

UNIFORM BUILDING CODE

**1946
EDITION**



Preface

¶ The Uniform Building Code is dedicated to the development of better building construction and greater safety to the public, through the elimination of needless red tape, favoritism and local politics by uniformity in building laws; to the granting of full justice to all building materials on the fair basis of the true merits of each material; and to the development of a sound economic basis for the future growth of cities through unbiased and equitable dealing with structural design and fire hazards.

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PACIFIC COAST BUILDING OFFICIALS CONFERENCE

UNIFORM BUILDING CODE

Ordinance No.

An ordinance regulating the erection, construction, enlargement, alteration, repair, moving, removal, conversion, demolition, occupancy, equipment, use, height, area, and maintenance of buildings or structures in the City of

.....; providing for the issuance of permits and collection of fees therefor; declaring and establishing Fire Districts; providing penalties for the violation thereof, and repealing all ordinances and parts of ordinances in conflict therewith.

Be it ordained by the of the
City of as follows:

PART I

ADMINISTRATIVE

CHAPTER 1—TITLE AND SCOPE

Sec. 101. This ordinance shall be known as the "Building Code," may be cited as such, and will be referred to herein as "this Code." **Title**

Sec. 102. The purpose of this Code is to provide minimum standards to safeguard life or limb, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use and occupancy, location and maintenance of all buildings and structures within the city and certain equipment specifically regulated herein. **Purpose**

The provisions of this Code shall supplement any and all laws of the State relating to buildings.

Sec. 103. New buildings and structures hereafter erected in the city, and buildings and structures moved into or within the city shall conform to the requirements of this Code. **Scope**

Additions, alterations, repairs and changes of use or occupancy in all buildings and structures shall comply with the provisions for new buildings and structures except as otherwise provided in Sections 104, 306, and 502 of this Code.

Where, in any specific case, different sections of this Code specify different materials, methods of construction or other requirements, the most restrictive shall govern.

Sec. 104. (a) General. Buildings or structures to which additions, alterations, or repairs are made shall comply with all the requirements for new buildings or structures except as specifically provided in this Section. **Application to Existing Buildings**

For construction in Fire Zones Nos. 1 and 2 see Chapter 16.

(b) Additions, Alterations and Repairs: More Than 50 Per Cent. When additions, alterations, or repairs within any 12-month period exceed 50 per cent of the value of an existing building or structure, such building or structure shall be made to conform to the requirements for new buildings or structures.

(c) Additions, Alterations, and Repairs: 25 to 50 Per Cent. Additions, alterations, and repairs exceeding 25 per cent but not exceeding 50 per cent of the value of an existing building or structure and complying with the requirements for new buildings or structures may be made to such building or structure within any 12-month period without making the entire building or structure comply. The new construction shall conform to the requirements of this Code for a new building of like area, height, and occupancy. Such building or structure, including new additions, shall not exceed the areas and heights specified in this Code.

(d) Additions, Alterations and Repairs: 25 Per Cent or Less. Structural additions, alterations, and repairs to any portion of an existing building or structure, within any 12-month period, not exceeding 25 per cent of the value of the building or structure shall comply with all of the requirements for new buildings or structures, except that minor struc-

tural additions, alterations, or repairs, when approved by the Building Official, may be made with the same material of which the building or structure is constructed.

(e) **Non-Structural Alterations and Repairs: 25 Per Cent or Less.** Alterations or repairs, not exceeding 25 per cent of the value of an existing building or structure, which are non-structural and do not affect any member or 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.

(f) **Repairs: Roof Covering.** Not more than 25 per cent of the roof covering of any building or structure shall be replaced in any 12-month period unless the new roof covering is made to conform to the requirements of this Code for new buildings or structures.

(g) **Change of Occupancy.** The use or occupancy of any existing building or structure shall comply with the provisions of Sections 306 and 502.

(h) **Moved Buildings.** Buildings or structures moved into or within the city shall comply with the provisions of this Code.

Buildings or structures moved into or within a Fire Zone shall comply with the provisions of Section 1601(c).

(i) **Maintenance.** All buildings or structures both existing and new, and all parts thereof, shall be maintained in a safe and sanitary condition. All devices or safeguards which are required by this Code in a building or structure when erected, altered, or repaired, shall be maintained in good working order. The owner or his designated agent shall be responsible for the maintenance of buildings and structures.

Alternate Materials and Methods of Construction

Sec. 105. The provisions of this Code are not intended to prevent the use of any material or method of construction not specifically prescribed by this Code, provided any such alternate has been approved.

The Building Official may approve any such alternate provided he finds that the proposed design is satisfactory and complies with the provisions of Chapter 23, 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.

The Building Official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use.

Tests

Sec. 106. Whenever there is evidence that any material or any construction does not conform to the requirements of this Code, or in order to substantiate claims for alternate materials or methods of construction, the Building Official may require tests as proof of compliance to be made at the expense of the owner or his agent by an approved agency.

Test methods shall be as specified by this Code for the material in question. If there are no appropriate test methods specified in this Code, the Building Official shall determine the test procedure.

Copies of the results of all such tests shall be kept on file in the office of the Building Official for a period of not less than two years after the acceptance of the structure.

CHAPTER 2—ORGANIZATION AND ENFORCEMENT

Sec. 201. There is hereby established in the city the "Building Department" which shall be under the jurisdiction of the Building Official designated by the appointing authority.

Creation of Department

Sec. 202. (a) General. The Building Official is hereby authorized and directed to enforce all the provisions of this Code. For such purpose he shall have the powers of a police officer.

Powers and Duties of Building Official

The determination of value or valuation under any of the provisions of the Code shall be made by the Building Official.

(b) Deputies. In accordance with the procedure and with the approval of the chief appointing authority of the municipality, the Building Official may appoint such number of officers, inspectors and assistants and other employees as shall be authorized from time to time. He may depute such employees as may be necessary to carry out the functions of the Building Department.

(c) Reports and Records. The Building Official shall submit a report to the proper city official not less than once a year, covering the work of the department during the preceding period. He shall incorporate in said report a summary of his recommendations as to desirable amendments to the law.

The Building Official shall keep a permanent, accurate account of all fees and other monies collected and received under this Code, the names of the persons upon whose account the same were paid, the date and amount thereof, together with the location of the building or premises to which they relate.

(d) Right of Entry. Upon presentation of proper credentials the Building Official or his duly authorized representatives may enter at reasonable times any building, structure or premises in the city to perform any duty imposed upon him by this Code.

(e) Stop Orders. Whenever any building work is being done contrary to the provisions of this Code, the Building Official may order the work stopped by notice in writing served on any persons engaged in the doing or causing such work to be done, and any such persons shall forthwith stop such work until authorized by the Building Official to proceed with the work.

Sec. 203. (a) General. All buildings or structures which are structurally unsafe or not provided with adequate egress, or which constitute a fire hazard, or are otherwise dangerous to human life, or which in relation to existing use constitute a hazard to safety or health by reason of inadequate maintenance, dilapidation, obsolescence, or abandonment, arc, for the purpose of this Section, unsafe buildings. All such unsafe buildings are hereby declared to be public nuisances and shall be abated by repair, rehabilitation, or demolition in accordance with the procedure of this Section.

Unsafe Buildings

(b) Notice to Owner. The Building Official shall examine or cause to be examined every building or structure or portion thereof reported as dangerous or damaged and, if found to be an unsafe building as defined in this Section, he shall give to

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the owner of such building or structure written notice stating the defects thereof. This notice shall require the owner, within 30 days, to commence either the required repairs or improvements or demolition and removal of the building or structure or portions thereof. If necessary, such notice shall also require the building, structure, or portion thereof to be vacated forthwith and not reoccupied until the required repairs and improvements are completed, inspected, and approved by the Building Official.

Proper service of such notice shall be by personal service upon the owner of record, if he shall be found within the city limits. If he is not found within the city limits such service may be made upon said owner by registered mail; provided, that if such notice is by registered mail, the 30-day period within which said owner is required to comply with the order of the Building Official, shall begin as of the date he receives such notice.

(c) **Posting of Signs.** The Building Official shall cause to be posted at each entrance to such building a notice to read: "DO NOT ENTER. UNSAFE TO OCCUPY. Building Department, City of....." Such notice shall remain posted until the required repairs are made or demolition is completed. Such notice shall not be removed without written permission of the Building Official and no person shall enter the building except for the purpose of making the required repairs or of demolishing same.

(d) **Right to Demolish.** In case the owner shall fail, neglect, or refuse to comply with the notice to repair, rehabilitate, or to demolish and remove said building or structure or portion thereof, the City Council may order the owner of the building prosecuted as a violator of the provisions of this Code and may order the Building Official to proceed with the work specified in such notice. A statement of the cost of such work shall be transmitted to the City Council, who shall cause the same to be paid and levied as a special assessment against the property.

(e) **Costs.** Costs incurred under Subsection (d) shall be paid out of the City Treasury. Such costs shall be charged to the owner of the premises involved as a special assessment on the land on which the building or structure is located, and shall be collected in the manner provided for special assessments.

Board of Examiners and Appeals

Sec. 204. In order to determine the suitability of alternate materials and types of construction and to provide for reasonable interpretations of the provisions of this Code, there shall be and is hereby created a Board of Examiners and Appeals, consisting of five members, who are qualified by experience and training to pass upon matters pertaining to building construction. The Building Official shall be an ex-officio member and shall act as Secretary to the Board. The Board of Examiners and Appeals shall be appointed by the Mayor and shall hold office at his pleasure. The Board shall adopt reasonable rules and regulations for conducting its investigations and shall render all decisions and findings in writing to the Building Official with a duplicate copy to the appellant and may recommend to the City Council such new legislation as is consistent therewith.

Sec. 205. It shall be unlawful for any person, firm or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish, equip, use, occupy or maintain any building or structure in the city, or cause the same to be done, contrary to or in violation of any of the provisions of this Code.

**Violations
and Penalties**

Any person, firm or corporation violating any of the provisions of this Code shall be deemed guilty of a misdemeanor, and each such person shall be deemed guilty of a separate offense for each and every day or portion thereof during which any violation of any of the provisions of this Code is committed, continued or permitted, and upon the conviction of any such violation such person shall be punishable by a fine of not more than \$300, or by imprisonment for not more than three months, or by both such fine and imprisonment.

CHAPTER 3—PERMITS AND INSPECTIONS**Applications
for Permits**

Sec. 301. (a) Permits Required. No person, firm or corporation shall erect, construct, enlarge, alter, repair, move, improve, remove, convert or demolish any building or structure in the city, or cause the same to be done, without first obtaining a separate building permit for each such building or structure from the Building Official.

(b) **Application.** To obtain a permit the applicant shall first file an application therefor in writing on a form furnished for that purpose. Every such application shall:

1. Describe the land on which the proposed work is to be done, by lot, block, tract, and house and street address, or similar description that will readily identify and definitely locate the proposed building or work;
2. Show the use or occupancy of all parts of the building;
3. Be accompanied by plans and specifications as required in Subsection (c) of this Section;
4. State the valuation of the proposed work;
5. Give such other information as reasonably may be required by the Building Official.

(c) **Plans and Specifications.** Each application for a permit shall be accompanied by two sets of plans and specifications.

Exception: Plans and specifications need not be submitted for small and unimportant work when authorized by the Building Official.

(d) **Information on Plans and Specifications.** Plans and specifications shall be drawn to scale upon substantial paper or cloth and shall be of sufficient clarity to indicate the nature and extent of the work proposed and show in detail that it will conform to the provisions of this Code and all relevant laws, ordinances, rules and regulations. The first sheet of each set of plans shall give the house and street address of the work and the name and address of the owner and person who prepared them. Plans shall include a plot plan showing the location of the proposed building and of every existing building on the property. In lieu of detailed specifications, the Building Official may approve references on the plans to a specific section or part of this Code or other ordinances or laws.

Computations, stress diagrams, and other data sufficient to show the correctness of the plans, shall be submitted when required by the Building Official.

**Building
Permits**

Sec. 302. (a) Issuance. The application, plans and specifications filed by an applicant for a permit shall be checked by the Building Official. Such plans may be reviewed by other departments of the city to check compliance with the laws and ordinances under their jurisdiction. If the Building Official is satisfied that the work described in an application for permit and the plans filed therewith conform to the requirements of this Code and other pertinent laws and ordinances, he shall issue a permit therefor to the applicant.

When the Building Official issues the permit, he shall endorse in writing or stamp on both sets of plans and specifications "APPROVED." Such approved plans and specifications shall

not be changed, modified or altered without authorization from the Building Official, and all work shall be done in accordance with the approved plans.

(b) **Retention of Plans.** One set of approved plans, specifications and computations shall be retained by the Building Official for a period of not less than 90 days from date of completion of the work covered therein, and one set of approved plans and specifications shall be returned to the applicant, which set shall be kept on such building or work at all times during which the work authorized thereby is in progress.

(c) **Validity.** The issuance or granting of a permit or approval of plans and specifications shall not be construed to be a permit for, or an approval of, any violation of any of the provisions of this Code. No permit presuming to give authority to violate or cancel the provisions of this Code shall be valid, except in so far as the work or use which it authorizes is lawful.

The issuance of a permit based upon plans and specifications shall not prevent the Building Official from thereafter requiring the correction of errors in said plans and specifications or from preventing building operations being carried on thereunder when in violation of this Code or of any other ordinance of the city.

(d) **Expiration.** Every permit issued by the Building Official under the provisions of this Code shall expire by limitation and become null and void, if the building or work authorized by such permit is not commenced within 60 days from the date of such permit, or if the building or work authorized by such permit is suspended or abandoned at any time after the work is commenced for a period of 60 days. Before such work can be recommenced a new permit shall be first obtained so to do, and the fee therefor shall be one-half the amount required for a new permit for such work, provided no changes have been made or will be made in the original plans and specifications for such work; and provided, further, that such suspension or abandonment has not exceeded one year.

Sec. 303. (a) Building Permit Fees. Before a building permit is issued a permit fee therefor shall be paid to the Building Official as set forth in Table No. 3-A. **Fees**

TABLE NO. 3-A—BUILDING PERMIT FEES

TOTAL VALUATION	FEE
Less than \$20.00.....	No Fee
\$20.00 to and including \$100.00.....	\$1.00
More than \$100.00, to and including \$400.00.....	2.00
More than \$400.00, to and including \$700.00.....	3.00
More than \$700.00, to and including \$1,000.00.....	4.00
Each additional \$1,000.00 or fraction, to and including \$15,000.00.....	2.00
Each additional \$1,000.00 or fraction, to and including \$50,000.00.....	1.00
Each additional \$1,000.00 or fraction exceeding \$50,000.00.....	0.50

Where work for which a permit is required by this Code is started or proceeded with prior to obtaining said permit, the fees above specified shall be doubled, but the payment of such double fee shall not relieve any persons from fully complying with the requirements of this Code in the execution of the work nor from any other penalties prescribed herein.

(b) **Plan-checking Fees.** Before plans and specifications are accepted for checking, a plan-checking fee in addition to the building permit fee shall be paid to the Building Official. The plan-checking fee shall be one-half the building permit fee.

Exception: A plan-checking fee shall not be required for:

1. Buildings or structures whose total valuation is less than \$5,000.00;
2. Buildings of stud bearing wall construction with no floor or roof span in excess of twenty-four feet (24'); and
3. Alterations and repairs of a non-structural nature.

Inspections

Sec. 304. (a) General. All construction or work for which a permit is required shall be subject to inspection by the Building Official, and certain types of construction shall have continuous inspection by special inspectors, as specified in Section 305.

(b) **Inspection Record Card.** Work requiring a building permit shall not be commenced until the permit holder or his agent shall have posted an inspection record card in a conspicuous place on the front premises and in such position as to allow the Building Official conveniently to make the required entries thereon regarding inspection of the work. This card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued.

(c) **Approvals Required.** No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Building Official. Such written approval shall be given only after an inspection shall have been made of each successive step in the construction as indicated by each of the inspections required in Subsection (d).

There shall be a final inspection and approval on all buildings when completed and ready for occupancy.

(d) **Called Inspections.** No reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatever without first obtaining the approval of the Building Official.

The Building Official upon notification from the permit holder or his agent shall make the following inspections of Type V buildings and shall either approve that portion of the construction as completed or shall notify the permit holder or his agent wherein the same fails to comply with the law.

1. **FOUNDATION INSPECTION:** To be made after trenches are excavated and forms erected and when all materials for the foundation are delivered on the job. Where concrete from a central mixing plant (commonly termed "transit mixed") is to be used, materials need not be on the job.
2. **FRAME INSPECTION:** To be made after the roof, all framing, fire-blocking and bracing are in place and all pipes, chimneys and vents are complete.

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3. **LATH INSPECTION:** To be made after all lathing, interior and exterior, is in place and all plastering materials are delivered on the job, but before any plaster is applied.
4. **FINAL INSPECTION:** To be made after building is completed and ready for occupancy.

(e) **Other Inspections.** In addition to the called inspections specified above, the Building Official may make any other inspections of any construction work to ascertain compliance with the provisions of this Code and other laws which are enforced by the Department.

Sec. 305. (a) General. In addition to the inspections to be made as specified in Section 304, the owner or his agent shall employ a special inspector during construction on the following types of work:

**Special
Supervision**

1. **CONCRETE:** On concrete work when the design is based on an f'_c in excess of 2,000 pounds.
2. **MASONRY:** On masonry when the design is based on unit stresses in excess of 50 per cent of those allowed in Chapter 24.
3. **WELDING:** On all structural welding.
4. **REINFORCED GYPSUM:** A special inspector shall be present on the work at all times when cast-in-place reinforced gypsum is being mixed or deposited.
5. **SPECIAL WORK:** On special construction or work involving unusual hazards.

Exception: The Building Official may waive the requirement for the employment of a special inspector if he finds that the construction or work is such that no unusual hazard exists.

(b) **Special Inspector.** The special inspector shall be a qualified person approved by the Building Official.

The special inspector shall furnish continuous inspection on the construction and work requiring his employment. He shall report to the Building Official in writing, noting all Code violations and other information as required.

Sec. 306. (a) Use or Occupancy. No new building or structure in Groups A to H, inclusive, shall be used or occupied, and no change in the existing occupancy classification of a building or structure or portion thereof shall be made until the Building Official has issued a Certificate of Occupancy therefor as provided herein.

**Certificate of
Occupancy**

(b) **Change in Use.** Changes in the character or use of a building shall not be made except as specified in Section 502 of this Code.

(c) **Certificate Issued.** If after final inspection it is found that the building or structure complies with the provisions of this Code, the Building Official shall issue a Certificate of Occupancy which shall contain the following:

1. The use and occupancy for which the certificate is issued.
2. A statement that the floor load signs, required by Section 2308, have been installed.
3. A certification that the building or structure complies with the provisions of this Code.

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(d) **Temporary Certificate.** A temporary Certificate of Occupancy may be issued by the Building Official for the use of a portion or portions of a building or structure prior to the completion of the entire building or structure.

(e) **Posting.** The Certificate of Occupancy shall be posted in a conspicuous place on the premises and shall not be removed except by the Building Official.

PART II

DEFINITIONS AND ABBREVIATIONS

CHAPTER 4—DEFINITIONS AND
ABBREVIATIONS

Sec. 401. For the purpose of this Code, certain abbreviations, terms, phrases, words and their derivatives shall be construed as set out in this Section. Words used in the singular include the plural and the plural the singular. Words used in the masculine gender include the feminine, and the feminine the masculine.

Definitions
and
Abbreviations

(a) **ALLEY** is any public space, public park or thoroughfare less than sixteen feet (16') but not less than ten feet (10') in width which has been dedicated or deeded to the public for public use. **A**

ALTER or **ALTERATION** is any change, addition or modification in construction or occupancy.

APARTMENT is a room or suite of rooms which is occupied or which is intended or designed to be occupied by one family for living and sleeping purposes.

APARTMENT HOUSE is any building, or portion thereof, which is designed, built, rented, leased, let or hired out to be occupied, or which is occupied as the home or residence of three or more families living independently of each other and doing their own cooking in the said building, and shall include flats and apartments.

APPROVED as to materials and types of construction, refers to approval by the Building Official as the result of investigation and tests conducted by him, or by reason of accepted principles or tests by national authorities, technical or scientific organizations.

APPROVED AGENCY is an established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.

AREA (see "Floor Area").

A. S. A. is the American Standards Association.

A. S. T. M. is the American Society for Testing Materials.

ASSEMBLY BUILDING is a building used, in whole or in part, for the gathering together of persons for such purposes as deliberation, worship, entertainment, amusement, or awaiting transportation.

ATTIC STORY is any story situated wholly or partly in the roof, so designated, arranged or built as to be used for business, storage or habitation.

(b) **BALCONY** is that portion of the seating space of an assembly room, the lowest part of which is raised four feet (4') or more above the level of the main floor. **B**

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Definitions
(Cont'd.)

BASEMENT is that portion of a building between floor and ceiling, which is partly below and partly above grade (as defined in this Section), but so located that the vertical distance from grade to the floor below is less than the vertical distance from grade to ceiling. (See "Story".)

BAY WINDOW is a rectangular, curved or polygonal window, supported on a foundation extending beyond the main wall of the building.

BUILDING is any structure built for the support, shelter, or enclosure of persons, animals, chattels, or property of any kind.

BUILDING—EXISTING BUILDING is a building erected prior to the adoption of this Code, or one for which a legal building permit has been issued.

BUILDING OFFICIAL is the officer charged with the administration and enforcement of the building code, or his regularly authorized deputy.

C

(c) **CAST STONE** is a building stone manufactured from cement concrete precast and used as a trim, veneer or facing on or in buildings or structures.

CELLAR is that portion of a building between floor and ceiling which is wholly or partly below grade (as defined in this Section) and so located that the vertical distance from grade to the floor below is equal to or greater than the vertical distance from grade to ceiling. (See "Story".)

CHIEF OF THE FIRE DEPARTMENT is the head of the Fire Department or his regularly authorized deputy.

COURT is an open, unoccupied space, bounded on two or more sides by the walls of the building. An inner court is a court entirely within the exterior walls of a building. All other courts are outer courts.

D

(d) **DEAD LOAD** in a building is the weight of the walls, permanent partitions, framing, floors, roofs and all other permanent, stationary construction forming a part of the building.

DWELLING is any building or any portion thereof, which is not an "Apartment House" or a "Hotel" as defined in this Code, which contains one or more "Apartments" or "Guest Rooms", used, intended, or designed to be built, used, rented, leased, let or hired out to be occupied, or which are occupied for living purposes.

E

(e) **EXISTING BUILDING**—(See Building—Existing).

EXIT is a continuous and unobstructed means of egress to a public way, and shall include intervening doorways, corridors, ramps, stairways, smokeproof towers, horizontal exits, and exterior courts.

(f) **FAMILY** is one person living alone or a group of two or more persons living together, whether related to each other by birth or not. **Definitions (Cont'd.)**

F

FIRE RESISTANCE or **FIRE-RESISTIVE CONSTRUCTION** is construction to resist the spread of fire, details of which are specified in Chapters 42 or 43 of this Code.

FLOOR AREA is the area included within surrounding walls of a building (or portion thereof), exclusive of vent shafts and courts.

FOOTING or **FOUNDATION** is the spreading course at the base or bottom of a foundation wall, column or pier.

FRONT OF LOT is the front boundary line of a lot bordering on the street, and in the case of a corner lot may be either frontage.

(g) **GARAGE** is a building or portion thereof in which a motor vehicle containing gasoline, distillate or other volatile, flammable liquid in its tank, is stored, repaired or kept. **G**

GARAGE, PRIVATE, is a building, or a portion of a building, in which only motor vehicles used by the tenants of the building or buildings on the premises are stored or kept, and with space for not more than 10 automobiles. (See Section 1509.)

GARAGE, PUBLIC, is any garage other than a private garage.

GRADE (Ground Level) is the average of the finished ground level at the center of all walls of a building. In case walls are parallel to and within five feet (5') of a sidewalk, the above ground level shall be measured at the sidewalk.

GRADE (Lumber) is the division of sawn lumber into quality classes with respect to its physical and mechanical properties as defined in published lumber manufacturers' standard grading rules.

GUEST is any person hiring or occupying a room for living or sleeping purposes.

(h) **HEIGHT OF BUILDING** is the vertical distance from the "Grade" to the highest point of the coping of a flat roof or to the deck line of a mansard roof or to the average height of the highest gable of a pitch or hip roof. **H**

HOTEL is any building containing six or more rooms intended or designed to be used, or which are used, rented or hired out to be occupied, or which are occupied for sleeping purposes by guests.

(i) No definitions.

(j) No definitions.

(k) No definitions.

(l) **LINTEL** is the beam or girder placed over an opening in a wall, which supports the wall construction above. **L**

LIVE LOADS are all imposed, fixed or transient loads other than "Dead Loads".

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UNIFORM BUILDING CODE

Definitions
(Cont'd.)
M

(m) **MARQUEE** is a permanent roofed structure attached to and supported by the building. Marquees projecting over public property are regulated in Chapter 45.

MASONRY is that form of construction, composed of stone, brick, concrete, gypsum, hollow clay tile, concrete block or tile, or other similar building units or materials or a combination of these materials laid up unit by unit and set in mortar. For the purpose of this Code plain monolithic concrete shall be considered as Masonry.

MASONRY, SOLID, is masonry built without hollow spaces.

MEZZANINE or **MEZZANINE FLOOR** is an intermediate floor placed in any story or room. When the total area of any such "Mezzanine Floor" exceeds 33½ per cent of the total floor area in that room, it shall be considered as constituting an additional "Story". The clear height above or below a "Mezzanine Floor" construction shall be not less than seven feet (7').

N

(n) **N. B. F. U.** is the National Board of Fire Underwriters.

O

(o) **OCCUPANCY** is the purpose for which a building is used or intended to be used. Change of occupancy is not intended to include change of tenants or proprietors.

ORIEL WINDOW is a window which projects from the main line of an enclosing wall of a building and is carried on brackets or corbels.

P

(p) **PERSON** is a natural person, his heirs, executors, administrators or assigns, and also includes a firm, partnership or corporation, its or their successors or assigns, or the agent of any of the aforesaid.

PLATFORM, ENCLOSED, is a partially enclosed portion of an assembly room the ceiling of which is not more than five feet (5') above the proscenium opening and which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, props, decorations, or other effects are to be installed or used.

(q) No definitions.

R

(r) **REPAIR** is the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. The word "Repair" or "Repairs" shall not apply to any change of construction.

S

(s) **SHAFT** is a vertical opening through a building for elevators, dumb-waiter, light, ventilation or similar purposes.

SHALL as used in this Code, is mandatory.

STAGE is a partially enclosed portion of an assembly building which is designed or used for the presentation of plays, demonstrations, or other entertainment wherein scenery, drops, or other effects may be installed or used, and where the distance between the top of the proscenium opening and the ceiling above the stage is more than five feet (5').

STORY is that portion of a building included between the upper surface of any floor and the upper surface of the floor

next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. If the finished floor level directly above a basement or cellar is more than six feet (6') above grade such basement or cellar shall be considered a story.

STREET is any thoroughfare or public park not less than sixteen feet (16') in width which has been dedicated or deeded to the public for public use.

STRUCTURE is that which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

(t) No definitions.

(u) No definitions.

(v) **VALUE** or **VALUATION** of a building shall be the estimated cost to replace the building in kind. **V**

VENEER is a facing of brick, stone, concrete, tile or similar material attached to a wall for the purpose of providing ornamentation, protection or insulation but not counted as adding strength to the wall.

(w) **WALLS** shall be defined as follows: **W**

Bearing Wall is a wall which supports any load other than its own weight.

Curtain Wall is a non-bearing wall between columns or piers which is not supported by girders or beams.

Enclosure Wall is an exterior, non-bearing wall in skeleton construction, anchored to columns, piers or floors, but not necessarily built between columns or piers.

Faced Wall is a wall in which the masonry facing and backing are so bonded as to exert a common action under load.

Interior Wall is a wall entirely surrounded by the exterior walls of the building.

Non-Bearing Wall is a wall which supports no load other than its own weight.

Panel Wall is a non-bearing wall in skeleton construction built between columns or piers and wholly supported at each story.

Parapet Wall is that part of any wall entirely above the roof line.

Party Wall is a wall used or adapted for joint service between two buildings.

Retaining Wall is any wall used to resist the lateral displacement of any material.

WINDOW. (See Bay Window; See Oriel Window).

(x) No definitions.

(y) **YARD** is an open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Code, on the lot on which a building is situated. **Y**

PART III

REQUIREMENTS BASED ON OCCUPANCY

CHAPTER 5—CLASSIFICATION OF ALL BUILDINGS BY USE OR OCCUPANCY AND GENERAL REQUIREMENTS FOR ALL OCCUPANCIES

**Occupancy
Classified**

Sec. 501. Every building, whether existing or hereafter erected, shall be classified by the Building Official according to its use or the character of its occupancy, as a building of Group A, B, C, D, E, F, G, H, I or J, as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 respectively. (See Table No. 5-A.)

When a building is used for more than one occupancy purpose, it shall be subject to the most restrictive requirements for the occupancies concerned.

When portions of a building are separated from the remainder of a building by one or more continuous four-hour fire-resistive walls extending from the foundation of the building to and through the roof, such portions may be considered as separate buildings for the purposes of determining areas. The total width of all openings in any such wall in any one story shall not exceed 25 per cent of the length of the wall in that story, and such openings shall be Class A openings protected as required in Section 4304 (d).

Any occupancy not mentioned specifically or about which there is any question shall be classified by the Building Official and included in the Group which its use most nearly resembles based on the existing or proposed life and fire hazard.

**Change
in Use**

Sec. 502. No change shall be made in the character of occupancy or use of any building which would place the building in a different Group of occupancy, unless such building is made to comply with the requirements of this Code for that Group.

Exception: The character of the occupancy of existing buildings may be changed subject to the approval of the Building Official, and the building may be occupied for purposes in other Groups without conforming to all the requirements of this Code for those Groups, provided the new or proposed use is less hazardous, based on life and fire risk, than the existing use.

No change in the character of occupancy of a building shall be made without a Certificate of Occupancy, as required in Section 306 of this Code.

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

**Mixed
Occupancy**

Sec. 503. (a) General. When a building is used for more than one occupancy purpose each part of the building comprising a distinct "Occupancy," as described in Chapters 5 to 15, shall be separated from any other occupancy as specified in Section 503 (d).

(b) Forms of Occupancy Separations. Occupancy separations shall be vertical or horizontal or both or, when necessary, of such other form as may be required to afford a complete separation between the various occupancy divisions in the building.

next above, except that the topmost story shall be that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. If the finished floor level directly above a basement or cellar is more than six feet (6') above grade such basement or cellar shall be considered a story.

Definitions (Cont'd.)

STREET is any thoroughfare or public park not less than sixteen feet (16') in width which has been dedicated or deeded to the public for public use.

STRUCTURE is that which is built or constructed, an edifice or building of any kind, or any piece of work artificially built up or composed of parts joined together in some definite manner.

(t) No definitions.

(u) No definitions.

(v) **VALUE or VALUATION** of a building shall be the estimated cost to replace the building in kind.

VENEER is a facing of brick, stone, concrete, tile or similar material attached to a wall for the purpose of providing ornamentation, protection or insulation but not counted as adding strength to the wall.

(w) **WALLS** shall be defined as follows:

W

Bearing Wall is a wall which supports any load other than its own weight.

Curtain Wall is a non-bearing wall between columns or piers which is not supported by girders or beams.

Enclosure Wall is an exterior, non-bearing wall in skeleton construction, anchored to columns, piers or floors, but not necessarily built between columns or piers.

Faced Wall is a wall in which the masonry facing and backing are so bonded as to exert a common action under load.

Interior Wall is a wall entirely surrounded by the exterior walls of the building.

Non-Bearing Wall is a wall which supports no load other than its own weight.

Panel Wall is a non-bearing wall in skeleton construction built between columns or piers and wholly supported at each story.

Parapet Wall is that part of any wall entirely above the roof line.

Party Wall is a wall used or adapted for joint service between two buildings.

Retaining Wall is any wall used to resist the lateral displacement of any material.

WINDOW. (See Bay Window; See Oriel Window).

(x) No definitions.

(y) **YARD** is an open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Code, on the lot on which a building is situated.

Y

(c) **Types of Occupancy Separation.** Occupancy separations shall be classed as "Absolute," "Special" and "Ordinary."

1. An "Absolute Occupancy Separation" shall have no openings therein and shall be of not less than four-hour fire-resistive construction.

**Mixed
Occupancy
(Cont'd.)**

2. A "Special Occupancy Separation" shall be of not less than three-hour fire-resistive construction. All openings in walls forming such separation shall be protected on each side thereof by Class "A" fire doors and such doors shall be kept normally closed. The total width of all openings in any "Special Occupancy Separation" wall in any one story shall not exceed 25 per cent of the length of the wall in that story and no single opening shall have an area greater than one hundred and twenty square feet (120 sq. ft.).

All openings in floors forming a "Special Occupancy Separation" shall be protected by vertical enclosures, extending above and below such openings. The walls of such vertical enclosures shall be of not less than two-hour fire-resistive construction and all openings therein shall be protected on one side thereof by Class "B" fire doors, and such doors shall be kept normally closed.

3. An "Ordinary Occupancy Separation" shall be of not less than one-hour fire-resistive construction. All openings in such separations shall be protected with Class "C" fire doors, and such doors shall be kept normally closed.

(d) **Fire Ratings for Occupancy Separations.** Occupancy separations shall be provided between the various groups and divisions of occupancies as set forth in Table No. 5-B, except that in no case need the separation be more fire-resistive than the exterior walls of the building in which the separation occurs, unless such walls are less than one-hour fire-resistive construction. Where any occupancy separation is required the minimum shall be an "Ordinary Occupancy Separation."

Sec. 504. The location of all buildings and the protection of certain openings shall conform to the requirements of the occupancy group in which such building is classified in this Code according to the use or character of the occupancy; provided, that exterior walls which form an angle of 75 degrees or more with the adjacent property line may have openings therein which are protected by not less than one-hour fire-resistive construction.

**Location
on
Property**

The specific requirements given in Sections 603, 703, 803, 903, 1003, 1103, 1203, 1303, 1403, and 1503, regulating the construction of exterior walls and the protection of openings therein with respect to adjacent property lines, shall apply to buildings erected on the same property, but with reference to an imaginary property line located between such buildings and parallel to the face of either building; provided that in the case of Group J-1 occupancies which are accessory to Group I occupancies on the same property the requirements for Occupancy Separations between such occupancies as specified in Section 503 may be substituted in lieu thereof.

Sec. 505. (a) General. The floor area of every building shall be determined by the character of the occupancy, the type of construction, and the location in a fire zone. Buildings shall

**Allowable
Floor
Areas**

Table 5-A

UNIFORM BUILDING CODE

TABLE NO. 5-A—GROUPS OF OCCUPANCY

Chapter Reference	Group	OCCUPANCY	Stage	Seating Capacity in Any One Room
		DIVISION		
6	A	Assembly Buildings.....	Yes	1000 or more
7	B	1—Assembly Buildings.....	Yes	Less than 1000
		2—Assembly Buildings.....	No	300 or more
		3—Assembly Buildings.....	No	Less than 300
		4—Stadiums, reviewing stands, and amusement park structures not included within Group A and Divisions 1, 2 and 3, of Group B.		
8	C	Any building used for school purposes, involving assemblage for instruction, education, or recreation....		
9	D	1—Jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.....		
		2—Nurseries for children under six; hospitals, sanitariums, and similar buildings (each accommodating six or more persons); kindergartens.....		
10	E	Public garages, paint or petroleum storage, dry cleaning plants using flammable liquids, paint shops, and spray painting rooms and shops..... Planing mills, box factories, wood-working and mattress factories.. Storage of hazardous and highly flammable or explosive materials and liquids.....		
11	F	Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations... Gasoline filling and service stations, factories and workshops using materials not highly flammable or combustible..... Storage and sales rooms for combustible goods.....		
12	G	Ice plants, power plants, pumping plants, cold storage, and creameries..... Factories and workshops using incombustible and non-explosive materials..... Storage and sales rooms of incombustible and non-explosive materials.		
13	H	1—Homes for aged, orphanages, dormitories for children over six (each accommodating six or more persons).....		
		2—Hotels, apartment houses, dormitories, lodging houses, convents, monasteries (each accommodating 10 or more persons).....		
14	I	Dwellings.....		
15	J	1—Private garages, sheds and minor buildings used as accessories only when not over one thousand square feet (1000 sq. ft.) in area.. 2—Fences over six feet (6') high, tanks and towers.....		

TABLE NO. 5-B—REQUIRED SEPARATIONS IN BUILDINGS OF MIXED OCCUPANCY

[illegible]

*No occupancy separations shall be required in Type I buildings.

******Provided that lath and plaster as approved for one-hour fire-resistant construction on the garage side and a self-closing, tight-fitting solid slab wood door one and three-eighths inches (1 3/8") in thickness, shall be permitted where the private garage space will accommodate not more than four automobiles.

adjoin a public space, yard, or street on not less than one side. Basement and cellar areas need not be included in the total allowable areas.

For the purposes of this chapter, a yard is an open, unoccupied space on the lot on which a building is located, permanently maintained as an integral part thereof, and free of all obstruction from the ground up.

(b) **One-Story Areas.** The area of a one-story building shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506, nor the limits specified in Chapter 16.

(c) **Areas of Buildings Over One Story.** The total area of all floors of buildings over one story in height shall not exceed 200 per cent of the area allowed for one-story buildings. No single floor area shall exceed that permitted for one-story buildings.

See Chapters 6 to 16 inclusive for special occupancy provisions.

Sec. 506. (a) General. The increases of floor areas permitted in this Section may be additive when applicable, except that such increases for one-hour fire-resistive construction or for automatic sprinkler installations shall not apply when other provisions of this Code require such construction or sprinkler installation.

Allowable Area Increases

(b) **One-Hour Fire Resistance.** For buildings having at least one-hour fire-resistive construction the areas specified in Section 505 for Types III, IV, and V may be increased one-third.

**TABLE NO. 5-C—BASIC ALLOWABLE FLOOR AREA
FOR BUILDINGS ONE STORY IN HEIGHT
(In Square Feet)**

Types of Construc- tion	OCCUPANCY								
	A	B	C	D	E	F	G	H	I
I	Unlimited								
II	Not Permitted	15000	21250	4250	12500	18750	30000	15000	Unlimited
III	Not Permitted	9000	12750	3750	7500	11250	18000	9000	Unlimited
IV	Not Permitted	7200	10200	2500	5000	9000	14400	7200	Unlimited
V	Not Permitted	6000	8500	2500	5000	7500	12000	6000	Unlimited

Note: For Group J Occupancy see Chapter 15.

TABLE NO. 5-D—MAXIMUM STORIES OF BUILDINGS

Types of Construction	OCCUPANCY								
	A	B	C	D	E	F	G	H	I
I	Unlimited								
II	Not Permitted	2	2	2	2	5	6	5	3
III	Not Permitted	1	1	1	1	3	3	3	3
IV	Not Permitted	1	1	1	1	2	2	2	3
V	Not Permitted	1	1	1	1	2	2	2	3

(c) **Separation on Two Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend along two sides of a building, the areas specified in Section 505 may be increased at a rate of 1¼ per cent for each foot by which the minimum width exceeds twenty feet (20'), but the increase shall not exceed 50 per cent.

(d) **Separation on Three Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend along three sides of a building, the areas specified in Section 505 may be increased at a rate of 2½ per cent for each foot by which the minimum width exceeds twenty feet (20'), but the increase shall not exceed 100 per cent.

(e) **Separation on All Sides.** Where public space, streets, or yards, more than twenty feet (20') in width, extend on all sides of one and two-story buildings and adjoin the entire perimeter, the areas specified in Section 505 may be increased at a rate of five per cent for each foot by which the minimum width

exceeds twenty feet (20'). Such increases shall not exceed 100 per cent, except for buildings of Group G occupancy.

(f) **Unlimited Area.** The area of any one or two-story building of Group F and G occupancy shall not be limited, if the building is provided with automatic sprinklers throughout, as specified in Chapter 38, and entirely surrounded by public space, streets, or yards not less than sixty feet (60') in width.

(g) **Sprinklers.** The areas specified in Section 505 may be doubled if the building is provided with automatic sprinklers throughout as specified in Chapter 38.

Sec. 507. The maximum number of stories in height of every building shall be dependent upon the character of the occupancy and the type of construction, and shall not exceed the limits set forth in Table No. 5-D, except as provided in this Section.

**Maximum
Heights
of
Buildings**

The maximum height in feet of any building shall not exceed the number of stories allowed times 15 plus twenty-five feet (25'), nor the limitation of Part V (Types of Construction).

The limits set forth in Table No. 5-D may be increased in height by one story in Type III, IV, and V buildings of Group B, C, F, G, and H occupancy, if the construction is at least one-hour fire-resistive construction throughout, except that such increases shall not apply when other provisions of this Code require one-hour fire-resistive construction or when the increases under Section 506 (b) are used.

See Chapters 6 to 16 inclusive for special occupancy provisions.

CHAPTER 6—REQUIREMENTS FOR GROUP A OCCUPANCIES

Group A Occupancies Defined

Sec. 601. Group A Occupancies shall be:
Any assembly building with a stage and a seating capacity of 1000 or more in any one room.

For occupancy separations see Table No. 5-B.

Construction, Height and Area Allowable

Sec. 602. (a) General. Buildings or parts of buildings classed in Group A because of the use or character of the occupancy shall be of Type I Construction and shall not be limited as to location in fire zones, seating capacity, height or area.

(b) Special Provisions. Stages and enclosed platforms as defined in Section 401 shall be constructed in accordance with Chapter 39.

The slope of the main floor of the assembly room shall not exceed one in five.

Location on Property

Sec. 603. Buildings housing Group A occupancies shall front directly upon at least one public street not less than twenty feet (20') in width in which front shall be located the main entrance and exit of such building. The main assembly floor shall be located at or near the adjacent ground level.

Exterior walls or parts of walls, except on street fronts, which are less than five feet (5') from adjacent property lines shall have no openings therein. Openings in exterior walls, except on street fronts, which are less than ten feet (10') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property see Section 504.

Exit Facilities

Sec. 604. Stairs and exits shall be provided as specified in Chapter 33.

Light, Ventilation, and Sanitation

Sec. 605. All portions of Group A occupancies customarily used by human beings and all dressing rooms shall be provided with light and ventilation by means of windows and skylights with an area not less than one-eighth of the total floor area, or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically operated ventilating system shall supply at least thirty cubic feet (30 cu. ft.) of pure air per minute per seat in all portions of the building and such system shall be kept continuously in operation during such time as the building is occupied. If the velocity of the air at the register exceeds ten feet (10') per second the register shall be placed more than eight feet (8') above the floor directly beneath.

Lights in all parts of the building customarily used by human beings shall be on a separate circuit from that of the stage and shall be controlled from the box office. All lights in corridors, exit courts and exit passageways shall be protected by a wire cage.

All registers or vents supplying air backstage shall be equipped with automatic closing devices with fusible links. Such closing devices shall be located where the vents or ducts pass through the proscenium wall and shall be operated by fusible links located on both sides of the proscenium wall and both inside of and outside of the vent or duct.

1946 EDITION**Sections 605-609**

There shall be provided in an approved location at least one lavatory for each two toilets for each sex, and at least one drinking fountain for each floor level.

Sec. 606. Exits shall be enclosed as specified in Chapter 33. Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be as specified in Section 1807.

**Enclosure
of
Vertical
Openings**

Sec. 607. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-Extinguishing
Apparatus
Special
Hazards**

Sec. 608. Stages shall be equipped with automatic ventilators as required in Section 3901.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in any Group A occupancy.

Every gas service to the stage portion of the building shall be separated from any other service to the building and each gas service shall be provided with an approved shut-off valve at a convenient and conspicuous place outside the building and adequately marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building with a "Special Occupancy Separation."

Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building with not less than an "Ordinary Occupancy Separation."

Sec. 609. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

**Exceptions
and
Deviations**

CHAPTER 7—REQUIREMENTS FOR GROUP B OCCUPANCIES

Group B Occupancies Defined

Sec. 701. Group B occupancies shall be:

Division 1. Any assembly building with a stage and a seating capacity of less than 1000 in any one room.

Division 2. Any assembly building without a stage and a seating capacity of 300 or more in any one room.

Division 3. Any assembly building without a stage and with no room having a seating capacity of more than 300.

Division 4. Stadiums, reviewing stands, and amusement park structures not included within Group A and Divisions 1, 2 and 3, Group B, occupancies.

For occupancy separations see Table No. 5-B.

Construction, Height and Area Allowable

Sec. 702. (a) General. Buildings or parts of buildings classed in Group B because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

Exception: Division 4 structures of open skeleton frame type shall not be limited in area or height.

(b) Special Provisions. Stages and enclosed platforms as defined in Section 401 shall be constructed in accordance with Chapter 39.

Divisions 1 and 2 occupancies shall be of not less than one-hour fire-resistive construction throughout. Division 2 occupancies with a seating capacity of 1000 or more shall be of Type I, II or III construction.

Exception: Gymnasiums which do not have more than two balconies, each with a seating capacity not to exceed 300, and which are not located over usable spaces need not have one-hour fire-resistive protection.

The assembly floor of Division 1 and 2 occupancies shall be located at or near the ground level, provided that Division 1 and 2 occupancies having a total seating capacity of not more than 1000 may be located in the basement or one story above ground level and stairs may be used as a means of ingress and egress, and provided further that assembly rooms with seating capacity exceeding 500 shall not be located above the second floor above grade.

For attic space partitions and draft stops see Section 3205.

(c) Division 4 Provisions. Erection and structural maintenance of structures housing Division 4 occupancies shall conform to the requirements of this Code, and where there are no such specific requirements, shall provide adequate safety for the loads to which they may be subjected.

Structures housing Division 4 occupancies, other than those of open skeleton frame type, when more than one story in height or four hundred square feet (400 sq. ft.) in area, shall be of not less than one-hour fire-resistive construction.

When the space under a Division 4 occupancy is used for any purpose, it shall be separated from all parts of such Division 4 occupancy, including exits, by walls, floors and ceilings of not less than one-hour fire-resistive construction.

The Building Official may cause all Division 4 structures to be re-inspected at least once every six months.

Sec. 703. All buildings housing Group B occupancies shall front directly upon at least one public street, not less than twenty feet (20') in width, in which front shall be located the main entrance of such building. **Location on Property**

Exterior walls or parts of walls except on street fronts which are less than five feet (5') from adjacent property lines, shall have no openings therein, shall be of not less than four-hour fire-resistive construction, and shall be constructed as specified in Parts V, VI and VII of this Code. Walls five feet (5') or more but less than ten feet (10') from adjacent property lines, except street fronts, shall be of not less than two-hour fire-resistive construction.

Exception: When any portion of a Division 4 occupancy is less than ten feet (10') from adjacent property lines, such portion shall have exterior walls of not less than one-hour fire-resistive construction, with openings protected by Class "E" or "F" fire doors or windows.

Openings in exterior walls of Divisions 1, 2 and 3, except on street fronts, which are less than ten feet (10') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property, see Section 504.

Sec. 704. (a) General. Stairs and exits shall be provided as specified in Chapter 33. **Exit Facilities**

(b) Amusement Structures. Stairs and exits for Division 4 amusement structures shall be provided as specified in Chapter 33, subject to the approval of the Building Official. Exit signs shall be installed as specified in Section 3312 and where required by the Building Official.

Sec. 705. All portions of Group B occupancies customarily used by human beings and all dressing rooms shall be provided with natural or artificial light, ventilation, and sanitary facilities as specified in Section 605. **Light, Ventilation, and Sanitation**

Sec. 706. Exits shall be enclosed as specified in Chapter 33. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction. **Enclosure of Vertical Openings**

Sec. 707. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38. **Fire-Extinguishing Apparatus**

Sec. 708. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51. **Special Hazards**

Motion picture machine booths shall conform to the requirements of Chapter 40.

Flammable liquids shall not be placed or stored in a Group B occupancy.

Every gas service shall be provided with an approved outside shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows

CHAPTER 8—REQUIREMENTS FOR GROUP C OCCUPANCIES

Sec. 801. Group C occupancies shall be:

Any building used for school purposes, involving assemblage for instruction, education or recreation, and not classed in Group A occupancies or in Divisions 1 and 2 of Group B occupancies.

For occupancy separations, see Table No. 5-B.

Sec. 802. (a) General. Buildings or parts of buildings classed in Group C because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Rooms having a seating capacity of more than 100 and rooms used for kindergarten, first or second grade pupils shall not be located above the first story above grade except in buildings of Type I construction.

Where there is usable space under the first floor of two-story Type IV and V buildings, the construction up to and including the first floor shall be of Type I construction, and the first floor shall be unpierced for human access.

Balconies and bleachers over usable space and all janitor closets shall be protected with lath and plaster approved for one-hour fire-resistive construction.

All curtains, drops and drapes shall be flame-proofed.

Stages and enclosed platforms shall be constructed in accordance with Chapter 39.

The provisions of Section 1813 shall not apply to openings in buildings not more than three stories high when such openings are not less than thirty feet (30') from adjacent property lines and not less than thirty feet (30') from buildings on the same property.

For attic space partitions and draft stops, see Section 3205.

Sec. 803. Group C occupancies shall front directly upon at least one public street, not less than twenty feet (20') in width, in which front shall be located at least one required exit.

Exterior walls or parts of walls, except on street fronts, which are less than three feet (3') from adjacent property lines shall have no openings therein and shall be of not less than four-hour fire-resistive construction. Walls which are three feet (3') or more but less than ten feet (10') from adjacent property lines, except street fronts, shall be of not less than two-hour fire-resistive construction. All openings in exterior walls, except on street fronts, which are less than ten feet (10') from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property, see Section 504.

Sec. 804. Stairs and exits shall be provided as specified in Chapter 33.

Sec. 805. All portions of Group C occupancies shall be provided with light and ventilation, either natural or artificial, as specified in Section 605.

**Group C
Occupancies
Defined**

**Construction,
Height
and Area
Allowable**

**Location on
Property**

**Exit
Facilities**

**Light,
Ventilation,
and
Sanitation**

Sections 805-809**UNIFORM BUILDING CODE**

Toilets shall be provided on the basis of the following ratios of toilets to number of students:

	Girls	Boys
Elementary Schools.....	1:35	1:100
Secondary Schools.....	1:45	1:100

In addition, urinals shall be provided for boys on a basis of 1:30.

There shall be provided at least one lavatory for each two toilets or urinals for each sex and at least one drinking fountain on each floor.

**Enclosure
of Vertical
Openings**

Sec. 806. Exits shall be enclosed as specified in Chapter 33. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

**Fire-Extin-
guishing
Apparatus
Special
Hazards**

Sec. 807. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Sec. 808. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Every gas service shall be provided with an approved outside shut-off valve conspicuously marked.

Exterior openings in a boiler room or room containing central heating equipment, if located below openings in another story or if less than ten feet (10') from other doors or windows of the same building, shall be protected by Class "E" or "F" fire doors or windows.

Every boiler room or room containing a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building with a "Special Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building with not less than an "Ordinary Occupancy Separation."

No flammable liquids shall be placed, stored or used in any Group C occupancies, except in approved quantities as necessary in laboratories and approved utility rooms, and such liquids shall be kept in tight or sealed containers when not in actual use.

**Exceptions
and
Deviations**

Sec. 809. Gymnasiums and similar buildings may have running tracks constructed of wood or unprotected steel or iron.

In gymnasiums, one-inch (1") nominal tight tongue and grooved wall covering may be used on the gymnasium side in lieu of fire-resistive plaster.

Roof covering shall be a "fire retardant" roofing as specified in Section 3204.

Arcades connecting buildings and used exclusively as passageways need not be considered as adjacent buildings for the provisions of this Chapter, provided that the walls of the building adjoining the arcades are finished with the same construction as required for the exterior walls of the building with no communicating openings between the arcades and the building, except doors; and provided that the arcades are of not less than one-hour fire-resistive construction or entirely of incombustible materials, or of heavy timber construction with two-inch (2") nominal sheathing.

CHAPTER 9—REQUIREMENTS FOR GROUP D OCCUPANCIES

Sec. 901. Group D occupancies shall be:

Division 1: Jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.

Division 2: Nurseries for the care of children under six years of age.

Hospitals, sanitariums, and similar buildings (each accommodating more than six), but not including kindergartens built in connection with and meeting all the requirements of other Group C occupancies.

For occupancy separations see Table No. 5-B.

Sec. 902. (a) General. Buildings or parts of buildings classed in Group D because of the use or character of the occupancy shall not exceed, in area or height, the limit specified in Sections 505, 506, and 507.

(b) Special Provisions. Division 1 occupancies shall be of Type I construction throughout. Division 2 occupancies shall be of not less than one-hour fire-resistive construction throughout, and when more than one story in height shall be of Type I construction.

For attic space partitions and draft stops, see Section 3205.

Sec. 903. All exterior walls or parts of walls except on street fronts, of Group D occupancies, which are less than five feet (5') from adjacent property lines shall have no openings therein, shall be of not less than four-hour fire-resistive construction and shall be constructed as specified in Parts V, VI and VII of this Code. All openings in exterior walls except on street fronts, which are less than ten feet (10') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property see Section 504.

Sec. 904. Stairs and exits shall be provided as specified in Chapter 33.

Sec. 905. All portions of Group D occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area equal to one-eighth of the total floor area, or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically driven ventilating system shall supply at least thirty cubic feet (30 cu. ft.) of pure air per minute for each occupant thereof in all portions of the building and such system shall be kept continuously in operation while the building is occupied.

Sec. 906. Exits shall be enclosed as specified in Chapter 33. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

Sec. 907. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

**Group D
Occupancies
Defined**

**Construction,
Height
and Area
Allowable**

**Location
on
Property**

**Exit
Facilities**

**Light and
Ventilation**

**Enclosure
of Vertical
Openings**

**Fire-Extin-
guishing
Apparatus**

Section 908**UNIFORM BUILDING CODE****Special
Hazards**

Sec. 908. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Motion picture machine booths shall conform to the requirements of Chapter 40.

Storage of volatile flammable liquids shall not be allowed in Group D occupancies and the handling of such liquid shall not be permitted in any Group D occupancies in quantities of more than one gallon unless such handling complies with the N. B. F. U. "Fire Prevention Ordinance," 1943.

Any gas service to a Group D occupancy shall be provided with an approved outside shut-off valve conspicuously marked.

Every boiler room or room containing a heating plant which burns liquid or solid fuel shall be separated from the rest of the building with a "Special Occupancy Separation." Every boiler room or room containing a heating plant which burns gas as fuel shall be separated from the rest of the building by not less than an "Ordinary Occupancy Separation."

CHAPTER 10—REQUIREMENTS FOR GROUP E OCCUPANCIES

See. 1001. Group E occupancies shall be:

**Group E
Occupancies
Defined**

Public garages, paint or petroleum storage, dry cleaning plants using flammable liquids, paint shops and spray painting rooms and shops.

Planing mills, box factories, woodworking and mattress factories.

Storage of hazardous and highly flammable or explosive materials and liquids.

For occupancy separations see Table No. 5-B.

Note:—Flammable liquids shall be deemed to be those with a flash point below 190 degrees Fahrenheit as determined by the closed cup tester.

Sec. 1002. (a) General. Buildings or parts of buildings classed in Group E because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

**Construction,
Height
and Area
Allowable**

(b) **Special Provisions.** Public garages shall have exterior walls of not less than one-hour fire-resistive construction.

Floors shall be of incombustible materials or of not less than Type II construction. In public garages and where flammable or explosive liquids are used or stored floors shall be entirely protected with incombustible materials against saturation.

For buildings over eighty-five feet (85') in height see Sections 1810 and 1910.

For attic space partitions and draft stops see Section 3205.

Sec. 1003. All exterior walls or parts of walls except on street fronts, of Group E occupancies, which are less than five feet (5') from adjacent property lines, shall have no openings therein and shall be of not less than four-hour fire-resistive construction; such walls five feet (5') or more but less than ten feet (10') from adjacent property lines except on street fronts, shall be of not less than two-hour fire-resistive construction and shall be constructed as specified in Parts V, VI, and VII of this Code. All openings in exterior walls except on street fronts, which are less than ten feet (10') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

**Location
on
Property**

For regulating adjacent buildings on the same property see Section 504.

Sec. 1004. Stairs and exits shall be provided as specified in Chapter 33.

**Exit
Facilities**

Smokeproof towers shall be provided as specified in Chapter 33.

Where ramps are used for the transfer of automobiles from one floor to another such ramps shall meet the ground floor level at a point not less than twenty feet (20') from the exit from such building.

Sec. 1005. All portions of Group E occupancies customarily used by human beings shall be provided with light and ventila-

**Light,
Ventilation,
and
Sanitation**

tion by means of windows or skylights with an area equal to one-eighth of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system. The mechanically driven ventilating system shall supply at least thirty cubic feet (30 cu. ft.) of pure air per minute for each occupant thereof in all portions of the building and such system shall be kept continuously in operation while the building is occupied.

In all buildings used for the storing or handling of automobiles operated under their own power and in all buildings where flammable liquids are used exhaust ventilation shall be provided sufficient to produce one complete change of air every 15 minutes. Such exhaust ventilation shall be taken from a point at or near the floor level.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Enclosure of Vertical Openings

Sec. 1006. Exits shall be enclosed as specified in Chapter 33. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

Doors which are part of an automobile ramp enclosure may be kept normally open but shall be equipped with fusible links and so arranged as to be self-closing when released.

Fire-Extinguishing Apparatus Special Hazards

Sec. 1007. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Sec. 1008. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51. In any room in which volatile flammable liquids are used or stored no device generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24") of the floor.

The use, handling, storage and sale of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group E occupancy unless such use, handling, storage and sale comply with the N. B. F. U. "Fire-Prevention Ordinance," 1943.

Dry cleaning plants in which combustible solvents are used or stored shall be of Type I construction and shall not exceed one story in height. All partitions shall be of four-hour fire-resistive construction, except for the necessary openings for the vent ducts, piping and shafting. All openings in exterior walls, except wall vents, shall be protected by Class "E" or "F" fire doors or windows. Wall vents having an area of not less than sixteen square inches (16 sq. in.) each, shall be placed in the exterior walls near the floor line, not more than six feet (6') apart horizontally. Each building shall be provided with a power driven fan exhaust system of ventilation which shall be arranged and operated so as to produce a complete change of air in each room every three minutes.

Each machine in dry cleaning establishments which uses a volatile flammable liquid shall have an adequate steam line di-

rectly connected to it, so arranged as to have the steam automatically released to the inside of such machine should an explosion occur in the machine.

Laws of the State regulating the construction and maintenance of dry cleaning plants or other buildings containing any occupancy or special hazard covered by this Chapter, shall be deemed to be a part of this Code and such buildings shall conform to the provisions of such state laws.

CHAPTER 11—REQUIREMENTS FOR GROUP F OCCUPANCIES

Group F Occupancies Defined

Sec. 1101. Group F occupancies shall be:

Wholesale and retail stores, office buildings, restaurants, undertaking parlors, printing plants, municipal police and fire stations.

Gasoline filling and service stations, factories and workshops using materials not highly flammable or combustible.

Storage and sales rooms for combustible goods.

For occupancy separations see Table No. 5-B.

Construction, Height and Area Allowable

Sec. 1102. (a) **General.** Buildings or parts of buildings classed in Group F because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) **Special Provisions.** Gasoline filling stations of Type V construction shall have incombustible exterior wall covering. Canopies, including supports thereof, over pumps shall be of incombustible materials or not less than one-hour fire-resistive construction.

For attic space partitions and draft stops see Section 3205.

Location on Property

Sec. 1103. All exterior walls or parts of walls except on street fronts of Group F occupancies which are less than four feet (4') from adjacent property lines shall have no openings therein, shall be of not less than four-hour fire-resistive construction and shall be constructed as specified in Parts V, VI and VII of this Code. All openings in exterior walls, except on street fronts which are less than eight feet (8') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property see Section 504.

Exit Facilities

Sec. 1104. Stairs and exits shall be provided as specified in Chapter 33.

No portion of a Group F occupancy shall be more than one hundred and fifty feet (150') from an exit to the outside. Passageways direct to outside exits, free of all incumbrances and at least seven feet (7') in width, clearly defined by floor markings and overhead signs shall be maintained permanently.

Smokeproof towers shall be provided as specified in Chapter 33.

Light, Ventilation, and Sanitation

Sec. 1105. All portions of Group F occupancies customarily used by human beings shall be provided with light and ventilation by means of windows or skylights with an area not less than one-eighth of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system. In no case shall less than four changes of air per hour be provided.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

Such toilet rooms in connection with food establishments where food is prepared, stored, or served, shall have a non-absorbent interior finish on floors, walls, and ceilings, shall be separated from such food establishments with close-fitting, tight doors with a vestibule between, and shall be provided with an exterior window at least three square feet (3 sq. ft.) in area, fully openable, or a vertical duct not less than four square feet (4 sq. ft.) in area, leading to the exterior.

Sec. 1106. Exits shall be enclosed as specified in Chapter 33. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

**Enclosure
of Vertical
Openings**

Sec. 1107. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-Extinguishing
Apparatus
Special
Hazards**

Sec. 1108. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

No storage of volatile flammable liquids shall be allowed in Group F occupancies and the handling and use of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group F occupancy unless such use and handling comply with the N. B. F. U. "Fire Prevention Ordinance," 1943.

Devices generating a glow or flame capable of igniting gasoline vapor shall not be installed or used within twenty-four inches (24") of the floor in any room in which volatile flammable liquids are used or stored.

UNIFORM BUILDING CODE

CHAPTER 12—REQUIREMENTS FOR
GROUP G OCCUPANCIES**Group G
Occupancies
Defined**

Sec. 1201. Group G occupancies shall be:

Ice plants, power plants, pumping plants, cold storage, creameries.

Factories and workshops using incombustible and non-explosive materials.

Storage and sales rooms of incombustible and non-explosive materials.

For occupancy separations see Table No. 5-B.

**Construction,
Height and
Area
Allowable**

Sec. 1202. (a) General. Buildings or parts of buildings classed in Group G because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Fire protection of the under side of roof framing may be omitted in all Types of Construction.

For attic space partitions and draft stops see Section 3205.

**Location on
Property**

Sec. 1203. All exterior walls or parts of walls, except on street fronts of Group G occupancies which are less than three feet (3') from adjacent property lines, shall have no openings therein, shall be of not less than one-hour fire-resistive construction, and shall be constructed as specified in Parts V, VI and VII of this Code.

For regulating adjacent buildings on the same property see Section 504.

**Exit
Facilities**

Sec. 1204. Stairs and exits shall be provided as specified in Chapter 33.

No portion of a Group G occupancy shall be more than one hundred and fifty feet (150') from an exit to the outside. Passageways direct to outside exits, free of all incumbrances and at least seven feet (7') in width, clearly defined by floor markings and overhead signs, shall be maintained permanently.

Smokeproof towers shall be provided as specified in Chapter 33.

**Light,
Ventilation,
and
Sanitation**

Sec. 1205. All portions of Group G occupancies customarily used by human beings shall be provided with light and ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are employed shall be provided with access to at least two toilets located either in such building or conveniently in a building adjacent thereto.

**Enclosure
of Vertical
Openings
Fire-Extinguishing
Apparatus
Special
Hazards**

Sec. 1206. Exits shall be enclosed as specified in Chapter 33. Other vertical openings are not required to be enclosed.

Sec. 1207. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

Sec. 1208. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51. In any room in which volatile flammable liquids are used or stored, no device

1946 EDITION**Section 1208**

generating a glow or flame capable of igniting gasoline vapor shall be installed or used within twenty-four inches (24") of the floor.

The storage, use and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group G occupancy unless such storage, use, and handling comply with the N. B. F. U. "Fire Prevention Ordinance," 1943.

CHAPTER 13—REQUIREMENTS FOR GROUP H OCCUPANCIES

Group H Occupancies Defined

Sec. 1301. Group H occupancies shall be:

Division 1. Homes for the aged, orphanages, homes and dormitories for children six years of age or older (each accommodating more than six).

Division 2. Hotels, apartment houses, dormitories, lodging houses, convents and monasteries (each accommodating 10 or more persons).

For occupancy separations see Table No. 5-B.

Sec. 1302. (a) General. Buildings or parts of buildings classed in Group H because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Division 1 occupancies shall be one-hour fire-resistive construction throughout and shall be of Type I construction if more than two stories in height.

For attic space partitions and draft stops see Section 3205.

Location on Property

Sec. 1303. All exterior walls or parts of walls, except on street fronts of Group H occupancies which are less than three feet (3') from adjacent property lines, shall have no openings therein, shall be of not less than one-hour fire-resistive construction and shall be constructed as specified in Parts V, VI and VII of this Code. Openings in exterior walls, except on street fronts, which are less than five feet (5') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property see Section 504.

Location of Group H occupancies on the property shall meet the requirements of any State laws which are intended to regulate such location.

Exit Facilities

Sec. 1304. Stairs and exits shall be provided as specified in Chapter 33.

Smokeproof towers shall be provided as specified in Chapter 33.

All stairs and exits in Group H occupancies shall open directly upon a street or alley or upon a yard or court not less than four feet (4') in width directly connected to a street or alley by means of a passageway not less in width than the stairway opening into such passageway and not less than seven feet (7') in height.

Light, Ventilation and Sanitation

Sec. 1305. (a) Windows. All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows or skylights with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such rooms. The window area in bathrooms, water-closet compartments, and other similar rooms shall not be less than three square feet (3 sq. ft.), unless adequate mechanical ventilation is provided. Not less than one-half such area shall be operable.

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height

of not less than seven feet (7') and a depth of not more than seven feet (7'). Such porch shall be at least 50 per cent open on at least two sides.

The width of such courts or yards shall be not less than three feet (3') when such courts or yards are not more than two stories high measured down from the top of the building and shall be increased at the rate of six inches (6") for each additional story in height. If such court is entirely surrounded by the building it shall have a width at least 50 per cent greater than that otherwise required.

(b) **Room Sizes and Ceiling Heights.** Every room required to have windows by Subsection (a) shall have a ceiling height of eight feet (8') in at least 50 per cent of its area. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) **Sanitation.** Every building shall be provided with at least one toilet. Every hotel and each subdivision thereof where both sexes are accommodated shall be provided with at least two toilets located in such building, which shall be conspicuously marked, one for each sex. Not less than one toilet shall be provided for each 15 persons or major fraction thereof that such building is designed to accommodate.

One toilet shall be provided for each apartment.

A kitchen sink shall be installed in every kitchen.

Light, ventilation, and sanitation shall be as specified by any state laws intended to regulate such light, ventilation, and sanitation.

Sec. 1306. Exits shall be enclosed as specified in Chapter 33.

**Enclosure
of Vertical
Openings**

Sec. 1307. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as specified in Chapter 38.

**Fire-Extinguishing
Apparatus**

Sec. 1308. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

**Special
Hazards**

The storage and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group H occupancy unless such storage and handling comply with the N. B. F. U. "Fire Prevention Ordinance," 1943.

Doors leading into rooms in which volatile flammable liquids are used or kept shall be protected by Class "C" fire doors and shall be kept normally closed.

Every boiler room or room containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a "Special Occupancy Separation."

Exceptions: 1. Such furnaces may be used without an "Occupancy Separation" in buildings not more than two stories in height.

2. In buildings of Type V construction an "Ordinary Occupancy Separation" may be used.

CHAPTER 14 — REQUIREMENTS FOR GROUP I OCCUPANCIES

Group I Occupancies Defined

Sec. 1401. Group I occupancies shall be:

Dwellings.

For occupancy separations see Table No. 5-B.

Construction and Area Allowable

Sec. 1402. Buildings or parts of buildings classed in Group I because of the use or character of the occupancy shall not exceed, in area or height, the limits specified in Sections 505, 506 and 507.

Location on Property

Sec. 1403. All exterior walls or parts of walls except on street fronts of Group I occupancies which are less than three feet (3') from adjacent property lines shall have no openings therein, shall be of not less than one-hour fire-resistive construction and shall be constructed as specified in Parts V, VI and VII of this Code.

For regulating adjacent buildings on the same property see Section 504.

Exit Facilities

Sec. 1404. Stairs and exits shall be provided as specified in Chapter 33.

Light, Ventila- tion and Sanitation

Sec. 1405. (a) Windows. All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows or skylights with an area not less than twelve square feet (12 sq. ft.) nor one-eighth of the floor area of such room. Not less than one-half such area shall be operable.

The window area in bathrooms, water-closet compartments, and other similar rooms shall not be less than three square feet (3 sq. ft.).

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of not less than seven feet (7') and a depth of not more than seven feet (7'). Such porch shall be at least 50 per cent open on at least one side.

(b) Room Sizes and Ceiling Heights. Every room required to have windows by Subsection (a) shall have a ceiling height of not less than seven feet six inches (7' 6") in at least 50 per cent of its required area. Rooms used for living, eating, or sleeping purposes shall have an area of not less than eighty square feet (80 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) Sanitation. Sanitation facilities shall be provided as required by the local health authorities.

There shall be no opening from a room in which a water closet is located into a room in which food is prepared or stored.

Light, ventilation, and sanitation shall be provided as specified by any state laws intended to regulate such light, ventilation, and sanitation.

Enclosure of Vertical Openings

Sec. 1406. Dumb-waiter shafts, clothes chutes and other similar vertical openings shall be protected as specified in Chapter 33 and under Types of Construction.

1946 EDITION**Sections 1407-1409**

Sec. 1407. Fire-extinguishing apparatus when installed shall conform to the requirements of Chapter 38.

**Fire-Extinguishing
Apparatus
Special
Hazards**

Sec. 1408. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Flammable liquids shall not be stored or used in Group I occupancies in quantities in excess of one gallon and all such flammable liquids shall be kept in tight or sealed containers when not in actual use.

Sec. 1409. Group I occupancies constructed on the roof of multiple storied buildings shall be considered as an additional story in so far as the construction, location, exposure, stairs, exits and fire-extinguishing are concerned.

**Exceptions
and
Deviations**

CHAPTER 15 — REQUIREMENTS FOR GROUP J OCCUPANCIES

Group J Occupancies Defined

Sec. 1501. Group J occupancies shall be:

Division 1. Private garages, sheds and minor buildings used as accessories only when not over one thousand square feet (1000 sq. ft.) in area.

Division 2. Fences over six feet (6') high, tanks and towers. For occupancy separations see Table No. 5-B.

Construction, Height and Area Allowable

Sec. 1502. Buildings or parts of buildings classed in Group J because of the use or character of the occupancy shall be one of the Types of Construction as specified in Part V of this Code. The floor area shall not exceed one thousand square feet (1000 sq. ft.). The height shall not exceed one story.

When any building exceeds the limit specified in this Chapter it shall be classed in the occupancy group other than Group J that it most nearly resembles.

Location on Property

Sec. 1503. All exterior walls, or parts of walls, except on street fronts, of Division 1, Group J occupancies, which are less than three feet (3') from adjacent property lines, shall be protected on the exterior with lath and plaster approved for one-hour fire-resistive construction.

For regulating adjacent buildings on the same property, see Section 504.

Exit Facilities

Sec. 1504. Stairs and exits shall be provided as specified in Chapter 33.

Light and Ventilation

Sec. 1505. Private garages which are constructed in conjunction with any Group H or I occupancies and which have openings into such buildings shall be equipped with fixed louvered or screened openings or exhaust ventilation with exhaust openings located within six inches (6") of the floor. The clear area of the louvered opening or of the openings into the exhaust ducts shall be not less than sixty square inches (60 sq. in.) per car stored in such private garage. Under no circumstances shall a private garage have any opening directly into a room used for sleeping purposes.

Enclosure of Vertical Openings

Sec. 1506. Enclosure of vertical openings shall not be required.

Fire-Extinguishing Apparatus

Sec. 1507. Fire-extinguishing apparatus shall be installed as specified in Chapter 38.

Where more than three automobiles are stored in any private garage there shall be installed not less than one two-and-one-half gallon chemical extinguisher to each five cars or major fraction thereof.

Special Hazards

Sec. 1508. Chimneys and heating apparatus shall conform to the requirements of Chapters 37 and 51.

Flammable liquids shall not be stored, handled or used in Group J occupancies unless such storage or handling shall comply with the N. B. F. U. "Fire Prevention Ordinance," 1943.

Exceptions and Deviations

Sec. 1509. When storage space termed in this Code a private garage is provided in any building of mixed occupancies, such storage space shall be limited to six hundred and fifty square feet (650 sq. ft.) of floor area unless such storage space is separated from other portions of the building as required for public garages.

PART IV

REQUIREMENTS BASED ON LOCATION IN FIRE ZONES

CHAPTER 16—RESTRICTIONS IN FIRE ZONES

Sec. 1601. (a) Fire Zones Defined. For the purpose of this Code, the entire city is hereby declared to be and is hereby established a Fire District and said Fire District shall be known and designated as Fire Zones One, Two and Three, and shall include such territory or portions of said City as outlined in an ordinance of said City, entitled: "An Ordinance Creating and Establishing Fire Zones." Whenever in such ordinance creating and establishing fire zones, reference is made to any fire zone, it shall be construed to mean one of the three fire zones designated and referred to in this Chapter. **General**

(b) Buildings Located in More than One Fire Zone. A building or structure which is located partly in one fire zone and partly in another shall be considered to be in the more highly restricted fire zone when more than one-third of its total floor area is located in such zone.

(c) Moved Buildings. Any building or structure moved within or into any Fire Zone shall be made to comply with all the requirements for new buildings in that Fire Zone.

(d) Temporary Buildings. Temporary buildings such as reviewing stands and other miscellaneous structures conforming to the requirements of this Code, and sheds, canopies or fences used for the protection of the public around and in conjunction with construction work may be erected in Fire Zones Nos. 1 or 2 by special permit from the Building Official for a limited period of time, and such building or structure shall be completely removed upon the expiration of the time limit stated in such permit.

Sec. 1602. (a) General. Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 1 shall be only of Type I, II, III or IV construction and shall meet the requirements of this Section. **Restrictions
in Fire Zone
No. 1**

(b) Limitation of Types of Construction. Floors over usable spaces, and all walls and partitions, shall be of not less than one-hour fire-resistive construction. Exterior walls within twenty feet (20') of adjacent property lines shall be of not less than four-hour fire-resistive construction.

Exceptions: 1. One-story buildings of Type IV construction, more than twenty feet (20') from adjacent property lines and not exceeding one thousand square feet. (1000 sq. ft.) in area, need not be fire protected.

2. Walls fronting on a street having a width of at least fifty feet (50') may be of incombustible construction with structural members fire protected as required in Part V.

(c) Openings. The sum of the widths of openings in exterior walls, except on street fronts, within twenty feet (20') of adjacent property lines or other buildings on the same property shall be limited to 25 per cent of the total length of the walls affected in each story. Openings in such walls and

openings within fifty feet (50') of the opposite side of a street or public space and openings into courts which are less than twenty feet (20') in least dimension, shall be protected by Class "E" or "F" fire doors or windows.

For the purpose of this Subsection, the center line of an adjoining alley may be considered as the adjacent property line. All distances in this Subsection shall be measured at right angles to the plane of the wall in which the opening occurs.

(d) **Alterations.** Any building or structure which is enlarged, altered, raised, repaired or built upon to an extent exceeding an expenditure within any five-year period of 20 per cent of the value of the building or structure, shall be made to comply with all the requirements for fire resistance of a new building or structure erected in Fire Zone No. 1.

No building of Type IV construction in excess of one thousand square feet (1000 sq. ft.) in floor area nor any building of Type V construction already erected in Fire Zone No. 1 shall hereafter be altered, raised, enlarged, added to or moved, except as follows:

1. Such Type IV building may be made to conform to all the provisions of subsections (b) and (c) of this Section.

2. Changes, alterations and repairs to the interior of such building or to the front thereof facing a public street may be made, provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "Fire Retardant" roofing as specified in Section 3204. See Section 104(f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 1.

5. Such building may be demolished.

(e) **Occupancies Prohibited.** No Group E occupancies except paint spray rooms having a floor area not exceeding one thousand square feet (1000 sq. ft.) and garages shall be permitted in Fire Zone No. 1.

Restrictions in Fire Zone No. 2

Sec. 1603. (a) General. Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 2 shall be one of the Types of Construction as defined in this Code and shall meet the requirements of this Section.

(b) **Limitation of Types of Construction.** Buildings or structures of Type IV or Type V construction having an area greater than seventy-five hundred square feet (7,500 sq. ft.) shall not be erected, constructed, or moved within or into Fire Zone No. 2, and such buildings shall have all exterior walls of not less than one-hour fire-resistive construction; provided that when such exterior walls are less than three feet (3') from adjacent property lines or less than six feet (6') from buildings on the same property, the exterior walls shall be of not less than four-hour fire-resistive construction. Roof covering shall be a fire-retardant roof covering as specified in Section 3204.

Exceptions: 1. Exterior walls of Type IV buildings not more than one thousand square feet (1,000 sq. ft.) in area are not required to be one-hour fire-resistive if three feet

(3') or more from adjacent property lines and six feet (6') or more from buildings on the same property.

2. Exterior walls fronting on a street having a width of at least thirty feet (30') may be of incombustible construction with all structural members fire-protected as required in Part V.

(c) **Alterations.** No building of Type IV construction in excess of one thousand square feet (1,000 sq. ft.) in floor area nor any building of Type V construction except as specified in Subsection (b) already erected in Fire Zone No. 2, shall hereafter be altered, raised, enlarged, added to or moved except as follows:

1. Such building may be made to conform to the provisions of Subsection (b) of this Section.

2. Changes, alterations and repairs to the interior of such building or to the front thereof facing a public street may be made provided such changes do not, in the opinion of the Building Official, increase the fire hazard of such building.

3. Roofs of such buildings may be covered only with a "Fire Retardant" roofing as specified in Section 3204. See Section 104 (f) for repairs.

4. Such building may be moved entirely outside the limits of Fire Zone No. 2.

5. Such building may be demolished.

6. Combustible finish on the outside of walls may be replaced by, or covered with exterior plaster as specified in Chapter 47.

(d) **Occupancies Prohibited.** No Group E Occupancies except paint spray rooms having a floor area not exceeding one thousand square feet (1000 sq. ft.) and garages shall be permitted in Fire Zone No. 2.

Sec. 1604. (a) General. Any building or structure complying with the requirements of this Code may be erected, constructed, moved within or into Fire Zone No. 3.

**Restrictions
in Fire Zone
No. 3**

PART V

REQUIREMENTS BASED ON TYPES OF CONSTRUCTION

CHAPTER 17 — CLASSIFICATION OF ALL BUILDINGS BY TYPES OF CONSTRUCTION AND GENERAL REQUIREMENTS

General

Sec. 1701. The requirements of Part V are the minimum requirements for the various Types of Construction. In order that a building may be classed in any specific Type of Construction, it shall comply with all of the requirements for that Type of Construction, as specified in this Code.

No building or portion thereof shall be required to conform to the details of a Type of Construction higher than that Type which meets the minimum requirements based on Occupancy (Part III) or Location in Fire Zone (Part IV) even though certain features of such building actually conform to a higher Type of Construction.

The various Types of Construction herein defined represent varying degrees of public safety and resistance to fire. Where specific materials, types of construction or fire-resistive protection are required, such requirements shall be the minimum requirements and any materials, types of construction or fire-resistive protection which will afford equal or greater public safety or resistance to fire, as specified in this Code, may be used.

Any system or method of construction to be used shall admit of a rational analysis in accordance with well established principles of mechanics.

Classification by Types of Construction

Sec. 1702. All buildings shall be divided into the following Types of Construction based upon their resistance to fire, and Type I shall be deemed to be the most fire-resistive and Type V the least fire-resistive Type of Construction.

Type I—FIRE-RESISTIVE Construction.

Type II—HEAVY TIMBER Construction.

Type III—ORDINARY MASONRY Construction.

Type IV—LIGHT INCOMBUSTIBLE FRAME Construction.

Type V—WOOD FRAME Construction.

When two or more types of construction occur in the same building and are not separated by an unpierced wall of four-hour fire-resistive construction, the entire building shall be classed in the least fire-resistive type of construction and such buildings shall be subject to the restrictions of such type. Any building erected prior to the passage of this Code, which by its construction cannot be classified definitely as Type I, II, III, IV or V as defined herein, shall for the purpose of this Code be deemed to belong to the least fire-resistive class of the two types to which it most nearly conforms. Any building which cannot be classed as Type I, II, III or IV construction shall be considered to be of Type V construction.

Sec. 1703. Exterior walls enclosing the floor areas shall be constructed and maintained for all buildings hereafter erected wherever no openings are allowed in exterior walls and wherever any fire protection for openings in the exterior walls is required in this Code.

**Exterior
Walls—
When
Required**

CHAPTER 18 — TYPE I BUILDINGS

(Fire-Resistive)

Definition

Sec. 1801. In "Type I Buildings," the structural frame shall be of structural steel or iron which shall be fire-protected, or shall be of concrete. The exterior walls, inner court walls, and walls enclosing vertical openings, shall be of fire-resistive construction. The roof construction and floors shall be of fire-resistive materials. Exterior doors and windows, except as specified in Section 1813 shall be of fire-resistive construction.

Height Allowable

Sec. 1802. The height of Type I buildings shall not be limited. See Section 507 for additional height limitations.

Area Allowable

Sec. 1803. The floor area of Type I buildings shall not be limited.

Foundations

Sec. 1804. Footings shall be of solid masonry as specified in Chapter 24 or of concrete as specified in Chapter 26, and shall be designed as specified in Section 2311 and Chapter 28. Foundation walls shall be of masonry or concrete as specified in Chapters 24 and 26.

Exterior and Inner Court Walls

Sec. 1805. Exterior walls shall be of not less than four-hour fire-resistive construction, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones No. 2 and No. 3 may be of incombustible construction with all structural members fire-protected as required in Section 1809.

Inner court walls shall be of not less than three-hour fire-resistive construction.

Partitions

Sec. 1806. Interior partitions shall be constructed of incombustible materials and shall be of not less than one-hour fire-resistive construction.

Exceptions: Temporary partitions dividing portions of stores, offices or similar places occupied by one tenant only may be constructed of wood panels or similar light construction up to three-fourths the height of the room in which placed; when more than three-fourths the height of the room, such partitions shall have not less than the upper one-fourth of the partition constructed of plain glass set in sash.

Enclosure of Vertical Openings

Sec. 1807. Enclosures for elevator shafts, vent shafts, and other vertical openings, when required because of occupancy in Part III shall be of not less than two-hour fire-resistive construction and all openings therein shall be protected by Class "E" or "F" fire doors for exterior openings and Class "B" doors for interior openings. (See Chapter 30.)

Exit enclosures shall be constructed as specified in Section 3308.

A parapet wall or hand rail at least thirty inches (30") in height above the roof shall be provided around all open shaft enclosures extending through the roof.

Structural Framework

Sec. 1808. Structural framework shall be of structural steel or iron as specified in Chapter 27 or shall be of reinforced concrete, as specified in Chapter 26.

The structural frame shall be considered as the columns, and all girders, beams, trusses or spandrels having rigid connections

to the columns and all other members essential to the stability thereof. The members of floor or roof panels which have no connection to the columns, shall be considered secondary members. The structural frame and secondary members shall be designed and constructed to carry all dead, live and other loads to which they may be subjected both during erection and after completion of the structure. Unless otherwise provided for in the structural frame the floor and roof panel construction shall be designed and constructed to carry the horizontal forces to such parts of the structural frame as are designed to carry the horizontal forces to the foundations.

The entire structural frame and each member which is a part of such frame shall be so designed and constructed that the stresses may be satisfactorily determined by a rational analysis in accordance with well established principles of mechanics and sound engineering practice.

Sec. 1809. (a) Structural Steel or Iron Members. All structural steel or iron members, not including frames or structural members for elevators and elevator enclosures, shall be thoroughly fire-protected with not less than four-hour fire-resistive protection for columns, beams and girders and three-hour fire-resistive protection for floors, for all buildings more than eight stories or eighty-five feet (85') in height housing Group E occupancies; and with not less than three-hour fire-resistive protection for columns, beams and girders and two-hour fire-resistive protection for floors for all other buildings..

Fire-Protection of Structural Members

Exceptions: 1. The thickness of the fire-protection on the outer edge of lugs or brackets on columns may be reduced to not less than one inch (1").

2. The masonry over window openings may be supported by a steel plate, angle or similar member which is not fire-protected on the under side, provided the member is supported at proper intervals from a structural beam or girder which is fire-protected on all sides. For openings in masonry bearing walls not exceeding four feet (4') in width, an angle or similar member supported by masonry and not fire-protected on the under side may be used.

3. Where every part of the structural steel framework of the roof of a Group A, B or C occupancy is not less than twenty-five feet (25') above any floor, balcony or gallery, fire-protection of all members of the roof construction may be omitted.

4. Where every part of the structural steel framework of the roof of a Group A, B or C occupancy is more than eighteen feet (18') and less than twenty-five feet (25') above any floor, balcony or gallery, the roof construction shall be protected by a suspended ceiling of not less than one-hour fire-resistive construction, and such ceiling shall be not less than six inches (6") distant from any part of such roof construction.

(b) Reinforced Concrete Members. All reinforced concrete columns, beams and girders shall be thoroughly fire-protected with not less than four-hour fire-resistive protection and all floors, joists and slabs shall be thoroughly fire-protected with

not less than three-hour fire-resistive protection, for all buildings more than eight stories or eighty-five feet (85') in height housing Group E occupancies; and all reinforced concrete columns, beams and girders shall be thoroughly fire-protected with not less than three-hour fire-resistive protection and all floors, joists and slabs shall be thoroughly fire-protected with not less than two-hour fire-resistive protection for all other buildings.

Floor Construction

Sec. 1810. Floor construction shall consist of any incombustible floor system of not less than three-hour fire-resistive construction for all buildings housing Group E occupancies more than eight stories or eighty-five feet (85') in height, and of not less than two-hour fire-resistive construction for all other buildings.

The type of floor construction used shall provide means to keep the beams and girders from spreading, by installing either ties or bridging, with no laterally unsupported length of joists being permitted to exceed eight feet (8') except as otherwise provided in Sections 3102 and 3103. The floor and roof panel construction shall be so designed and constructed as to transfer horizontal forces to such parts of the structural frame as are designed to carry the horizontal forces to the foundations, unless such forces are provided for otherwise.

Where wood sleepers are used for laying wood floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material in such a manner that there will be no open spaces under the flooring which will exceed one hundred square feet (100 sq. ft.) in area and such space shall be filled solidly under all partitions so that there is no communication under the flooring between adjoining rooms.

Roof Deck Construction

Sec. 1811. Roofs shall be constructed of any materials or combination of materials as allowed for floors in Section 1810.

Exception: Roofs more than twenty-five feet (25') above any floor, balcony or gallery, may be of unprotected incombustible materials.

Roof Covering shall be a "Fire Retardant" roofing as specified in Section 3204.

Any drainage fill placed on a roof deck of any building shall be of incombustible material and such fill shall be considered as a part of the dead load in designing the roof framing.

Stair Construction

Sec. 1812. Stairs and stair platforms shall be constructed of reinforced concrete, iron or steel with treads and risers of concrete, iron or steel. Brick, marble, tile or other hard incombustible materials may be used for the finish of such treads and risers.

Stairs shall be designed and constructed as specified in Chapter 33.

Doors and Windows

Sec. 1813. Doors, windows and other openings in the exterior walls shall be protected by Class "E" or "F" fire doors or windows.

Exceptions: 1. The provisions of this Section shall not apply to doors, windows and other openings which face directly upon, and are not within fifty feet (50') in Fire Zone No. 1 or are not within thirty feet (30') in Fire Zones No. 2 and 3, of the opposite side of a public street or other public

place, this distance to be measured at right angles to the plane of the wall in which such openings occur.

2. The provisions of the first paragraph of this Section shall not apply to openings in an outer court twenty feet (20') or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20') of an adjacent property line.

Sec. 1814. Bays, oriels and similar projections shall be constructed of incombustible materials with walls, floors and roofs as specified in this Chapter and Chapter 35.

**Projections
from the
Building**

Porches and exterior balconies shall be constructed of incombustible materials but structural steel or iron members need not be fire-protected; provided, that loading platforms for warehouses, freight depots and similar buildings may be of heavy timber construction with wood floors not less than one and five-eighths inches ($1\frac{5}{8}$ ") thick. Such wood construction shall not be carried through the exterior walls of any Type I building.

Cornices, marquees and similar appendages which are a part of a Type I building shall be constructed of substantial incombustible materials and as required in Chapter 45.

Sec. 1815. Penthouses and other roof structures shall be constructed of masonry or reinforced concrete, and all doors, windows and other openings therein shall be protected by Class "E" or "F" fire doors or windows. (See Chapter 36.)

**Penthouses
and
Skylights**

Skylights shall be constructed of not less than one-hour fire-resistive materials. (See Chapter 34.)

Sec. 1816. Wood or unprotected steel or iron shall be permitted in the following places:

**Combustible
Materials
Regulated**

1. Mezzanine floors may be of wood or unprotected steel provided that there shall be not more than two such mezzanines in any room of any building and provided, further, that no such mezzanine floor or floors shall cover more than $33\frac{1}{3}$ per cent of the area in the room where located. Such mezzanine floors constructed in Fire Zone No. 1 shall be of heavy timber construction as required for floor construction in Type II buildings or of incombustible material protected with lath and plaster approved for one-hour fire-resistive construction.

2. Show window frames and aprons, also show cases and other appurtenances on the first floors of stores or other similar buildings may be of wood with or without unprotected steel or iron.

3. Trim, picture molds, chair rails, wainscoting, baseboards, hand rails, show window backing, temporary partitions, floors, and sleepers may be of wood. Wood doors may be used except in stair, elevator or other shaft enclosures or where not specifically prohibited under Occupancy in Part III.

4. Roofs may be sheathed by wood planks of two and one-half inch ($2\frac{1}{2}$ ") nominal thickness when such sheathing is more than thirty feet (30') distant from any floor, balcony or gallery and when such plank sheathing is protected on the underside by a ceiling of not less than one-hour fire-resistive construction.

CHAPTER 19—TYPE II BUILDINGS

(Heavy Timber Construction)

Definition

Sec. 1901. In "Type II Buildings" the structural frame shall be of structural steel or iron which shall be fire-protected, of concrete, masonry, or heavy timbers, or bearing walls may be used. Exterior walls shall be of fire-resistive construction. Inner court walls shall be of incombustible materials or protected solid wood. Roof construction shall be of wood, or incombustible materials. Floors and non-bearing partitions shall be of wood or incombustible materials. Concealed or inaccessible spaces in combustible framing shall not be permitted.

Height Allowable

Sec. 1902. Type II buildings shall not exceed a height of seventy-five feet (75'); provided, that the height of a building erected on sloping ground may be seventy-five feet (75') plus a vertical distance equal to the vertical change in slope along the length of any side of such building but in no case shall such height exceed eighty-five feet (85') above the adjacent finished ground level. Towers, spires, and steeples erected as a part of the building and not used for habitation or storage may extend not to exceed twenty feet (20') above such height limit.

See Section 507 for additional height limitations.

Area Allowable

Sec. 1903. The floor area of Type II buildings shall be limited according to occupancy as required in Chapter 5 of this Code.

Foundations

Sec. 1904. Footings shall be of solid masonry as specified in Chapter 24 or of concrete as specified in Chapter 26, and shall be designed as specified in Section 2311 and Chapter 28. Foundation walls shall be of masonry or concrete as specified in Chapters 24 and 26.

Exterior and Inner Court Walls

Sec. 1905. Exterior walls shall be of not less than four-hour fire-resistive construction, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones No. 2 and No. 3 may be of incombustible construction, with columns and beams fire protected as specified in Section 1909.

All walls within five feet (5') of adjacent property lines (excepting property lines abutting a street or an alley) and all walls within ten feet (10') of other buildings on the same property shall be provided with a parapet wall at least thirty inches (30") high above the roof at all points, provided that parapet walls need not be constructed on buildings twenty feet (20') or less in height or where the roof slopes more than 20 degrees from the horizontal back from the exterior wall of such building.

Inner court walls shall be the same as exterior walls or shall be of not less than four-inch solid wood laminated construction protected on the weather side thereof by incombustible fire-resistive materials as provided in Section 4202.

Partitions

Sec. 1906. Interior partitions shall be of solid wood construction formed by not less than two layers of one-inch (1") nominal matched boards or laminated construction three and

five-eighths inches (3 $\frac{3}{8}$ ") thick, or shall be of one-hour fire-resistive construction fire-stopped at floor and ceiling.

Where partitions adjoin masonry walls they shall be tied as specified in Section 2518.

Temporary partitions as specified in Section 1806 may be used.

Sec. 1907. Enclosures for elevator shafts, vent shafts, and other vertical openings when required because of occupancy in Part III shall be of not less than two-hour fire-resistive construction (see Chapter 30); provided, that in buildings not more than three stories in height which are completely sprinklered as specified in Chapter 38 such enclosure walls may be constructed as required for interior partitions.

**Enclosure of
Vertical
Openings**

Exit enclosures shall be constructed as specified in Section 3308.

A parapet wall or handrail at least thirty inches (30") in height above the adjacent roof level shall be provided around all open shaft enclosures extending through the roof.

Sec. 1908. Structural framework shall be of masonry as specified in Chapter 24, of wood as specified in Chapter 25, of concrete as specified in Chapter 26, or of structural steel as specified in Chapter 27.

**Structural
Framework**

All wood columns in such structural frame shall be directly superimposed, one above the other (no girders or bolsters between columns), and shall be provided with reinforced concrete, steel or cast iron caps, pintles or base plates, or be connected by timber splice blocks fastened to columns by connectors housed within the contact faces or by bolts. No wood column shall be less than eight inches (8") nominal in its least dimension; no beam, girder or joist shall be less than six inches (6") nominal in its least dimension, nor less than forty-eight square inches (48 sq. in.) nominal in cross-sectional area; and no wood roof truss or arch framing member shall be less than four inches (4") nominal in least dimension, except that top and bottom chords of truss may be built up of two or more elements of not less than three inches (3") nominal thickness when the space between such elements is either solidly filled or is tightly closed for the full length on the underside thereof with a wood cover plate of two-inch (2") nominal thickness.

Where adjoining ends of girders and beams meet at columns they shall be closely fitted and cross-tied by approved reinforced concrete, steel or iron post caps or metal straps, or shall be intertied with columns by through bolted wood corbel and splice blocks or side bolsters with load transferred by connectors housed within the contacting faces or by bolts. Approved wall plates, boxes or hangers shall be provided where wood beams, girders or trusses rest on masonry or concrete walls.

Sec. 1909. (a) Structural Steel and Concrete Members. All structural steel and concrete members (not including frames and structural members for elevators and elevator enclosures) shall be thoroughly fire protected. Such fire protection shall be

**Fire
Protection of
Structural
Members**

of two-hour fire-resistive protection for columns and one-hour fire-resistive protection for beams, girders, and floor systems.

Exceptions: 1. The thickness of the fire protection on the outer edge of steel lugs or brackets on columns may be reduced to not less than one inch (1").

2. The masonry over window openings may be supported by a steel plate, angle or similar member which is not fire protected on the underside, provided the member is supported at proper intervals from a structural beam or girder which is fire protected on all sides. For openings in masonry bearing walls not exceeding four feet (4') in width an angle or similar member supported by masonry and not fire protected on the underside may be used.

3. Porch and exterior balcony framing need not be fire protected.

4. Where the structural steel framework of the roof of a Group A, B, or C occupancy is not less than twenty-five feet (25') above any floor, balcony or gallery, fire protection of all members of the roof construction may be omitted.

5. Where the structural steel framework of the roof of a Group A, B, or C occupancy is more than eighteen feet (18') and less than twenty-five feet (25') above any floor, balcony, or gallery, the roof construction shall be protected by a suspended ceiling of not less than one-hour fire-resistive construction, and such ceiling shall be not less than six inches (6") distant from any part of such roof construction.

(b) Wood Structural Members. Wood structural members shall not be required to be fire-protected.

Floor Construction

Sec. 1910. Floors shall be constructed of tongued and grooved or splined lumber not less than three inches (3") nominal thickness or of square-edged lumber not less than four inches (4") nominal width set on edge and securely spiked together, each covered with one inch (1") nominal tongued and grooved top flooring laid crosswise and diagonally, or shall be an incombustible floor system of not less than one-hour fire-resistive construction.

A space of one-half inch ($\frac{1}{2}$ ") shall be required between the wood flooring and adjoining walls to allow for expansion due to wetting. This space shall be covered by a molding secured to the wall only or masonry may be corbeled under the floor to cover this space.

Roof Deck Construction

Sec. 1911. Roof decks shall be as required for floors in Section 1910 or shall be constructed of tongued and grooved or splined lumber not less than two inches (2") nominal thickness or of square-edged lumber not less than three inches (3") nominal width set on edge and securely spiked together.

Exception: Roofs more than twenty-five feet (25') above any floor, balcony, or gallery, may be of unprotected incombustible materials.

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 3204.

Stair Construction

Sec. 1912. Stairs shall be constructed with wood treads and risers of not less than two-inch (2") nominal thickness, except

where built on laminated or plank inclines as required for floors, when they may be of one-inch (1") nominal thickness or may be constructed as required in Type I buildings.

In buildings four or more stories in height, stairs and stair construction shall be as required for Type I buildings.

Stairs and exits shall be designed and constructed as specified in Chapter 33.

Sec. 1913. Doors, windows and other openings in the exterior walls shall be protected by Class "E" or "F" fire doors or windows. **Doors and Windows**

Exceptions: 1. The provisions of this section shall not apply to doors, windows, and other openings which face directly upon, and are not within fifty feet (50') in Fire Zone No. 1, or thirty feet (30') in Fire Zones No. 2 and 3, of the opposite side of a public street or public place, this distance to be measured at right angles to the plane of the wall in which such openings occur.

2. The provisions of this section shall not apply to openings in an outer court twenty feet (20') or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20') of an adjacent property line.

Sec. 1914. Bays, balconies, oriels, porches, and similar projections shall be constructed of incombustible materials with walls, floors, and roofs as specified in this chapter and Chapter 35; provided, that loading platforms for warehouses, freight depots, and other similar buildings may be of heavy timber construction with wood floors not less than two inches (2") nominal thickness, but such wood construction shall not be carried through the exterior walls.

Cornices, marquees and similar appendages which are a part of a Type II building shall be constructed of substantial incombustible materials and as specified in Chapter 45.

Sec. 1915. Penthouses shall be constructed as required in Chapter 36. **Penthouses and Skylights**

Skylights shall be constructed as required in Chapter 34.

Sec. 1916. No wood lath or wood furring shall be allowed, and no incombustible furring shall pass through any wall, partition, or floor. Unprotected steel and iron or wood may be used in the following places: **Combustible Materials Regulated**

1. Mezzanine floor construction, provided that there shall be not more than two such mezzanines in any room of any building, and provided, further, that no such mezzanine floor or floors shall cover more than 33½ per cent of the area of the room where located.

2. Show window frames, aprons, showcases and other appurtenances on the first floors of stores and other similar buildings.

3. Trim, handrails, show window backing, temporary partitions as specified in Section 1906, picture molds, chair rails, wainscoting, baseboards, and doors, except in stair, elevator and other shaft enclosures, or where not specifically prohibited under Occupancy in Part III.

CHAPTER 20 — TYPE III BUILDINGS

(Ordinary Masonry)

Definition

Sec. 2001. In "Type III Buildings," the interior load bearing construction may be masonry or concrete walls or a structural frame of steel, reinforced concrete or wood. Exterior walls shall be of fire-resistive materials. Partitions, floors and roof framing may be of wood.

Height Allowable

Sec. 2002. Type III buildings shall not exceed a height of fifty-five feet (55'); provided, that the height of a building erected on sloping ground may be fifty-five feet (55') plus a vertical distance equal to the vertical change in slope along and in the length of any side of such building, but in no case shall such height exceed sixty-five feet (65') above the adjacent finished ground level; and provided, further, that towers, spires and steeples erected as a part of such building and not used for habitation or storage may extend not to exceed fifteen feet (15') above such height limit.

See Section 507 for additional height limitations.

Area Allowable

Sec. 2003. The floor area of Type III buildings shall be limited according to Occupancy as required in Part III.

Foundations

Sec. 2004. Footings shall be of solid masonry as specified in Chapter 24 or of concrete as specified in Chapter 26, and shall be designed as specified in Section 2311 and Chapter 28. Foundation walls shall be of masonry or concrete as specified in Chapters 24 and 26.

Exterior and Inner Court Walls

Sec. 2005. Exterior walls shall be not less than four-hour fire-resistive construction, except that walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1 or thirty feet (30') in Fire Zones No. 2 and No. 3 may be of incombustible construction with all structural members having not less than one-hour fire-resistive protection.

All walls within five feet (5') of adjacent property lines (except property lines abutting a street or alley) and all walls within ten feet (10') of other buildings on the same property shall be provided with parapet walls at least thirty inches (30") high above the roof at all points; provided, that parapet walls need not be constructed on buildings twenty feet (20') or less in height or where the roof slopes more than 20 degrees from the horizontal back from the exterior wall of such building.

Inner court walls and all other walls not forming the exterior walls of the building may be as required for Type I or Type II buildings, or shall be of not less than one-hour fire-resistive construction.

Partitions

Sec. 2006. Partitions of wood shall be constructed as required in Chapter 25. Bearing partitions, when constructed of wood, shall not support more than two stories and a roof.

Temporary partitions as specified in Section 1806 may be used.

Enclosure of Vertical Openings

Sec. 2007. Enclosures for elevator shafts, vent shafts and other vertical openings when required because of Occupancy in Part III shall be of not less than one-hour fire-resistive construction. (See Chapter 30.)

Exit enclosures shall be constructed as specified in Section 3308.

A parapet wall or hand rail at least thirty inches (30") in height above the roof shall be provided around all open shaft enclosures extending through the roof.

Sec. 2008. Structural framework shall be of steel, iron, concrete, masonry or wood and shall be designed and erected as specified in Chapter 26 for concrete, Chapter 27 for steel and iron, Chapters 22 and 25 for wood and Chapter 24 for masonry.

Structural Framework

Sec. 2009. Fire-protection of steel or iron structural members may be omitted unless otherwise provided, because of location as in Part IV or Occupancy as in Part III, or as required in this Chapter.

Fire-Protection of Structural Members

All members carrying masonry in buildings over one story in height shall be fire-protected with not less than one-hour fire-protection. Bottom flanges of exterior lintels need not be fire-protected.

Sec. 2010. Floors may be constructed as specified in Chapter 26 for concrete, Chapter 24 for masonry, Chapter 25 for wood, and Chapter 27 for steel or iron.

Floor Construction

In all buildings having a usable space under the first floor, except Groups I and J occupancies, the underside of such floor construction when of metal or wood shall be protected by a ceiling of lath and plaster approved for one-hour fire-resistive construction.

Wood joists, beams and girders supported by masonry walls shall be anchored thereto as required in Section 2518. Ventilation shall be provided between the ground and a wood floor as required in Section 2523.

Sec. 2011. Roof construction shall be of any Type of Construction permitted for floors except where otherwise required because of Occupancy in Part III.

Roof Deck Construction

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 3204.

Sec. 2012. Stairs may be of steel, iron, concrete, masonry or wood and shall be designed and constructed as specified in Chapter 33.

Stair Construction

Sec. 2013. Doors, windows and other openings in exterior walls may be of wood or of plain glass and wood sash unless otherwise required under Occupancy in Part III or Location in Part IV.

Doors and Windows

Sec. 2014. Bays, oriels and similar projections shall be constructed of incombustible materials with walls, floors and roof as specified in this chapter and Chapter 35.

Projections from the Building

Porches and exterior balconies shall be constructed of incombustible materials but structural steel or iron members need not be fire-protected; provided that loading platforms for warehouses, freight depots and similar buildings may be of heavy timber construction with wood floors not less than one and five-eighths inches (1 $\frac{5}{8}$ ") thick. Such wood construction shall not be carried through the exterior walls of any Type III building.

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Cornices, marquees and similar appendages which are a part of a Type III building shall be constructed of substantial incombustible materials and as required in Chapter 45.

**Penthouses
and Skylights**

Sec. 2015. Penthouses and other roof structures shall be of not less than one-hour fire-resistive construction. (See Chapter 36.)

Skylights shall be of not less than one-hour fire-resistive construction. (See Chapter 34.)

**Combustible
Materials
Regulated**

Sec. 2016. Wood shall be permitted in a building of Type III construction except where specifically prohibited under Occupancy in Part III or Location in Part IV.

Combustible insulating materials may be placed in the partition, floor or roof framing but shall in no way interfere with the fire blocking or fire separations required by this Code.

CHAPTER 21 — TYPE IV BUILDINGS

(Light Incombustible Frame)

Sec. 2101. In "Type IV Buildings" the structural framework shall be of steel, iron, masonry or concrete and exterior walls shall be of incombustible materials. Partitions, floors and roof construction shall be of incombustible materials except as specified in this Chapter. Foundations shall be of masonry or concrete. **Definition**

Sec. 2102. Type IV buildings shall not exceed a height of forty-five feet (45'); provided that the height of such building erected on sloping ground may be forty-five feet (45') plus a vertical distance equal to the vertical change in slope along and in the length of any side of such building but in no case shall such height exceed fifty-five feet (55') above the adjacent finished ground level. Towers, spires and steeples erected as a part of such building and not used for habitation or storage may extend not to exceed ten feet (10') above such height limit except that the height of such towers on Group G occupancies shall not be limited. **Height Allowable**

See Section 507 for additional height limitations.

Sec. 2103. The floor area of a Type IV building shall be limited as specified under Occupancy in Part III and Location in Part IV. **Area Allowable**

Sec. 2104. Footings shall be of solid masonry as specified in Chapter 24 or of concrete as specified in Chapter 26, and shall be designed as specified in Section 2311 and Chapter 28. Foundation walls shall be of masonry or concrete as specified in Chapters 24 and 26. **Foundations**

Sec. 2105. Exterior wall covering shall provide suitable protection from the elements and shall be of incombustible material of such thickness, strength and so anchored to the wall frame as to resist effectively wind and other forces that may be applied to it. Wall coverings may be considered a structural part of the structural frame if designed and constructed to act integrally therewith. **Exterior Walls**

Studs or other similar vertical supports shall in no case be spaced more than four feet (4') on centers. All openings wider than the regular stud spacing in the wall shall be trussed or provided with lintels with proper end support, provided that where no studs are used the structural frame shall be designed in accordance with Chapter 24, Chapter 26 or Chapter 27. All walls shall be thoroughly and effectively braced; and effectively fire-stopped at all floor and ceiling levels with incombustible materials. All steel studs shall be designed in accordance with Chapter 27.

All roof and floor loads shall be transmitted to the steel studs or other supporting members, either directly or by means of a load distributing member. Maximum wall height between horizontal supports perpendicular to bearing walls shall not exceed forty-five (45) times the structural thickness of the wall.

Portland cement plaster not less than one and one-half inch (1½") in thickness reinforced in two directions with not less than three-tenths per cent of steel may be considered to act with

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the studs to resist bending and shear under horizontal forces when said reinforcement is anchored to the stud in such a manner as to resist effectively the stresses developed. The unit stresses for such reinforced plaster shall not be more than 50 per cent of those allowed for concrete beams in Table No. 26-B, based on a compressive strength of such plaster of 1500 pounds per square inch.

Partitions

Sec. 2106. Bearing partitions shall be constructed as required for exterior walls. Interior non-bearing partitions shall be of incombustible materials.

Enclosure of Vertical Openings

Sec. 2107. Enclosures for elevator shafts and other vertical openings when required because of Occupancy in Part III shall be of not less than one-hour incombustible fire-resistive construction. (See Chapter 30.)

Exit enclosures shall be constructed as specified in Section 3308.

A parapet wall or hand rail at least thirty inches (30") in height above a flat roof shall be provided around all open shaft enclosures extending through the roof.

Structural Framework

Sec. 2108. The structural framework shall be as specified in Chapter 27 for iron and steel, Chapter 24 for masonry and Chapter 26 for concrete.

Fire-Protection of Structural Members

Sec. 2109. Fire protection of structural members may be omitted unless otherwise provided, because of location as in Part IV or occupancy as in Part III, or as required in this Chapter.

All members carrying masonry in buildings over one story in height shall be fire-protected with not less than one-hour fire protection. Bottom flanges of exterior lintels need not be fire-protected.

Floor Construction

Sec. 2110. Floor construction shall be of incombustible material, provided, however, that wood flooring may be used.

Roof Construction

Sec. 2111. Roof construction may be of any type of construction permitted by this Code.

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 3204.

Stair Construction

Sec. 2112. Stairs shall be of any type permitted by this Code and shall comply with the requirements of Chapter 33.

Doors and Windows

Sec. 2113. Doors, windows and other openings in exterior walls may be of any type permitted by this Code, unless otherwise required under Occupancy in Part III, and Fire Zones in Part IV.

Projections from the Building

Sec. 2114. Porches, cornices, marquees, canopies and all other similar projections from the building shall be of incombustible materials, except that a loading platform not including the roof or roof structure thereof, may be constructed of wood as specified in Section 1914.

Penthouses and Skylights

Sec. 2115. Penthouses and other roof structures shall be constructed as required for the main portion of the building. (See Chapter 36.) Skylights shall be constructed as required in Chapter 34.

CHAPTER 22—TYPE V BUILDINGS (Wood Frame)

Sec. 2201. In "Type V Buildings," enclosing walls, interior walls, partitions, floors and roofs shall be of wood as specified in Chapter 25 or of wood in combination with other materials except where prohibited as specified under Occupancy in Part III. Any building which cannot be classed as Type I, II, III or IV construction shall be considered to be of Type V.

Definition

Sec. 2202. Type V buildings shall not exceed a height of thirty-eight feet (38'); provided that the height of a building erected on sloping ground may be thirty-eight feet (38') plus a vertical distance equal to the vertical change in slope along and in the length of any side of such building but in no case shall such height exceed forty-five feet (45') above the adjacent finished ground level; provided, further, that spires, towers or steeples erected as a part of such building and not used for habitation or storage may extend not to exceed ten feet (10') above such height limit.

Height Allowable

See Section 507 for additional height limitations.

Sec. 2203. The maximum floor area allowable for a Type V building shall in no case exceed that specified under Occupancy in Part III or Location in Part IV.

Area Allowable

Sec. 2204. All exterior walls and interior bearing walls of Type V buildings shall be supported on continuous solid masonry or concrete footings which shall be of sufficient size to support safely the loads imposed as determined from the character of the soil. Foundation walls shall extend at least six inches (6") above the finished grade adjacent to the wall at all points. Mudsills shall be bolted to the foundation or foundation wall with not less than one-half inch ($\frac{1}{2}$ ") bolts, embedded at least seven inches (7") into the masonry and spaced not more than six feet (6') apart.

Foundations

Exceptions: 1. Interior bearing walls in one-story buildings may be supported on piers.

2. For Type V buildings, (except Group H and I occupancies) isolated piers of solid masonry or concrete may be used for post and girder construction.

3. A one-story building (except a Group I occupancy) which does not exceed four hundred square feet (400 sq. ft.) in area, including additions, may be constructed without a masonry or concrete foundation if the walls are supported on a wood mudsill.

See Appendix for table of minimum foundation requirements for Type V buildings.

All mudsills shall be all-heart cedar, all-heart cypress or Foundation Grade redwood, or any species of wood if treated under pressure with an approved preservative.

Foundations for all buildings where the surface of the ground slopes more than one foot (1') in ten feet (10') shall be level or shall be stepped so that both top and bottom of such foundation are level.

Foundations of Type V buildings may be of piles, constructed as specified in Chapter 28.

Sections 2204-2205**UNIFORM BUILDING CODE****Retaining Walls**

Foundation walls and all other walls used as retaining walls in connection with Type V buildings shall be not less than eight inches (8") in thickness. All such walls shall be designed for the loads specified in Section 2310.

Exterior Walls and Wall Coverings

Sec. 2205. (a) **Construction.** Exterior walls may be of any materials permitted by this Code.

Exterior walls of wood shall be constructed as specified in Chapter 25.

(b) **Sheathing.** Type V buildings three stories in height shall have the exterior walls covered with a solid sheathing as specified in this Section.

Sheathing where required for exterior walls shall be applied solidly over the wall surface and shall be one or more of the following materials:

Wood not less than five-eighths inch ($\frac{5}{8}$ ") thick.

Approved fiber board not less than seven-sixteenths inch ($\frac{7}{16}$ ") thick.

Approved gypsum sheathing not less than one-half inch ($\frac{1}{2}$ ") thick.

Approved plywood not less than five-sixteenths inch ($\frac{5}{16}$ ") thick.

Wall Coverings

(c) **Wall Coverings.** 1. **General.** Exterior walls shall be covered on the outside with the materials and in the manner specified in this Section.

2. **Weatherboarding.** Studs or sheathing shall be covered on the outside face with one layer of building paper as specified in Section 2217. Weatherboarding, when in place, shall have an average thickness of not less than five-eighths inch ($\frac{5}{8}$ ") and a minimum thickness of not less than three-eighths inch ($\frac{3}{8}$ "). Such weatherboarding shall be placed over the paper and shall be securely nailed to the studding with not less than two nails to each stud in each piece of such weatherboarding. Horizontal joints in the weatherboarding shall be tongued and grooved or shiplapped joints, or such weatherboarding shall be laid shingle fashion and lapped not less than one-half inch ($\frac{1}{2}$ "). Siding patterns known as rustic, drop siding or shiplap shall have an average thickness in place of not less than nineteen thirty-seconds inch ($\frac{19}{32}$ ") and a minimum thickness of not less than three-eighths inch ($\frac{3}{8}$ "). Bevel siding shall have a minimum thickness measured at the butt section of not less than twenty-one thirty-seconds inch ($\frac{21}{32}$ ") and a tip thickness of not less than one-quarter inch ($\frac{1}{4}$ "). Siding of lesser dimensions may be used, provided the outside face of the stud is first covered with sheathing as provided in this Section.

3. **Plywood.** Where plywood is used for covering the exterior of outside walls it shall be of the exterior type not less than three-eighths inch ($\frac{3}{8}$ ") thick. If three-ply is used without sheathing, it shall be placed so that the grain of the outside plies runs perpendicular to the supporting members. Joints shall be backed solid with nailing pieces not less than two inches (2") wide.

4. **Shingles or Shakes.** Shingles or shakes may be used for exterior wall covering provided the frame of the structure is

covered with building paper as specified in Section 2217. The thickness of shingles or shakes between wood nailing boards shall be not less than three-eighths inch ($\frac{3}{8}$ ").

5. **Exterior Plastering.** See Chapter 47. (See also Section 2205 in the Appendix.)

6. **Masonry Veneer.** See Chapter 29.

7. **Galvanized Iron.** Galvanized iron not less than 28 gauge may be used on stud walls without sheathing. Walls shall be effectively braced and nailing strips shall be placed in such manner as to permit the metal to be nailed at vertical intervals of not more than four feet (4').

Sec. 2206. Interior partitions may be of any material permitted for exterior walls in this Code. If of wood, interior partitions shall be constructed, framed and firestopped as required for exterior walls as specified in Chapter 25, except that interior non-bearing partitions may have a single top plate, and except that where non-bearing partitions are approximately parallel and not more than four feet (4') apart, two-inch by three-inch (2"x3") studs sixteen inches (16") on centers, may be used.

Interior Partitions

Sec. 2207. Enclosure walls for elevator shafts, vent shafts, and similar vertical openings, when required under Occupancy in Part III, shall be of not less than one-hour fire-resistive construction, except that chutes and dumb-waiter shafts with a cross-sectional area of not more than nine square feet (9 sq. ft.) may be lined with approved incombustible materials covered with not less than 26 U. S. gauge sheet metal with all joints in such sheet metal lock-lapped. (See Chapter 30.) All openings into any such vertical enclosure shall be protected by metal or metal-clad doors with either metal or metal-clad jams, casings or frames.

Enclosure of Vertical Openings

Exit enclosures shall be constructed as specified in Section 3308.

Sec. 2208. Structural framework may be of any type of construction permitted in this Code.

Structural Framework

Sec. 2209. Fire-protection of structural framework shall not be required except as provided under Occupancy in Part III.

Fire-Protection of Structural Members

Sec. 2210. Floors may be of any type of construction permitted in this Code.

Floor Construction

Sec. 2211. Roof construction may be of any type of construction permitted in this Code. When roof construction is of wood it shall conform to the requirements of Chapter 25.

Roof and Ceiling Construction

Attic or roof spaces shall be divided into areas not exceeding twenty-five hundred square feet (2500 sq. ft.) as required in Section 3205.

Roof covering shall be a "Fire-Retardant" roofing, except that for Groups H, I and J occupancies, an ordinary roofing may be used as specified in Section 3204. Wherever a composition roofing is used, the roof construction shall be solidly sheathed with wood, sheathing to be not less than twenty-five thirty-seconds inch ($25/32$ ") thick, or with plywood not less than that set forth in Table No. 31-B.

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Stair Construction	Sec. 2212. Stair construction may be of any type permitted in this Code and shall conform to the requirements of Chapter 33.
Doors and Windows	Sec. 2213. Doors and windows may be of any type permitted in this Code.
Projections from Building	Sec. 2214. Any projections from the building shall conform to the requirements for exterior walls, and those over public property shall be as required in Chapter 45.
Penthouses and Skylights	Sec. 2215. Penthouses and skylights may be of any material permitted in Chapters 34 and 36 of this Code.
Combustible Materials Regulated	Sec. 2216. Combustible insulating materials may be used in any part of the building but shall not be installed in such a manner as to interfere with the firestopping elsewhere herein required.
Weather Protection	Sec. 2217. (a) Building Paper. Asphalt-saturated felt free from holes and breaks and weighing not less than 14 pounds per 100 square feet, or approved waterproof paper, shall be applied over studs or sheathing. Such felt or paper shall be applied weatherboard fashion, lapped not less than two inches (2") at horizontal joints and not less than six inches (6") at vertical joints. Building paper may be omitted in the following cases: 1. When exterior covering is of sheet metal. 2. In back-plastered construction. 3. When there is no human occupancy. (b) Flashing. Exterior openings exposed to the weather shall be flashed with rust-resistive metal or other approved flashing in such a manner as to make them waterproof.

PART VI

ENGINEERING REGULATIONS, QUALITY
AND DESIGN OF THE MATERIALS OF
CONSTRUCTION

CHAPTER 23—LIVE AND DEAD LOADS

Sec. 2301. Dead Load. The dead load of a building shall include the weight of the walls, permanent partitions, framing, floors, roofs and all other permanent stationary construction entering into and becoming a part of a building.

Definitions

Live Load. The live load includes all loads except dead and lateral loads.

Sec. 2302. (a) General. Buildings and all parts thereof shall be of sufficient strength to support the estimated or actual imposed dead and live loads in addition to their own proper dead load, without exceeding the stresses noted elsewhere in this Code, provided that no building or part thereof shall be designed for live loads less than those specified in the following sections. Impact shall be considered in the design of any structure where impact loads occur.

Loads

(b) **Special.** Provision shall be made in designing office floors for load of 2000 pounds placed upon any space two and one-half feet ($2\frac{1}{2}'$) square wherever this load upon an otherwise unloaded floor would produce stresses greater than those caused by a uniformly distributed load of 50 pounds per square foot.

In designing floors to be used for industrial or commercial purposes the actual live load caused by the use to which the building or part of the building is to be put, shall be used in the design of such building or part thereof, and special provision shall be made for machine or apparatus loads when such machine or apparatus would cause a greater load than specified for such use in Section 2304.

Floors in office buildings and in other buildings, where partition locations are subject to change, shall be designed to support in addition to all other loads, a uniformly distributed load equal in pounds per square foot to one-twelfth of the weight of one linear foot of the partition.

Public garages and commercial or industrial buildings in which loaded trucks are placed, used or stored shall have the floor systems designed to support a concentrated rear wheel load of a loaded truck placed in any possible position.

Sec. 2303. Any system or method of construction to be used shall admit of a rational analysis in accordance with well established principles of mechanics.

**Method
of Design**

Sec. 2304. The following unit loads shall be taken as the minimum live loads in pounds per square foot of horizontal projection to be used in the design of buildings for the occupancies listed, and loads at least equal shall be assumed for uses not listed in this Section but which create or accommodate similar loadings.

**Unit
Live
Loads**

Apartments	40
Armories	150
Auditoriums—Fixed Seats	50
Movable Seats	100
Balconies and Galleries—Fixed Seats	50
Movable Seats	100
Cornices	60
Corridors, Public	100
Dance Halls	100
Drill Rooms	100
Dwellings	40
Exterior Balconies	100
Fire Escapes	100
Garages	100
Gymnasiums	100
Hospitals—Wards and Rooms	40
Hotels—Guest Rooms and Private Corridors	40
Libraries—Reading Rooms	60
Stack Rooms	125
Loft Building	100
Manufacturing — Light	75
Heavy	125
Marquees	60
Offices	50
Printing Plants—Press Rooms	150
Composing and Linotype Rooms	100
Public Rooms	100
Rest Rooms	50
Reviewing Stands and Bleachers	100
Roof Loads	(See Section 2305)
Schools—Class Rooms	40
Sidewalks	250
Skating Rinks	100
Stairways	100
Storage — Light	125
Heavy (Load to be determined from pro-	
posed use or occupancy, but never less than)	250
Stores—Retail (Light Merchandise)	75
Wholesale (Light Merchandise)	100

Ceilings

All ceiling joists shall be designed for not less than 10 pounds per square foot total load.

Railings

All balcony railings shall be designed to withstand a horizontal force of 20 pounds per lineal foot, applied at the top of the railing.

**Roof
Loads**

Sec. 2305. Roofs shall be designed for a vertical live load of 20 pounds per square foot of horizontal projection applied to any and all slopes, except as hereinafter provided.

Where the rise exceeds twelve inches (12") per foot no vertical live loads need be assumed, but the roof shall be designed for the dead load and for a wind load of 15 pounds per square foot of vertical projection.

Where snow loads occur, roofs shall be designed for the increase in loading.

Sec. 2306. The following reductions in assumed live loads shall be permitted in designing of columns, piers, walls, foundations, trusses and girders. **Reduction of Live Loads**

1. No reduction of the assumed live load shall be allowed in the design of any slabs, joists or beams.

2. A reduction of the total live load used in the design of girders based on a certain tributary floor area shall be permitted as noted in the following schedule. This reduction shall not be carried into the columns nor shall such reduction be used in design of buildings to be used or occupied as warehouses or for storage purposes.

Reduction Allowed	Tributary Floor Area
5%	100 sq. ft.
10%	200 sq. ft.
15%	300 sq. ft. or more

3. For determining the total live loads carried by columns the following reductions shall be permitted, the reductions being based on the assumed live loads applied to the entire tributary floor area:

Allowable Reductions for Warehouses and Storage Buildings

Carrying the roof.....	0 per cent
Carrying 1 floor and roof.....	0 per cent
Carrying 2 floors and roof.....	5 per cent
Carrying 3 floors and roof.....	10 per cent
Carrying 4 floors and roof.....	15 per cent
Carrying 5 or more floors and roof.....	20 per cent

Live Load Reductions for Manufacturing Buildings, Stores and Garages

Carrying the roof.....	0 per cent
Carrying 1 floor and roof.....	0 per cent
Carrying 2 floors and roof.....	10 per cent
Carrying 3 floors and roof.....	20 per cent
Carrying 4 or more floors and roof.....	30 per cent

Allowable Live Load Reductions for All Other Buildings

Carrying the roof.....	0 per cent
Carrying 1 floor and roof.....	0 per cent
Carrying 2 floors and roof.....	10 per cent
Carrying 3 floors and roof.....	20 per cent
Carrying 4 floors and roof.....	30 per cent
Carrying 5 floors and roof.....	40 per cent
Carrying 6 floors and roof.....	45 per cent
Carrying 7 or more floors and roof.....	50 per cent

Sec. 2307. For purposes of design the wind pressure upon the gross area of the vertical projection of buildings and structures shall be taken at not less than 15 pounds per square foot for those portions of the building less than sixty feet (60') above ground and at not less than 20 pounds per square foot for those portions more than sixty feet (60') above ground. **Wind Pressure**

The wind pressure upon sprinkler tanks, sky signs, or other similar exposed structures and their supports shall be taken as not less than 30 pounds per square foot of the gross area of the plane surface, acting in any direction. In calculating

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the wind pressure on circular tanks, towers or stacks this pressure shall be assumed to act on 6/10 of the projected area.

The overturning moment calculated from the wind pressure shall in no case exceed two-thirds of the dead load resisting moment.

The weight of earth superimposed over footings may be used to calculate the dead load resisting moment.

For combined stresses due to wind and other loads the allowable unit stresses may be increased 33⅓ per cent in excess of the values specified in Chapters 24, 25, 26, and 27. For members carrying wind stresses only the allowable unit stresses may be increased 33⅓ per cent. In no case shall the section be less than required if the wind stress be neglected.

**Live Loads
Posted**

Sec. 2308. The live loads for which each floor or part thereof of a commercial or industrial building is or has been designed, shall have such designed live loads conspicuously posted by the owner in that part of each story in which they apply, using durable metal signs, and it shall be unlawful to remove or deface such notices. The occupant of the building shall be responsible for keeping the actual load below the allowable limits.

**Occupancy
Certificates for
Changed
Floor
Loading**

Sec. 2309. Plans for other than residential buildings filed with the Building Official with applications for permits shall show on each drawing the live loads per square foot of area covered, for which the building is designed, and occupancy certificates for buildings hereafter erected shall not be issued until the floor load signs, required by Section 2308, have been installed.

**Retaining
Walls and
Basement
Floors**

Sec. 2310. When earth or water, or earth and water, cause or may cause a pressure on any building or structure, such total pressure created shall be calculated in accordance with the best accepted engineering practice, and such calculations and design shall take into account any possible surcharge due to moving or fixed loads.

**Footing
Design**

Sec. 2311. The base area of the footings of all buildings shall be designed in the following manner: The area of the footing which has the largest percentage of live load to total load shall be determined by dividing the total load by the allowable soil load. From the area thus obtained the dead load soil pressure of such footing is determined and the areas of all other footings of the building shall be determined on the basis of their respective dead loads only and such dead load soil pressure. In no case shall the load per square foot under any portion of any footing, due to the combined dead, live, wind and/or any other loads, exceed the safe sustaining power of the soil upon which the footing rests. The total reduced live load occurring in the column immediately above the footing shall be the live load used in the above computation.

**Walls and
Structural
Framing**

Sec. 2312. Walls and structural framing shall be erected true and plumb in accordance with the design. Bracing shall be placed during erection wherever necessary to take care of all loads to which the structure may be subjected.

**Earthquake
Regulations**

Sec. 2313. (See Appendix.)

CHAPTER 24—MASONRY

Sec. 2401. (a) Quality and Design. The quality of masonry materials shall conform to the minimum requirements specified in this Chapter. Masonry units may be re-used when clean, sound, and conforming to the other requirements of this Chapter. Masonry construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2313 is applicable, masonry shall also be designed in accordance with the allowable stresses specified in this Chapter. **General**

(b) Combination of Units. Where units of different type or strength are used in combination, the lowest allowable stresses shall be used.

(c) Freezing. All masonry shall be protected against freezing for at least 48 hours after being laid. No masonry shall be built upon frozen material.

(d) Dimensions. Dimensions given are nominal; actual dimensions of unit masonry may not be decreased by more than one-half inch ($\frac{1}{2}$ ").

Sec. 2402. (a) Brick. Building brick of clay, shale, sand-lime, or concrete shall be of a quality at least equal to that required by A.S.T.M. "Standard Specifications for Building Brick (Made from Clay or Shale)," (C62-44); A.S.T.M. "Standard Specifications for Sand-Lime Building Brick," (C73-39); or A.S.T.M. "Standard Specifications for Concrete Building Brick," (C55-37). When in contact with the ground or where severe frost action occurs in the presence of moisture, the brick shall be of at least Grade MW for clay, shale, or sand-lime brick; or Grade A for concrete brick. Other solid masonry units of clay or shale shall meet the requirements for the physical properties of brick as specified in A.S.T.M. "Standard Specifications for Building Brick (Made from Clay or Shale)," (C62-44). **Materials***

(b) Concrete Masonry Units. Concrete masonry units shall be of a quality at least equal to that required by A.S.T.M. "Standard Specifications for Hollow Load-Bearing Concrete Masonry Units," (C90-44), or A.S.T.M. "Standard Specifications for Solid Load-Bearing Concrete Masonry Units," (C145-40), when used for bearing walls or piers, or when in contact with ground or exposed to the weather; or equal to A.S.T.M. "Standard Specifications for Hollow Non-Load-Bearing Concrete Masonry Units," (C129-39), when used for non-bearing purposes and not exposed to the weather.

(c) Structural Clay Tile. Structural clay tile shall be of a quality at least equal to that required by A.S.T.M. "Standard Specifications for Structural Clay Load-Bearing Wall Tile," (C34-41), Grade LB when used for bearing walls or piers, or Grade LBX when exposed to the weather or soil; or equal to A.S.T.M. "Standard Specifications for Structural Clay Non-Load-Bearing Tile," (C56-41), when used for interior non-load-bearing purposes; or equal to A.S.T.M. "Standard Specifications for Structural Clay Floor Tile," (C57-39), when used for floor construction.

*For regulations covering PLAIN CONCRETE, see Section 2624.

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(Cont'd.)**

(d) **Cast Stone.** Cast stone shall be of a quality at least equal to that required by A.C.I. "Specifications for Cast Stone," (704-44).

(e) **Stone.** Natural stone shall be sound and free from loose or friable inclusions, with sufficient strength and durability for the proposed use.

(f) **Gypsum Units.** Gypsum partition tile or block shall be of a quality at least equal to that required by A.S.T.M. "Standard Specifications for Gypsum Partition Tile or Block," (C52-41).

(g) **Structural Glass Block.** Structural glass block shall be precoat with a material to improve adhesion on all mortar bearing surfaces.

(h) **Glazed Building Units.** Glazed building units shall conform to the requirements of A.S.T.M. "Tentative Specifications for Glazed Masonry Units," (C126-44T), except that the requirements for finish shall not apply to salt-glazed building units.

(i) **Cementitious Materials.** Cementitious materials used in mortars shall be of a quality at least equal to the quality of materials required by the following applicable specifications: A.S.T.M. "Standard Specifications for Quicklime for Structural Purposes," (C5-26); A.S.T.M. "Standard Specifications for Normal Finishing Hydrated Lime," (C6-44), and before slaking shall contain at least 85 per cent, by weight, of calcium oxide; A.S.T.M. "Standard Specifications for Hydraulic Hydrated Lime for Structural Purposes," (C141-42); A.S.T.M. "Standard Specifications for Natural Cement," (C10-37); "Federal Specifications for Masonry Cement," (SS-C-181b); A.S.T.M. "Standard Specifications for Portland Cement," (C150-44); A.S.T.M. "Standard Specifications for Gypsum," (C22-41).

(j) **Aggregate.** Aggregate for mortar shall be of a quality at least equal to that required by A.S.T.M. "Standard Specifications for Aggregate for Masonry Mortar," (C144-44).

(k) **Water.** Water used in mixing mortar shall be clean, and free from deleterious amounts of acids, alkalies, or organic materials.

**Mortar
and Grout**

Sec. 2403. (a) General. Mortar other than gypsum mortar used in masonry construction shall be classified as set forth in Table No. 24-A.

Mortar when applied shall have a flow after suction for one minute of not less than 70 per cent of that immediately before suction when determined by the method of the water retention test of the "Federal Specifications for Masonry Cement," (SS-C-181b).

TABLE NO. 24-A—TYPES OF MORTAR

TYPE	MINIMUM COMPRESSIVE STRENGTH OF 2-IN. CUBES AT 28 DAYS, LB. PER SQ. IN.
A	2,500
B	1,800
C	600

Tests made to classify mortar by compressive strength shall be made as described in the "Federal Specifications for Masonry Cement," (SS-C-181b), using the proportions and materials proposed for use.

(b) **Strength.** Unless the strength classification of the mortar has been established by tests in accordance with this section, mortars using the cementitious materials set forth in Table No. 24-B shall be assumed to meet the strength classification shown when mixed with aggregate in the proportions required by this section.

The volume of aggregate in mortar shall be at least two times but not more than three times the sum of the volumes of cementitious materials or the amounts set forth in Table No. 24-B.

(c) **Gypsum Mortar.** Gypsum mortar shall be composed by weight of one part of gypsum and not more than three parts of mortar aggregate.

(d) **Grout.** Grout shall be Type A mortar to which is added water to produce consistency for pouring without segregation of constituents of the mortar.

(e) **Footings and Foundations.** Masonry units used in foundation walls and footings shall be laid up in Type A or B mortar.

Sec. 2404. (a) General. The thickness of masonry walls shall be sufficient at all points to withstand all vertical and horizontal loads as specified in Chapter 23, but in no case shall such thickness be less than that set forth in Table No. 24-C; nor shall the ratio of unsupported height or length of the wall (whichever is the lesser) to thickness, be greater than that set forth in Table No. 24-C.

General Requirements for Masonry Construction

Exception: The walls of one-story single-family dwellings and private garages may be six inches (6") thick when not greater than nine feet (9') in height with an allowance of an additional six feet (6') for gables.

This exception shall not apply to cavity wall or stone masonry.

(b) **Bearing Walls.** The minimum thickness of bearing walls of masonry shall be twelve inches (12") for the uppermost thirty-five feet (35') of their height and shall be increased four inches (4") in thickness for each successive thirty-five feet (35') or fraction thereof measured downward from the top of the wall.

Exceptions: 1. The top story walls of a building not exceeding three stories or thirty-five feet (35') in height or the walls of a one-story building may have a wall thickness equal to the least dimensions as set forth in Table No. 24-C.

2. The thickness of grouted brick masonry walls may be two inches (2") less than required by this subsection but in no case less than as set forth in Table No. 24-C.

3. In residence buildings not more than three stories in height, masonry walls may be of eight inches (8") nominal thickness when not over thirty-five feet (35') in height. Such walls in one-story single-family dwellings, and one-

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General
Requirements
(Cont'd.)TABLE NO. 24-B—MORTAR PROPORTIONS OF
CEMENTITIOUS MATERIALS
(by volume)

Type	Minimum Portland Cement	Maximum Hydrated Lime or Lime Putty	Masonry Cement	Maximum Dry Loose Aggregate
			Type II	
Type A	1 part	$\frac{1}{4}$ part	.....	3 parts
Type B	1 part	$\frac{1}{2}$ part	.....	4½ pts.
Type C	1 part	1 part	.....	6 parts
Type C	.....	.....	1 part	3 parts

TABLE NO. 24-C—MINIMUM THICKNESS OF
MASONRY WALLS

Type of Masonry	Maximum Ratio Unsupported Height or Length to Thickness	Nominal Minimum Thickness (Inches)
Plain Solid Masonry	20	8
Grouted Brick Masonry	22	7
Reinforced Brick Masonry	25	7
Hollow Unit Masonry	18	8
Cavity Wall Masonry	12	10
Stone Masonry (Ashlar)	14	12
Interior Non-Bearing	48	2

TABLE NO. 24-D—ALLOWABLE SHEAR ON BOLTS

Diameter of Bolt (Inches)	Plain, Grouted, and Hollow Unit Masonry	
	Embedment (Inches)	Shear (Pounds)
$\frac{1}{2}$	4	350
$\frac{5}{8}$	4	500
$\frac{3}{4}$	5	750
$\frac{7}{8}$	6	1000
1	7	1250
$1\frac{1}{8}$	8	1500

story private garages, may be of six inches (6") nominal thickness when not over nine feet (9') in height, provided that when gable construction is used, an additional six feet (6') is permitted to the peak of the gable.

This exception shall not apply to cavity wall or stone masonry.

(c) **Non-Bearing Walls and Partitions.** Wire mesh may be used to resist tensile stresses when embedded in plaster applied to the surface of the wall. Plaster shall be as specified in Chapter 47.

(d) **Change in Thickness.** When a change in thickness due to minimum thickness requirements occurs between floor levels

the greater thickness shall be carried to the higher floor level.

(e) **Chases.** Chases in masonry walls shall not be deeper than one-third the wall thickness nor longer than four feet (4') horizontally and shall have at least eight inches (8") of masonry in back of the chases and between chases and jambs of openings, provided that in dwellings not over two stories high, chases not over four inches (4") deep, thirty inches (30") wide and twenty-four inches (24") high, may be built in eight-inch (8") walls, and provided that chases below windows may equal the width of the opening above. The back and sides of such chases in exterior walls shall be made water resistant and insulated.

(f) **Supported Members.** When unprotected steel or combustible structural members frame into walls of thickness not greater than twelve inches (12"), they shall have not less than four inches (4") of fire-resistive materials on all sides and ends.

Beams, joists, girders or other concentrated loads supported by a wall or pier shall have bearing at least three inches (3") in length upon solid masonry not less than four inches (4") thick or upon a metal bearing plate of adequate design and dimensions to distribute the loads safely on the wall or pier, or upon a continuous reinforced masonry member projecting not less than three inches (3") from the face of the wall.

(g) **Support.** No masonry shall be supported on combustible construction.

(h) **Anchorage.** Masonry walls that meet or intersect shall be securely bonded or anchored.

Wood joists or wood beams shall be securely anchored to masonry walls at intervals not exceeding four feet (4'), by metal anchors having a minimum cross section of twenty-five hundredths of a square inch (0.25 sq. in.) and at least sixteen inches (16") long, securely fastened to the joists or beams at one end of the anchor by means of a single bolt or other approved method, and the other end of the anchor in the form of a T securely built into the masonry not less than three and one-half inches (3½") with the T vertical.

Where joists run parallel to walls said anchors shall be carried beyond the third joist and shall be solid bridged to the wall. The ends of all wooden beams or joists entering masonry walls shall be cut to a bevel of at least three inches (3").

Structural members framing into or supported by walls or columns shall be adequately anchored.

(i) **Piers.** The height of isolated piers shall not exceed 10 times their least lateral dimension. Every pier whose width is less than three times its thickness shall be designed and constructed as required for columns if such pier is a structural member.

(j) **Openings.** The masonry above openings shall be supported by well buttressed arches or adequately anchored lintels of metal, reinforced masonry, or reinforced concrete, which shall have a minimum bearing of four inches (4"). Timber centering for arches may remain in place provided the opening is not over four feet (4') wide and the timber at each end bears on the wall for a distance not exceeding two inches (2").

(k) **Bolts.** Bolts which are embedded in masonry shall be grouted in place and the connection shall be designed so that

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(Cont'd.)**

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the shear on every bolt is not more than the values set forth in Table No. 24-D.

Plain Solid Masonry

Sec. 2405. (a) General. Plain solid masonry is that form of construction made with brick, solid load-bearing concrete masonry units, or stone in which the units are all laid and set in mortar placed with a trowel.

(b) Construction. Plain solid masonry shall be laid with full header courses at least every sixth course or sixteen inches (16") clear vertically, or there shall be at least one full header in every seventy-two square inches (72 sq. in.) of wall surface. Brick shall be laid with full shoved mortar joints and all head, bed, and wall joints shall be solidly filled with mortar. At the time of laying, clay or shale units shall be clean, damp, and shall have sufficient moisture content so that the amount of water per square inch absorbed during the absorption test is not more than 0.030 ounce.

During the absorption test the surface of the unit shall be held one-eighth inch ($\frac{1}{8}$ ") below the surface for a period of one minute.

(c) Corbeling. Corbels may be built only into solid masonry walls twelve inches (12") or more in thickness. The projection for each course in such corbel shall not exceed one inch (1") and the maximum projection shall not exceed one-third the total thickness of the wall when used to support structural members and not more than six inches (6") when used to support a chimney built into the wall. The top course of all corbels shall be a header course.

(d) Allowable Stresses. The maximum allowable working unit stresses in plain solid masonry shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Grouted Brick Masonry

Sec. 2406. (a) General. Grouted brick masonry is that form of construction made with brick in which interior joints of the masonry are filled by pouring grout therein as the work progresses.

(b) Construction. All brick in the outer tiers shall be laid with full head and bed joints of Type A or B mortar and all interior joints shall be filled with grout. Brick in the interior tiers shall be placed or floated in grout poured between the two outer tiers. One of the outer tiers may be carried up not more than three courses before grouting but the other shall be carried up not more than one course above the grout. Each pour of grout shall be stopped at least one and one-half inches ($1\frac{1}{2}$ ") below the top and properly stirred. The longitudinal vertical joints shall be not less than three-fourths inch ($\frac{3}{4}$ ") wide. Head or end joints shall be not less than one-half inch ($\frac{1}{2}$ ") wide. Bonding headers shall not be used.

(c) Allowable Stresses. The allowable unit working stresses in grouted brick masonry shall not exceed the values set forth in Table No. 24-E, except as provided in Chapter 23.

Reinforced Brick Masonry

Sec. 2407. (a) General. The compressive strength of masonry, f'_m , shall be determined by tests on masonry prisms or may be assumed to be 60 per cent of the compressive strength

TABLE NO. 24-E—WORKING STRESSES IN UNREINFORCED MASONRY

MATERIAL Grade of Unit	WORKING STRESS LB. PER SQUARE INCH GROSS AREA								
	TYPE A MORTAR			TYPE B MORTAR			TYPE C MORTAR		
	Com- pression	Tension in Flexure	Shear	Com- pression	Tension in Flexure	Shear	Com- pression	Tension in Flexure	Shear
Plain Solid Brick Masonry									
4500 lb. p.s.i.....	250	20	20	225	15	15	200	15	15
2500 lb. p.s.i.....	175	20	20	160	15	15	140	15	15
1500 lb. p.s.i.....	125	20	20	115	15	15	100	15	15
Grouted Brick Masonry									
4500 lb. p.s.i.....	350	25	25	275	20	20	—	—	—
2500 lb. p.s.i.....	275	25	25	215	20	20	—	—	—
1500 lb. p.s.i.....	225	25	25	175	20	20	—	—	—
Concrete Units—Solid									
Type A.....	175	12	12	150	12	12	125	12	12
Type B.....	125	12	12	115	12	12	100	12	12
Hollow Unit Masonry.....	85	12*	12*	75	10*	10*	70	10*	10*
Cavity Wall Masonry									
Solid Units.....	125*	12*	12*	115*	10*	10*	100*	10*	10*
Hollow Units.....	60*	12*	12*	55*	10*	10*	50*	10*	10*
Stone Masonry									
Cast Stone.....	400	12	12	350	12	12	320	12	12
Natural Stone.....	125	8	8	125	8	8	125	8	8
Gypsum Masonry.....	20	—	—	20	—	—	20	—	—

*Net Area.

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**Reinforced
Brick
Masonry
(Cont'd.)**

of the brick used with grout and Type A mortar, or 45 per cent of the compressive strength of the brick used with grout and Type B mortar, but such assumed compressive strength shall not exceed a value of 2,000 pounds per square inch or 1,500 pounds per square inch respectively.

Tests made to determine the strength f'_m shall be made on not less than five prisms built of the material called for by design, cured in moist atmosphere for 15 days and then allowed to dry at least 30 days before testing. Tests shall be made in accordance with the procedure required for testing concrete cylinders. The prisms for beams and slabs shall be approximately eight by eight by twenty-five inches (8"x8"x25"), built in a horizontal position with unselected brick laid as stretchers in running bond, two bricks wide and three courses high, with one-half-inch ($\frac{1}{2}$ ") joints. Prisms representing walls shall be approximately eight by sixteen inches (8"x16") in plan and sixteen inches (16") high. Those representing columns and pedestals shall be approximately eight by eight inches (8"x8") in plan and sixteen inches (16") high. The bonding arrangement of the brick shall be similar to that in the structures represented. The compressive f'_m value shall be the average value of all prisms tested.

Reinforcement shall conform to the requirements of Section 2604.

(b) **Construction.** Only grouted brick masonry shall be used and such masonry shall conform to all of the construction requirements specified in Section 2406 (b).

The thickness of grout or mortar between brick and steel shall be not less than one-fourth inch ($\frac{1}{4}$ "), except that one-fourth-inch ($\frac{1}{4}$ ") bars may be laid in one-half-inch ($\frac{1}{2}$ ") horizontal mortar joints. Vertical reinforcing shall be accurately placed and held in position before brickwork is started.

**TABLE NO. 24-F—WORKING STRESS IN
REINFORCED BRICK MASONRY**

TYPE OF STRESS	FOR ANY STRENGTH OF BRICK MASONRY f'_m
	(Pounds per Square Inch) [SEE SECTION 2407 (a)]
Compression—Axial	0.18 f'_m
Compression—Flexural	0.33 f'_m
Shear—No Web Reinforcement	0.015 f'_m
Shear—Web Reinforcement, taking $\frac{2}{3}$ of vertical and $\frac{1}{3}$ of horizontal shear	0.033 f'_m
Bearing	0.25 f'_m
Modulus of Elasticity	1000 f'_m
Modulus of Rigidity	400 f'_m
Bond Type A Grout	
Plain Bars	80
Deformed Bars	100

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Horizontal reinforcement may be placed as the brickwork progresses.

In addition to the minimum required reinforcement, at least one one-half-inch ($\frac{1}{2}$ ") bar or equivalent shall be placed on all sides of every opening which exceeds twenty-four inches (24") in either dimension. The bars shall extend twenty-four inches (24") beyond the corners of the opening.

(c) **Design.** The design of reinforced brick masonry shall be based on the assumptions, limitations, and methods of stress determination specified for reinforced concrete in Chapter 26 and shall conform to the additional requirements of this Chapter.

In reinforced masonry walls, the minimum area of reinforcement shall be not less than 0.002 times the cross-sectional area of the wall, not more than two-thirds of which may be used in either direction. A lesser amount of reinforcement may be used to resist tensile stresses if the masonry is designed under limitations and stresses specified for unreinforced masonry. No required vertical reinforcement shall be less than three-eighths inch ($\frac{3}{8}$ ") in diameter.

(d) **Stresses.** The allowable unit working stresses in reinforced brick masonry shall not exceed the values set forth in Table No. 24-F, except as provided in Chapter 23.

**TABLE NO. 24-G—MINIMUM ULTIMATE
COMPRESSIVE STRENGTH**

Reinforced Gypsum

CLASS	MIXTURE	COMPRESSIVE STRENGTH (Pounds per Sq. In.)
1	Neat (gypsum and water only)	1800
2	Not more than 3 per cent by weight of wood chips, shavings or fiber	1000
3	Not more than 12½ per cent by weight of wood chips, shavings or fiber	500

TABLE NO. 24-H—WORKING STRESSES

Reinforced Gypsum

TYPE OF STRESS	WORKING STRESS (Pounds Per Sq. In.)		
	Class 1	Class 2	Class 3
Compression—flexural	350	220	125
Compression—bearing	200	165	100
Bond (Reinf. Anchored)	36	20	10
Shear (Reinf. Anchored)	36	20	10
Modulus of Elasticity	1,000,000	600,000	200,000

**Hollow Unit
Masonry**

Sec. 2408. (a) General. Hollow unit masonry is that type of construction made with structural clay tile or hollow concrete masonry units in which the units are all laid and set in mortar. Types A, B, or C mortar shall be used in such construction except that interior non-bearing masonry of hollow units may be laid up in gypsum mortar.

(b) **Construction.** Hollow masonry units shall have full mortar coverage of the face shells in both horizontal and vertical joints. Where two or more hollow units are used to make up the thickness of the wall, the stretcher courses shall be bonded at vertical intervals not exceeding thirty-four inches (34") by lapping at least three and three-fourths inches (3¾") over the unit below, or by lapping with units at least 50 per cent greater in thickness than the units below at vertical intervals not exceeding seventeen inches (17"). Where walls of hollow masonry units are decreased in thickness a course of solid masonry not less than four inches (4") in height shall be interposed between the wall section below such point and that next above, or special units or construction shall be used to adequately transmit the loads from the shells above to those below.

(c) **Stresses.** The allowable unit working stresses in hollow unit masonry shall not exceed the values set forth in Table No. 24-E or as provided in this Section, except as provided in Chapter 23.

(d) **Reinforced Filled Cell Construction.** In walls of hollow unit masonry, structural members may be built by filling continuous cores or spaces with concrete or grout in which reinforcement is embedded. Such members may be designed as specified for reinforced brick masonry in Section 2407. The area of such core walls in contact with the fill, and of the face shells of units containing such cores not exceeding the length of one unit, may be included in the computation of the effective areas of the section. In such walls the required horizontal steel may be concentrated in bond beams and at the tops and bottoms of walls and openings. The minimum steel required shall be calculated on the gross area of the wall.

The value of f'_m may be assumed as provided in Section 2407 (a), applying the designated percentages to the net compressive strength of the units. The value of f'_m may be determined by tests as provided in Section 2407 (a) based on specimens of the dimensions specified for beams and slabs, which may be built of units in the form of hollow squares laid with the mortar and filled with the concrete or grout on which the design is based.

**Cavity Wall
Masonry**

Sec. 2409. (a) General. Cavity wall masonry is that type of construction made with brick, structural clay tile or hollow concrete masonry units or any combination of such units in which facing and backing are completely separated except for the metal ties which serve as bonding. Type A, B, or C mortar shall be used in cavity wall masonry except that Type A mortar shall be used in cavity walls having a nominal thickness of ten inches (10").

Cavity walls ten inches (10") in thickness shall not exceed twenty-five feet (25') in height, and in no case shall any cavity wall exceed thirty-five feet (35') in height.

(b) **Construction.** In cavity walls neither the facing nor the backing shall be less than four inches (4") in thickness and the cavity shall be not less than two inches (2") nor more than three inches (3") in width. The facing and backing of cavity walls shall be securely tied together with suitable non-corrosive bonding ties of adequate strength. There shall be at least one three-sixteenths inch (3/16") diameter steel rod or equivalent metal tie for each three square feet (3 sq. ft.) of wall surface placed in the horizontal mortar joints of the facing and backing. Where hollow masonry units are laid with cells vertical, rectangular ties shall be used. The ends of ties shall be bent to 90 degree angles to provide hooks not less than two inches (2") long. Additional bonding ties shall be placed around the perimeter of all openings and shall be spaced not more than three feet (3') apart and within one foot (1') of the opening.

(c) **Stresses.** The allowable unit working stresses in cavity wall construction shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Sec. 2410. (a) General. Stone masonry is that form of construction made with natural or cast stone in which the units are laid and set in mortar, with all joints thoroughly filled.

**Stone
Masonry**

Walls of rubble stone masonry shall be at least four inches (4") greater in thickness than specified for ashlar stone masonry in Section 2404.

(b) **Construction.** All ashlar stone masonry shall be so laid that there is at least one bond stone extending through the wall for every five stretchers. Such bond stones shall be uniformly distributed throughout the wall.

(c) **Stresses.** The allowable unit working stresses in ashlar stone masonry shall not exceed the values set forth in Table No. 24-E, except as provided in Chapter 23.

Sec. 2411. (a) General. Gypsum masonry is that form of construction made with gypsum block or tile in which the units are laid and set in gypsum mortar. No gypsum masonry shall be used in any bearing wall or in any location where the gypsum will be directly exposed to moisture or weathering.

**Gypsum
Masonry**

(b) **Construction.** All units in gypsum masonry shall be placed in side construction with cells horizontal and the bonding of units in such masonry shall comply with the requirements for bonding of hollow unit masonry as specified in Section 2408 (b). The entire bearing surface of every unit shall be covered with mortar spread in an even layer and all joints shall be filled with mortar.

(c) **Stresses.** The allowable unit working stresses in gypsum masonry shall not exceed the values set forth in Table No. 24-E except as provided in Chapter 23.

Sec. 2412. (a) General. Reinforced gypsum shall consist of a mixture of gypsum with or without wood chips, shavings or fiber or other approved aggregates, premixed at the mill,

**Reinforced
Gypsum**

Reinforced Gypsum (Cont'd.)

with only water added at the job. Reinforced gypsum shall not be used in any bearing wall or in any location where the gypsum is directly exposed to moisture or weathering.

Precast reinforced gypsum shall contain not more than three per cent, and cast-in-place reinforced gypsum not more than 12½ per cent of wood chips, shavings, or fiber measured as a percentage by weight of the dry mix.

Reinforced gypsum shall develop the minimum ultimate compressive strength in pounds per square inch set forth in Table No. 24-G when dried to constant weight, with tests made on cylinders six inches (6") in diameter and twelve inches (12") long.

Tests, when required, shall follow the procedure specified in Section 2-2 of A.S.A. "Building Requirements for Reinforced Gypsum Concrete," (A59.1-1941).

(b) **Design.** Except as hereinafter provided, methods of design admitting of rational analysis according to established principles of mechanics shall be used. The general assumptions and principles established for reinforced concrete shall also apply to reinforced gypsum insofar as they are pertinent.

For precast floor and roof slabs which cannot be analyzed in accordance with established principles of mechanics, the safe load, uniformly distributed, shall be taken as one-fifth of the total load causing failure in a full-size test panel with the load applied along two lines each distant one-fourth of the clear span from the support.

The minimum thickness of reinforced gypsum in floors and roofs shall be two inches (2") except in the suspension system, which shall be not less than three inches (3"). Hollow precast reinforced gypsum units for roof construction shall be not less than three inches (3") thick and the shell not less than one-half inch (½") thick.

Precast gypsum units for floor and roof construction shall be reinforced and, unless the shape or marking of the unit is such as to insure its being placed right side up, the reinforcement shall be placed symmetrically so that the unit can support its load either side up.

In floor or roof slabs of the suspension type, the reinforcement shall consist of wires with continuity through multiple spans and anchored at the ends. The wires shall be supported in the top of the slab by the roof or floor beams and shall be tightly drawn down as near to the bottom of the slab at mid-span as fire protection requirements will allow, but not closer than one-half inch (½"). Provisions shall be made in the framing of the end bays of this system for resisting the forces due to end anchorage of the wires. The wires shall be designed for a tension in pounds per foot width of slab equal to:

$$\frac{wL^2}{8d}$$

WHERE

w = the total load in pounds per square foot.

L = the clear span in feet.

d = the sag of the wires in feet.

(c) **Stresses.** The working stresses in reinforced gypsum shall not exceed the values set forth in Table No. 24-H except as provided in Chapter. 23.

CHAPTER 25—WOOD

Quality and Design

Sec. 2501. (a) General. The quality and design of all wood members used for load-supporting purposes in buildings or other structures shall conform to the standards specified in this Chapter.

(b) **Workmanship.** All members shall be so framed, anchored, tied, and braced together as to develop the strength and rigidity necessary for the purposes for which they are used.

(c) **Fabrication.** Preparation, fabrication, and installation of wood members, and glues and mechanical devices for the fastening thereof, shall conform throughout to good engineering practices.

(d) **Grade and Species.** The species and grade of all wood used for load-bearing purposes shall be shown on the plans filed with the Building Department.

Sizes

Sec. 2502. (a) Required Size. All wood structural members shall be of sufficient size to carry the dead and required live loads without exceeding the allowable working stresses as hereinafter specified.

(b) **Size Defined.** Minimum sizes of lumber members required by this Code refer to nominal sizes. American Lumber Standard dressed sizes shall be accepted as the minimum net sizes conforming to nominal sizes. Computations to determine the required sizes of members shall be based on the net dimensions (actual size) and not the nominal sizes. If rough sizes or finish sizes exceeding American Lumber Standard dressed sizes are to be used, computations may be predicated upon such actual sizes, provided they are specified on the plans. Nominal sizes may be shown on the plans.

Allowable Unit Stresses

Sec. 2503. (a) Working Stress—General. Stresses in pounds per square inch for permanent loads shall not exceed the allowable working stresses, except as hereinafter modified, for the respective species and grades set forth in Table No. 25-A; provided, however, other stress grades may be approved, and stresses for species and grades not given in the following tables shall be established, by the Building Official in accordance with the principles set forth in American Lumber Standards, Simplified Practice Recommendation R16-39, and Guide to the Grading of Structural Timber and Determination of Working Stresses, Miscellaneous Publication No. 185, United States Department of Agriculture, dated February, 1934. Stresses that exceed those set forth in Table No. 25-A for the lowest structural grade of any species shall be used only when the higher grade of that species is identified by the grade mark of, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent.

Studding, posts, joists, rafters, planks, beams, stringers, and similar load-bearing members shall be 900#f grade or better.

(b) **Duration of Load.** For the case of members designed for a live load that will be intermittent, or of infrequent occurrence and duration of less than 24 hours insofar as maximum conditions are concerned, unit stresses may be increased 25 per cent. Such increase shall be applicable to roof rafters, roof joists and roof trusses. Such increase shall not be applicable

Sec. 2413. (a) General. Masonry of glass blocks may be used in any non-bearing wall if designed and constructed in conformity with this section. **Glass Masonry**

(b) **Horizontal Forces.** The block shall be restrained laterally by an approved mechanical device capable of resisting the horizontal forces specified in Section 2312 for bearing walls.

(c) **Maximum Size of Panels.** No panel of glass block masonry shall exceed thirteen feet (13') in any dimension or one hundred forty-four square feet (144 sq. ft.) in area.

(d) **Expansion Joints.** Every glass block panel shall be provided with one-half-inch ($\frac{1}{2}$ ") expansion joints between the edges of the panel and the supporting structural members.

Sec. 2414. (a) Material. Materials used in the backing and facing of faced walls shall conform in all respects to the requirements prescribed for such materials in Section 2402. The facing shall be not less than two and one-fourth inches ($2\frac{1}{4}$ ") thick, and in no case less in thickness than one-eighth the height of the unit. **Faced Walls**

(b) **Allowable Stresses.** The stresses in faced walls shall not exceed the allowable stress for the weakest of the combinations of units and mortars of which the wall is composed. Where bonded to the backing as prescribed in Section 2405 (b), the full cross section of both the facing and the backing may be considered in computing the stresses.

(c) **Thickness.** Faced walls shall be not less in thickness than is required for masonry walls of the weakest of the combinations of units and mortars of which the wall is composed. Where bonded to the backing as provided in Section 2405 (b), the facing may be considered a part of the wall thickness.

(d) **Bond.** Ashlar facing of either natural or cast stone shall have at least 20 per cent of the superficial area extending not less than three and three-fourths inches ($3\frac{3}{4}$ ") into the backing to form bond stones, which shall be uniformly distributed throughout the wall.

Every projecting stone, and, except when alternate courses are full bond courses, every stone not a bond stone, shall be securely anchored to the backing with substantial noncorrodible metal anchors with a cross section of not less than two-tenths of a square inch (0.2 sq. in.). There shall be at least one anchor to each stone and not less than two anchors for each stone more than two feet (2') in length and three square feet (3 sq. ft.) in superficial area. Facing stones not over twelve square feet (12 sq. ft.) in area shall have at least one anchor to each four square feet (4 sq. ft.) of superficial face area.

When walls of structural clay tile or hollow concrete masonry units are faced with hollow units, the facing units shall be bonded to the backing as required by Section 2408 (b).

Facing of grouted masonry construction as specified in Section 2406 need be neither bonded nor anchored, provided the bond of grout to facing unit will develop a strength in shear of not less than 50 pounds per square inch.

Sec. 2415. Masonry of Unburned Clay Units. See Appendix.

where the dead load is greater than the live load, nor to the minimum required live loads on floors, nor shall it be applicable to columns. Allowable unit stresses may be used without allowance for impact up to impact of 100 per cent of live loads figured.

(c) **Conditions of Exposure.** For special conditions of moisture or service, adequate protection of lumber shall be provided or the working stresses set forth in Table No. 25-A shall be reduced as required by the Building Official.

(d) **Working Stress—Joint Details.** 1. **COMPRESSION.** Allowable unit compression stresses perpendicular to grain set forth in Table No. 25-A shall be increased in accordance with the following factors for bearings less than six inches (6") in length and located three inches (3") or more from the end of a timber.

Length of bearing (inches)	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	3	4	6 or more
Factor	1.85	1.60	1.45	1.30	1.15	1.10	1.00

For stress under a washer or small plates the same factor may be taken as for a bearing, the length of which equals the diameter of the washer.

2. **SHEAR.** Allowable unit stresses for joint details shall be 150 per cent of the horizontal shear values set forth in Table No. 25-A.

(e) **Plywood Stresses.** Working stresses of plywood shall not exceed the values set forth in the bulletin, "Methods of Calculating the Strength of Plywood," issued by the Forest Products Laboratory, April 17, 1942.

Plywood of Douglas fir shall conform to U. S. Commercial Standard CS 45-45. Plywood of other species, when used structurally, shall be identified as to veneer grade and glue type by an approved agency and shall meet the performance standards in U. S. Commercial Standard CS 45-45 for its type.

Sec. 2504. The maximum allowable unit stress in horizontal shear in beams and other members in flexure shall be computed by use of the following formula:

$$H = \frac{3R}{2bh}$$

WHERE

H=maximum unit horizontal shear, pounds per square inch

b=breadth of beam, inches

h=height of beam, inches

R=Reaction, pounds, under the following conditions:

- (1) Distribution of load to adjacent beams through flooring or other members shall be considered.
- (2) All loads uniform or concentrated, within a distance of the height of the beam from the nearest support shall be neglected.
- (3) All concentrated loads located at a distance from the support of one to three times the height of the beam shall be considered as placed at three times the height of the beam from the support.

TABLE NO. 25-A—ALLOWABLE UNIT STRESSES IN WOOD
Continuously Dry Locations—Long Time Loading

SPECIES	COMMERCIAL GRADE	ALLOWABLE UNIT STRESSES, POUNDS PER SQ. INCH					Rules under which Graded
		Com- pression Parallel to Grain (Short Columns $L/d =$ 11 or less)	Com- pression Perpen- dicular to Grain	Extreme Fiber in Bending (and Tension Parallel to Grain)	Maximum Horizontal Shear	Modulus of Elasticity	
	SYMBOL:	c or p	q	f	H	E	
Tidewater Red Cypress	1400 # f Tidewater Red Cypress 1100 # f Tidewater Red Cypress 1200 # o Tidewater Red Cypress 1000 # o Tidewater Red Cypress	 1200 1000	300	1400 1100	120 100	1,200,000	Southern Cypress Mfgs. Assn., Jacksonville, Fla., dated Jan. 1, 1941
Douglas Fir (Coast Region)	Dense Select Structural— 210 ^a , 214 ^a , 218 ^a , Select Structural—210 ^a , 214, 218 ^a No. 1 Timbers—200 ^a 1400f—215a or 219 ^a 1200f—215 or 219 ^a 900f—216 ^a	1300 1200 1100 1100 1000 900	380 345 325 380 325 325	1800 1600 ... 1400 1200 900	120 100 ... 120 100 90	1,600,000	West Coast Bureau of Lum- ber Grades and Inspec- tion, Seattle, Wash. Standard Grading and Dressing Rules No. 12, dated March 1, 1943
West Coast Hemlock	1200f—498, 500 ^a 900f—499 ^a No. 1 Timbers—503 ^a	900 700 900	300	1200 900	85 75 ...	1,400,000	
Douglas Fir (Inland Empire)	Select Structural Structural Common Structural	1466 1175 1050	380 335 315	1800 1600 1200	120 85 80	1,600,000 1,500,000 1,500,000	Western Pine Assn., Portland, Ore., dated July 1, 1942
Larch	Select Structural Structural Common Structural	1466 1200 1100	380 345 325	1800 1600 1200	133 100 90	1,300,000	

Eastern Hemlock	Select Structural 1000 SG Eastern Hemlock 900 SG Eastern Hemlock 800 SG Eastern Hemlock	700	300	1100 1000 900 800	70 52 52 52	1,100,000	Northern Hemlock & Hdwd. Mfrs. Assn., Oshkosh, Wis., dated June 27, 1941
Oak	1800f Oak, Red and White 1600f Oak, Red and White 1400f Oak, Red and White 1200f Oak, Red and White 1100c Oak, Red and White 1000c Oak, Red and White 900c Oak, Red and White	 1100 1000 900	500	1800 1600 1400 1200	120 120 120 100	1,500,000	Nat'l Hardwood Lumber Assn., Chicago, Ill., dated Jan. 1, 1941
Longleaf So. Pine	Select Structural Prime Structural Merchantable Structural Structural Sq. Edge and Sound No. 1 Structural No. 1 L.L. Dimension No. 2 L.L. 1050f Dimension	1450 1300 1200 1200 1000	380	2000 1800 1600 1600 1400 1400 1050	100 ^a 100 100 100 100 100 100	1,600,000	Southern Pine Inspection Bureau of Southern Pine Association, New Orleans, La., dated May 28, 1940 ^a
Shortleaf So. Pine	Dense Select Structural Dense Structural Dense Str. Sq. Edge and Sound Dense No. 1 Structural No. 1 Dense Dimension No. 1 Dimension No. 2 Dense—1050f Dimension No. 2 Medium Grain—900f Dim.	1450 1300 1200 1000	380	2000 1800 1600 1400 1400 1200 1050 900	100 ^a 100 100 100 100 100 100 100	1,600,000	
Redwood	Dense Select All-heart Structural Select All-heart Structural	1200 1200	267	1400 1200	80 70	1,200,000	California Redwood Assn., San Francisco, Calif., dated May, 1940

NOTES:

¹This grade not intended to be used in bending.²Numbers refer to paragraph numbers, W.C.B.L.G.I.—Standard Grading and Dressing Rules No. 12.³With slope of grain not more than one inch (1") in ten inches (10").⁴Southern Pine Inspection Bureau adopted "1939 Standard Specification for Southern Pine Lumber" in May, 1940.⁵For other shear values see paragraphs 368 and 450 of S.P.I.B. grading rules.

Horizontal shear for notched members shall be computed in accordance with stress values specified in Section 2521.

Columns

Sec. 2505. Columns, including struts and other members in compression parallel to grain, shall be designed structurally as follows:

(a) **Short Columns.** The safe load, in pounds per square inch of net cross sectional area, for columns and other members stressed in compression parallel to the grain, with a ratio of unsupported length to least dimension l/d not exceeding 11 (short columns), shall not exceed the allowable unit compression stress parallel to grain for short columns, as set forth in Table No. 25-A, i.e.:

$$\frac{P}{A} = c$$

(b) **Intermediate Columns.** For columns with a ratio of unsupported length to least dimension greater than 11 (intermediate columns), the following formula shall be used until the reduction in allowable stress equals one-third the stress permitted for short columns:

$$\frac{P}{A} = c \left[1 - \frac{1}{3} \left(\frac{l}{Kd} \right)^4 \right]$$

(c) **Long Columns.** For columns with a ratio of unsupported length to least dimension greater than K , (long columns), the safe unit load shall be determined by the following formula:

$$\frac{P}{A} = \frac{\pi^2 E}{36 \left(\frac{l}{d} \right)^2} = \frac{0.274 E}{\left(\frac{l}{d} \right)^2}$$

WHERE

P —total load in pounds

A —area in square inches of net cross-section

P

—working stress or maximum load per square inch

A

c —allowable unit stress in compression parallel to grain for short columns (see Table No. 25-A).

l —unsupported length of column in inches

d —least dimension of column in inches

E —modulus of elasticity

K —the — at the point of tangency of the parabolic and Euler d

curves, at which point

$$\frac{P}{A} = \frac{2c}{3}$$

$$K = \frac{\pi}{2} \sqrt{\frac{E}{6c}}$$

Columns shall be limited in maximum length between points of lateral support to $l=50d$, except as specified in Section 2516.

(d) **Round Columns.** The safe load on a column of round cross-section shall not exceed that permitted for a square column of the same cross-sectional area.

Sec. 2506. Members subject to both axial and bending stresses shall be proportioned in accordance with the following formula: **Combined Stresses**

$$\frac{P/A}{c_1} + \frac{M/S}{f_1} \text{ equals or is less than 1.}$$

WHERE

P=total axial load (in pounds).

A=area (in square inches) of net cross-section.

c₁=allowable unit axial stress permitted for members acting solely as a column (see Table No. 25-A and Section 2505).

M=total bending moment in inch pounds resulting from load causing flexure.

S=section modulus (in inches cubed) for net cross section.

f₁=allowable unit fiber stress in bending permitted for member (see Table No. 25-A).

Sec. 2507. The unit stress normal to a plane inclined to the fiber of a wood member shall not exceed that determined from the formula:

**Compression
on Inclined
Surfaces**

$$n = \frac{p q}{p \sin^2 \theta + q \cos^2 \theta}$$

WHERE

n=allowable unit stress on inclined surface, pounds per square inch.

p=allowable compressive unit stress parallel to grain (see Table No. 25-A).

q=allowable compressive unit stress perpendicular to grain (see Table No. 25-A).

θ=angle between the direction of the load and the direction of the grain in degrees.

Sec. 2508. (a) Design of Bolted Joints. Bolted joints where in bolts are used to resist stresses in wood structures shall be designed in accordance with the principles set forth in the "Wood Handbook," U. S. Department of Agriculture, 1940, and in addition thereto shall comply with the requirements of this Section.

**Bolted
Joints**

(b) Safe Loads, Double Shear. Safe loads, in pounds on bolts in seasoned lumber of the following species: cedar, eastern red; cypress, southern; Douglas fir (coast region); larch, western; pine, southern yellow; redwood and tamarack, in joints consisting of three members in which the side members are one-half the thickness of the main member, shall not exceed values set forth in Tables No. 25-B and 25-C.

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**Bolted
Joints**
(Cont'd.)

(c) **Loads at Angle to Grain.** When a force is applied by means of a bolt at an angle with the fiber of a wood member, the safe load shall be determined in accordance with the formula:

$$n = \frac{pq}{p \sin^2 \theta + q \cos^2 \theta}$$

WHERE

n = safe load in pounds on bolt.

p = safe load on bolt parallel to grain as set forth in Table No. 25-B.

q = safe load on bolt perpendicular to grain as set forth in Table No. 25-C.

θ = angle between direction of load and direction of member, in degrees.

TABLE NO. 25-B—HOLDING POWER OF BOLTS
Loads Parallel to Grain (p)

Length of Bolt in main member, in inches*	Diameter of Bolt in Inches						
	½	¾	¾	7/8	1	1½	1¾
2	960	1280	1550	1820	2080		
3	1050	1620	2160	2660	3090		
4	1050	1640	2360	3110	3850		
5	1050	1640	2360	3210	4160	5150	
6		1640	2360	3210	4190	5330	
7		1640	2360	3210	4190	5330	
8		1640	2360	3210	4190	5330	6550
10				3210	4190	5330	6550
12					4190	5330	6550

* This assumes full size lumber, i.e., not dressed sizes.
Safe loads on dressed sizes may be obtained by interpolation.

TABLE NO. 25-C—HOLDING POWER OF BOLTS
Loads Perpendicular to Grain (q)

Length of Bolt in main member, in inches*	Diameter of Bolt in Inches						
	½	¾	¾	7/8	1	1½	1¾
2	460	520	570	640	700		
3	690	780	890	960	1050		
4	810	1040	1160	1280	1400		
5	780	1150	1440	1600	1750	1900	
6		1110	1540	1880	2100	2280	
7		1060	1500	1970	2390	2660	
8		980	1440	1940	2460	2940	3273
10				1800	2340	2970	3610
12					2180	2820	3460

* This assumes full size lumber, i.e., not dressed sizes.
Safe loads on dressed sizes may be obtained by interpolation.

(d) **Bolts in Other Species of Wood.** For species of wood other than those set forth in Tables No. 25-B and 25-C, bolt values shall be derived in accordance with the principles stated in the "Wood Handbook," U. S. Department of Agriculture, 1940.

**Bolted
Joints
(Cont'd.)**

(e) **Joints Other than Double Shear.** When a joint consists of two members (single shear) of equal thickness, one-half the tabulated load for a piece twice the thickness of one of the members shall be used. When members of a two-member joint are of unequal thickness, one-half the tabulated load for a piece twice the thickness of the thinner member shall be used.

For multiple-member joints other than two or three members, the load for each shear plane shall be computed in the same manner as for a two-member joint.

(f) **Metal Side Plates.** When metal plates are used each side of a wood member, tabulated bolt values may be increased one-quarter for values parallel to the grain.

(g) **Joints in Wet Locations.** When the joint is to be used in a location "occasionally wet but quickly dried," tabulated bolt values shall be reduced one-quarter.

In locations "usually wet," tabulated bolt values shall be reduced one-third.

(h) **Definition of Seasoned Lumber.** "Seasoned lumber" for the purpose of this Section, is defined as lumber which has been air-dried for at least 60 days, or which has at the time of installation in the structure reached a moisture content approximately equal to that which it will eventually contain in service.

Where green or recently cut lumber is used, tabulated bolt values shall be reduced one-third.

(i) **Bolt Holes.** Bolt holes in wood members shall be made the same diameter as the bolt, unless otherwise specified on plans. Bolt holes may be specified to be not more than one-sixteenth of an inch larger than the bolt, in which case allowable loads shall be reduced 10 per cent.

(j) **Bolt Hole Spacing.** "Row of Bolts" is defined as a number of bolts placed in a line parallel to the direction of load.

Minimum center-to-center spacing of bolts in any one row for full design loads shall be four times the bolt diameter. In no case shall the bolt bearing capacity of any member be exceeded.

Spacing center-to-center between rows of bolts for loads perpendicular to grain shall be not less than two and one-half times the bolt diameter for an l/d ratio of two, and not less than five times the bolt diameter for l/d ratios of six or more. Intermediate values shall be directly interpolated.

Spacing center-to-center between rows of bolts for loads parallel to grain shall be such that the net tension area remaining at a critical section shall be not less than 80 per cent for softwoods, and 100 per cent for hardwoods, of the total area in bearing under all bolts in the particular timber.

End margin is defined as the distance from the end of a bolted member to the center of the bolt hole nearest the end. This distance, for a member in tension, shall be not less than

seven times the bolt diameter for softwoods and five times for hardwoods. End margin, for members in compression, shall be not less than four times the bolt diameter.

Edge margin is defined as the distance from the edge of the timber to the center of the nearest bolt hole. For members loaded perpendicular to grain, edge margin nearest the edge toward which the load is acting shall be at least four times the bolt diameter. For members loaded parallel to grain, edge margin shall be at least one and one-half times the bolt diameter.

Timber Connectors

Sec. 2509. Joints wherein timber connectors are used with bolts to transmit stresses between structural or load-bearing members shall be designed in accordance with the principles and recommended safe loads set forth in the "Wood Handbook," U. S. Department of Agriculture, 1940.

Safe loads and design practice for types of connectors not mentioned or fully covered by the above publication may be determined from other published recommendations, provided such recommendations are first approved by the Building Official. Allowable load values for timber connectors shall be based on empirical test data. Connector safe load values shall be determined from the combined resistance of the connector and its bolt.

Cylindrical Pins

Sec. 2510. In connections involving the use of tightly fitting cylindrical pins of iron, steel, heavy steel pipe or hardwood, the allowable load on a pin shall be determined in the same manner as for bolts as set forth in the "Wood Handbook," U. S. Department of Agriculture, 1940.

Lag Screws

Sec. 2511. Connections involving the use of lag screws shall be designed in accordance with the provisions of Technical Bulletin 597, "Lag-Screw Joints: Their Behavior and Design," U. S. Department of Agriculture, 1938.

Wood Screws

Sec. 2512. (a) Shear Connections. A wood screw used to fasten a metal plate to a wooden member or a wooden member to a wooden member shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wood screw as set forth in Table No. 25-D. Screws shall have an embedment into the farther member of at least six-tenths of the length of the screw. The length of the screw shall be not less than seven times the diameter of the screw.

(b) Tension Connections. A wood screw inserted perpendicular to the grain of the wood shall not be subjected to a greater load tending to cause withdrawal than the safe resistance of the screw to withdrawal as set forth in Table No. 25-E.

A wood screw inserted parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

Nails

Sec. 2513. (a) Safe Lateral Strength. A wire nail inserted perpendicular to the grain of the wood when used to fasten wooden members together, shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wire nail or spike as set forth in Table No. 25-F.

A wire nail inserted parallel to the grain of the wood shall not be subjected to more than three-fourths of the lateral load allowable when inserted perpendicular to the grain.

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Tables 25D-25G

**TABLE NO. 25-D—SAFE LATERAL RESISTANCE
OF WOOD SCREWS
In Pounds Per Screw**

Kind of Wood	Gauge of Screw					
	12	14	16	18	20	22 24
Douglas fir	159	198	239	287	335	400 460
Redwood	124	155	190	230	272	320 372
Other Species	As determined by the Building Official.					

**TABLE NO. 25-E—SAFE RESISTANCE OF WOOD
SCREWS TO WITHDRAWAL**

**When Inserted Perpendicular to Grain of Wood in Pounds per
Linear Inch of Screw**

Kind of Wood	Gauge of Screw				
	12	16	20	22	28
Douglas fir	125	140	150	170	185
Redwood	75	85	90	100	110
Other Species	As determined by the Building Official.				

**TABLE NO. 25-F—SAFE LATERAL STRENGTH OF
COMMON WIRE NAILS**

**Inserted Perpendicular to the Grain of the Wood,
in Pounds Per Nail**

Kind of Wood	Size of Nail									
	6d	8d	10d	12d	16d	20d	30d	40d	50d	60d
Length of Nail	2"	2½"	3"	3¼"	3½"	4"	4½"	5"	5½"	6"
Douglas fir or Southern Pine	70	100	120	130	160	190	230	270	310	360
Redwood	58	82	98	106	123	155	188	220	250	295
Other Species	As determined by the Building Official.									

**TABLE NO. 25-G—SAFE RESISTANCE TO WITHDRAWAL
OF COMMON WIRE NAILS**

**Inserted Perpendicular to the Grain of the Wood, in Pounds
Per Linear Inch of Penetration into the Main Member**

Kind of Wood	Size of Nail									
	6d	8d	10d	12d	16d	20d	30d	40d	50d	60d
Douglas Fir or Southern Pine or Redwood	27	29	35	35	39	48	52	56	61	67
Other Species	As determined by the Building Official.									

(b) **Safe Resistance to Withdrawal.** A wire nail inserted perpendicular to the grain of the wood shall not be subjected to a greater load, tending to cause withdrawal, than the safe resistance of the nail to withdrawal, as set forth in Table No. 25-G.

Nails inserted parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

(c) **Spacing and Penetration.** Nails shall not be driven closer together than one-half their length unless driven in bored holes nor closer to the edge of the timber than one-quarter their length. Holes for nails when necessary to prevent splitting, shall be bored of diameter smaller than that of the nails. Nails shall be of such length that, when joining one timber to another, the penetration of the nail into the second or farther timber shall be not less than one-half the length of the nail.

Washers

Sec. 2514. All bolts in direct tension shall be provided with steel plate washers under heads and nuts. The area of these washers must be such that the unit bearing stress on the wood shall not exceed the allowable unit stress. The washer shall be not less in thickness than one-tenth the diameter or the length of the longer side of the washer.

Bolts taking shear only shall have Standard O. G. malleable iron washers, or equivalent, under head and nuts.

Columns or Posts

Sec. 2515. For allowable unit stresses see Sections 2503, 2504, 2505, and 2506.

All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to hold securely the column or post in position and to protect its base from deterioration; and shall be supported in basements by footings projecting at least two inches above the finished floor and separated therefrom by a metal plate of not less than one-quarter inch ($\frac{1}{4}$ ") thickness.

Preservatives shall be applied to column ends where necessary to protect against dampness.

Untreated wood columns in basements, when built into masonry partitions or walls, shall be exposed on at least two sides.

Wood posts, where used as foundations below ground and as piles, (except for minor structures), shall be pressure-treated with an approved preservative.

Built-Up Columns or Compression Members

Sec. 2516. (a) Built-Up Columns. The compressive strength of built-up columns or compression members, when composed of two or more members spiked or bolted together, either with or without spacing blocks between members, shall be taken as the combined compressive strength of the individual pieces, each considered as an independent column; provided, however, that compression members which are fastened together by bolts and timber connectors, or otherwise used in such a manner as to approach fixed-end conditions, or which are laterally braced parallel to the least dimension of the individual members, may be calculated as having 80 per cent of the compressive strength of long columns having a slenderness ratio $\frac{l}{d}$ based on the least over-all dimension of the composite member.

slenderness ratio $\frac{l}{d}$
based on the least over-all dimension of the composite member.

(b) **Spaced Columns.** Spaced columns or compression members shall be based upon design principles acceptable to the Building Official, or the design principles set forth for spaced columns in "National Design Standard for Stress-Grade Lumber and Its Fastenings," National Lumber Manufacturers' Association, 1914.

Sec. 2517. (a) End Bearing. Every beam, girder, and joist shall have end bearing in accordance with compression perpendicular to grain values set forth in Table No. 25-A, but the length of end bearing shall never be less than three inches (3") on masonry or concrete or one and one-half inches (1½") on wood or metal, except that joists when nailed to the adjacent studs may be supported on a one-inch (1") let-in ribbon.

Wood members bearing on or in contact with masonry or concrete at or below adjacent ground level shall be treated with an approved preservative or provided with a moisture-resistant separation over bearing or contact.

(b) **Vertically Laminated Members.** 1. **BEAMS.** Laminated built-up beams with laminations perpendicular to the plane of the neutral axes shall be considered as having the same resistance to bending moment as solid members of the same size and area, if the laminations are not cut between the ends of the members.

2. **SLABS.** A laminated lumber slab built up of planks set on edge, when meeting the following requirements, may be designed as a solid floor or roof slab of the same thickness, and continuous spans may be designed on the basis of the full cross-section using the simple span moment coefficient:

- (1) Planks shall be driven up and spiked closely together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed eighteen inches (18") for two-by-eight-inch (2"x8") nominal plank and be proportional for other plank widths. Nail length shall be equal to two and one-half times the net plank thickness.
- (2) A single span slab shall have all planks full length.
- (3) A continuous slab of two spans shall have not more than each fourth plank spliced between supports.
- (4) A continuous slab of more than two spans shall have not less than each third plank spliced between supports.
- (5) Joints shall be closely butted over supports or staggered across the slab but within the adjoining quarter-spans. No plank shall be spliced more than twice in any span. (See also Section 3104.)

3. **OTHER TYPES.** Types of built-up members not mentioned in this Code may be designed and constructed as recommended in the "Wood Handbook," U. S. Department of Agriculture, 1940.

(c) **Floor Joist Bridging.** Solid wood blocking of two-inch (2") nominal thickness, wood cross bridging of not less than one inch by four inches (1"x4"), or metal cross bridging of equal strength, shall be placed between joists where the joist span exceeds eight feet (8'). The distance between lines of bridging or between bridging and bearing shall not exceed

**Horizontal
Members**

eight feet (8'). Solid blocking shall be placed between joists at all points of support and at all points where flooring is not continuous, except that bridging may be omitted when the joists are nailed to studs. The lower ends of the cross bridging shall be driven up and nailed after the floor or subfloor has been nailed.

(d) **Double Joists.** Joists under and parallel to bearing partitions shall be doubled and well spiked or may be separated by solid bridging spaced at not more than four-foot (4') intervals.

(e) **Special Framing.** Header joists over six feet (6') long and tail joists over twelve feet (12') long shall be hung in joist or beam hangers, or secured by other devices affording equivalent support. Trimmers and header joists more than four feet (4') long shall be doubled. Headers shall be not less than twenty inches (20") from face of chimney breast. Trimmers and headers shall be not less than two inches (2") from the flue or chimney.

(f) **Entering Masonry or Concrete.** Wood members entering masonry or concrete walls shall be not less than four inches (4") from other wood members entering from opposite side of wall nor from the exterior face of wall, except on street fronts.

Ends of wood members entering masonry or concrete walls, unless treated with an approved preservative, shall be provided with a one-half-inch ($\frac{1}{2}$ ") air space on sides, top, and end, and shall be beveled so that top edge does not enter masonry or concrete more than one inch (1").

(g) **anchors and Ties.** Interior wood floor framing above the first floor that abuts or joins masonry or concrete walls shall be securely anchored thereto at not more than four-foot (4') intervals.

Wood in Combination with Masonry or Concrete

Sec. 2518. No structural masonry or concrete shall be supported by wood members except wood piling as specified in Section 2803, except that wood may be combined structurally with masonry or concrete if provision is made for the different rigidities and other properties of the materials.

Cutting and Notching

Sec. 2519. Girders, beams, or joists may be notched or bored in any part of the section within three times the beam depth from either support. Such notches or holes shall not exceed one-fifth of the depth of beam except at point of support and as hereinafter provided.

Where girders, beams, or joists are notched at points of support they shall meet design requirements for net section in bending and also for shear. The unit shearing stress at such point shall be calculated by the following formula and shall not exceed the values set forth in Table No. 25-A:

$$H = \frac{3V}{2bd} \times \frac{h}{d}$$

WHERE

V=vertical shear at section under consideration.

b=width of beam.

d=actual depth of beam at the notch.

h=total depth of beam.

H=allowable unit horizontal shear stress.

Where notches or holes are made in other portions of the beam, the net remaining depth of beam shall be used in determining the bending strength.

Sec. 2520. Floor joists supporting plastered ceilings shall be so proportioned that their deflection under full live load and dead load exclusive of weight of plaster, shall not exceed one three-hundred-and-sixtieth of the span length.

Deflection

Sec. 2521. (a) **Placing.** Studs in walls and partitions may be placed with the longest dimension parallel with the wall or partition, provided the studs are considered as columns and comply with the column formulas. Such walls shall have top and bottom plates except when framed as provided in Section 2517, first paragraph.

Stud Walls and Partitions

(b) **Plates.** In bearing partitions the top plate shall be doubled and lapped at each intersection with walls or partitions. Joints in the upper and lower members of the top plate shall be staggered not less than four feet (4').

(c) **Bridging.** All stud partitions or walls over ten feet (10') in height shall have herringbone bridging, not less than two inches (2") in thickness and of the same width as the stud, fitted snugly and spiked into the studs at mid-height of stud, or other means for giving equal lateral support to the studs. Herringbone bridging may serve as fire-stopping as required in Section 2522.

(d) **Size and Height.** Exterior stud walls and bearing partitions for buildings of two stories or less shall consist of not less than two-inch by four-inch (2"x4") studs; for buildings of three stories, the studding shall be not less than three-inch by four-inch (3"x4") or two-inch by six-inch (2"x6") to the bottom of the second floor joists and two-inch by four-inch (2"x4") for the two upper stories. Maximum allowable height of two-inch by four-inch (2"x4") and three-inch by four-inch (3"x4") stud framing shall be fourteen feet (14') and of two-inch by six-inch (2"x6") stud framing shall be twenty feet (20') unless the wall is supported laterally by adequate framing. No studding shall be spaced more than sixteen inches (16") center, except that in lieu of this requirement the studs and plates may be designed as a system of columns and beams, provided structural grade material is used, or such walls may be constructed of not less than four-inch by four-inch (4"x4") posts spaced not more than five feet (5') on centers or of larger members designed as required in this chapter, or may be of post and beam framing with plank sheathing not less than one and one-half inches (1½") thick or may be of laminated construction not less than four inches (4") nominal in thickness with the structural assembly properly designed to support all loads.

One-story buildings having a total floor area of not more than four hundred square feet (400 sq. ft.) may have exterior walls of vertical one-inch (1") boards and battens without studs.

(e) **Base Plates.** Stud walls resting on masonry shall have base plates or sills of foundation grade redwood, cedar, cypress or wood treated with approved preservative. Such sills shall be

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bolted to the masonry at corners and between corners with bolts not less than one-half inch ($\frac{1}{2}$ ") in diameter, embedded not less than seven inches (7") into the masonry and spaced not more than six feet (6') apart, center to center. These sills shall be not less than the width of the studs nor less than two inches (2") thick.

(f) **Corners and Bracing.** Angles at corners where stud walls or partitions meet shall be framed solid so that no lath can extend from one room to another. All exterior and main cross stud partitions shall be effectively and thoroughly braced.

(g) **Pipes in Walls.** Stud partitions containing plumbing, heating or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged with solid bridging. Where plumbing, heating or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less than one-eighth inch ($\frac{1}{8}$ ") thick and one-and one-half inches ($1\frac{1}{2}$ ") wide shall be fastened to the plate across and to each side of the opening with not less than four 16d nails.

(h) **Chimney Space.** Wood lath, furring or framing shall be placed not less than two inches (2") from any chimney and not less than four inches (4") from the back of any fireplace.

(i) **Underpinning.** The underpinning of bearing stud walls shall be so constructed as to resist the design forces.

Underpinning shall be not less in size than the studding above, and when exceeding four feet (4') in height shall be of the size required for an additional story.

No underpinning shall be less than fourteen inches (14") in height. Underpinnings of bearing walls and partitions shall be thoroughly and effectively braced.

(j) **Headers.** All wall openings four feet (4') wide or less shall be provided with double headers not less than two inches (2") thick, placed on edge, securely fastened together, and such headers shall have two-inch (2") solid bearing to the floor or bottom plate. All openings more than four feet (4') wide shall be trussed or provided with lintels which shall have not less than two-inch (2") solid bearing at each end to the floor or bottom plate.

Fire Stops

Sec. 2522. Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal), and form an effective fire barrier between stories, and between a top story and the roof space. It shall be used in specific locations, as follows:

1. In exterior or interior stud walls, at ceilings and floor levels.
2. In all stud walls and partitions, including furred spaces, so placed that the maximum dimension of any concealed space is not over seven feet (7').

3. In furred masonry walls.
4. Between stair stringers at least once in the middle portion of each run, at top and bottom, and between studs, along and in line with run of stair adjoining such partition.
5. Around top, bottom, sides and ends of sliding door pockets.
6. In spaces between chimneys and wood framing, loose incombustible materials shall be placed in incombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.
7. Any other locations not specifically mentioned above, such as holes for pipes, shafting, etc., which could afford a passage for flames.

Fire stops when of wood shall be two-inch (2") nominal thickness. If width of opening is such that more than one piece of lumber is necessary, there shall be two thicknesses of one-inch (1") material with joints broken.

Sec. 2523. The space between bottom of floor joists and the ground of any building (except such space as is occupied by a basement or cellar) shall be provided with a sufficient number of ventilating openings through foundation walls or exterior walls to insure ample ventilation, and such openings shall be covered with a corrosion-resistant wire mesh with openings in such mesh not greater than one-half inch ($\frac{1}{2}$ ") nor less than one-fourth inch ($\frac{1}{4}$ ") in any dimension. The minimum total area of ventilating openings shall be proportioned on the basis of two square feet (2 sq. ft.) for each twenty-five linear feet (25 lin. ft.) or major fraction thereof of exterior wall. Such openings need not be placed in the front of the building.

Minimum clearance between bottom of floor joists and the ground beneath shall be eighteen inches (18").

Sec. 2524. Wood diaphragms may be used to distribute horizontal forces to resisting elements such as walls or partitions, provided the maximum deflection in the plane of the diaphragm, as determined by tests or analogies drawn therefrom, does not exceed the permissible deflection of such wall or partition.

In determining the permissible deflection of walls or partitions, the actual elastic properties of the materials (modulus of elasticity, allowable extreme fiber stresses, etc.) may be determined by tests or other data acceptable to the Building Official, or the assigned values for such properties elsewhere herein provided shall be used.

In determining the maximum horizontal deflection of a proposed wood diaphragm under assumed design loads, data from actual tests of diaphragms corresponding to the type proposed may be used or an analogy may be drawn from data furnished in an article entitled "Tests Indicate Design Methods for Earthquake-Proof Timber Floors" appearing in Building Standards Monthly, June, 1943, or in "The Rigidity and Strength of Frame Walls" and "Plywood as a Structural Covering for Frame Walls and Wall Units," published by the U. S. Forest Products Laboratory.

Foundation Ventilation

Wood Diaphragms

Connections and anchorage of wood diaphragms to resisting elements shall be provided along all the margins of the diaphragm. Such connections shall be capable of resisting the design loads or forces elsewhere herein prescribed.

Termite Provisions

Sec. 2525. For additional termite and fungus precautions, see Appendix.

Glues

Sec. 2526. (a) **Definitions.** **Glued Built-Up Sections**—Structural elements consisting of wood, plywood, or combinations of the two in which the grain is not parallel and in which all pieces are bonded together with glue.

Glued Laminated Structural Lumber—Lumber consisting of laminations in which the grain of all laminations is approximately parallel and where all laminations are bonded together with glue.

Joint—The contact surface between two adjacent pieces of wood. An "edge or face joint" is parallel to the grain of the wood. An "end or butt joint" is at right angles to the grain of the wood. A "scarf joint" is a sloping or bevel joint, where pieces of wood are lapped together.

Moisture Content—The amount by weight of water in wood computed as a percentage of the oven-dry weight of the wood.

(b) **General Requirements.** Glues shall provide an adequate bond, shall subject the wood to no deleterious chemical reactions, and shall not support the growth of micro-organisms under any conditions of use. Glues used in a structural assembly of wood shall conform to the provisions of this section and Section 2527.

(c) **Use.** Type I glue shall be used only in the interior of buildings where the moisture content of the wood is not permitted to exceed 18 per cent.

Type II glue may be used under any conditions of exposure.

(d) **Fabrication.** Structural gluing shall be done only by an approved fabricator.

Tests for Glues

Sec. 2527. (a) **General.** If sufficient evidence on the type of glue to be used is not available, the Building Official may require tests to be made as specified in this section.

(b) **Test Samples.** Each test series shall consist of a minimum of nine samples. One test series shall be required for each type and brand of glue to be used and each species of wood to be used.

Samples shall be prepared as specified in A.S.T.M. "Tentative Specifications for Testing Veneer, Plywood, and Other Wood and Wood-Base Materials," (D805-45T).

(c) **Tests for Type I Glue.** Test samples shall be submerged in water at room temperature for a period of 48 hours, followed by drying at a temperature not to exceed 100 degrees Fahrenheit for a period of 20 hours. This cycle shall be repeated with the drying period extending until these samples attain a moisture content not to exceed 18 per cent. Test samples shall have an average shear resistance of at least five times the allowable shear stress in the wood. None of the samples shall show evidence of delamination after the submersion test.

(b) **Laminations.** In members subject to bending stresses, all laminations shall be approximately parallel to the neutral plane of the beam. Members shall consist of three or more laminae.

(c) **Thickness.** Individual laminations shall be not more than two inches (2") in thickness.

(d) **Variation in Laminae.** Adjacent laminae shall not differ by more than 35 per cent in allowable stress, and all lumber shall be stress graded.

(e) **Grading.** Lumber shall be stress graded. In members for exterior use, the diameter of any knot appearing at a glue joint on a face of the member shall be limited to one inch (1").

(f) **Moisture Content.** The maximum moisture content of the wood at the time of gluing shall not exceed 18 per cent and shall not be less than seven per cent. No lamina shall have a moisture content differing by more than three per cent from the average moisture content of the assembly.

(g) **Surfaces.** Surfaces to be glued shall be free from dust, dirt, and grease. Individual laminae shall have machined surfaces with a maximum tolerance of one-sixty-fourth inch (1/64"). Lumber surfaces shall not be sanded before gluing.

**Allowable
Stresses
and Design
in Glued
Construction**

Sec. 2529. (a) General. The allowable stresses in glued laminated structural lumber shall be as specified in this section. Whenever glued laminated lumber is an integral part of glued built-up sections, it shall conform to all requirements and be subject to the same working stresses provided for glued laminated lumber in this chapter. Stresses used to design the plywood members of glued built-up sections shall not exceed the values specified in Section 2503 (e).

(b) **Columns.** The formulas used in the design of solid wood columns shall apply to the design of glued laminated lumber columns.

(c) **Compression.** The allowable axial compressive stress parallel to the grain permitted in Section 2503 shall be increased 40 per cent for glued laminated lumber of the same stress grade. Where the member is composed of laminations having different stress grades, the compressive strength of the lowest stress grade shall govern.

The allowable compressive stress perpendicular to the grain shall be the same for glued laminated lumber as for solid lumber of the same stress grade.

(d) **Flexure.** The allowable extreme fiber stresses in bending may be increased 20 per cent. When the lumber in the middle three-fifths of the depth of cross-section in a glued laminated beam is of lower grade, the allowable unit stresses in bending for the grade in the outer two-fifths shall apply without increase.

(e) **Combined Bending and Compression.** Combined bending and compression shall be determined according to Section 2506.

(f) **Tension.** Axial tension may be increased 20 per cent over the allowable for solid lumber of the same grade. Tension perpendicular to the grain shall be one-seventh of the allowable compressive stress perpendicular to the grain.

(d) **Tests for Type II Glue.** Three test samples shall be glued for each combination of glue and species of wood to be used. Each shall consist of six laminations of clear lumber, three-fourths inch ($\frac{3}{4}$ ") thick by six inches (6") wide by fifteen inches (15") long. The laminations shall have a moisture content between eight and 12 per cent at the time of gluing. Gluing shall be done in accordance with the glue manufacturer's instructions. After gluing and before testing, the samples shall be conditioned for not less than 14 days at a room temperature not higher than 85 degrees Fahrenheit.

Not less than 10 standard glue joint shear blocks shall then be cut from each sample (an equal number from each glue joint) and shall be tested at a moisture content of 10 to 12 per cent. The average shear strength value for the glue joints from the three beams shall be not less than 90 per cent of the average shear strength at 12 per cent moisture for the species of wood (see Table 8, column 14, "Wood Handbook," U.S. Department of Agriculture, 1940), and the average wood failure shall be not less than 75 per cent.

A section three inches (3") along the grain shall be cut from each test sample and shall be tested as follows:

The test samples shall be immersed in water at room temperature under a vacuum of not less than twenty inches (20") for two hours. A pressure of 75 pounds per square inch shall then be applied for two hours. Relieve pressure and repeat vacuum-pressure treatment. The immersion shall be continued at atmospheric pressure for 16 hours, making total soaking period of 24 hours. The wet samples shall then be dried in a room at a relative humidity of 30 per cent or less and a temperature of 70 to 85 degrees Fahrenheit for three days with forced circulation of air, making the total soaking-drying cycle of four days.

At the end of three such cycles, the glue joints shall show not more than 10 per cent of delamination measured on the length of the glue joint exposed on the end grain faces of the test samples.

As an alternate to the foregoing soaking-drying cycle, the specimens may be placed in water at room temperature for not less than 15 days, after which they shall be dried in a room at a relative humidity of 30 per cent or less and a temperature of 70 to 85 degrees Fahrenheit for three days and with forced circulation of air, making a total soaking-drying cycle of 18 days. Repeat soaking-drying cycle twice, for a total of three cycles (54 days).

(e) **Shear Test Procedure.** The shear test shall conform to the A.S.T.M. "Tentative Specifications for Testing Veneer, Plywood, and Other Wood and Wood-Base Materials," (D805-45T).

Sec. 2528. (a) General. Glued laminated lumber and built-up sections shall be constructed as required by this section.

**Glued
Construction**

Exception: Subsections (b) and (c) of this section shall not apply to glued laminated lumber in which the allowable working stresses do not exceed those specified in Section 2503.

(g) **Shear.** Horizontal shear shall be the greatest allowable unit shear allowed for lumber in the Code for a given species.

(h) **Curved Portions.** In curved portions, the allowable unit stress in bending shall be modified by multiplication by the following factor:

$$1 - 2000 \left(\frac{t}{r} \right)^2$$

WHERE

t = thickness of lamination in inches.

r = radius of curvature in inches.

All end joints in the laminations where the radius of curvature is less than 150 times the thickness of the laminations shall be scarfed.

(i) **Allowable Stresses on Joints.** For purposes of design wood shall be assumed to be continuous across the edge on a face joint or across a scarf joint. End joints, and scarf joints sloping more than one to 12, shall not be assumed to carry stress.

(j) **Scarfed Joints.** In that portion of glued laminated lumber which is stressed to more than one-half of its allowable axial stress, the end joints in lamination shall be scarfed. All scarfed joints shall approximate the slope of the grain of the lumber and shall be in the same general direction as the slope of the grain, but shall not be required to be flatter than one to 12.

Sec. 2530. Stressed skin panels shall be designed in accordance with the publication, "The Designing for Strength of Flat Panels with Stressed Coverings," issued by the Forest Products Laboratory, March, 1940.

**Stressed Skin
Panel Design**

CHAPTER 26—CONCRETE—REINFORCED AND PLAIN

REINFORCED CONCRETE

- Quality** **Sec. 2601.** The quality of the materials used in concrete and the quality of concrete shall conform to the physical and chemical properties as specified in Sections 2604, 2605, and 2606.
- Design** **Sec. 2602.** The design of reinforced concrete shall conform to the rules and principles specified in this Chapter.
- Definitions** **Sec. 2603.** The following definitions give the meaning of certain terms as used in this Chapter.
- Aggregate**—Inert material which is mixed with portland cement and water to produce concrete.
- Column**—An upright compression member the length of which exceeds three times its least lateral dimension.
- Column Capital**—An enlargement of the upper end of a reinforced concrete column designed and built to act as a unit with the column and flat slab.
- Column Strip**—A portion of a flat slab panel one-half panel in width occupying the two quarter-panel areas outside of the middle strip, and extending through the panel in the direction in which bending moments are being considered.
- Combination Column**—A column in which a structural steel section, designed to carry the principal part of the load, is wrapped with wire and encased in concrete of such quality that some additional load may be allowed.
- Composite Column**—A column in which a steel or cast-iron section is completely encased in concrete containing reinforcement of spiral reinforcement and longitudinal bars.
- Concrete**—A mixture of portland cement, fine aggregate, coarse aggregate and water.
- Deformed Bar**—Reinforcing bars with closely spaced shoulders, lugs or projections formed integrally with the bar during rolling so as to firmly engage the surrounding concrete. Wire mesh with welded intersections not farther apart than twelve inches (12") in the direction of the principal reinforcement and with cross wires not smaller than No. 10 W. & M. Gauge may be rated as a deformed bar.
- Diagonal Band**—A group of bars covering a width approximately 0.4 the average span, symmetrical with respect to the diagonal running from corner to corner of the panel of a flat slab.
- Direct Band**—A group of bars, covering a width approximately 0.4 l , symmetrical with respect to the center lines of the supporting columns of a flat slab.
- Dropped Panel**—The structural portion of a flat slab which is thickened throughout an area surrounding the column capital.
- Effective Area of Concrete**—The area of a section which lies

between the centroid of the tensile reinforcement and the compression face of a slab or beam.

Effective Area of Reinforcement—The area obtained by multiplying the right cross-sectional area of the metal reinforcement by the cosine of the angle between its direction and that for which the effectiveness of the reinforcement is to be determined.

Flat Slab—A concrete slab reinforced in two or more directions, generally without beams or girders to transfer the loads to supporting columns.

Laitance—Extremely fine material of little or no hardness which may collect on the surface of freshly deposited concrete or mortar, resulting from the use of excess mixing water and usually recognized by its relatively light color.

Middle Strip—A portion of a flat slab panel one-half panel in width, symmetrical with respect to the panel center line and extending through the panel in the direction in which bending moments are being considered.

Mortar—A mixture of portland cement, fine aggregate and water.

Negative Reinforcement—Reinforcement so placed as to take tensile stress due to negative bending moment.

Paneled Ceiling—The ceiling of a flat slab in which approximately that portion of the area enclosed within the intersection of the two middle strips is reduced in thickness.

Panel Length—The distance along a panel side from center to center of columns of a flat slab.

Pedestal—An upright compression member whose height does not exceed three times its least lateral dimension.

Plain Concrete—Concrete without metal reinforcement, or reinforced only for shrinkage or temperature changes.

Pneumatically Placed Concrete—A mixture of portland cement and fine aggregate, mixed dry, passed through a cement gun, or other similar device, hydrated at the nozzle and deposited under pressure in its place of final repose. It shall be considered as concrete for particulars of design as specified in this Chapter.

Portland Cement—The product obtained by finely pulverizing clinker produced by calcining to incipient fusion an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

Positive Reinforcement—Reinforcement so placed as to take tensile stress due to positive bending moment.

Ratio of Reinforcement—The ratio of the effective area of the reinforcement cut by a section of a beam or slab to the effective area of the concrete at that section.

Reinforced Concrete—Concrete in which metal other than that provided for shrinkage or temperature changes is embedded in such a manner that the two materials act together in resisting forces.

Surface Water—The water carried by the aggregate except that held by absorption within the aggregate particles themselves.

Two-Way Slab—A concrete slab reinforced in two directions and supported on four sides.

Materials

Sec. 2604. (a) Portland Cement. Portland cement shall conform to the A.S.T.M. "Standard Specifications for Portland Cement," (C150-44).

(b) Concrete Aggregates. Concrete aggregates, except lightweight aggregates, shall conform to the A.S.T.M. "Standard Specifications for Concrete Aggregates," (C33-44) including the methods of sampling and testing.

Lightweight aggregates for concrete shall conform to the A.S.T.M. "Standard Specifications for Lightweight Aggregates for Concrete," (C130-42) including the methods of sampling and testing.

Aggregates that do not meet the above specifications and that have been shown by test or actual service to produce concrete of the required strength, durability, watertightness and wearing qualities, may be used under the provisions of Section 2606, Method 2, where authorized by the Building Official.

The maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between forms of the member for which the concrete is to be used nor larger than three-fourths of the minimum clear spacing between reinforcing bars.

(c) Water. Water used in mixing concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter or other harmful substances.

(d) Metal Reinforcement. Metal reinforcement shall conform to the requirements of the A.S.T.M. "Standard Specifications for Billet-Steel Bars for Concrete Reinforcement" (A15-39) or the A.S.T.M. "Standard Specifications for Rail-Steel Bars for Concrete Reinforcement" (A16-35) or the A.S.T.M. "Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement," (A82-34) or the A.S.T.M. "Standard Specifications for Axle-Steel Bars for Concrete Reinforcement," (A160-39); provided, that hard grade steel bars larger than three-fourths inch ($\frac{3}{4}$ " in diameter shall not be used where bending would be required; and provided, further, that the requirements in the above-mentioned specifications for machining of deformed bars shall be eliminated.

All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturers' guarantee of grade which will identify variations.

Deformed bars, to receive that rating which permits the use of bond stresses higher than those allowed for plain bars, shall show a bond strength 25 per cent greater than that shown by plain bars of equivalent cross-sectional area.

(e) Storage. Storage of cement and aggregates shall be in a manner to prevent deterioration or the intrusion of foreign matter. Any material which has been damaged shall be immediately and completely removed from the work.

Sec. 2605. On concrete work the Building Official shall have the right to require the owner or his agent to make tests of the concrete and other materials from time to time to determine whether the materials and methods in use are such as to produce concrete or reinforced concrete of the quality specified and used in the design of the building or structure. The tests shall be made, when ordered by the Building Official, by the owner or his authorized representative and no responsibility for the expense of these tests shall attach to the Building Department. All such tests shall be made by an approved agency, and copies of the results shall be kept on file in the office of the Building Official for a period of not less than two years after the acceptance of the structure. Specimens for concrete cylinder tests shall be taken at the place where the concrete is being deposited and shall be taken, cured and tested in accordance with the A.S.T.M. "Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field," (C31-44).

Tests

The Building Official shall have the right to order the test under load of any portion of a completed structure, when the conditions have been such as to leave reasonable doubt as to the adequacy of the structure to serve the purpose for which it is intended.

Load Tests

When a load test is required, the member or portion of the structure under consideration shall be subject to a superimposed load equal to one and one-half times the live load plus one-half of the dead load. This load shall be left in position for a period of 24 hours before removal. If, during the test, or upon removal of the load, the member or portion of the structure shows evident failure, such changes or modifications as are necessary to make the structure adequate for the rated capacity shall be made; or, where lawful, a lower rating shall be established. The structure shall be considered to have passed the test if the maximum deflection at the end of the 24 hour period does not exceed the value of D as given by the following:

$$D = \frac{.001 L^3}{12I} \dots \dots \dots (1)$$

WHERE:

L is the span, I is the total depth of the slab or beam and D is the maximum deflection—all expressed in the same units.

If the deflection exceeds the value of D as given in formula (1), the construction shall be considered to have passed the test if within 24 hours after the removal of the load the slabs or beams show a recovery of at least 75 per cent of the observed deflection.

Sec. 2606. For the design of concrete structures, the value of f'_c used for determining the working stresses as stipulated in Section 2613 shall be based on the specified minimum ultimate 28-day compressive strength of the concrete, or on the specified minimum ultimate compressive strength at the earlier age at which the concrete may be expected to receive its full

Quality of Concrete

**Strength—
Quality of
Materials**

**TABLE NO. 26-A—ASSUMED STRENGTH OF
CONCRETE MIXTURES**

Water-Content U. S. Gallons Per 94-lb. Sack of Cement		Assumed Compressive Strength at 28 Days
U.S. Gallons	Cu. Ft.	p. s. i.
7½	1.00	2000
6¾	.90	2500
6	.80	3000
5	.67	3750

NOTE: In interpreting this table, surface water contained in the aggregate must be included as part of the mixing water in computing the water-content.

load. All plans submitted for approval or used on the job shall clearly show the assumed strength of concrete at a specified age for which all parts of the structure were designed.

All concrete exposed to freezing and thawing weather shall have a minimum ultimate 28-day compressive strength of not less than 3000 pounds per square inch. All other concrete shall have a minimum compressive strength of 2000 pounds per square inch.

The determination of the proportions of cement, aggregate and water to attain the required strengths shall be made by one of the following methods:

Method 1—Concrete made from average materials—When no preliminary tests of the materials to be used are made, the water-content per sack of cement shall not exceed the values set forth in Table No. 26-A. Method 2 shall be employed when artificial aggregates or admixtures are used.

Method 2—Controlled concrete—Proportions of the materials and water-content, other than those set forth in Table No. 26-A, may be used provided that the strength-quality of the materials proposed for use in the structure shall be established by tests which shall be made in advance of the beginning of operations, using the consistencies suitable for the work and in accordance with the A.S.T.M. "Standard Method of Test for Compressive Strength of Molded Concrete Cylinders," (C-39-44). A curve representing the relation between the water-content and the average 28-day compressive strength or earlier strength at which the concrete is to receive its full working load, shall be established for a range of values including all the compressive strengths called for on the plans. The curve shall be established by at least three points, each point representing average values from at least four test specimens. The water-content used in the concrete for the structure as determined from the curve, shall correspond to a strength which is 15 per cent greater than that called for on the plans. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

**Proportions
and
Consistency**

Sec. 2607. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around

reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. The combined aggregates shall be of such composition of sizes that when separated on the No. 4 standard sieve, the weight passing the sieve (fine aggregate) shall be not less than 30 per cent nor greater than 50 per cent of the total unless otherwise required by the Building Official, except that these proportions do not necessarily apply to light-weight aggregates.

Measurement of materials for ready mixed concrete shall conform to the A.S.T.M. "Standard Specifications for Ready Mixed Concrete," (C94-44).

Admixtures of lime or finely pulverized inert materials may be added but not in excess of six per cent by volume of the cement used.

Sec. 2608. The methods of measuring concrete materials shall be such that the proportions of all materials can be accurately controlled during the progress of the work and easily checked at any time by the Building Official or his authorized representative. A tolerance of one-fourth gallon of water per sack of cement in any batch of concrete will be allowed, provided that the average for any 10 consecutive batches does not show a water content greater than that set forth in Table No. 26-A, and on plans as specified in Section 2606.

The method of delivering the aggregates to the work and of storing and handling shall be such that the moisture content of the aggregates as they come to the mixer shall not be subject to frequent or unnecessary changes.

Sec. 2609. (a) Mixing. The concrete shall be mixed until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. In machine mixing, only batch mixers shall be used. Each batch shall be mixed not less than one minute after all the materials are in the mixer and must be discharged completely before the mixer is recharged. Machine mixers shall have a peripheral speed of approximately two hundred feet (200') per minute.

Ready mixed concrete shall be mixed and delivered in accordance with the requirements set forth in the A.S.T.M. "Standard Specifications for Ready Mixed Concrete," (C94-44).

(b) Cleaning Forms and Equipment. Before concrete is placed all equipment for mixing and transporting the concrete shall be cleaned, all debris shall be removed from the spaces to be occupied by the concrete, forms shall be thoroughly wetted (except in freezing weather) or oiled, and masonry that will be in contact with concrete shall be well drenched (except in freezing weather). Reinforcement shall be thoroughly cleaned and secured in position. Concrete shall not be placed until the forms and reinforcement have been inspected and approved by the Building Official.

(c) Removal of Water From Excavations. Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Building Official. Any flow of water into an excavation shall be diverted through proper side

Control of Proportions

Mixing and Placing Concrete

drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. Water vent pipes and drains shall be filled by grouting or otherwise, after the concrete has hardened thoroughly.

(d) **Transporting Concrete.** Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which shall prevent the separation or loss of the ingredients. It shall be deposited as nearly as practicable in its final position to avoid rehandling or flowing. Under no circumstances shall concrete that has attained its initial set be used.

Equipment for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of the materials.

(e) **Placing.** Concrete shall be thoroughly compacted with suitable tools. When necessary, openings shall be provided in the forms to permit the placing of concrete in such a manner as to avoid accumulations of hardened concrete on the forms or reinforcing bars. The concrete shall be thoroughly worked around the reinforcement.

(f) **Curing.** Exposed surfaces of concrete shall be kept moist for a period of at least seven days after being deposited for ordinary cement and three days for high early strength cement.

(g) **Depositing in Cold Weather.** Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers and ground with which the concrete is to come in contact, shall be free from frost. Wherever the temperature of the surrounding air is below 40 degrees Fahrenheit, all concrete when placed in the forms shall have a temperature of between 60 and 90 degrees Fahrenheit and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least 72 hours for normal concrete or 24 hours for high-early-strength concrete, or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact for at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Manure, when used for protection, shall not be applied directly to concrete.

(h) **Bonding Fresh and Hardened Concrete.** Before new concrete is deposited on or against concrete which has set, the forms shall be re-tightened, the surface of the set concrete shall be roughened, cleaned of foreign matter and laitance and thoroughly wetted but not saturated. The clean and wetted surfaces of the hardened concrete, including vertical and inclined surfaces, shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its set. For walls and columns the grout may be omitted on the horizontal surfaces, but a layer of

mortar having the composition of the mortar in the concrete shall be placed before resuming concreting.

Sec. 2610. (a) Design of Forms. Forms shall conform to the shape, lines and dimensions of the member as called for on the plans and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

Forms and Details of Construction

Temporary openings shall be provided at the base of column and wall forms, and at other points where necessary, to facilitate cleaning and inspection.

(b) Removal of Forms. Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal with safety. Shoring shall not be removed until the member has acquired sufficient strength to support safely its own weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to support both the member and construction loads in a manner that will protect the member from damage.

The Building Official may require forms to remain in place for a specified time.

(c) Cleaning and Bending Reinforcement. Metal reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce the bond. Bends for stirrups and ties shall be made around a pin having a diameter not less than two times the minimum thickness of the bar. Bends for other bars, except hooks, shall be made around a pin having a diameter not less than six times the minimum thickness of the bar, except that for bars larger than one inch, the pin shall be not less than eight times the minimum thickness of the bar. All bars shall be bent cold.

(d) Placing Reinforcement. Metal reinforcement shall be accurately placed and secured and shall be supported by chairs, spacers, or hangers. The minimum clear distance between parallel bars shall be one-and-one-half times the diameter for round bars or two times the side dimension for square bars. The minimum clear distance between bars and forms shall be the diameter of round bars and one-and-one-half times the side dimension of square bars. If the ends of bars are anchored as specified in Section 2618 (c), the clear spacing may be made equal to the diameter of round bars or to one-and-one-half times the dimension of square bars, but in no case shall the spacing between bars be less than one inch (1") or less than one-and-one-third times the maximum size of the coarse aggregate. Bars shall be embedded a distance from any face of any member not less than the minimum distance as specified in Section 4301.

When wire or other reinforcement, not exceeding one-fourth inch ($\frac{1}{4}$ ") in diameter is used as reinforcement for slabs not exceeding ten feet (10') in span, the reinforcement may be curved from a point near the top of the slab over the support to a point near the bottom of the slab at mid-span; provided such reinforcement is either continuous over, or securely anchored to the support.

Section 2610

UNIFORM BUILDING CODE

Forms and
Details of
Construction
(Cont'd.)

(e) **Splices and Offsets in Reinforcement.** In slabs, beams and girders, splices of reinforcement shall not be made at points of maximum stress without the approval of the Building Official. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars by bond and shear. In such splices the bars shall be in contact and wired together and the minimum distance specified in subsection (d) of this Section shall be maintained between bars or between wired splices and adjacent bars or splices.

Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall not be more than 1 in 6, and in the case of tied columns the ties shall be spaced not over three inches (3") on centers for a distance of one foot (1') below the actual point of offset.

(f) **Protective Covering of Concrete.** At the under side of footings metal reinforcement shall have a minimum covering of three inches (3") of concrete.

In fire-resistive construction, metal reinforcement shall be protected as specified in Section 4301.

Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion.

(g) **Construction Joints.** Joints not indicated on the plans shall be so made and located as least to impair the strength of the completed structure. Where a joint is to be made, any excess water and laitance shall be removed from the surface after concrete is deposited. Before depositing of concrete is resumed the hardened surface shall be treated as specified in Section 2609 (h).

At least two hours must elapse after concrete is deposited in the columns or walls before depositing in beams, girders, or slabs supported thereon. Haunches and column capitals shall be considered as part of, and to act continuous with, the floor.

Construction joints in floors shall be located near the middle spans of slabs, beams or girders, unless a beam intersects a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. Provision shall be made for shear by use of reinforcement, inclined in both directions across the joint.

Pipes which will contain liquid, gas or vapor at other than room temperature shall not be embedded in concrete necessary for structural stability or fire protection. Drain pipes and pipes whose contents will be under pressure greater than atmospheric pressure by more than one pound per square inch shall not be embedded in structural concrete except in passing through from one side to the other of a floor, wall or beam. Electric conduits and other pipes whose embedment is allowed shall not, with their fittings, displace that concrete of a column on which stress is calculated or which is required for fire protection, to greater extent than four per cent of the area of the cross section. Sleeves or other pipes passing through floors, walls or beams shall not be of such size or in such location as unduly to impair the strength of the construction; such sleeves or pipes may be considered as replacing structurally the displaced concrete, provided they are not exposed to rusting or other deterior-

ation, are of uncoated iron or steel not thinner than standard wrought-iron pipe, have a nominal inside diameter not over two inches, and are spaced not less than three diameters on centers. Embedded pipes or conduits other than those merely passing through shall not be larger in outside diameter than one-third the thickness of the slab, wall or beam in which they are embedded; shall not be spaced closer than three diameters on centers, nor so located as unduly to impair the strength of the construction. Circular uncoated or galvanized electric conduit of iron or steel may be considered as replacing the displaced concrete.

Sec. 2611. The design of reinforced concrete members shall be made with reference to working stresses and safe loads. The accepted theory of flexure as applied to reinforced concrete shall be applied to all members resisting bending. The following assumptions shall be made:

Assumptions for Design

- (1) The steel takes all the tensile stress.
- (2) In determining the ratio n for design purposes, the modulus of elasticity for the concrete shall be taken as $1000f_c$, and that for steel as 30,000,000 pounds per square inch.

Sec. 2612. The symbols and notations used in these regulations are defined as follows:

Symbols and Notations

- a = Width of face of column or pedestal.
- α = Angle between inclined web bars and axis of beam.
- A = Total area of top of pedestal, pier, or footing at the column base.
- A' = Loaded area of pedestal, pier, or footing at the column base.
- A_c = Area of core of a spirally-reinforced column measured to the outside diameter of the spiral; net area of concrete section of a composite column.
- A_g = The overall or gross area of spirally-reinforced or tied columns; the total area of the concrete encasement of combination columns.
- A_s = Area of the steel or cast iron core of a composite column; the area of the steel core in a combination column.
- A_j = Effective cross-sectional area of reinforcement in tension in beams or in compression in columns; the effective cross-sectional area of reinforcement which crosses any of the principal design sections of a flat slab.
- A_w = Total area of web reinforcement in tension within a distance of s , or the total area of all bars bent up in any one plane.
- b = Width of rectangular beam or width of flange of T-beam.
- b' = Thickness of web in beams of I or T sections.
- b_1 = Dimension of the dropped panel of a flat slab in the direction parallel to l_1
- c = Diameter, in feet, of column capital of a flat slab at the underside of the slab, or dropped panel. No portion of the column capital shall be considered for structural purposes which lies outside of the largest 90° cone that can be included within the outlines of the column capital; distance from gravity axis to extreme fiber in compression (in a column).
- C = Moment coefficient for two-way slabs as set forth in Table No. 26-C.

Section 2612

**Symbols and
Notations
(Cont'd.)**
UNIFORM BUILDING CODE

- d = Depth from compression face of beam or slab center to of longitudinal tensile reinforcement; the least lateral dimension of a concrete column; the diameter of a round bar or side of a square bar.
 D = Deflection of a floor member under test load.
 e = Eccentricity of the resultant load on a column, measured from the gravity axis.
 E_o = Modulus of elasticity of concrete in compression.
 E_s = Modulus of elasticity of steel in tension or compression (30,000,000 lbs. per sq. in.).
 f'_c = Compressive unit stress in extreme fiber of concrete in flexure or axial compression in concrete columns.
 f'_c = Ultimate compressive strength of concrete *usually* at age of 28 days. (See Section 2606).
 f_r = Permissible unit stress in the metal core of a composite column.
 f'_r = Permissible unit stress on unencased steel columns and pipe columns.
 f_s = Tensile unit stress in longitudinal reinforcement; nominal working stress in vertical column reinforcement
 f'_s = Useful limit stress of spiral reinforcement.
 f_o = Tensile unit stress in web reinforcement.
 h = Unsupported length of column.
 I = Moment of inertia of a section about the neutral axis for bending.
 j = Ratio of distance between centroid of compression and centroid of tension to the depth (d).
 K = Least radius of gyration of a metal pipe section (in pipe columns).
 l = Span length of beam or slab; span length of flat slab (usually expressed in feet) center to center of columns in the direction in which moments are considered (see Section 2619).
 l_1 = Span length of flat slab panel center to center of columns, perpendicular to the rectangular direction in which moments are considered.
 l' = Clear span for positive moment and the average of the two adjacent clear spans for negative moment (see Section 2614 [a]).
 L = Span of member under load test (see Section 2605).
 m = Ratio of short span to long span for two-way slabs.
 M = Bending moment or moment of resistance in general.
 M_f = Bending moment in foot-pounds per foot of width for two-way slabs.
 M_o = Sum of positive and negative bending moments at the principal design sections of a panel of a flat slab.
 n = Ratio of modulus of elasticity of steel to that of concrete

$$= \frac{E_s}{E_c}$$
 N = Total length of slab periphery which is continuous with adjacent slabs in two-way slabs.
 Σ_o = Sum of perimeters of bars in one set.
 p = Ratio of effective area of tensile reinforcement to effective area of concrete in beams.

- p_g = Ratio of effective cross-sectional area of vertical reinforcement to the gross area A_g (see Section 2620).
- p' = Ratio of volume of spiral reinforcement to the volume of the concrete core (out to out of spirals) of a spirally reinforced concrete column.
- P = Total allowable axial load on a column whose length does not exceed 10 times its least cross-sectional dimension.
- P' = Total allowable axial load on long column.
- r_a = Permissible unit working stress in concrete over the loaded area of a pedestal, pier, or footing.
- R = Least radius of gyration of a section; ratio of gross area to core area of a spirally-reinforced concrete column, $\frac{A_g}{A_c}$.
- s = Spacing of stirrups or of bent bars in a direction parallel to that of the main reinforcement.
- S = Length of short span for two-way slabs.
- t = Thickness of the flange of T-beams; the total thickness or depth of a member under load test.
- t_1 = Thickness of flat slab without dropped panels; or the thickness of flat slabs, including dropped panels where such are used.
- t_2 = Thickness of flat slabs with dropped panels at points outside the dropped panel.
- t_3 = Total thickness of slab for two-way slabs.
- u = Bond stress per unit of surface area of bar.
- v = Shearing unit stress.
- v_c = Unit shearing stress permitted on the concrete of the web.
- V = Total shear.
- V' = Excess of the total shear over that permitted on the concrete.
- w = Uniformly distributed load per unit of length of beam or slab.
- w' = Uniformly distributed dead and live load per unit of area of a floor or roof.
- W = Total dead and live load uniformly distributed over a single panel area.

Sec. 2613. The structural drawings and plans shall show the ultimate strength of concrete for which the several parts of the structures were designed as specified in Section 2606. The working stresses for the design of buildings or structures shall be based on the ultimate strength indicated on the drawings as specified in Section 2606 and shall be in the ratios specified in this Chapter. The ultimate strength (f'_c) shall be the average strength attained at 28 days, based on six-inch by twelve-inch (6"x12") or eight-inch by sixteen-inch (8"x16") cylinders made, cured and tested in accordance with the A.S.T.M. "Standard Methods of Making and Curing Concrete Compression and Flexure Test Specimens in the Field," (C31-44) and A.S.T.M. "Standard Method of Test for Compressive Strength of Molded Concrete Cylinders," (C39-44). Test cylinders of pneumatically placed concrete shall be made in a manner that will permit the blast of air to compact firmly the materials and provide proper

TABLE NO. 26-B—ALLOWABLE UNIT STRESSES
IN CONCRETE

Description		For Any Strength of Concrete as Fixed by Test in Accordance with Sec. 2606 $n = 30000$ f_c	Allowable Unit Stresses			
			$f'_c = 2000$ p. s. i. $n = 15$	$f'_c = 2500$ p. s. i. $n = 12$	$f'_c = 3000$ p. s. i. $n = 10$	$f'_c = 3750$ p. s. i. $n = 8$
Flexure: f_t	f_t	0.45 f'_c	900	1125	1350	1688
Extreme fiber stress in compression						
Shear: τ	τ	0.03 f'_c	40	50	60	75
Beams with no web reinforcement and without special anchorage of longitudinal steel						
Beams with no web reinforcement, but with special anchorage of longitudinal steel	τ	0.03 f'_c	60	75	90	113
Beams with properly designed web reinforcement but without special anchorage of longitudinal steel	τ	0.06 f'_c	120	150	180	225
Beams with properly designed web reinforcement and with special anchorage of longitudinal steel						
Flat slabs at distance d from edge of column capital or dropped panel	τ	0.12 f'_c	240	300	360	450
Footings where longitudinal bars have no special anchorage	τ	0.03 f'_c	60	75	90	113
Footings where longitudinal bars have special anchorage	τ	0.03 f'_c	40	50	60	75
	τ	0.03 f'_c	60	75	90	113
Bond: u	u	0.04 f'_c	80	100	120	150
In beams and slabs and one-way footings:						
Plain bars or structural shapes	u	0.05 f'_c	100	125	150	188
Deformed bars						
In two-way footings:						
Plain bars or structural shapes	u	0.03 f'_c	60	75	90	113
Deformed bars	u	0.0375 f'_c	75	94	112	141
(Where special anchorage is provided (see Sec. 2618c), one and one-half times these values in bond may be used)						
Bearing: f_c	f_c	0.25 f'_c	500	625	750	938
On full area	f_c	0.375 f'_c	750	938	1125	1405
On one-third area*						
Pedestals (see Sec. 2621e)	τ					

*The allowable bearing stress on an area greater than one-third but less than the full area shall be interpolated between the values given.

escapement of the air to eliminate possible back pressure, and such cylinders shall be cured and tested as specified above.

The unit stresses in pounds per square inch on concrete to be used in the design shall not exceed the values set forth in Table No. 26-B where f'_c equals the minimum ultimate compressive strength at 28 days.

The following unit stresses in reinforcing steel shall not be exceeded:

Tension:

Intermediate grade billet steel.....(f_s) = 20,000 p. s. i.
 Rail steel bars.....(f_s) = 20,000 p. s. i.
 Web reinforcement.....(f_s) = 20,000 p. s. i.
 Structural steel shape.....(f_s) = 18,000 p. s. i.
 Wire mesh or other steel reinforcement, not exceeding $\frac{3}{8}$ inch in diameter (used in one-way slabs), 50 per cent of the minimum yield point as established by the A. S. T. M. Standards for the particular grade of steel used; but not to exceed.....(f_s) = 30,000 p. s. i.

**Allowable
Unit Stresses
in Reinforce-
ment**

Compression:

Structural steel section in composite columns	16,000 p. s. i.
Cast-iron section in composite columns	10,000 p. s. i.

Note: If special conditions require the use of billet-steel concrete reinforcement bars of structural or hard grades, the allowable unit stress shall not exceed 18,000 p. s. i. for structural grade nor 20,000 p. s. i. for hard grade bars.

Sec. 2614. All members shall be designed to resist at all sections the maximum bending moments and shears produced by dead load, live load and other loads, as determined by the principle of continuity. In the case of approximately equal spans with loads uniformly distributed, where the intensity of live load does not exceed three times the intensity of dead load, this is satisfied essentially by the following values:

Flexural Computations

Negative moment at face of first interior support:

For beams and girders and for slabs exceeding 10 feet:

$$\text{Two spans} \quad \frac{1}{8} w l'^2$$

$$\text{More than two spans} \quad \frac{1}{10} w l'^2$$

For slabs not exceeding 10 feet in span

$$\text{Two spans} \quad \frac{1}{10} w l'^2$$

$$\text{More than two spans} \quad \frac{1}{12} w l'^2$$

Negative moment at face of other interior supports

$$\frac{1}{12} w l'^2$$

Positive moment at center of span

$$\text{End spans} \quad \frac{1}{10} w l'^2$$

$$\text{Interior spans} \quad \frac{1}{12} w l'^2$$

$$\text{Shear in end members at first interior support} \quad 1.20 \frac{w l'}{2}$$

$$\text{Shear at other supports} \quad \frac{w l'}{2}$$

For the purpose of applying this method "approximately" shall be construed to mean that the longer of two adjacent spans shall not exceed the shorter by more than 20 per cent. In these expressions l' = the clear span for positive moments and the average of the two adjacent clear spans for negative moment.

(a) **Permissible Assumptions.** The span length of freely supported beams and slabs shall be the clear span plus the depth of beam or slab, but shall not exceed the distance between centers of the supports.

Section 2614

UNIFORM BUILDING CODE

Flexural
Computations
(Cont'd.)

In the application of the principle of continuity, the following assumptions shall be permissible:

1. Consideration may be limited to combinations of dead load on all spans with full live load on two adjacent spans and with full live load on alternate spans.

2. Any reasonable and consistent assumption may be made as to the relative stiffness of the floor construction and columns. In computing the relative stiffness of floors to columns, the value I of the floor members may be based on the entire concrete section neglecting the reinforcement, and that of columns on the entire concrete section plus the transformed steel section. The moment of inertia assumed for the columns in computing bending moments must also be used in computing stresses.

3. The far ends of columns above and below the floor under consideration may be considered fixed.

4. When members are deepened near their ends by haunches they may be analyzed as members of constant section provided the minimum depth is used throughout in computing stresses due to bending; otherwise a complete analysis is required. Where members are widened near their supports the additional width may be neglected in computing moments but may be used in computing stresses.

Additional section at the end may in any case be utilized in resisting shear if properly reinforced.

5. Where slabs of uniform thickness are built integrally with their supports the span length may be taken equal to the clear span between faces of supports and the width of support otherwise neglected.

6. In the application of the principle of continuity, center to center distances may be used in the moment determination of all members.

Moments prevailing at the faces of support may be used to proportion the members at these sections.

7. In slabs other than ribbed floor construction or flat slabs, the principal reinforcement shall not be spaced farther apart than three times the slab thickness.

8. All beams except cantilevers shall have positive reinforcement of not less than .005 $b'd$.

9. Not less than .005 $b'd$ of negative reinforcement shall be provided at the outer end of members built integrally with their supports.

10. Where analysis indicates negative reinforcement along the full length of a span, the reinforcement need not be extended beyond the point where the required amount is .0025 $b'd$ or less.

11. In slabs of uniform thickness the minimum amount of reinforcement in the direction of principal stress shall be

For structural, intermediate and hard grades and rail steel..... .0025 ba

For steel having a minimum yield point of 56,000 lb. per sq. in..... .002 ba

(b) Distance between Lateral Supports. The clear distance between lateral supports of a beam shall not exceed 32 times the least width of compression flange.

(c) **Depth of Beam or Slab.** The depth of the beam or slab shall be taken as the distance from the centroid of the tensile reinforcement to the compression face of the structural members. Any floor finish not placed monolithically with the floor slab shall not be included as a part of the structural member. When the finish is placed monolithically with the structural slab in buildings of the warehouse or industrial class, the over-all depth shall be at least one-half inch ($\frac{1}{2}$ ") over that required by the design of the member.

(d) **Requirements for T-Beams.** 1. In T-beam construction the slab and beam shall be built integrally or otherwise effectively bonded together. The effective flange width to be used in the design of symmetrical T-beams shall not exceed one-fourth of the span length of the beam, and its overhanging width on either side of the web shall not exceed eight times the thickness of the slab nor one-half the clear distance to the next beam.

T-Beams

2. For beams having a flange on one side only, the effective overhanging flange width shall not exceed one-twelfth of the span length of the beam, nor six times the thickness of the slab, nor one-half the clear distance to the nearest beam.

3. Where the principal reinforcement in a slab which is considered as the flange of a T-beam (not a rib in ribbed floors) is parallel to the beam, transverse reinforcement shall be provided in the top of the slab. This reinforcement shall be designed to carry the load on the portion of the slab assumed as the flange of the T-beam. The spacing of the bars shall not exceed five times the thickness of the flange, nor in any case eighteen inches (18").

4. Provisions shall be made for the compressive stress at the support in continuous T-beam construction, care being taken that the provisions of Section 2610 relating to the spacing of bars, and Section 2609(e), relating to the placing of concrete shall be fully met.

5. The overhanging portion of the flange of the beam shall not be considered as effective in computing the shear and diagonal tension resistance of T-beams.

6. Isolated beams in which the T-form is used only for the purpose of providing additional compression area, shall have a flange thickness not less than one-half the width of the web and a total flange width not more than four times the web thickness.

(e) **One-way Ribbed Floor Construction.** 1. Ribbed floor construction consists of concrete ribs and slabs placed monolithically with or without burned clay or concrete tile fillers. The ribs shall not be farther apart than thirty inches (30") face to face. The ribs shall be straight, not less than four inches (4") wide, nor of a depth more than three times the width.

Ribbed
Floors

2. When burned clay or concrete tile fillers, of material having a unit compressive strength at least equal to that of the designed strength of the concrete in the ribs, are used, and the fillers are so placed that the joints in alternate rows are staggered, the shells of the fillers in contact with the ribs may be included in the calculations involving shear or negative bending moment. No other portion of the fillers may be included in the design calculations.

3. The concrete slab over the fillers shall be not less than one and one-half inches ($1\frac{1}{2}$ ") in thickness, nor less in thickness than one twelfth of the clear distance between ribs. Shrinkage reinforcement in the slab shall be provided as specified in Section 2615.

4. Where removable forms or fillers not complying with (2) are used, the thickness of the concrete slab shall not be less than one-twelfth of the clear distance between ribs and in no case less than two inches (2"). Such slab shall be reinforced at right angles to the ribs with a minimum of .049 square inches of reinforcing steel per foot of width, and in slabs on which the prescribed live load does not exceed 50 pounds per square foot, no additional reinforcement will be required.

5. When the finish used as a wearing surface is placed monolithically with the structural slab in buildings of the warehouse or industrial class, the thickness of the concrete over the fillers shall be one-half inch ($\frac{1}{2}$ ") greater than the thickness used for design purposes.

6. Where the slab contains conduits or pipes, the thickness shall be not less than one inch (1") plus the total over-all depth of such conduits or pipes at any point. Such conduits or pipes shall be so located as not to impair the strength of the construction.

(f) **Compression Steel in Flexural Members.** Compression steel in beams, girders, or slabs shall be anchored by ties or stirrups not less than one-fourth inch ($\frac{1}{4}$ ") in diameter, spaced no farther apart than 16 bar diameters or 48 tie diameters. Such ties or stirrups shall be used throughout the distance where compression steel is required.

The effectiveness of compression reinforcement in resisting bending may be taken at twice the value indicated from calculations assuming a straight line relation between stress and strain and the modular ratio given in Section 2611, but not of greater value than the allowable stress in tension.

Shrinkage and Temperature Reinforcement

Sec. 2615. Reinforcement for shrinkage and temperature stresses normal to the principal reinforcement shall be provided in floor and roof slabs where the principal reinforcement extends in one direction only. Such reinforcement shall provide for the following minimum ratios of reinforcement area to concrete area (*bd*), but in no case shall such reinforcing bars be placed farther apart than five times the slab thickness nor more than eighteen inches (18").

Floor slabs where plain bars are used.....	0.0025
Floor slabs where deformed bars are used.....	0.002
Floor slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches.....	0.0018
Roof slabs where plain bars are used.....	0.003
Roof slabs where deformed bars are used.....	0.0025
Roof slabs where wire fabric is used, having welded intersections not farther apart in the direction of stress than 12 inches.....	0.0022

Two-Way Slabs

Sec. 2616. (a) General Provisions. This construction, consisting of floors reinforced in two directions and supported on four sides, includes solid reinforced concrete slabs; concrete ribs with burned clay or concrete tile fillers, with or without con-

crete top slabs; and concrete ribs with top slabs placed monolithically with the ribs. The supports for the floor slabs may be walls, reinforced concrete beams, or steel beams fully encased in concrete.

When burned clay or concrete tile fillers, of material having a unit compressive strength at least equal to that of the designed strength of the concrete in the ribs, are used, the shells in contact with the concrete ribs may be included in calculations involving resistance to shear and bending moment, and the top and bottom shells may be included in calculations involving resistance to bending moment.

When a concrete top slab, placed monolithically with the ribs is used, it shall be not less in thickness than one and one-half inches ($1\frac{1}{2}$ ") nor less than one-twelfth of the clear distance between ribs. It shall be reinforced for shrinkage as required in Section 2615.

Where removable forms or fillers not complying with this Subsection are used, the thickness of the concrete slab shall be not less than one-twelfth of the clear distance between ribs and in no case less than two inches (2"). Such slab shall be reinforced to provide sufficient strength to carry the imposed loads.

(b) **Limitations.** A two-way slab shall be considered as consisting of strips in each direction as follows:

A middle strip one-half panel in width, symmetrical about panel center line and extending through the panel in the direction in which moments are considered.

A column strip one-half panel in width, occupying the two quarter-panel areas outside the middle strip.

Where the ratio of short to long span is less than 0.5 the middle strip in the short direction shall be considered as having a width equal to the difference between the long and short span, the remaining area representing the two column strips.

The critical sections for moment calculations are referred to as principal design sections and are located as follows:

For negative moment, along the edges of the panel at the faces of the supporting beams.

For positive moment, along the center lines of the panels.

(c) **Bending Moments.** The bending moments for the middle strips shall be computed from the formula

$$M_f = Cw'S^2 \dots\dots\dots (2)$$

In which M_f is bending moment in foot-pounds per foot of width; C is a coefficient as given in Table No. 26-C; w' is total load per square foot; and S is short span in feet. The span shall be considered as the center-to-center distance between supports or the clear span plus twice the thickness of slab, whichever value is the smaller.

The average moments per foot of width in the column strip shall be two-thirds of the corresponding moments in the middle strip. In determining the spacing of the reinforcement in the column strip, the moment may be assumed to vary from a maximum at the edge of the middle strip to a minimum at the edge of the panel.

Where the negative moment on one side of a support is less than 80 per cent of that on the other side, two-thirds of the

TABLE NO. 26-C—BENDING MOMENT COEFFICIENTS FOR RECTANGULAR PANELS SUPPORTED ON FOUR SIDES AND BUILT MONOLITHICALLY WITH SUPPORTS

Coefficients are for moments in middle strips

Moments	Short Span Values of m						Long Span All Values of m
	1.0	0.9	0.8	0.7	0.6	0.5 and less	
Case 1—Interior Panels							
Negative Moment at Continuous edge	.033	.040	.048	.055	.063	.083	.033
Discontinuous edge	.025	.030	.036	.041	.047	.062	.025
Positive Moment at Midspan							
Case 2—One Edge Discontinuous							
Negative Moment at Continuous edge	.041	.048	.055	.062	.069	.085	.041
Discontinuous edge	.021	.024	.027	.031	.035	.042	.021
Positive Moment at Midspan	.031	.036	.041	.047	.052	.064	.031
Case 3—Two Edges Discontinuous							
Negative Moment at Continuous edge	.049	.057	.064	.071	.078	.090	.049
Discontinuous edge	.025	.028	.032	.036	.039	.046	.025
Positive Moment at Midspan	.037	.043	.048	.054	.059	.068	.037
Case 4—Three Edges Discontinuous							
Negative Moment at Continuous edge	.058	.066	.074	.082	.090	.098	.058
Discontinuous edge	.029	.033	.037	.041	.045	.049	.029
Positive Moment at Midspan	.044	.050	.056	.062	.068	.074	.044
Case 5—Four Edges Discontinuous							
Negative Moment at Continuous edge	.033	.038	.043	.047	.053	.055	.033
Discontinuous edge	.050	.057	.064	.072	.080	.083	.050
Positive Moment at Midspan							

difference shall be distributed in proportion to the relative stiffnesses of the slabs.

(d) **Shear.** The shearing stresses in the slab may be computed on the assumption that the load is distributed to the supports in accordance with Section 2616 (f).

(e) **Minimum Slab Thickness.** The slab thickness shall be not less than four inches (4"), nor less than the value computed by the formula

$$t_s = \left[S + \frac{S}{m} - \frac{N}{10} \right] \frac{1}{72} \sqrt{\frac{2500}{f'_c}} \dots \dots \dots (3)$$

in which t_s , S and N are in inches.

(f) **Supporting Beams.** The loads on the supporting beams for a two-way rectangular panel may be assumed as the load within the tributary areas of the panel bounded by the intersection of 45-degree lines from the corners with the median line of the panel parallel to the long side.

The bending moments may be determined approximately by using an equivalent uniform load per lineal foot of beam for each panel supported as follows:

$$\text{For the short span, } \frac{w S}{3}$$

$$\text{For the long span, } \frac{w S}{3} \left(\frac{3m^2}{2} \right) \dots \dots \dots (4)$$

(g) **Arrangement of Reinforcement.** 1. In any panel, the reinforcement per unit width in the long direction shall be at least one-third of that provided in the short direction:

2. The positive moment reinforcement adjacent to a continuous edge only and for a width not exceeding one-fourth of the shorter dimension of the panel may be reduced 25 per cent.

3. At a non-continuous edge negative moment reinforcement per unit width in amount at least as great as one-half that required for maximum positive moment for the center half of the panel shall be provided across the entire width of the exterior support.

4. The spacing of the reinforcement shall be not more than three times the slab thickness and the ratio of reinforcement shall be at least 0.0025.

5. The amount of reinforcement in any one foot wide strip shall be at least 0.003 times the product of the width of strip by the effective depth.

Sec. 2617. (a) Shearing Unit Stress. The shearing unit stress (v) in reinforced concrete beams shall be computed by formula (5):

$$v = \frac{V}{bjd} \dots \dots \dots (5)$$

For beams of I or T section b' shall be substituted for b in formula (15).

**Two-Way
Slabs
(Cont'd.)**

**Shear and
Diagonal
Tension**

**Shear and
Diagonal
Tension
(Cont'd.)**

In ribbed construction, where burned clay or concrete tile are used, b' may be taken as a width equal to the thickness of the concrete web plus the thickness of the vertical shells of the concrete or burned clay tile in contact with the joist as specified in Sections 2614 and 2616.

Where the value of the shearing unit stress computed by formula (5) exceeds the shearing unit stress (v_c) permitted on the concrete of an unreinforced web (see Section 2613), web reinforcement shall be provided to carry the excess.

(b) **Types of Web Reinforcement.** Web reinforcement may consist of:

1. Stirrups or web reinforcement bars perpendicular to the longitudinal steel.

2. Stirrups or web reinforcement bars welded or otherwise rigidly attached to the longitudinal steel and making an angle of 30 degrees or more thereto.

3. Longitudinal bars bent so that the axis of the inclined portion of the bar makes an angle of 15 degrees or more with the axis of the longitudinal portion of the bar.

4. Special arrangements of bars with adequate provisions to prevent slip of bars or splitting of the concrete by the reinforcement [See Subsection (d) last paragraph].

Stirrups or other bars to be considered effective as web reinforcement shall be anchored at both ends, according to the provisions of Section 2618.

(c) **Stirrups.** The area of steel required in stirrups placed perpendicular to the longitudinal reinforcement shall be computed by formula (6).

$$A_v = \frac{V's}{f_v j d} \dots\dots\dots (6)$$

Inclined stirrups shall be proportioned by formula (8).

Stirrups placed perpendicular to the longitudinal reinforcement shall not be used alone as web reinforcement when the shearing unit stress (v) exceeds $0.08f'_c$.

(d) **Bent Bars.** When the web reinforcement consists of a single bent bar or of a single group of bent bars the required area of such bars shall be computed by formula (7).

$$A_s = \frac{V'}{f_v \sin \alpha} \dots\dots\dots (7)$$

In formula (7) V' shall not exceed $0.040f'_c b j d$.

Only the center three-fourths of the inclined portion of such bar, or group of bars, shall be considered effective as web reinforcement.

Where there is a series of parallel bent bars, the required area shall be determined by formula (8).

$$A_v = \frac{V's}{f_v j d (\sin \alpha + \cos \alpha)} \dots\dots\dots (8)$$

When bent bars having a radius of bend of not more than two times the diameter of the bar are used alone as web rein-

forcement, the allowable shearing unit stress shall not exceed **Shear and**
 0.060 f'_c . This shearing unit stress may be increased at the rate of 0.01 f'_c for each increase of four bar diameters in the radius **Diagonal**
 of bend until the maximum allowable shearing unit stress is **Tension**
 reached. (See Section 2613.) **(Cont'd.)**

The shearing unit stress permitted when special arrangements of bars are employed shall be that determined by making comparative tests, to destruction, of specimens of the proposed system and of similar specimens reinforced in conformity with the provisions of this Code, the same factor of safety being applied in both cases.

(e) **Combined Web Reinforcement.** Where more than one type of reinforcement is used to reinforce the same portion of the web, the total shearing resistance of this portion of the web shall be assumed as the sum of the shearing resistances computed for the various types separately. In such computations the shearing resistance of the concrete shall be included only once, and no one type of reinforcement shall be assumed to

$2 V'$

resist more than $\frac{\quad}{3}$.

(f) **Spacing of Web Reinforcement.** Where web reinforcement is required it shall be so spaced that every 45 degree line (representing a potential crack) extending from the mid-depth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement. If a unit shearing stress in excess of 0.06 f'_c is used, every such line shall be crossed by at least two such lines of web reinforcement.

(g) **Shearing Stress in Flat Slabs.** In flat slabs, the shearing unit stress on a vertical section which lies at a distance $t_1 - 1\frac{1}{2}$ inches beyond the edge of the column capital and parallel with it, shall not exceed the following values when computed by formula (5) (in which d shall be taken as $t_1 - 1\frac{1}{2}$ inches):

1. 0.03 f'_c , when at least 50 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

2. 0.025 f'_c , when 25 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

3. For intermediate percentages, intermediate values of the shearing unit stress shall be used.

In flat slabs, the shearing unit stress on a vertical section which lies at a distance of $t_1 - 1\frac{1}{2}$ inches beyond the edge of the dropped panel and parallel with it shall not exceed 0.03 f'_c when computed by formula (5) in which d shall be taken as $t_1 - 1\frac{1}{2}$ inches. At least 50 per cent of the cross-sectional area of the negative reinforcement in the column strip must be within the width of strip directly above the dropped panel.

(h) **Shear and Diagonal Tension in Footings.** The shearing unit stress computed by formula (5) on the critical section [see Section 2621 (d)], shall not exceed 0.02 f'_c for footings with straight bars, nor 0.03 f'_c for footings in which the bars are anchored at both ends by adequate hooks or as otherwise specified in Section 2618.

Section 2618.**UNIFORM BUILDING CODE****Bond and Anchorage**

Sec. 2618. (a) Computation of Bond Stress in Beams. In flexural members in which the tensile reinforcement is parallel to the compression face, the bond stress at any cross section shall be computed by formula (9).

$$u = \frac{V}{\Sigma a_j d} \dots \dots \dots (9)$$

in which V is the shear at that section.

Adequate end anchorage shall be provided for the tensile reinforcement in all flexural members to which formula (9) does not apply, such as footings, brackets and other tapered or stepped beams in which the tensile reinforcement is not parallel to the compression face.

(b) Ordinary Anchorage Requirements. Tensile negative reinforcement in any span of a continuous, restrained, or cantilever beam, or in any member of a rigid frame shall be adequately anchored by bond, hooks or mechanical anchors in or through the supporting member. Within any such span every reinforcing bar shall be extended at least 12 diameters beyond the point at which it is no longer needed to resist stress. In cases where the length from the point of maximum tensile stress in the bar to the end of the bar is not sufficient to develop this maximum stress by bond, the bar shall extend into a region of compression and be anchored by means of a standard hook or it shall be bent across the web at an angle of not less than 15 degrees with the longitudinal portion of the bar and either made continuous with the positive reinforcement or anchored in a region of compression.

Of the positive reinforcement in continuous beams not less than one-fourth the area shall extend along the same face of the beam into the support a distance of 10 or more bar diameters, or shall be extended as far as possible into the support and terminated in standard hooks.

In simple beams, or at the outer ends of freely supported end spans of continuous beams, at least one-half the positive reinforcement shall extend along the same face of the beam into the support a distance of 10 or more bar diameters, or shall be extended as far as possible into the support and terminated in standard hooks.

(c) Special Anchorage Requirements. Where increased shearing or bond stresses are permitted because of the use of special anchorage (see Section 2613), every bar shall be terminated in a standard hook in a region of compression, or it shall be bent across the web at an angle of not less than 15 degrees with the longitudinal portion of the bar and made continuous with the negative or positive reinforcement.

(d) Anchorage of Web Reinforcement. Single separate bars used as web reinforcement shall be anchored at each end by one of the following methods:

1. Welding to longitudinal reinforcement.
2. Hooking tightly around the longitudinal reinforcement through 180 degrees.
3. Embedment in the compression area of the beam a distance sufficient to develop the allowable tensile stress specified

in Section 2613 at a bond stress not exceeding $0.04f'_c$ on plain bars nor $0.05f'_c$ on deformed bars.

Bond and Anchorage
(Cont'd.)

4. Standard hook, considered as developing 10,000 pounds per square inch, plus embedment sufficient to develop by bond the remainder of the stress to which the bar is subjected. The unit bond stress shall not exceed that set forth in Table No. 26-B. The effective embedded length shall not be assumed to exceed the distance between the mid-depth of the beam and the tangent of the hook.

The extreme ends of bars forming simple U or multiple stirrups shall be anchored by one of the methods of Subsection (d) or shall be bent through an angle of at least 90 degrees tightly around a longitudinal reinforcing bar not less in diameter than the stirrup bar, and shall project beyond the bend at least 12 diameters of the stirrup bar.

The loops or closed ends of such stirrups shall be anchored by bending around the longitudinal reinforcement through an angle of at least 90 degrees, or by being welded or otherwise rigidly attached thereto.

Hooking or bending stirrups or separate web reinforcement bars around the longitudinal reinforcement shall be considered effective only when these bars are perpendicular to the longitudinal reinforcement.

Longitudinal bars bent to act as web reinforcement shall, in a region of tension, be continuous with the longitudinal reinforcement. The tensile stress in each bar shall be fully developed in both the upper and the lower half of the beam by one of the following methods:

I. As specified in Subsection (d-3).

II. As specified in Subsection (d-4).

III. By bond, at unit bond stress not exceeding $0.04f'_c$ on plain bars nor $0.05f'_c$ on deformed bars, plus a bend of radius not less than two times the diameter of the bar, parallel to the upper or lower surface of the beam, plus an extension of the bar of not less than 12 diameters of the bar terminating in a standard hook. This short radius bend extension and hook shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

IV. By bond, at a unit bond stress not exceeding $0.04f'_c$ on plain bars nor $0.05f'_c$ on deformed bars, plus a bend of radius not less than two times the diameter of the bar, parallel to the upper or lower surface of the beam and continuous with the longitudinal reinforcement. The short radius bend and continuity shall together not be counted upon to develop a tensile unit stress in the bar of more than 10,000 pounds per square inch.

V. The tensile unit stress at the beginning of a bend may be increased from 10,000 pounds per square inch when the radius of bend is two bar diameters, at the rate of 1,000 pounds per square inch tension for each increase of one and one-half bar diameters in the radius of bend, provided that the length of the bar in the bend and extension is sufficient to develop this increased tensile stress by bond at the unit stresses given in Subsection (d-III).

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Bond and Anchorage (Cont'd.)

In all cases web reinforcement shall be carried as close to the compression surface of the beam as fireproofing regulations and the proximity of other steel will permit.

(e) **Anchorage of Bars in Footing Slabs.** All bars in footing slabs, except the longitudinal reinforcement between loads in continuous slab footings, shall be anchored by means of standard hooks. The outer faces of these hooks shall be not less than three inches (3") nor more than six inches (6") from the face of the footing.

(f) **Hooks.** The terms "hook" or "standard hook" as used herein shall mean a complete semicircular turn with a radius of bend on the axis of the bar of not less than three and not more than six bar diameters, plus an extension of at least four bar diameters at the free end of the bar. Hooks having a radius of bend of more than six bar diameters shall be considered merely as extensions to the bars, and shall be treated as in Subsection (d)-V.

In general, hooks shall not be permitted in the tension portion of any beam except at the ends of simple or cantilever beams or at the freely supported ends of continuous or restrained beams.

No hook shall be assumed to carry a load which would produce a tensile stress in the bar greater than 10,000 pounds per square inch.

Any mechanical device capable of developing the strength of the bar without damage to the concrete may be used in lieu of a hook. Tests must be presented to show the adequacy of such devices.

Flat Slabs

Sec. 2619. (a) Limitations. The term flat slabs as used in these regulations refers to concrete slabs, generally without beams or girders to carry the load to supporting members, reinforced with bars extending in two or four directions. Slabs with dropped panels or paneled ceilings shall be considered as flat slabs provided that they meet the requirements herein given for such construction.

The moment coefficients, moment distribution, and slab thicknesses specified herein are for a series of rectangular slabs of approximately uniform size arranged in three or more rows of panels in each direction, and in which the ratio of length to width of panel does not exceed 1.33.

For structures having a width of less than three rows of panels, or in which irregular panels are used, an analysis shall be made of the moments developed in both slabs and columns.* When so required, computations shall be submitted to the Building Official.

(b) **Panel Strips and Principal Design Sections.** A flat slab panel shall be considered as consisting of strips in each direction as follows:

A middle strip one-half panel in width, symmetrical about panel center line and extending through the panel in the direction in which moments are considered.

*It is not the intention to prohibit flat slab construction for panels longer than 1.33 times the width, or for buildings less than three bays wide, provided the moment factors are properly adjusted.

Flat Slabs
(Cont'd.)

A column strip one-half panel in width occupying the two quarter-panel areas outside of the middle strip.

The critical sections for moment calculations are referred to as principal design sections and are located as follows:

1. **Sections for Negative Moment.** These shall be taken along the edges of the panel, on lines joining the column centers, except that they follow the perimeter of the column capital instead of passing through it.

2. **Sections for Positive Moment.** These shall be taken on the center lines of the panel.

In the two-way system it shall be assumed that the various moments in the strips are resisted by the bands located within the strips, each band being $.5l_n$ in width.

In the four-way system, it shall be assumed that the column strip positive moment is resisted by the direct band; that the column strip negative moment is resisted by the direct band plus the two diagonal bands multiplied by the cosine of the angle between the direct band and the diagonal bands; that the middle strip positive moment is resisted by the two diagonal bands multiplied by the cosine of the angle between the axis of the middle strip and the diagonal bands; and that the middle strip negative moment is resisted by an independent top band across the middle of the direct band. The width of direct and middle strip negative bands shall be approximately $.4l_n$, the width of the diagonal bands shall be approximately $.4$ of the average span length or

$$\frac{(l + l_n)}{5}$$

The width of the column head section for compression shall be taken as the width of the dropped panel (b_d), or half the width of the panel ($.5l_n$) where no dropped panel is used.

(c) **Slab Thickness and Dropped Panel Sizes.** In Table No. 26-D are given the thicknesses, dimensions and moments governing flat slab design when f'_c equals 2,000 pounds per square inch. The general formulas are given under the heading "General Case"; the formulas for the case where the diameter of the column capital (c) = $0.225 l$ are given under the heading "Special Case" for (c) = $0.225 l$.

Where f'_c is greater than 2,000 pounds per square inch, the required and minimum slab thicknesses given in Table No. 26-D may be reduced by multiplying by the factor

$$\sqrt[3]{\frac{2000}{f'_c}}$$

in which f'_c is the ultimate 28-day compressive strength of the concrete to be used.

(d) **Column Capital Sizes.** The average (c) for the columns at the four corners of a panel shall be used in obtaining the slab thickness, the numerical sum of the total positive and negative moments (M_n) in either direction and the middle strip positive and negative moments in either direction.

The average (c) for two adjacent columns shall be used in obtaining the positive and negative moments in the column strip between these adjacent columns.

(e) **Panels with Marginal Beams or Reinforced Bearing Walls.** Moments to be used in the design of panels with mar-

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Flat Slabs
(Cont'd.)TABLE NO. 26-D—LIMITATIONS FOR SLAB THICKNESSES
—DROPPED PANELS AND MOMENTS

	Symbol	Unit	General Case	Special Case For $c = .225l$
Minimum Floor Slab Thickness	t_1 or t_2	Inches	.375 (long l)	0.375 (long l)
Minimum Roof Slab Thickness	t_1 or t_2	Inches	0.300 (long l)	0.300 (long l)
Slab Thickness without Dropped Panel	t_1	Inches	$0.038 \left(1 - 1.44 \frac{c}{l}\right) l \sqrt{w'} + 1\frac{1}{2}$ (19)	$0.025l \sqrt{w'} + 1\frac{1}{2}$ (19a)
Slab Thickness beyond Dropped Panel	t_2	Inches	$0.02l \sqrt{w'} + 1$ (20)	$0.02l \sqrt{w'} + 1$ (20a)
Slab Thickness through Dropped Panel	t_1	Inches	(Minimum = 1.25 t_2) (Maximum = 1.50 t_2)	(Minimum = 1.25 t_2) (Maximum = 1.50 t_2)
Minimum side or diameter of Dropped Panel	b_1	Feet	0.35 l_1	0.35 l_1
Numerical sum of positive and negative moments in direction of either side of interior rectangular panel	M_2	ft. lb.	$0.09Wl \left(1 - \frac{2c}{3l}\right)^2$ (21)	$0.065Wl$ (21a)

Maximum l shall be used in thickness formulas.

In these tables (l), (t_1), (b_1) and (c) are always expressed in feet while the units to which the formulas develop are shown in the column headed "units."

TABLE NO. 26-E—MOMENTS TO BE USED IN DESIGN OF
AN INTERIOR PANEL OF FLAT SLAB

	Symbol	Units	General Case	Special Case $c = .225l$
TWO-WAY SYSTEM WITH DROPPED PANEL				
Column Strip, Negative Moment	$-M_c$	ft. lb.	$0.50M_o$	$0.0325Wl$
Column Strip, Positive Moment	$+M_o$	ft. lb.	$0.20M_o$	$0.0130Wl$
Middle Strip, Negative Moment	$-M_m$	ft. lb.	$0.15M_o$	$0.0075Wl$
Middle Strip, Positive Moment	$+M_m$	ft. lb.	$0.15M_o$	$0.0075Wl$
TWO-WAY SYSTEM WITHOUT DROPPED PANEL				
Column Strip, Negative Moment	$-M_c$	ft. lb.	$0.46M_o$	$0.030Wl$
Column Strip, Positive Moment	$+M_o$	ft. lb.	$0.22M_o$	$0.0132Wl$
Middle Strip, Negative Moment	$-M_m$	ft. lb.	$0.16M_o$	$0.0104Wl$
Middle Strip, Positive Moment	$+M_m$	ft. lb.	$0.16M_o$	$0.0104Wl$
FOUR-WAY SYSTEM WITH DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip, Negative Moment	$-M_c$	ft. lb.	$0.51M_o$	$0.0351Wl$
Column Strip, Positive Moment	$+M_o$	ft. lb.	$0.19M_o$	$0.0124Wl$
Middle Strip, Negative Moment	$-M_m$	ft. lb.	$0.08M_o$	$0.0052Wl$
Middle Strip, Positive Moment	$+M_m$	ft. lb.	$0.19M_o$	$0.0124Wl$
(MOMENTS BY BANDS)				
Direct Band, Negative Moment	$-M$	ft. lb.	$0.307M_o$	$0.0200Wl$
Direct Band, Positive Moment	$+M$	ft. lb.	$0.19M_o$	$0.0124Wl$
Diagonal Band, Negative Moment	$-M$	ft. lb.	$0.168M_o$	$0.0109Wl$
Diagonal Band, Positive Moment	$+M$	ft. lb.	$0.134M_o$	$0.0057Wl$
Cross Band, Negative Moment	$-M$	ft. lb.	$0.03M_o$	$0.0052Wl$
FOUR-WAY SYSTEM WITHOUT DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip, Negative Moment	$-M$	ft. lb.	$0.50M_o$	$0.0325Wl$
Column Strip, Positive Moment	$+M$	ft. lb.	$0.20M_o$	$0.0130Wl$
Middle Strip, Negative Moment	$-M$	ft. lb.	$0.15M_o$	$0.0075Wl$
Middle Strip, Positive Moment	$+M$	ft. lb.	$0.20M_o$	$0.0130Wl$
(MOMENTS BY BANDS)				
Direct Band, Negative Moment	$-M$	ft. lb.	$0.30M_o$	$0.0195Wl$
Direct Band, Positive Moment	$+M$	ft. lb.	$0.20M_o$	$0.0130Wl$
Diagonal Band, Negative Moment	$-M$	ft. lb.	$0.141M_o$	$0.0092Wl$
Diagonal Band, Positive Moment	$+M$	ft. lb.	$0.141M_o$	$0.0092Wl$
Cross Band, Negative Moment	$-M$	ft. lb.	$0.10M_o$	$0.0065Wl$

TABLE NO. 26-F—MOMENTS TO BE USED IN DESIGN OF Flat Slabs (Cont'd.)

Moments in the strips perpendicular to the discontinuous edge where they differ from an interior panel, are given in the following table. Negative moments in the column strip and middle strip on the line of the first interior columns are the same as for an interior panel. Moments in the strips parallel to the discontinuous edge are the same as for an interior panel.

	Symbol	Units	General Case	Special Case $c = .225l$
TWO-WAY SYSTEM WITH DROPPED PANEL				
Column Strip Negative Moment at discontinuous edge	$-M_c$	ft. lb.	$0.45M_u$	$0.029W_l$
Column Strip Positive Moment	$+M_c$	ft. lb.	$0.23M_u$	$0.016W_l$
Middle Strip Negative Moment at discontinuous edge	$-M_m$	ft. lb.	$0.10M_u$	$0.0085W_l$
Middle Strip Positive Moment	$+M_m$	ft. lb.	$0.19M_u$	$0.012W_l$
TWO-WAY SYSTEM WITHOUT DROPPED PANEL				
Column Strip Negative Moment at discontinuous edge	$-M_c$	ft. lb.	$0.41M_u$	$0.027W_l$
Column Strip Positive Moment	$+M_c$	ft. lb.	$0.23M_u$	$0.018W_l$
Middle Strip Negative Moment at discontinuous edge	$-M_m$	ft. lb.	$0.10M_u$	$0.007W_l$
Middle Strip Positive Moment	$+M_m$	ft. lb.	$0.20M_u$	$0.013W_l$
FOUR-WAY SYSTEM WITH DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip Negative Moment at discontinuous edge	$-M$	ft. lb.	$0.455M_u$	$0.0315W_l$
Column Strip Positive Moment	$+M$	ft. lb.	$0.24M_u$	$0.0156W_l$
Middle Strip Negative Moment at discontinuous edge	$-M$	ft. lb.	$0.05M_u$	$0.0032W_l$
Middle Strip Positive Moment	$+M$	ft. lb.	$0.24M_u$	$0.0156W_l$
(MOMENTS BY BANDS) (FOR SQUARE PANEL)				
Direct Band at Column Head at discontinuous edge	$-M$	ft. lb.	$0.28M_u$	$0.018W_l$
Direct Band at Center	$+M$	ft. lb.	$0.24M_u$	$0.0156W_l$
Diagonal Bands at Column Head at discontinuous edge	$-M$	ft. lb.	$0.15M_u$	$0.010W_l$
Diagonal Bands at Center	$+M$	ft. lb.	$0.17M_u$	$0.011W_l$
Top Band (across Middle of Direct) at discontinuous edge	$-M$	ft. lb.	$0.05M_u$	$0.003W_l$
FOUR-WAY SYSTEM WITHOUT DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip Negative Moment at discontinuous edge	$-M$	ft. lb.	$0.45M_u$	$0.029W_l$
Column Strip Positive Moment	$+M$	ft. lb.	$0.23M_u$	$0.0163W_l$
Middle Strip Negative Moment at discontinuous edge	$-M$	ft. lb.	$0.052M_u$	$0.004W_l$
Middle Strip Positive Moment	$+M$	ft. lb.	$0.25M_u$	$0.016W_l$
(MOMENTS BY BANDS) (FOR SQUARE PANEL)				
Direct Band at Column Head at discontinuous edge	$-M$	ft. lb.	$0.27M_u$	$0.017W_l$
Direct Band at Center	$+M$	ft. lb.	$0.25M_u$	$0.016W_l$
Diagonal Bands at Column Head at discontinuous edge	$-M$	ft. lb.	$0.13M_u$	$0.0084W_l$
Diagonal Bands at Center	$+M$	ft. lb.	$0.18M_u$	$0.0117W_l$
Top Band (across Middle of Direct) at discontinuous edge	$-M$	ft. lb.	$0.06M_u$	$0.004W_l$

ginal beams or reinforced concrete bearing walls shall be as set forth in Table No. 26-G.

(f) **Limitations (Applicable to Tables No. 26-E, 26-F and 26-G).** Any of the above moments may be varied by not more than six per cent, provided that the total numerical sum of the positive and negative moments on the principal design sections is not reduced.

Flat Slabs
(Cont'd.)**TABLE NO. 26-G—MOMENTS TO BE USED IN DESIGN OF
PANELS WITH MARGINAL BEAMS OR
REINFORCED BEARING WALLS**

	Marginal Beams with Depth greater than $1\frac{1}{4}$ times the Slab Thickness; or reinforced Bearing Wall.				Marginal Beam with depth $1\frac{1}{4}$ times the Slab Thickness or less.			
(a) Load to be carried by Marginal Beam or Wall.	Loads directly superimposed upon it plus a uniform load equal to one-quarter of the total live and dead panel load.				Loads directly superimposed upon it exclusive of any panel load.			
	Two-Way System		Four-Way System		Two-Way System		Four-Way System	
	With Drop	Without Drop	With Drop	Without Drop	With Drop	Without Drop	With Drop	Without Drop
(b) Moment to be used in the design of Half Column Strip adjacent and parallel to Marginal Beam or Wall.	Neg. $.125M_o$	$.115M_o$	$.135M_o$	$.125M_o$	Neg. $.25M_o$	$.23M_o$	$.27M_o$	$.25M_o$
	Pos. $.05M_o$	$.055M_o$	$.0475M_o$	$.05M_o$	Pos. $.10M_o$	$.11M_o$	$.095M_o$	$.10M_o$
(c) Negative Moment to be used in Design of Middle Strip continuous over Beam or Wall.	Neg. $.195M_o$	$.208M_o$	$.104M_o$	$.13M_o$	Neg. $.15M_o$	$.16M_o$	$.08M_o$	$.10M_o$

The ratio of reinforcement considered in any strip shall not exceed the value of (p) calculated for balanced reinforcement by Section 2613. The ratio of reinforcement in any strip shall be not less than .0025. Bars shall not be spaced farther apart than one and one-half times the slab thickness for the full width of the bands.

Moments for the four-way system are shown in Table No. 26-F by strips, and for convenience, also by bands.

Slabs supported by marginal beams on opposite edges shall be designed as solid one- or two-way slabs to carry the entire panel load.

(g) **Length of Bars and Points of Bend.** The positive moment reinforcement perpendicular to the discontinuous edge shall extend to this edge and have an embedment of at least six inches (6") in spandrel beams or columns. All negative moment reinforcement shall be bent or hooked at spandrel beams or columns to provide adequate bond resistance. Length of bars and points of bend shall be as set forth in Table No. 26-H.

(h) **Arrangement of Reinforcement.** The slab reinforcement shall be accurately placed so as to resist not only the moments at the critical sections, but also the moments at intermediate sections, and shall be secured and supported by concrete or metal chairs and spacers.

(i) **Brackets.** Brackets extending the full width of the column may be substituted for column capitals at exterior columns, provided the sloping face of the bracket makes an angle not more than forty-five degrees with the face of the column, projected upward.

TABLE NO. 26-H—LENGTH OF BARS AND POINTS OF BEND **Flat Slabs (Cont'd.)**

	With Drop		Without Drop	
	General Case	$c = .225l$	General Case	$c = .225l$
TWO-WAY FLAT SLAB (COLUMN STRIP) Length of straight bars (not less than .4 total band steel) Length of bent bars (not less than .4 total band steel) Length of additional straight bars over column head (if required) Point of top bend in bent bars (from column center)	$l - b_1 + (2' \text{ or } 40d)$ $1.5l + .6c \uparrow$.5l + .6c .25l	.65l + (2' or 40d) 1.635l† .035l .25l	.75l 1.44l + .66c† .44l + .66c .25l	.75l 1.59l† .59l .25l
MIDDLE STRIP Length of straight bars (not more than .5 total band steel) Length of bent bars (not less than .5 total band steel) Point of top bend in bent bars (from column center)	.65l 1.5l† .175l	.65l 1.5l† .175l	.7l 1.5l† .15l	.7l 1.5l† .15l
FOUR-WAY FLAT SLAB (COLUMN STRIP) Length of straight bars (not less than .4 total band steel) Length of bent bars (not less than .4 total band steel) Length of additional straight bars over column head (if required) Point of bend for bent bars (from column center)	$l - b_1 + (2' \text{ or } 40d)$ 1.5l + .6c† .5l + .6c .2l	.65l + (2' or 40d) 1.635l† .035l .2l	.75l 1.44l + .66c† .44l + .66c .2l	.75l 1.59l† .59l .2l
DIAGONAL BAND Length of straight bars (not more than .6 total band steel area) Length of bent bars (not less than .4 total band steel area) Point of bend for bent bars (from column center) Length of additional straight bars over column head (if required) Top band across middle of direct band (length of straight bars)	$l - b_1 + (2' \text{ or } 40d)$ 2.21l† .33l .8l .5l	.65l + (2' or 40d) 2.21l† .33l .8l .5l	.75l 2.21l† .33l .8l .5l	.75l 2.21l† .33l .8l .5l

†Note: To these lengths proper allowance to be added for bends.

The value of (c) where brackets are used is twice the distance from the center of the column to a point where the bracket is one and one-half inches ($1\frac{1}{2}"$) thick.

(j) **Columns Without Capitals or Brackets.** Brackets and column capitals may be omitted altogether, provided the slab thickness is sufficient to resist fully the moments and shears at the column head section.

The value of (c) where brackets and column capitals are omitted is the width of the column in the direction in which moments are considered, except that, when a beam of greater depth than the thickness of the slab or dropped panel extends into the column in the direction in which moments are considered, the value of (c) may be taken as the width of the column plus twice the projection of the beam below the slab or dropped panel.

(k) **Openings in Flat Slabs.** Openings of any size may be cut through the floor in the area common to two intersecting middle strips, provided the total positive and negative resisting moments be maintained as required in Subsection (d) and that these total positive and total negative moments be redistributed.

between the remaining principal design sections to meet the new conditions.

In any area common to two column strips, not more than one opening shall be allowed and the greatest dimension of such an opening shall not exceed .05 l.

In any area common to one column strip and one middle strip, openings shall not interrupt more than one-quarter of the bars in either strip and the equivalent of the bars so interrupted shall be provided by extra steel on both sides of the opening.

Any opening larger than described above shall be completely framed on all sides with beams to carry the loads to the columns.

(1) **Shearing Stresses in Flat Slabs.** See Section 2617.

Reinforced Concrete Columns and Walls

Sec. 2620. (a) Limiting Dimensions. The following subsections on reinforced concrete and composite columns except Subsection (g) apply to a short column, for which the unsupported length is not greater than 10 times the least lateral dimension. When the unsupported length exceeds this value, the design shall be modified as shown in Subsection (g). Principal columns in buildings shall have a minimum diameter or thickness of ten inches (10") and a minimum gross area of one hundred and twenty square inches (120 sq. in.). Posts that are not continuous from story to story shall have a minimum diameter or thickness of six inches (6").

(b) Unsupported Length of Columns. For purposes of determining the limiting dimensions of columns, the unsupported length of reinforced concrete columns shall be taken as the clear distance between floor slabs.

Exceptions: 1. In flat slab construction, it shall be the clear distance between the floor and the lower extremity of the capital.

2. In beam and slab construction, it shall be the clear distance between the floor and the under side of the deeper beam framing into the column in each direction at the next higher floor level.

3. In columns restrained laterally by struts, it shall be the clear distance between consecutive struts in each vertical plane; provided that to be an adequate support, two such struts shall meet the column at approximately the same level, and the angle between vertical planes through the struts shall not vary more than 15 degrees from a right angle. Such struts shall be of adequate dimensions and anchorage to restrain the column against lateral deflection.

4. In columns restrained laterally by struts or beams, with brackets used at the junction, it shall be the clear distance between the floor and the lower edge of the bracket, provided that the bracket width equals that of the beam or strut and is at least half that of the column.

For rectangular columns, that length shall be considered which produces the greatest ratio of length to depth of section.

(c) **Spirally Reinforced Columns.** 1. Permissible Load—**Spirally Reinforced Columns**
The maximum permissible axial load, P , on columns with closely spaced spirals enclosing a circular concrete core reinforced with longitudinal bars shall be that given by Formula (10).

$$P = A_g (0.225f'_c + f_s p_s) \quad (10)$$

WHERE

A_g = the gross area of the column.

f'_c = compressive strength of the concrete.

f_s = nominal working stress in vertical column reinforcement, to be taken at 40 per cent of the minimum specification value of the yield point; viz., 16,000 pounds per square inch for intermediate grade steel and 20,000 pounds per square inch for rail or hard grade steel.*

p_s = ratio of the effective cross-sectional area of vertical reinforcement to the gross area, A_g .

2. Vertical Reinforcement—The ratio (p_s) shall not be less than 0.01 nor more than 0.08. The minimum number of bars shall be six, and the minimum diameter shall be five-eighths inch ($\frac{5}{8}$ "). The center to center spacing of bars within the periphery of the column core shall be not less than $2\frac{1}{2}$ times the diameter for round bars or 3 times the side dimension for square bars. The clear spacing between bars shall be not less than one and one-half inches ($1\frac{1}{2}$ "), or one and one-half times the maximum size of the coarse aggregate used. These spacing rules apply to adjacent pairs of bars at a lapped splice.

3. Splices in Vertical Reinforcement—Where lapped splices in the column verticals are used, the minimum amount of lap shall be as follows:

- I For deformed bars—with concrete having a strength of 3000 pounds per square inch or above, 24 diameters of bar of intermediate grade steel and 30 diameters of bar of rail steel or hard grade steel. For bars of higher yield point, the amount of lap shall be increased in proportion to the nominal working stress. When the concrete strengths are less than 3000 pounds per square inch, the amount of lap shall be one-third greater than the values given above.
- II For plain bars—the minimum amount of lap shall be 25 per cent greater than that specified for deformed bars.
- III Welded splices or other positive connections may be used instead of lapped splices. Welded splices shall preferably be used in cases where the bar diameter exceeds one and one-fourth inch ($1\frac{1}{4}$ "). An approved welded splice shall be defined as one in which the bars are butted and welded and that will develop in tension at least the yield point stress of the reinforcing steel used.
- IV Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where

*Nominal working stresses for reinforcement of higher yield point may be established at 40 per cent of the yield point stress, but not more than 30,000 pounds per square inch, when the properties of such reinforcing steels have been definitely specified by standards of A. S. T. M. designation. If this is done, the lengths of splice required by Section 2620, Sub-section (c) paragraph (3) shall be increased accordingly.

Spirally Reinforced Columns (Cont'd.)

lateral support is afforded by a concrete capital, floor slab or by metal ties or reinforcing spirals. Where bars are offset, the slope of the inclined portion from the axis of the column shall not exceed one in six and the bars above and below the offset shall be parallel to the axis of the column.

4. Spiral Reinforcement—The ratio of spiral reinforcement, (p') shall be not less than the value given by Formula (11), nor shall it be less in any case than 0.0112 for hot rolled spirals of intermediate grade or 0.0075 for cold drawn wire spirals.

$$p' = 0.45 (R - 1) \frac{f'_c}{f'_s} \quad (11)$$

WHERE

p' = ratio of volume of spiral reinforcement to the volume of the concrete core (out to out of spirals).

R = ratio of gross area to core area of column, A_g/A_c .

f'_s = useful limit stress of spiral reinforcement, to be taken as 40,000 pounds per square inch for hot rolled rods of intermediate grade (A.S.T.M. A15-39)¹ and 60,000 pounds per square inch for cold drawn wire A.S.T.M. (A82-34)¹.

The spiral reinforcement shall consist of evenly spaced continuous spirals held firmly in place and true to line by at least three vertical spacer bars. Anchorage of spiral reinforcement shall be provided by one and one-half extra turns of spiral rod or wire at each end of the spiral unit. Splices, when necessary, shall be made in spiral rod or wire by welding or by a lap of one and one-half turns. The center to center spacing of the spirals shall not exceed one-sixth of the core diameter. The clear spacing between spirals shall not exceed three inches (3") nor be less than one and three-eighths inches ($1\frac{3}{8}$ ") or one and one-half times the maximum size of coarse aggregate used. The reinforcing spiral shall extend from the floor level in any story, or from the top of the footing in the basement, to the level of the lowest horizontal reinforcement in the slab, dropped panel or beam above. In a column with a capital, it shall extend to the plane at which the diameter or width of the capital is twice that of the column.

5. Protection of Reinforcement — The column reinforcement shall be protected everywhere by a covering of concrete cast monolithically with the core, for which the thickness shall not be less than one and one-half inches ($1\frac{1}{2}$ ") nor less than one and one-half times the maximum size of the coarse aggregate, nor shall it be less than required by the fire protection and weathering provisions specified in Section 2610 (f).

6. Limits of Column Section — For columns built monolithically with concrete walls or piers, the outer boundary of the column section shall be taken either as a circle at least one and one-half inches ($1\frac{1}{2}$ ") outside the column spiral or as a square or rectangle of which the sides are at least one and

¹See "Specification Documents".

one-half inches ($1\frac{1}{2}$ ") outside the spiral. The value of A_s thus defined shall be used in both Formulas (10) and (11). In any case it shall be permissible to design a circular column and to build it as a square column of the same least lateral dimension. In such case the permissible load, the gross area considered, and the required percentage of reinforcement must be taken as those of the circular column.

(d) **Tied Columns.** 1. Permissible Load — The maximum permissible axial load on columns reinforced with longitudinal bars and separate lateral ties shall be 80 per cent of that given by Formula (10). The ratio, (p_g) , to be considered in tied columns shall be not less than 0.01 nor more than 0.04. The longitudinal reinforcement shall consist of at least four bars, of minimum diameter of five-eighths of an inch ($\frac{5}{8}$ "). Splices in reinforcing bars shall be made as described in Subsection (c), paragraph (3).

2. Lateral Ties—Lateral ties shall be at least one-fourth inch ($\frac{1}{4}$ ") in diameter and shall be spaced apart not over 16 bar diameters, 48 tie diameters or the least dimension of the column. When there are more than four vertical bars, additional ties shall be provided so that every longitudinal bar is held firmly in its designed position and has lateral support equivalent to that provided by a 90-degree corner of a tie.

3. Limits of Column Section — In a tied column which for architectural reasons has a larger cross section than required by consideration of loading, a reduced effective area (A_g) not less than one-half of the total area may be used in applying the provisions of Subsection (d), paragraph (1).

(c) **Composite Columns.** 1. Permissible Load — The permissible load on a composite column consisting of a structural steel or cast-iron column thoroughly encased in concrete reinforced with both longitudinal and spiral reinforcement, shall not exceed that given by Formula (12).

$$P = 0.225 A_c f'_c + f_s A_s + f_r A_r \quad (12)$$

WHERE

A_c = net area of concrete

$$= A_g - A_s - A_r$$

A_s = cross-sectional area of longitudinal bar reinforcement.

A_r = cross-sectional area of the steel or cast-iron core.

f_r = permissible unit stress in metal core, not to exceed 16,000 pounds per square inch for a steel core; or 10,000 pounds per square inch for a cast-iron core.

The remaining notation is that of Subsection (c).

2. Details of Metal Core and Reinforcement—The cross-sectional area of the metal core shall not exceed 20 per cent of the gross area of the column. If a hollow metal core is used it shall be filled with concrete. The amounts of longitudinal and spiral reinforcement and the requirements as to spacing of bars, details of splices and thickness of protective shell outside the spiral shall conform to the limiting values specified in Subsection (c), paragraphs (2), (3), (4), and (5). A clearance of at least three inches (3") shall be maintained be-

tween the spiral and the metal core at all points except that when the core consists of a structural steel H-column, the minimum clearance may be reduced to two inches (2").

3. **Splices and Connections of Metal Cores**—Metal cores in composite columns shall be accurately milled at splices and positive provision shall be made for alignment of one core above another. At the column base, provision shall be made to transfer the load to the footing at safe unit stresses in accordance with Section 2613 and Table No. 26-B. The base of the metal section shall be designed to transfer the load from the entire composite column to the footing, or it may be designed to transfer the load from the metal section only, provided it is so placed in the pier or pedestal as to leave ample section of concrete above the base for the transfer of load from reinforced concrete section of the column by means of bond on the vertical reinforcement and by direct compression on the concrete. Transfer of loads to the metal core shall be provided for by the use of bearing members such as billets, brackets or other positive connections; these shall be provided at the top of the metal core and at intermediate floor levels where required. The column as a whole shall satisfy the requirements of Formula (12) at any point; in addition to this, the reinforced concrete portion shall be designed to carry, in accordance with Formula (10), all floor loads brought onto the column at levels between the metal brackets or connections. In applying Formula (10), the value of A_g shall be interpreted as the area of the concrete section outside the metal core, and the permissible load on the reinforced concrete section shall be further limited to $0.35 f'_c A_g$. Ample section of concrete and continuity of reinforcement shall be provided at the junction with beams or girders.

4. **Permissible Load on Metal Core Only** — The metal cores of composite columns shall be designed to carry safely any construction or other loads to be placed upon them prior to their encasement in concrete.

Combination Columns

(f) **Combination Columns.** 1. **Steel Columns Encased in Concrete.** The permissible load on a structural steel column which is encased in concrete at least two and one-half inches (2½") thick over all metal (except rivet heads) reinforced as hereinafter specified, shall be computed by Formula (13).

$$P = A_s f'_r \left(1 + \frac{A_g}{100 A_r} \right) \quad (13)$$

WHERE

A_r = cross-sectional area of steel column.

f'_r = permissible stress for unencased steel column.

A_g = total area of concrete section.

The concrete used shall develop a compressive strength, (f'_c) of at least 2000 pounds per square inch at 28 days. The concrete shall be reinforced by welded wire mesh having wires of No. 10 W. & M. gauge or equivalent, the wires encircling the column being spaced not more than four inches (4") apart and those parallel to the column axis not more than eight inches (8") apart. This mesh shall extend entirely around the column at a distance of one inch (1") inside the outer concrete surface and shall be lap-spliced at least 40 wire diameters and wired at the splice. Special brackets shall be used to receive the en-

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tire floor load at each floor level. The steel column shall be designed to carry safely any construction or other loads to be placed upon it prior to its encasement in concrete.

2. Pipe Columns. — The permissible load on columns consisting of steel pipe filled with concrete shall be determined by Formula (14).

$$P = 0.225f'_cA_c + f'_rA_r \quad (14)$$

The value of f'_r shall be that given by Formula (15).

$$f'_r = \left(18,000 - 70 \frac{h}{K} \right) F \quad (15)$$

WHERE

f'_r = average unit stress in metal core.

h = unsupported length of column.

K = least radius of gyration of metal core section.

$$F = \frac{\text{(yield point of pipe)}}{45,000}$$

If the yield point of the pipe is not known, the factor F shall be taken as 0.5.

(g) **Long Columns.** The maximum permissible load P' on axially loaded reinforced concrete or composite columns having a length, (h), greater than 10 times the least lateral dimension, (d), shall be given by Formula (16).

$$P' = P \left(1.3 - .03 \frac{h}{d} \right) \quad (16)$$

where P is the permissible axial load on a short column as given by Formulas (10) and (12).

The maximum permissible load P' on eccentrically loaded columns in which $\frac{h}{d}$ exceeds 10 shall also be given by Formula

(16), in which P is the permissible eccentrically applied load on a short column as determined by the provisions of Subsections (i) and (j). In long columns subjected to definite bending stresses, as determined in Subsection (h), the ratio h/d shall not exceed 20.

(h) **Bending Moments in Columns.** The bending moments in the columns of all reinforced concrete structures shall be determined on the basis of loading conditions and restraint and shall be provided for in the design. When the stiffness and strength of the columns are utilized to reduce moments in beams, girders, or slabs, as in the case of rigid frames, or in other forms of continuous construction wherein column moments are unavoidable, they shall be provided for in the design. In building frames, particular attention shall be given to cases of unbalanced floor loads on both exterior and interior columns and of eccentric loading due to other causes. Wall columns shall be designed to resist moments produced by:

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1. Loads on all floors of the building
2. Loads on a single exterior bay at two adjacent floor levels, or
3. Loads on a single exterior bay at one floor level.

Resistance to bending moments at any floor level shall be provided by distributing the moments between the columns immediately above and below the given floor in proportion to their relative stiffness and conditions of restraint.

Combined Stresses

(i) **Combined Axial and Bending Stress.** In reinforced concrete columns subjected to bending moments, the recognized methods of analysis shall be followed in calculating the stresses due to combined axial load and bending. The maximum fiber stress in compression and (in case of large eccentricities of loading) the tensile stress in the vertical bars will govern the design. The gross area of both spiral and tied columns shall be used in the computations.

Note: For preliminary designs it will usually give satisfactory results to compute the combined fiber stress in compression on the basis of an uncracked section of the column, using Formula (17).

$$f_c = \frac{P}{A_g} \cdot \frac{\left(1 + \frac{ee}{R^2}\right)}{1 + (n-1) p_k} \quad \text{.....(17)}$$

WHERE

e = eccentricity of resultant load, measured from the gravity axis.

c = distance from gravity axis to extreme fiber in compression.

R = radius of gyration of equivalent concrete section.

$$n = \frac{30,000}{f_c}$$

This will result in a fairly accurate design if the eccentricity is less than one-half the over-all column depth and the value of $p_k n$ is 0.3 or more.

The term $\frac{ee}{R^2}$ may be replaced by the value $\frac{6e}{t}$ for rectangular

columns and $\frac{8e}{t}$ for round columns without appreciable error

(t = over-all depth of section). This design shall then be analyzed by more accurate methods to insure that permissible stresses are not exceeded.

(j) **Permissible Combined Compressive and Tensile Stress.** For spiral and tied columns, eccentrically loaded or otherwise subjected to combined axial compression and flexural stress, the

maximum permissible compressive fiber stress, f_c , is given by Formula (18).

$$f_c = f_a \frac{1 + \frac{ec}{R^2}}{1 + C \frac{ec}{R^2}} \quad (18)$$

wherein f_a is the average permissible stress on an equivalent axially loaded concrete column, and C is the ratio of f_a to the permissible fiber stress for members in flexure. Thus

$$f_a = \frac{0.225f'_c + f_a p_g}{1 + (n-1) p_g} \quad (19)$$

for spiral columns, and 0.8 of this value for tied columns. In general $C = f_a / 0.4f'_c$.

The permissible tensile stress in the longitudinal reinforcement may equal that specified for flexural members, provided however that splices in the tensile steel at or near the section of maximum column moment are capable of developing fully the yield point strength of the reinforcement.

(k) **Walls. 1. Lateral and Eccentric Loads.** Walls shall be designed for any lateral or other loads to which they are subjected. Proper provision shall be made for eccentric loads.

2. Height and Thickness. The thickness of reinforced concrete walls shall be not less, and the maximum height, number of stories, and distance between supports shall be not more, than shown in Table No. 26-I.

Walls

Exception: The provisions of this paragraph may be waived when written evidence is submitted by a qualified person showing that the walls meet all the other requirements of this Code.

3. Design: The maximum allowable compressive stress in reinforced concrete bearing walls with minimum reinforcement as required by this Subsection shall not exceed

$$\left[1 - \left(\frac{h}{30d} \right)^3 \right] 0.2f'_c \quad (20)$$

When the reinforcement in bearing walls is designed, placed, and anchored in position as for columns, the working stresses shall be on the basis of formulas for columns. For calculating

TABLE NO. 26-I—REQUIREMENTS FOR REINFORCED CONCRETE WALLS

MAXIMUM HEIGHT IN FEET	STORY	LIMITING RATIO—DISTANCE BETWEEN SUPPORTS TO WALL THICKNESS	MINIMUM THICKNESS IN INCHES		
38	3	25	6		
	2		7	6	
	1		7	7	6
	Basement		8	8	8

wall stresses, concentrated loads may be assumed to be distributed over a maximum length of wall not exceeding the center to center distance between loads nor five times the width of the bearing.

Reinforced concrete walls shall be reinforced with an area of steel in each direction, both vertical and horizontal, at least equal to 0.0025 times the cross-sectional area of the wall. Walls more than ten inches (10") in thickness shall have the reinforcement for each direction placed in two layers parallel with the faces of the wall. One layer consisting of not less than one-half and not more than two-thirds the total required reinforcement shall be placed not less than one and one-half inches (1½") nor more than one-third the thickness of the wall from the exterior surface. The other layer, comprising the balance of the required reinforcement, shall be placed not less than three-fourths inch (¾") and not more than one-third the thickness of the wall from the interior surface. Bars shall be not less than three-eighths inch (⅜") round, nor shall they be spaced more than eighteen inches (18") on centers.

Reinforced concrete walls shall be anchored at all points of lateral support. Such anchorage shall be capable of resisting the horizontal forces with a minimum of 200 pounds per lineal foot.

Non-Bearing Partitions

(1) **Non-Bearing Partitions.** Non-bearing partitions of reinforced concrete shall have a thickness of not less than one forty-eighth of the distance between their supports nor less than three inches (3").

Footings

Sec. 2621. (a) Loads. Footings resting directly on soil or on piles shall be proportioned as to soil bearing area or number of piles on the basis of the total column load plus the weight of the footing itself. For computations of moments and shears, an upward reaction per unit area or per pile shall be based on the total column load (not including the weight of the footing itself) divided by the area or by the number of piles.

(b) **Sloped or Stepped Footings.** Footings in which the thickness has been determined by the requirements for shear as specified in Section 2617, Subsection (h), may be sloped or stepped, provided that the shear on no section outside the critical section exceeds the value specified, and provided further that the thickness of the footing above the reinforcement at the edge shall not be less than six inches (6") for footings on soil, nor less than twelve inches (12") for footings on piles. Sloped or stepped footings shall be cast as a unit.

(c) **Bending Moment in Footings.** The critical section for bending moment in a concrete footing which supports a concrete column, pedestal or wall, shall be considered to be at the face of the column, pedestal or wall. For footings under masonry walls, the critical section shall be assumed as halfway between the middle and edge of the wall. For footings under metallic bases, the critical section shall be assumed as halfway between the face of the column or pedestal and the edge of the metallic base.

The bending moment at the critical section in a square footing, or in a rectangular footing having its side not greater than one and one-half times its width, shall be computed from the load on trapezoids bounded by the line of the critical section for moment, the corresponding outside edge of the footing, and the portions of the two diagonals. The load on the two corner tri-

angles of the trapezoid shall be considered as applied at a distance equal to six-tenths of the projection of the footing from the line of critical section for moment. The load on the rectangular portion of the trapezoid shall be considered as applied at its center of gravity.

For a round or octagonal concrete column or pedestal, the face of the column shall be taken as the side of a square of an area equal to the area enclosed within the perimeter of the column or pedestal.

(d) **Shearing and Bond Stresses.** The critical section for diagonal tension in footings on soil shall be assumed as a vertical section at a distance (d) from the face of the column or pedestal supported by the footing.

In footings on piles the critical section shall be assumed at a distance $\frac{d}{2}$ from the face of the column or pedestal, and any piles whose centers are at or within the section shall be excluded in computing shear.

For shearing stresses see Subsection 2617 (h).

The critical sections for bond shall be assumed at the face of the column or pedestal; at vertical planes where changes occur, and near the end of the bending moment reinforcement.

For bond stresses see Section 2618, Subsections (a) to (e) inclusive.

(e) **Transfer of Stress at Base of Column.** The compressive stress in longitudinal reinforcement at the base of a column shall be transferred to the pedestal or footing by dowels. There shall be at least one dowel for each column bar, and the total sectional area of the dowels shall not be less than the sectional area of the longitudinal reinforcement in the columns. The dowels shall extend up into the column and down into the pedestal or footing the distance required for lap of longitudinal column bars [see Subsection 2620 (c)].

The permissible compressive unit stress on top of the pedestal or footing directly under the column shall not be greater than that determined by Formula (21).

$$r_a = 0.25 f'_c \sqrt[3]{\frac{A}{A'}} \quad (21)$$

In sloped or stepped footings, A may be taken as the area of the top horizontal surface of the footing, or as the area of the lower base of the largest frustum of a pyramid or cone contained wholly within the footing and having for its upper base the loaded area A' , and having side slopes of one vertical to two horizontal.

(f) **Pedestals and Footing (Plain Concrete).** See Section 2624 (e).

Sec. 2622. The depth of precast concrete joists shall be not more than four times the width of the top or bottom flanges nor less than one twenty-fourth of the span length.

The thickness of the top slab shall be not less than one-twelfth of the clear span between joists nor less than two inches (2") for roofs or floors and not less than one and one-half inches (1½") over the joists. The slab shall have not less than 0.2 per cent reinforcement at right angles to the span

**Precast
Concrete
Joists**

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of joists. The reinforcement shall be spaced not farther apart than five times the slab thickness.

When the top slab is adequately reinforced and bonded to the joist, the construction may be considered as a T-beam.

Composite Beams

Sec. 2623. The term "Composite Beam" shall apply to any rolled or fabricated steel floor beam entirely encased in poured concrete at least four inches (4") wider, at its narrowest point, than the flange of the beam, supporting a concrete slab on each side without openings adjacent to the beam; provided that the top of the beam is at least one and one-half inches (1½") below the top of the slab and at least two inches (2") above the bottom of the slab; provided that a good grade of stone or gravel concrete with portland cement, is used; and provided that the concrete has adequate mesh, or other reinforcing steel, throughout its whole depth and across the soffit.

Composite beams may be figured on the assumption that:

1. The steel beam carries unassisted all dead loads prior to the hardening of the concrete, with due regard for any temporary support provided.

2. The steel and concrete carry by joint action all loads, dead and live, applied after the hardening of the concrete.

The total tensile unit stress in the extreme fiber of the steel beam thus computed shall not exceed 20,000 pounds per square inch. (See Section 2702).

The maximum stresses in concrete, and the ratio of Young's moduli for steel and concrete, shall be as prescribed by the specifications governing the design of reinforced concrete for the structure.

The web and end connections of the steel beam shall be adequate to carry the total dead and live load without exceeding the unit stresses prescribed in this Code, except as this may be reduced by the provision for other proper support.

Plain Concrete

Sec. 2624. (a) **General.** Plain concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 2,000 pounds per square inch, and material, proportioning, and placing shall conform to the requirements of this Chapter.

Provisions shall be made to care for temperature and shrinkage stresses either by use of reinforcement or by means of joints.

Plain concrete construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2313 is applicable, plain concrete shall also be designed in accordance with the allowable stresses specified in this Chapter.

(b) **Wall Thickness.** The thickness of plain concrete walls may be two inches (2") less than required by Section 2404 for plain masonry walls but in no case less than seven inches (7"), and the ratio of unsupported height or length (whichever is the lesser) to thickness, shall not be greater than 22.

(c) **Design.** Plain concrete walls shall be designed to withstand all vertical and horizontal loads as specified in Chapter 23.

(d) **Stresses.** The allowable working stresses in plain concrete walls shall not exceed the following percentages of ultimate strength:

Compression	.25 f'_c
Tension	.01 f'_c
Shear	.02 f'_c

(e) **Pedestals and Footings (Plain Concrete).** The allowable compressive unit stress on the gross area of a concentrically loaded pedestal shall not exceed $0.25 f'_c$. Where this stress is exceeded, reinforcement shall be provided and the member designed as a reinforced concrete column.

The depth and width of a pedestal or footing of plain concrete shall be such that the tension in the concrete shall not exceed $0.03 f'_c$, and the average shearing stress shall not exceed $0.02 f'_c$, taken on critical sections as determined for reinforced concrete footings.

Sec. 2625. Bolts shall be solidly embedded in plain or reinforced concrete, and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 26-J. **Bolts**

TABLE NO. 26-J—ALLOWABLE SHEAR ON BOLTS

Diameter (in inches)	Embedment (in inches)	Shear (in pounds)
$\frac{1}{2}$	$1\frac{1}{2}$	520
$\frac{5}{8}$	$1\frac{3}{4}$	820
$\frac{3}{4}$	2	1180
$\frac{7}{8}$	$2\frac{1}{4}$	1600
1	$2\frac{1}{2}$	2100
$1\frac{1}{8}$	3	2660
$1\frac{1}{4}$	4	3280

CHAPTER 27—STEEL AND IRON**(Quality and Design)**

Sec. 2701. The quality and design of steel and iron used structurally in buildings or structures shall conform to the requirements specified in this Chapter. **Quality and Design**

Steel used structurally shall be of such quality as to conform to A.S.T.M. "Standard Specifications for Structural Steel for Bridges and Buildings," (A7-42).

Steel pipe for steel pipe columns shall be of such quality as to conform to A.S.T.M. "Standard Specifications for Welded and Seamless Steel Pipe," (A53-42), and shall be a medium carbon steel manufactured by the open hearth or electric furnace process.

Cast steel used in buildings or structures shall be of such quality as to conform to the A.S.T.M. "Standard Specifications for Carbon Steel Castings," (A27-42).

Cast iron used in buildings or structures shall be of such quality as to conform to the A.S.T.M. "Standard Specifications for Gray Iron Castings," (A48-41).

All structural steel, cast steel and cast iron shall be tested in accordance with the above specifications when deemed necessary by the Building Official and copies of such tests shall be filed in the office of the Building Official. No structural steel, cast steel and cast iron shall be used in any building or structure which does not comply with the above requirements or for which no test results have been filed with the Building Official. All such tests shall be made by competent testing laboratories at the expense of the owner.

The computation and design shall be properly made so that the unit working stresses specified in this chapter are not exceeded. The structure and its details shall possess the requisite strength and rigidity for proper stability and the design of structural members shall be such as to admit of a rational analysis according to well established principles of mechanics and sound engineering practice.

All structural steel sections shall be straight and true and any section so damaged as to affect its proper carrying capacity shall not be used in the construction of any building or structure.

Sec. 2702. All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per square inch shall not exceed those specified in this Section. **Allowable Unit Stresses**

(a) Tension

Structural Steel, net section.....	20,000
Cast Steel on net section.....	15,000
Cast Iron on net section.....	(not allowed)
Rivets, on area based on nominal diameter.....	15,000
Bolts, at root of thread.....	15,000

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Allowable
Unit
Stresses
(Cont'd.)

(b) Compression

Columns, gross section

For columns with values of l/r not

$$\text{greater than } 120 \dots\dots\dots 17,000 - 0.485 \frac{l^2}{r^2}$$

For columns with values of l/r

$$\text{greater than } 120 \dots\dots\dots \frac{18,000}{1 + \frac{P}{18,000r^2}} \left\{ 1.6 - \frac{l}{200r} \right\}$$

Plate Girder Stiffeners, gross section..... 20,000

Webs of Rolled Sections at toe of fillet..... 24,000

For main compression members, the ratio of l/r shall not exceed 180 and for bracing, struts and similar members 200.

On cast iron columns, with square or fixed ends;

$$P = 9,000 - 40 l/r$$

with a minimum gross diameter of six inches (6") and with the ratio l/r never in excess of 70.

In the foregoing formulas "P" equals the maximum unit working stress in pounds per square inch; l equals the unsupported length of the column or compression member in inches; and r equals the least radius of gyration of the column or compression member.

(c) Bending

Tension in extreme fibers of rolled sections,
plate girders, and built-up members.....

20,000

Compression on extreme fibers of rolled sections,
plate girders, and built-up members,
for values of l/b not greater than

22,500

40.....

$$1 + \frac{l^2}{1800 b^2}$$

with a maximum of 20,000 in which l is the unsupported length of the member, and b is the width of the compression flange, both in inches.

Girders, beams, lintels and similar members may be laterally braced by joists, tie rods, or similar members anchored thereto so as to laterally stay such members in both directions. Two or more cast iron or steel separators rigidly joining such members together shall be considered as lateral support if the length of flanges between separators does not exceed $40b$.

On extreme fibers of pins, when the forces are assumed as acting at the center of gravity of the pieces.....

30,000

(d) Shearing

Rivets, pins, and turned bolts in reamed or
drilled holes.....

15,000

Unfinished bolts.....

10,000

Webs of beams and plate girders, gross section

13,000

(e) **Bearing**

	Double Shear	Single Shear
Rivets, and turned bolts in reamed or drilled holes.....	40,000	32,000
Unfinished bolts.....	25,000	20,000
Pins.....	32,000	
Contact Area		
Milled Stiffeners and other Milled Surfaces.....	30,000	
Fitted Stiffeners.....	27,000	

(f) **Combined Stresses.** Members subject to both direct and bending stresses shall be so proportioned that the greatest combined stresses shall not exceed the allowed limits.

All members and their connections which are subject to stresses of both tension and compression due to the action of live loads shall be designed to sustain the stress giving the largest section, with 50 per cent of the smaller stress added to it. If the reversal of stress is due to the action of wind, the member shall be designed for the stress giving the largest section and the connections proportioned for the largest stress.

(g) **Members Carrying Wind Load Only.** (See Section 2307.)

(h) **Roller Loads.** The load in pounds per lineal inch on expansion rollers shall not exceed 600 times the diameter of the roller in inches.

(i) **Allowable Unit Stresses for Used Steel.** The allowable unit stresses assigned by the Building Official to any steel not complying with the requirements of Section 2701 shall in no case be more than 80 per cent of the stresses given in 2702. In designs where used steel is provided for, proper allowances shall be made for holes, reduction in section by rust or other defects.

(j) **Allowable Unit Stresses in Light Steel.** The allowable unit stresses in steel used in structural members of light steel construction and having an ultimate tensile strength of less than 60,000 pounds per square inch, shall be reduced in proportion to the ultimate tensile strength of such member.

Sec. 2703. Every member and combination of members shall be designed to provide for any stress due to an eccentric load or force, whenever the increase in stress due to eccentric load or force exceeds 10 per cent of the stress due to a direct load or force on the member or members; but a member framed directly to a central web of another member shall not be considered an eccentric load or force in case the resultant of the load or force acts parallel with the said central web.

**Eccentric
Loads**

Members subject to both axial and bending stresses shall be so proportioned that the quantity $\frac{f_a}{F_a} + \frac{f_b}{F_b}$

shall not exceed unity

F_a = Axial unit stress that would be permitted by this Code if axial stresses only existed.

F_b = Bending unit stress that would be permitted by this Code if bending stresses only existed.

f_a = Unit axial stress (actual) that is, the total axial stress divided by the area of the member.

f_b = Unit bending stress (actual) that is, the bending moment divided by the section modulus of the member.

Beams and Girders

Sec. 2704. (a) Riveted Plate Girders. Riveted plate girders, cover-plated beams, and rolled beams shall in general be proportioned by the moment of inertia of the gross section. No deduction shall be made for standard shop or field rivet holes in either flange; (except that in special cases where the reduction of the area of either flange by such rivet holes, calculated in accordance with the provisions of Section 2707, exceeds 15 per cent of the gross flange area, the excess shall be deducted.) If such members contain other holes, as for bolts, pins, or counter-sunk rivets, the full deduction for such holes shall be made. The deductions thus applicable to either flange shall be made also for the opposite flange if the corresponding holes are there present. When two or more rolled beams or channels are used to form a girder, they shall be so connected to each other as to properly distribute the loads to be carried.

(b) Plate Girder Webs. Plate girder webs shall have a thickness of not less than $1/170$ of the unsupported distance between flanges.

(c) Web Splices in Plate Girders. Web splices in plate girders shall be proportioned to transmit the full shearing and bending stresses in the web at the point of splice.

(d) Stiffeners. Stiffeners shall be placed on the webs of plate girders at the ends and at points of concentrated loads. They shall have a close bearing against the flanges, shall extend as closely as possible to the edges of the flange angles, and shall not be crimped. They shall be connected to the web by enough rivets to transmit the stress. Only that portion of the outstanding legs outside the fillets of the flange angles shall be considered effective in bearing.

Intermediate stiffeners shall be required at all points where

$$\frac{h}{t} > \frac{8000}{\sqrt{s}}$$

WHERE

h = clear depth between flanges, in inches.

t = thickness of the web, in inches.

s = greatest unit shear in panel, in pounds per square inch, under any condition of complete or partial loading.

The clear distance between stiffeners, when stiffeners are required by the foregoing, shall not exceed eighty-four inches (84") or that given by the formula

$$d = \frac{270,000 t}{s} \times \sqrt{\frac{st}{h}}$$

In which d equals the clear distance between stiffeners, in inches.

Plate girder stiffeners shall be in pairs, one on each side of the web, and shall be connected to the web by rivets spaced not more than eight times their nominal diameter apart.

Intermediate stiffeners may be crimped over the flange angles.

(e) **Crane Runway Girders.** Crane runway girders shall be proportioned to resist any lateral forces produced by loads carried by them. These lateral forces shall in no case be less than 20 per cent of the maximum wheel loads.

(f) **Rivets Connecting Flanges to Web.** Rivets connecting the flanges to the web shall be proportioned to resist the horizontal shear due to bending as well as any loads applied directly to the flange.

(g) **Plate Girder Flanges.** Cover plates of girders shall extend not more than six inches (6") nor more than 12 times the thickness of the thinnest plate beyond the outer row of rivets connecting them to the angles. When no cover plates are used the width of the outstanding leg of the compression flange shall not exceed 12 times its thickness.

(h) **Cover Plates.** Cover plates, when required, shall be of equal thickness or shall diminish in thickness from the flange angles outward. No plate shall be thicker than the flange angles.

(i) **Flange Sections.** The gross section of the compression flange of a plate girder shall be not less than the gross section of the tension flange.

(j) **Rolled Beams.** Rolled beams shall be so proportioned that the unit compression stresses at the web toe of the fillets resulting from concentrated loads shall not exceed 24,000 pounds. Such stresses shall be determined by the formulas:

For interior loads $\frac{R}{t(A + 2N)}$, but not to exceed 24,000

For end bearing $\frac{R}{t(A + N)}$, but not to exceed 24,000

WHERE

R = concentrated interior load or end reaction, in pounds.

t = thickness of web, in inches.

A = Length of bearing, in inches.

N = distance from outer face of flange to web toe of fillet, in inches.

(k) **Effective Span Length.** Beams, girders and trusses shall ordinarily be designed on the basis of simple spans whose effective length is equal to the distance between centers of gravity of the members to which they deliver their end reactions.

If, on the assumption of end restraint, full or partial, based on continuous or cantilever action, beams, girders, and trusses are designed for a shorter effective span length than that specified in the paragraph above, their sections, as well as the sections of the members to which they connect, shall be designed to carry the shears and moments so introduced, in addition to all other forces without exceeding at any point the unit stresses specified in Section 2702.

**Thickness
of
Materials**

Sec. 2705. The minimum thickness of metal in structural steel shapes shall be: for sections exposed to the weather five-sixteenths inch (5/16"); for interior construction one-quarter inch (1/4"); and shall be not less than one-half inch (1/2") at every point for any cast iron or cast steel member, except as follows:

Exceptions: 1. The webs of channels and I-beams, the edges of rolled steel sections, steel joists, signs, skylight bars, non-bearing walls and partitions, suspended ceilings, cornice brackets, steel studs, and similar steel shapes shall not be limited to the above thickness requirements except as provided in Section 2715. (See also Section 3305 for outside stairways.)

2. In steel trusses carrying roof loads only on buildings not exceeding two stories in height, the minimum thickness of metal shall be 3/8", provided that no projecting part of any compression member shall be less in thickness than 1/4" of the unsupported width of the outstanding leg or projecting part.

3. Steel floor and wall panels shall not be limited by the above thickness requirements, but shall be not less than 18 gauge.

**Compression
Splices**

Sec. 2706. Compression members when faced for bearings shall be spliced sufficiently to hold the connected members accurately in place. Other joints in riveted work, whether in tension or compression, shall be spliced so as to transfer the stress to which the member is subject.

**Gross and
Net
Sections**

Sec. 2707. (a) Riveted Holes. In computing net area the diameter of a rivet hole shall be taken as one-eighth inch (1/8") greater than the nominal diameter of the rivet.

(b) **Pin Holes.** In pin connected tension members, the net section across the pin hole, transverse to the axis of the mem-

ber, shall be not less than 140 per cent and the net section beyond the pin hole, parallel with the axis of the member, not less than 100 per cent, of the net section of the body of the member.

In all pin connected riveted members the net width across the pin hole, transverse to the axis of the member, shall preferably not exceed 12 times the thickness of the member at the pin.

(c) **Chain of Holes.** In the case of a chain of holes extending across a part in any diagonal or zigzag line, the net width of the part shall be obtained by deducting from the gross width the sum of the diameters of all the holes in the chain, and adding to the section so obtained for each gauge space in the

chain, the quantity $\frac{s^2}{4g}$

WHERE

s = longitudinal pitch of any two successive holes

g = transverse gauge of the same two holes.

The critical net section of the part is obtained from the chain which gives the least net width.

(d) **Gross Width of Angles.** For angles, the gross width shall be the sum of the widths of the legs less their thickness. The gauge for the holes in opposite legs shall be the sum of the gauges from back of angle less the thickness.

(e) **Splice Members.** For splice members, the thickness shall be only that part of the thickness of the member which has been developed by rivets beyond the section considered.

(f) **Designed Sections.** Unless otherwise specified, tension members shall be designed on the basis of net section. Columns shall be designed on the basis of gross section. Beams and girders shall be designed as specified in Section 2704.

Sec. 2708. (a) Minimum Number of Rivets. Connections carrying calculated stresses, except for lacing, sag bars and girts, shall have not fewer than two rivets. **Connections**

(b) **Eccentricity in Members.** Members meeting at a joint shall have their gravity axis meet at a point if practicable; if not, provision shall be made for their eccentricity.

(c) **Eccentricity in Rivets.** The rivets at the ends of a member transmitting stresses into that member should have their centers of gravity on the line of the center of gravity of the member; if not, provision shall be made for the effect of the resulting eccentricity. Pins may be so placed as to counteract the effect of bending due to dead load.

(d) **Eccentricity in Angles.** Where angles in tension are connected through but one leg and the eccentricity is not taken into account, only 80 per cent of the net section of the angle shall be considered as effective.

(e) **Eccentricity in Members in Flexure.** When beams, girders or trusses are designed on the basis of simple spans, their end connections may ordinarily be designed for the reaction

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Connections
(Cont'd.)

shears only. If, however, the eccentricity of the connection is excessive, provision shall be made for the resulting moment.

(f) **Combined Shear and Moment.** When beams, girders or trusses are subject both to reaction shear and end moment, due to full or partial end restraint, based on continuous or cantilever action, their connections shall be especially designed to carry both shear and moment without exceeding at any point the unit stresses specified in Section 2702. Ordinary end connections comprising only a pair of web angles, with not more than nominal seat and top angle, shall not be assumed to provide for this kind of end moment.

(g) **Filler Plates.** When rivets carrying computed stress pass through fillers, the fillers shall be extended beyond the connected member and the extension secured by sufficient rivets to develop the strength of the filler.

(h) **Fillers Under Stiffeners.** Fillers under plate girder stiffeners at end bearing or points of concentrated loads shall be secured by sufficient rivets to prevent excessive bending and bearing stresses.

(i) **Riveted Joints.** All joints in riveted work, whether in tension or compression, shall be so spliced as properly to transmit all stresses, except as specified in Section 2706.

The minimum distance from the center of any rivet or bolt hole to any edge shall be as set forth in Table No. 27-A.

TABLE NO. 27-A—MINIMUM EDGE DISTANCES

Rivet Diameter (Inches)	Minimum Edge Distance (Inches) for Punched Holes in		
	Sheared Edge	Rolled Edge of Plates & Sections with Parallel Flanges	Rolled Edge of Sections with Sloping Flanges
$\frac{1}{2}$	1	$\frac{3}{8}$	$\frac{3}{8}$ *
$\frac{5}{8}$	$1\frac{1}{8}$	1	$\frac{7}{8}$ *
$\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	1 *
$\frac{7}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{8}$ *
1	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{4}$ *
$1\frac{1}{8}$	2	$1\frac{3}{4}$	$1\frac{1}{2}$ *
$1\frac{1}{4}$	$2\frac{1}{4}$	2	$1\frac{3}{4}$ *

*May be decreased $\frac{1}{8}$ inch when holes are near end of beam.

TABLE NO. 27-B—SPACING OF RIVET HOLES

Rivet Diameter (in Inches)	Center to Center Spacing (in Inches)
$1\frac{1}{4}$	$4\frac{1}{2}$
$1\frac{1}{8}$	4
1	$3\frac{1}{2}$
$\frac{7}{8}$	3
$\frac{3}{4}$	$2\frac{1}{2}$
$\frac{5}{8}$	2
$\frac{1}{2}$	$1\frac{1}{2}$

The minimum distance between centers of rivet holes shall be three diameters of the rivet; but the distance shall be not less than that specified in Table No. 27-B.

The maximum pitch in the line of stress of compression members composed of plates and shapes shall not exceed 16 times the thinnest outside plate or shape, or 20 times the thinnest enclosed plate or shape with a maximum of twelve inches (12"); and at right angles to the direction of stress the distance between lines of rivets shall not exceed 30 times the thinnest plate or shape. For angles in built sections with two gauge lines, with rivets staggered, the maximum pitch in the line of stress in each gauge line shall not exceed 24 times the thinnest plate with a maximum of eighteen inches (18").

In tension members composed of two angles, a pitch of three feet six inches (3'-6") will be allowed, and in compression members two feet (2'-0") but the ratio l/r for each angle between rivets shall be not more than three-fourths of that of the whole member.

The pitch of rivets at the ends of built-up compression members shall not exceed four diameters of the rivets for a length equal to one and one-half times the maximum width of the member.

The minimum distance between the center of any rivet under computed stress, and the end or other boundary of the connected member toward which the pressure of the rivet is directed, shall be not less than the shearing area of the rivet shank (single or double shear respectively) divided by the plate thickness. This end distance may however be decreased in such proportion as the stress per rivet is less than that specified in Section 2702; and the requirement may be disregarded in case the rivet in question is one of three or more in a line parallel to the direction of the stress.

Sec. 2709. In proportioning rivets, the nominal diameter of the rivet shall be used.

**Rivets
and
Bolts**

Rivets carrying calculated stresses, whose grip exceeds five diameters, shall have their number increased one per cent for each additional one-sixteenth inch ($\frac{1}{16}$ ") in the rivet grip. Special care shall be used in heating and driving such rivets.

Rivets shall be used for the connections of main members carrying live loads which produce impact, and for connections subject to reversal of stresses.

Unfinished bolts may be used in shop or field work for connections in small structures used for shelters, and for secondary members of all structures such as purlins, girts, door and window framing, alignment bracing and secondary beams in floor.

The effective bearing area of pins, bolts, and rivets shall be the diameter multiplied by the length in bearing; except that for countersunk rivets, half the depth of the countersink shall be deducted.

Rivets shall be used in the following cases:

In all connections in structures over one hundred feet (100') in height when the height is more than two and one-half times the minimum horizontal dimension at the ground line.

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In all connections in structures one hundred feet (100') or less in height where the height is more than four times the least horizontal dimension at the ground line.

In all connections of beams and girders to columns and of beams and girders bracing columns in buildings over one hundred feet (100') in height, and in column splices of buildings more than two hundred feet (200') in height.

In all connections for supports of machinery or other moving loads.

Unfinished bolts may be used for connections not mentioned in the preceding paragraphs.

Turned bolts in reamed holes may be used, in place of rivets, in either shop or field work where it is impracticable to obtain satisfactory power driven rivets, provided holes are as specified in Section 2717. The finished shank shall be long enough to provide a full grip for the nut, and washers shall be used under all nuts.

The end reaction stresses of trusses, girders, or beams, and the axial stresses of tension or compression members which are carried on rivets, shall have such stresses developed by the shearing and bearing values of the rivets or bolts.

**Welded
Connections**

Sec. 2710. Fusion welding may be used (in place of riveting or bolting) for connecting structural steel or wrought iron parts or members to one another, but in no case shall the stresses in such joints exceed the allowable unit working stresses given in the following table:

Allowable Unit Working Stresses for Static Loads	
Tension in weld metal (butt welds).....	16,000 lbs. per sq. in.
Shear in weld metal (fillet welds).....	13,600 lbs. per sq. in.
Compression in weld metal.....	20,000 lbs. per sq. in.

Maximum fiber stresses due to bending shall not exceed the values prescribed above for tension and compression, respectively. In designing welded joints adequate provision shall be made for bending stresses due to eccentricity, if any, in the disposition or section of base metal parts.

The same proportional increase in the above working stresses shall be allowed for the various given conditions as specified in Section 2702, Subsections (f) and (g).

The "Code for Arc and Gas Welding in Building Construction," Edition of 1941, (Tentative), Sections II, III and IV, formulated by the American Welding Society, shall be followed in the design and execution of structural welding.

**Construction
Details**

Sec. 2711. Trusses shall be riveted structures and only when there is sufficient reason to justify, as where riveted field connections become unwieldy, may they be designed as pin-connected structures.

All joints in riveted work, whether in tension or compression, shall be spliced properly to transmit the stresses.

Bracing shall be sufficient to withstand safely wind and other forces when the building is in the process of erection as well as after completion.

When two or more plates are in contact they shall be stitch riveted with rivets not more than twelve inches (12") apart in either direction.

The ends of beams, channels, girders and trusses that bear on masonry or reinforced concrete shall be so framed that the allowable stresses for masonry or reinforced concrete shall not be exceeded, and anchors of ample size and strength shall be provided thoroughly embedded in the masonry or reinforced concrete construction.

The ends of all beams, channels, girders, girts, purlins and similar members, that meet on a beam, girder, truss, column or pier shall be connected to each other by a strap or through the carrying members with not less than two bolts or rivets each not less than five-eighths inch ($\frac{5}{8}$ ") in diameter in the end of each connecting member.

Tie rods shall be proportioned to resist their respective stresses, and holes for them shall be placed as near the spring of the arches as practicable.

Sec. 2712. (a) Compression Members. The open sides of compression members shall be provided with lacing having tie plates at each end and at intermediate points if the lacing is interrupted. Tie plates shall be as near the ends as practicable. In main members carrying calculated stresses the end tie plates shall have a length of not less than the distance between the lines of rivets connecting them to the flanges, and intermediate ones of not less than one-half of this distance. The thickness of tie plates shall be not less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the members, and the rivet pitch shall be not more than four diameters. **Lattice**

(b) Tension Members. Tie plates shall be used to secure the parts of tension members composed of shapes. They shall have a length not less than two-thirds of the length specified for tie plates in compression members. The thickness shall be not less than one-fiftieth of the distance between the lines of rivets connecting them to the segments of the member and they shall be connected to each segment by at least three rivets.

(c) Spacing of Lacing Bars. Lacing bars of compression members shall be so spaced that the ratio l/r of the flange included between their connections shall be not over three-fourths of that of the member as a whole.

(d) Proportioning of Lacing Bars. Lacing bars shall be proportioned to resist a shearing stress normal to the axis of the member equal to two per cent of the total compressive stress of the member. In determining the section required the compression formula shall be used, l being taken as the length of the bar between the outside rivets connecting it to the segment for single lacing and 70 per cent of that distance for double lacing. The ratio l/r shall not exceed 140 for single lacing and 200 for double lacing.

(e) Thickness of Lacing Bars. The thickness of lacing bars shall be not less than one-fortieth for single lacing and

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one-sixtieth for double lacing of the distance between end rivets; their minimum width shall be three times the diameter of the rivets connecting them to the segments.

(f) **Inclination of Lacing Bars.** The inclination of lacing bars to the axis of the members shall preferably be not less than 45 degrees for double lacing and 60 degrees for single lacing. When the distance between rivet lines in the flanges is more than fifteen inches (15") the lacing shall be double and riveted at the intersection if bars are used, or else shall be made of angles.

**Pins and
Pin Holes**

Sec. 2713. Pins shall be long enough to insure a full bearing of all parts connected upon the turned-down body of the pin.

Members packed on pins shall be held against lateral movement.

Pin-holes shall be reinforced by plates wherever necessary to give proper bearing. At least one plate shall be as wide as the projecting flanges will allow. Where angles are used this plate shall contain sufficient rivets to distribute their portion of the pin pressure to the full cross section of the member.

**Bearing
Plates and
Anchorage**

Sec. 2714. Provision shall be made to transfer the column loads to the footings and foundations.

Column bases shall be set level and to correct elevation with full bearing on the masonry.

Column bases shall be finished to accord with the following requirements:

1. Rolled steel bearing plates two inches (2") or less in thickness may be used without planing or straightening; rolled steel bearing plates over two inches (2") but less than four inches (4") in thickness may be straightened by pressing, or planed on all bearing surfaces if presses are not available; rolled steel bearing plates four inches (4") or over in thickness shall be planed on all bearing surfaces (except as noted under paragraph 3 of this Section).

2. Column bases other than rolled steel bearing plates shall be planed on all bearing surfaces (except as noted in paragraph 3).

3. The bottom surfaces of column bases which rest on masonry foundations and are grouted to insure full bearing contact need not be planed.

4. Anchor bolts shall be of sufficient size and number to develop the computed stresses.

**Light
Steel
Construction**

Sec. 2715. (a) General. Steel studs and other supports used in the structural frame of light steel construction and steel joists shall be light weight rolled steel sections or sections formed from light gauge flat rolled steel sheets, or a combination of both used alone or in combination with other materials of construction, all of which shall be of a standard or commonly accepted type or shape; or such members may be of a determinate truss design built up of rolled structural steel sections effective

tively arc or resistance welded together. For such steel studs the ratio l/r shall not exceed 180.

**Light
Steel
Construction
(Cont'd.)**

The effective width of flanges on such members having a channel section shall not exceed 20 times the thickness of the flange. The effective width of flanges on such members having an I-section shall not exceed 20 times the thickness of the flange on each side of the neutral axis. The effective width of steel sheets or plates constructed to act integrally with steel joists, studs, or other steel supporting members shall not extend more than 20 times the thickness of such sheet or plate on each side of the point or points of fixation to such members.

Open web or trussed members shall be so constructed that the lines of force of all connected members shall intersect at a point or proper allowance shall be made in the design for any resulting stress. The web elements shall be of sufficient strength to resist effectively the shearing stresses.

The following are the minimum thicknesses of metal permitted for various members of the structural frame of light steel construction:

Bearing studs, floor and roof framing members—16 gauge

Roof decks supported on ribs—20 gauge

(See also Section 2705.)

All connections shall be riveted, bolted or welded. All steel work, including welds and connections, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of acceptable metal protection well worked into the joints and open spaces.

(b) **Stresses.** Stresses in structural members of light steel construction shall not exceed those specified in Section 2702. No steel floor under its calculated load shall deflect more than $1/360$ of the span, when plaster is supported. The actual spacing of floor joists, studs or other light steel wall supports shall be determined by their capacity to sustain the loads which they carry, but in no case shall such spacing exceed four feet (4').

(c) **Construction Details.** Steel studs or other steel supporting members used in the structural frame of light steel construction and steel joists shall be connected to the supporting beams, girders, foundations or other steel supporting members by arc or resistance welding, riveting, bolting or other approved methods. All such welds in light steel construction shall be made on two sides or two edges of each bearing in such a manner as to resist effectively the stresses developed. Resistance welding shall develop the full strength of the member welded.

Steel floor and roof members supported on masonry and reinforced concrete shall have end bearings at least four inches (4") in length and the ends of such members resting on masonry or reinforced concrete shall be provided with approved joist anchors thoroughly embedded therein.

Bearing plates, when required by design, shall be securely welded, bolted or riveted to such floor and roof members, studs or other supporting members.

Bearing studs or other vertical bearing members shall rest on a sole or plate having an effective width equal to the depth

of such member and having a thickness of not less than 14 gauge but in no case less than that of the vertical member resting thereon unless each such vertical bearing member is thoroughly embedded in the concrete foundation. Such soles or plates shall be effectively anchored to the foundation and all splices and intersections shall develop the full strength of the members connected.

When bearing studs or other vertical bearing members are spliced, the full strength of such members shall be developed in the splice.

Where studs do not continue full length from one story through the next story above, a cap plate or steel member shall be provided on top of the lower story studs or a sill plate on the upper story. Such cap plate or sill plate shall be of sufficient strength to distribute adequately the loads from the upper story studs to the lower story studs.

All horizontal or diagonal ties or bracing in exterior walls and bearing partitions shall be effectively arc welded, bolted or riveted to the structural frame or effectively anchored to supporting masonry.

Where plumbing, heating or other pipes or conduits are placed in or partly in an exterior wall or bearing partition necessitating the cutting of soles or plates, bracing or structural member in said wall, such members shall be reinforced so as to provide sufficient strength to resist the stresses imposed thereon or proper provisions shall be made to transfer such stresses to the points of support.

Expansion

Sec. 2716. Proper provision shall be made for expansion and contraction.

Workmanship

Sec. 2717. All workmanship shall be equal to the best practice in modern structural shops.

Drifting to enlarge unfair holes shall not be permitted. Holes that must be enlarged to admit the rivets shall be reamed. Poor matching of holes shall be cause for rejection.

All material shall be clean and straight. If straightening or flattening is necessary, it shall be done by a process that will not injure the material. Sharp kinks or bends shall be cause for rejection.

Rolled sections, except for minor details, shall preferably not be heated, or, if heated shall be annealed.

All steel castings shall be properly annealed.

Material may be punched one-sixteenth inch ($\frac{1}{16}$ ") larger than the nominal diameter of the rivets, whenever the thickness of the metal is equal to or less than the diameter of the rivets, plus one-eighth inch ($\frac{3}{8}$ "). When the metal is thicker than the diameter of the rivet, plus one-eighth inch ($\frac{1}{8}$ "), the holes shall be drilled, or sub-punched and reamed.

Holes for shop turned bolts shall be sub-punched and reamed or drilled from the solid. Holes for field turned bolts shall be sub-punched in the shop and reamed in the field.

When sub-punching and reaming is required the die used for punching shall be one-sixteenth inch ($\frac{1}{16}$ ") smaller than the

nominal diameter of the rivet. Rivet holes, after assembling, shall be reamed to a diameter one-sixteenth inch ($\frac{1}{16}$ ") greater than the nominal diameter of the rivet. Turned bolt holes, after assembling, shall be reamed (for field bolts in the field) to a diameter one-fiftieth inch ($1/50$ ") larger than the diameter of the turned bolt.

**Workman-
ship
(Cont'd.)**

Rivets are to be driven hot, and wherever practicable, by power. Rivet heads shall be of hemispherical shape and uniform in size throughout the work for the same size rivet, full, neatly finished, and concentric with the bores. Rivets, after driving, shall be tight, completely filling the holes, and with heads in full contact with the surface.

Rivets shall be heated uniformly to a temperature not exceeding 1950° F. They shall not be driven after their temperature is below 1000° F. Loose, burned and otherwise defective rivets shall be replaced.

Compression joints depending upon contact bearing shall have the bearing surfaces truly faced after the members are riveted. All other joints shall be cut or dressed true and straight.

Finished members shall be true to line and free from twists, bends and open joints.

Compression members may have a lateral variation not greater than 1/1000 of the axial length between points which are to be laterally supported.

An allowable variation of one thirty-second inch ($\frac{1}{32}$ ") is permissible in the overall length of members with both ends milled.

Members without milled ends which are framed to other steel parts of the structure may have a variation from the detailed length not greater than one-sixteenth inch ($\frac{1}{16}$ ") for members thirty feet (30') or less in length, and not greater than one-eighth inch ($\frac{1}{8}$ ") for members over thirty feet (30') in length.

Planing or finishing of sheared plates or shapes will not be required unless specifically called for on the drawings.

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting done during assembling shall not distort the metal or enlarge the holes.

Gas cutting may be done under the following conditions:

1. The contractor shall be required to satisfy the Building Official as to his ability to produce satisfactory gas cuts.
2. Gas cut edges shall be regular in contour.
3. Gas cutting may be used in the preparation of base metal parts for welding, provided the edges so cut are thoroughly cleaned after cutting so as to expose clean metal.
4. Gas cutting shall not be permitted to replace the milling of surfaces specified elsewhere in this Code.
5. Gas cutting shall not be permitted on any member while it is carrying stress. To determine the net area of members so cut, one-eighth inch ($\frac{1}{8}$ ") shall be deducted from the gas cut edges. The radius of re-entrant gas cut fillets shall be as large as possible, but never less than one inch (1"). This restriction shall not apply to detail cutting for the correction of minor fabricating errors, where the removal of metal resulting from such gas

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cutting would not reduce the required strength of the member that is to be cut.

6. Gas cutting of holes in any member which has not been designed therefor shall not be permitted.

Painting

Sec. 2718. Parts not in contact, but inaccessible after assembling, shall be properly protected by paint.

All steel work, except where entirely encased in concrete, shall be thoroughly cleaned and given one coat of approved metal protection well worked into the joints and open spaces.

Machine finished surfaces shall be protected against corrosion.

Cast iron columns shall not be painted until after acceptance by the Building Official.

PART VII

DETAILED REGULATIONS

CHAPTER 28—EXCAVATIONS, FOOTINGS AND FOUNDATIONS

Sec. 2801. Excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property. Permanent excavations shall have retaining walls of masonry or concrete of sufficient strength to retain the embankment together with any surcharged loads. No excavation for any purpose shall extend within one foot (1') of the angle of repose or natural slope of the soil under any footing or foundation, unless such footing or foundation is first properly underpinned or protected against settlement. **Excavations**

Any person making or causing an excavation to be made to a depth of twelve feet (12'), or less, below the grade, shall protect the excavation so that the soil of adjoining property will not cave in or settle, but shall not be liable for the expense of underpinning or extending the foundation of buildings on adjoining properties where his excavation is not in excess of twelve feet (12') in depth. Before commencing the excavation the person making or causing the excavation to be made shall notify in writing the owners of adjoining buildings not less than 10 days before such excavation is to be made that the excavation is to be made and that the adjoining buildings should be protected. The owners of the adjoining properties shall be given access to the excavation for the purpose of protecting such adjoining buildings.

Any person making or causing an excavation to be made exceeding twelve feet (12') in depth below the grade, shall protect the excavation so that the adjoining soil will not cave in or settle, and shall extend the foundation of any adjoining buildings below the depth of twelve feet (12') below grade at his own expense. The owner of the adjoining buildings shall extend the foundations of his buildings to a depth of twelve feet (12') below grade at his own expense as provided in the preceding paragraph.

Sec. 2802. Footings and foundations, unless specifically provided, shall be constructed of masonry or concrete and shall in all cases extend below the frost line. The base areas of all footings and foundations shall be proportioned as specified in Section 2311. Mortar used in foundation walls and footings shall be as specified in Section 2403 (e). **Footings and Foundations**

Footings shall be so designed that the allowable bearing capacity of the soil in tons per square foot as given below shall not be exceeded unless the particular soil on which the building is to be placed shows a greater bearing capacity than that specified in this Section.

Rock.....Not more than 20 per cent of the ultimate crushing strength of such rock.

Gravel or coarse sand, well cemented..... 6 tons
 Dry, hard clay or coarse firm sand (hardpan)..... 4 tons
 Moderately dry clay or moderately dry sand and clay.. 3 tons
 Ordinary clay and sand..... 2 tons
 Soft clay, sandy loam or silt..... 1 ton
 Adobe..... ½ ton

Where the bearing capacity of the soil is not definitely known or is in question, the Building Official may require load tests or other adequate proof as to the permissible safe bearing capacity at that particular location. To determine the safe bearing capacity of soil it shall be tested by loading an area not less than two square feet (2 sq. ft.) to not less than twice the maximum bearing capacity desired for use. Such double load shall be sustained by the soil until no additional settlement takes place for a period of not less than 48 hours in order that such desired bearing capacity may be used. Examination of sub-soil conditions may be required when deemed necessary.

Foundations shall be built upon natural solid ground where possible. Loam or soil containing organic matter shall not be used to support buildings exceeding one story in height. Where solid natural ground does not occur at the foundation depth, such foundations shall be extended down to natural solid ground or piles shall be used, unless there is a practically level fill of good ground which has been in place a sufficient length of time to settle properly, when such fill may be used.

Piles

Sec. 2803. (a) General Requirements. All piles used to support any building or part thereof shall be driven to a reasonably solid bearing in such a manner as not to impair their strength. No pile or group of piles shall be loaded eccentrically.

(b) Wood Piles. Wood piles shall be of oak, Douglas fir, Southern pine, cedar, or other approved wood containing no evidences of decay. The piles shall be free from short kinks or reverse bends and shall have a uniform taper from butt to tip. A straight line drawn from the center of the butt to the tip shall lie wholly within the body of the pile. The diameter of wood piles at the point shall be not less than six inches (6") and at the butt shall be not less than ten inches (10") for piles twenty-five feet (25') or less in length, and not less than twelve inches (12") at the butt for piles more than twenty-five feet (25') in length. No piles with spiral grain which exceeds one complete turn in forty feet (40'), shall be used. All wood piles and capping shall be cut off and/or placed below mean low water level or below lowest ground water level, with the exception of creosoted piles as covered in this Section.

Piles of Douglas fir or Southern pine treated with Grade 1 creosote in accordance with Specifications No. 41-b and 39-c respectively of the American Wood-Preservers' Association, with final retention of not less than 12 pounds per cubic foot for Douglas fir nor less than 15 pounds per cubic foot for Southern pine, may be used as follows:

1. Where the upper portion of the creosoted piling is to be exposed and available for inspection the cut-off may be above ground level or above water level.

2. Where the upper part of the creosoted piling will not be readily available for inspection the cut-off shall be below ground level but may be above ground water level provided the tops of the cut-off piles are treated with three coats of hot creosote and capped with concrete so that no part of the pile will be exposed to the air. **Piles (Cont'd.)**

No creosoted piling shall be used which has been so injured in handling or driving as to penetrate the creosoted shell, except in the case of bolt holes and unavoidable framing including the top cut-off, all of which shall be treated with three coats of hot creosote.

The allowable load on wood piles shall be in conformity with the requirements of Section 2803 (f).

(c) **Concrete Piles.** Concrete piles shall be of material complying with the requirements for portland cement, fine aggregate, coarse aggregate and reinforcement as specified in Chapter 26 and steel as specified in Chapter 27. The maximum allowable working stress on any concrete pile shall not exceed 20 per cent of the ultimate compressive strength of the concrete used in the piles, determined by tests as specified in Chapter 26. The maximum allowable load on any pile shall not exceed such working stress multiplied by the average cross sectional area of the pile.

Concrete piles cast in place in drilled or bored holes shall be made in such a manner as to insure the exclusion of any foreign matter and to secure a full-sized shaft. The length of such piles shall be limited to not more than 30 times the average diameter.

Concrete piles cast in place in steel shells shall have permanent shells driven for their full length in contact with the surrounding soil and left permanently in place. The shells shall be sufficiently strong to resist collapse and shall be sufficiently watertight to exclude water and foreign material during placing of concrete. Such piles shall have a tip diameter of not less than eight inches (8") and an average diameter of not less than eleven inches (11").

Precast concrete piles shall be sufficiently cured to attain the ultimate strength upon which their use is based, before driving. Such piles shall be reinforced and so handled as not to be fractured in any manner which will affect their durability or strength. Precast concrete piles shall have a diameter at the point of not less than six inches (6"), and an average diameter of not less than ten inches (10"). The length of such piles when driven to rock shall be limited to 20 times the average diameter and shall not exceed 40 times the average diameter in any other case.

The allowable load on concrete piles shall be as specified in Section 2803 (f).

(d) **Steel Piles.** Rolled structural steel piles shall comply with the requirements for structural steel as specified in Chapter 27. The minimum thickness of metal shall be three-eighths inch ($\frac{3}{8}$ "). The allowable load on structural steel piles shall be as specified in Section 2803 (f).

(e) **Concrete-Filled Steel Pipe Piles.** Concrete-filled steel pipe piles shall have a nominal outside diameter of not less than

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Piles
(Cont'd.)

ten and three-quarters inches (10 $\frac{3}{4}$ ") and a nominal wall thickness of not less than five-sixteenths inch (5/16"), except that piles having a nominal outside diameter of fourteen inches (14") or over shall have a nominal wall thickness of not less than three-eighths inch ($\frac{3}{8}$ "). Concrete filling shall conform to the requirements of this Section for concrete piles. Splices shall develop at least one-third of the full bending strength of the steel section, except that where the piles are required to be designed as columns by the provisions of Section 2803 (f), splices shall develop the full bending strength of the steel section.

The allowable load on concrete-filled steel pipe piles shall be as specified in Section 2803 (f). In applying the formulas of that Section, the values of P, L, A and E which are used shall be those for the empty shell as driven. In no case shall the allowable load exceed 7500 pounds per square inch on the steel plus 25 per cent of the ultimate 28-day compressive strength on the concrete, except that where the length of the piles exceeds 40 times the nominal outside diameter, the unit load on the concrete shall not exceed 20 per cent of its 28-day compressive strength.

Exception: Where concrete-filled steel pipe piles are driven open-ended to refusal on sound bed rock which is not underlain by a softer stratum, the formula of Section 2803 (f) may be disregarded and the allowable load may be based upon the unit stresses prescribed above.

(f) **Safe Load.** The assumed safe load on a pile shall not exceed the value given by the following formula, unless such safe load is determined by test loading as specified in this Section:

Safe load = $R/4$ for all piles,

WHERE:

$$R \text{ (for steel piles)} = \frac{12 Wh \frac{W + 0.25P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

$$R \text{ (for other piles)} = \frac{12 Wh \frac{W + 0.1P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

WHERE:

R = ultimate driving resistance, in tons

W = weight of hammer, in tons

P = weight of pile in tons

S = permanent settlement of pile under the average of the last 10 blows, in inches

h = height of fall of hammer, in feet

L = length of pile, in feet

A = average right cross-sectional area of pile, in square inches

E = modulus of elasticity of pile, in pounds per square inch

No wooden pile shall be loaded in excess of 500 pounds per square inch of the right section of the pile at mid-length. **Piles (Cont'd.)**

The safe bearing value of a pile may be determined by a load test, upon due notice to the Building Official. The assumed safe load shall not exceed one-half of the load which shows no settlement for 24 hours, and a total settlement not to exceed 0.01 inch per ton of test load.

The supporting value of piles depending solely upon friction when driven in clusters or groups, shall be determined by multiplying the bearing value of a single pile by an efficiency factor as determined by the following formula:

$$\text{Efficiency} = 1 - \theta \left(\frac{(n-1)m + (m-1)n}{90 mn} \right)$$

WHERE:

n = number of piles in a row

m = number of rows

d = diameter of pile

s = center to center spacing of piles

$\tan \theta$ = d/s , in which θ is numerically equal to the angle expressed in degrees

Piles standing free in water or very soft soil shall conform with the applicable column formula as stated in this Code. Piles driven into firm ground may be considered fixed at five feet (5') below the ground surface and in soft material at ten feet (10') below the ground surface.

When precast concrete piles frame into a concrete deck structure, the unsupported length may be taken as two-thirds the distance from the top of the pile to the point of fixity as stated in the foregoing paragraph.

Sec. 2804. (a) Caissons. The footings of any structure may be carried down to a firm foundation by isolated piers of reinforced concrete or by open or pneumatic caissons either with or without enlarged base or bell at the bottom. The safe carrying capacity of such shafts or caissons shall not exceed the allowable unit bearing capacity of the soil multiplied by the area of the base or bell at bottom. **Caissons**

(b) Caissons With Belled Footings. In the case of piers or caissons with belled footings, the slope of the sides of the bell shall not exceed one foot horizontally for each two feet vertically unless properly reinforced in accordance with Section 2621.

CHAPTER 29 — VENEERED WALLS

General

Sec. 2901. (a) Limitations. Veneer shall not be assumed to add to the strength of any wall.

(b) Height. Exterior veneer shall not be attached to wood at any point more than twenty feet (20') above the adjacent ground elevation.

(c) Horizontal Forces. Veneer shall not be assumed to resist horizontal forces, except as specifically provided in Section 2902.

(d) Exceptions. The limitations in this Chapter shall not apply to interior veneer of units five-eighths inch ($\frac{5}{8}$ ") or less in thickness.

**Veneer
Composed
of
Masonry
Units**

Sec. 2902. (a) Scope. The provisions of this Section shall apply to all veneer which is constructed of masonry conforming to the requirements of Chapter 24.

(b) Vertical Loads. No veneer shall support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported upon lintels of incombustible material.

(c) Anchorage. Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties capable of resisting a horizontal force equal to four times the weight of the attached veneer.

Veneer ties shall be not less in thickness than No. 6 W & M gauge wire. Veneer ties shall be spaced not more than twenty-four inches (24") apart horizontally and not more than twelve inches (12") apart vertically.

Veneer ties shall be attached to a continuous horizontal tie not less in thickness than No. 8 W & M gauge wire and embedded in a horizontal joint.

(d) Support. The weight of masonry veneer shall be supported upon footings or other incombustible structural supports spaced not over twelve feet (12') vertically above a point twenty feet (20') above the adjacent ground elevation.

Exception: The weight of masonry veneer attached to wood frame walls shall be supported entirely upon footings.

**Veneer
Composed
of Non-
Structural
Units**

Sec. 2903. (a) Scope. The provisions of this Section shall apply to all veneer of materials not regulated by the requirements of Chapter 24.

(b) Loads and Stresses. For the purpose of this Section, veneer of non-structural units shall not be assumed to support any superimposed loads.

(c) Anchorage. Non-structural material used as veneer shall be anchored to the supporting wall by corrosion-resistant metal ties not less in thickness than No. 9 W & M gauge wire, and spaced not more than twelve inches (12") apart both horizontally and vertically.

Exceptions: Approved units, or units of flat tile, stone or terra cotta which are manufactured with scored surface

may be cemented to a masonry or concrete wall or to exterior plaster with Type A portland cement mortar, provided the mortar bond is sufficient to withstand a shearing stress of 50 pounds per square inch after curing for 28 days.

Sec. 2904. (a) General. In addition to the general requirements of this Chapter, all veneer of glass shall comply with the regulations in this Section.

Glass veneer shall not be attached to any exterior wall at a point more than thirty-five feet (35') above the adjoining ground elevation.

(b) Dimension. Glass veneer units shall be not less than one-eighth inch ($\frac{1}{8}$ ") in thickness. Units less than three-sixteenths inch ($\frac{3}{16}$ ") in thickness shall be not larger in area than one square foot (1 sq. ft.). Units not more than one-quarter inch ($\frac{1}{4}$ ") nor less than three-sixteenths inch ($\frac{3}{16}$ ") in thickness shall be not larger in area than four square feet (4 sq. ft.).

No unit shall be larger in area than ten square feet (10 sq. ft.) or more than four feet (4') in length.

(c) Attachment. Every glass veneer unit shall be attached to the backing by approved corrosion-resistant ties and shall be supported upon shelf angles.

Exceptions: 1. Below a point twenty-two feet (22') above the adjacent ground elevations, the ties may be omitted.

2. Below a point three feet (3') above the adjacent ground elevations, the ties and shelf angles may be omitted.

(d) Mastic. The mastic shall cover not less than one-half of the area of the unit after the unit has been set in place and shall be neither less than one-quarter inch ($\frac{1}{4}$ ") nor more than one-half inch ($\frac{1}{2}$ ") in thickness.

The mastic shall be insoluble in water and shall not lose its adhesive qualities when dry.

Absorbent surfaces shall be sealed by a bonding coat before mastic is applied. The bonding coat shall be cohesive with the mastic.

Glass veneer surfaces, to which mastic is applied, shall be clean and uncoated.

(e) Shelf Angles. Shelf angles shall be of corrosion-resistant material capable of supporting four times the weight of the supported veneer.

The shelf angles shall be spaced vertically in alternate horizontal joints but not more than three feet (3') apart.

The shelf angles shall be spaced not farther apart horizontally than the width of the supported units.

(f) Backing. Exterior glass veneer shall be applied only upon masonry, concrete, or exterior plaster.

(g) Expansion Joints. Glass veneer units shall be separated from each other and from adjoining materials by an expansion joint at least one thirty-second inch ($\frac{1}{32}$ ") in thickness. There shall be at least one sixty-fourth inch ($\frac{1}{64}$ ") clearance between bolts and the adjacent glass.

Special Requirements for Glass Veneer

CHAPTER 30—ENCLOSURE OF VERTICAL OPENINGS

Enclosures: When Required

Sec. 3001. Vertical openings are required to be enclosed in certain buildings depending upon the occupancy of the building, height of building or the Type of Construction. The vertical openings required to be enclosed are specified under Occupancy in Part III, and for stairways and ramps are specifically included in Chapter 33.

Elevator Enclosures

Sec. 3002. Walls and partitions enclosing elevators shall be of not less than the fire-resistive construction required under Types of Construction in Part V. Enclosing walls of elevator shafts may consist of wire glass set in metal frames on the entrance side only. Elevator shafts extending through more than two stories shall be equipped with an approved means of adequate ventilation to and through the main roof of the building.

Other Vertical Openings

Sec. 3003. All shafts, ducts, chutes and other vertical openings not covered in Section 3002 shall have enclosing walls conforming to the requirements specified under Type of Construction of the building in which they are located when they exceed nine square feet (9 sq. ft.) in area, and all other shafts shall be lined with sheet metal having lock jointed or riveted seams and joints. Combustible material of partitions and floors through which the ducts pass shall be kept at least three inches (3") from the metal lining or be protected by not less than three-eighths inch ($\frac{3}{8}$ ") of plaster or one-fourth inch ($\frac{1}{4}$ ") of asbestos or plasterboard. Openings between any ducts and the floor construction through which they pass shall be filled with mortar or other incombustible material supported by wire baskets that prevent the passage of fire. All doors opening into such vertical shafts shall be of metal or shall be covered on the shaft side by not less than one-fourth inch ($\frac{1}{4}$ ") of asbestos and not less than 26 U. S. gauge metal returned around all edges and well fastened to the door. Windows in such shafts shall be wire glass and metal frames and sash or such frame and sash may be of wood entirely clad with metal of not less than 26 U. S. gauge.

CHAPTER 31—FLOOR CONSTRUCTION

Sec. 3101. Floor construction shall be of materials and construction as specified under Occupancy in Part III and under Types of Construction in Part V. **General**

All floors shall be so framed and tied into the framework and supporting walls as to form an integral part of the whole building. Fire-resistive standards of floor construction are specified in Section 4303.

The type of floor construction used shall provide means to keep the beams and girders from spreading by installing ties or bridging.

Sec. 3102. Concrete slab floors shall be not less than two inches (2") thick. Topping when poured monolithic with the slab may be included as a structural part of the slab. Sleepers for the nailing of a wood floor shall not decrease the required structural depth of the slab unless placed in the direction of span and then shall not be placed more than one-half inch ($\frac{1}{2}$ ") into the slab. **Concrete Floors**

Sec. 3103. Steel joisted floors shall consist of steel joists as specified in Section 2715. When used in Type I or Type II buildings they shall have a reinforced concrete or gypsum slab not less than two inches (2") thick placed on and secured to the top thereof, and a fire-resistive ceiling as specified in Section 4303 on the under side thereof, fully covering and protecting the joists; provided that when such joists are used in places where unprotected wood joists are permitted the steel joists need not be protected with fire-resistive materials as specified above. Fire-resistive ceilings as specified in Section 4303 shall, except in the case of one-hour fire-resistive construction, be designed and constructed to support a load of not less than 10 pounds per square foot in addition to its own weight. **Steel Joisted Floors**

The reinforced concrete or gypsum slab placed on and secured to the top of the steel joists shall be sufficiently reinforced to support all dead, live or other loads between joists. Joists shall be securely cross bridged at intervals not to exceed eight feet (8') along the joist length. The lateral unsupported length of the top chord of any steel joist shall not exceed 40 times the width of the compression flange.

Bridging shall be provided during the period of construction to adequately support the top chord or flange against lateral movement and such bridging shall be designed to hold each joist in a vertical plane. Sufficient permanent bridging shall be installed to laterally stay the joists and to transmit any horizontal forces in either direction perpendicular to the direction of the joists. Such bridging shall consist of solid concrete sections, structural steel shapes or plates, portal bridging, diagonal rods, or other bridging which will provide equal stiffness. Any row of bridging shall be capable of transferring 500 pounds from each joist to the adjoining joists.

FORM BUILDING CODE**Cellular
Steel Floors**

Sec. 3104. (a) General. Cellular steel floor construction shall consist of sheet or strip steel formed into an integrated system of parallel steel beams which combine the function of load-bearing members and a continuous deck spanning between main supporting girders, beams, or walls.

When used in fire-resistive construction, steel floors shall have a minimum of two inches (2") of concrete fill on top and shall be protected with a fire-resistive ceiling suspended from the underside.

(b) Physical Properties. The steel used in the manufacture of steel floor units shall be equal to the requirements of A.S.T.M. "Tentative Specifications for Light Gauge Structural Quality Flat Hot-Rolled Carbon Steel," (A245-42T), Grades A, B, or C.

(c) Minimum Thickness. The thickness of the steel used in the manufacture of steel floors shall be not less than U. S. Standard Gauge No. 18.

(d) Design. Cellular steel floors shall admit of a rational analysis, and such floor assemblies shall have been tested and certified by a recognized testing agency to substantiate stress values used.

Flexural stress values shall not exceed 60 per cent of the yield point specified for the grade steel permitted in subsection (b) of this section.

When plastered ceilings are suspended from steel subfloor units, the maximum permissible deflection due to the full live load after the plaster is applied shall not exceed 1/360 of the span.

**Wood
Joisted
Floors**

Sec. 3105. (a) Wood joisted floors shall be framed and constructed and anchored to supporting wood stud or masonry walls as specified in Chapter 25. Wood joisted floors need not be fire-protected on the under side except where specifically required under Occupancy in Part III, Location in Part IV, or Type of Construction in Part V.

Girders supporting first floor joists in residence buildings shall be not less than four inches by four inches (4" x 4") for spans of five feet (5') or less, or not less than four inches by six inches (4" x 6") (placed on edge) for spans not more than seven feet (7').

Table No. 31-A gives the maximum allowable spans for floor joists for Douglas fir and Southern pine using a 1200/ grade, surfaced four sides to American Lumber Standard sizes and based on live load of 40 pounds per square foot uniformly distributed.

Joists of other grades, other woods and other sizes may be used, in which case they shall not be stressed to exceed the maximum allowable fiber stress as specified in Chapter 25.

Floor joists shall have a clearance of not less than eighteen inches (18") between the bottom of the joists and the surface of the ground underneath.

Joists under bearing partitions shall be installed as specified in Chapter 25. All joists, beams and girders shall be framed away at least two inches (2") from all flues and chimneys and at least four inches (4") from the back of any fireplace. All wood floor joists having a span of more than eight feet (8') shall have bridging as specified in Chapter 25.

TABLE NO. 31-A—ALLOWABLE SPANS FOR FLOOR JOISTS

Size (Inches)	Spacing Center to Center (Inches)	Maximum Allowable Span (Feet and Inches)	
		Plastered Ceiling Below	Without Plastered Ceiling Below
2 x 6	12	10-8	12-0
	16	9-6	10-6
	24	7-10	8-7
2 x 8	12	14-1	15-10
	16	12-7	13-10
	24	10-4	11-5
2 x 10	12	17-9	19-11
	16	15-10	17-5
	24	13-1	14-5
2 x 12	12	21-4	23-11
	16	19-1	21-0
	24	15-9	17-4
2 x 14	12	24-11	27-10
	16	22-4	24-5
	24	18-5	20-3
3 x 6	12	12-4	15-0
	16	11-3	13-2
	24	9-10	10-10
3 x 8	12	16-4	19-9
	16	14-11	17-4
	24	13-1	14-4
3 x 10	12	20-6	24-8
	16	18-10	21-9
	24	16-5	18-1
3 x 12	12	24-6	29-5
	16	22-7	26-0
	24	19-9	21-8
3 x 14	12	28-7	34-1
	16	26-4	30-3
	24	23-1	25-3

Solid blocking not less than two inches (2") nominal in thickness and full depth of the joists shall be provided in the following places: over all bearing walls, bearing partitions and around all stairways or other vertical openings; and over all girders, except when joists are not ceiled on the underside thereof. Such solid blocking shall serve as the required bridging specified in Chapter 25.

(b) **Plywood Flooring.** Where used as flooring, plywood shall be of the minimum thicknesses specified in Table No. 31-B.

TABLE No. 31-B—MINIMUM THICKNESSES OF PLYWOOD

PLYWOOD THICKNESS (Inches)	LIVE LOADS (lbs. per sq. ft.)	
	20	40
$\frac{1}{8}$	18 inch span	12 inch span
$\frac{3}{8}$	22 inch span	16 inch span
$\frac{1}{2}$	27 inch span	21 inch span
$\frac{5}{8}$	33 inch span	24 inch span

Mill Constructed Floors

Sec. 3106. Mill constructed floors shall be not less than three inches (3") nominal splined or tongued and grooved plank covered with one inch (1") nominal flooring laid crosswise or diagonal. Top flooring shall not extend closer than one-half inch ($\frac{1}{2}$ ") to walls to allow for swelling in case the floor becomes wet. Such one-half inch space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinking movements of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.

If laminated floors are used, at least two laminations at the wall shall be omitted until after glazing and roofing has been completed.

See Section 2517 (b) for detailed requirements.

CHAPTER 32—ROOF CONSTRUCTION AND COVERING

Sec. 3201. Roof covering shall be as required under Occupancy in Part III, Location in Part IV or Types of Construction in Part V. All roofs shall be so framed and tied into framework and supporting walls as to form an integral part of the whole building.

General

Sec. 3202. The general requirements for construction of floors as specified in Chapter 31 shall apply to roofs except that in Type II buildings the roof sheathing shall be not less than two inches (2") nominal in thickness and except that concrete or gypsum roof slabs shall be not less than two inches (2") in thickness.

Construction

Roof trusses shall have all joints well fitted and shall have all tension members well tightened before any load is placed on the truss. Diagonal and sway bracing shall be used to brace all roof trusses. The allowable working stresses of materials in trusses shall be as specified in Chapters 25 and 27. The minimum net section of the members after framing shall be used in determining the strength of the truss at any point.

Plywood roof sheathing, unless of exterior type, shall have no surface or edge exposed to weather.

Sec. 3203. The design of the roof construction shall be in accordance with engineering regulations for the materials used.

Design

Table No. 32-A gives the maximum allowable spans for ceiling joists and roof rafters of Douglas fir and Southern pine

**TABLE NO. 32-A—ALLOWABLE SPANS FOR CEILING
JOISTS AND ROOF RAFTERS**

Size (Inches)	Spacing Center to Center (Inches)	Maximum Allowable Span (Feet and Inches)		
		Ceiling Joists	Rafters	
			Slope of 6 in 12 and Greater	Slope of Less than 6 in 12
2 x 4	12	11-0	11-6	10-4
	16	10-1	10-0	9-0
	24	8-11	8-3	7-5
	32	8-1	7-2	6-5
2 x 6	12	16-7	17-6	15-9
	16	15-4	15-4	13-10
	24	13-8	12-8	11-5
	32	12-2	11-1	9-11
2 x 8	12	21-7	22-10	20-9
	16	20-1	20-1	18-3
	24	17-11	16-9	15-1
	32	16-6	14-8	13-2
2 x 10	12	26-9	28-4	25-10
	16	25-0	25-1	22-10
	24	22-5	21-0	19-0
	32	20-8	18-5	16-7

using a 1200/ grade, surfaced four sides to American Lumber Standards sizes and based on live load of 20 pounds per square foot uniformly distributed.

Joists or rafters of other grades, other woods and other sizes may be used, in which case they shall not be stressed to exceed the minimum allowable fiber stress as specified in Chapter 25.

The allowable span of roof rafters shall be measured from plate to ridge, except that where rafters are braced to ceiling joists and a complete truss is formed, the span shall be considered as the distance between intersecting points of trussing.

Roof framing and trussing shall be thoroughly and effectively angle braced. Roof joists when supported on a ribbon board shall be well nailed to the stud.

Roof Coverings

Sec. 3204. (a) General. Roof coverings for all buildings shall be either "Fire Retardant" or "Ordinary" roofings as specifically required either by Location in Part IV, or by Type of Construction in Part V. The roof covering shall be securely fastened to the supporting roof construction.

(b) Composition Roofing Materials. 1. Definitions. **FELT** is the dry or de-saturated product produced by "felting" vegetable or animal fibers or other suitable materials or by "felting" not less than 85 per cent by weight of asbestos fibers.

ROOFING FELT is felt saturated with a bituminous compound.

ROLL ROOFING is felt saturated with a bituminous saturant, then coated on both sides with a bituminous coating and then surfaced on both sides with powdered talc, mica or other suitable mineral matter; provided, that such roll roofing need not be coated nor surfaced if felt is produced from asbestos and two or more layers are used in combination.

FELT MEMBRANE is felt saturated with bituminous saturant, then coated on one or both sides with a bituminous coating.

2. Physical Properties. Materials used in composition roofing shall conform to the requirements set forth in the "Standard for Class C Asphalt, Rag Felt, Sheet Roofing and Shingles," published by the Underwriters' Laboratories, Incorporated, edition of 1941.

3. Method of Laying. Where there is not a ceiling underneath, a layer of unsaturated building paper weighing not less than five pounds to each one hundred square feet (100 sq. ft.) of such paper shall be laid over wood decks before the laying of composition fire retardant roof covering, except asphalt shingles.

Built-up composition roofings shall be thoroughly mopped between layers with an approved bituminous compound so that no layer touches unmopped the layer next above.

Gravel top covering shall mean flowing a coat of an approved bituminous compound and completely covering with gravel, crushed rock, crushed brick, other crushed earthenware of similar mineral surfacing material, a sufficient quantity being embedded in the bituminous compound in accordance with good standard practice.

4. Tests. Test methods, used to determine the specific requirements for physical properties of roll roofing, roofing felt,

or felt membrane given in this Section shall be those methods set forth in the A.S.T.M. "Tentative Methods of Testing Felted and Woven Fabrics Saturated with Bituminous Substances for Use in Waterproofing and Roofing," (D146-44T).

(c) **Fire Retardant Roofings.** "Fire Retardant" roofing shall be any roof covering which meets the requirements specified for any one of the following roofings, 1 to 7 inclusive, or shall be any roofing meeting the requirements of the Class A or B specifications of the Underwriters' Laboratories, Incorporated.

1. Any built up composition roofing consisting of layers of roofing felt, roll roofing, felt membrane or gravel, the sum of whose fire-retardant values as given in Table No. 32-B, equals not less than 15 including a top covering selected from parts (b) or (c) of said table.

2. Hydraulic compressed rigid shingles not less than one-eighth inch ($\frac{1}{8}$ ") thick, composed of portland cement and asbestos fibers, laid over a layer of saturated felt weighing not less than 14 pounds to the one hundred square feet (100 sq. ft.) or hydraulic compressed rigid sheets not less than seven thirty-seconds inch ($\frac{7}{32}$ ") thick, composed of portland cement and asbestos fibers. The aforesaid felt may be omitted when the compressed shingles are placed over an existing roof covering.

3. Asphalt-saturated mineral-surfaced prepared composition shingles laid so there are not less than two thicknesses at any point. The combined weight of such shingles shall be not less than 200 pounds to the one hundred square feet (100 sq. ft.) of completed roof area.

4. Concrete slab or concrete tile roofs, constructed as specified in Chapter 26 without additional roof covering.

5. Metal roof covering of corrugated, standing seam or flat type of not less than No. 26 U. S. gauge metal. All flat metal roof coverings shall be laid on solid sheathing. Corrugated or standing seam metal roof covering shall be designed to support the required live load between supporting members.

6. Slate shingles securely fastened with copper nails or with copper nails and No. 14 B. and S. gauge copper wire, with nails of such length as to provide not less than three-fourths inch ($\frac{3}{4}$ ") of penetration into the nailing strips or sheathing. Under all such shingles there shall be placed at least one layer of asphalt saturated felt weighing not less than 30 pounds to 108 square feet.

7. Clay roof tile securely fastened with copper nails or copper wire; provided that for roofs not exceeding a rise of eight inches (8") in twelve inches (12"), galvanized iron nails may be used, and provided further that tile with projection lugs need not be nailed or wired in place. Wire shall be not smaller than No. 14 B and S gauge. Nails shall penetrate the supporting roof construction not less than three-fourths inch ($\frac{3}{4}$ ").

Roofing tile other than flat pan tile with or without flanges, or flat shingle tile, or flat decorative tile, shall satisfy the following strength requirements: When supported on the turned down edges at points six inches (6") each side of the center of

the tile, giving four points of support and a span of twelve inches (12") and loaded with a concentration at the center, the average breaking load per tile for five representative tile tested shall be not less than 400 pounds and the breaking load for any individual tile tested shall be not less than 350 pounds.

Roof tile shall not absorb more than 15 per cent of the dry weight of the tile during a 48-hour immersion test.

Under all burned clay units, there shall be placed not less than two layers of asphalt saturated rag felt, each layer weighing not less than fourteen pounds (14 lbs.) to 100 sq. ft., solidly mopped between and surfaced with asphalt.

(d) **Ordinary Roofings.** "Ordinary" roofing shall be any roof covering which meets the requirements specified for any one of the following roofings, 8 to 11 inclusive, or shall be any roofing meeting the Class C Specifications of the Underwriters' Laboratories, Inc., edition of 1941.

8. Any composition roofing or any built up composition roofing consisting of layers of roofing felt, roll roofing, felt membrane or gravel, the sum of whose fire retardant values as set forth in Table No. 32-B equals not less than 10.

9. Asphalt shingles laid in one or more layers.

10. Wood shingles of clear vertical grain all-heart wood, not less in thickness than five shingles to two inches (2") at the butt, laid with the following exposures:

Total Length of Shingle	Permissible Exposed Length
16 in.	5 in.
18 in.	5½ in.
24 in.	7½ in.
32 in.	9½ in.
36 in.	11 in.

All wood shingles shall be nailed firmly with copper, zinc, zinc-coated or commercially pure iron nails of at least 14 B. and S. gauge and not less than one and one-fourth inch (1¼") long. Each shingle shall be nailed with two nails driven substantially into the supporting roof construction.

Wood shingles bearing the label of any recognized inspection agency, certifying compliance with Commercial Standard CS 31-38 of the United States Department of Commerce Bureau of Standards may be accepted as meeting the requirements of this Code.

(e) **Roofings for Group J Occupancies.** On buildings housing Group J Division 1 occupancies any composition roofing having a fire-retardant value as set forth in Table No. 32-B equal to not less than six, unless otherwise required because of location as specified in Parts IV and V of this Code.

Attics: Access and Areas

Sec. 3205. All buildings shall have access provided to the attic space by means of a stairway or permanent ladder or a scuttle. The openings provided through the ceiling for such access into the attic space shall be not less than twenty-two inches by thirty inches (22"x30") and shall be located in the hallway or corridor of all Type III and V buildings three stories or more in height.

TABLE NO. 32-B
MINIMUM PHYSICAL PROPERTIES AND FIRE-RETARDANT VALUE OF ROOFING MATERIALS

Type of Roofing	Min. Wt. per 108 sq. ft.	Min. Felt wt. per 108 sq. ft.	Min. Saturation Percentage*	Fire Retardant Value
(a) BASE SHEETS				
Roofing Felt (Rag).....	14	5.6	140	3
Roofing Felt (Asbestos).....	14	9.5	40	5
Felt Membrane (Asbestos).....	18	8.5	50	5
Felt Membrane (Rag).....	20	5.0	120	3
Roll Roofing (Rag).....	37	7.5	140	6
Roll Roofing (Rag).....	40	10.0	150	6
Roofing Felt (Rag).....	26	10.0	150	6
(b) CAP SHEETS (MAY BE USED AS BASE SHEETS)				
Split Sheet Roofing (2 layers min.).....	58 (each)	10.0 (each)	150	15
Roll Roofing (Asbestos).....	40	13.0	50	9
Built up Felt (Asbestos).....	41	6.4 (each)	40	9
Mineral Surfaced (Rag).....	87	10.0	150	10
(2 layers) Roofing Felt (Asbestos).....	.....	.....	.....	10
Roll Roofing Black Top (Asbestos).....	50	17.5	50	10
Roll Roofing White Top (Asbestos).....	30	9.5	40	5
(c) GRAVEL AND CERAMIC MATERIAL				
Gravel	250	.....	.....	4
Crushed Hard Burned Ceramic Material.....	200	.....	.....	4

*These figures shall be not less than 80% of the Kerosene value of the felt.

NOTE: For Fire Retardant Roofings top covering shall be selected from (b) or (c).

Type III or V buildings; one or two stories in height shall have scuttle holes into the attic space which are not less than eighteen inches (18") square.

In wood frame roof construction where ceilings occur the attic spaces or spaces between ceilings and the under side of roofs shall be divided into horizontal areas of not more than twenty-five hundred square feet (2500 sq. ft.) with tight one-inch (1") partitions of matched wood, one-half inch ($\frac{1}{2}$ ") thick exterior type plywood, or approved incombustible materials. All openings through these partitions shall be protected by self-closing doors of the same thickness and materials as the partition.

In buildings with no ceilings and having rooms with floor areas of over thirty thousand square feet (30,000 sq. ft.), tight draft stops shall be installed to prevent a free current of air under the roof. These draft stops in trussed roofs shall extend from the roof down to the bottom chord of the truss and shall divide the under roof or attic into sections not to exceed twenty thousand square feet (20,000 sq. ft.) in area.

Roof Drainage

Sec. 3206. The water from the roof of all buildings which would flow by gravity over a public sidewalk shall be carried by means of conductors under the sidewalk and through the curb into the gutter. Overflows shall be installed at each low point of the roof to which the water drains.

Exception: Buildings of Group I or J, the walls of which are ten feet (10') or more from the street property line, need not comply with the above.

CHAPTER 33—STAIRS AND EXITS

Sec. 3301. (a) Purpose. The purpose of this chapter is to provide minimum standards of egress facilities for occupants of buildings. **General**

(b) Scope. Every building shall be provided with exits as required by this chapter. Where there is conflict between a general requirement and a specific requirement for an individual occupancy, the specific requirement shall be applicable.

(c) Definitions. "Occupant Load" is the total number of persons actually occupying a building or portion thereof at any one time, but shall never be assumed to be less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A for the occupancy housed therein.

"Panic Bar" is a bar which extends across at least half the width of each door leaf and which will open the door if subjected to pressure.

(d) Room Capacity. The occupant load of a room or building shall be the actual number of seats but not less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A.

(e) Benches. Where benches or pews are used the number of seats shall be based on one person for each eighteen inches (18") of length of the pews or benches.

(f) Mixed Occupancies. The capacity of a building containing mixed occupancies shall be determined by adding the number of occupants of the various portions as set forth in Table No. 33-A.

(g) More Than One Occupancy. The capacity of a room or building which is used for different occupancies at different times shall be determined by the occupant load which gives the largest number of persons.

(h) Exit Obstruction. No obstruction shall be placed in the required width of an exit.

(i) Seating Capacity Posted. The maximum seating capacity shall be conspicuously posted by the owner of the building by means of durable metal signs placed in each assembly room, auditorium or room used for a similar purpose where fixed seats are not installed, and it shall be unlawful to remove or deface such notice or to permit more than this legal number of persons within such space.

Sec. 3302. (a) Width. The total width of exits in feet shall be not less than the total occupant load served divided by 50. Such width of exits shall be divided approximately equally among separate exits. **Exits Required**

The width of exits from any story of a building shall be determined from the occupant load in that story plus one-half the tributary occupant load in the story next above or below, provided the resulting width is not less than that required for the upper story considered separately.

(b) **Number of Persons.** The number of persons permitted in any building or portion thereof shall not exceed those set forth in Table No. 33-A, except that where additional exit facilities are provided the occupancy load may be increased in accordance with Section 3302 (a) and (c).

(c) **Number of Exits.** Group D occupancies having an occupant load of more than 10 shall have not less than two exits.

Dining-room areas having an occupant load of more than 100 shall have not less than two exits.

Other occupancies having an occupant load of more than 50 shall have not less than two exits.

Buildings or portion thereof having an occupant load of 500 to 999 shall have not less than three exits.

Buildings or portion thereof having an occupant load of 1,000 or more shall have not less than four exits.

If two or more exits are required, they shall be arranged a reasonable distance apart so that if one becomes blocked the other will be available.

TABLE NO. 33-A—SQUARE FEET PER OCCUPANT FOR VARIOUS OCCUPANCIES

OCCUPANCY	SQUARE FEET PER OCCUPANT
Groups A and B	
Assembly Areas	7
Dining-Room Areas	15
Dance Floors	7
Gymnasiums	15
Skating Rinks	15
Portions Not Used as Assembly Areas	100
Group C	
Classrooms	20
Dining-Room Areas	15
Shops and Vocational Rooms	50
Group D	
Children's Homes	50
Dining-Room Areas	15
Homes for Aged	50
Hospitals, Sanitariums	100
Group E	100
Group F	
Retail Sales:	
Basement	20
First Floor	30
Upper Floors	50
Dining-Room Areas	15
All Others	100
Group G	
Assembly Areas	7
Dining-Room Areas	15
All Others	100
Group H	
Assembly Areas	7
Dining-Room Areas	15
All Others	100
Group I	300

Sec. 3303. (a) General. This section shall apply to every **Doors** exit door serving an occupant load of more than 10, and from hazardous rooms or areas.

(b) **Swing.** Exit doors shall swing in the direction of exit travel when serving an occupant load of 50 or more.

(c) **Operation.** Exit doors shall be openable from the inside without the use of key or any special knowledge or effort.

(d) **Width.** The required width of a door opening shall not be reduced more than three inches (3") by any projections.

No required doorway shall be less than thirty-six inches (36") in width.

(e) **Door Leaf Width.** No leaf of an exit door shall exceed four feet (4') in width.

(f) **Revolving Doors.** Revolving doors shall not be used unless exit doors of required width are installed adjacent thereto.

(g) **Egress from Door.** Every door shall open into a corridor, enclosed stairway, exterior stairway where permitted as a required exit, an exterior exit court, or public way.

(h) **Doors Opening into Stairway.** Every door opening into a stairway shall open on a landing within two inches (2") of the floor level. The width of the landing shall not be reduced more than six inches (6") by the door when fully open.

Sec. 3304. (a) General. This section shall apply to every **Corridors** corridor serving as a required exit for an occupant load of more than 10.

(b) **Width.** Every required corridor shall be not less in width than forty-four inches (44").

(c) **Projections.** The required width of corridors shall be unobstructed.

Exceptions: 1. Trim and handrails may project three and one-half inches (3½").

2. Doors, when fully open, may project six inches (6").

(d) **Access to Exits.** Floors above the first floor shall have exits so arranged that it is possible to go in either direction from any point in a corridor to a stairway.

(e) **Walls.** Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction, except one-story buildings housing Groups F and G occupancies.

Sec. 3305. (a) Width. Every stairway shall be not less in **Stairs** width than forty-four inches (44").

Exceptions: 1. Stairways serving an occupant load of 50 or less may be thirty-six inches (36") wide.

2. Stairways serving an occupant load of 10 or less may be thirty inches (30") wide.

3. Trim and handrails may project three and one-half inches (3½") into the required width of any stairway.

(b) **Rise and Run.** The rise of every step in a stairway shall not exceed seven and one-half inches (7½"), and the run shall be not less than ten inches (10").

Except as provided under Subsection (c) of this section, the maximum variations in the height of risers and in the width of treads in any one flight shall be three-sixteenths inch ($3/16''$).

Exception: In stairways serving an occupant load of 50 or less the rise may be eight inches ($8''$) and the run may be nine inches ($9''$).

(c) **Winders.** In Group I occupancies and in monumental unrequired stairways, winders may be used if the required width of run is provided at a point not more than twelve inches ($12''$) from the side of the stairway where the treads are the narrower, but in no case shall any width of run be less than six inches ($6''$) at any point.

(d) **Landings.** Every intermediate landing shall have a dimension measured in the direction of travel equal to the width of the stairway, but such dimension need not exceed four feet ($4'$).

In Groups A, B, and C occupancies the walls at the outer corners of landings shall be curved on a radius of at least two feet ($2'$), or a 45-degree splay not less than twenty inches ($20''$) wide shall be provided to eliminate right-angle corners.

(e) **Basement Stairways.** Where a basement stairway and a stairway to an upper story terminate in the same vestibule or other space, the basement stairway shall be cut off by a one-hour fire-resistive partition and a self-closing Class "B" fire door.

(f) **Distance Between Landings.** There shall be not more than twelve feet ($12'$) vertically between landings nor less than two risers.

(g) **Handrails.** Stairways shall have handrails on each side, and every stairway more than eighty-eight inches ($88''$) in width shall have intermediate handrails dividing the stairway into portions not more than sixty-six inches ($66''$) in width.

Handrails shall be placed not less than thirty inches ($30''$) nor more than thirty-four inches ($34''$) above the nosing of treads, and ends of handrails shall be returned to the wall.

Exception: Stairways three feet ($3'$) or less in width may have one handrail.

(h) **Exterior Stairways.** Every opening in the exterior wall of a building served by an exterior stairway used as a required exit shall be protected by an automatically closing Class "E" or "F" fire door or window if the opening is within twenty feet ($20'$) of the stairway.

Exception: Openings above or level with the highest portion of the stairway may be unprotected if not nearer than ten feet ($10'$) to the stairway.

(i) **Space under Stairways.** The underside of interior stairways of wood construction and enclosed usable spaces under all stairways shall be protected with lath and plaster approved for one-hour fire-resistive construction, except in Group I occupancies.

(j) **Stairway Construction—Interior.** Interior stairways shall be constructed as specified in Part V of this Code.

(k) **Stairway Construction—Exterior.** Exterior stairs shall be of incombustible material or of wood not less than two inches (2") in nominal thickness.

(l) **Stairway to Roof.** In every building more than two stories in height, one stairway shall extend to the roof surface unless the roof has a slope greater than four in 12.

(m) **Headroom.** Every required stairway shall have headroom clearance of not less than six feet six inches (6'6") measured vertically from the nearest nosing to the nearest soffit.

Sec. 3306. (a) General. A ramp conforming to the requirements of this section may be used as an exit. Aisles need not conform to this section. **Ramps**

(b) **Width.** The width of ramps shall be as required for corridors.

(c) **Slope.** The slope of a ramp shall not exceed one in eight.

(d) **Handrails.** A ramp with slope exceeding one in 10 shall have handrails as required for stairways.

(e) **Construction.** Ramps shall be constructed as required for stairways.

(f) **Surface.** The surface of ramps shall be roughened or shall be of non-slip material.

Sec. 3307. (a) Definition. A horizontal exit is a horizontal passageway or ramp into another building or into another section of the same building through an "Ordinary Occupancy Separation." **Horizontal Exits**

(b) **Used as a Required Exit.** If conforming to the provisions of Section 3303 and of this section, a horizontal exit may be considered as a required exit.

(c) **Discharge Areas.** A horizontal exit shall lead into a floor area having capacity for an occupant load not less than the occupant load served by such exit. The capacity shall be determined by allowing three square feet (3 sq. ft.) of net clear floor area per occupant. The area into which the horizontal exit leads shall be provided with exits as required by Section 3302, at least one of which shall lead directly to a public way.

Sec. 3308. (a) General. Every interior stairway, ramp, or escalator shall be enclosed as specified in this section. **Exit Enclosures**

Exceptions: 1. In occupancies other than Group D, an enclosure will not be required for a stairway, ramp, or escalator serving only the second floor and not connected with corridors or stairways serving floors above the second floor.

2. In sprinklered buildings of Type I construction housing Group F and G occupancies, enclosures are not required for escalators.

3. Stairs in Group I occupancies need not be enclosed.

(b) **Enclosure Construction.** Enclosure walls shall be of not less than two-hour fire-resistive construction in buildings more than four stories in height and shall be of not less than one-hour fire-resistive construction elsewhere.

(c) **Openings into Enclosures.** There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. Every exit door in an exit enclosure shall be a self-closing Class "B" fire door. Every opening in an exterior wall forming part of an exit enclosure shall be protected by a Class "E" or "F" fire door or window unless opening into a public way at least sixteen feet (16') wide.

(d) **Extent of Enclosure.** Stairway enclosures shall include the necessary landings between flights and shall also include any corridors or passageways necessary for continuous exit to the exterior of the building.

Smokeproof Enclosures

Sec. 3309. (a) General. A smokeproof enclosure shall consist of a continuous stairway enclosed from the highest point to the lowest point by walls of four-hour fire-resistive construction. The supporting structural frame shall be of four-hour fire-resistive construction.

(b) **Where Required.** In buildings five stories or more in height, one of the required exits shall be a smokeproof enclosure.

(c) **Construction.** Stairs in smokeproof enclosures shall be of incombustible construction.

(d) **Access.** There shall be no opening directly into the interior of the building. Access shall be through a vestibule open to the outside having an exit door from the interior of the building and an exit door leading to the smokeproof enclosure. In lieu of a vestibule, access may be by way of an exterior open balcony of incombustible materials.

(e) **Doors.** Exit doors to smokeproof enclosures shall be self-closing Class "B" fire doors.

(f) **Outlet.** A smokeproof enclosure shall exit into a public way or into a passageway leading to a public way. The passageway shall be without other openings and shall have walls of four-hour fire resistance and floors and ceilings of two-hour fire resistance.

Exit Outlets

Sec. 3310. Every exit shall discharge into a public way or exit court.

Exit Courts

Sec. 3311. (a) Discharge. Every exit court shall discharge into a public way or passageway leading to a public way. The passageway shall be without other openings and shall have walls, floors, and ceilings of the same period of fire resistance as the walls, ceilings, and floors of the building but shall be not less than one-hour construction.

(b) **Width.** Every exit court shall be not less in width than the required total width of the tributary exits.

(c) **Slope.** The slope of exit courts shall not exceed one in 10.

(d) **Openings.** Openings between a Group A and B occupancy and an exit court less than sixteen feet (16') wide shall be protected by Class "E" or "F" fire doors or windows.

Exception: Openings more than twenty feet (20') above the floor of the exit court may be unprotected.

(e) **Obstructions.** The required width of exit courts shall be unobstructed except for trim and handrails which may project not more than three and one-half inches ($3\frac{1}{2}$ ") into the required width.

At any point where the width of an exit court is reduced from any cause, the reduction in width shall be effected gradually by a guard rail at least three feet (3') high. The guard rail shall make an angle of not more than 30 degrees with the axis of the exit court.

Sec. 3312. (a) Exit Illumination. Exits shall be illuminated at all times with light having an intensity of not less than one foot candle at floor level.

**Exit Sign
and
Illumination**

(b) **Exit Signs.** Every exit doorway from an area with an occupant load of more than 100 persons shall be marked with an exit sign. Exit sign letters shall be at least five inches (5") high.

(c) **Illumination of Signs.** Exit signs in every Group A Occupancy; Group B, Division 1 and 2 Occupancy; Group D Occupancy; Group F Occupancy with an occupant load in excess of 1,000 persons; and Group H Occupancy with an occupant load of more than 100 persons, shall be lighted with two separate electric lamps of at least 20 watts capacity on separate circuits, one such circuit being separate from any other circuit in the building.

Sec. 3313. (a) General. Every portion of every building in which are installed fixed seats, tables, or equipment, shall be provided with aisles leading to an exit.

Aisles

(b) **Width.** Every aisle shall be not less than three feet (3') wide if having seats on only one side and not less than three feet six inches (3' 6") wide if having seats on both sides. Such minimum width shall be measured at the end farthest from the foyer and shall be increased by one and one-half inches ($1\frac{1}{2}$ ") for each five feet (5') in length toward the foyer.

Exception: In Group B, Division 4 occupancies, aisles need not be over three feet six inches (3' 6") wide.

(c) **Distances to Nearest Exit.** In areas occupied by seats, and in Group A and B occupancies without seats, the line of travel to an exit door by an aisle shall not be more than one hundred and fifty feet (150').

(d) **Aisle Spacing.** Aisles shall be located so that there will be not more than six intervening seats between any seat and the nearest aisle.

Exception: There may be 20 intervening seats between any seat and the nearest aisle in Group B, Division 4 occupancies.

(e) **Cross Aisles.** Where aisles terminate in a cross aisle instead of a foyer, the width of the cross aisle shall be not less than the sum of the widths of all contributory aisles.

(f) **Vomitories.** Vomitories connecting the main exit with the cross aisles shall have a total width not less than the sum of the width of the widest aisle leading thereto plus 50 per cent of the total width of the remaining aisles leading thereto.

Sections 3314-3317**UNIFORM BUILDING CODE****Seats**

Sec. 3314. (a) Spacing. The spacing of rows of seats from back to back shall be not less than thirty-three inches (33"), nor less than twenty-seven inches (27") plus the sum of the thickness of the back and inclination of the back.

Exception: In Group B, Division 4 occupancies, the spacing of rows of seats without backs may be twenty-four inches (24").

(b) Width. The width of any seat shall be not less than eighteen inches (18").

Group A Occupancies

Sec. 3315 (a) Main Exit. Every Group A occupancy shall be provided with a main exit.

The main exit shall be of sufficient width to accommodate one-half the total occupant load but shall not be less than the total width of all aisles and stairways leading thereto and shall connect to a stairway or ramp leading to a public way.

Steps may be used if separated from the main exit by a landing not less in area than the foyer.

(b) Side Exits. Every auditorium and balcony of a Group A occupancy shall be provided with exits on each side. The exits on each side of the auditorium or balcony shall be of sufficient width to accommodate one-third of the total occupant load served. Side exits shall open directly into an exit court or a ramp leading to an exit court, except that side exits from a balcony may lead to a stairway, and side exits from balconies above the first balcony shall be by way of a stairway or ramp in a smokeproof enclosure. Side exits shall be accessible from a cross aisle or a side aisle.

(c) Panic Bars. An exit door from any Group A occupancy if provided with a latch shall be equipped with a panic bar if the exit door serves an occupant load of more than 50.

Group B Occupancies

Sec. 3316. (a) Group B, Divisions 1 and 2. Divisions 1 and 2 occupancies shall have exits as required by Section 3315.

(b) Group B, Divisions 3 and 4. An exit door from any Group B occupancy, Divisions 3 and 4, if provided with a latch, shall be equipped with a panic bar if the exit door serves an occupant load of more than 100.

Group C Occupancies

Sec. 3317. (a) Corridors. The width of a corridor in a Group C occupancy shall be the width required by Section 3302 plus two feet (2'), but no corridor shall be less than six feet (6') wide.

Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction.

There shall be no change of elevation of less than two feet (2') in a corridor unless ramps are used.

(b) Corridors Serving Auditoriums. An exit serving both an auditorium and other rooms need provide only for the capacity of whichever requires the greater width if the auditorium is not to be used simultaneously with the other rooms.

(c) Stairs. Each floor above or below the ground floor level shall have not less than two exit stairs and the required exit width shall be equally divided between such stairs, pro-

vided that no stair shall be less than five feet (5') in width exclusive of rails.

Exception: This subsection does not apply to rooms used for maintenance, storage, and similar purposes.

(d) **Distance to Exit.** Each room shall have an exit door located not more than one hundred twenty-five feet (125') distant from the nearest exit to the exterior or to a stairway, measured along the line of travel.

(e) **Doors.** The width of exit doors from corridors, halls and stairs shall be not more than two feet (2') narrower than the required width of such corridors, halls, or stairs.

Exit doors in schoolrooms shall swing in the direction of egress.

(f) **Corridor Dead End.** There shall be no dead end in any corridor or hall more than twelve feet (12') beyond the exit stair or door.

(g) **Exterior Exit.** Any room, the floor of which is below grade and which is used by pupils shall have at least one exit leading directly to the exterior of the building, and such exit shall be not less in width than one-half the required aggregate width of exits from such room.

(h) **Panic Bars.** Panic bars shall be installed on exit doors if provided with a latch from rooms having an occupant load of more than 100 and from corridors.

Sec. 3318. (a) Separate Exits. Every room in a Group D occupancy shall have access to two separate exits. **Group D Occupancies**

(b) **Corridor Dead Ends.** There shall be no dead end in any corridor or hall more than ten feet (10') beyond the exit stair or door.

(c) **Corridors.** There shall be no change of elevation of less than two feet (2') in a corridor unless ramps are used.

The corridors shall be not less than six feet (6') wide in occupancies where bedridden patients are housed.

(d) **Basement Exits.** One exit from every room below grade shall be to the exterior.

(e) **Ramps.** Every portion of a Group D occupancy, Division 2, in buildings of Types II, III, IV, and V housing bedridden patients, shall have access to a horizontal exit or a ramp leading to the exterior.

(f) **Doors.** Exit doors serving areas housing bedridden patients shall be not less than three feet six inches (3' 6") in width.

(g) **Locks.** No exterior door shall be lockable from the inside, except in sanitariums for mental patients.

(h) **Places of Detention.** No requirements of this Chapter shall be so construed as to prohibit the construction of cell blocks in jails or prevent the use of any locks or safety devices in buildings where it is necessary forcibly to restrain the inmates.

(i) **Exceptions.** Where construction meets the requirements of Section 902 (b), the exterior doors may be fastened with

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locks, provided that room doors shall not be fastened from the corridor side by other means than doorknobs or similar devices which can be opened readily from the inside without the use of keys.

**Group E
Occupancies**

Sec. 3319. Every portion of a Group E occupancy having a floor area of two hundred square feet (200 sq. ft.) or more shall be served by at least two separate exits.

**Special
Hazards**

Sec. 3320. (a) Boiler Rooms. Every boiler room and every room, except in Group I occupancies, containing an oil-fired furnace or incinerator shall be provided with at least two means of exit, one of which may be a ladder.

(b) Cellulose Nitrate Handling. Film laboratories, projection rooms, and nitrocellulose processing rooms shall have not less than two exits.

CHAPTER 34—DOORS, WINDOWS AND SKYLIGHTS

Sec. 3401. Fire doors and windows where required shall be as specified in Section 4304. **Doors and Windows**

Sec. 3402. All skylights constructed with metal frames shall be substantially built with interlocking seams. Frames of skylights shall be designed to carry loads required for roofs as specified in Section 2305. All skylights, the glass of which is set at an angle of less than 45 degrees from the horizontal, if located above the first story, shall be set at least one foot (1') above the roof. The curbs on which the skylight rests shall be constructed as required for inner court walls or for masonry. **Skylights**

When wire glass is required for skylights the size shall not exceed seven hundred and twenty square inches (720 sq. in.) in area or forty-eight inches (48") in any dimension in any one panel. All glass in skylights shall be wire glass, except that skylights over vertical shafts extending through two or more stories shall be glazed with plain glass as specified in this Section; provided, that wire glass may be used if ventilation equal to not less than one-eighth the cross sectional area of the shaft but never less than four feet (4') is provided at the top of such shaft.

Any glass not wire glass shall be protected above and below with a screen constructed of wire not smaller than No. 12 B. and S. gauge with a mesh not larger than one inch (1"). The screen shall be substantially supported below the glass.

Skylights installed for the use of photographers may be constructed of metal frames and plate glass without wire netting.

Ordinary glass may be used in the roofs and skylights for greenhouses, provided the height of the greenhouse at the ridge does not exceed twenty feet (20') above the grade. The use of wood in the frames of skylights will be permitted in greenhouses outside of Fire Zones No. 1 and 2, if the height of the skylight does not exceed twenty feet (20') above the grade, but in other cases metal frames and metal sash bars shall be used.

Glass used for the transmission of light, if placed in floors or sidewalks, shall be supported by metal or reinforced concrete frames, and such glass shall be not less than one-half inch ($\frac{1}{2}$ ") in thickness. Any such glass over sixteen square inches (16 sq. in.) in area, shall have wire mesh embedded in the same or shall be provided with a wire screen underneath as specified for skylights in this Section. All portions of the floor lights or sidewalk lights shall be of the same strength as is required by this Code for floor or sidewalk construction, except in cases where the floor is surrounded by a railing not less than three feet six inches (3' 6") in height, in which case the construction shall be calculated for not less than roof loads.

CHAPTER 35—BAYS AND BALCONIES**Construction**

Sec. 3501. Construction of walls and floors in bay and oriel windows shall conform to the construction allowed for exterior walls and floors of the type of construction of the building to which they are attached. The roof covering of a bay or oriel window shall conform to the requirements for roofing of the main roof of the building.

All exterior balconies attached to or supported by masonry walls shall have brackets or beams constructed of wire, steel, concrete or other incombustible material. All railings for balconies or porches shall be not less than three feet (3') in height above the floor of such balcony or porch.

CHAPTER 36—PENTHOUSES AND ROOF STRUCTURES

Sec. 3601. No penthouse or other projection above the roof shall exceed twenty-eight feet (28') in height above the roof when used as an enclosure for tanks or for elevators which run to the roof and in all other cases shall not extend more than twelve feet (12') in height above the roof. The aggregate area of all penthouses and other roof structures shall not exceed 20 per cent of the area of the roof. No penthouse, bulkhead or any other similar projection above the roof shall be used for manufacturing, business, habitation, offices or storage, except that they may be permitted to be used for the making of blue prints, photographic prints, for scientific observation, for summer houses or for Group I occupancies.

Penthouses and Roof Structures

Roof structures of Type I buildings shall be constructed with walls, floors and roof as required for the main portion of the building.

Walls of roof structures parallel to and within four feet (4') of the exterior walls of Type II or III buildings shall be constructed the same as the exterior wall of the story immediately below. Such wall shall project two feet (2') above the roof and two feet (2') beyond the sides of such roof structure, except that the side projection shall not be required when the adjoining side walls are of masonry. Walls other than those occurring within four feet (4') of an exterior wall on Type II or III buildings shall be of not less than one-hour fire-resistive construction. The restrictions of this paragraph shall not prohibit the placing of wood flagpoles or similar structures on the roof of any building.

Sec. 3602. Towers or spires when enclosed shall have exterior walls as required for the building to which they are attached. Towers not enclosed and which extend more than seventy-five feet (75') above grade shall have their framework constructed of iron, steel or reinforced concrete. No tower or spire shall occupy more than one-fourth of the street frontage of any building to which it is attached and in no case shall the base area exceed sixteen hundred square feet (1,600 sq. ft.) unless it conforms entirely to the type of construction requirements of the building to which it is attached and is limited in height as a main part of the building. If the area of the tower or spire exceeds one hundred square feet (100 sq. ft.) at any horizontal cross section its supporting frame shall extend directly to the ground. The roof covering of spires shall be as required for the main roof of the rest of the structure.

Towers and Spires

Skeleton towers used as radio masts and placed on the roof of any building shall be constructed entirely of incombustible materials when more than twenty-five feet (25') in height and shall be directly supported on an incombustible framework to the ground. They shall be designed to withstand a wind load from any direction as specified in Section 2307 in addition to any other loads.

CHAPTER 37—CHIMNEYS, VENTS AND FIREPLACES

General

Sec. 3701. (a) Scope. Chimneys, fireplaces, flues and vents carrying products of combustion, and their connections, shall conform to the requirements of this chapter.

(b) **Appliances.** See Chapter 51, Appendix.

Chimneys

Sec. 3702. (a) Design. Chimneys shall be reinforced and anchored as required in this chapter and shall be designed to resist the loads specified in Chapters 23 and 28.

**TABLE NO. 37-A—FLUE AREA FOR SOLID OR
LIQUID FUELS**

TYPE OF EQUIPMENT	MINIMUM AREA OF FLUE		
	LINED		UNLINED
	ROUND	RECTANGLE	
Small stoves and heaters	28 sq. in.	36 sq. in.	64 sq. in.
Ranges and room heaters	40 sq. in.	50 sq. in.	85 sq. in.
Fireplaces	1/12 of opening—minimum 50 sq. in.	1/10 of opening—minimum 64 sq. in.	1/8 of opening—minimum 100 sq. in.
Warm air furnaces or boilers	70 sq. in.	90 sq. in.	135 sq. in.

(b) **Materials.** Flue linings used in connection with solid or liquid fuel and bricks used in lieu of such flue linings shall have a softening point not lower than 1994 degrees Fahrenheit.

(c) **Flue Area.** No flue used in connection with solid or liquid fuel shall be smaller in area than the flue connection on the appliance attached thereto, and in no case shall be less than as set forth in Table No. 37-A.

(d) **Height.** Every chimney shall extend to a point at least two feet (2') above the highest elevation of any portion of the building within ten feet (10') of the chimney; provided that the Building Official may approve a chimney of lesser height installed with an approved vent cowl having a spark arrester whose opening shall be not less than six feet (6') from any portion of the building measured horizontally.

(e) **Inlets.** Every inlet to any chimney shall enter the side thereof and shall be of not less than one-eighth-inch (1/8") thick metal or five-eighths-inch (5/8") thick refractory material. Every inlet shall be at least six inches (6") from any combustible material. There shall be only one inlet connection to a flue.

(f) **Loads on Chimney.** No chimney shall support any load other than its own weight.

(g) **Anchorage.** Chimneys in wood frame buildings shall be anchored laterally at each floor and ceiling line which is more than six feet (6') above grade.

(h) **Special Designs.** Chimneys may be built of other materials than specified in this chapter, provided they meet all the requirements of the N.B.F.U. "Standard Ordinance for Chimney Construction," 1927, or may be approved as specified in Section 105.

Sec. 3703. (a) Flue Lining. Masonry chimneys shall be lined with fire-clay flue lining not less than five-eighths-inch ($\frac{5}{8}$ ") thick or with firebrick lining not less than four inches (4") thick. The lining shall extend from eight inches (8") below the lowest inlet to four inches (4") above enclosing walls. **Masonry Chimneys**

(b) **Wall Thickness.** Walls shall be not less than eight inches (8") in thickness, except that where flue lining is used, the thickness of brick may be reduced to four inches (4"). Division walls separating flues shall be at least three inches (3") in thickness including flue lining.

(c) **Chimneys of Hollow Clay Tile.** Chimneys shall not be built of hollow clay tile units unless such chimneys are an integral part of a wall of such units. Eight inches (8") of such wall may serve as the wall of the chimney.

(d) **Support.** Masonry chimneys shall be supported on foundations designed as required in Chapters 23 and 28.

(e) **Protection.** No combustible material shall be placed within two inches (2") of masonry chimneys.

Sec. 3704. (a) Construction. Terra cotta chimneys erected on the exterior of a building shall be not less than six inches (6") from all combustible material, except that when encased in an incombustible casing they shall be not less than two inches (2") from combustible materials, as specified in subsection (d). Such chimneys shall be exposed to view for the full length, and if erected in the interior of a building shall be encased in an incombustible casing so arranged as to provide not less than one inch (1") air space between the chimney and the casing. Such air space shall have ventilating openings top and bottom. **Terra Cotta Chimneys**

(b) **Anchorage.** Terra cotta chimneys shall be anchored each six feet (6') of their height. Such anchorage shall be designed to withstand a load of not less than 200 pounds applied in any direction.

(c) **Support.** Exterior terra cotta chimneys shall be supported directly on their own foundation or upon an incombustible support. Interior terra cotta chimneys shall not be supported on brackets but shall be carried on the floor system or directly on their own foundations.

(d) **Protection.** Incombustible casings of terra cotta chimneys required by subsection (a) shall be not less than two inches (2") from combustible materials. When terra cotta chimneys are enclosed, the enclosures shall have ventilating openings at both top and bottom. The support for such

chimneys shall be protected by four inches (4") of incombustible material in the bottom of the flue.

Metal Smokestacks

Sec. 3705. (a) Thickness. Metal smokestacks shall be constructed of material not less than one-eighth-inch (1/8") in thickness.

(b) **Location.** Metal smokestacks shall be not less than twenty-four inches (24") from any combustible materials.

(c) **Support.** Metal smokestacks shall be supported directly on their own foundation or may be supported upon boilers which are designed to support them.

(d) **Interior Smokestacks.** Interior metal smokestacks extending through any story or roof space shall be enclosed in vertical shaft of two-hour fire-resistive construction. The shaft shall provide at least six inches (6") of clearance on all sides of stack. Every opening into the shaft, other than openings for inlet thimbles and for ventilation at top and bottom, shall be protected with an incombustible one-hour fire-resistive door. The shaft shall have ventilating openings at top and bottom.

(e) **Flue Linings.** When flue gas temperatures exceed 1,000 degrees Fahrenheit, flue lining shall be used.

Smoke Pipes

Sec. 3706. (a) General. Smoke pipes are pipes used in connection with solid and liquid fuel connecting fire boxes or combustion chambers with chimneys or smokestacks.

(b) **Materials.** Every smoke pipe connecting a fire box or combustion chamber with a chimney or smokestack shall be of metal.

(c) **Location.** Combustible material within twelve inches (12") of any smoke pipe shall be protected by not less than three inches (3") of fire-resistive material. When within three feet (3'), such combustible material shall be protected by fire-resistive plaster. These distances shall be measured at right angles to the smoke pipe.

Fireplaces

Sec. 3707. (a) Walls. Fireplace and smoke chamber walls shall be of solid masonry not less than eight inches (8") thick. The face of such walls exposed to fire shall be lined with material meeting the requirements of Section 3702 (b). Where four inches (4") of firebrick are used for lining, they may be included in the eight-inch (8") minimum thickness.

Exception: Approved metal heat circulators may be installed in fireplaces in lieu of the lining required by this subsection.

(b) **Lintel.** Masonry over the fireplace opening shall be supported by an incombustible lintel.

(c) **Hearth.** Every fireplace shall be provided with an incombustible hearth slab at least twelve inches (12") wider on each side than the fireplace opening and projecting at least twenty inches (20") therefrom. This slab shall be not less than four inches (4") thick and shall be supported by incombustible material or reinforced to carry its own weight and all imposed loads. Combustible forms and centering shall be removed.

(d) **Combustible Materials.** No wood or other combustible materials shall be placed within six inches (6") of the fireplace opening. No such combustible material within twelve inches (12") of the fireplace opening shall project more than one-eighth inch ($\frac{1}{8}$ ") for each one-inch (1") clearance from such opening.

(e) **Imitation Fireplaces.** The maximum depth of the recess of any imitation fireplace or recess for heating equipment shall be six inches (6") unless such recess meets the requirements for fireplaces. The surface of the recess shall be of fire-resistive plaster or masonry. Location of combustible materials shall be as required for fireplaces in subsection (d). No flue other than a gas vent shall be installed within the recess opening.

Sec. 3708. (a) Construction. Gas vents shall be constructed of unglazed tile or clay not less than one-half inch ($\frac{1}{2}$ ") in thickness. The connections of such pipe shall be by sleeves or flanges well cemented. The pipe shall be securely fixed to the building frame at each sleeve or flange, and shall be at least three-fourths inch ($\frac{3}{4}$ ") away from all combustible material between flanges. Vents of other materials or design may be approved by the procedure specified in Section 105. **Gas Vents**

(b) **Height.** Every gas vent shall extend above the roof surface and terminate in an approved hood or cap with a venting capacity not less than that of the vent.

(c) **Size.** Except as specified in subsection (d), the area of any flue or vent shall be not less than the area of the largest connection plus 50 per cent of the areas of all additional connections with a minimum area of not less than twelve square inches (12 sq. in.) and a minimum dimension of not less than two inches (2").

(d) **Connection Inlet.** Any two inlets shall be staggered by not less than the diameter of the larger inlet. All inlets to any one vent shall be within the same story.

(e) **Connection.** The vent connection shall be of an incombustible material not less durable than galvanized or copper-bearing metal pipe exposed to view in a room throughout its entire length. It shall be not less in diameter than the vent outlet on the appliance. Vent connections shall have a rise of not less than one inch (1") per foot. The horizontal projected length shall not exceed the vertical projected length of the vent and vent connection.

(f) **Combustible Material.** Combustible material within twelve inches (12") vertically or six inches (6") horizontally of any vent connection shall be protected by fire-resistive material. These distances shall be measured at right angles to the vent connection.

(g) **Kitchen Ventilation.** There shall be installed in the wall or ceiling, approximately over the cooking facilities, a ventilating opening with an area of not less than six inches by eight inches (6"x8"), connected to a ventilating duct leading to the outside air, such duct for each kitchen to be not less than thirty-six square inches (36 sq. in.) in cross sectional area. An approved system of forced draft ventilation may be substituted for the natural draft ventilating system.

(h) **Water Heater Vents.** Every gas water heater shall have an entirely separate and independent vent, except that not more than four gas water heaters may be connected to a common vent manifold if constructed and installed in accordance with the following additional requirements:

1. **LOCATION.** All water heaters that are connected to the common vent shall be located in the same story of the building.

2. **VENT MANIFOLD REQUIRED.** If more than three feet (3') of vent connection is required to connect a water heater to the common vent, the water heater shall be connected to a vent manifold.

3. **LENGTH OF VENT MANIFOLD.** The length of the vent manifold shall not be greater than the height of the vertical vent to which it connects, nor shall the length of the vent manifold exceed fifteen feet (15').

4. **SLOPE.** Vent manifold and vent connections shall slope upward toward the vent at a rate of not less than one inch (1") per foot of length.

5. **CONNECTIONS.** The connection between any heater and a vent manifold shall not exceed three feet (3') in length.

Vent connections shall approach and intersect the vent manifold so that the flow of the products of combustion will converge at an angle of not more than 45 degrees.

6. **SIZE OF VENT.** The size of the common vent and the vent manifold shall be not less than the values set forth in Table No. 37-B.

**TABLE NO. 37-B—VENT AND VENT MANIFOLD
FOR GAS WATER HEATERS**

Number of Gas Water Heaters	Maximum Gas Input Rating of all Gas Water Heaters	Minimum Internal Diameter of Vent and Vent Manifold
2 or 3	75,000 B.t.u.	5 inches
4	100,000 B.t.u.	6 inches
4	200,000 B.t.u.	7 inches
4	300,000 B.t.u.	8 inches

Protection of Combustible Construction Incinerators

Sec. 3709. Combustible construction for heating equipment shall be protected as required in Chapter 51. (See Appendix.)

Sec. 3710. Incinerators, whether free standing or within or attached to a building, shall meet the minimum construction requirements of fireplaces. Such incinerators with horizontal areas in excess of fifteen square feet (15 sq. ft.) shall have walls not less than twelve inches (12") thick.

Chimneys for such incinerators shall be constructed as required in this chapter and shall have an approved spark arrester over the top thereof.

Exception: Small free-standing incinerators approved by the Building Official need not comply with this section.

CHAPTER 38—FIRE-EXTINGUISHING APPARATUS

Sec. 3801. Standard automatic sprinklers shall be installed as specified in this Chapter in the following places:

**Automatic
Sprinklers;
Where Re-
quired**

1. In the cellar of every building.
2. In assembly buildings with a stage: under the gridiron, under the stage floor, under all fly and tie galleries, in all dressing rooms, storerooms, property rooms, carpenter shops, paint shops, passageways and all places back of the proscenium wall. A line of sprinklers shall be installed on the stage side of, and immediately back of the proscenium curtain and not more than five feet (5') above the proscenium arch.

Over enclosed platforms, having a floor area in excess of one thousand square feet (1000 sq. ft.) and over any usable space under such platforms, together with dressing-room sections, workshops, and storerooms.

In assembly rooms having an occupant load of more than 500, enclosed platforms less than one thousand square feet (1000 sq. ft.) and more than five hundred square feet (500 sq. ft.) in area, together with all dressing-room sections, workshops, and storerooms.

3. In all Group E occupancies occupied wholly or in part as a planing mill, box factory, wood working establishment where lumber is made into a finished product and in which more than two power operated wood working machines exclusive of saws are used.

4. In all Group E occupancies occupied wholly or in part as a mattress factory used to manufacture, assemble or renovate mattresses or stuffed furniture using cotton, silk floss, mohair or other like material for packing or stuffing.

5. In all Group E occupancies used as film exchanges.

6. In Group B and C occupancies in any enclosed occupied space below or over a stairway, except where the entire construction is as required for Type I buildings, and in all portions of basements or cellars used for storage or maintenance work rooms.

Exception: The above provisions shall not apply in the following places:

Automatic sprinklers shall not be required in the cellars of Group H and I occupancies having four or less apartments, nor in the cellars of Group C, D, E, F, G, and H occupancies when the ceiling of such cellar or basement is three feet (3') or more above grade, nor when such cellars or basements have an area of fifteen hundred square feet (1500 sq. ft.) or less.

Sec. 3802. Required automatic sprinkler systems shall comply in all respects with the regulations of the N. B. F. U. "Installation of Sprinkler Equipment," 1943.

**Detailed
Requirements**

Exceptions: A single water supply equal to the primary supply required by such regulations may be accepted as complying with the requirements of this Code. In no case where a connection to a city water main constitutes the source of supply shall such connection be less than four inches (4") in diameter.

Sprinklers required in paragraph 6, Section 3801, may be supplied from the domestic water system and need not comply with the provisions of this section except as to pipe sizes and spacing of heads, provided that where the domestic water supply has a pressure less than 15 pounds per square inch, an approved automatic chemical extinguisher may be used in lieu of the sprinklers.

The alarm valve required for a standard automatic sprinkler system shall not be required in the cellars of Group B, C, D, E, F, G, and H occupancies where the area of such cellar is less than three thousand square feet (3000 sq. ft.).

**Dry Stand-
pipes; Where
Required**

Sec. 3803. Every building three or more stories in height shall be equipped with one or more dry standpipes.

**Detailed
Requirements**

Sec. 3804. (a) Construction. Dry standpipes shall be of wrought iron or galvanized steel and together with fittings and connections shall be of sufficient strength to withstand 300 pounds of water pressure to the square inch when ready for service, without leaking at the joints, valves or fittings.

Tests shall be conducted by the owner or contractor in the presence of a representative of the Fire Department whenever deemed necessary and ordered by the Building Official. The tests shall be applied at the top and bottom connections of such standpipes and the owner or contractor shall be responsible for any damage caused by breakage or faulty installation while such tests are being conducted. After such standpipes have been tested, the owner or contractor shall remove all water therefrom.

(b) Size. Dry standpipes shall be of such a size as to be capable of delivering 250 gallons per minute from each of any three outlets simultaneously under the pressure created by one fire engine or pumper, based on the existing city equipment available. No part of a dry standpipe system other than hose connections shall be less than three inches (3") in diameter.

(c) Number Required. Every building three or more stories in height where the area of any floor above the second floor is ten thousand square feet (10,000 sq. ft.) or less shall be equipped with not less than one dry standpipe and an additional standpipe shall be installed for each additional ten thousand square feet (10,000 sq. ft.) or fraction thereof.

(d) Location. Standpipes shall be located within stairway enclosures or as near such stairways as possible or shall be on the outside of, embedded within, or immediately inside of an exterior wall and within one foot (1') of an opening in a stairway enclosure or the balcony or vestibule of a smokeproof tower or an outside exit stairway.

(e) Siamese Connections. All four inch (4") dry standpipes shall be equipped with a two-way Siamese fire department connection. All five inch (5") dry standpipes shall be equipped with a three-way Siamese fire department connection and all six inch (6") dry standpipes shall be equipped with a four-way Siamese fire department connection. All Siamese inlet connections shall be located on a street front of the building and not less than one foot (1') nor more than four feet (4') above the grade and shall be equipped with clapper-checks and substantial plugs. All Siamese inlet connections shall be recessed in the wall or otherwise substantially protected.

(f) **Outlets.** All dry standpipes shall extend from the ground floor to and over the roof and shall be equipped with a two and one-half inch (2½") outlet not more than four feet (4') above the floor level at each story. All dry standpipes shall be equipped with a two-way two and one-half inch (2½") outlet above the roof. All outlets shall be equipped with gate-valves with substantial chains.

(g) **Threads.** All hose threads in connection with such standpipe installations shall be uniform with that used by the local fire department.

(h) **Signs.** An iron or bronze sign with raised letters at least one inch (1") high shall be rigidly attached to the building adjacent to all Siamese connections and such sign shall read: "CONNECTION TO DRY STANDPIPE."

Sec. 3805. Every Group A, B and C occupancy of any height and every Group D, E, F, G and H occupancy three or more stories in height and every Group E and F occupancy over 20,000 square feet in area shall be equipped with one or more interior wet standpipes extending from the cellar or basement into the topmost story, provided that Group B and C buildings having no stage and having a seating capacity of less than 500 need not be equipped with interior standpipes.

**Wet
Standpipes;
Where
Required**

Sec. 3806. (a) Construction. Interior wet standpipes shall be constructed as required for dry standpipes.

**Detailed
Requirements**

(b) **Size.** Interior wet standpipes shall have an internal diameter sufficient to deliver 50 gallons of water per minute under 30 pounds per square inch pressure at the base connection, based on the available water supply. Buildings of Groups A and B occupancies shall have wet standpipe systems capable of delivering the required quantity and pressure from any two outlets simultaneously, for all other occupancies only one outlet need be figured to be open at one time. In no case shall the internal diameter of a wet standpipe be less than two inches (2").

Any approved formula which determines pipe sizes on a pressure drop basis may be used to determine pipe sizes for wet standpipe systems. The Building Official may require delivery and pressure tests on completed wet standpipe systems before approving such systems.

(c) **Number Required.** Wet standpipes shall be so located that any portion of the building can be reached therefrom with a hose not exceeding seventy-five feet (75') in length.

(d) **Location.** In Groups A and B occupancies, outlets shall be located as follows:

On each side of the stage, on each side of the rear of the auditorium and on each side of the rear of the balconies. Where seating capacities are less than 500 the number of locations noted above may be reduced upon the approval of the Building Official. In Groups C, D, E, F, G, and H occupancies the location of all interior wet standpipes shall be approved by the Building Official.

(e) **Siamese Connections.** All interior wet standpipes shall be equipped with a Siamese fire department inlet connection located

on the street front of the building and such connection shall have two inlets for buildings five stories or less in height, three inlets for buildings six to ten stories inclusive in height, and four inlets for buildings more than ten stories in height.

(f) **Outlets.** All interior wet standpipes shall be equipped with a one and one-half inch (1½") straightway composition gate-valve in each story including the basement or cellar of the building and located not less than one foot (1') nor more than five feet (5') above the floor.

(g) **Threads.** All hose threads in connection with the installation of such standpipes, including valves and reducing fittings, shall be uniform with that used by the local fire department.

(h) **Signs.** An iron or bronze sign with raised letters at least one inch (1") high shall be rigidly attached to the building adjacent to all Siamese connections and shall read: "CONNECTION TO WET STANDPIPE."

(i) **Water Supplies.** All interior wet standpipes shall be connected to a street water main of not less than four inches (4") in diameter or when the water pressure is insufficient to maintain 30 pounds pressure at the highest hose outlet such standpipe shall be connected to a pressure tank, gravity tank or fire pump. Such supply shall be sufficient to furnish at least 30 pounds pressure at the topmost standpipe outlet.

When more than one interior wet standpipe is required in the building, such standpipes shall be connected at their bases or at their tops by pipes of equal size.

(j) **Pressure and Gravity Tanks.** Tanks shall have a capacity sufficient to furnish at least 250 gallons per minute for a period of not less than 10 minutes. Such tanks shall be located so as to provide not less than 25 pounds pressure at the topmost hose outlet for its entire supply. Discharge pipes from pressure tanks shall extend two inches (2") into and above the bottom of such tanks. All tanks shall be equipped with a manhole, ladder and platform, drain pipe, water and pressure gauges. Every pressure tank shall be tested in place after installation and proved tight at a hydrostatic pressure 50 per cent in excess of the working pressure required. Where such tanks are used for domestic purposes the supply pipe for such purposes shall be located at or above the center line of such tanks. Incombustible supports shall be provided for all such supply tanks and not less than a three foot (3') clearance shall be maintained over the top and under the bottom of all pressure tanks.

(k) **Fire Pumps.** Fire pumps shall have a capacity of not less than 250 gallons per minute with a pressure of not less than 25 pounds at the topmost hose outlet. The source of supply for such pumps shall be a street water main of not less than four inch (4") diameter or a well or cistern containing a one-hour supply. Such pumps shall be supplied with an adequate source of owner and shall be automatic in operation.

(l) **Hose and Hose Reels.** Each hose outlet of all interior wet standpipes shall be supplied with a hose not less than one and one-half inches (1½") in diameter. Such hose shall be equipped

with a suitable brass or bronze nozzle and shall be not over seventy-five feet (75') in length. An approved standard form of wall hose reel or rack shall be provided for the hose and shall be located so as to make the hose readily accessible at all times and shall be recessed in the walls or protected by suitable cabinets.

Sec. 3807. Basement pipe inlets shall be installed in the first floor of every store, warehouse or factory where there are cellars or basements under same, except where in such cellars or basements there is installed an automatic sprinkler system as specified by this Code, or where the cellars or basements are used for banking purposes, safe deposit vaults or similar uses.

**Basement
Pipe
Inlets**

All basement pipe inlets shall be of cast iron, steel, brass or bronze with lids of cast brass or bronze and shall consist of a sleeve not less than eight inches (8") in diameter through the floor extending to and flush with the ceiling below and with a top flange, recessed with an inside shoulder, to receive the lid and flush with the finish floor surface. The lid shall be a solid casting and have a ring lift recessed in the top thereof, so as to be flush. The lid shall have the words "Fire Department Only, Do Not Cover Up," cast in the top thereof. The lid shall be installed in such a manner as to permit its removal readily from the inlet.

The location of such basement pipe inlets shall be approved by the Building Official and shall be kept readily accessible at all times to the Fire Department.

Sec. 3808. All fire extinguishing apparatus, including automatic sprinklers, wet and dry standpipes, automatic chemical extinguishers, basement pipe inlets and the appurtenances thereto shall meet the approval of the chief of the Fire Department as to installation and location and shall be subject to such periodic tests as he may require.

Approvals

CHAPTER 39—STAGES AND PLATFORMS**Stage
Ventilators**

Sec. 3901. There shall be one or more ventilators constructed of metal or other incombustible material near the center and above the highest part of any working stage raised above the stage roof and having a total ventilation area equal to at least five per cent of the floor area within the stage walls. The entire equipment shall conform to the following requirements or their equivalent:

1. Doors shall open by force of gravity sufficient to overcome the effects of neglect, rust, dirt, frost, snow or expansion by heat or warping of the framework.

2. Glass, if used in ventilators, must be protected against falling on the stage. A wire screen, if used under the glass, must be so placed that if clogged it cannot reduce the required ventilating area or interfere with the operating mechanism or obstruct the distribution of water from the automatic sprinklers.

3. The doors and other covers shall be arranged to open instantly after the outbreak of fire, by the use of approved automatic fusible links which will fuse and separate at not more than 160 degrees Fahrenheit. A manual control must also be provided by a cord running down to the stage at a point on each side of the stage designated by the Building Official.

4. The fusible link and the cord must hold the doors closed against a force of at least 30 pounds excess counter weight tending to open the door. The fusible links shall be placed in the ventilator above the roof line and in at least two other points in each controlling cord and so located as not to be affected by the sprinkler heads above. Each stage ventilator shall be operated to an open and closed position at least once before each performance.

Gridirons

Sec. 3902. Gridirons, fly galleries and pin-rails shall be constructed of incombustible materials and fire-protection of steel and iron may be omitted. Gridirons and fly galleries shall be designed to support not less than 75 pounds live load per square foot.

The main counter-weight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load equal to not less than five pounds per square foot over the area of the gridiron directly back of the proscenium opening.

**Rooms
Accessory
to Stage**

Sec. 3903. In buildings having a stage, the dressing room sections, workshops, and storerooms shall be located on the stage side of the proscenium wall and shall be separated from each other and from the stage by not less than a "Special Occupancy Separation."

**Proscenium
Walls**

Sec. 3904. A stage as defined in Section 401 shall be completely separated from the auditorium by a proscenium wall of not less than four-hour fire-resistive construction. The proscenium wall shall extend not less than four feet (4') above the roof over the auditorium.

Proscenium walls may have, in addition to the main proscenium opening, one opening at the orchestra pit level and not more than two openings at the stage floor level, each of which shall be not more than twenty-five square feet (25 sq. ft.) in area.

Openings in the proscenium wall of a stage shall be protected on each side by Class "A" fire doors. The proscenium opening, which shall be the main opening for viewing performances, shall be provided with a self-closing fire-resistive curtain as provided in Chapter 41.

Sec. 3905. All parts of stage floors shall be of Type I **Stage Floors** construction except the part of the stage extending back from and the full width of the proscenium opening, which may be constructed of steel or heavy timbers covered with a wood floor not less than two inches (2") nominal thickness. No part of the combustible construction except the floor finish shall be carried through the proscenium opening. All parts of the stage floor shall be designed to support not less than 125 pounds per square foot.

Openings through stage floors shall be equipped with tight-fitting trap doors of wood not less than two inches (2") nominal thickness.

Sec. 3906. (a) **Ventilators.** There shall be one or more **Platforms** ventilators, conforming to the requirements of Section 3901, near the center and above the highest part of every enclosed platform having a floor area of five hundred square feet (500 sq. ft.) or more.

(b) **Construction.** Walls and ceiling of an enclosed platform in an assembly room shall be of not less than one-hour fire-resistive construction.

Any usable space having headroom of four feet (4') or more under a raised platform of an assembly room shall be of not less than one-hour fire-resistive construction.

(c) **Accessory Rooms.** In buildings having an enclosed platform, the dressing-room section, workshops, and storerooms shall be separated from each other and from the rest of the building by not less than an "Ordinary Occupancy Separation," except that a chair-storage area having headroom of not more than four feet (4') need not be so separated.

Rooms containing heating apparatus and located under an enclosed platform shall be separated from the remainder of the building by a "Special Occupancy Separation."

Sec. 3907. At least one exit two feet and six inches (2' 6") wide shall be provided from each side of the stage opening directly or by means of a passageway not less than three feet (3') in width to a street or exit court. An exit stair not less than two feet six inches (2' 6") wide shall be provided for egress from each fly gallery. Each tier of dressing rooms shall be provided with at least two means of egress each not less than two feet six inches (2' 6") wide and all such stairs shall be constructed as specified in Chapter 33. The stairs required in this Subsection need not be enclosed. **Stage Exits**

Sections, 3908-3909**UNIFORM BUILDING CODE****Miscellaneous**

Sec. 3908. A protecting hood shall be provided over the full length of the stage switchboard.

Flame-Proofing Requirements

Sec. 3909. No combustible scenery, drops, props, decorations, or other combustible effects shall be placed on any stage or enclosed platform unless it is treated with an effective fire-retardant solution and maintained in a non-flammable condition as approved by the Fire Department.

CHAPTER 40—MOTION PICTURE PROJECTION ROOMS

Sec. 4001. (a) **Scope.** The provisions of this Chapter shall **General** apply only where nitrocellulose film is used.

(b) **Projection Room Required.** Every motion picture machine using nitrocellulose films, together with all electrical devices, rheostats, sewing machines and all such films present in any Group A, B, or C occupancy, shall be enclosed in a projection room large enough to permit the operator to walk freely on either side and back of the machine.

Sec. 4002. Every projection room shall be of not less than one-hour fire-resistive construction throughout and the walls and ceiling shall be finished with incombustible material. **Construction**

The ceiling shall be not less than eight feet (8') from the finished floor. The room shall have a floor area of not less than eighty square feet (80 sq. ft.) and forty square feet (40 sq. ft.) for each additional machine.

Sec. 4003. Every projection room shall have at least two doorways separated by not less than one-third the perimeter of the room, each at least thirty inches (30") wide and eighty inches (80") high. **Exits**

The entrances to the projection room shall be protected by Class "C" fire doors as specified in Section 4304. Such doors shall open outward and lead to proper exits as required in Chapter 33 and shall not be equipped with any latch. The maximum width of such door need be no more than thirty inches (30").

Sec. 4004. (a) **Types.** Ports in projection room walls shall be of three kinds: projection ports; observation ports; and combination ports used for both observation and for stereopticon, spot, or floodlight machines. **Ports and Openings**

(b) **Ports Required.** There shall be provided for each motion picture projector not more than one projection port, which shall be limited in area to one hundred and twenty square inches (120 sq. in.), and not more than one observation port, which shall be limited in area to two hundred square inches (200 sq. in.). There shall be not more than three combination ports, each of which shall not exceed thirty inches (30") by twenty-four inches (24"). Each port opening shall be completely covered with a single pane of glass not less than one-quarter inch ($\frac{1}{4}$ ") in thickness.

(c) **Shutters.** Each port and every other opening in projection room walls, including any fresh-air inlets but excluding exit doors and exhaust ducts, shall be provided with a shutter of not less than No. 10 U. S. gauge sheet metal or its equivalent large enough to overlap at least one inch (1") on all sides of such opening. Shutters shall be arranged to slide without binding in guides constructed of material equal to the shutters in strength and fire resistance. Each shutter shall be equipped with a 160-degree Fahrenheit fusible link, which when fused by heat will cause closure of the shutter by

gravity. There shall also be a fusible link located over the upper magazine of each projector, which, upon operating, will close all the shutters. In addition, there shall be provided suitable means for manually closing all shutters simultaneously from any projector head and from a point within the projection room near each exit door. Shutters on openings not in use shall be kept closed.

Ventilation

Sec. 4005. (a) Inlet. A fresh-air inlet from the exterior of the building not less than one hundred and forty-four square inches (144 sq. in.) and protected with wire netting shall be installed within two inches (2") of the floor in every projection room, the source of which shall be remote from other outside vents or flues.

(b) Outlets. Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a noncombustible flue used for no other purpose. Exhaust capacity shall be not less than fifteen cubic feet (15 cu. ft.) nor more than fifty cubic feet (50 cu. ft.) per minute for each arc lamp plus two hundred cubic feet (200 cu. ft.) per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in such exhaust systems.

Ventilation of these rooms shall not be connected in any way with ventilating or air-conditioning systems serving other portions of the building.

(c) Exhaust Ducts. Exhaust ducts shall be of incombustible material, and shall either be kept one inch (1") from combustible material or covered with one-half inch ($\frac{1}{2}$ ") of incombustible heat-insulating material.

Regulation of Equipment

Sec. 4006. (a) Shelves and Fixtures. All shelves, fixtures, and fixed equipment in a projection room shall be constructed of incombustible materials.

(b) Films. All films not in actual use shall be stored in metal cabinets having individual compartments for reels or shall be in I.C.C. shipping containers. Metal used in the construction of cabinets shall be not less than U.S.S.G. No. 18. No solder shall be used in the construction of such metal cabinets.

Sanitary Requirements

Sec. 4007. Every projection room shall be provided with an unenclosed water closet and lavatory.

CHAPTER 41—PROSCENIUM CURTAINS

Sec. 4101. Proscenium curtains when required shall be made of incombustible materials constructed and mounted so as to intercept hot gases, flames and smoke, and to prevent glow from a severe fire on the stage showing on the auditorium side within a period of five minutes. The curtain shall be raised and lowered each evening at the close of the performance. The closing of the curtain from the full open position shall be effected in less than thirty seconds, but the last five feet (5') of travel shall require not less than five seconds.

Proscenium Curtains; General Requirements

Sec. 4102. A proscenium curtain for stage openings over sixty feet (60') in width shall comply with the regulations contained in "Appendix P" of the building code recommended by the National Board of Fire Underwriters, Fifth Edition, revised reprint, 1934, or with the regulations contained in "Schedule for Rating Theaters and Motion Picture Halls" of the Board of Fire Underwriters of the Pacific, Revision of September 10, 1930. A proscenium curtain for stage openings sixty feet (60') or less in width, shall be constructed and installed as specified in this Chapter. The curtain shall be made of one thickness of asbestos cloth weighing not less than three and one-quarter pounds per square yard.

Curtain Coverings

The asbestos cloth used in the construction of the curtain shall have incorporated into the yarn before weaving, either monel metal, nickel, brass or other metal or alloy having not less strength than these metals at temperatures up to 1700 degrees Fahrenheit and no less resistance to corrosion at ordinary temperatures. Asbestos cloth made of long fiber blue crocidolite asbestos may be used in place of chrysotile asbestos cloth of the same weight. The wires used to reinforce the yarn shall be either single or double but the tensile strength of each wire shall be sufficient to support a load of not less than three pounds at ordinary temperatures, and the strength of two strands of yarn and one wire twisted together shall be sufficient to support a load of six pounds. The strength of the cloth in tension when tested by the strip method shall be not less than 160 pounds per inch of width of warp and 52 pounds per inch of filling.

The asbestos fiber of yarns may contain cotton or other combustible fiber not to exceed 20 per cent of the weight of the asbestos. The total carbon content of the cloth shall not exceed 10 per cent of the total weight of the fiber. When required by the Building Official, a sample of the cloth of sufficient size for testing shall be submitted.

In addition to any decoration, the curtain shall be painted on both sides with a mineral paint having a silicate of soda binder, which will completely fill the cloth. Filler paint shall have not less than four parts of casein in each 10 parts of silicate of soda. This paint shall be well brushed into the cloth so that no light or smoke can come through.

Sec. 4103. The curtain shall be made of continuous vertical strips of asbestos cloth. The widths of cloth shall overlap at the seams not less than one inch (1") and shall be sewed with a double row of stitching of asbestos thread.

Design and Construction

The curtain shall be wide enough to extend into steel smoke grooves on each side of the proscenium opening at least eight

inches (8") and shall overlap the top and sides of the proscenium opening at least twelve inches (12").

Six-inch (6") pockets shall be sewed in the top and the bottom of the curtain to hold the pipe battens; the sides shall be hemmed at least six inches deep. A two-inch pipe batten shall be placed at the top and a one and one-half inch (1½") batten at the bottom. For stage openings over forty feet (40') in width the bottom batten shall be not less than two and one-half inches (2½") in diameter. The battens shall be reinforced at the joints with twelve-inch (12") sections of pipe housed and riveted.

The curtain shall be held to the steel guides in the smoke pockets with substantial roller grips riveted or bolted to the side hem, not more than eighteen inches (18") on center. Each roller grip shall be fastened to the curtain with not less than three bolts or rivets.

No. 16 U. S. gauge galvanized metal shall be bent and placed vertically along each side hem of the curtain material, so that both faces of the hem are covered not less than six inches (6"). This metal edging shall be fastened to the side hem with rivets spaced not more than six inches (6") on center.

The top of the curtain shall have a smoke stop fitted to make it as smoke-tight as practicable. The bottom of the curtain shall have a yielding pad of incombustible material not less than three inches (3") thick to form a seal against the floor.

Operating Equipment

Sec. 4104. Smoke grooves which protect the sides of the curtain shall be of structural steel shapes and plates not less than one-quarter inch (¼") thick. These grooves shall be not less than fourteen inches (14") deep and six inches (6") wide and shall be set back from the face of the arch at least six inches (6"). Grooves shall extend from the stage floor to a point three feet (3') above the top of the raised curtain, and shall be securely bolted to the proscenium wall. Details of the grooves shall be submitted to the Building Official and Fire Chief for approval.

Steel tracks shall be built into the smoke grooves upon which shall travel the roller curtain guides. This track must be so installed that it is held rigidly in place and so that roller guides will operate smoothly. Safe support and smooth operation are required with a wind load of one pound per square foot over the entire area of the curtain.

Support for the curtain shall be by means of one-quarter-inch (¼") flexible steel cables for curtains forty feet (40') or less in width, and three-eighths-inch (⅜") flexible steel cables for curtains over forty feet (40') in width. These cables shall be spaced not more than twelve feet (12') on centers, and the end overhang shall be not more than fifteen inches (15"). Supporting cables shall be tied to the top batten with a clove-hitch and the end secured with two iron rope clips. A substitute method of attachment will be allowed if approved by the Building Official.

The supporting cables shall pass through sheaves in the gridiron and over to the counter-weight guides and shall fasten to the counter-weight by means of three-eighth-inch (⅜") turn-

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buckles with clove-hitches and cable clips. Turnbuckles shall be locked to prevent backing out. Weight of the curtain shall be evenly divided on the cables.

**Operating
Equipment
(Cont'd.)**

There shall be safety stay chains of straight welded link fastened to the top curtain batten of sufficient strength to support safely the weight of the curtain. There shall be one more stay chain than the number of supporting cables and, except for the stay chains at the ends of the curtain, shall be centered between the supporting cables. Stay chains shall be securely attached to the top batten of the curtain and thence to the gridiron, if of steel construction, or shall be bolted through the proscenium wall with three-fourths-inch ($\frac{3}{4}$ ") bolts. Safety chains shall be so adjusted that they support the curtain when it is lowered and the bottom batten is resting on the pad supported by the floor.

All cables shall be carried over head and loft blocks fitted with ball or roller bearings of ample capacity to accommodate the weight at the speeds required. Grooves in the blocks shall be machined properly to cradle and protect the cable. All blocks supporting the proscenium curtain shall be supported on the proscenium wall by means of steel brackets of suitable size safely to carry the weight, or shall be mounted on structural steel beams.

Blocks shall be installed so that the head-block is sufficiently higher than the loft blocks to prevent cables from fouling loft block housings.

Diameters of the blocks shall be a minimum of twelve inches (12") for three-line sets and sixteen inches (16") for all other sets.

The mechanism and devices for controlling the curtain shall be of simple design and shall be positive in operation. Opening of the curtain shall be by hydraulic or electric power. For curtains where the overbalance on the curtain side does not exceed 150 pounds, manual operation may be used. In this case, manual operation will be allowable only if a method is provided which allows the curtain and counterbalance to be approximately equal under normal conditions, but which adds the required over-weight on the curtain side automatically in case of an emergency.

Emergency release shall be by gravity obtained by overbalancing the curtain. The emergency control line shall be of cotton sash cord, fitted with not less than four fusible links, one on each side of the stage and two overhead in the gridiron, which when the links are fused or the sash cord burned will allow the curtain to lower itself automatically. This control line shall extend up both sides of the proscenium arch and across the gridiron, and shall be so arranged that when released it will also automatically open the stage ventilators.

On each side of the proscenium arch, at a location in plain view shall be located an easily read sign, bearing the inscription: "In case of fire, cut line to lower fire curtain," with an indicator pointing to the location of a knife for that purpose. The knives shall be attached to the wall by a chain sufficiently long to reach the release line.

**Operating
Equipment
(Cont'd.)**

For electric operation there shall be installed push buttons plainly marked: "Fire Curtain—stop: Fire Curtain—down." One set of control buttons shall be installed on each side of the proscenium opening. For hydraulic or manual operation the endless line shall be marked plainly with an arrow pointing the direction for closing.

For manual operation the operating hand line shall be not less than three-fourths inch ($\frac{3}{4}$ ") diameter manila rope secured to the top and bottom of the counterweight arbor, and shall pass under a floor block, adjustable for tension, of not less than twelve-inch (12") diameter.

The top and bottom counterweight sections of the arbor shall be of cast iron, sufficiently heavy to accommodate safely the loads. The top and bottom sections shall be connected with rods not less than three-fourths-inch ($\frac{3}{4}$ ") diameter, with one tie-plate for every four feet (4') of rod. There shall be smooth grooves on the ends of the top and bottom weights which engage the steel guides. Intermediate weights shall be of cast iron, grooved to drop into place on top of the lower carrying weight. The turnbuckles connecting the supporting cables to the top weight shall be attached to eye-bolts passing through the top weight.

Counterweight guide tracks shall be structural "T's" or angles, properly tied together and securely anchored to the proscenium wall. All joints where the counterweight travels shall be ground smooth and a liberal coating of grease shall be applied to the tracks. These guides shall extend from the gridiron a length equivalent to the length of the arbor, plus the travel of the curtain, plus five feet (5'). The specified length shall be considered as the minimum. A structural steel stop shall be provided at the bottom of the arbor.

For proscenium curtains in which the overbalance is in excess of 150 pounds, an approved adjustable checking device shall be installed to check the speed of fall during the last five feet (5') of travel and an alarm shall be installed at the center of the top of the proscenium arch, which will sound when the curtain is descending through the emergency release.

Tests

Sec. 4105. The complete installation of every proscenium curtain shall be subjected to operating tests and any theater in which such proscenium curtain is placed shall not be opened to public performances until after the proscenium curtain has been accepted and approved by the Building Official.

**New
Designs**

Sec. 4106. Curtains of other designs and materials, when not obviously of greater fire resistance than specified in this Chapter, shall before acceptance be subjected to the standard fire test specified in Chapter 42, as applicable to non-bearing partitions, except that such tests shall be continued only for a period of five minutes unless failure shall have occurred previously. The unexposed face of the curtain shall not glow within a period of five minutes nor shall there be any passage of smoke or flame through the curtain.

PART VIII

FIRE-RESISTIVE STANDARDS FOR
FIRE PROTECTION

CHAPTER 42—GENERAL

Sec. 4201. Building materials, systems, units and forms of construction as regulated by this Code shall be classified as "four-hour fire-resistive construction," "three-hour fire-resistive construction," "two-hour fire-resistive construction" and "one-hour fire-resistive construction," for fire-resistive purposes and protection. Materials, systems, units and forms of construction, in order to be classed as four-hour, three-hour, two-hour or one-hour fire-resistive construction shall meet the respective requirements for such rating as specified in the A.S.T.M. "Standard Specifications for Fire Tests of Building Construction and Materials," (C19-41).

Fire-Resistive Construction Defined

Any materials, systems, units or forms of construction which meet the requirements of the aforesaid standard specifications shall be accepted as fire-resistive construction of the degree specified, if and when they shall be shown by an authoritative test conducted in accordance with all of the provisions of such aforesaid specifications, to possess such fire resistance.

Sec. 4202. The following materials, combinations of materials, systems and units shall be classed as fire-resistive materials:

Fire-Resistive Materials

Brick
Concrete brick, block or tile
Gypsum block or tile
Gypsum (plain or reinforced)
Gypsum plaster hoard (or lath) and plaster.
Gypsum vermiculite plaster
Hollow clay tile
Metal
Metal and asbestos
Metal lath and plaster
Portland cement concrete (plain or reinforced)
Sand-lime brick

Sec. 4203. Plaster fire protection shall be as specified in Chapters 43 and 47.

All concrete, pneumatically placed concrete, gypsum or similar protection for steel or iron structural members which is cast, poured or similarly applied shall be reinforced at the edges of such members in a manner sufficient to prevent cracking and disintegrating of such protection. All such applied fire protection materials shall be reinforced by metal rods, wire or mesh to provide against cracking and disintegrating of the protecting material.

Fire-Resistive Construction

All plaster fire protection shall consist of gypsum mortar, portland cement mortar or other equally fire-resistive material. Gypsum plaster only shall be used for plastering on gypsum units. When plaster is used for fire protection purposes it shall be reinforced with a metal mesh or lath when the plaster is more than one inch (1") thick. Pneumatically placed plaster applied to masonry need not be reinforced and when properly bonded shall be considered a part of the required thickness.

Gypsum lath as specified in Chapter 43 shall be three-eighths inch ($\frac{3}{8}$ ") in thickness and shall have perforations not less than three-quarters inch ($\frac{3}{4}$ ") in diameter, distributed over the face of the lath and comprising not less than two and three-quarters per cent of the area of the lath.

CHAPTER 43—FIRE-RESISTIVE STANDARDS

Sec. 4301. The thickness of fire-resistive materials for fire protection of structural parts shall be as set forth in Table No. 43-A for the respective degree of fire protection shown. The figures shown shall be the net thickness of the protecting materials and shall not include any hollow space or spaces between the fire-protecting materials and the member protected. The thickness of plaster protection shall be measured from the face of the plaster to the plane of the back surface of the metal or wire lath where such lath is used and shall include two-thirds of the thickness of the gypsum plaster board (or lath) where such board (or lath) is used.

Protection of Structural Parts

Grade A concrete shall mean concrete with a coarse aggregate of limestone, pumice, calcareous pebbles, trap rock, blast furnace slag, burnt clay, burnt shale or other coarse aggregates containing not more than 65 per cent of siliceous material, such as granite, sandstone, chert pebbles, flint, or quartz.

Grade B concrete shall mean concrete with a coarse aggregate other than that allowed in Grade A concrete.

Soffit tile protecting beam and girder flanges shall be tied to the flange with steel or iron ties.

If the structural part is of iron or steel the thickness given in Table No. 43-A shall be measured outside of the extreme edges of the structural shapes, except that projecting edges of lugs and brackets shall be given a minimum protection of one-inch (1") thickness. For reinforced concrete members, the thickness set forth in Table No. 43-A shall be outside of the reinforcement. For purposes of design the protection shall not be considered as carrying load except as permitted for columns in Section 2620.

Plaster protection of over one inch (1") in thickness shall have, in addition to the required mesh or lath, a layer of metal lath, wire or metal mesh embedded not more than three-fourths inch ($\frac{3}{4}$ ") from the surface and securely tied into the supporting members.

Wire of not less than No. 10 B. and S. gauge wound or tied around members at not more than a six-inch (6") pitch, or wire, or expanded metal mesh shall be placed and well embedded in all concrete, poured gypsum and pneumatically placed concrete protections.

Wire mesh or other forms of metal ties in concrete protections shall be held away from the structural members and embedded in the protection not less than three-fourths inch ($\frac{3}{4}$ ") from its outer surface at points of minimum thickness. Hollow tile or gypsum block protections shall have iron or steel ties embedded in each horizontal joint, or have outside iron or steel ties over each unit, the diameter of wire to be 0.18 inch, or of equivalent area in ties of other forms. Wire mesh, where used for tying protections, shall weigh not less than one and one-half pounds per square yard. Where metal lath or wire mesh is used as a plaster base or tie it shall weigh not less than two and two-tenths pounds per square yard, and shall have two and one-half or more meshes per inch or equivalent.

Sec. 4302. Fire-resistive bearing and non-bearing walls and partitions shall be of not less than the thicknesses and construction specified in this Chapter, to be classed for the respective degrees of protection indicated.

Fire-Resistive Walls and Partitions

TABLE NO. 43-A — MINIMUM PROTECTION OF STRUCTURAL PARTS BASED ON TIME PERIODS FOR VARIOUS INCOMBUSTIBLE INSULATING MATERIALS

Structural Parts to Be Protected	Insulating Material Used	Minimum thickness of material in inches for the following fire resistive periods			
		4 hr.	3 hr.	2 hr.	1 hr.
Steel or Cast Iron Columns; Projecting Steel Beam or Girder Flanges; All Members of Primary Trusses	Grade A concrete	2	2	1½	1
	Grade B concrete	3	2½	2	1½
	Pneumatically placed concrete	2	1½	1	¾
	Brick of clay, shale, concrete or sand-lime	3¾	3¾	2¼	1¾
	Clay tile, clay tile and concrete or concrete block (see note 2)	4 or 2 pl.	4 or 2 pl.	2	2
	Solid gypsum blocks	2 pl.	2 pl.	2	2
	Hollow gypsum blocks	3 pl.	3	2	2
	Poured gypsum	2	1½	1	1
	Metal lath and gypsum or portland cement plaster	.....	.....	2½*	1
	Grade A concrete	2	1½	1	1
Webs of Steel Beams and Girders	Grade B concrete	3	2½	1½	1
	Pneumatically placed concrete	2	1½	1	¾
	Brick of clay, shale, concrete or sand-lime	3¾	2¼	2¼	2¼
	Clay tile, clay tile and concrete or concrete block	3 or 2 pl.	2	2	2
	Solid gypsum block	2 pl.	2	2	2
	Hollow gypsum block	3 pl.	2	2	2
	Poured gypsum	2	1½	1	1
	Metal lath and gypsum or portland cement plaster	.....	.....	2	1
	Grade A concrete	1½	1½	1½	1
	Grade B concrete	2	1½	1½	1
Reinforcing Steel in Reinforced Concrete Columns, Beams, Girders and Trusses	Grade A concrete	1½	1½	1	¾
	Grade B concrete	1¾	1½	1	¾
Reinforcing Steel in Reinforced Concrete Joists	Grade A concrete	1½	1½	1	¾
	Grade B concrete	1¾	1½	1	¾
Ceiling Protection for Roof Members including Roof Trusses and Secondary Trusses	Metal or wire lath and gypsum or cement plaster, concrete, burned clay products or gypsum	2	1½	1	¾
	Pneumatically placed concrete	1½	1	¾	¾
Reinforcing and Tie Rods in Floor and Roof Slabs	Grade A concrete	1	1	¾	¾
	Grade B concrete	1½	1	1	¾
	Gypsum	1	1	¾	¾

NOTE: (1) pl. in above table shall be not less than ½ in. gypsum or cement plaster.
 (2) Reentrant parts of protected members shall be filled solid for 4 and 3 hour protections.
 * Two ¾ in. layers with ¾ in. air space between.

The structural requirements of the masonry and concrete walls shown in Table No. 43-B are specified in Chapter 24 for the specific location or use of the walls and all walls shall comply with those structural requirements as well as the fire-resistive limitations as specified in this Chapter.

The tabulated thicknesses given in Table No. 43-B are minimum and shall not be broken into; provided that where combustible floor or partition members project into solid masonry or concrete walls or partitions the required effective thickness of wall shall be measured from two inches (2") back along the member from the end in the wall, to the opposite face of the wall. Where such members project into hollow walls and the space between the members and for not less than four inches (4") above and below them is filled solid with fire-resistive incombustible materials for the full thickness of the wall, or where such hollow walls are constructed of hollow units laid with cells horizontal (side construction) the required thickness shall be measured as specified for solid masonry walls in this paragraph. Where hollow units are laid with cells vertical (end construction) and the hollow spaces are not thus filled, the required effective thickness of walls shall be measured from the ends of members in walls to the opposite face of the wall.

Plaster, in order that it may be considered as adding to the fire resistance of walls and partitions shall be gypsum or portland cement plaster applied to an average thickness of not less than one-half inch ($\frac{1}{2}$ "). Plaster over one inch (1") in thickness, as measured to the plaster base, shall have, in addition to the required mesh or lath, a layer of metal lath, wire or metal mesh embedded not more than three-fourths inch ($\frac{3}{4}$ ") from the surface and securely tied into the supporting members.

Required fire-resistive plastering or stucco on the outside of exterior masonry walls may be omitted from inaccessible portions of the wall provided the inside plastering opposite the inaccessible portions is doubled in thickness.

Gypsum lath shall comply with provisions of the A.S.T.M. "Standard Specifications for Gypsum Lath," (C37-42).

Metal or wire lath shall weigh not less than two and two-tenths pounds per square yard. Metal or wire mesh where used as ties in concrete shall weigh not less than one and one-half pounds per square yard. Where used as ties for plaster it shall weigh not less than two and two-tenths pounds per square yard and have not less than two and one-half meshes per inch, or equivalent.

Wood studs for bearing partitions or walls shall be not less than the two inch by four inch (2"x4") nominal size and be spaced not more than sixteen inches (16") apart.

Sec. 4303. Fire-resistive floor construction shall be accepted for the following respective degrees of fire-resistive protection when constructed as specified in this Section. For the structural details of any floor construction, the particular details specified under Part VI of this Code shall govern.

**Fire-Resistive
Floor, Roof
and Ceiling
Construction**

TABLE NO. 43-B—Rated Fire-Resistive Periods for Various Walls and Partitions

MATERIAL	CONSTRUCTION	Minimum Finished Thickness face to face (including plaster where mentioned) in inches			
		4-hr.	3-hr.	2-hr.	1-hr.
Brick of Clay, Shale, Sand-Lime or Concrete, and Plain Concrete	Solid unplastered	8			4*
	Solid plastered	9		5*	
	Hollow (rowlock) unplastered	12	10	8	
	Hollow (rowlock) plastered	9			
	End or side construction. One cell in wall thickness. Plastered				3*
Hollow Clay Tile Wall	End or side construction. Two cells in 8-in. or less thick- ness. Unplastered	16	12		6* or 8
	End or side construction. Two cells in 8-in. or less thick- ness. Plastered	13	9	7*	
	End or side construction. Two cells in wall thickness. Unplastered			6	
Hollow Clay Tile A. S. T. M. Load Bearing	End or side construction. Two cells in wall thickness. Plastered			5*	
	End or side construction. Three cells in 8-in. or less thickness. Unplastered	12			
	End or side construction. Three cells in 8-in. or less thickness. Plastered one side		8½		
	End or side construction. Three cells in 8-in. or less thickness. Plastered	9			
	4-in. brick and 4-in. tile plastered one side (tile side)	9			
Combination of Brick and A. S. T. M. Load- Bearing Tile, or Hol- low Concrete Block or Tile					

TABLE NO. 43-B (Continued)

Concrete Block or Tile	Aggregate— Expanded Slag, Burned Clay or Shale, Cinders	1½-in. face Shells	Unplastered	8	4†
		1½-in. face Shells	Plastered one side	8½	4½†
		1½-in. face Shells	Unplastered	12**	8
		1½-in. face Shells	Plastered each side	9	
		2¼-in. face Shells	Unplastered	8	
	Other Aggregates—	1½-in. face Shells	Unplastered	8	4†
		1½-in. face Shells	Plastered each side	9	5†
		1½-in. face Shells	Unplastered	12	8
		1½-in. face Shells	Plastered each side	9	
		2¼-in. face Shells	Unplastered	8	
Solid Concrete	Reinforcement not less than 0.2% in each direction		6	5	4
Solid Pneumatically Placed Concrete	Reinforcement not less than 0.2% in each direction		5* or 6	4	3
Hollow Gypsum Blocks	Unplastered		6*	5*	4*
	Plastered each side		5*	4*	4*
Hollow Wall of Reinforced Pneumatically Placed Concrete	Outer shell 2-in. thick for 10-in. wall and 1½-in. thick for 8-in. wall		10*	8*	
Solid Gypsum or Portland Cement Plaster	Incombustible studding with metal or wire lath				2*
	Incombustible studding with metal or wire lath, neat wood fiber gypsum plaster.				2*
	Incombustible studding with metal or wire lath, ¼-in. plaster on each side				3
	Incombustible studding with metal or wire lath, 1-in. plaster on each side				4½
	Wood studs with metal or wire lath. Fire-stopped. ¾-in. plaster on each side				3* or 5
	Wood studs with metal or wire lath. Fire-stopped. 1-in. neat wood fiber plaster each side				5*
	Wood studs with ¾-in. perforated gypsum lath. Fire- stopped. ¼-in. gypsum plaster each side				3* or 5

*Shall be used for non-bearing purposes only.

**8 in. for Expanded Slag.

†¾ in. Face Shells.

Section 4303

UNIFORM BUILDING CODE

**Fire-Resistive
Floor, Roof
and Ceiling
Construction
(Cont'd.)**

Four-hour, three-hour and two-hour fire-resistive floors as specified in this Section shall be constructed entirely of incombustible materials.

(a) **Four-Hour.** Four-hour fire-resistive floor construction shall consist of concrete, gypsum or solid masonry slabs or arches not less than four inches (4") in thickness or shall consist of hollow masonry slabs or arches not less than four inches (4") in thickness with a top covering of not less than two inches (2") of solid masonry, or shall consist of steel joists or steel floors protected with fire-resistive materials of the kind and thickness set forth in Table No. 43-C. Except in the case of steel-joisted construction, all reinforcing, tie rods and supporting structural members in such floors shall be protected with not less than four-hour fire-resistive construction.

(b) **Three-Hour.** Three-hour fire-resistive floor construction shall consist of concrete, gypsum, or solid masonry slabs or arches not less than three inches (3") in thickness or shall consist of hollow masonry slabs or arches not less than four inches (4") in thickness with a top covering of solid masonry not less than one and one-half inches (1½") in thickness, or shall consist of steel joists or steel floors protected with fire-resistive materials of the kind and thickness set forth in Table No. 43-C. Except in the case of steel-joisted construction all reinforcing, tie rods and supporting structural members in such floor construction shall be protected with not less than three-hour fire-resistive construction.

(c) **Two-Hour.** Two-hour fire-resistive floor construction shall consist of concrete, gypsum or solid masonry slabs or arches not less than two and one-half inches (2½") in thickness or shall consist of hollow masonry slabs or arches not less than three inches (3") in thickness with a top covering of not less than one inch (1") of solid masonry, or shall consist of steel joists or steel floors protected with fire-resistive materials of the kind and thickness set forth in Table No. 43-C. Except in the case of steel-joisted construction all reinforcing, tie rods and supporting structural members in such floor construction shall be protected with not less than two-hour fire-resistive construction.

(d) **One-Hour.** One-hour fire-resistive floor construction shall consist of one of the following:

1. Concrete, gypsum or solid masonry slabs or arches not less than two and one-half inches (2½") in thickness.
2. Hollow masonry slabs or arches not less than three inches (3") in thickness with all joints in such hollow unit construction thoroughly filled with cement or gypsum mortar.
3. Steel joists or steel floors protected with fire-resistive materials as set forth in Table No. 43-C.

Exceptions: (1) The incombustible floor slab may be omitted where no usable space occurs above the joists.

(2) Plaster ceiling may be omitted below floor joists over unusable space.

4. Wood-joisted construction with a double floor on top [the subfloor not less than three-fourths inch ($\frac{3}{4}$ ") thick and a total thickness of the two layers of not less than one and one-fourth inch ($1\frac{1}{4}$ ")] and with a ceiling of three-fourths inch ($\frac{3}{4}$ ") gypsum or portland cement plaster on metal or wire lath meeting requirements of Chapter 47, or gypsum plaster one-half inch ($\frac{1}{2}$ ") thick on three-eighths inch ($\frac{3}{8}$ ") perforated gypsum lath with joints reinforced with three-inch (3") strips of metal lath. The ceiling shall be securely fastened to or suspended from the underside of such joists.

Exceptions: (1) The double flooring on top may be omitted where no usable space occurs above the joists.

(2) Plaster ceiling may be omitted below the lowest floor joists over unusable space.

(3) Five-eighths inch ($\frac{5}{8}$ ") approved plywood subfloor may be used in lieu of three-fourths inch ($\frac{3}{4}$ ") solid wood subfloor.

Except in the case of steel-joisted construction, all reinforcing, tie rods and supporting structural members shall be protected with not less than one-hour fire-resistive construction.

Where a ceiling of lath and plaster as approved for one-hour fire-resistive construction as specified in this Chapter is used below slabs or structural members not otherwise required to be protected by such a ceiling, the required thickness of slab and fireproofing of structural members may be reduced one-half inch ($\frac{1}{2}$ ") but in no case shall the slab thickness be less than two inches (2").

Sec. 4304. (a) Where Required. Class "A" fire doors shall be installed when required in Sections 503 (c) and 3904.

Class "B" fire doors shall be installed when required in Sections 503 (c), 1807, 3305 (e), 3308 (c), and 3309 (d).

Class "C" fire doors shall be installed when required in Sections 503 (c), 1308, and 4003.

Class "D," "E," and "F" fire doors shall be installed when

**Fire-Resistive
Assemblies for
Protection
of Openings**

**TABLE NO. 43-C—MINIMUM PROTECTION FOR
STEEL FLOOR SYSTEMS**

(Based on Time Periods for Various Insulating Materials)

FIRE RESISTANCE PERIOD (in hours)	THICKNESS OF INCOMBUSTIBLE SLAB ABOVE FLOOR (in inches)	THICKNESS OF PROTECTION UNDER FLOOR (in inches)					CONCRETE, BURNED CLAY PRODUCTS OR GYPSUM (in inches)
		PLASTER ON METAL OR WIRE LATH (As specified in Chapter 47)					
		Pneumatically Placed Plaster	Not Wood-Fibred Gypsum	Sanded Gypsum	Portland Cement	Gypsum Vermiculite	
4	2 1/4	1 1/2	2	2	...	1	2
3	2 1/4	1	1	1 1/2	...	3/4	1 1/2
2	2 1/4	3/4	3/4	3/4	3/4	3/4	1
1	2	3/4	3/4	3/4	3/4	3/4	3/4

**Fire-Resistive
Assemblies for
Protection
of Openings
(Cont'd.)**

required in Sections 603, 608, 703, 708, 803, 808, 903, 1003, 1008, 1103, 1303, 1602 (c), 1807, 1813, 1815, 1913, 3305 (h), 3308 (c), 3311 (d), and 3316.

Fire doors and windows are not required in fire-resistive walls or partitions unless specified elsewhere in this Code.

(b) **Scope.** Fire doors and windows wherever specified in this Code shall meet the requirements of this Section.

(c) **Classification of Openings.** Openings requiring fire doors or windows shall be classified as follows:

"Class 'A' openings" are openings in three-hour fire-resistive "Special Occupancy Separation."

"Class 'B' openings" are openings in Ordinary Occupancy Separation and in enclosures to vertical shafts.

"Class 'C' openings" are in corridor or room partitions.

"Class 'D,' 'E,' and 'F' openings" are in exterior walls which have severe, moderate, or light fire exposure, respectively.

(d) **Class "A" Openings.** Class "A" openings shall be protected by two automatic Class "A" fire doors, one on each side of the opening and interconnected.

Each Class "A" fire door shall have a fire resistance time period of three hours and shall be without glazed openings.

(e) **Class "B" Openings.** Class "B" openings shall be protected by one automatic or self-closing Class "B" fire door.

A Class "B" fire door shall have a fire resistance time period of one and one-half hours.

Glass panels in a Class "B" fire door shall be limited to one observation panel not exceeding twelve inches (12") in width or height and one hundred square inches (100 sq. in.) in area. Where doors are hung on each jamb of a Class "B" opening, an observation panel may be installed in each of the two doors.

(f) **Class "C" Openings.** Class "C" openings shall be protected by one self-closing Class "C" fire door.

A Class "C" fire door shall have a fire resistance time period of one hour, except that doors with glass panels larger than one hundred square inches (100 sq. in.) may have a fire resistance time period of 45 minutes.

Individual glass lights in glazed openings shall be limited in area to twelve hundred and ninety-six square inches (1296 sq. in.).

(g) **Class "D" Openings.** Class "D" openings shall be protected by one automatic closing Class "D" fire door.

Class "D" fire doors shall have a fire resistance time period of one and one-half hours and shall have no glazed openings.

(h) **Class "E" and "F" Openings.** Class "E" and "F" openings shall be protected by a Class "E" or "F" fire door or fire window. Self-closing devices shall not be required.

Class "E" and "F" fire doors and fire windows shall have a time period of fire resistance of 45 minutes.

Individual glass lights shall be limited to fifty-four inches (54") in height, forty-eight inches (48") in width, and seven hundred and twenty square inches (720 sq. in.) in area.

Class "E" and "F" fire windows shall be limited in area to eighty-four square feet (84 sq. ft.) with neither width nor height exceeding twelve feet (12').

Double hung fire windows shall be not more than six feet (6') wide nor more than twelve feet (12') high.

(i) **Glass.** Glass used in fire doors or fire windows shall be not less than one-fourth inch ($\frac{1}{4}$ ") thick and shall be reinforced with wire mesh, 24 gauge or heavier, with openings not larger than one inch (1") square.

Glass shall be held in place by metal glazing angles, except that in casement windows, wire clips may be used.

(j) **Closing Devices.** Automatic fire doors shall be designed to close automatically when the temperature of a heat-actuated device reaches 165 degrees Fahrenheit or 50 degrees above maximum room temperature under normal conditions. Heat-actuated devices shall be installed, one on each side of the wall at the top of the opening and one on each side of the wall at ceiling height where the ceiling is more than three feet (3') above the opening.

Interconnected doors shall be designed so that both doors will close automatically by the action of any of the heat-actuated devices.

Self-closing doors shall be designed to close by gravity or by the action of a mechanical device. Self-closing doors shall have no attachments capable of preventing the operation of the closing devices.

(k) **Fire Resistance Tests.** The fire resistance time rating of every type of required fire protection assembly shall be determined in the manner prescribed by the A.S.T.M. "Standard Methods of Fire Tests of Door Assemblies," (C152-41T). A minimum transmitted temperature end point shall not be required.

(l) **Label.** Every fire door and fire window shall bear the label or other identification of an approved testing agency showing the classification thereof. The following labels of the Underwriters' Laboratories, Inc., shall be approved labels within the meaning of this Section.

Label marked "Fire Door for Opening in Fire Wall" shall be approved for Class "A" fire doors.

Label marked "Fire Door for Opening in Vertical Shaft" shall be approved for Class "B" fire doors.

Label marked "Fire Door for Opening in Corridor or Room Partition" shall be approved for Class "C" fire doors.

Label marked "Fire Door for Opening in Exterior Wall" shall be approved for Class "D," "E," and "F" fire doors.

Label marked "Fire Window Frame for Light Exposures" shall be an approved label for fire windows when glazed with wired glass conforming to Subsection (h).

Exception: Unlabeled passenger elevator hoistway doors may be installed if the panels are of equivalent fire resistance.

(m) **Tin-Clad Doors.** If constructed as specified in "Standard for Tin-Clad Fire Doors and Shutters," published December, 1941, by the Underwriters' Laboratories, Inc., tin-clad fire doors shall be considered as meeting the requirements of this Section, provided each door bears the label of an approved inspection agency showing the classification thereof.

(n) **Installation.** Fire doors and fire windows shall be installed as specified in the N.B.F.U. "Regulations for the Protection of Openings in Walls and Partitions against Fire," 1939.

Sec. 4305. Fire-resistive roof coverings shall be as specified in Section 3204.

**Roof
Coverings**

PART IX

REGULATIONS FOR USE OF PUBLIC STREETS AND PROJECTIONS OVER PUBLIC PROPERTY

CHAPTER 44—PROTECTION OF PEDESTRIANS DURING CONSTRUCTION OR DEMOLITION

Sec. 4401. No person shall place or store any material or equipment necessary for the work under a building permit on a street, alley or public sidewalk, nor shall any work be performed except in accordance with the provisions of this Chapter. **General**

No person shall perform any work on any building or structure, if by so doing he endangers pedestrians on the street that abuts the property line, unless the pedestrians are protected as specified in this Chapter.

Sec. 4402. Material or equipment necessary for the work under a building permit may be placed or stored on public property in the following locations: **Temporary
Use of
Streets and
Alleys**

(a) **In Front of the Building Site.** In the one-third portion of the roadway of the street that is adjacent to the curb in front of the building site for which a permit has been issued; provided that no material or equipment shall be placed or stored within five feet (5') of any rail or any street railway track.

(b) **In Front of the Adjoining Site.** In the roadway of the street adjoining the building site for which a permit has been issued to the same extent and under the same restrictions as specified in Subsection (a) of this Section.

A due waiver of claim against the city for damages, on account of such placement or storage must be obtained from the owner of such property and filed in the office of the Building Official before such materials or equipment may be placed or stored.

(c) **In the Alley.** In the alley adjoining the building site for which a permit has been issued, provided that a clear and unobstructed roadway not less than ten feet (10') in width is maintained through such alley along the building site.

(d) **Public Sidewalk in Front of Building Site.** On any portion of the public sidewalk in front of the building site for which a permit has been issued, except on the walkway required to be maintained.

Sec. 4403. Material and equipment necessary for work to be done under a permit shall not be placed or stored on public property so as to obstruct free and convenient approach to any fire hydrant, fire or police alarm box, any utility box or to any catch-basin or manhole, or so as to interfere with the free flow of water in any street or alley gutter. **Restrictions
to Storage
on Public
Property**

Sec. 4404. The mixing of mortar or concrete on public property shall be done in a mechanical mixer or in a tight box in such a manner as to prevent dripping or splashing on the public property. **Mixing Mortar
on Public
Property**

Sec. 4405. A substantial protective frame and boarding shall be built around and over every street lamp, utility box, fire or police alarm box, fire hydrant, and every catch basin and man- **Protection of
Utilities**

TABLE NO. 44-A—TYPE OF PROTECTION REQUIRED FOR PEDESTRIANS

HEIGHT OF CONSTRUCTION	DISTANCE FROM CONSTRUCTION TO WALKWAY	PROTECTION REQUIRED
Eight feet or less	Less than six feet	Railing
	Six feet or more	None
More than eight feet	Less than six feet	Fence and Canopy
	Six feet or more and one-quarter height of construction or less	Fence and Canopy
	Six feet or more and one-fourth to one-half height of construction	Fence
	Six feet or more and at least one-half height of construction	None

hole that may be damaged by any work being done under the permit. This protection shall be maintained while such work is being done.

Protection of Pedestrians on Public Property

Sec. 4406. (a) Walkway. A walkway not less than four feet (4') wide with a railing on the street side shall be maintained on the sidewalk in front of the building site during construction, alterations or demolition.

(b) Type of Protection Required. Protection shall be provided for pedestrians as set forth in Table No. 44-A, and be constructed as specified in this Chapter.

Such protection shall be maintained in place and kept in good order for the entire length of time pedestrians on the street that abuts the property line may be endangered, and shall be completely removed as soon as such construction work permits.

(c) Construction of Railings. Railings shall be substantially built and not less than three feet (3') high.

(d) Construction of Fences. Fences shall be substantially built of tight boards eight feet (8') high above grade, placed on the side of the walkway nearest to the building site. Fences shall extend the entire length of the building site and each end shall be turned and extended to the building line.

Doorways may be cut in the fence if they are protected by doors and kept closed, except when opened to permit materials or persons to pass through.

(e) Construction of Canopies. The protective canopy shall have a clear height of ten feet (10') above the walkway. The roof shall be tightly boarded. Every canopy shall have a tight board fence built along its entire length, on the side thereof next to the building site. The fence shall be solid from the

sidewalk or walkway to the canopy roof and each end shall be turned and extended solid to the building site.

The entire structure shall be designed to carry the loads to be imposed on it, provided, the minimum live load to be used in design shall be not less than 35 pounds per square foot, uniformly loaded.

If materials are stored or work is done on the roof of the canopy, the street sides and ends of the canopy roof shall be protected by a tight curb board not less than one foot (1') high and a railing not less than three feet (3') high.

The space under the canopy over the walkway and the approaches thereto shall be kept well lighted with artificial lighting continuously between sunset and sunrise.

Sec. 4407. When the area or a portion thereof occupied by a public sidewalk is to be excavated, the holder of the building permit shall construct a substantial temporary walkway not less than four feet (4') in width for pedestrian travel over the areas to be excavated or around the same.

Protection of Sidewalk Excavations

The walkway over the excavated area shall be designed for a uniform live load of 150 pounds per square foot. The walkway shall be provided with suitable ramps or stairs at each end and with a handrail not less than three feet (3') high along each side or with a railing on one side and a fence on the other, as the case may require.

The walkway around the excavated area shall be as close to the excavation on the street side as possible and constructed with a railing not less than three feet (3') high and a fence on the excavation side of the walkway.

CHAPTER 45—PERMANENT OCCUPANCY OF PUBLIC PROPERTY

General

Sec. 4501. No part of any structure or any appendage thereto, except signs, shall project beyond the property line of the building site, except as specified in this Chapter.

Structures or appendages regulated by this Code shall be constructed of materials as required in Sections 1814, 1914, 2014, 2114 and 2214 and Chapter 35.

The projection of any structure or appendage shall be the distance measured horizontally from the property line to the outermost point of the projection.

Projection Into Alleys

Sec. 4502. No part of any structure or any appendage thereto, except signs, shall project into any alley except that a curb or buffer block may project not more than nine inches (9") and not exceed a height of nine inches (9") above grade.

Space Below Sidewalk

Sec. 4503. The space adjoining a building below a sidewalk on public property may be used and occupied in connection with the building for any purpose not inconsistent with this Code or other laws or ordinances regulating the use and occupancy of such spaces on condition that the right to so use and occupy may be revoked by the city at any time and that the owner of the building will construct the necessary walls and footing to separate such space from the building and pay all costs and expenses attendant therewith.

Balconies and Appendages

Sec. 4504. Oriel windows, balconies, unroofed porches, cornices and belt courses and appendages such as watertables, sills, capitals, bases and other decorative features may project over the public property of the building site a distance as determined by the clearance of the lowest point of the projection above the grade immediately below, as follows:

Clearance above grade less than eight feet (8')—no projection is permitted.

Clearance above grade over eight feet (8')—one inch (1") of projection is permitted for each additional inch of clearance, provided that no such projection shall exceed a distance of four feet (4').

Marquees

Sec. 4505. (a) General. For the purpose of this Section a marquee shall include any object or decoration attached to or a part of said marquee.

(b) Projection and Clearance. The horizontal clearance between a marquee and the curb line shall be not less than two feet (2').

A marquee projecting more than two-thirds of the distance from the property line to the curb line shall be not less than twelve feet (12') above the ground or pavement below.

A marquee projecting less than two-thirds of the distance from the property line to the curb line shall be not less than eight feet (8') above the ground or pavement below.

(c) Length. A marquee projecting more than two-thirds the distance from the property line to the curb line shall not exceed twenty-five feet (25') in length along the direction of the street.

(d) **Thickness.** The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed three feet (3') when the marquee projects more than two-thirds of the distance from the property line to the curb line and shall not exceed nine feet (9') when the marquee is less than two-thirds of the distance from the property line to the curb line.

(e) **Construction.** A marquee shall be supported entirely from the building and constructed as specified under Types of Construction and shall be of incombustible material or of not less than one-hour fire-resistive construction.

(f) **Roof Construction.** The roof or any part thereof may be a skylight provided wire glass is used not less than one-fourth inch ($\frac{1}{4}$ ") thick with no single pane more than eighteen inches (18") wide.

Every roof and skylight of a marquee shall be sloped to downspouts which shall conduct any drainage from the marquee under the sidewalk to the curb.

(g) **Location Prohibited.** Every marquee shall be so located as not to interfere with the operation of any exterior standpipe or to obstruct the clear passage of stairways or exits from the building or the installation or maintenance of electroliers.

Sec. 4506. Movable awnings or hoods may have combustible coverings supported on incombustible frames attached to the building.

**Movable
Awnings or
Hoods**

Such awning or hood may extend over the public property not more than two-thirds the distance from the property line to the nearest curb in front of the building site.

The lowest part of any movable awning or hood frame shall be not less than eight feet (8') above the ground immediately below, and the lowest part of any fringe attached to such awning or hood shall be not less than seven feet (7') above the grade immediately below.

Sec. 4507. Doors in Fire Zones Nos. 1 and 2, either fully opened or when opening, shall not project more than one foot (1') beyond the property line, except that in alleys no projection beyond property line is permitted. Doors in Fire Zone No. 3, that swing over the property line, shall be maintained normally closed.

Doors

PART X

CHAPTER 47—LATHING AND PLASTERING

General

Sec. 4701. Lathing and plastering shall be done in the manner and with the materials specified in this Chapter, and when required for fire protection shall also comply with the provisions of Chapters 42 and 43.

No plaster shall be applied until the lathing has been inspected and approved by the Building Official.

The Building Official may require that test holes be made in the wall for the purpose of determining the thickness of the plaster, provided the permit holder has been notified 24 hours in advance of the time of making such test.

Materials

Sec. 4702. (a) **Sand.** Sand shall be washed sand conforming to A.S.T.M. "Standard Specifications for Sand for Use in Plaster," (C35-39); except that when used with portland cement for scratch coat plastering, the amount of sand retained on a No. 8 sieve shall be not less than 10 per cent or more than 30 per cent.

(b) **Gypsum Plaster.** Gypsum plaster shall conform to A.S.T.M. "Standard Specifications for Gypsum Plasters," (C28-40).

(c) **Lime.** Lime shall conform to the requirements of A.S.T.M. "Standard Specifications for Quicklime for Structural Purposes," (C5-26), or the A.S.T.M. "Standard Specifications for Normal Finishing Hydrated Lime," (C6-44).

Lime putty shall be made from quicklime or hydrated lime, and shall be prepared in an approved manner, stored and protected for an approved period of time.

(d) **Keene's Cement.** Keene's cement shall conform to A.S.T.M. "Standard Specifications for Keene's Cement," (C61-40).

(e) **Portland Cement.** Portland cement shall conform to A.S.T.M. "Standard Specifications for Portland Cement," Types I, II, or III, (C150-44), except with respect to insoluble residue.

Approved types of plasticity agents may be added to portland cement, Types I or II, in the manufacturing process or when mixing the plaster, but in no case shall the amount of plasticity agent exceed 10 per cent of the volume of cement in the plaster mixture.

(f) **Wood Lath.** Wood lath shall conform to the requirements of Section 13 (b) of A.S.A. "Standard Specifications for Gypsum Plastering Including Requirements for Lathing and Furring," (A42, 1-1938).

(g) **Fiber Insulation.** Fiber insulation lath shall be manufactured from wood or other vegetable fiber in accordance with "Federal Specifications for Insulating Fiberboard," (F.S. LLL-F-321a).

(h) **Gypsum Lath.** Gypsum lath shall conform to A.S.T.M. "Standard Specifications for Gypsum Lath," (C37-42), and shall be not less than five-sixteenths inch (5/16") in thickness.

(i) **Metal and Wire Lath.** Metal and wire lath, metal accessories and channels shall conform to the requirements of Section 13 of A.S.A. "Standard Specifications for Gypsum Plastering Including Requirements for Lathing and Furring," (A42, 1-1938).

Sec. 4703. (a) Distance Between Supports. For gypsum, wood, and fiber insulation laths, the distance between supports shall not exceed sixteen inches (16").

**Interior
Plastering:
Lathing**

Internal angles, external angles, coves, arches and junctures between wood, fiber insulation, gypsum lath and other plaster bases shall be reinforced with cornerite, except where metal or wire lath is carried around such intersections.

No interior lath shall be applied until all exterior framing is covered.

(b) Gypsum Lath. Gypsum lath shall be nailed to wood supports at intervals not to exceed four inches (4") with 13-gauge, one and one-eighth inch ($1\frac{1}{8}$ "), three-eighths inch ($\frac{3}{8}$ ") flathead, galvanized or blued nails and shall be secured to horizontal or vertical metal supports by means of approved special clips.

Joints between walls and ceilings shall be staggered. Lath shall be applied with joints broken in each course. The laths shall be spaced not more than one-quarter inch ($\frac{1}{4}$ ") apart.

(c) Wood Lath. Wood lath shall be spaced not less than one-quarter inch ($\frac{1}{4}$ ") or more than three-eighths inch ($\frac{3}{8}$ ") apart at edges, one-quarter inch ($\frac{1}{4}$ ") apart at ends, and shall be nailed with 3d fine, 16-gauge, blued nails, full driven. Joints shall be broken every seventh lath and above or below all openings.

Lath shall run approximately at right angles to the supporting members, and no lath shall extend through any wall.

Wood lath shall be thoroughly soaked before being nailed in place, and kept damp until plaster is applied.

(d) Fiber Insulation Lath. Fiber insulation lath shall be nailed to wood supports at intervals not to exceed four and one-half inches ($4\frac{1}{2}$ ") with nails of the following sizes, placed not less than three-eighths inch ($\frac{3}{8}$ ") from the ends, and not less than one-half inch ($\frac{1}{2}$ ") from shiplapped, tongued and grooved, or interlocking edges:

For one-half inch ($\frac{1}{2}$ ") lath—One and one-eighth inch ($1\frac{1}{8}$ ") fiberboard nails or 6d box nails.

For one-inch (1") lath—One and three-fourths inch ($1\frac{3}{4}$ ") fiberboard nails or 4d box nails.

End joints, except in interlocking type lath, shall be not less than three-sixteenths inch ($3/16$ ") wide. Shiplapped, tongued and grooved, or interlocking edges shall be fitted to contact.

(e) Metal and Wire Lath. 1. The weight of metal and wire lath and the spacings of supports shall conform to the requirements set forth in Table No. 47-A.

2. Metal and wire lath shall be lapped at least one mesh at side and ends, but need not exceed one inch (1").

3. Metal and wire lath shall be attached to vertical wood supports at not to exceed six-inch (6") spacing with not less than 4d common nails driven to a penetration of at least three-quarters inch ($\frac{3}{4}$ ") and bent over to engage not less than three strands of lath. Metal and wire lath shall be attached to ceiling joists or other horizontal wood supports with not less than one and one-half inch ($1\frac{1}{2}$ "), 11 gauge, barbed nails with a head

TABLE NO. 47-A—WEIGHTS OF METAL AND WIRE LATH

TYPES OF LATH	WEIGHT (lbs. per sq. yd.)	MAXIMUM SPACING OF SUPPORTS	
		FOR WALLS	FOR CEILINGS
Wire Lath	2.48	16"	12"
Flat Expanded	2.5	16"	0
Flat Expanded	3.4	16"	16"
Flat Rib	2.75	16"	16"
Flat Rib	3.4	24"	24"
$\frac{3}{8}$ " Rib	3.4	24"	24"
Sheet Lath	4.5	24"	24"

TABLE NO. 47-B—SIZES OF MAIN RUNNERS IN SUSPENDED AND FURRED CEILINGS

DISTANCE CENTER TO CENTER OF HANGERS	SIZE	MAIN RUNNERS	
		Hot Rolled	Cold Rolled
Up to 2 feet	$\frac{3}{4}$ "	300 lb./1000 ft.	300 lb./1000 ft.
Up to 3 feet	1"	410 lb./1000 ft.	
Up to 4 feet	$1\frac{1}{2}$ "	650 lb./1000 ft.	475 lb./1000 ft.

not less than seven-sixteenths inch ($7/16$ ") in diameter, or an equivalent approved attachment.

4. Metal and wire lath shall be attached to horizontal and vertical metal supports at not to exceed six-inch (6"), spacing with not less than No. 18 W & M gauge, galvanized annealed wire, or an equivalent approved attachment.

Reinforced Non-Bearing Partitions

Sec. 4704. Where reinforced plaster or pneumatically placed plaster partitions are used they shall have vertical steel or iron channels with a depth of not less than one-third the thickness of the partition, made of not less than No. 16 U. S. gauge metal and spaced not more than twenty-four inches (24") on center. They shall be securely fastened and anchored to adjoining framing members.

Hollow non-bearing partitions of reinforced plaster or pneumatically placed plaster shall have a shell thickness of not less than three-fourths inch ($3/4$ ").

Reinforcement shall be as set forth in Table No. 47-A. The minimum thickness of reinforced plaster or pneumatically placed plaster partitions shall be not less than one and one-half inch ($1\frac{1}{2}$ ") nor one eighty-fourth of the distance between supports.

Interior Plastering: Suspended and Furred Ceilings

Sec. 4705. (a) General. Suspended or furred ceilings shall be designed to meet the requirements of this Section, or shall be designed for a live load of 10 pounds per square foot.

(b) Main Runners. Main runners shall be hot rolled or cold rolled steel channels, and shall be not less than the sizes and weights set forth in Table No. 47-B.

**TABLE NO. 47-C—SIZES OF CROSS FURRING IN
SUSPENDED AND FURRED CEILINGS**

DISTANCE CENTER TO CENTER OF MAIN RUNNER	SIZE OF CROSS FURRING	MAXIMUM SPACING
Up to 2 feet	$\frac{1}{4}$ " pencil rods	12"
Up to 3 feet	$\frac{1}{4}$ " channels	24"
Up to 4 feet	$\frac{1}{4}$ " channels	16"

**TABLE NO. 47-D—REQUIRED THICKNESS OF
INTERIOR PLASTER**

TYPE OF LATH	THICKNESS OF PLASTER
Metal or wire lath	$\frac{3}{8}$ " minimum
All other types allowed in Chapter 47	$\frac{1}{2}$ " minimum

(c) **Cross Furring.** Cross furring for various spacings of main runners or other supports shall be not less than as set forth in Table No. 47-C.

Cross furring shall be securely attached to the main runners or other supports by not less than two strands of No. 16 W & M gauge galvanized wire or equivalent approved attachments.

(d) **Hangers.** Hangers for suspended ceilings shall be not less than No. 8 W & M gauge galvanized wire, fastened to or embedded in the structural framing, masonry or concrete. Not less than two strands of No. 14 W & M gauge galvanized wire or equivalent approved attachments shall be used to attach carrying members to joists or beams.

Hangers shall be saddle tied or wrapped around main runners so as to develop the full strength of the hangers. Lower ends of flat hangers shall be bolted with three-eighths inch ($\frac{3}{8}$ ") bolts to runner channels, or bent tightly around runners and bolted to the main part of the hanger.

Sec. 4706. (a) Number of Coats. Plastering with gypsum, hardwall, lime or cement plaster shall be three-coat work when applied over metal and wire lath, and shall be not less than two-coat work when applied over other plaster bases allowed in this Chapter.

Lime or cement plaster shall not be applied directly to fiber insulation lath or gypsum lath.

In no case shall a brush coat be accepted as a required coat where three-coat work is required by this Section.

(b) **Thickness.** Grounds shall be installed to provide for the following thicknesses of plaster, from face of plaster base to finished plaster surfaces as set forth in Table No. 47-D.

If monolithic concrete ceiling surfaces require more than three-eighths inch ($\frac{3}{8}$ ") of plaster to produce desired lines or surfaces, metal lath or wire lath shall be attached thereto.

**Interior
Plastering:
Number of
Coats and
Thickness**

Section 4707**UNIFORM BUILDING CODE****Interior
Plastering:
Proportioning
and Mixing**

Sec. 4707. (a) Base Coats. The base coats shall be mixed and proportioned in accordance with the following procedure:

1. **Gypsum or Hardwall Plaster.** The first coat, for three-coat work, shall be mixed in the proportion of one part of gypsum or hardwall plaster to not more than two parts of sand by weight. The first coat for two-coat work shall be mixed in the proportion of one part gypsum or hardwall plaster to not more than three parts sand by weight.

The second coat for all three-coat work shall be mixed in the proportion of one part of gypsum or hardwall plaster to not more than three parts of sand by weight.

2. **Wood Fiber Gypsum Plaster.** Wood fiber gypsum plaster shall be mixed with water only, for use on all types of lath, and shall be mixed in the proportion of one part of plaster to one part of sand by weight for use on masonry.

3. **Lime Plaster.** The first coat for three-coat work on metal and wire lath shall be composed of eleven cubic feet (11 cu. ft.) of lime putty or 500 pounds of hydrated lime, 150 pounds of Keene's cement and six pounds of fiber to one cubic yard (1 cu. yd.) of sand.

The second coat for three-coat work on metal and wire lath and for two-coat work on wood lath, brick, tile, or concrete, shall be composed of ten cubic feet (10 cu. ft.) of lime putty or 450 pounds of hydrated lime, 150 pounds of Keene's cement and four pounds of fiber to one cubic yard (1 cu. yd.) of sand.

4. **Portland Cement Plaster.** For three-coat work, the first two coats shall be as required for the first two coats of exterior work.

(b) **Finish Coats for Gypsum or Lime Plaster.** The finish coats shall be mixed and proportioned in accordance with the following procedure:

1. **Smooth white finish,** mixed in the proportion of not less than one part gypsum gauging plaster or Keene's cement to three parts lime putty by volume, or a prepared gypsum trowel finish.

2. **Sand-float finish,** mixed in the proportion of one part gypsum neat unfibred plaster to not more than two parts sand by weight, or one and one-half parts of Keene's cement to two parts of lime putty and not more than four and one-half parts of sand by volume, or a prepared gypsum sand-float finish.

3. **Keene's cement finish,** mixed in the proportions of three parts Keene's cement to one part lime putty, by volume.

4. **Lime sand-float finish** shall be mixed in the proportion of one part of gypsum gauging plaster or Keene's cement, three parts of lime putty, and three parts of sand by volume.

5. **Interior stucco finish** shall be mixed in the proportion of one part of Keene's cement, two parts of lime putty, and three parts of white sand by volume, or a prepared color finish.

(c) **Finish Coat for Portland Cement Plaster.** Finish coats for interior portland cement plaster may be:

1. As required for the third coat of exterior stucco.
2. A gauged cement plaster mixed in proportion of one part portland cement to not more than two and one-half parts of lime putty and not more than four parts of sand by volume.
3. Smooth white finish, mixed in the proportion of not less than one part gypsum gauging plaster or Keene's cement to three parts lime putty by volume.
4. Keene's cement finish, mixed in the proportions of three parts Keene's cement to one part lime putty, by volume.
5. Lime sand-float finish shall be mixed in the proportion of one part gypsum gauging plaster or Keene's cement, three parts of lime putty, and three parts of sand, by volume.
6. Interior stucco finish shall be mixed in the proportion of one part of Keene's cement, two parts of lime putty, and three parts of white sand by volume, or a prepared color finish.

Exception: When finishes No. 3, No. 4, No. 5, or No. 6 are used, portland cements having plasticity agents added in the manufacturing process shall not be used in the coat to which this finish is applied.

Sec. 4708. (a) Base Coats. 1. Gypsum Plaster. The scratch coat shall be applied with sufficient material and pressure to form a full key or bond.

For two-coat work it shall be doubled back to bring the plaster out to grounds and straightened to a true surface and left rough to receive the finish coat. For three-coat work, the surface shall be scratched to provide a bond for the brown coat and shall have been in place at least 12 hours before the second or brown coat is applied. The second or brown coat shall be brought out to grounds, and straightened to a true surface and left rough, ready to receive the finish coat.

2. Lime Plaster. The first two coats shall be applied in the same manner as gypsum plaster, except that in three-coat work, the second or brown coat shall be applied over a dry base coat.

3. Portland Cement Plaster. The first two coats shall be as required for the first two coats of exterior work, except that the interval between the first and second coats shall be not less than 24 hours.

(b) Finish Coats. 1. Smooth white finish shall be applied over base coat which has set and is surface-dry. Thickness shall be from one-sixteenth inch ($1/16''$) to one-eighth inch ($1/8''$).

2. Sand-float finish shall be applied over set base coat which is not quite dry.

3. Keene's cement finish shall be applied over set base coat which is not quite dry. Thickness shall be from one-sixteenth inch ($1/16''$) to one-eighth inch ($1/8''$), unless finish coat is marked off or jointed, in which case the thickness may be increased as required by depth of marking or jointing.

4. The finish coat for interior portland cement plastering shall be applied in the same manner as required for the third coat of exterior stucco, except that other types of finish coat may be applied as specified in Section 4707 (c).

**Interior
Plastering:
Application
of Plaster**

TABLE NO. 47-E—EXTERIOR PLASTER REINFORCEMENT

TYPE OF REINFORCEMENT	MINIMUM DIMENSION OF OPENINGS	MAXIMUM DIMENSION OF VERTICAL OPENINGS	MINIMUM W & M GAUGE	MINIMUM WEIGHT lbs./sq. yd.
Expanded metal				1.8
Metal lath				3.4
Woven netting	1"	1 "	18	1.6
Woven netting	1"	1½"	17	1.4
Woven netting	1"	2 "	16	1.4
Welded netting	1"	1 "	18	1.4

(c) **Plaster on Concrete.** Monolithic concrete surfaces shall be clean, free from efflorescence, damp and sufficiently rough to insure adequate bond.

Gypsum plaster applied to monolithic concrete ceilings shall be specially prepared bond plaster for use on concrete, to which water only shall be added. Gypsum plaster on monolithic walls and columns shall be applied over a scratch coat of bond plaster before it has set. The brown coat shall be brought out to grounds, straightened to a true surface and left rough, ready to receive finish coat.

Lime plaster applied to concrete walls shall be as specified in Section 4707.

Portland cement plaster applied to interior concrete walls or ceilings shall conform to requirements for application to exterior concrete walls as specified in Section 4711 (c).

**Interior
Plastering:
Staff**

Sec. 4709. Staff. Staff shall be soaked before stieking. Lugs shall be of pure fiber and plaster of paris. Rust-resistive fastenings of sufficient strength to anchor the staff to the support shall be not less than No. 14 B & S gauge copper wire.

**Exterior
Plastering:
Backing**

Sec. 4710. (a) Backing. Except in back plastered construction, studs shall be sheathed or wire of not less than No. 18 W & M gauge shall be stretched taut horizontally at intervals not exceeding six inches (6") on centers vertically and securely fastened in place.

(b) **Weather Protection.** Weather protection shall be as specified in Section 2217.

(e) **Metal Reinforcement.** Exterior plaster, except when applied to concrete or masonry, shall be reinforced with one of the materials having a rust-resistive coating applied after fabrication as set forth in Table No. 47-E.

Metal reinforcement shall be furred out from the backing at least one-quarter inch (¼") with an approved furring device, and shall be nailed with galvanized nails or approved furring devices driven to at least three-quarters inch (¾") penetration which shall be spaced not more than six inches (6") apart vertically and sixteen inches (16") apart horizontally. Metal reinforcement shall be lapped at least one full mesh at all joints. When no sheathing is used, all vertical joints shall be made at

TABLE NO. 47-F—EXTERIOR PORTLAND CEMENT PLASTER

COAT	MAXIMUM VOLUME OF SAND PER VOLUME OF CEMENT	MINIMUM THICKNESS	MINIMUM PERIOD MOIST CURING	MINIMUM INTERVAL BEFORE APPLICATION OF SUCCEEDING COAT
First or scratch	3 ½	½"	48 hrs.	7 days
Second or brow	4 ½	(1st & 2nd coats) ¾"	48 hrs.	7 days
Third or finish	2**	⅛"		

*Measured from backing to crest of scored plaster.

**Approved prepared finish coats containing not less than 1/3 by weight of portland cement may be used.

the studs and horizontal joints where expanded metal or metal lath is used shall have at least one tie between studs, made with No. 18 W & M gauge galvanized annealed tie wire.

Sec. 4711. (a) General. Exterior cement plaster shall be portland cement plaster meeting the requirements of Table No. 47-F, except when applied over concrete or masonry.

(b) Plasticity Agents. Plasticity agents shall be of approved types and amounts, and if added to portland cement in the manufacturing process, no later additions shall be made.

(c) Application. 1. General. Except when applied to concrete or masonry, and except as otherwise provided for pneumatically applied plaster, exterior cement plastering materials shall be mixed by machine methods for not less than two minutes, and shall be applied in three coats as set forth in Table No. 47-F.

The first coat shall be forced through all openings in the reinforcement so as solidly to fill all spaces. It shall then be scored horizontally with a scratcher having one-eighth inch (⅛") clipped teeth and grooves not more than one-half inch (½") deep.

The second coat shall be rodded and water floated, with no variation greater than one-quarter inch (¼") in any direction under a five-foot (5') straightedge.

The third coat shall not be a brush coat.

2. Plastering on Masonry or Concrete. The masonry surface on which plaster is to be applied shall be clean, free of efflorescence, damp and sufficiently rough to insure proper bond. Mixtures specified for the second coat in this Section may be applied directly to masonry.

Sec. 4712. Pneumatically placed cement plaster shall be a mixture of portland cement and sand, mixed dry, conveyed by air through a pipe or flexible tube, hydrated at the nozzle at the end of the conveyor and deposited by air pressure in its final position.

Rebound material may be screened and re-used as sand in an amount not greater than 25 per cent of the total sand in any batch.

**Exterior
Plastering:
Application**

**Pneumatically
Placed
Plaster**

Section 4712**UNIFORM BUILDING CODE**

Pneumatically placed cement plaster shall consist of a mixture of one part cement to not more than five parts of sand. Plasticity agents may be used as specified in Section 4711 (b). Except when applied to concrete or masonry, such plaster shall be applied in not less than two coats to a minimum total thickness of seven-eighths inch ($\frac{7}{8}$ "'). The first coat shall be rodded as specified in Section 4711(c) for the second coat. The curing period and time interval shall be as set forth in Table No. 47-F.

PART XI
SPECIAL SUBJECTS

CHAPTER 48—FILM STORAGE

Secs. 4801 and 4802. Where it is desired to regulate film storage complete provisions covering handling and storage of photographic and X-Ray nitrocellulose films may be found in Appendix Chapter 48, page 271.

Film
Storage

CHAPTER 49—MECHANICAL REFRIGERATION

Secs. 4901 to 4903. Where it is desired to regulate the type and installation of mechanical refrigeration complete provisions may be found in Appendix Chapter 49, page 271.

Refrigeration

Appendix 48

CHAPTER 50—PREFABRICATED CONSTRUCTION

Sec. 5001. (a) Purpose. The purpose of this Chapter is to regulate materials and establish methods of safe construction where any structure or portion thereof is wholly or partially prefabricated.

General

(b) Scope. Unless otherwise specifically stated in this Chapter, all prefabricated construction and all materials used therein shall conform to all the requirements of this Code. (See Section 105.)

(c) Definition. **PREFABRICATED ASSEMBLY** is a structural unit, the integral parts of which have been built up or assembled prior to incorporation in the building.

Sec. 5002. Every approval of a material not specifically mentioned in this Code shall incorporate as a proviso the kind and number of tests to be made during prefabrication.

Test of
Materials

Sec. 5003. The Building Official may require special tests to be made on assemblies to determine their durability and weather resistance.

Tests of
Assemblies

Sec. 5004. (a) Design. Every device designed to connect prefabricated assemblies shall be capable of developing the strength of the members connected, except in the case of members forming part of a structural frame designed as specified in Chapter 23. The connection device shall be designed as required by the other chapters in this Code. Connections between roofs and the supporting walls shall be capable of withstanding an uplift equal to five pounds per square foot of roof.

Connections

Sec. 5005. (a) Structural Design. In structural design, due allowance shall be made for any material to be removed for the installation of pipes, conduits, or other equipment.

Pipes and
Conduits

Section 5006**Certificate
and
Inspection****UNIFORM BUILDING CODE**

Sec. 5006. (a) Materials. Materials and the assembly thereof shall be inspected to determine compliance with this Code. Every material shall be grade marked or labeled where required elsewhere in this Code.

(b) Certificate. A certificate of approval shall be furnished with every prefabricated assembly, except where the assembly is readily accessible to inspection at the site. The certificate of approval shall certify that the assembly in question has been inspected and meets all the requirements of this Code. When mechanical equipment is installed so that it cannot be inspected at the site, the certificate of approval shall certify that such equipment complies with the laws applying thereto.

(c) Certifying Agency. To be acceptable under this Code, every certificate of approval shall be made by an approved agency.

(d) Field Erection. Placement of prefabricated assemblies at the building site shall be inspected by the Building Official to determine compliance with this Code.

(e) Continuous Inspection. If continuous inspection is required for certain materials where construction takes place on the site, it shall also be required where the same materials are used in prefabricated construction.

Exception: Continuous inspection will not be required during prefabrication if the approved agency certifies to the construction and furnishes evidence of compliance.

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CHAPTER 51—HEATING APPLIANCES

(See Appendix)

PART XII LEGISLATIVE

CHAPTER 60—LEGISLATIVE

Sec. 6001. If any section, subsection, sentence, clause or phrase of this Ordinance is, for any reason held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this Ordinance. The City Council hereby declares that it would have passed this Ordinance, and each section, subsection, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

Validity

Sec. 6002. The specifications, suggested ordinances and regulations which are mentioned by title and date of publication in various parts of this Ordinance are hereby declared to be a part of this Ordinance when not in conflict with a specific statement contained in the body of this Ordinance to the contrary. The following list includes all of the specifications, suggested ordinances and regulations referred to in this Code:

Appended Documents

NATIONAL STANDARD SPECIFICATIONS REFERRED TO IN CHAPTERS 1 TO 51

Uniform Building Code

<i>Author Organization's Designation</i>	<i>Subject</i>	<i>Section</i>
American Concrete Institute:		
704-44	Specifications for Cast Stone	2402(d)
American Society of Refrigerating Engineers:		
April, 1939	Safety Code for Mechanical Refrigeration. Approved by A.S.A.	4901
American Society for Testing Materials:		
A7-42	Standard Specifications for Structural Steel for Bridges and Buildings	2701
A15-39	Standard Specifications for Billet-Steel Bars for Concrete Reinforcement	2604(d), 2620(c)
A16-35	Standard Specifications for Rail-Steel Bars for Concrete Reinforcement	2604(d)
A27-44	Standard Specifications for Carbon Steel Castings	2701
A48-41	Standard Specifications for Gray Iron Castings	2701
A53-44	Standard Specifications for Welded and Seamless Steel Pipe	2701
A82-34	Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement	2604(d), 2620(c)
A160-39	Standard Specifications for Axle-Steel Bars for Concrete Reinforcement	2604(d)
A245-44T	Tentative Specifications for Light Gauge Structural Quality Flat Hot-Rolled Carbon Steel	3104(b)
C5-26	Standard Specifications for Quicklime for Structural Purposes	2402(i), 4702(c)
C6-44	Standard Specifications for Normal Finishing Hydrated Lime	2402(i), 4702(c)
C10-37	Standard Specifications for Natural Cement	2402(i)
C19-41	Standard Specifications for Fire Tests of Building Construction and Materials	4201
C22-41	Standard Specifications for Gypsum	2402(i)

Section 6002

UNIFORM BUILDING CODE

		Section
C28-40	Standard Specifications for Gypsum Plasters	4702(b)
C31-44	Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field	2605, 2613
C33-44	Standard Specifications for Concrete Aggregates	2604(b)
C34-41	Standard Specifications for Structural Clay Load-Bearing Wall Tile	2402(c)
C35-39	Standard Specifications for Sand for Use in Plaster	4702(a)
C37-42	Standard Specifications for Gypsum Lath	4302, 4702(h)
C-39-44	Standard Method of Test for Compressive Strength of Molded Concrete Cylinders	2606, 2613
C52-41	Standard Specifications for Gypsum Partition Tile or Block	2402(f)
C55-37	Standard Specifications for Concrete Building Brick	2402(a)
C56-41	Standard Specifications for Structural Clay Non-Load-Bearing Tile	2402(c)
C57-39	Standard Specifications for Structural Clay Floor Tile	2402(c)
C61-40	Standard Specifications for Keene's Cement	4702(d)
C62-44	Standard Specifications for Building Brick (Made from Clay or Shale)	2402(a)
C67-44	Standard Methods of Sampling and Testing Brick	2415(d)
C73-39	Standard Specifications for Sand-Lime Building Brick	2402(a)
C90-44	Standard Specifications for Hollow Load-Bearing Concrete Masonry Units	2402(b)
C94-44	Standard Specifications for Ready Mixed Concrete	2607, 2609(a)
C126-44T	Tentative Specifications for Glazed Masonry Units	2402(h)
C129-39	Standard Specifications for Hollow Non-Load-Bearing Concrete Masonry Units	2402(b)
C130-42	Standard Specifications for Lightweight Aggregates for Concrete	2604(b)
C141-42	Standard Specifications for Hydraulic Hydrated Lime for Structural Purposes	2402(i)
C144-44	Standard Specifications for Aggregate for Masonry Mortar	2402(j)
C145-40	Standard Specifications for Solid Load-Bearing Concrete Masonry Units	2402(h)
C150-44	Standard Specifications for Portland Cement	2402(i), 2604(a), 4702(e)
C152-41	Standard Methods of Fire Tests of Door Assemblies	4304(k)
D146-44T	Tentative Methods of Testing Felted and Woven Fabrics Saturated with Bituminous Substances for Use in Waterproofing and Roofing	3204(h)
D805-44T	Tentative Specifications for Testing Veneer, Plywood, and Other Wood and Wood-Base Materials	2527(e)

American Standards Association:

A42.1-1938	Standard Specifications for Gypsum Plastering, Including Requirements for Lathing and Furring	4702(f), (i)
A59.1-1941	Building Requirements for Reinforced Gypsum Concrete	2412(a)
Z21.11-1942	Approval Requirements for Gas Space Heaters	5101(e)
Z21.13-1943	Approval Requirements for Central Heating Gas Appliances	5101(e)
Z21.16-1940	Approval Requirements for Gas Unit Heaters	5101(c)
Z21.34-1934	Approval Requirements for Gas-Fired Duct Furnaces	5101(e)

American Welding Society:

1941 Edition	Code for Arc and Gas Welding	
(Tentative)	In Building Construction, Sections 2, 3, 4	2710

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Sections 6002-6004

American Wood-Preservers' Association:

39-c	Specification	2803(b)
41-b	Specification	2803(b)

Board of Fire Underwriters of the Pacific:

Sept. 10, 1930	Schedule for Rating of Theaters and Motion Picture Halls	4102
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Building Standards Monthly:

June, 1943	Tests Indicate Design Methods for Earthquake-Proof Timber Floors	2524
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California Redwood Association:

1942 Revised	Standard Grading and Dressing Rules	2525
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National Board of Fire Underwriters:

1927	Standard Ordinance for Chimney Construction	3702(h)
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July 15, 1920	Storage and Handling of Photographic and X-Ray Nitrocellulose Films	4802
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July 1, 1939	Regulations for Nitrocellulose Motion Picture Film	4803
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1934	Building Code, Appendix P, Fifth Edition Revised	4102
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1940 Edition	Installation of Sprinkler Equipments	3802
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April, 1941	Installation of Oil-Burning Equipments	5101(c)
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1943	Recommended Fire Prevention Ordinance	908, 1008, 1108, 1208, 1308, 1508
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January, 1930	Protection of Openings in Walls and Partitions Against Fire	4304
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National Lumber Manufacturers Association:

1944	National Design Standard for Stress-Grade Lumber and Its Fastenings	2516
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Underwriters' Laboratories, Inc.

December, 1941	Standard for Class C Asphalt, Rag Felt, Sheet Roofing and Shingles	3204(b)
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December, 1941	Standard for Tin-Clad Fire Doors and Shutters	4304
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United States Department of Agriculture:

1940	Wood Handbook	2508(d), 2509, 2510, 2517(h), 2527(d)
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Misc. Pub. No. 135	Guide to the Grading of Structural Timber and Determination of Working Stresses	2503(a)
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Tech. Bull. 597, Jan. 1938	Lag-Screw Joints: Their Behavior and Design	2511
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United States Department of Commerce, Bureau of Standards:

CS31-38	Wood Shingles	3204(d)
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CS45-45	Douglas Fir Plywood	2503(e)
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CS75-42	Automatic Mechanical-Draft Oil Burners Designed for Domestic Installations	5101(c)
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CS99-42	Gas Floor Furnaces—Gravity Circulating Type	5101(e)
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CS109-44	Solid-Fuel-Burning Forced-Air Furnaces	5101(b)
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CS113-44	Oil-Burning Floor Furnaces Equipped with Vaporizing Pot-Type Burners	5101(c)
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R16-39	American Lumber Standards for Softwood Lumber	2503(a)
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United States Federal Government:

LLL-F-321b	Federal Specifications for Insulating Fiberboard	4702(g)
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SS-C-181b	Federal Specifications for Masonry Cement	2402(i), 2403(a)
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United States Forest Products Laboratory:

R896	Rigidity and Strength of Frame Walls	2528
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R1025	Plywood as a Structural Covering for Frame Walls and Wall Units	2524
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R1220	The Designing for Strength of Flat Panels with Stressed Coverings	2530
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April 17, 1942	Approximate Tentative Methods of Calculating the Strength of Plywood	2503(e)
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Sec. 6003. Ordinance No. _____ and all ordinances amendatory thereto, and all ordinances or parts of ordinances in conflict with this Ordinance are hereby repealed.

Ordinances Repealed

Sec. 6004. This Ordinance shall be, and is hereby declared, to be in full force and effect, from and after 30 days from its date of final passage and approval.

Date Effective

APPENDIX

The Appendix, pages 260-280, contains suggested ordinances covering subjects which may not be desired in all cities, also other pertinent information designed to be of assistance to the Building Official.

**Reviewing
Stands**

Refer to Sec. 702(c). The following suggestions are given as a guide for the detailed design and construction of reviewing stands.

Every reviewing stand shall be constructed with four-inch by six-inch (4"x6") girders running parallel to the front of such stand, spaced not more than six feet (6') apart, and supported at distances not exceeding six feet (6') apart by posts of not less than four inches by six inches (4"x6"). These posts shall be braced diagonally with one-inch by six-inch (1"x6") bracing, forming a continuous herringbone bracing, the full length of such stand for each vertical six feet (6') of such posts. The girders at the top of the posts shall be braced with braces not less than four inches by four inches (4"x4") at right angles to the joists above the girders. Every post or brace shall be thoroughly secured to a foot plate, which shall be of sound wood not less than two inches by six inches (2"x6") in cross section laid solidly on the ground at right angles to the front of the stand and forming the base for each line of posts. There shall be joists resting on the girders of not less than two inches by eight inches (2"x8") cross section. Such joists shall be spaced not exceeding forty inches (40") apart and two-inch (2") plank shall be used for the seats and steps. Braces shall be provided whenever necessary to make a solid, substantial structure, which shall be safe under any possible emergency. All timbers forming the framing shall be thoroughly spiked together. There shall be a level stringer of two inches by six inches (2"x6") cross section at the bottom of each line of posts, parallel to the stand; also a horizontal piece of two inches by six inches (2"x6") cross section the full length of the stand and at right angles to same for every row of posts, and every six feet (6') of vertical height thereof. All timbers used in the construction of reviewing stands shall be sound (no second-hand or broken lumber permitted). Wherever the stand, or a portion thereof, extends over an excavation, the posts shall be extended to the bottom of said excavation and shall be braced with horizontal braces as hereinbefore provided.

**Foundations
for Type V
Buildings**

Refer to Sec. 2204. Minimum foundation requirements shall be as set forth in Table No. 22-A of this Section.

TABLE NO. 22-A—MINIMUM FOUNDATION REQUIREMENTS FOR TYPE V BUILDINGS

Number of Stories	Thickness of Foundation Wall in Inches		Width of Footing in Inches	Thickness of Footing in Inches	Depth of Foundation Below Natural Surface of Ground and Finish Grade in Inches
	Concrete	Unit Masonry			
1	6	6	14	6	12
2	8	8	16	6	18
3	10	10	18	6	30

Sec. 2205. (c) Wall Coverings. 5. Exterior Plaster. (1) Exterior Lathing. Studs shall be sheathed, or wire of not less than 18 W & M gauge shall be stretched taut horizontally at intervals not exceeding six inches (6") on centers vertically and securely fastened in place. The frame shall be covered with building paper as required in Section 2217.

Plaster shall be reinforced with one of the materials having a rust-resistive coating applied after fabrication, as set forth in Table No. 22-B.

Metal reinforcement shall be furred out from the backing at least one-quarter inch ($\frac{1}{4}$ ") with an approved furring device, and shall be nailed with galvanized nails or approved furring devices driven to at least three-quarters inch ($\frac{3}{4}$ ") penetration which shall be spaced not more than six inches (6") apart vertically and sixteen inches (16") apart horizontally. Metal reinforcement shall be lapped at least one full mesh at all joints. When no sheathing is used, all vertical joints shall be made at the studs and horizontal joints where expanded metal or metal lath is used shall have at least one tie between studs, made with not less than No. 18 W & M gauge galvanized annealed tie wire.

(2) Application. Exterior plaster shall be portland cement plaster meeting the requirements set forth in Table No. 22-C.

TABLE NO. 22-B—EXTERIOR PLASTER REINFORCEMENT

TYPE OF REINFORCEMENT	MINIMUM DIMENSION OF OPENINGS	MAXIMUM DIMENSION OF VERTICAL OPENINGS	MINIMUM W & M GAUGE	MINIMUM WEIGHT lbs./sq. yd.
Expanded metal				1.8
Metal lath				3.4
Woven netting	1"	1"	18	1.6
Woven netting	1"	1½"	17	1.4
Woven netting	1"	2"	16	1.4
Welded netting	1"	1"	18	1.4

TABLE NO. 22-C—EXTERIOR PORTLAND CEMENT PLASTER

COAT	MAXIMUM VOLUME OF SAND PER VOLUME OF CEMENT	MINIMUM THICKNESS	MINIMUM PERIOD MOIST CURING	MINIMUM INTERVAL BEFORE APPLICATION OF SUCCEEDING COAT
First or scratch	3½	¼"	48 hrs.	7 days
Second or brown	4½	(1st & 2nd coats) ¾"	48 hrs.	7 days
Third or finish	2**	¾"		

*Measured from backing to crest of scored plaster.

**Approved prepared finish coats containing not less than 1/3 by weight of portland cement may be used.

**Exterior
Plaster**

Plasticity agents shall be of approved types and if added to portland cement in the manufacturing process, no later additions shall be made.

Except for pneumatically placed plaster, exterior cement plastering materials shall be mixed by machine for not less than two minutes and shall be applied in three coats as set forth in Table No. 22-C.

The first coat shall be forced through all openings in the reinforcement so as solidly to fill all spaces. It shall then be scored horizontally with a scratcher having one-eighth inch ($\frac{1}{8}$ ") clipped teeth and grooves not more than one-half inch ($\frac{1}{2}$ ") deep. The second coat shall be rodded and water doated with no variation greater than one-fourth inch ($\frac{1}{4}$ ") in any direction under a five foot (5') straightedge. The third coat shall not be a brush coat.

(3) **Pneumatically Placed Plaster.** Pneumatically placed cement plaster shall be a mixture of one part portland cement to not more than five parts sand, mixed dry, conveyed by air through a pipe or flexible tube, hydrated at the nozzle at the end of the conveyor, and deposited by air pressure in its final position. Rebound material may be screened and re-used as sand in an amount not greater than 25 per cent of the total sand in any batch.

Except when applied to concrete or masonry, such plaster shall be applied in not less than two coats to a minimum total thickness of seven-eighths inch ($\frac{7}{8}$ "). The first coat shall be rodded as specified in Subsection (2) for the second coat. The curing period and time interval shall be as set forth in Table No. 22-C.

Refer to Sec. 2301.

WEIGHTS OF BUILDING MATERIALS

	Lbs. Per Cu. Ft.
Brick, Pressed	150
Brick, Common	125
Brick, Common, laid $\frac{3}{8}$ " joints.....	120
Brick, Soft, laid $\frac{3}{8}$ " joints.....	100
Cast Iron	450
Cinders, dry, bituminous, in bulk.....	45
Concrete—	
Cinder, structural	110
Stone or gravel.....	144
Concrete Building Tile, 60% solid.....	87
Concrete Building Tile, 55% solid.....	79
Earth—	
Common loam, dry and loose.....	76
Clay and gravel, dry and loose.....	100
Common earth, dry and packed.....	100
Wet mud	120
Glass	157
Granite	170
Gravel, dry	120

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Lbs. Per
Cu. Ft.

Granite Masonry, dressed.....	165
Granite Masonry, rubble.....	155
Limestone Masonry, dressed.....	162
Marble Masonry, dressed.....	170
Mortar, hard, cement.....	135
Mortar, hard, lime.....	105
Slag (blast furnace).....	130
Steel.....	490
Terra Cotta, filled with brickwork.....	120
Terra Cotta, Dennison interlock tile, laid.....	65

Timber—

Fir, dry.....	32
Fir, wet.....	44
Oak.....	46
Water, fresh at 60 degrees Fahrenheit.....	62½
Sand, dry.....	100
Sand, wet.....	120

Lbs. Per
Sq. Ft.

Ceilings—

Wood, lath and plaster.....	8
Metal lath and plaster suspended.....	10

Partitions—

2"x4" studs, wood lath, 5/8" plaster, both sides.....	16
2"x4" studs, plaster board, 5/8" plaster, both sides.....	16
Channel studs, metal lath, cement plaster, solid 2" thick.....	20
Plaster on hollow clay tile (one side).....	5
2" Hollow Clay Tile.....	13
3" Hollow Clay Tile.....	16
4" Hollow Clay Tile.....	18
5" Hollow Clay Tile.....	20
6" Hollow Clay Tile.....	25
8" Hollow Clay Tile.....	30
12" Hollow Clay Tile.....	45
Plaster on plaster block partitions (one side).....	5
2" Plaster Blocks.....	7
2½" Plaster Blocks.....	8.5
3" Plaster Blocks.....	9.5
3½" Plaster Blocks.....	10.5
4" Plaster Blocks.....	12
5" Plaster Blocks.....	15
6" Plaster Blocks.....	18
8" Plaster Blocks.....	22

Roofings—

Wood shingles.....	3
Slate 1½".....	7
Slate 1¼".....	10
Tile and clay shingles.....	11 to 14
Roman tile, clay.....	12
Spanish tile, clay.....	19

	Lbs. Per Sq. Ft.
Ludowici tile, Spanish.....	10
Tile roof laid in mortar, add.....	10
Copper (if no weight is specified).....	1½
Tin	1
Corrugated iron.....	2
Tar and gravel.....	6
Prepared composition.....	1
Skylights, metal covered, wire glass.....	5

Refer to Sec. 2313. The following provisions are suggested for inclusion in the Code by cities located within an area subject to earthquake shocks.

Lateral Bracing

Sec. 2313. (a) General. Every building or structure and every portion thereof, except Type V buildings of Group I occupancy which are less than twenty-five feet (25') in height, and minor accessory buildings, shall be designed and constructed to resist stresses produced by lateral forces as provided in this Section. Stresses shall be calculated as the effect of a force applied horizontally at each floor or roof level above the foundation. Such force shall be proportional to the total dead plus one-half the vertical design live load, except for warehouses and tanks, in which case such force shall be proportional to the total dead plus the total vertical designed live load. The force shall be assumed to come from any horizontal direction.

All bracing systems both horizontal and vertical shall transmit all forces to the resisting members and shall be of sufficient extent and detail to resist the horizontal forces provided for in this Section and shall be located symmetrically about the center of mass of the building or the building shall be designed for the resulting rotational forces about the vertical axis.

Junctures between distinct parts of buildings, such as wings which extend more than twenty feet (20') from the main portion of the building, shall be designed at the juncture with other parts of the building for rotational forces, or the juncture may be made by means of sliding fragile joints having a minimum width of not less than eight inches (8"). The details of such joints shall be made satisfactory to the Building Official.

(b) **Horizontal Force Formula.** In determining the horizontal force to be resisted, the following formula shall be used:

$$F = CW$$

where "F" equals the horizontal force in pounds.

"W" equals the total dead load plus one-half the total vertical designed live load,

at and above the point of elevation under consideration, except for warehouses and tanks, in which case "W" shall equal the total dead load plus the total vertical designed live load at and above the point or elevation under consideration. Machinery or other fixed concentrated loads shall be considered as part of the dead load.

"C" equals a numerical constant as shown in Table No. 23-A.

TABLE NO. 23-A—HORIZONTAL FORCE FACTORS

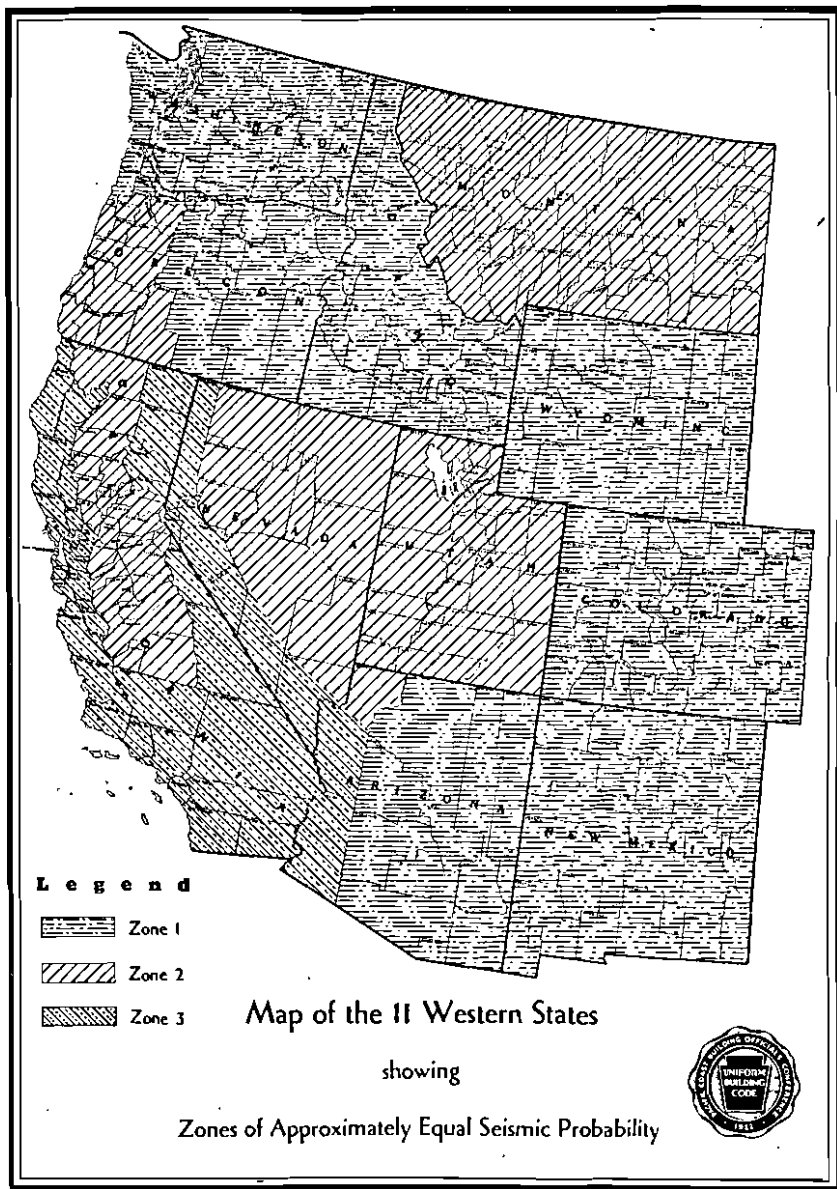
<i>Part or Portion</i>	<i>Value of "C"*</i>	<i>Direction of Force</i>
The structure as a whole and every portion not itemized in this table**	.02 on soil, over 2000 lbs. .04 on soil up to 2000 lbs.	Any direction horizontally
Bearing walls, non-bearing walls, partitions, curtain walls, enclosure walls, panel walls	.05 With a minimum of five pounds per square foot.	Normal to surface of wall
Cantilever parapet and other cantilever walls, except retaining walls	25	Normal to surface of wall
Exterior and interior ornamentations and appendages	.25	Any direction horizontally
Towers, tanks, towers and tanks plus contents, chimneys, smokestacks, and penthouses when connected to or a part of a building	.05	Any direction horizontally

*See map on page 266 for zones. The values given "C" are minimum and should be adopted in locations not subject to frequent seismic disturbances as shown in Zone 1. For locations in Zone 2, "C" should be doubled. For locations in Zone 3, "C" should be multiplied by four.

**Where wind load as set forth in Section 2307 would produce higher stresses, this load should be used in lieu of the factor shown.

(c) **Foundation Ties.** In the design of buildings of Types I, II and III, where the foundations rest on piles or on soil having a safe bearing value of less than 2,000 pounds per square foot, the foundations shall be completely inter-connected in two directions approximately at right angles to each other. Each such inter-connecting member shall be capable of transmitting by both tension and compression at least 10 per cent of the total vertical load carried by the heavier only of the footings or foundations connected. The minimum gross size of each such member if of reinforced concrete shall be twelve inches by twelve inches (12"x12") and shall be reinforced with not less than the minimum reinforcement specified in Section 2620. If the inter-connecting members are of structural steel, they shall be designed as provided in Section 2702, and encased in concrete. A reinforced concrete slab may be used in lieu of inter-connecting tie members, providing the slab thickness is not less than one forty-eighth of the clear distance between the connected foundations; also providing the thickness is not less than six inches (6").

Inter-connecting slabs shall be reinforced with not less than eleven-hundredths square inch (.11 sq. in.) of steel per foot of slab in a longitudinal direction and the same amount of steel



in a transverse direction. The bottom of such slab shall not be more than twelve inches (12") above the tops of at least 80 per cent of the piers or foundations. The footings and foundations shall be tied to the slab in such a manner as to be restrained in all horizontal directions.

**Lateral
Bracing
(Cont'd.)**

(d) **Plans and Design Data.** With each set of plans filed, a brief statement of the following items shall be included:

1. A summation of the dead and live load of the building, floor by floor, which was used in figuring the shears for which the building is designed.

2. A brief description of the bracing system used, the manner in which the designer expects such system to act, and a clear statement of any assumptions used. Assumption as to location of all points of counter-flexure in members must be stated.

3. Sample calculation of a typical bent or equivalent.

(e) **Stresses.** Stresses in materials shall not exceed by more than $33 \frac{1}{3}$ per cent the allowable working stresses permitted in this Code, except that rivets may be stressed the same in tension as is allowed in shear. The allowable shear in reinforced concrete walls, six inches (6") or more in thickness, shall not exceed five one-hundredths of the ultimate compressive strength of the concrete.

(f) **Detailed Requirements.** 1. **Bonding and Tying.** Cornices and ornamental details shall be bonded in the structure so as to form an integral part of it. This applies to the interior as well as to the exterior of the building.

2. **Overturning Moment.** In no case shall the calculated overturning moment of any building or structure due to the forces provided for in this Section exceed two-thirds of the moment of stability of such building or structure. Moment of stability shall be calculated using the same loads as used in calculating the overturning moment.

3. **Additions.** Every addition to an existing building or structure shall be designed and constructed to resist and withstand the forces provided for in this Section, and in any case where an existing building or structure is increased in height all portions thereof affected by such increased height shall be reconstructed to resist and withstand the forces provided for in this Section.

4. **Alterations.** No existing building or structure shall be altered or reconstructed in such a manner that the resistance to the forces provided for in this Section will be less than that before such alteration or reconstruction was made; provided, however, that this provision shall not apply to non-bearing partitions, and shall not apply to other minor alterations which are made in a manner satisfactory to the Building Department.

(g) **Lime Mortars.** Lime mortars shall not be used in any unit masonry construction forming a part of a building.

(h) **Veneer Ties.** Veneer ties provided in Section 2902(c) shall be of sufficient strength to support the full weight of the veneer in tension.

(i) **Intention or Interpretation of Lateral Force Provisions.** These lateral force requirements are intended to make buildings earthquake-resistive. The provisions of this Section apply to the buildings as a unit and also to all parts thereof, including the structural frame or walls, floor and roof systems, and other structural features.

The provisions incorporated in this Section are general and, in specific cases, may be interpreted or added to as to detail by rulings of the Building Official in order that the intent shall be fulfilled.

Refer to Section 2415.

Masonry of Unburned Clay Units

Sec. 2415. (a) **Soil.** The soil used shall contain not more than 45 per cent of material passing a No. 200 mesh sieve. The soil shall contain sufficient clay to bind the particles together when an asphalt stabilizer is used but shall not contain more than 0.2 per cent of water-soluble salts.

(b) **Stabilizer.** The stabilizing agent shall be emulsified asphalt, portland cement, or other approved material, and shall be uniformly mixed with the soil in amounts sufficient to provide the required resistance to absorption.

(c) **Sampling.** Each of the tests prescribed in this Section shall be applied to five sample brick selected at random from each 5,000 brick to be used.

(d) **Compressive Strength.** The brick shall have an average compressive strength of 300 pounds per square inch when tested in accordance with A.S.T.M. "Standard Methods of Sampling and Testing Brick," (C67-44). One sample out of five may have a compressive strength not less than 250 pounds per square inch.

(e) **Modulus of Rupture.** Bricks shall average 50 pounds per square inch in modulus of rupture, when tested by applying a centrally located concentrated load at a uniform rate by the use of two-inch (2") cylinders to a unit having a test span of four inches (4") less than its length.

(f) **Moisture Content.** The moisture content of the brick shall be not more than four per cent, by weight.

(g) **Absorption.** A dried four-inch (4") cube cut from a sample brick shall absorb not more than 2½ per cent moisture, by weight, when placed upon a constantly water-saturated porous surface for seven days.

(h) **Shrinkage Cracks.** No brick shall contain more than three shrinkage cracks and no shrinkage crack shall exceed three inches (3") in length or one-eighth inch (⅛") in width.

(i) **Mortar.** Mortar shall be portland cement mortar as specified in Section 2403, to which a stabilizer may be added in an approved amount.

(j) **Weathering.** A unit when exposed to water sprayed at 20 pounds pressure for two hours from a standard four-inch (4") shower head set seven inches (7") from its face shall not show an erosion of more than one-sixteenth inch (1/16") nor any appreciable pitting.

(k) **Footings.** Footing walls shall be of concrete, burned clay units, or solid concrete units, and shall extend not less than six inches (6") above the adjacent ground at all points.

**TABLE NO. 24-I—WORKING STRESSES IN MASONRY
OF UNBURNED CLAY UNITS**

(Pounds per Square Inch Gross Area)

TYPE OF MORTAR	COMPRESSION	TENSION IN FLEXURE	SHEAR
A, B, or C	30	4	4

(l) **Laying.** At the time of laying, units shall be free of foreign material. Joints shall be solidly filled with mortar. Bond shall be provided as required for masonry of hollow units in Section 2408 (b).

(m) **Limitations.** Masonry of unburned clay units shall not be used in any building more than one story in height.

No bearing wall of unburned clay units shall have a height of more than 10 times the thickness of such walls, and the thickness shall in no case be less than sixteen inches (16").

Fireplaces and chimneys of unburned clay units shall be lined with fire brick not less in thickness than four inches (4").

(n) **Allowable stresses.** The maximum allowable working stresses in masonry of unburned clay units shall not exceed the values set forth in Table No. 24-I except as provided in Chapter 23.

Refer to Sec. 2525. The following precautions are recommended for territories where foundation timber is subject to special hazard of decay and termite damage.

**Termite
Provisions**

1. Before any new building is erected all stumps and roots shall be removed from the soil to a depth of at least twelve inches (12") below the surface of the ground in the area to be occupied by the building.

2. The exterior walls of, and all wood posts supporting girders in wood frame buildings over four hundred square feet (400 sq. ft.) in area shall be placed on masonry or concrete foundation walls or piers.

3. All masonry for foundation purposes shall be laid in portland cement mortar. Portland cement mortar shall be composed of one part of cement and three parts of sand by volume with an allowable addition of lime putty or hydrated lime of not more than 15 per cent by volume of the cement content.

4. The top of every masonry or concrete foundation wall or pier which supports and is in contact with wood construction of any kind shall be not less than six inches (6") above the final grade level or finished surface of any ground adjacent thereto (except as provided in the case of slabs). Masonry or concrete foundation walls shall in all cases extend at least as high as the top of any adjacent concrete or masonry slab which is supported by either natural ground or an earth fill.

5. Floor joists shall have a clearance of not less than eighteen inches (18") between the bottom of the joists and the surface of the ground underneath. The ground underneath floor

Section 2525

UNIFORM BUILDING CODE

Termite
Provisions
(Cont'd.)

joists shall be leveled or smoothed off so as to maintain a reasonably even surface under the entire area covered by the floor joists.

6. All wood sills, including mudsills and sole plates, which are placed directly on the ground or on masonry or concrete foundations, shall be of the grade and kind of lumber specified in paragraph No. (9).

7. Wood sleepers or similar floor supports when placed directly on masonry or concrete which is in contact with the ground shall be of the grade and kind of lumber specified in paragraph No. (9).

8. All wood members used to support permanently a load of any kind, in buildings over four hundred square feet (400 sq. ft.) in area, shall be of the grade and kind of lumber specified in paragraph (9) when any part of such member is placed within eighteen inches (18") of any earth, either natural ground or earth fill.

9. Lumber permitted in the above locations shall be either an approved grade of cedar, cypress or redwood or any species of wood if treated under pressure with an approved preservative. Such treated lumber shall show a penetration of an approved preservative of not less than one-quarter inch ($\frac{1}{4}$ ") at any point.

Redwood where used in such locations shall be of Foundation Grade as defined in the Standard Grading and Dressing Rules of the California Redwood Association (1940).

10. Wood posts or columns shall not extend through or be placed directly on concrete floors. They shall be supported on concrete footings extending at least two inches (2") above the finished floor or may be placed on a corrosion-resisting metal plate at least one-sixteenth inch ($\frac{1}{16}$ ") thick and not smaller than the base of the post or column. Such plate may be flush with the concrete floor.

11. Where timbers extend into a masonry wall at a point below the level of the ground outside of the wall, metal wall boxes shall be provided or the end and all surfaces of the timber within one foot (1') of the end shall be painted with at least two coats of hot coal tar creosote or other approved wood preservative.

12. Openings through foundation walls or exterior walls shall be provided for cross ventilation of the space below the first floor in every building in which the first floor is of wood frame construction, and shall have a total area as required in Section 2527.

13. All wood forms which have been used in placing concrete, if within the ground or less than eighteen inches (18") above the ground, shall be removed before a building is occupied or used for any purpose.

14. Loose or casual wood shall not be stored in direct contact with the ground under any building.

1946 EDITION

Sections 4801-4903

Refer to Chapter 48. The following provisions are recommended for inclusion in the Code where provisions covering the handling and storage of photographic and X-ray nitrocellulose films are desired:

Photographic and X-ray Films

Sec. 4801. The provisions of this Chapter do not apply to:

Classes of Film Excepted

1. Film for amateur photographic use in original packages of "roll" and "film pack" films in quantities of less than fifty cubic feet (50 cu. ft.).

2. Safety film (cellulose acetate base).

3. Dental X-ray film.

4. Establishments manufacturing photographic films and storage incidental thereto.

5. Films stored or being used in standard motion picture booths (see Chapter 40).

Safety photographic and X-ray film (cellulose acetate base) may be identified by the marking on the edge of the film. This marking shows plainly before and after developing. Where film is not so marked it shall be inspected to determine whether it is of the safety acetate or nitrate type.

Sec. 4802. All regulations for the storage and handling of photographic and X-ray nitrocellulose films shall conform to the regulations of the N.B.F.U. "Storage and Handling of Photographic and X-ray Nitrocellulose Films," 1930.

General Regulations

Exceptions: Where definite fire-resistive materials are specified, materials of equal fire resistance as specified in this Code may be used.

Sec. 4803. The storage and handling of nitrocellulose motion picture film shall conform to the N.B.F.U. "Regulations for Nitrocellulose Motion Picture Film," 1939.

Motion Picture Film

Refer to Chapter 49: Where it is desired to regulate the installation or alteration of refrigeration systems, the following provisions are recommended for inclusion in the Code:

Sec. 4901. It shall be unlawful for any person, firm or corporation to install or alter or cause to be installed or altered, any system of refrigeration, unless such system is an approved type and is installed in accordance with the provisions of the "Safety Code for Mechanical Refrigeration," as published by the American Society of Refrigerating Engineers, April, 1939, which is hereby declared a part of this Chapter.

General

Sec. 4902. "Approved." When this term is used to apply to systems, appliances and materials in this Chapter, it shall mean that such systems, appliances or materials have either been listed as standard by the Underwriters' Laboratories, Incorporated, or have been approved by the Building Official.

Definitions

Sec. 4903. Regulations of this Chapter shall apply to all refrigeration systems hereafter installed and to alterations of and additions to such existing systems.

Scope

CHAPTER 51—HEATING APPLIANCES

Construction and Performance Requirements

Sec. 5101. (a) General. Warm air heating appliances used for house heating shall conform to the following nationally recognized standards, or shall have the approval of the Building Official.

(b) **Solid Fuel Furnaces.** Solid-fuel-burning warm air furnaces designed to circulate air mechanically shall conform to United States Bureau of Standards Commercial Standard CS109-44, "Solid-Fuel-Burning Forced Air Furnaces."

(c) **Oil-Burning Equipment.** Oil-burning apparatus using commercial fuel oil, furnace oil, diesel oil, or other flammable liquids shall be constructed and installed in compliance with the regulations of the N.B.F.U. "Installation of Oil-Burning Equipments," 1941.

Oil-burning floor furnaces equipped with vaporizing pot-type burners shall comply with United States Bureau of Standards Commercial Standard CS113-44, "Oil-Burning Floor Furnaces Equipped with Vaporizing Pot-Type Burners."

Liquid-fuel-burning warm air furnaces designed to operate with mechanical draft shall also conform to United States Bureau of Standards Commercial Standard CS75-42, "Automatic Mechanical-Draft Oil Burners Designed for Domestic Installations."

(d) **Label on Oil-Burning Appliances.** Every oil burner and every oil-burning furnace, heater, and boiler regulated by this Code shall bear a permanent name plate on which shall appear in permanent form:

1. The manufacturer's or distributor's name.
2. The manufacturer's hourly B.t.u. output rating of the burner or appliance.
3. The manufacturer's or distributor's number of the appliance.
4. Instructions for the lighting, operation, care, and shut-down of the burner or appliance.
5. Grade of fuel oil approved for use in such burner or appliance. (Commercial Standard Grade Number.)
6. Seal of approval of such burner or appliance by a recognized testing laboratory.

(e) **Gas-Burning Furnaces and Equipment.** Central warm air furnaces designed to burn gaseous fuels shall conform to A.S.A. "Approval Requirements for Central Heating Gas Appliances," (Z21.13-1943). Gas-fired unit heaters shall conform to A.S.A. "Approval Requirements for Gas Unit Heaters," (Z21.16-1940). Gas-fired duct furnaces shall comply with A.S.A. "Approval Requirements for Gas-Fired Duct Furnaces," (Z21.34-1942). Gas floor furnaces shall comply with United States Bureau of Standards Commercial Standard CS99-42, "Gas Floor Furnaces—Gravity Circulating Type."

Permanently installed recessed gas wall heaters shall comply with A.S.A. "Approval Requirements for Gas Space Heaters," (Z21.11-1942).

Air Supply

Sec. 5102. (a) Air Supply for Combustion. An air supply for combustion shall be provided for every gas burning warm

air furnace. Such supply shall be from outside the building into the furnace space through one or more openings. The openings shall have a total area of not less than two hundred square inches (200 sq. in.) plus one hundred square inches (100 sq. in.) for each blower-type warm air furnace installed in such room plus two hundred square inches (200 sq. in.) for each gravity-type warm air furnace installed in such room, and in no case shall have a net area of less than one square inch (1 sq. in.) for each 1,000 B.t.u. input rating of all fuel-burning appliances in such room.

No obstruction of any kind shall be placed over the openings except wire netting with openings not less than one-fourth inch ($\frac{1}{4}$ ") square.

(b) **Circulating Air Supply.** Circulating air used for conveying heat and for ventilation may be taken from outside the building, from inside the building, or from both sources. Where such air is taken from inside the building or from both inside and outside the building, it shall be conducted to the furnace in ducts of incombustible material.

No damper shall be placed in any air intake, except that a diverting damper may be placed in a combination fresh-air intake and return air intake so arranged that for all possible positions of the damper the cross-sectional area of the circulating air intake to the furnace is not less than the total cross-sectional area of all hot air outlets.

No circulating air supply inlet for any forced air heating system shall be located closer than ten feet (10') from any fire box or vent opening of any warm air furnace, nor shall such circulating air supply inlet be located where it will pick up any objectionable odors, fumes, or flammable vapors.

Sec. 5103. Every warm air furnace burning gas or liquid fuel shall be equipped with an automatic control or controls. Such controls shall be arranged to shut off the main fuel supply in the event that the temperature in the warm air pipe exceeds 250 degrees Fahrenheit, within twenty-four inches (24") of the point where the hot air pipe connects to the furnace.

Where a gravity warm air heating system is installed with at least one warm air outlet having an area not less than thirty-five square inches (35 sq. in.) and permanently open and unobstructed, except by an open-faced grill, the automatic control will not be required. Such warm air outlet shall not be subject to control by any manually operated shutter, louver, or damper.

Sec. 5104. (a) Access. Every appliance shall be accessible for inspection, repair, or replacement, and sufficient room shall be available to enable the operator to observe the firebox, burner, and pilot while starting the appliance.

An opening or door not less in size than two feet six inches by six feet three inches (2'6" x 6'3") shall be provided for access to the room or space in which any furnace except a floor or attic furnace is installed.

(b) **Furnace Room.** Every warm air furnace shall be installed in a room or space not less than six feet (6') in width and not less than forty-eight square feet (48 sq. ft.) in area with a ceiling height of not less than seven feet (7'), unless

Automatic Controls

Location of Appliances

the warm air furnace is designed and approved for installation adjacent to combustible materials and is installed in accordance with the conditions of approval.

Gas-Burning Warm Air Furnaces— Clearances

Sec. 5105. (a) Floor Protection under Gas-Burning Appliances. Every floor of combustible construction under a gas-burning warm air furnace shall be covered with one-fourth inch ($\frac{1}{4}$ ") of asbestos millboard, or other equivalent fire protective material. The floor protection shall project at least twelve inches (12") beyond all sides of the furnace or to the furnace enclosure. The floor covering may be omitted on a wood floor under any gas-burning warm air furnace, if the combustion chamber is not less than twenty-four inches (24") distant from the floor and is separated therefrom by a metal plate or shield.

(b) Clearances from Combustible Materials. The top of every warm air gas furnace shall be not less than nine inches (9") from protected combustible material, nor less than eighteen inches (18") from unprotected combustible material. The side walls of such furnace shall be not less than twelve inches (12") from unprotected combustible material, nor less than six inches (6") from protected combustible material. The clearances may be reduced for appliances which are designed and approved for installation adjacent to combustible materials and installed in accordance with the conditions of such approval.

Venting Gas Furnaces

Sec. 5106. Every warm air furnace designed to burn gas for fuel shall be vented into a gas vent as provided for in Section 3708, or into a terra cotta chimney as specified in Section 3704.

When a chimney with a cross-sectional area over 50 per cent larger than the cross-sectional area of the vent connections to the chimney, is used as a vent, the chimney shall contain a gas vent as specified in Section 3708 or a terra cotta chimney as specified in Section 3704, and such vent or terra cotta chimney shall be used to vent the gas appliance.

No damper shall be installed in any vent, vent connection, or terra cotta chimney to which a gas appliance is vented.

Every unused vent opening shall be securely closed or capped.

Solid-Fuel- Burning Warm Air Furnaces

Sec. 5107. (a) Furnace Clearances. The clear distance between a warm air furnace burning solid fuel, and combustible material, including plaster on combustible base, shall not be less than four feet (4') at the top or front, and not less than three feet (3') at the sides and rear; provided, that when the appliance is encased in brick or has an incombustible protective covering not less than one and one-half inches ($1\frac{1}{2}$ ") thick, such distance may be three feet (3') at the top and two feet (2') at the sides and rear.

(b) Smoke Pipe Installation. The smoke pipe of warm air furnaces designed to burn solid fuel shall be at least eighteen inches (18") from any combustible material, or such combustible material shall be protected by a covering of No. 24 U. S. Gauge galvanized iron, furred with metal furring not less than one and one-half inches ($1\frac{1}{2}$ ") from such combustible construction, or shall be entirely covered with one-hour fire-resistive construction.

(c) **Chimney.** Every such furnace shall be connected to a chimney as specified in Section 3702.

The smoke pipe of a heating appliance shall not be connected into the flue of an incinerator which has the rubbish chute identical with the smoke flue.

All unused openings in any chimney, except fireplace openings, shall be closed or capped with non-combustible material.

Sec. 5108. Stoves, furnaces, and other heating or power apparatus in which oil burners are installed, unless specifically regulated by one or more of the national standards listed in Section 5101, shall be constructed and installed as required for similar apparatus using solid fuel.

Oil-Burning Equipment

Sec. 5109. (a) Location. No floor furnace shall be installed in the floor of any aisle or passageway of any room used as a place of public assembly or in any egress from such room.

Floor Furnaces and Attic Furnaces

No floor furnace shall be installed where it will extend below the floor into any garage, finished room, or space used for storage of flammable materials or wastes, unless portions of the furnace extending below the floor are entirely encased within a metal enclosure constructed of No. 20 U. S. Gauge iron or steel. The enclosure shall be connected with the outside air through metal ducts of sufficient capacity properly to support combustion in such furnace within the enclosure. The metal enclosure shall be made or installed so as to make the furnace accessible for inspection or repair.

(b) **Accessibility.** The space in which any floor furnace or attic furnace is installed shall be accessible by an opening or trapdoor not less than eighteen by twenty-four inches (18" x 24") in any cross section thereof, and a passageway not less than twenty-four by twenty-four inches (24" x 24") in any cross section thereof. The passageway shall be continuous from the opening or trapdoor to the furnace controls and valves, and the opening to the passageway shall be located not more than twenty feet (20') from the furnace.

(c) **Protection from Flooding.** Every portion of the ground within twenty-four inches (24") horizontally from any floor furnace which projects below the first floor of any building shall be excavated to a level not less than six inches (6") below the lowest portion of the furnace. Any excavation which is lined with galvanized iron of not less than No. 24 U. S. Gauge with an exterior coating of red lead or tar or lined with not less than three inches (3") of concrete shall not be required to extend more than twelve inches (12") in a horizontal direction from any gas control valve on the floor furnace and not more than six inches (6") from any other portion of the heater. The metal lining shall be securely held in place by a structural steel angle riveted, bolted, or welded to each corner of the lining and bolted or spiked to the adjoining framework of the building.

Sec. 5110. (a) Length and Slope. For gravity systems no leader heat pipes shall be over twenty feet (20') in length measured horizontally, except where a booster fan is installed, when the length shall not exceed forty feet (40'). All heat pipes under first floor joists shall have a uniform rise of at least one inch (1") per lineal foot of horizontal run.

Warm Air Ducts and Appurtenances

Section 5110

UNIFORM BUILDING CODE

**Warm Air
Ducts and
Appurtenance
(Cont'd.)**

(b) **Size.** Warm air pipes and appurtenances serving first floor rooms shall have a minimum cross-sectional area in square inches of not less than the cubic foot capacity of the room or rooms in which registers are located, divided by 40; provided, that no leader pipe shall have a net area of less than fifty square inches (50 sq. in.). Risers and appurtenances serving floors above the first floor shall have a net area of not less than two-thirds that required to serve the first floor.

(c) **Material for Ducts.** Ducts shall be of incombustible material equivalent in structural strength and durability to galvanized sheet iron or steel of the thickness set forth in Table No. 51-A. Wired glass may be used for inspection windows in ducts.

**TABLE NO. 51-A—THICKNESS OF METAL FOR
AIR DUCTS**

ROUND DUCTS DIAMETER (IN INCHES)	RECTANGULAR DUCTS MAXIMUM SIDE (IN INCHES)	MINIMUM THICKNESS U.S. GAUGE
Up to 18	Up to 12	26
19 to 30	13 to 30	24
31 to 45	31 to 60	22
46 to 60	61 to 90	20
61 and above	91 and above	18

(d) **Ducts Formed by Part of the Building Structure.** Ducts may be of independent construction or may be formed by parts of the building structure if they conform to the requirements of this Section. Duct walls may be of lath and plaster as approved for one-hour fire-resistive construction.

(e) **Registers.** Registers shall be located in or near the wall of the room nearest the furnace. No register shall be located in outside walls unless the weather side is covered with air-cell asbestos paper.

Where double registers are supplied by one leader pipe, each register shall have a capacity of not less than two-thirds the area of the leader pipe.

(f) **Construction and Installation.** Ninety-degree bends in round pipe shall be made by not less than four piece elbows. Sixty-degree bends shall be made by means of not less than three piece elbows.

All warm air pipes and fittings, cold air or recirculating pipes, ducts, boxes, and fittings shall be made of bright tin or galvanized iron. All such appurtenances, except leader heat pipes under the first floor, shall be covered with two thicknesses of asbestos paper weighing at least eight pounds to one hundred square feet (100 sq. ft.) or with air-cell asbestos insulation, or shall be double walled with a one-fourth-inch ($\frac{1}{4}$ ") space between the inner and outer walls. Horizontal warm air pipes shall be kept at least three inches (3") from any combustible material or shall be protected with an asbestos shield and a one-inch (1") air space. Air-cell asbestos paper not less than one-fourth inch ($\frac{1}{4}$ ") in thickness shall be securely cemented around all leader pipes.

(g) **Support.** All riser pipes shall be held in place by means of metal strips securely fastened to the pipe and shall in no case be held in place by nailing diagonally through the corners of such pipe. No joint shall depend wholly upon solder to make it tight. All leader pipes shall be securely fastened in place by means of wires or metal strips.

(h) **Branch or Y-Runs.** In the installation of Y-runs or branch runs, the cross-sectional area of the warm air pipe at the furnace shall equal in square inches the cubic contents of all the rooms served by such warm air pipe divided by 40. Sizes of branch runs shall be determined in the same manner on the basis of the room or rooms served. Branches from trunk lines shall be taken off in a generally horizontal plane at an angle not more than 45 degrees from the line of the pipe. Fifteen-degree Y-branches may be permitted in forced draft systems. Riser pipes shall not be taken off the top of the first floor register boxes.

(i) **Clearance between Joists or Studs.** Where warm air pipes and appurtenances are to be installed in a building, the joists and studs shall be so arranged as to provide not less than fourteen inches (14") clear space in continuous horizontal runs and vertical risers from the furnace to the register served.

(j) **Air Filters.** Air filters shall be of a type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when attacked by flames. Liquid adhesive coatings used on filters shall have a flash point of 350 degrees Fahrenheit, Cleveland open cup tester, or higher.

Sec. 5111. (a) Protection of Combustible Material: Combustible partitions or walls within six inches (6") of any ordinary domestic water heater and within three inches (3") of any approved domestic automatic storage water heater shall be protected by one-fourth inch ($\frac{1}{4}$ ") of asbestos, covered with a No. 26 gauge metal covering, or shall have not less than one-hour fire-resistive protection.

Domestic Water Heaters

(b) **Location.** No water heater shall be installed in any room used or designed to be used as a bathroom or closet or for sleeping purposes. Any compartment less than twenty-five square feet (25 sq. ft.) in area in which a water heater is to be installed shall have at least one side open and unobstructed.

(c) **Venting.** All gas-fired water heaters shall be connected to a gas vent as provided for in Section 3708.

Sec. 5112. (a) Protection of Combustible Materials. Ranges used for commercial cooking, such as in school cafeterias, hotels, restaurants, churches, and other establishments doing large-volume cooking, shall be supported at least six inches (6") above any wood floor and if less than twelve inches (12") above the floor the wood shall be protected by a metal shield. Such ranges shall be separated from wood partitions or other combustible material by not less than six inches (6"), and if nearer than twelve inches (12") the combustible material shall be protected with a metal or asbestos shield. The distance

Ranges for Commercial Cooking

Section 5112

UNIFORM BUILDING CODE

**Ranges for
Commercial
Cooking
(Cont'd.)**

from any such range to a wood ceiling or other combustible material above shall not be less than twelve inches (12"), and if less than three feet (3') the ceiling or combustible material above shall be protected with a double metal shield with one inch (1") air space between or with lath and plaster as approved for one-hour fire-resistive construction.

(b) **Hoods.** Ranges used for commercial cooking shall be provided with a ventilating hood and duct to take off smoke, gases, and vapors. The ducts shall be separate from any other ventilating system, provided, however, that a single flue may serve one or more hoods.

Hoods provided for commercial ranges shall be constructed of metal or masonry and if of metal shall be not less than No. 22 gauge thickness galvanized iron, or other equivalent corrosion resistant material.

Every ventilating hood shall be provided with a grease trough extending around the entire inside perimeter of the hood draining to a grease container outside the hood.

(c) **Ventilating Ducts.** Flues or ducts for any ventilating hood shall be constructed of metal or masonry, and if of metal shall have not less than the thickness set forth in Table No. 51-B.

TABLE NO. 51-B—DUCT THICKNESS

MAXIMUM WIDTH OR DIAMETER OF DUCT (in inches)	MINIMUM THICKNESS OF METAL (U. S. Standard Gauge)
12	24
20	22
30	20
48	18
over 48	16

The face of any square or rectangular metal duct which is more than thirty-six inches (36") in its greatest width shall have a standing seam at every lateral joint and at intervals not exceeding four feet (4').

Every duct shall be so constructed that grease or other material cannot become pocketed in any portion thereof.

A sufficient number of cleanout openings shall be provided in every duct to permit cleaning all portions of the interior of such duct system. All such openings shall be provided with tight-fitting metal doors.

All seams in any hood or duct shall be grease tight. Solder shall not be used for the purpose of making joints or seams grease tight.

Every hood and duct shall be securely attached to the building by means of non-flammable supports.

(d) **Insulation.** All combustible materials within eighteen inches (18") of any metal hood or duct shall be covered with a one-fourth-inch ($\frac{1}{4}$ ") thickness of asbestos covered with sheet metal or other equivalent insulation.

All combustible materials within nine inches (9") of any metal hood or duct shall be covered with lath and plaster as approved for one-hour fire-resistive construction or other equivalent insulation.

Every hood or duct shall be at least four inches (4") from any combustible material.

Sec. 5113. (a) Protection of Combustible Materials. All stoves used for heating, cooking, or laundry purposes using solid or liquid fuel shall have all combustible partitions in back of and extending not less than twelve inches (12") beyond each side of such stove protected by not less than one-hour fire-resistive construction. Such stoves shall be securely supported at least twelve inches (12") above any wood floors by metal supports and there shall be a metal and asbestos pad at least three-eighths inch ($\frac{3}{8}$ ") thick below such stove extending at least six inches (6") beyond each side and at least twelve inches (12") in front of such stove. Such stoves shall not be placed nearer than six inches (6") to any combustible partition.

**Stoves Using
Solid or
Liquid Fuel**

Stoves and ranges using solid or liquid fuel shall be separated from unprotected combustible material by not less than three feet (3'); shall be separated from wood lath and plaster by not less than eighteen inches (18"); and shall be separated from incombustible lath and plaster on wood studs by not less than twelve inches (12"). Such separations may be reduced 50 per cent if a sheet-metal shield is used, set out at least one inch (1") from the partition and extending three feet (3') above the top and one foot (1') below the sides of the stove or range.

(b) Smoke Pipe Connection. All such stoves shall be connected by a smoke pipe conforming to the requirements of Section 3706 or to a chimney meeting the requirements of Section 3702.

Sec. 5114. (a) Protection of Combustible Material. Steam heating plants, for not more than 15 pounds pressure and water heaters using solid or liquid fuel, shall rest upon masonry or concrete floors and shall be protected on the outside by asbestos. The clearance of wooden partitions, ceilings, and other combustible materials shall be the same as given for warm air furnaces.

**Low Pressure
Steam Heating
Plants**

(b) Air Supply for Combustion. An air supply for combustion shall be supplied for all low pressure steam heating plants. The air supply shall be from outside the building into the space in which the boiler is installed through two or more openings. The openings shall have a net area of not less than two hundred square inches (200 sq. in.) plus not less than one hundred square inches (100 sq. in.) for each 100,000 B.t.u. or fraction thereof in excess of 100,000 B.t.u. of the approved fuel input rating for such boiler.

Sec. 5115. (a) Protection of Combustible Material. Large boilers for power or steam purposes or for generating high pressure steam shall be so located that no wood or other combustible material shall be less than five feet (5') from the top or sides or ten feet (10') from the front of such apparatus

Large Boilers

Section 5115**UNIFORM BUILDING CODE****Large Boilers
(Cont'd.)**

and all combustible material less than ten feet (10') from the top or sides or less than twenty feet (20') from the front shall be protected with at least four inches (4") of concrete, brick, or other similar incombustible material. No boiler shall be so located as to cause the temperature of any adjoining combustible portion of any building to exceed 120 degrees Fahrenheit above the ambient temperature at any time such boiler is in operation at its approved B.t.u. ratings. Steel, cast iron or concrete columns adjacent to such boilers shall not be in direct contact with furnace settings but there shall be an open and unobstructed space at least four inches (4") wide for ventilation.

(b) **Air Supply for Combustion.** An air supply for combustion shall be supplied for all large boilers. Such air supply shall meet the requirements specified in Section 5114 for air supply for low pressure boilers.

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