equipment is made at the higher ambient temperature, and the allowable temperature rises specified in the table are

to be reduced by the amount of the difference between that higher ambient temperature and 25°C (77°F).

5. Temperature measurements on equipment intended for recessed mounting shall be made with the unit installed in an enclosure of nominal $^{3}/_{4}$-inch (19 mm) wood having clearances of 2 inches (51 mm) on the top, sides and rear, and the front extended to be flush with the detector cover.

6. A temperature is considered to be constant when three successive readings, taken at not less than 5 minute intervals, indicate no change.

7. Temperatures are to be measured by means of thermocouples consisting of wires not larger than No. 24 AWG. The preferred method of measuring the temperature of a coil is the thermocouple method, but a temperature measurement by either the thermocouple or resistance method is acceptable, except that the thermocouple method is not to be employed for a temperature measurement at any point where supplementary thermal insulation is employed.

8. If thermocouples are used in the determination of temperatures, it is standard practice to employ thermocouples consisting of No. 24-30 AWG iron and constantan wires and a potentiometer type indicating instrument. Such equipment will be used whenever referee temperature measurements by thermocouples are necessary.

9. The thermocouple wire is to conform with the requirements for "special" thermocouples as listed in the Table of Limits of Error of Thermocouples in ANSI C96.1-1964 (R1969).

10. The temperature of a copper coil winding is determined by the resistance method by comparing the resistance of the winding at the temperature to be determined with the resistance at a known temperature by means of the equation:

$$TE\ (R/r)\ (234.5 + t) - 234.5$$

where:

T = is the temperature to be determined in degrees C.

t = is the known temperature in degrees C.

R = is the resistance in ohms at the temperature to be determined.

r = is the resistance in ohms at the known temperature.

11. As it is generally necessary to de-energize the winding before measuring R, the value of R at shutdown may be determined by taking several resistance measurements at short intervals, beginning as quickly as possible after the instant of shutdown. A curve of the resistance values and the time may be plotted and extrapolated to give the value of R at shutdown.

12. To determine compliance with this test, a detector is to be connected to a source of supply in accordance with Section 12-72-303 (a), Item 5, and operated under the following conditions:

   A. **Normal standby—**(16 hours) constant temperatures.

   B. **Alarm**—(1 hour).

   C. **Alarm**— (7 hours) abnormal test.

13. For test condition C the temperature limits may be exceeded but there shall be no manifestation of a fire hazard or approaching failure and the detector shall operate in a normal manner following the test.

14. The detector is to be subjected to the Dielectric Withstand Test following the above test.

(k) **Over-and-under voltage operation.**

1. A detector shall withstand the continuous application of 110 percent of the test voltage specified by Section 12-72-303 (a), Item 5, in the normal standby condition at maximum and minimum sensitivity settings without being affected adversely and shall operate successfully for normal signaling performance at the specified increased voltage. Sensitivity measurements at the increased voltage shall be within 50 percent from the readings measured at rated voltage.

2. For operation at the higher voltage four new detectors are to be subjected to the specified increased voltage in the normal standby condition for at least 16 hours and then tested for normal signaling operation and sensitivity.

3. A detector shall operate for its normal signaling performance while energized from a supply of 85 percent of the test voltage specified by Section 12-72-303 (a), Item 5, for both maximum and minimum sensitivity settings. Sensitivity measurements at the reduced voltage shall be at 50 percent of the readings measured at rated voltage.

4. For operation at the reduced voltage four new detectors are to be energized from a source of supply in accordance with Section 12-72-303 (a), Item 5, following which the voltage is to be reduced to 85 percent of nameplate rating and then tested for normal signaling operation and sensitivity.

(l) **Variable ambient temperature.**

1. A detector shall be capable of operating in a normal manner when tested in an ambient temperature of 0°C and 49°C (32°F and 120°F), at a relative humidity between 30-50 percent.

2. Two detectors are to be maintained at each ambient temperature for a sufficient length of time to ensure that thermal equilibrium has been reached. The units are then to be tested for sensitivity while connected to a source of supply in accordance with Section 12-72-303 (a), Item 5.

3. Sensitivity measurements shall be recorded before and during exposure to each ambient temperature in accordance with the sensitivity test.

4. Each unit shall operate normally in each ambient. The sensitivity readings measured with the units in each ambient temperature shall be within 50 percent of the value recorded in the normal ambient condition.

(m) **Overload.**

1. A detector shall be capable of operating in a normal manner after being subjected to 50 cycles of alarm signal operation at a rate of not more than 6 cycles per minute with the supply circuit to the detector at 115 percent of rated nameplate voltage. Each cycle shall consist of starting with the detector energized in the normal standby condition, initiation of an alarm by smoke or electrical means, and restoration of the detector to normal standby condition.

2. Rated test loads are to be connected to those output circuits of the detector which are energized from the detector power supply, such as remote indicators, relays, etc. The test loads shall be those devices, or the equivalent, normally intended for connection. If an equivalent load is employed for a device consisting of an inductive load, a power factor of 60 percent is to be employed. The rated loads are established initially with the detector connected to a source of supply in accordance with Section 12-72-303 (a), Item 5, following which the voltage is increased to 115 percent of rating.

3. For direct current signaling circuits an equivalent inductive test load is to have the required direct current resistance for the test current and the inductance (calibrated) to obtain a power factor of 60 percent when connected to a 60 Hertz (Hz) alternating current potential equal to the rated direct current test voltage. When the inductive load has both the required direct current resistance and the required inductance, the current measured with the load connected to an alternating current circuit will be equal to 0.6 times the current measured with the load connected to a direct current circuit when the voltage of each circuit is the same.

4. Separately energized circuits of a detector such as dry contacts shall be capable of operating in a normal manner after being subjected for 50 cycles of signal operation at a rate of not more than 6 cycles per minute while connected to a source of supply in accordance with Section 12-72-303 (a), Item 5, with 150 percent rated loads at 60 percent power factor applied to output circuits which do not receive energy from the detector. There shall be no electrical or mechanical failure of the switching circuit.

5. The test loads shall be set at 150 percent of rated current while connected to a separate power source of supply in accordance with Section 12-72-303 (a), Item 5.

(n) **Endurance.**

1. A detector shall be capable of operating in a normal manner after being subjected to 6,000 cycles of alarm signal operation at a rate of not more than 10 cycles per minute with the detector connected to a source of supply in accordance with Section 12-72-303 (a), Item 5, and with related devices or equivalent loads connected to the output circuits. There shall be no electrical or mechanical failure or evidence of failure of the detector components. The same detector shall be tested that had been subjected previously to the overload test.

2. Separately energized circuits of a detector shall be capable of performing acceptably when operated for 6,000 cycles at a rate of not more than 10 cycles per minute. When an electrical load is involved, the contacts of the device shall be caused to make and break the normal current at the voltage specified by Section 12-72-303 (a), Item 5. The load shall represent that which the device is intended to control. The endurance tests of the separately energized circuits may be conducted in conjunction with the endurance test of the detector. There shall be no electrical or mechanical failure of the detector nor undue pitting, burning or welding of any relay contacts.

(o) **Dielectric tests.**

1. A detector shall be capable of withstanding, without breakdown for a period of 1 minute, the application of a 60 Hz alternating potential between high-voltage, live parts and dead-metal parts, and between live parts of high- and low-voltage circuits, except as noted in Item 2. The test potential shall be:

   A. 1,000 volts RMS plus twice rated voltage for high-voltage circuits.

2. A detector employing a low-voltage circuit shall be capable of withstanding, for 1 minute without breakdown, a 60 Hz alternating potential of 500 volts RMS applied between low-voltage live parts and dead-metal parts.

3. Any reference grounds shall be disconnected prior to the test applications.

4. A transformer, the output voltage of which is essentially sinusoidal, can be varied and can maintain the specified high potential voltage at the equipment during the duration of the test and is to be used to determine compliance with the foregoing. The applied potential is to be increased gradually from zero until the required test value is reached and is to be held at that value for 1 minute.

(p) **Abnormal operation.**

1. A detector shall be capable of operating continuously under abnormal conditions without resulting in a fire hazard.

2. To determine if a detector complies with the requirement of Item 1, it is to be operated under the most severe abnormal conditions liable to be encountered in service while connected to a source of supply in accordance with Section 12-72-303 (a), Item 5. Emission of flame or molten metal, or any other

manifestation of a fire hazard, is considered to be a failure.

3. In determining if a detector complies with the requirement with respect to circuit-fault conditions, the fault condition is to be maintained continuously until constant temperatures are attained, or until burnout occurs, if the fault does not result in the operation of an overload protective device. Shorting of electrolytic capacitors would represent a typical fault.

(q) **Transient tests.**

1. Two detectors shall be capable of operating in a normal manner after being subjected to 500 externally induced and 500 internally induced transients while energized from a source of supply in accordance with Section 12-72-303 (a), Item 5, and connected to the devices normally used with the unit.

2. The primary of a 120/240 volt, 60 Hz, 2 kilovolt-amperes (kVA) isolating power transformer, with the secondary open circuited, is to be connected to the same branch circuit as the detector. The input to the transformer is to be de-energized for approximately 1 second by an automatic switching device at a rate of not more than 6 cycles per minute for 500 cycles. During the test the detector is to be operated for normal signaling performance to determine whether transients, generated by the random collapse of the magnetic field of the transformer, resulted in a component failure or other adverse effect.

3. The electrical characteristics of the testing transformer are as follows:

	VOLTAGE	FREQUENCY	INDUCTANCE (*L*) MILLIHENRIES	QUALITY FACTOR *Q*	DC RESISTANCE (*R*) OHMS (23°C)
Primary winding	120	1,000	21.2	11.50	0.244
Secondary winding	240	1,000	109.3	4.65	0.371

4. Two detectors are to be energized in the normal standby condition while connected to a source of supply in accordance with Section 12-72-303 (a), Item 5, which is to be interrupted for approximately 1 second at a rate of not more than 6 cycles per minute for a total of 500 cycles. Following the test the detector is operated for normal signaling performance.

(r) **Humidity test.**

1. Two detectors shall be capable of operating in a normal manner while energized from a source of supply in accordance with Section 12-72-303 (a), Item 5, after having been exposed for 24 hours to moist air having a relative humidity of 85 + 5 percent at a temperature of 30 ± 2°C (86 ± 3°F). The sensitivity shall be determined with the detector connected to a source of supply in accordance with Section 12-72-303 (a), Item 5.

2. Sensitivity measurements shall be recorded before and during exposure to the humidity condition in accordance with the sensitivity test.

3. The sensitivity values measured with the unit in the humid atmosphere shall be within 50 percent of the value recorded in the normal ambient condition.

(s) **Component failure.**

1. Failure of electronic components of questionable reliability such as opening or shorting of electrolytic capacitors shall either have no adverse effect on normal operation or may be indicated by a trouble or an alarm signal.

2. If failure of a questionable component cannot be indicated by a trouble or alarm signal, a reliable component shall be employed. The reliability may be based on derating or on reliability data recorded for the particular component. See Section 12-72-303 (a).

(t) **Dust test.**

1. The sensitivity of a detector shall either not be affected adversely by an accumulation of dust or may result in a false alarm.

2. To determine compliance with Item 1 two samples in their normal mounting position, are to be placed, de-energized, in an air tight chamber having an internal volume of at least 3 cubic feet.

3. Approximately 2 ounces of cement dust, capable of passing through a 200 mesh screen, is to be circulated for 15 minutes by compressed air or a blower under controlled velocity conditions not exceeding 50 rpm so as to completely envelop the sample in the chamber.

4. Following the exposure to dust the detector is to be removed carefully, mounted in its intended position, energized from a source of supply in accordance with Section 12-72-303 (a), Item 5, and tested for sensitivity unless a false alarm is obtained. Sensitivity measurements after subjection to the dust test may be greater than 50 percent toward the more sensitive region but shall not be more than 50 percent toward the insensitive region.

(u) **Static discharge test.**

1. The components of a detector shall be shielded so that its operation is not affected adversely, or a false alarm obtained, when subjected to static electric discharges. Operation of the trouble circuit during this test is not considered a failure.

2. Each of two detectors is to be mounted in its intended mounting position and connected to a source of supply in accordance with Section 12-72-303 (a), Item 5. A 250 picofarad low leakage capacitor rated 10,000 volts direct current, is to be connected to two high-voltage insulated leads, 3 feet (914 mm) long, stripped 1 inch (25 mm) at each end. The end of each lead is to be attached to a metal test probe mounted on a plastic insulating rod to permit

manipulation and isolation from shock hazard. The test probes shall be metallic rods with a spherical end of $^1/_4$-inch (6 mm) radius. The capacitors are to be charged by touching the ends of the test leads to a source of 10,000 volts direct current for at least 2 seconds for each discharge.

3. Ten discharges with at least a 5 minute interval between discharges are to be applied to different points on the exposed surface of the detector, recharging the capacitors for each discharge. Five discharges are to be made with one probe connected to earth ground and the other probed on the detector surface followed by five discharges with the polarity reversed.
4. Following the discharges, if a trouble or an alarm signal is not obtained, the detector is to be tested for sensitivity. Sensitivity measurements shall be within 25 percent of the average of the readings measured prior to the test.

(v) **Vibration test.**

1. A detector shall be capable of withstanding vibration without breakage or damage to parts. Following the vibration the detector shall be capable of operating in a normal manner.
2. To determine compliance with Item 1, sensitivity measurements following the vibration shall be conducted in accordance with the sensitivity test and shall be within 50 percent of the value recorded in the normal ambient condition.
3. Two samples, one at the maximum and one at the minimum sensitivity setting, are to be secured in their intended mounting position on a mounting board and the board, in turn, securely fastened to a variable speed vibration machine having an amplitude of 0.01 inch (0.2 mm). The frequency of vibration is to be varied from 10 to 35 cycles per second in increments of five cycles per second until a resonant frequency is obtained. The samples are then to be vibrated at the maximum resonant frequency for a period of one-fourth hour. If no resonant frequency is obtained, the samples are to be vibrated at 35 cycles per second for a period of 4 hours.
4. For these tests, amplitude is defined as the maximum displacement of sinusoidal motion from a position of rest or one-half of the total table displacement. Resonance is defined as the maximum magnification of the applied vibration.

(w) **Jarring test.**

1. A detector shall be capable of withstanding jarring resulting from impact and vibration such as might be experienced in service, without affecting adversely its subsequent normal operation. A trouble signal resulting from the jarring may be permitted if the normal operation is not affected.
2. The detector and associated equipment, if any, are to be mounted in a position of intended use to the center of a 6 by 4 foot (1829 mm by 1219 mm) nominal $^3/_4$-inch (19 mm) thick plywood board which is secured in place at four corners. A 3-foot (914 mm) board impact is to be applied to the center of the reverse side of this board by means of a 1.18 pound, 2 inch (51 mm) diameter steel sphere either (1) swung through a pendulum arc from a sufficient height, (*h*) of 2.54 feet (774 mm) or (2) dropped from a sufficient height (*h*) of 2.54 feet to apply 3 foot-pounds of energy depending upon the mounting of the equipment. See Figure 12-72-3-3.
3. Compliance with Item 1 is to be determined by supporting the detector in its intended mounting position and conducting the jarring while the unit is in the normal standby condition and connected to a rated source of supply in accordance with Section 12-72-303 (a), Item 5. Following the jarring the unit(s) shall be tested for sensitivity. Sensitivity measurements following the jarring shall be within 25 percent of the average of the readings measured prior to the test.

(x) **Corrosion test.**

1. A detector shall be capable of operating in a normal manner after being subjected to the corrosive atmosphere tests described in the following paragraphs.
2. Two samples, one at maximum and one at minimum sensitivity setting, are to be exposed to an atmosphere containing approximately 1 percent hydrogen sulphide by volume in air saturated with water vapor at room temperature for 10 days. The units are not energized during the exposure.
3. Two samples, one at maximum and one at minimum sensitivity settings are to be exposed to an atmosphere containing approximately 1 percent carbon dioxide and 0.5 percent sulfur dioxide by volume in air saturated with water vapor at room temperature for 10 days.
4. The detectors are to be tested for sensitivity prior to exposure to the corrosive atmospheres. Twenty-four hours or more after the required exposure the detectors are to be again tested for sensitivity. Sensitivity measurements following the exposure to the corrosive atmospheres shall be within 50 percent of the value recorded in the sensitivity test, except as indicated in Item 5.
5. The sensitivity following exposure to the corrosion atmospheres described in Item 3 may exceed 50 percent from the value measured prior to the corrosion exposure if the same units, set at their minimum sensitivity, are subjected to and comply with the fire test requirements described in Section 12-72-303 (i), Items 1-5.

(y) **Radioactive element measurement test.**

1. The total activity of the radioactive source(s) of a detector shall not exceed the maximum content specified in the marking on the detector by more than 10 percent.

2. The measurement shall be made on at least five samples of the detector in the as-received condition using appropriate instrumentation and techniques.

(z) **Paint loading test.**

1. A detector shall operate in a normal manner and shall comply with the requirements of the sensitivity test after painting, if the detector assembly, screens, openings, etc., are likely to be clogged by painting. If a detector is marked prominently so it will be visible after the unit is installed which prohibits painting, then this test need not be conducted. See Section 12-72-303 (a) and (b).
2. The exterior surfaces of two samples, including screened openings, etc., are to be coated with a lead-oil base paint which is spread at approximately two times the paint manufacturer's recommended spreading rate. The paint is to be allowed to dry, for 5 days at room temperature. Following this, the samples are to be given a second identical application of paint and again permitted to dry for 5 days. The detectors are to be tested for sensitivity, one at maximum and one at minimum sensitivity setting before and after the specified paint loading. Sensitivity measurements following the paint loading shall be within 25 percent of the average of the readings measured prior to the paint loading.

TESTS ON THERMOPLASTIC MATERIALS

Sec. 12-72-304.

(a) **General.** Thermoplastic materials included for the sole support of current carrying parts or as an enclosure of an appliance shall be subjected to the tests included in Sections 12-72-304(b) - (i) inclusive. Where possible, the complete appliance shall be used.

(b) **Temperature test.**

1. There shall be no excessive warping or exposure of high-voltage uninsulated current carrying parts so as to impair operation when representative samples of a plastic material are aged for 7 hours in an air circulating oven maintained at 90°C (194°F).
2. At least three representative samples shall be placed in the oven. At the end of the 7 hours, the samples shall be removed, permitted to cool and then examined for adverse distortion.

(c) **Flame test.** A plastic material employed as part of an appliance for the sole support of current carrying parts or as an enclosure shall not continue to burn for more than 1 minute after the fifth 5-second application of a test flame, with an interval of 5 seconds between applications of the flame. There shall be do dripping of particles, complete consumption of the sample during the test and the material shall not be destroyed in the area of the test flame to such an extent that the integrity of the enclosure is affected. Three samples of the material or three test specimens consisting of a part or section of the polymeric enclosure shall be subjected to this test. Consideration may be given to leaving in place components and other parts which may influence the performance.

(d) Two of the three test samples shall show acceptable performance. If one sample fails, the test shall be repeated on a new sample with the flame applied under the same conditions as for the failing sample. If the new specimen fails to comply with the requirements, the material is not acceptable. The following test equipment is employed.

1. **Test chamber.** The test chamber consists of a sheet-metal cell 2 feet by 1 foot by 1 foot (609 mm by 305 mm by 305 mm), open at the top and on one long side. The chamber shall be located so that an ample supply of air is provided, but the sample is not subjected to drafts. The chamber may be placed in a hood, provided that the fan is turned off during the test and is allowed to run only between tests to remove fumes.
2. A ring stand with a suitable clamp is used for supporting the specimens.
3. **Burner and mounting block.** The test flame is to be obtained by means of a Tirrill Burner having a nominal bore of $^3/_8$ inch (9 mm). The tube length above the primary air inlets is to be approximately 4 inches (101 mm). The burner is to be adjusted so that, while the burner is in a vertical position, the overall height of the flame is 5 inches (127 mm) and the height of the inner blue cone is $1^1/_2$ inches (38 mm). A mounting block is to be provided so that the burner may be positioned at an angle of 20 degrees from the vertical.
4. A stopwatch or clock.
5. Circulating-air oven.

(e) **Conditioning and mounting.** The test samples are to be conditioned by placing them in a circulating-air oven maintained at a uniform temperature not less than 10°C higher than the maximum temperature of the material measured under normal operating conditions but not less than 70°C in any case. The samples are to remain in the oven for 7 days. Prior to test the samples are to be returned to room temperature. The test sample is to be mounted as intended in service in the test chamber. The test flame is to be applied at an angle of 20 degrees from the vertical to any portion of the interior of the enclosure judged as liable to be ignited by proximity to live or arcing parts, coils, wiring, etc. The test flame shall be applied to a different location on each of the three samples tested. The test flame is to be applied for 5 seconds and removed for 5 seconds. The operation is to be repeated until the specimen has been subjected to a total of five applications of the test flame.

(f) **Impact test.** An appliance employing a thermoplastic enclosure shall withstand three 5 foot-pound impacts without exposure of live parts, impairment of the operation of the appliance or result in a shock hazard.

Each of two units is to be mounted securely in a position of normal use on a surface representative of a typical installation. Three 5 foot-pound impacts are to be applied to each sample, each trial on a different section of the enclosure, by means of a 1.18 pound, 2-inch (51 mm) diameter steel sphere swung through a pendulum arc from a sufficient height to apply 5 foot-pounds of energy.

Following the impacts, the unit is to be examined for damage and checked for normal operation by being energized from a source of rated voltage and frequency. Cracking of the enclosure is acceptable if it does not impair normal operation, but is not acceptable if a dust or moisture tight enclosure is required.

(g) **Infrared analysis of plastics.** The basic composition of a plastic material employed for the sole support of current carrying parts or an enclosure is to be by infrared analysis.

(h) **Sample preparation.** The general technique for preparing plastics for infrared analysis is to dissolve the sample in a suitable boiling hot solvent. The resulting solution is then to be placed on a sodium chloride plate from which the solvent is evaporated by gentle heating, thereby leaving a reasonably uniform thin film of the plastic on the sodium chloride plate. The salt plate is then mounted in a spectrometer and the infrared spectrum of the plastic is recorded.

A suitable solvent is one which will dissolve the plastic without reacting with it and which can be readily evaporated on gentle heating.

Examples of solvents suitable for certain polymer types are:

acetone—for polymers of high oxygen content, e.g., polyesters and phenolic resins.

o-dichlorobenzene—for simple vinyl type polymers e.g., polyvinylchlorides.

n,n-dimethylformamide—for polymers of nitrogen content, e.g., polyamides.

Some high molecular weight or highly cross-linked polymers which are insoluble in all volatile solvents are to be prepared by the pressed halide-disk technique. A few milligrams of the plastic are to be removed from the surface of a sample by a fine file. These filings are to be ground in a mechanical vibrating ball mill for three to 5 minutes. Care must be taken to reduce the particle size to a size (approximately 2 micrometers) smaller than that of the shortest wave length to be scanned so as to minimize scattering effects. The appropriately ground sample is to be intimately mixed with spectroscopic grade potassium bromide and a sufficient amount of this mixture to produce a 1 mm thick, $^1/_2$-inch (13 mm) diameter disk is to be placed in an evacuable die. The die is to be placed under vacuum and a pressure of 10,000-15,000 psi is to be applied. The pressed disk is removed from the die and mounted in a spectrometer, and the infrared spectrum of the plastic is recorded.

(i) **Instrumentation.** The infrared spectrum from 2.0–15.0 micrometers (5000–667 cm^{-1}) of a given plastic is to be obtained on an optical double beam recording infrared spectrometer, having either a grating or sodium chloride prism dispersing element.

TABLE 12-72-3A—CAST-METAL ENCLOSURES

USE OR DIMENSIONS OF AREA INVOLVED	MINIMUM THICKNESS IN INCHES	
	Die-cast metal	Cast metal of other than the die-cast type
Area of 24 square inches or less and having no dimension greater than 6 inches	$^1/_{16}$	$^1/_8$
Area greater than 24 square inches or having any dimensions greater than 6 inches	$^3/_{32}$	$^1/_8$
At a threaded conduit hole	$^1/_4$	$^1/_4$
At an unthreaded conduit hole	$^1/_8$	$^1/_8$

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

TABLE 12-72-3B—SHEET METAL ENCLOSURES

MAXIMUM ENCLOSURE DIMENSIONS		MINIMUM THICKNESS OF SHEET METAL IN INCHES		
		Steel		COPPER, BRASS OR ALUMINUM
Any linear dimension in inches	Area of any surface in square inches	Coated	Uncoated	
12	90	0.035 (20)	0.031 (20)	0.045 (16)
24	360	0.046 (18)	0.042 (18)	0.058 (14)
48	1,200	0.057 (16)	0.053 (16)	0.075 (12)
60	1,500	0.070 (14)	0.067 (14)	0.095 (10)
Over 60	Over 1,500	0.097 (12)	0.093 (12)	0.122 (8)

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

TABLE 12-72-3C—THICKNESS OF GLASS COVERS

MAXIMUM SIZE OF OPENING		MINIMUM THICKNESS OF GLASS IN INCHES
Length or width in inches	Area in square inches	
4	16	$^{1}/_{16}$
12	144	$^{1}/_{8}$[1]
Over 12	Over 144	1

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

1. One-eighth inch or more, depending upon the size, shape and mounting of the glass panel.

TABLE 12-72-3D—THICKNESS OF INSULATING MATERIAL

MAXIMUM DIMENSION IN INCHES	MAXIMUM AREA IN SQUARE INCHES	MINIMUM THICKNESS IN INCHES
24	360	$^{3}/_{8}$[1]
48	1,152	$^{1}/_{2}$
48	1,728	$^{5}/_{8}$
Over 48	Over 1,728	$^{3}/_{4}$

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

1. Material less than $^{3}/_{8}$ inch but not less than $^{1}/_{8}$ inch in thickness may be employed for a panel if the panel is adequately supported or reinforced to provide rigidity not less than that of a $^{3}/_{8}$-inch sheet. Material less than $^{1}/_{8}$ inch may be employed for subassemblies, such as supports for terminals for internal wiring, resistors and other components.

TABLE 12-72-3E—MINIMUM SPACINGS

POINT OF APPLICATION	MINIMUM SPACING—INCHES[1]		
	Voltage Range Volts	Through Air	Over Surface
To walls of enclosure Cast-metal enclosures Sheet metal enclosures	 0–300 0–300	 $^{1}/_{4}$ $^{1}/_{2}$	 $^{1}/_{4}$ $^{1}/_{2}$
Installation wiring terminals With barriers—see Section 12-72-302 (t), Item 6	0–30 31–150 151–300	$^{1}/_{8}$ $^{1}/_{8}$ $^{1}/_{4}$	$^{3}/_{16}$ $^{1}/_{4}$ $^{3}/_{8}$
Without barriers	0–30 31–150 151–300	$^{3}/_{16}$ $^{1}/_{4}$ $^{1}/_{4}$	$^{3}/_{16}$ $^{1}/_{4}$ $^{1}/_{8}$
Rigidly clamped assemblies[2] 100 volt-amperes maximum Over 100 volt amperes	0–30 0–30 31–150 151–300	$^{1}/_{32}$[3] $^{3}/_{64}$ $^{1}/_{16}$ $^{3}/_{32}$	$^{1}/_{32}$[3] $^{3}/_{64}$ $^{1}/_{16}$ $^{3}/_{32}$
Other parts	0–30 31–150 151–300	$^{1}/_{16}$ $^{1}/_{8}$ $^{1}/_{4}$	$^{1}/_{8}$ $^{1}/_{4}$ $^{3}/_{8}$

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

1. Measurements are to be made with solid wire of adequate ampacity for the applied load connected to each terminal. In no case is the wire to be smaller than No. 18 AWG.
2. Rigidly clamped assemblies include such parts as contact springs on relays or cam switches, printed wiring boards, etc.
3. Spacings less than those indicated, but in no case less than $^{1}/_{64}$ inch are acceptable for connection of integrated circuits and similar components where the spacing between the adjacent connecting wires on the component is less than $^{1}/_{32}$ inch.

TABLE 12-72-3F—MAXIMUM TEMPERATURE RISES

DEVICE OR MATERIAL	DEGREES °C	DEGREES °F
1. Any point on rectifiers:		
A. Copper oxide	30	54
B. Germanium	50	90
C. Magnesium-copper sulphide	95	171
D. Selenium	50	90
E. Silicon	75	135
2. Rubber or thermoplastic insulation	35[1]	63[1]
3. Varnished cloth insulation	60	108
4. Fuses	65	117
5. Surfaces adjacent to or upon which the unit may be mounted in service	65	117
6. Wood or other combustible material	65	117
7. Fiber used as electrical insulation	65	117
8. Class A (Class 105) insulation	65[3]	117[3]
9. Class B (Class 130) insulation	85[3]	153[3]
10. Phenolic composition used as electrical insulation	125	225
11. Capacitors	40	72
12. Solid state devices (transistors, silicon-controlled rectifiers, etc.) integrated circuits	See[4]	
13. Wirewound resistor	150[2]	302[2]
14. Carbon resistor	See[4]	
15. Sealing compound	15	(27) less than the melting point[2]

For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

1. This limitation does not apply to an insulated conductor or a material which has been investigated and accepted for a higher temperature.
2. These are limiting temperatures, not temperature rises.
3. 10°C (18°F) higher on coil insulation if measured by the resistance method.
4. The temperature of a solid-state device shall not exceed 50 percent of its rating during the normal standby condition. The temperature of a solid-state device shall not exceed 75 percent of its rated temperature under any other condition of operation of the complete unit which produces the maximum temperature dissipation of its components. For reference purposes 0°C (32°F) shall be considered as 0 percent. For integrated circuits the loading factor shall not exceed 50 percent of its rating under the normal standby condition and 75 percent under any condition of operation. Both solid-state components and integrated circuits may be operated up to the maximum ratings, under any one of the following conditions:
   - 4.1. All components comply with the requirements Mil-Std. 883C.
   - 4.2. A quality control program is established by the manufacturer consisting of inspection and test of 100 percent of all components, either on an individual basis, as part of a subassembly, or equivalent.
   - 4.3. Each assembled production unit is subjected to a burn in test while in an alarm condition for 24 hours while connected to a source of rated nameplate voltage and frequency in an ambient of at least 49°C (120°F) followed by an operational test the maximum temperature on a carbon resistor shall be not greater than 50°C during the normal standby condition and not greater than 75°C during the alarm condition.

TABLE 12-72-3G—OBSCURATION—OPTICAL DENSITY CHART
(Based on a 5-foot light beam)

METER READING (Microamperes)	PERCENT PER FOOT OBSCURATION O_u	TOTAL OBSCURATION O_d	TOTAL OPTICAL DENSITY OD_t	OPTIC DENSITY PER FOOT OD_f
100.0	0.0000	0.0000	0.0000	0.0000
99.5	0.1002	0.5001	0.0022	0.0004
99.0	0.2008	1.0001	0.0044	0.0009
98.5	0.3019	1.5001	0.0066	0.0013
98.0	0.4033	2.0001	0.0088	0.0018
97.5	0.5051	2.5002	0.0110	0.0022
97.0	0.6074	3.0002	0.0132	0.0027
96.5	0.7101	3.5002	0.0155	0.0031
96.0	0.8132	4.0003	0.0177	0.0036
95.5	0.9167	4.5003	0.0200	0.0040
95.0	1.0227	5.0003	0.0223	0.0045
94.5	1.1251	5.5004	0.0246	0.0049
94.0	1.2300	6.0004	0.0296	0.0054
93.5	1.3353	6.5004	0.0292	0.0058
93.0	1.4410	7.0005	0.0315	0.0063
92.5	1.5473	7.5005	0.0339	0.0068
92.0	1.6539	8.0005	0.0362	0.0072
91.5	1.7611	8.5005	0.0386	0.0077
91.0	1.8687	9.0006	0.0410	0.0082
90.5	1.9768	9.5006	0.0434	0.0087
90.0	2.0853	10.0006	0.0458	0.0092
89.5	2.1944	10.5007	0.0482	0.0096
89.0	2.3039	11.0007	0.0506	0.0101
88.5	2.4139	11.5007	0.0531	0.0106
88.0	2.5244	12.0008	0.0555	0.0111
87.5	2.6355	12.5008	0.0580	0.0116
87.0	2.7470	13.0008	0.0605	0.0121
86.5	2.8590	13.5008	0.0630	0.0126
86.0	2.9716	14.0009	0.0655	0.0131
85.5	3.0847	14.5009	0.0680	0.0136
85.0	3.1984	15.0009	0.0706	0.0141
84.5	3.3125	15.5010	0.0732	0.0146
84.0	3.4272	16.0010	0.0757	0.0152
83.5	3.5425	16.5010	0.0783	0.0157
83.0	3.6583	17.0011	0.0809	0.0162
82.5	3.7746	17.5011	0.0836	0.0167
82.0	3.8916	18.0011	0.0862	0.0172
81.5	4.0091	18.5011	0.0889	0.0178
81.0	4.1271	19.0012	0.0915	0.0183
80.5	4.2458	19.5012	0.0942	0.0188
80.0	4.3651	20.0012	0.0969	0.0194

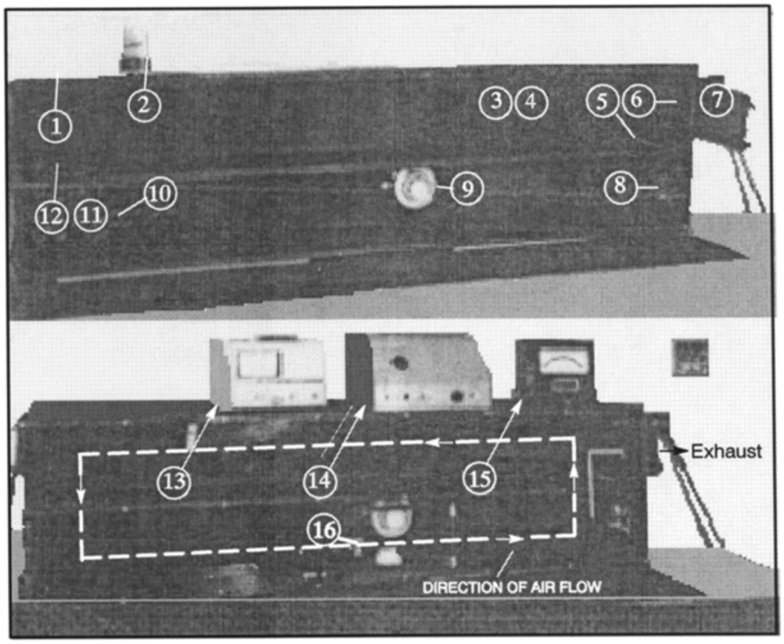


FIGURE 12-72-3-1—SMOKE DETECTOR TEST CHAMBER

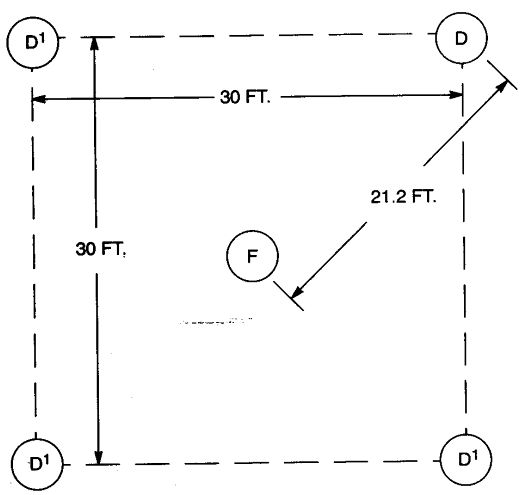


FIGURE 12-72-3-2—FIRE TEST DETECTOR INSTALLATION

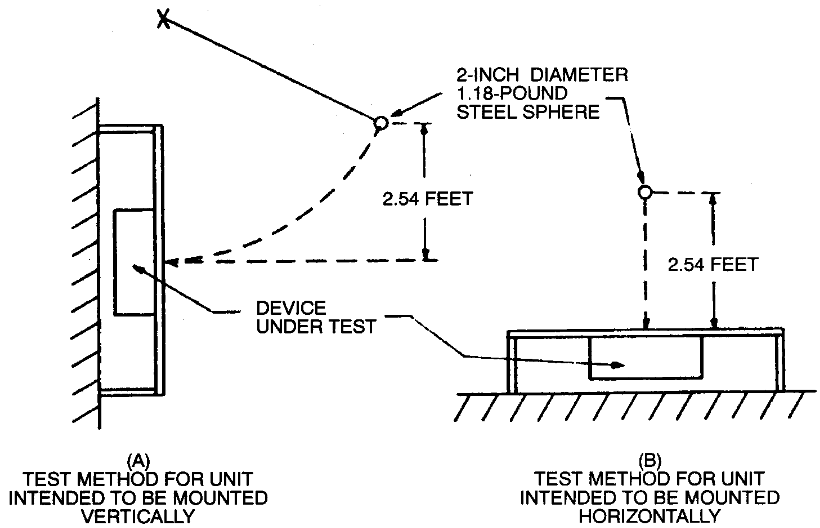


FIGURE 12-72-3-3—JARRING TEST

HISTORY NOTE APPENDIX

2022 California Referenced Standards Code
California Code of Regulations, Title 24, Part 12

HISTORY:

For prior code history, see the History Note Appendix to the *California Referenced Standards Code,* 2019 Triennial Edition, effective January 1, 2020.

1. (BSC 07/21) – Amendments to the 2022 *California Referenced Standards Code*, CCR Title 24, Part 12. Approved by the California Building Standards Commission on January 18, 2022; filed with the Secretary of State on February 2, 2022; and effective on January 1, 2023.

2. (SFM 08/21) – Repeal the 2019 Adoption of the *California Referenced Standards Code,* CCR Title 24, Part 12 and adopt the 2022 *California Referenced Standards Code.* Approved by the California Building Standards Commission on January 19, 2022; filed with Secretary of State on February 2, 2022; and effective on January 1, 2023.

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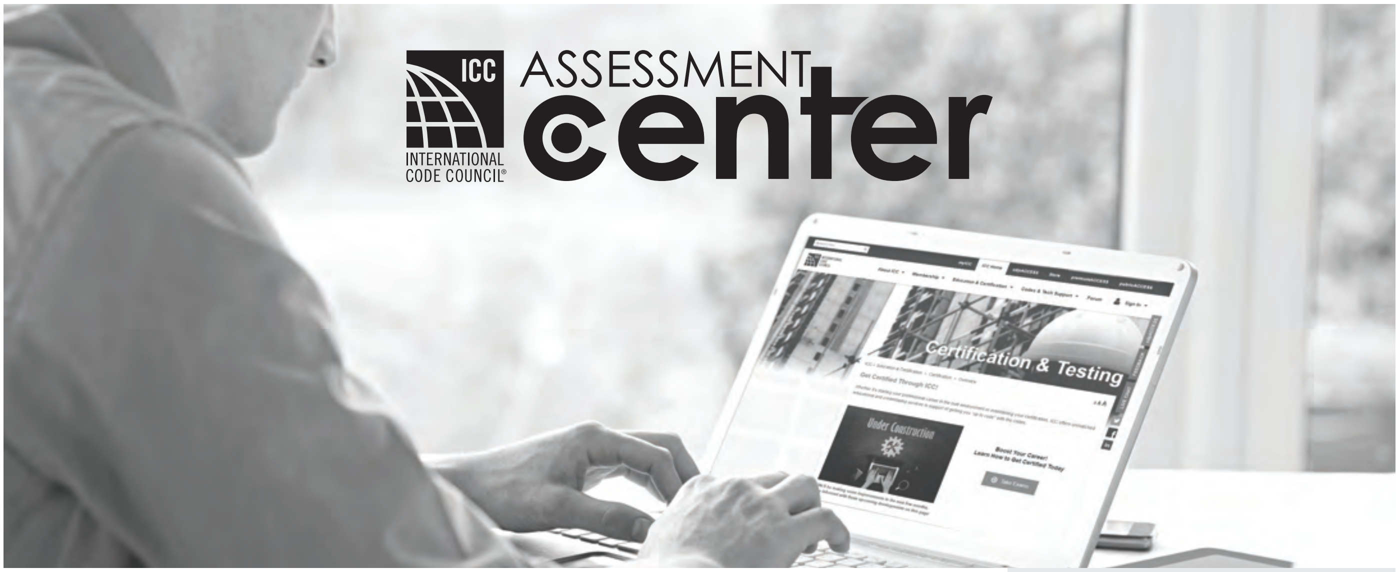

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