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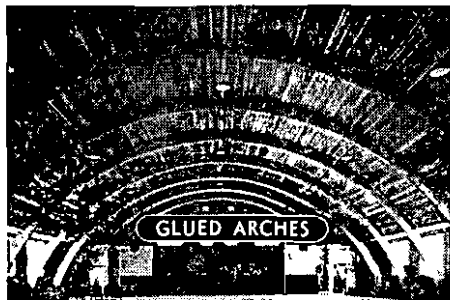
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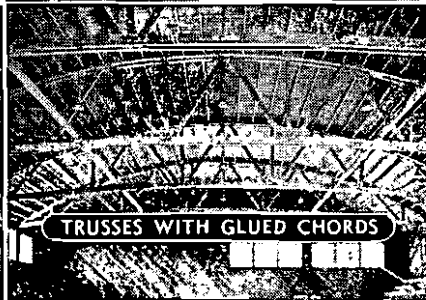
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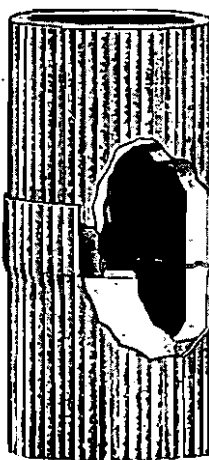
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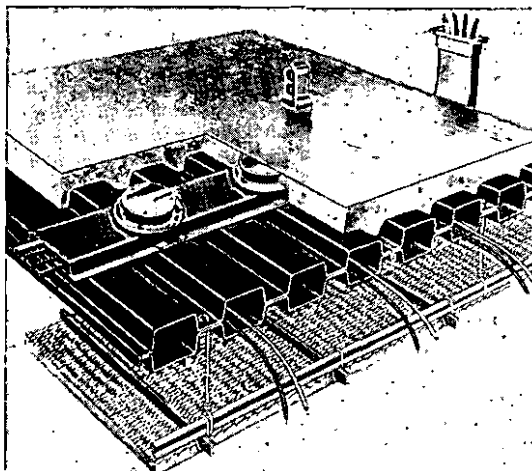
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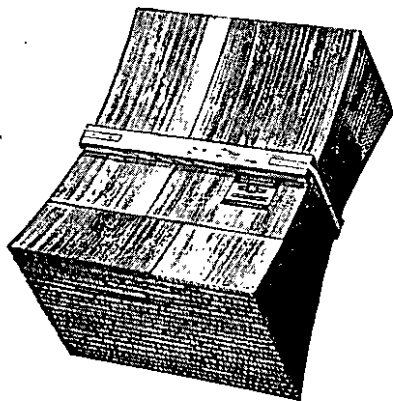
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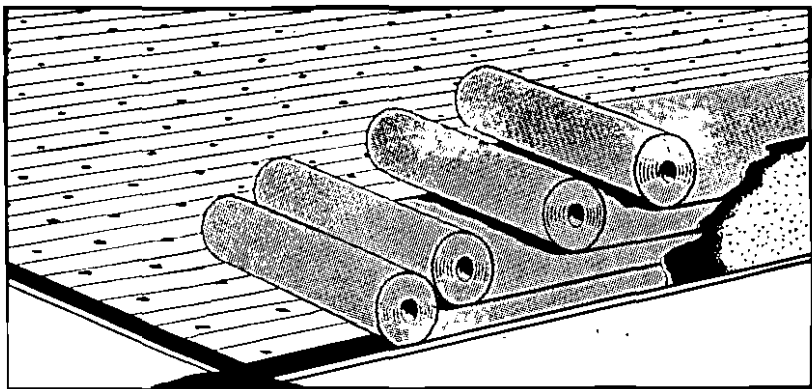
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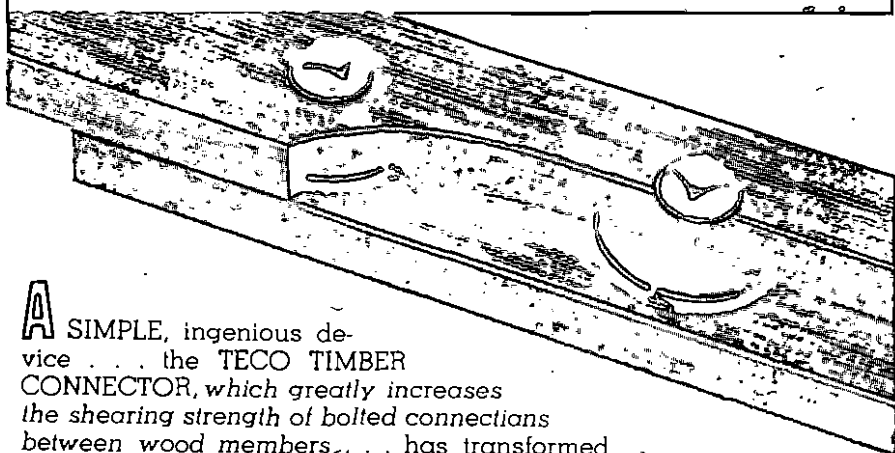
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Preface

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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 in this Ordinance as "this Code." **Title**

Wherever a section, chapter, or part is referred to in this Code by number it shall be understood to refer to a section, chapter or part of this Code.

Sec. 102. The purpose of this Code is to provide certain minimum standards, provisions and requirements for safe and stable design, methods of construction and uses of materials in buildings and structures hereafter erected, constructed, enlarged, altered, repaired, moved, converted to other uses or demolished and to regulate the equipment, maintenance, use and occupancy of all buildings and structures. **Purpose**

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

Sec. 103. New buildings and structures hereafter erected in the City and buildings and structures moved into the City shall conform to all requirements of this Code; and all requirements in this Code, unless otherwise specifically provided, shall apply to all such buildings and structures. **Scope**

Additions, alterations, repairs and changes of use or occupancy in all buildings and structures shall comply with the requirements for new buildings and structures except as otherwise provided in Section 104 of this Code. (See Chapter 16).

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

Sec. 104. The following specified requirements shall apply to existing buildings which for any reason whatsoever do not conform to the requirements of this Code for new buildings: **Application to Existing Buildings**

(a) **Major Alterations and Repairs.** Except as provided in Section 1602 when alterations and repairs in excess of 50 per cent of the value of an existing building are made to such building within any period of 12 months, the entire building shall be made to conform with the requirements given herein for new buildings. Any existing building which for any reason whatsoever, requires repairs, at any one time, in excess of 50 per cent of the value thereof, not deducting from such value any loss caused by fire or any other reason, shall be made to conform to the requirements of this Code or shall be demolished.

(b) **Changed Use.** If the existing use or occupancy of an existing building is changed to a use or occupancy which would not be permitted in a similar building hereafter erected, the entire building shall be made to conform with the requirements given herein for new buildings; provided, however, that if the use or occupancy of only a portion or portions of an existing building is changed and such portion or portions are segregated as specified in Section 503 of this Code then only such portion or

Sections 104-105

portions of the building need to be made to comply with said requirements; and provided, further, that the Building Inspector is hereby given authority to approve any change in the use or occupancy of any existing building within any one Group of Occupancy as specified in Part III, even though such building is not made to fully conform to the requirements of this Code, when it is obvious that such a change in the use or occupancy of the existing building will not extend or increase any existing non-conformity or hazard of the building.

(c) **Additions.** Any existing building not covered by the preceding paragraphs (a) and (b) which has its floor area or its number of stories increased or its use or occupancy changed in any way from its former or existing use or occupancy shall be provided with stairways, emergency exits and fire protection facilities as required in this Code for buildings hereafter erected for similar uses or occupancies.

(d) **Structural Alterations and Repairs.** Where any alteration or repair is made to the structural portion of any building or structure, the structural portion or any part thereof shall be made to conform to the requirements of this code for new buildings where deemed necessary by the Building Inspector.

(e) **Non-Structural Alterations and Repairs.** Minor non-structural alterations, repairs and changes may be made with the same materials of which the building is constructed; provided, that not more than 25 per cent of the roof covering of any building shall be replaced in any period of 12 months unless the new roof covering is made to conform to the requirements of this Code for new buildings.

Maintenance

Sec. 105. The requirements contained in this Code, covering the maintenance of buildings, shall apply to all buildings and structures now existing or hereafter erected. All buildings and structures and all parts thereof shall be maintained in a safe condition, and all devices or safeguards which are required by this Code at the erection, alteration or repair of any building shall be maintained in good working order.

This Section shall not be construed as permitting the removal or non-maintenance of any existing devices or safeguards unless authorized in writing by the Building Inspector.

The Chief of the Fire Department shall inspect periodically the storage of volatile or flammable liquids, exits, fire-prevention and fire-extinguishing apparatus and facilities in all buildings or structures, and shall report in writing to the Building Inspector any violations of the provisions of this Code applicable to any building or structure inspected.

CHAPTER 2 — GENERAL PROVISIONS

Sec. 201. No person shall erect or construct or proceed with the erection or construction of any building or structure, nor add to, enlarge, alter, repair, move, convert, extend or demolish any building or structure, or cause the same to be done, without first obtaining a building permit therefor from the Building Inspector. **Application for Permit**

Any person desiring a building permit as required by this Code shall file with the Building Inspector an application therefor in writing on a blank form to be furnished for that purpose.

Every such application for a permit shall describe the land upon which the proposed building or work is to be done, either by lot, block and tract, or similar description that will readily identify and definitely locate the proposed building or work.

Every such application shall show the use or occupancy of all parts of the building and such other reasonable information as may be required by the Building Inspector.

Copies of plans and specifications and a lot plan showing the location of the proposed building and of every existing building on the property, shall accompany every application for a permit, and shall be filed in duplicate with the Building Inspector; provided, however, that the Building Inspector may authorize the issuance of a permit without plans or specifications for small or unimportant work.

Plans shall be drawn to scale upon substantial paper or cloth and the essential parts shall be drawn to a scale of not less than one-eighth inch ($\frac{1}{8}$ ") to one foot (1').

Plans and specifications shall be of sufficient clarity to indicate the nature and character of the work proposed and to show that the law will be complied with. Computations, strain sheets, stress diagrams and other data necessary to show the correctness of the plans, shall accompany the plans and specifications when required by the Building Inspector.

Any specifications in which general expressions are used to the effect that "work shall be done in accordance with the Building Code" or "to the satisfaction of the Building Inspector" shall be deemed imperfect and incomplete and every reference to this Code shall be to the section or subsection applicable to the material to be used or to the method of construction proposed.

All plans shall bear the name of the Architect, Structural Engineer or person responsible therefor.

Sec. 202. (a) Issuance. The application, plans and specifications filed by an applicant for a permit shall be checked by the Building Inspector. Such plans may be reviewed by the Chief of the Fire Department with respect to the storage of volatile and flammable liquids as specified in Part III, and the installation of fire-prevention and fire-extinguishing apparatus and facilities as provided in this Code. When such plans and **Building Permits**

Sections 202-203

Building Permits (Cont'd.)

specifications are found to be in conformity with the requirements of this Code and all other laws or ordinances applicable thereto, the Building Inspector shall issue a permit for the specified construction upon receipt of the required permit fee.

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

One such approved set of plans and specifications shall be retained by the Building Inspector as a public record, 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 and shall be open to inspection by public officials. Such approved plans and specifications shall not be changed, modified or altered without authorization from the Building Inspector, and all work shall be done in accordance with the approved plans.

(b) **Validity.** The issuance or granting of a permit or approval of plans and specifications shall not be deemed or 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 upon plans and specifications shall not prevent the Building Inspector 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.

(c) **Expiration.** Every permit issued by the Building Inspector 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, 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.

Fees

Sec. 203. Any person desiring a building permit shall, at the time of filing an application therefor, as provided in Sec. 201 of this Code, pay to the Building Inspector a fee as required in this Section.

For a total valuation of \$50.00 or less no fee.

For a total valuation from \$50.00 to \$1,001 a \$2.00 fee; and an additional fee of \$2.00 for each additional \$1000 or fraction thereof of total valuation to and including \$15,000; and an additional fee of \$1.00 for each additional \$1000 or fraction thereof of total valuation to and including \$50,000; and an additional fee of 50c for each additional \$1000 or fraction thereof of total valuation exceeding \$50,000.

The city, county, state, or the United States of America shall be exempt from the paying of any fee for any building.

Sections 203-204

The Building Inspector shall determine the estimated valuation in all cases, and for such purpose he shall be guided by approved estimating practices.

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.

The Building Inspector 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.

Sec. 204. (a) Inspections Required. The Building Inspector shall inspect or cause to be inspected at various intervals during the erection, construction, enlarging, alteration, repairing, moving, demolition, conversion, occupancy and underpinning all buildings or structures referred to in this Code and located in the City, and a final inspection shall be made of every building or structure hereafter erected prior to the issuance of the Certificate of Occupancy as required in Section 206.

**Inspection
and
Registered
Inspectors**

No building construction, alteration, repair or demolition requiring a building permit shall be commenced until the permit holder or his agent shall have posted the building permit card in a conspicuous place on the front premises and in such position as to permit the Building Inspector to conveniently make the required entries thereon respecting inspection of the work. This permit card shall be maintained in such position by the permit holder until the Certificate of Occupancy has been issued by the Building Inspector.

The Building Inspector 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.

Foundation Inspection: To be made after trenches are excavated and the necessary 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.

Frame Inspection: To be made after the roof, all framing, fire-blocking and bracing is in place and all pipes, chimneys and vents are complete.

Exterior Plastering Inspection: To be made after all lathing and backing is in place and all plastering materials are delivered on the job, but before any exterior plaster is applied.

Final Inspection: To be made after building is completed and is ready for occupancy.

No work shall be done on any part of the building and structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Building Inspector. 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 above four inspections.

Section 204

No reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatsoever without first obtaining the approval of the Building Inspector.

In all buildings where plaster is used for fire protection purposes the permit holder or his agent shall notify the Building Inspector after all lathing and backing is in place and all plastering materials are delivered on the job and no plaster shall be applied until the approval of the Building Inspector has been received.

Registered Inspectors

(b) **Registered Inspector Required.** In addition to the inspections to be made by the Building Inspector as specified in this Section, the owner or his agent shall employ a registered inspector for full-time inspection on the following types of work:

1. **Reinforced Concrete.** On reinforced 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.

The "registered inspector" shall be approved by, registered with, deputized by and assigned to a particular building or structure by the Building Inspector. Such "registered inspector" shall be thoroughly qualified by knowledge and experience in the design and construction of the structure to which he is assigned and he shall be thoroughly familiar with the requirements of this Code applying to that building or structure and with their practical application. The Building Inspector may authorize one such "registered inspector" to supervise the simultaneous construction of a limited number of buildings or structures, provided that his service shall extend over all the important details of framing, erection and assembly and that he is able to render full engineering inspection service on each building or structure under his supervision and control.

Before commencing his duties the "registered inspector" shall obtain a certificate of registration from the Building Inspector for which he shall pay the sum of \$1.00. The "registered inspector" shall remain constantly upon the work during the process of construction, and his duties shall terminate only when a Certificate of Compliance is issued by the Building Inspector in approval and acceptance of the work on which he may be engaged as required in Section 205.

Each such "registered inspector" shall carefully inspect all materials entering into the construction of the structure and be responsible for obtaining full information regarding the strength of materials where new or untried materials are intended for any use involving structural safety. He shall report in writing, upon the special forms furnished by the building department, the true details regarding the progress of the work, the condition of same, deviation, defects, delays, general character of materials, working situations, weather conditions and all and any influencing factors that affect, in any manner, the structural safety and strength of the building. He shall be held directly responsible for the enforcement of this Code wherever same is applicable to the structure upon which he is

Sections 204-207

engaged. He shall notify the Building Inspector of any attempt to cover, conceal, patch or repair any defect in materials, or workmanship before such materials have been examined by the Building Inspector or his duly authorized representative. He shall be held directly responsible for the infraction of any ruling of the Building Inspector and shall have the authority to compel the removal of defective materials or to suspend or stop work pending the rulings of the Building Inspector. He shall not be engaged in any other labor on the project upon which he is employed.

Sec. 205. The duties of the "registered inspector" shall terminate only when a Certificate of Compliance has been issued by the Building Inspector. Such Certificate of Compliance shall bear a statement signed by the "registered inspector" stating that the work upon the building or structure to which he has been assigned has been completed in a satisfactory manner and that the regulations of this Code affecting the structural features of such building or structure have been fully complied with. If there have been any infractions of this ordinance they shall be noted in this statement. The Building Inspector shall approve such Certificate of Compliance filed by the "registered inspector" if after inspection the structural features of such building or structure are found to be in accordance with the provisions of this Code. Each Certificate of Compliance shall bear the legal description of the property upon which such building or structure is located and an identifying description of the building. A duplicate of each Certificate of Compliance shall be kept on file permanently in the office of the Building Inspector.

**Certificate
of
Compliance**

Sec. 206. No building shall be occupied in any part thereof unless or until a Certificate of Occupancy has been issued by the Building Inspector. The Building Inspector shall, after an application therefor has been filed by the owner or his agent, issue a Certificate of Occupancy for such building, if after inspection it is found that such building complies with the provisions of this Code and all other requirements of law or ordinance applicable thereto. Such Certificate of Occupancy shall show the use to which the structure may be put and the maximum allowable floor loads for each floor thereof. A temporary Certificate of Occupancy may be issued by the Building Inspector for the temporary use of a portion of a building prior to the completion and occupancy of the entire building.

**Certificate
of
Occupancy**

Sec. 207. The use or occupancy of any building shall not be changed until a Certificate of Occupancy permitting the new use or occupancy is issued by the Building Inspector when the new occupancy is such as to require alterations or repairs of the building, as specified in this Code. Where such changes involve storage of volatile or flammable liquids as specified in Part III, exits as specified in Chapter 33, or fire-prevention and fire-extinguishing apparatus as specified in Chapter 38, the Chief of the Fire Department, upon request of the Building Inspector, within two days shall certify his approval in writing to the Building Inspector when such changes are found to comply with the requirements of this Code. No such Certificate of Occupancy shall be issued unless the building shall comply with the requirements of this Code. (See Section 104.)

**Change of
Occupancy**

CHAPTER 3 — ENFORCEMENT

**Powers and
Duties of
Building
Inspector**

Sec. 301. The office of Building Inspector is hereby created and the Building Inspector is hereby authorized and directed to enforce all of the provisions of this Code and for such purpose he shall have the powers of a police officer.

The Building Inspector or his authorized representative may enter any building or premises for the purpose of inspection or to prevent violation of this Code, upon presentation of the proper credentials.

Whenever any building work is being done contrary to the provisions of this Code, or is being done in an unsafe or dangerous manner, the Building Inspector 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 Inspector to recommence and proceed with the work.

Whenever any building or portion thereof is being used or occupied contrary to the provisions of this Code the Building Inspector shall order such use or occupancy discontinued and the building or portion thereof vacated by notice served on any person using or causing such use or occupancy to be continued and such person shall vacate such building or portion thereof within ten days after receipt of such notice, or make the building or portion thereof comply with the requirements of this Code; provided however, that in the event of an emergency the following paragraph shall apply:

Any building or portion thereof, including buildings and structures in process of erection, if found to be dangerous to persons or property, or unsafe for the purpose for which it is being used, or in danger from fire due to defects in construction, or dangerous for use because of insufficient means of egress in case of fire, or which violates the provisions of this Code due to the removal, decay, deterioration or the falling off of any thing, appliance, device or requirement originally required by this Code, or which has become damaged by the elements or fire to an extent of 50 per cent of its value, may be condemned by the Building Inspector. The Building Inspector may order portions of the structural frame of a building or structure to be exposed for inspection when in his opinion they are in an unsafe condition. In any of the aforesaid cases the Building Inspector shall serve notice in writing on the owner, reputed owner or person in charge of such building or premises, setting forth what must be done to make such building safe. The person receiving such notice shall commence within 48 hours thereafter to make the changes, repairs or alterations set out in such notice and shall proceed diligently with such work or demolish the building. No such building shall be occupied or used for any purpose after the Building Inspector serves written notice of its unsafe or dangerous condition until the instructions of the Building Inspector have been complied with.

If, at the expiration of the time as specified in the first notice, the instructions, as stated, have not been complied with, a second notice shall be served personally upon the owner, his

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agent, or the person in possession, charge or control of such building or structure or part thereof, stating therein such precautionary measures as may be necessary or advisable to place such building or structure or part thereof in a safe condition. Should the necessary changes not be made within 30 days after the service of such second notice the City Council may order the owner or agent of the building prosecuted as a violator of the provision of this Code and may order the Building Inspector 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 lien against the property. Proper service of either of such notices shall be 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 had upon any person accustomed to collect rents on the property in question who may be in the city and in the absence of such a person, upon the tenant of the premises. In the event such premises are vacant, and the owner is not found in the city, such service will be completed when the notice is sent by registered mail to the last known address of the said owner. Whenever the owner, agent or tenant is a corporation, service may be made upon the president, vice-president, secretary or treasurer, or in the absence of any of these, the local representatives of such corporation.

Sec. 302. The provisions of this Code are not intended to prevent the use of types of construction or materials offered as an alternate for the types of construction or materials required by this Code, but such alternate types of construction or materials to be given consideration shall be offered for approval as specified in this chapter. Corresponding materials or types of construction referred to in this Code, the use of which is the same as is intended for the new material or construction, and which has been approved, shall be considered as standards of quality and strength if no specification is provided.

Alternate Materials and Types of Construction

Any person desiring to use types of construction or materials not specifically mentioned in this Code shall file with the Building Inspector authentic proof in support of claims that may be made regarding the sufficiency of such types of construction and materials and request approval and permission for their use.

The Building Inspector may approve such alternate types of construction or materials. If the evidence and proof are not sufficient, in the opinion of the Building Inspector, to justify approval, the applicant may refer the entire matter to the Board of Examiners and Appeals as specified in Section 303.

Sec. 303. Any person whose application for a building permit for the use of an alternate material or type of construction has been refused by the Building Inspector or who may consider that the provisions of this Code do not cover the point raised or that any particular provision would cause a manifest injury to be done may appeal to the Board of Examiners and Appeals by serving written notice on the Building Inspector in which it shall be stated that the applicant desiring to use the alternate materials or types of construction shall guarantee payment of

Appeals

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all expenses for necessary tests made or ordered by the Board of Examiners and Appeals. Such notice shall be at once transmitted to the Board, which Board shall arrange for a hearing on the particular point raised.

Such written notice shall be accompanied by the sum of \$10.00 payable to the City. If the appeal is denied such fee shall be retained by the City, otherwise the fee shall be returned to the appellant.

Tests

Sec. 304. Whenever there is evidence that any material used or any construction does not conform to the requirements of this Code, the Building Inspector may require tests as proof of compliance to be made at the expense of the owner or his agent by a testing laboratory or other organization approved for the purpose by the Building Inspector. Copies of the results of all such tests shall be kept on file in the office of the Building Inspector for a period of not less than two years after the acceptance of the structure.

Board of Examiners and Appeals

Sec. 305. 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. One member shall be a practicing architect, one a competent builder, one a lawyer and two structural engineers, each of whom shall have had at least 10 years' experience as an architect, builder, lawyer or structural engineer. The Building Inspector 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 Inspector with a duplicate copy to the appellant and may recommend to the City Council such new legislation as is consistent therewith.

The Board of Examiners and Appeals may interpret the provisions of this Code to cover a special case, if it appears that the provisions of this Code do not definitely cover the point raised or that a manifest injustice might be done, provided that every such decision shall be by unanimous vote of the Board of Examiners and Appeals. Decisions as to the use of alternate materials and types of construction shall be by majority vote and if not permitted by this Code shall become effective only when authorized by an amendment to this Code.

Violations and Penalties

Sec. 306. It shall be unlawful for any person, firm or corporation to erect, construct, enlarge, alter, repair, move, remove, demolish, convert, equip, use or occupy or maintain any building and structure or any portion of any building or structure in the city, contrary to or in violation of any provision of this Code or to cause, permit or suffer the same to be done.

Any person, firm or corporation violating any of the pro-

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visions 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 \$500, or by imprisonment in the city jail for not more than six months, or by both such fine and imprisonment.

PART II

DEFINITIONS AND ABBREVIATIONS

CHAPTER 4—DEFINITIONS AND ABBREVIATIONS

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.

A

(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.

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 Inspector 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.

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, except when used for school purposes.

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

(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.

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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".) **Definitions (Cont'd.)**

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 INSPECTOR is the Chief Building Inspector or any regularly authorized deputy.

(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. **O**

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 any 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) **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. **D**

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

(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. **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.

Section 401

Definitions
(Cont'd.)

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

(g) **GALLERY** is that portion of the seating space of an assembly room having a seating capacity of more than 10 located above a balcony.

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.

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

(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.

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

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

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

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.

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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. (See Section 2405.)

Definitions
(Cont'd.)

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) No definitions.

(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) **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.

(q) No definitions.

(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.

ROOM CAPACITY. (See Seating Capacity).

(s) **SEATING CAPACITY.** The seating capacity of a theater, auditorium, or any room or place of public assemblage in which seats are not fixed, shall be determined on the basis of seven square feet (7 sq. ft.) of floor, balcony and gallery area per person, and in the case of fixed seats such as pews or benches the seating capacity shall be based on one person to each eighteen inches (18") of pew or bench length.

Exceptions: 1. The capacity of dance floors or the playing areas of gymnasiums when such areas or floors are not to be used for general assembly purposes shall be determined on the basis of fifteen square feet (15 sq. ft.) of floor area per person.

2. The capacity of school class rooms, individual rooms in public libraries and museums, when two thousand square feet (2000 sq. ft.) or less in floor area, shall be determined

Section 401

Definitions (Cont'd.)

on the basis of twenty square feet (20 sq. ft.) of floor area per person.

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. (See Working Stage.)

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 (t) **THEATER** is a building or part thereof which contains an assembly hall, having a stage which may be equipped with curtains and permanent stage scenery or mechanical equipment adaptable to the showing of plays, operas, motion pictures, performances, spectacles and similar forms of entertainment.

(u) No definitions.

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

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.

Section 401

Faced Wall is a wall in which the masonry facing and backing are so bonded as to exert a common action under load. **Definitions (Cont'd.)**

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).

WORKING STAGE is a portion of an assembly building which is cut off from the audience section by a proscenium wall, provided with an opening, so arranged that curtains or drops may be lifted more than ten feet (10'), or so that their lower edges are higher than one-half of the height of the proscenium opening.

(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.

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 Inspector 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 Tables No. 5-A and 5-B.)

When a building is used for more than one occupancy purpose it shall be classified in the occupancy group representing the greatest occupancy hazard. Group A Occupancy shall be considered the most hazardous and Group J the least hazardous. When portions of a building are separated from the remainder of a building by one or more unpierced continuous walls extending from the foundation of the building to and through the roof and affording four-hour fire-resistive protection, such portions may be considered as separate buildings.

Any occupancy not mentioned specifically or about which there is any question shall be classified by the Building Inspector 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 Inspector, 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 207 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.

(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.

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 self-closing one-hour fire-resistive 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 self-closing one-hour fire-resistive 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 self-closing fire-resistive 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

TABLE NO. 5-A—GROUPS OF OCCUPANCY

Chapter Reference	Group	OCCUPANCY	Working Stage	Seating Capacity in Any One Room
		DIVISION		
6	A	Assembly Buildings.....	Yes	1000 or more
7	B	1—Assembly Buildings..... 2—Assembly Buildings..... 3—Assembly Buildings..... 4—Stadiums, reviewing stands, and amusement park structures not included within Group A and Divisions 1, 2 and 3, of Group B.	Yes No No	Less than 1000 100 or more Less than 100
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—Hospitals, sanitariums, old peoples homes, orphanages, nurseries, and similar buildings (each accommodating more than six)		
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	Hotels, apartment houses, dormitories, lodging houses..... Convents and monasteries (each accommodating more than ten 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

Legend: A—Absolute Separation. S—Special Separation. O—Ordinary Separation. N—No Separation.											
Chapter Reference	Group	A	B	C	D	E	F	G	H	I	J
6	A	N	N	N	S	A	S	S	O	O	O
7	B		N	N	S	A	S	S	O	O	O
8	C			N	O	A	O	O	O	O	O
9	D				N	A	A	A	N	N	S
10	E					N	O	O	S	S	O
11	F						N	N	O*	N	N
12	G							N	N	N	N
13	H								N	N	O
14	I									N	O**
15	J										N

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

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

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. 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 one story in height shall adjoin a public space, yard, or street, and their areas 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.

**Allowable
Floor
Areas**

Buildings over one story in height shall adjoin a public space, yard, or street on not less than one side. The total area of all floors shall not exceed 200 per cent of the area allowed for one-story buildings, except as provided in Section 506, provided, however, that no single floor area shall exceed that permitted for one-story buildings.

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.

See Chapters 6 to 16 inclusive for special occupancy provisions.

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**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	6250	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: 1 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

**Allowable
Area
Increases**

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.

(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.

(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

Sections 506-507

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'), but the increase shall not exceed 100 per cent.

(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 working 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.

Platforms which are used in lieu of working stages shall be included in the floor area of the assembly rooms, when determining the seating capacity.

(b) **Special Provisions.** Working stages as defined in Section 401 shall be of Type I Construction, except as specified in Section 3905.

The slope of the main floor of the assembly room shall not exceed one in five. Ramps steeper than one in eight shall have non-slip floor surfaces.

Bleachers in a gymnasium over usable spaces shall be protected with lath and plaster as approved for one-hour fire-resistive construction.

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 doors or windows of one-hour fire-resistive protection.

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

Exit Facilities

Sec. 604. (a) **Main Entrance and Exits.** There shall be not less than one exit on each of three sides of the auditorium. Each of these exits shall be not less than five feet (5') in width and shall open directly upon a street or into an open exit court which shall be directly connected to a street as specified in Section 604 (b).

One such exit on a street front which shall serve as the main entrance shall be proportioned on the basis of two feet (2') of width for each 100 persons or major fraction thereof to and including 1000 persons, with an additional one foot (1') per 100 persons for each additional 100 persons or major fraction thereof to and including 2000 persons and an additional six inches (6") for each additional 100 persons or major fraction thereof,

Section 604

all based upon the total seating capacity of the building served by such entrance and exit.

**Exit
Facilities
(Cont'd.)**

At the main entrance there shall be a foyer having an area of one square foot (1 sq. ft.) to each seat in such building having access to such foyer. The required width of the foyer at any point shall be the combined width of the aisles, passageways and stairways tributary thereto at that point but need not exceed the required width of the entrance. The foyer shall be at the same level as the back of the auditorium and all changes in elevation between the foyer and the public street adjacent thereto shall be by ramps with a slope of not more than one in 10.

The foyer if not abutting directly upon a public street shall communicate therewith by a straight and unobstructed corridor or passageway equal in width to that required for the main entrance which shall be used only as an exit or entrance; provided, however, that not to exceed 10 per cent of such required width may be used for the placing of a ticket booth.

(b) **Exit Courts.** Along each side of, and long enough to accommodate all side exits of the auditorium not fronting directly upon a street, (not including that side bounded by the stage) shall be an open court, or a passageway of Type I construction, not less than five feet (5') in width when the total seating capacity is 1000 or less, and such width shall be increased by one foot (1') for each additional 500 persons or major fraction thereof. These are required widths and shall not be reduced in any manner.

The courts shall extend full width to a street or shall be connected to the street by a passageway of the same required width, with a height of not less than seven feet (7') and such passageway shall not exceed a length of fifty feet (50'). The floor of a court or passageway shall meet the street level and all changes in elevation shall be by ramps with a slope of not more than one in eight.

Doors opening into such open courts or passageways of Type I construction shall be arranged so as not to decrease the clear width of the court when open.

(c) **Main Floor Auditorium Exits.** Exits, which shall be not less in width than the full width of the aisle or aisles leading thereto, shall be provided at the rear of the auditorium leading into the foyer, passageway or street. [See also Section 604 (a)]. Additional exits, located on each side of and in the front half of the auditorium, shall be provided on the main floor. These additional exits shall be proportioned on the basis of not less than twenty-two inches (22") of combined width to each 150 seats or major fraction thereof on the main floor of the auditorium, and this exit width shall be equally divided to each side of the auditorium. All such exits shall open directly upon a street or upon an exit court or upon corridors connected to an exit court. Each such corridor shall have a clear width not less

Section 604

Exit Facilities (Cont'd.)

than the required width of the largest door opening into the corridor, plus one-half the sum of the widths of all other doors opening into the corridor. There shall be no openings in such corridors other than the exit openings, and the exit doors shall be hung so as not to decrease the required width. Egress from the main floor of the auditorium to the street shall be by means of ramps having a slope of not more than one in eight, except as required in subsection (a) of this Section.

Where fixed seats are not provided the exits shall be proportioned on the seating capacity as defined in Section 401 and shall be evenly distributed and so arranged that the distance between adjacent exits shall not exceed one hundred feet (100') measured along the wall.

(d) **Balcony and Gallery Exits.** For balconies or galleries having a seating capacity of over 50, exits shall be provided from each side of each balcony or gallery, leading directly to a street or exit court. These exits shall have a combined width of not less than twenty-two inches (22") for every 75 seats or major fraction thereof in such balcony or gallery and such exits shall be equally divided on each side. No exit shall be less than three feet six inches (3'-6") in width. All exits shall be served by stairs or ramps completely enclosed and constructed as specified in Chapter 33. Balconies or galleries having a seating capacity of 50 or less shall be provided with not less than two means of egress at least one of which shall lead directly to a street or court. These exits shall be not less than three feet six inches (3'-6") in width. All such exits shall be located as far apart as is practicable and all combined exits shall continue the full combined width to the street. No stair exit shall be continued to or communicate with a basement.

Exits leading to the foyer shall have a combined width of not less than twenty-two inches (22") for each 150 seats or major fraction thereof in such balcony or gallery. No such exit shall be less than three feet six inches (3'-6") in width.

Where fixed seats are not provided the exits shall be proportioned on the seating capacity as defined in Section 401.

Hand rails shall be provided for stairs as specified in Section 3305.

Stairs emptying into exit courts shall meet the court floor at not less than the stair width from the near side of any main floor exit opening into such exit court.

(e) **Stage Exits.** For size and location of stage exits see Section 3907.

(f) **Aisles.** Aisles on the main floor shall be located so that there are not more than six seats between any seat and an aisle. 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 (1½") for each five feet (5') in length toward the foyer. There shall be no steps or obstructions of any kind in any aisles, and aisles may have a slope of not more than one in five. Ramps steeper than

one in eight shall have non-slip floor surfaces. Required exits shall have aisles or cross aisles leading thereto.

Aisles in balconies or galleries shall be located so that there are not more than six seats between any seat and an aisle.

Aisles in balconies and galleries shall have the same minimum width as for aisles on the first floor and shall have the same ratio of increase in width with the exception that the increase shall be in the direction of exit travel. There shall be provided in all balconies or galleries having more than 20 rows of seats a cross aisle not less than four feet (4') wide from the back of one chair to the edge of the seat when down in the next row. Such cross aisle shall lead directly to an entrance or to an emergency exit.

Risers shall be not more than seven and one-half inches (7½") and shall be the full width of the aisle and no tread shall be less than ten inches (10"). When the slope of the aisle is not more than one in five it shall be ramped. All aisles shall lead directly to exits.

The floor between rows of seats shall be on the same level as the aisles where they intersect.

(g) **Seats.** Seats shall be spaced not less than thirty-three inches (33") back to back.

Seats on the main floor and in balconies and galleries shall be fastened securely to the floor and shall be not less than eighteen inches (18") in minimum width.

(h) **Boxes.** Boxes may be served by stairs not less than three feet (3') in width with a rise and tread as required for main stair exits. Boxes accommodating more than 25 persons shall be considered as balconies. Seats in boxes need not be fastened to the floor.

(i) **Doors and Gates.** All exit and entrance doors or gates shall swing in the direction of exit travel and if provided with latches such latches shall be of self-releasing type, such as panic bolts or similar devices, which will permit the door to open when pressed against. All doors shall be installed so as not to decrease the required width of any opening, passageway or corridor in any manner whatsoever. No single door shall be more than three feet six inches (3'-6") in width and every exit door on the exterior of such building shall be not less than one-hour fire-resistive construction as specified in Section 4304 except at the main entrance and exit. Doors opening from within the building into a stair or ramp enclosure may be metal-clad doors as specified in Section 4304.

(j) **Exit Lights.** All exits shall be marked with illuminated signs bearing the word "EXIT" in letters at least five inches (5") high. Each sign shall be provided with two separate electric light globes on separate circuits, one such circuit being separate from any other circuit in the building. All exit signs shall be illuminated at all times when the building is occupied.

(k) **Smokeproof Tower.** Where there is more than one balcony or gallery all balconies or galleries above the first shall be served by not less than one smokeproof tower located on each side of such balcony or gallery and constructed as specified in Chapter 33.

**Exit
Facilities
(Cont'd.)**

Sections 604-608

(1) **General.** No obstructions shall be placed in any aisle, exit, foyer, passageway or corridor.

No bars shall be placed upon any window or any other opening in any Group A occupancy except on the windows of a private office.

All doors shall have a clear height of not less than six feet eight inches (6'-8").

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.

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.

Enclosure of Vertical Openings

Sec. 606. Main stair or ramp exits from the first or lower balcony or gallery need not be enclosed but all other stair exits shall be enclosed and the enclosure shall be as specified in Chapter 30. There shall be no openings into stair or ramp enclosures except necessary entrance and exit doors. All emergency stair or ramp enclosures shall lead directly to a public street, alley or exit court.

All elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be as specified in Section 1807.

Fire-Extin- guishing Apparatus

Sec. 607. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as and when required in Chapter 33.

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 Chapter 37.

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

No flammable liquids shall 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 provided with one-hour fire-resistive protection.

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 working stage and a seating capacity of less than 1000 in any one room.

Division 2. Any assembly building without a working stage and a seating capacity of 100 or more in any one room.

Division 3. Any assembly building without a working stage and a seating capacity of less than 100 in any one room.

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.

Platforms which are used in place of working stages shall be included in the floor area of assembly rooms when determining seating capacity.

(b) **Special Provisions.** Working stages and platforms shall be constructed as specified in 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. (See Appendix.)

Structures housing Division 4 occupancies, other than those of open skeleton frame type, when more than one story in height or two hundred square feet (200 sq. ft.) in area, shall

have exterior walls, bearing partitions and floors 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 Inspector 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 and exit of such building or such building may be connected to the street by an entrance passageway as specified in Section 604 (a).

**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, including openings, of not less than one-hour fire-resistive construction.

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 provided with doors and windows of one-hour fire-resistive construction.

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

Sec. 704. (a) General. Requirements in this Section for Division 1, 2 and 3 occupancies, shall be the same as for Group A occupancies, as specified in Section 604, except that:

**Exit
Facilities**

1. A foyer shall not be required.
2. Ramps shall not be required.
3. The minimum width of exits may be three feet (3').
4. The minimum number of exits may be not less than two.

(b) Stadiums and Reviewing Stands. Stairs, exits, aisles and seating for Division 4 stadiums and reviewing stands shall be as follows:

1. **STAIRS.** Stairs shall have a rise of not more than seven and one-half inches (7½") and a tread of not less than ten inches (10").

2. **EXITS.** There shall be provided one exit not less than seven feet (7') wide for each 2000 persons or major fraction thereof, which the stadium or reviewing stand is designed to seat. Such exits shall be spaced not more than seventy-five feet (75') apart. Passageways serving such exits shall be not less than seven feet (7') in clear height nor less than seven feet (7') in clear width.

Sections 704-709

3. **AISLES.** Aisles not less than three feet six inches (3'6") wide shall be provided so that there are not more than 20 seats between any seat and an aisle.

4. **SEATS.** Where seats are not marked or spaced off, a distance of eighteen inches (18") along any bench or platform shall constitute one seat in computing the required aisles, stairs and exits.

Seats shall be spaced not less than twenty-six inches (26") back to back, except that where backs are provided they shall be spaced not less than thirty inches (30") back to back.

(c) **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 Inspector. Stairs and ramps in such structures not exceeding two stories in height need not be enclosed. Exit lights shall be installed as specified in Section 3312 where required by the Building Inspector.

Light, Ventilation, and Sanitation

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.

Enclosure of Vertical Openings

Sec. 706. All vertical openings such as elevator shafts, stairs, ramps and vent shafts shall be enclosed and the enclosure shall be as specified in Chapter 30, provided, however, that stair or ramp exits serving only a Division 1, 2, or 3 occupancy on the second floor of a building need not be enclosed. There shall be no openings into stair or ramp enclosures except necessary entrance and exit doors.

Fire-Extin- guishing Apparatus

Sec. 707. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as and when required in Chapter 38.

Special Hazards

Sec. 708. Chimneys and heating apparatus shall conform to the requirements of Chapter 37.

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

No flammable liquids shall 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 of the same building, shall be provided with one-hour fire-resistive protection.

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."

Exceptions and Deviations

Sec. 709. Gymnasiums and similar occupancies 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.

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.

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

**Group C
Occupancies
Defined**

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.

Platforms which are used in place of working stages shall be included in the floor area of assembly rooms when determining room capacity.

**Construction,
Height
and Area
Allowable**

(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 unperforated 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.

Stairs and corridors shall be of not less than one-hour fire-resistive construction.

All curtains, drops and drapes shall be flame-proofed. (See Section 3809.)

Any working stage shall be constructed as specified in Section 602 (b).

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.

**Location on
Property**

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 provided with doors and windows of one-hour fire-resistive construction.

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

Section 804

Exit Facilities

Sec. 804. 1. For the purpose of area determination and defining required exit facilities, rooms in Group C occupancies shall be classified as follows:

Class 1 shall be lecture rooms, auditoriums, and similar rooms wherein seats are either fixed or movable and the capacity unit therefor shall be seven square feet (7 sq. ft.).

Class 2 shall be the main exercise rooms of gymnasiums and the capacity unit therefor shall be fifteen square feet (15 sq. ft.).

Class 3 shall be general class rooms, recreation rooms, and similar rooms and the capacity unit therefor shall be twenty square feet (20 sq. ft.).

Class 4 shall be museums, libraries, laboratories and similar rooms not having fixed seats and the capacity unit therefor shall be thirty square feet (30 sq. ft.).

Class 5 shall be the same as Class 4, but with fixed seats and the capacity unit therefor shall be forty square feet (40 sq. ft.).

Class 6 shall be all other rooms, such as shops, vocational and similar rooms and the capacity unit therefor shall be one hundred square feet (100 sq. ft.).

2. A capacity unit shall be the floor area required per person.

3. For the purpose of this Chapter the room capacity shall be determined by dividing the superficial area by the appropriate capacity unit.

4. An exit-width unit shall be twenty-two inches (22").

5. Total exit width in inches from rooms shall be determined by dividing the room capacity by 100 and multiplying by 22.

6. The basic number of exit-width units required for any corridor, hall, stair or exit door opening therefrom shall be determined by dividing by 100 the capacity of each room emptying into such corridor, hall or stair between exits therefrom and such individual basic numbers shall be added together.

7. One exit-width unit shall be added to the basic widths for all corridors and halls, provided that no such corridor shall be less than six feet (6') in width exclusive of rails.

8. A corridor or hall serving additional floors as a required means of egress shall have added to its required width one exit-width unit.

9. Rooms having required width of exits directly to the exterior need not be considered in determining the required width of corridors, halls or stairs.

10. Where Class 1 rooms other than those designed to be used simultaneously with other rooms exit into a corridor or hall that serves as a required means of egress from other rooms, the corridor, hall, stairs and exits to the exterior need provide only for the capacity of whichever requires the greater width.

11. Each floor above or below the ground floor shall have not less than two exit stairs and the required exit width shall be equally divided between such stairs, provided that no stair shall be less than five feet (5') in width exclusive of rails.

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12. Each room shall have an exit door located not more than one hundred and twenty-five feet (125') distant from the nearest exit to the exterior or enclosed stairway, measured along the line of travel.

13. The width of exit doors from corridors, halls and stairs shall be not more than one exit-width unit less than the required width of such corridors, halls or stairs.

14. There shall be no dead end in any corridor or hall more than ten feet (10') beyond the exit stair or door.

15. Any room, the floor of which is below ground 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 width of exits from such room.

16. Schoolrooms shall have at least two exits and the distance between exits shall be not less than the width of the room.

17. Exit doors from rooms shall be not less than three feet (3') wide.

18. Doors to exterior stairs shall open on a landing not less than eight feet (8') wide.

19. No stairs or steps shall be placed in any corridor or hall.

20. For all other requirements see 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.

Toilets shall be provided on the basis of one toilet for each 25 persons, or major fraction thereof, based on the capacity of the building, for each sex, provided that there shall be at least one toilet for each sex.

Urinals may be substituted for two-thirds of the toilets required for males.

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.

Sec. 806. All vertical openings such as elevator shafts, stair wells and vent shafts which permit the passage of fire or smoke through more than one floor shall be enclosed and the enclosure shall be as specified in Chapter 30.

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

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

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 provided with one-hour fire-resistive protection.

Every boiler room or room containing a central heating plant which burns liquid or solid fuel shall be separated from

**Light,
Ventilation,
and
Sanitation**

**Enclosure
of Vertical
Openings**

**Fire-Extinguishing
Apparatus**

**Special
Hazards**

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." Every such boiler room or room containing a heating plant shall have at least one door opening directly to the outside of the building.

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 4305.

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: Hospitals, sanitariums, old people's homes, orphanages, nurseries and similar buildings (each accommodating more than six).

For occupancy separations see Table No. 5-B.

Group D Occupancies Defined

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.

Construction, Height and Area Allowable

(b) **Special Provisions.** 1. **General:** 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.

2. **Special Construction:** One-story buildings with not less than two-hour fire-resistive floors, and divided into areas of not more than two thousand five hundred square feet (2,500 sq. ft.) by means of two-hour fire-resistive walls extending from the floor to the roof with no openings therein except in the corridor, may have the special exits provided in Section 904.

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 provided with doors or windows of one-hour fire-resistive construction.

Location on Property

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

Sec. 904. Not less than two exits shall be provided from each floor in every Group D occupancy regardless of the height or area of the building, and additional exits shall be provided as required in Chapter 33.

Exit Facilities

In hospitals or sanitariums, ramps with a slope of not more than one in six, or horizontal exits, shall be installed instead of stairways or in addition thereto to serve all portions of the building where bedridden patients are or may be placed. These ramps shall land at the first or ground floor level at points giving the most direct access practicable to the outer air. The width of all ramps and corridors shall be not less than five feet (5') clear of all obstructions, except handrails.

Sections 904-908

In Division 2 occupancies, exit doors shall not be fastened against exit by any device other than a self-releasing latch, panic bolt, or similar device which can be opened readily from the inside at all times without the use of keys or any special knowledge or effort.

Exceptions: 1. In buildings housing less than 25, exit doors may be fastened against exit by latches operated by door knobs or similar devices, which can be opened readily from the inside at any time without the use of keys.

2. In buildings meeting the requirements of paragraph 2 of Subsection 902 (b), exterior doors may be fastened with locks. Room doors shall not be fastened from the corridor side by any device other than allowed for in Exception 1 for exterior doors.

Smokeproof towers shall be provided as and when required in Chapter 33.

Light and Ventilation

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.

Enclosure of Vertical Openings

Sec. 906. Elevator shafts, vent shafts and other vertical openings shall be enclosed and the enclosure shall be as specified under Types of Construction.

Fire-Extinguishing Apparatus

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

Special Hazards

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

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

No storage of volatile flammable liquids shall 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 suggested Fire Prevention Ordinance, Edition of 1943, recommended by the National Board of Fire Underwriters.

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."

Section 909

Sec. 909. 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 to forcibly restrain the inmates. **Exceptions and Deviations**

CHAPTER 10—REQUIREMENTS FOR GROUP E OCCUPANCIES

Group E Occupancies Defined

Sec. 1001. Group E occupancies shall be:

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.

Construction, Height and Area Allowable

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.

(b) **Special Provisions.** Public garages shall not be of Type V construction, and shall be not over six hundred square feet (600 sq. ft.) in area when of Type IV construction.

Public garage floors shall be of incombustible materials and if not placed directly on the ground shall conform to the requirements for floors of Type I construction, or the floors may be of Type II construction properly protected with incombustible materials against saturation by oil and grease.

For buildings over eighty-five feet (85') in height see Sections 1809 and 1910.

For attic space partitions and draft stops see Section 3205.

Location on Property

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, 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 provided with doors or windows of one-hour fire-resistive construction.

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

Exit Facilities

Sec. 1004. All Group E occupancies shall have not less than two means of egress from each story including basements or cellars unless such basements or cellars are used for heating apparatus only, in which case only one exit shall be required.

Stairs and exits shall be provided as and when required in Chapter 33.

Smokeproof towers shall be provided as and when required in Chapter 33.

Sections 1004-1008

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 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.

**Light,
Ventilation,
and
Sanitation**

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 more than four 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.

Sec. 1006. 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**

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.

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

**Fire-Extinguishing
Apparatus**

Sec. 1008. Chimneys and heating apparatus shall conform to the requirements of Chapter 37. 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.

**Special
Hazards**

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 suggested Fire Prevention Ordinance, Edition of 1943, recommended by the National Board of Fire Underwriters.

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-resistant construction, except for the necessary openings for the vent ducts, piping and shafting. All openings in exterior

Section 1008**Special
Hazards
(Cont'd.)**

walls, except wall vents, shall be protected with one-hour fire-resistive 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 directly 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

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.

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.

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 provided with doors and windows of one-hour fire-resistive construction.

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

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

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.

**Group F
Occupancies
Defined**

**Construction,
Height
and Area
Allowable**

**Location
on Property**

**Exit
Facilities**

**Light,
Ventilation,
and
Sanitation**

Sections 1105-1108

Every building or portion thereof where more than four 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. 1106. Elevator shafts, vent shafts and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

**Fire-Extinguishing
Apparatus**

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

**Special
Hazards**

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

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 suggested Fire Prevention Ordinance, Edition of 1943, recommended by the National Board of Fire Underwriters.

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.

CHAPTER 12—REQUIREMENTS FOR GROUP G OCCUPANCIES

Sec. 1201. Group G occupancies shall be:

**Group G
Occupancies
Defined**

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.

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.

**Construction,
Height and
Area
Allowable**

(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.

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.

**Location on
Property**

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

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

**Exit
Facilities**

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 and when required in Chapter 33.

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

**Light,
Ventilation,
and
Sanitation**

Every building or portion thereof where more than four 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.

Sec. 1206. Except as required in Chapter 33, vertical openings are not required to be enclosed.

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

Sec. 1207. Automatic sprinklers, standpipes and basement pipe inlets shall be installed as and when required in Chapter 33.

**Special
Hazards**

Sec. 1208. Chimneys and heating apparatus shall conform to the requirements of Chapter 37. 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 storage, use and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group G occupancy unless such storage and handling comply with the suggested Fire Prevention Ordinance, Edition of 1943, recommended by the National Board of Fire Underwriters.

CHAPTER 13—REQUIREMENTS FOR GROUP H OCCUPANCIES

Sec. 1301. Group H occupancies shall be:

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. 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.

For attic space partitions and draft stops see Section 3205.

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 provided with doors or windows of one-hour fire-resistive construction.

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.

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

Smokeproof towers shall be provided as and when required 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.

Sec. 1305. All rooms of Group H occupancies used for eating, living or sleeping purposes shall be provided with light and ventilation by means of windows with an area not less than one-eighth of the total floor area of such room or rooms.

Every building shall be provided with at least one toilet. Every building and each subdivision thereof where both sexes are accommodated shall be provided with at least two toilets located in such building and one such toilet shall be conspicuously marked "For Women" and the other conspicuously marked "For Men." Not less than one toilet shall be provided for each 15 persons or major fraction thereof that such building is designed to accommodate.

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

**Group H
Occupancies
Defined**

**Construction,
Height
and Area
Allowable**

**Location
on Property**

**Exit
Facilities**

**Light,
Ventilation,
and
Sanitation**

Sections 1306-1308

Enclosure of Vertical Openings

Sec. 1306. All elevator shafts, vent shafts, stairways and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction, except stairways in buildings two stories in height.

Fire-Extinguishing Apparatus

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

Special Hazards

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

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 suggested Fire Prevention Ordinance, Edition of 1943, recommended by the National Board of Fire Underwriters.

All doors leading into rooms in which volatile flammable liquids are used or kept shall be of one-hour fire-resistive construction 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

Sec. 1401. Group I occupancies shall be:

Dwellings.

For occupancy separations see Table No. 5-B.

**Group I
Occupancies
Defined**

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.

**Construction
and Area
Allowable**

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.

**Location
on
Property**

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

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

**Exit
Facilities**

Sec. 1405. All rooms of Group I occupancies used for eating, living or sleeping purposes shall be provided with light and ventilation by means of windows with an area not less than one-eighth of the total floor area of such room or rooms.

**Light,
Ventilation,
and
Sanitation**

Light, ventilation and sanitation shall be provided as required by any State laws which are intended to regulate such light, ventilation and sanitation.

Sec. 1406. Stairs in Group I occupancies need not be enclosed. Dumb-waiter shafts, clothes chutes and other similar vertical openings shall be protected as specified in Section 3003.

**Enclosure
of Vertical
Openings**

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

**Fire-Extinguishing
Apparatus**

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

**Special
Hazards**

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 apparatus 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 (including windows and doors), except on street fronts, of Division 1, Group J occupancies which are less than three feet (3') from adjacent property lines shall be of not less than 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 and when required 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 Fire-Extinguishing Apparatus

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

Sec. 1507. Fire-extinguishing apparatus shall be installed as and when required 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 Chapter 37.

Flammable liquids shall not be stored, handled or used in Group J occupancies unless such storage or handling shall comply with the suggested Fire Prevention Ordinance recommended by the National Board of Fire Underwriters, Edition of 1943.

Section 1509

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.

**Exceptions
and
Deviations**

PART IV

REQUIREMENTS BASED ON LOCATION IN FIRE ZONES

CHAPTER 16—RESTRICTIONS IN FIRE ZONES

General

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.

(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 Inspector 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.

Restrictions in Fire Zone No. 1

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.

(b) Limitation of Types of Construction. 1. Type III. Buildings or structures of Type III construction hereafter erected shall have all walls and partitions and floors over usable spaces of not less than one-hour fire-resistive construction.

2. Type IV. No building of Type IV construction having an area greater than four hundred square feet (400 sq. ft) exclusive of canopies that are open on at least two sides, shall be erected, constructed in, or moved into or within Fire Zone No. 1.

(c) Openings. All openings in exterior walls within twenty feet (20') of adjacent property lines or other buildings on the same property or within fifty feet (50') of the opposite side of a street or public place or in courts which are less than twenty feet (20') in least dimension, shall be provided with doors or windows of one-hour fire-resistive construction.

Sections 1602-1603

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 of a new building or structure erected in Fire Zone No. 1.

No building of Type IV construction in excess of four hundred square feet (400 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 Inspector, 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 4305. See Section 104 (e) for repairs.

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

5. Such building may be demolished.

(c) **Occupancies Prohibited.** No Group E occupancies except garages shall be permitted in Fire Zone No. 1.

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.

**Restrictions
in Fire Zone
No. 2**

(b) **Limitation of Types of Construction. 1. Type IV.** Buildings or structures of Type IV construction having an area greater than seventy-five hundred square feet (7,500 sq. ft.) shall not be erected, constructed, moved within or into Fire Zone No. 2 and such buildings over one thousand square feet (1,000 sq. ft.) in area, erected, constructed, moved within or into Fire Zone No. 2 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.

2. **Type V.** Buildings or structures of Type V construction erected, constructed, moved within or into Fire Zone No. 2 shall have all exterior walls of not less than one-hour fire-resistive construction and shall not exceed seventy-five hundred square feet (7,500 sq. ft.) in area; 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-re-

Sections 1603-1604

sistive construction. In all cases the roofs of such buildings shall be covered with a "Fire Retardant" roofing as specified in Section 4305.

(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 Inspector, 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 4305. See Section 104 (e) 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 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

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. **General**

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.

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. **Classification
by Types 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

Sections 1702-1703

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.

**Exterior
Walls—
When
Required**

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.

CHAPTER 18 — TYPE I BUILDINGS (Fire-Resistive)

- 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 reinforced 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. **Definition**
- Sec. 1802.** The height of Type I buildings shall not be limited. **Height Allowable**
- Sec. 1803.** The floor area of Type I buildings shall not be limited. **Area Allowable**
- Sec. 1804.** Footings shall be of solid masonry as specified in Chapter 24 or of reinforced 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 reinforced concrete as specified in Chapter 29. **Foundations**
- 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. **Exterior and Inner Court Walls**
- Inner court walls shall be of not less than three-hour fire-resistive construction.
- Sec. 1806.** Interior partitions shall be constructed of incombustible materials and shall be of not less than one-hour fire-resistive construction. **Partitions**
- 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.
- Sec. 1807.** Enclosures for elevator shafts, vent shafts, stair wells 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 fire-resistive doors or windows. (See Chapter 30.) **Enclosure of Vertical Openings**
- 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. 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. **Structural Framework**
- The structural frame shall be considered as the columns, and

Sections 1808-1809

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.

Fire-Protection of Structural Members

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.

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

Sections 1809-1813

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.

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. **Floor Construction**

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.

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

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 4305.

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.

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. **Stair Construction**

All stairs shall be designed and constructed as specified in Chapter 33 and as required under Occupancy in Part III.

Sec. 1813. Doors, windows and other openings in the exterior walls shall be protected by one-hour fire-resistive construction. **Doors and Windows**

Exceptions: 1. The provisions of this Section shall not apply to doors, windows and other openings which face

Sections 1813-1816

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.

Projections from the Building

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

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.

Penthouses and Skylights

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 of not less than one-hour fire-resistive construction. (See Chapter 36.)

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

Combustible Materials Regulated

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

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)

Sec. 1901. In "Type II Buildings" the structural frame shall be of structural steel or iron which shall be fire-protected, of reinforced concrete, of masonry or of heavy timbers, provided, that in buildings not exceeding one story and sixty-five feet (65') in height the structural steel or iron may have the fire-protection omitted. 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.

Definition

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 not to exceed 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; provided, further, that no one-story building shall exceed a height of sixty-five feet (65').

Height**Allowable**

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.

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

Area**Allowable**

Sec. 1904. Footings shall be of solid masonry as specified in Chapter 24 or of reinforced 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 reinforced concrete as specified in Chapter 29.

Foundations

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 having not less than three-hour fire-resistive protection and beams and girders not less than two-hour fire-resistive protection.

Exterior**and Inner****Court Walls**

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.

Sections 1906-1909

Partitions

Sec. 1906. Interior partitions shall be of one-hour fire-resistive construction or may be of solid wood construction formed of two layers of one-inch (1") nominal matched boards or of solid wood laminated construction not less than three and five-eighths inches (3 $\frac{5}{8}$ ") thick.

Where wood partitions abut or adjoin masonry walls they shall be tied as required in Section 2518.

Temporary partitions as specified in Section 1806 may be used.

Enclosure of Vertical Openings

Sec. 1907. Enclosures for elevator shafts, vent shafts, stair wells and other vertical openings 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 of any construction permitted for interior partitions.

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. 1908. The structural frame shall be as specified in Chapter 26 for reinforced concrete, Chapter 27 for structural steel and Chapter 25 for solid wood.

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 steel or cast iron caps or pintles which shall be self-releasing wherever any horizontal members are framed into such columns. 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 lightly closed for the full length on the underside thereof with a wood cover plate of two-inch (2") nominal thickness.

Fire-Protection of Structural Members

Sec. 1909. (a) **Structural Steel or Iron Members.** All structural steel or iron members (not including frames and structural members for elevators and elevator enclosures) shall be thoroughly fire-protected. Such fire-protection shall be of three-hour fire-resistive protection for columns, and two-hour fire-resistive protection for beams, girders and floor systems, provided, that such fire-protection may be omitted when the building does not exceed a height of one story and sixty-five feet (65').

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 sup-

ported 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 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 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 two-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.

(c) **Reinforced Concrete Members.** All reinforced concrete columns shall be thoroughly fire-protected with not less than three-hour fire-resistive protection and all joists, beams, girders and slabs shall be thoroughly fire-protected with not less than two-hour fire-resistive protection outside of all steel reinforcing.

Sec. 1910. Floor construction shall be as required for Type I buildings or shall be of one of the types noted below: **Floor Construction**

1. Floor construction shall be of tongued and grooved or splined lumber not less than three inches (3") nominal thickness with a top layer of flooring of one inch (1") nominal thickness laid thereon.

2. Construction of solid lumber placed on edge and securely spiked together to make a floor not less than four inches (4") nominal thickness.

If such floor is six inches (6") nominal or more in thickness the lumber shall be air seasoned or kiln dried.

A space of one-half inch ($\frac{1}{2}$ ") shall be required between all floor construction and the wall which it adjoins, to allow for swelling in case the floor becomes wet. This space shall be properly covered by a molding so arranged that it will not interfere with the swelling and shrinking movements of the flooring.

Wood joists, beams and girders supported by masonry walls shall be anchored thereto as required in Chapter 25. Ventilation shall be provided between the ground and a wood floor as required in Section 2527.

The timbers and planking shall be self-releasing at end support on walls and no planking or timber shall extend through or across any party or occupancy separation walls.

Sec. 1911. Roof construction shall be as required for floor construction in Section 1910 except that the minimum allowable thickness of roof sheathing shall be two and one-half inches ($2\frac{1}{2}$ "). **Roof Deck Construction**

Roof covering shall be a "Fire-Retardant" roofing as specified in Section 4305 and shall be required over all combustible roof construction.

Sections 1912-1916**Stair
Construction**

Sec. 1912. Stair construction may be of wood in buildings not exceeding three stories in height.

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

All stairs and exits shall be designed and constructed as specified in Chapter 33 and as required under Occupancy in Part III.

**Doors
and
Windows**

Sec. 1913. Doors, windows and other openings in the exterior walls shall be protected by one-hour fire-resistive construction.

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 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 in 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.

**Projections
from the
Building**

Sec. 1914. Bays, oriels and similar projections shall be constructed of incombustible materials with walls, floors and roofs as specified in this Chapter and in Chapter 35.

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 other 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 II building.

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.

**Penthouses
and
Skylights**

Sec. 1915. Penthouses shall be of not less than two-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. 1916. No wood lath or wood furring shall be allowed in any building of Type II construction, but unprotected steel or iron or wood will be allowed in the following places:

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.

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

Section 1916.

3. Trim, hand rails, show window backing and temporary partitions as specified in Section 1906, picture molds, chair rails and wainscoting or baseboards may be of wood. Wood doors may be used, 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 reinforced 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.

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 reinforced 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 reinforced concrete as specified in Chapter 29.

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, stair wells 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.)

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, reinforced concrete, masonry or wood and shall be designed and erected as specified in Chapter 26 for reinforced concrete, Chapter 27 for steel and iron, Chapters 22 and 25 for wood and Chapters 24 and 29 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 reinforced 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 2527.

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 4305.

Sec. 2012. Stairs may be of steel, iron, reinforced concrete, masonry or wood and shall be designed and constructed as specified in Chapter 33, and as required under Occupancy in Part III.

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 required in this Chapter and in 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.

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 reinforced 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 reinforced 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**

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 reinforced 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 reinforced concrete as specified in Chapter 29. **Foundations**

Sec. 2105. Exterior Walls. 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 the studs to resist bending and shear under horizontal forces when said reinforcement is anchored to the stud in such a man-

Sections 2105-2115

ner 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, stair wells 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.)

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, Chapters 24 and 29 for masonry and Chapter 26 for reinforced 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 4305.

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**

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 reinforced concrete footings which shall be of sufficient size to support safely the loads imposed as determined from the character of the soil. Masonry 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. (See appendix for table of minimum foundation requirements for Type V buildings.) **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 reinforced 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 reinforced concrete foundation if the walls are supported on a wood mudsill.

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 provided in Chapter 28.

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 of all Type V buildings having a floor area of four hundred square feet (400 sq. ft.) or more, including additions, shall be constructed with studding not less than two inches by four inches (2"x4") spaced not more than sixteen inches (16") on centers, 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 Chapter 25, 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.

Buildings two stories in height shall have walls constructed as specified above. Buildings three stories in height shall have the first story studs not less than two inches by six inches (2"x6") spaced not more than sixteen inches (16") on centers.

Underpinning shall be not less in size than the studding of the story above; provided, that all underpinning exceeding four feet (4') in height shall be not less in size than the studding required for an additional story. All such underpinning shall be effectively braced.

Where studs continue through more than one story, joists shall be nailed securely to the studs and shall be supported upon a one inch by four inch (1"x4") ribbon notched into the studs and securely nailed thereto, or by other means affording equivalent strength and rigidity. Where stories are framed separately, each tier of studding shall have top and bottom plates and the top plates shall be doubled and lapped at all corners and intersections. Laps in separate pieces of the top plate shall be staggered not less than four feet (4').

All exterior walls and partitions shall be thoroughly and effectively braced.

Maximum allowable height of two inch by four inch (2"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 in a horizontal direction, perpendicular to the direction of the stud wall.

All walls shall be fire-stopped effectively as required in Section 2526.

Ventilating openings under first floor joists shall be provided as required in Section 2527.

A wood mudsill, not less than two inches (2") thick and not less in width than the wall framing supported thereon, and of the quality required in Section 2204 shall be placed under all wood frame walls or partitions directly supported by masonry or reinforced concrete foundations.

Section 2205

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

**Exterior
Walls and
Wall Coverings
(Cont'd.)**

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.

All Type V buildings three stories in height shall have the exterior walls covered with a solid sheathing as set forth in this section.

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

Wall Coverings

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 for Exterior Plastering. (See also Section 2205 in the Appendix.)

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

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

Sections 2205-2215

manner as to permit the metal to be nailed at vertical intervals of not more than four feet (4').

Interior Partitions

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.

Enclosure of Vertical Openings

Sec. 2207. Enclosure walls for elevator shafts, vent shafts, stair wells and similar vertical openings through a building shall be of not less than one-hour fire-resistive construction when required under Occupancy in Part III, 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 enclosures shall be protected by metal or metal-clad doors with either metal or metal-clad jambs, casings or frames.

Structural Framework

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

Fire-Protection of Structural Members

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

Floor Construction

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

Roof and Ceiling 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.

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 4305. 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.

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 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.

Sections 2216-2217

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.

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

Definitions

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. (See Appendix for weights of construction materials.)

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

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.

(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.

Method of Design

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.

Unit Live Loads

Sec. 2304. The following unit loads shall be taken as the minimum live loads in pounds per square foot 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.

Sections 2304-2306

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

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

All balcony railings shall be designed to withstand a hori- **Railings**
zontal force of 20 pounds per lineal foot, applied at the top of
the railing.

Sec. 2305. Roofs shall be designed for a vertical live load of **Roof**
20 pounds per square foot of horizontal projection applied to **Loads**
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 **Reduction**
shall be permitted in designing of columns, piers, walls, founda- **of Live Loads**
tions, trusses and girders.

Sections 2306-2307

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

Wind Pressure

Sec. 2307. For purposes of design the wind pressure upon all vertical plane surfaces of all 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.

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 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

Sections 2307-2312

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 $33\frac{1}{3}$ per cent in excess of the values given in Chapters 24, 25, 26, and 27. For members carrying wind stresses only the allowable unit stresses may be increased $33\frac{1}{3}$ per cent. In no case shall the section be less than required if the wind stress be neglected.

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.

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. 2309. Plans for other than residential buildings filed with the Building Inspector 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 permits for buildings hereafter erected shall not be issued until the floor load signs, required by Section 2308, have been installed. No changes in the occupancy of a building now existing or hereafter erected shall be made until a revised occupancy permit has been issued by the Building Inspector certifying that the floors are suitable for the loads characteristic of the proposed occupancy. (See Sections 206 and 207.)

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.

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.

Sec. 2312. (See Appendix.)

**Live Loads
and Seating
Capacity
Posted**

**Occupancy
Permits for
Changed
Floor
Loading**

**Retaining
Walls and
Basement
Floors**

**Footing
Design**

**Earthquake
Regulations**

CHAPTER 24—MASONRY

General

Sec. 2401. (a) Scope. Masonry shall conform to the regulations of this Chapter and shall be limited to the materials specified in this Chapter.

(b) Definitions and Symbols. For the purpose of this Chapter, certain terms are defined as follows:

GROSS CROSS-SECTIONAL AREA OF HOLLOW UNITS is the total area including cells of a section perpendicular to the direction of loading. Re-entrant spaces are included in the gross area unless these spaces are to be occupied in masonry by portions of adjacent units.

MASONRY UNIT is any brick, tile, block, or natural stone conforming to the requirements of Section 2402.

(c) Use of Masonry Units. Walls may be constructed of approved mechanically interlocking masonry units laid without mortar if all vertical and horizontal loads are sustained by structural members, or studs formed by reinforcing bars in cells filled with concrete.

Every masonry unit used in a bearing wall or structural member shall have a surface capable of adhering to cement mortar with sufficient tenacity to resist a tensile stress of 50 pounds per square inch, after curing for 28 days.

Masonry units may be re-used when clean, whole and conforming to the other requirements of this Section appropriate to the type of unit.

(d) Facing. Facing shall be bonded with the backing as specified in this Chapter for the respective materials. No facing shall be considered in computing the bearing strength or thickness of the wall, unless such facing has a strength equal to that of the backing.

(e) Tests of Materials. Where tests of materials are made they shall be in accordance with the standard specifications of the A.S.T.M. or other specifications as given in this Chapter.

Materials

Sec. 2402. (a) Burned Clay or Shale Brick. Except for size all brick of burned clay or shale shall conform to the requirements for Grade "NW" or Grade "MW" brick given in A.S.T.M. "Tentative Specifications for Building Brick," (C62-41T).

(b) Concrete Brick. Except for size, concrete brick shall conform to the requirements for Grade "A" or Grade "B" brick, given in A.S.T.M. "Standard Specifications for Solid Load-Bearing Concrete Masonry Units," (C145-40), provided that the minimum compressive strength of Grade "B" brick shall be not less than 1,500 pounds per square inch.

(c) Hollow Clay Tile. Hollow clay tile used in exterior walls and bearing walls shall conform to the requirements for Grade "LB X" clay tile, given in A.S.T.M. "Standard Specifications for Structural Clay Load-Bearing Wall Tile," (C34-41).

Hollow clay tile used in non-bearing partitions, fire protection, and furring, shall conform to the requirements of A.S.T.M. "Standard Specifications for Structural Clay Non-Load-Bearing Tile," (C56-41).

Section 2402

(d) **Hollow Concrete Block or Tile.** Hollow concrete block or tile shall conform to the requirements of A.S.T.M. "Standard Specifications for Hollow Load-Bearing Concrete Masonry Units," (C90-39).¹

(e) **Gypsum and Gypsum Block or Tile.** Gypsum shall conform to the requirements of A.S.T.M. "Standard Specifications for Gypsum," (C22-41).

Gypsum block or tile shall conform to the requirements of A.S.T.M. "Standard Specifications for Gypsum Partition Tile or Block," (C52-41).

(f) **Cast Building Stone.** Cast building stone with no dimension more than eighteen inches (18") shall conform to the requirements for Grade "A" brick, given in A.S.T.M. "Standard Specifications for Solid Load-Bearing Concrete Masonry Units," (C145-40). Every concrete unit more than eighteen inches (18") in any dimension shall conform to the requirements for concrete in Chapter 26.

(g) **Reinforcing Steel.** Reinforcing steel shall conform to the physical and chemical requirements for metal reinforcement in concrete, as specified in Chapter 26.

(h) **Unburned Clay Brick.** Unburned clay brick shall conform to the requirements of Section 2411.

(i) **Cement.** Cement for mortar shall be Type I or Type II portland cement as specified in A.S.T.M. "Standard Specifications for Portland Cement," (C150-42). Cement may contain approved amounts of plasticizers if such plasticizers have been approved in accordance with the requirements for approval of admixtures as specified in Chapter 26.

(j) **Hydrated Lime.** Hydrated lime shall conform to the requirements of A.S.T.M. "Standard Specifications for Hydrated Lime for Structural Purposes," (C6-31)¹, and before slaking shall contain at least 85 per cent, by weight, of calcium oxide.

(k) **Quicklime.** Quicklime shall conform to the requirements of A.S.T.M. "Standard Specifications for Quicklime for Structural Purposes," (C5-26)¹, and shall contain at least 85 per cent, by weight, of calcium oxide.

(l) **Lime Putty.** Lime putty shall be made from quicklime or hydrated lime. If made from quicklime, the lime shall be slaked and then screened through a 16-mesh sieve. After slaking, screening, and before using, it shall be stored and protected for not less than 10 days. The resulting lime putty shall weigh not less than 83 pounds per cubic foot.

Exception: Processed lime which will pass through a No. 60 mesh sieve need be stored for only 24 hours after slaking.

Lime putty that is made from hydrated lime shall be stored for 48 hours before using.

(m) **Sand.** Sand for mortar shall conform to A.S.T.M. "Tentative Specifications for Aggregate for Masonry Mortar," (C144-42T), except that the sand shall be graded from coarse to fine within the limits set forth in Table No. 24-A. Ocean or beach sand shall not be used for mortar.

¹See "Specification Documents".

Sections 2402-2403

Materials
(Cont'd.)TABLE NO. 24-A—GRADING LIMITS FOR SAND
FOR MORTAR

Sieve Size	Percentage (by weight) Passing through Sieve
No. 8	95 - 100
No. 30	30 - 60
No. 50	10 - 30
No. 100	1 - 10

(n) **Water.** Water for mortar shall be clean and free from injurious amounts of deleterious materials.

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

(p) **Cement-Lime Mortar.** Cement-lime mortar shall be composed, by volume, of one part portland cement, one-half part lime putty, and not more than four and one-half parts of mortar sand.

(q) **Cement Mortar.** Cement mortar shall be composed, by volume, of one part portland cement, and not more than three and one-half parts of mortar sand. Lime putty may be added to the mix, not in excess of one-fourth part, by volume, of the cement content.

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

Plain Masonry **Sec. 2403. (a) General.** At the time of laying all units used in plain masonry shall be clean and damp on the surface.

Units laid in mortar shall be laid with full shoved mortar joints and all head, bed, and wall joints shall be solidly filled with mortar.

Masonry units laid in cement mortar shall be kept moist continuously for at least seven days after being laid.

(b) **Materials.** Plain masonry shall be of burned clay or shale brick, concrete brick, natural or cast stone, each laid up in cement-lime mortar or cement mortar.

(c) **Allowable Stresses.** Plain masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-B.

(d) **Bond.** In plain masonry of brick all stretcher courses shall be bonded by making vertical joints over centers of stretchers. There shall be not less than one header in every fifty square inches (50 sq. in.) of wall surface. If the thickness of the wall is greater than the length of the headers, each header shall be covered with another header that breaks joints with the header below.

In plain masonry of stone, the bond stones shall be uniformly distributed throughout the wall and shall comprise not less than 20 per cent of the wall surface. There shall be at least one bond stone for every five stretchers and each bond stone shall extend through the wall.

**TABLE NO. 24-B—ALLOWABLE STRESSES IN
UNREINFORCED MASONRY**

MATERIAL	ALLOWABLE STRESS IN POUNDS PER SQUARE INCH		
	COMPRESSION	TENSION*	SHEAR
Plain Masonry	100	12	12
Plain Concrete	.15f _c	.01f _c **	.02f _c
Unreinforced Grouted Masonry			
Lime-Cement Mortar	125	14	14
Cement-Mortar Grade MW or Grade A Brick	180	16	16
Masonry of Natural Stone or Hollow Units on Gross Section	70	None	7
Gypsum Masonry	20	None	None
Masonry of Unburned Clay Units	30	4	4

*Tension shall be allowed only in masonry built under the supervision of a registered inspector.

**Cold joints shall not be assumed to carry tension.

(e) **Strength.** Plain masonry shall have a minimum strength of 900 pounds per square inch.

Sec. 2404. (a) General. At the time of laying, all masonry units used in grouted masonry shall be damp and free of excess dust and dirt. When immersed in water for five minutes each unit shall absorb at least five per cent and not more than 10 per cent of the dry weight of the unit.

**Grouted
Masonry**

Masonry units laid in cement mortar shall be kept moist continuously for at least seven days after being laid.

(b) **Materials.** Grouted masonry shall be of burned clay or shale brick or concrete brick laid up as specified in Subsection (d) of this Section.

(c) **Allowable Stresses.** Unreinforced grouted masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-B.

(d) **Construction.** All units in the two outer tiers shall be laid with full bed and head joints of cement mortar. All interior joints shall be filled with grout.

One face tier may be carried up three courses before grouting, but the other face tier shall be carried up not more than one course above the grouting.

All longitudinal vertical joints shall be not less than three-fourths inch ($\frac{3}{4}$ ") in thickness.

Horizontal construction joints shall be formed by stopping the grout one and one-half inches ($1\frac{1}{2}$ ") below the top of the face tiers.

(e) **Strength.** Grouted masonry shall have a minimum strength of 1,500 pounds per square inch when Grade "MW" burned clay or Grade "A" concrete brick are used with cement

TABLE NO. 24-C—ALLOWABLE STRESSES IN REINFORCED GROUTED MASONRY

KIND OF STRESS	ALLOWABLE WORKING UNIT STRESS IN POUNDS PER SQUARE INCH	
	GRADE "MW" BURNED CLAY BRICK OR GRADE "A" CONCRETE BRICK AND CEMENT MORTAR	GRADE "NW" BURNED CLAY BRICK OR GRADE "B" CONCRETE BRICK AND CEMENT MORTAR
Compression—Axial	225	135
Compression—Flexural	400	240
Shear—No Web Reinforcement	25	15
Shear—Web Reinforcement Taking 2/3 of the entire shear	50	30
Bond—Plain Bars	60	60
Bond—Deformed Bars	75	75
Bearing	300	180
Modulus of Elasticity	1,500,000	1,000,000
Modulus of Rigidity	600,000	400,000

mortar. When cement-lime mortar is used or when Grade "NW" burned clay brick or Grade "B" concrete brick are used, the minimum strength shall be 900 pounds per square inch.

Reinforced Grouted Masonry

Sec. 2405. (a) General. Reinforced grouted masonry shall conform to all of the requirements for grouted masonry specified in Section 2404, except that the unit stresses shall not exceed those set forth in Table No. 24-C.

(b) Reinforcement. Reinforcement for reinforced grouted masonry shall be plain or deformed steel bars as specified in Section 2604. The unit stress in reinforcement shall not exceed that specified in Section 2613.

All reinforcement shall be tested as specified in Chapter 26 except that tests shall not be required when the working stresses used in design are not more than 50 per cent of those specified in Section 2613.

The width of any space containing reinforcement shall be at least three-fourths inch ($\frac{3}{4}$ ") larger than the sum of the nominal sizes of all reinforcement contained therein.

(c) Design. The design of reinforced grouted 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 limitations of this Chapter.

Hollow Unit Masonry

Sec. 2406. (a) General. Hollow unit masonry shall conform to the general requirements for plain masonry specified in Subsection 2403 (a).

Sections 2406-2408

(b) **Materials.** Hollow unit masonry shall be of hollow clay tile, or hollow concrete block or tile, laid up in cement mortar or cement-lime mortar, except that interior non-bearing masonry of hollow units may be laid up in gypsum mortar.

(c) **Allowable Stresses.** Hollow unit masonry shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-B when computed on the gross cross-sectional area.

(d) **Bond.** Bond in hollow unit masonry shall be provided by placing the vertical joints of each course over the centers of the units of the course immediately below. Corners and intersections shall be bonded by overlapping units in alternate courses.

(e) **Method of Laying.** When the thickness of the walls of the units is one and one-quarter inches ($1\frac{1}{4}$ ") or more, the units may be placed in end construction with cells vertical. When the thickness of walls is less than one and one-quarter inches ($1\frac{1}{4}$ "), the units shall be placed in side construction with cells horizontal.

Exception: Hollow units used in non-bearing walls and partitions may be laid in either end or side construction regardless of the thickness of unit walls.

(f) **Filled Cell Construction.** Masonry of hollow units may be designed as reinforced concrete where cells are continuously filled with concrete in which reinforcement is embedded. The area of cell walls which are in contact with the concrete core may be included in the computation of the effective areas of the section. The allowable stresses shall be those allowed for concrete of the same strength as units.

Sec. 2407. (a) General. 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) **Materials.** Gypsum masonry shall be gypsum block or tile laid up in gypsum mortar.

(c) **Allowable Stresses.** Gypsum masonry shall be so constructed that the unit compressive stresses do not exceed those set forth in Table No. 24-B.

(d) **Bond.** The bond in gypsum masonry shall conform to the requirements for bond in masonry or hollow units specified in Subsection 2406 (d).

(e) **Method of Laying.** All units in gypsum masonry shall be placed in side construction with cells horizontal. 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.

Sec. 2408. (a) General. Reinforced gypsum concrete shall conform to the requirements for gypsum masonry as specified in Subsection 2407 (a). **Gypsum Concrete**

(b) **Allowable Stresses.** The allowable working stresses shall be those set forth in Table No. 24-D.

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Gypsum
Concrete
(Cont'd.)TABLE NO. 24-D—ALLOWABLE UNIT STRESSES
(GYPSUM)

TYPE OF STRESS	NEAT GYPSUM	GYPSUM FIBER CONCRETE with not more than 3 per cent of wood chips, shavings or fiber	GYPSUM FIBER CONCRETE with not more than 12½ per cent of wood chips, shavings or fiber
	Pounds per square inch		
Extreme fiber stress in compression in flexure	350	220	125
Direct Compression or bearing	200	165	100
Bond between gypsum and reinforcing	40	30	30
Shearing Stress	30	25	20
Modulus of elasticity	1,000,000	600,000	200,000
Ratio of Modulus of elasticity of steel to that of gypsum (n)	30	50	150

(c) **Design.** Except as specified in this Section the design of all precast or poured-in-place slabs or tiles of reinforced gypsum shall be based on the assumptions, limitations, and methods of stress determination specified for reinforced concrete in Chapter 26.

(d) **Suspension Systems.** Gypsum suspension systems shall be not less than three inches (3") in thickness, and shall be of such character as to be readily calculable by the use of accepted engineering formulas, in which the stress in the suspension wires or cables shall be determined by the formula:

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

WHERE

L = clear span in feet.

T = maximum tension in wires in pounds per foot width of slab.

w = uniformly distributed load per foot length of beam.

d = sag of wires in feet at center of span.

The wires or cables used shall be cold drawn steel in which the allowable working stress shall not exceed 20,000 pounds per square inch.

Sections 2408-2411

(e) **Strength.** Neat gypsum and gypsum fiber concrete used in floor and roof construction shall develop the following minimum ultimate compressive strengths in pounds per square inch when dried to constant weight:

Neat gypsum (containing gypsum and water only).....	1,800
Gypsum fiber concrete (containing not more than three per cent by weight of wood chips, shavings or fiber)	1,000
Gypsum fiber concrete (containing not more than 12½ per cent by weight of wood chips, shavings or fiber)....	500

Compressive tests shall be made on cylinders six inches (6") in diameter and twelve inches (12") long. The average compressive strength shall be not less than noted above, and no one specimen shall test less than 75 per cent of the average of the lot tested, and not less than five samples from the lot shall be tested to determine the average.

Sec. 2409. (a) General. Plain concrete shall conform to all the requirements for reinforced concrete as specified in Chapter 26, except for reinforcement. Provisions shall be made to care for temperature and shrinkage stresses either by use of steel or by joints. **Plain Concrete**

(b) **Allowable Stresses.** Plain concrete shall be so constructed that the unit stresses do not exceed those set forth in Table No. 24-B.

Sec. 2410. (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 blocks shall be restrained laterally by an approved mechanical device capable of resisting the horizontal forces specified in Chapter 23 (Loads) 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 (½") expansion joints between the edges of the panel and the supporting structural members.

Sec. 2411. (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. **Masonry of Unburned Clay Units**

(b) **Stabilizer.** The stabilizing agent shall be emulsified asphalt, portland cement, or other approved material. The stabilizing agent 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.

Sections 2411-2412

(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," (C67-41). 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 used in masonry of unburned clay units shall be portland cement mortar as specified in Section 2402 (q), 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 which support masonry of unburned clay units shall extend to an elevation not less than six inches (6") above the adjacent ground at all points and shall be of concrete, burned clay units, or solid concrete units.

(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 2406 (d).

(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").

Bearing Walls

Sec. 2412. (a) **General.** Masonry bearing walls shall be constructed only of plain masonry, grouted masonry, reinforced masonry, masonry of hollow units or of unburned clay units.

Masonry bearing walls shall not exceed three stories in height.

(b) **Height and Thickness.** The thickness of masonry walls shall be not less, and the maximum height, number of stories, and distance between supports not more, than shown in Table No. 24-E.

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TABLE NO. 24-E—REQUIREMENTS FOR MASONRY WALLS

Bearing
Walls
(Cont'd.)

MAXIMUM HEIGHT IN FEET	STORY	LIMITING RATIO— DISTANCE BETWEEN SUPPORTS AND WALL THICKNESS	MINIMUM THICKNESS IN INCHES (NOMINAL)		
PLAIN AND HOLLOW MASONRY					
38	3	16'	12		
	2		16	12	
	1		16	16	12
	Basement		20	16	16
REINFORCED MASONRY					
38	3	20	7		
	2		10	7	
	1		12	10	7
	Basement		12	12	10

Exception: The provisions of this Subsection may be waived when written evidence is submitted by a qualified person showing that the walls meet all the other requirements of this Code.

(c) **Stresses.** Unless designed as reinforced columns the axial stress in bearing walls, or portions thereof, shall not exceed the value set forth in Table No. 24-B or Table No. 24-C multiplied by the expression

$$1 - \left(\frac{h}{28t} \right)^2$$

WHERE

h = the unsupported height of wall.

t = thickness of wall.

Exception: Bearing walls of hollow units with vertical cells reinforced and continuously filled with concrete may be designed in accordance with Section 2620 (k) (Concrete Bearing Walls). The effective area used in design shall be that of the filled cell plus the area of the cell walls in contact with the core. The stresses shall be those allowed for concrete, with a maximum of f'_c of 2,000 pounds per square inch.

(d) **Minimum Reinforcement.** Bearing walls of reinforced masonry shall be reinforced with both vertical and horizontal bars not more than twenty-six inches (26") center to center.

**Minimum
Reinforcement**

In reinforced masonry walls the minimum area of reinforcement in each direction shall be not less than 0.001 times the area of the wall. Other walls, if they are grouted, may be reinforced in lesser amounts to resist tensile stresses.

No required vertical reinforcement shall be less than three-eighths inch ($\frac{3}{8}$ ") in diameter.

If the wall is constructed of more than two tiers, the reinforcement shall be equally divided into two layers.

Sections 2412-2413

Bearing Walls (Cont'd.)

(e) **Concentrated Loads.** For calculating 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.

(f) **Eccentricity.** Due allowance shall be made for the effect of eccentric loads upon bearing walls.

(g) **Piers.** 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.

(h) **Chases and Recesses.** Chases and recesses in masonry walls shall not be constructed so as to reduce the required strength, thickness, or required fire resistance of the wall.

(i) **Pipes and Conduits.** No pipe or conduit shall be embedded in any structural masonry or required fireproofing.

Exceptions: 1. Rigid electric conduits may be embedded in structural masonry when their location has been detailed on the approved plans.

2. Any pipe or conduit may pass through any wall or floor slab by means of a sleeve at least large enough to pass any hub or coupling on the pipe line. Such sleeves shall not be spaced closer than three diameters, center to center, and when not detailed on the approved plans shall not exceed five inches (5") in diameter.

(j) **Anchorage.** Masonry bearing walls shall be anchored at all lines of lateral support. Such anchorage shall be capable of resisting the horizontal forces with a minimum of 200 pounds per linear foot of wall.

(k) **Arches and Lintels.** The heads of openings in masonry walls shall be formed only of lintels of incombustible materials or of masonry arches.

(l) **Openings in Walls.** In addition to the minimum required reinforcement, not less than a one-half inch ($\frac{1}{2}$ ") bar for each longitudinal joint shall be provided at all edges 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.

Non-Bearing Walls

Sec. 2413. (a) General. Non-bearing walls may be constructed of any masonry as specified in this Chapter.

Non-bearing masonry walls shall conform to the provisions of Subsections (h), (i), and (k) of Section 2412.

(b) **Thickness.** Every non-bearing masonry wall shall be so constructed and have a sufficient thickness to withstand all vertical and horizontal loads as specified in Chapter 23, but in no case shall the thickness of such wall be less than that set forth in Table No. 24-F.

TABLE NO. 24-F—MINIMUM THICKNESS OF NON-BEARING WALLS

	MINIMUM RATIO THICKNESS TO UNSUPPORTED HEIGHT	MINIMUM THICKNESS (Inches)
Exterior unreinforced walls	1/20	8
Exterior reinforced walls	1/30	6
Interior partitions	1/48	2

Sections 2413-2414

(c) **Use.** Non-bearing walls may be used to carry a superimposed ceiling load of not more than 100 pounds per linear foot of wall.

(d) **Wire Mesh Reinforcement.** Wire mesh reinforcement may be used to resist tensile stresses when embedded in plaster applied to the surface of any non-bearing wall. Wire mesh reinforcement shall be as specified in Chapter 26 and plaster shall be as specified in Chapter 47.

(e) **Anchorage.** Non-bearing partitions shall be anchored along the top edge to a structural member or a suspended ceiling, or shall be provided with equivalent anchorage along the sides. Such anchorage shall be capable of resisting a horizontal force of not less than 50 pounds per linear foot of wall.

Exterior non-bearing walls shall be anchored along all edges to structural members. Such anchorage shall be not less than three-eighths inch ($\frac{3}{8}$ ") round bars twenty-six inches (26") center to center and shall develop the full strength of the bars.

Sec. 2414. (a) General. No column shall be constructed of Columns unreinforced masonry.

Every masonry column shall be designed and constructed as required for reinforced concrete columns by the provisions of Section 2620, and shall conform to the additional requirements of this Chapter.

(b) **Limiting Dimensions.** The least dimension of every masonry column shall be not less than twelve inches (12"). [See Piers, Section 2412 (f)].

No masonry column shall have an unsupported length greater than 12 times its least dimension.

(c) **Allowable Loads.** The axial compressive stress of a masonry column shall be based on the gross area and shall not exceed the value set forth in Table No. 24-C.

(d) **Ties.** Lateral ties shall be placed approximately two inches (2") from the surface of the column.

TABLE NO. 24-G—ALLOWABLE SHEAR ON BOLTS

DIAMETER OF BOLT (Inches)	CONCRETE AND PLAIN, GROUTED AND HOLLOW UNIT MASONRY		MASONRY OF UNBURNED CLAY UNITS	
	Embedment (Inches)	Shear (Pounds)	Embedment (Inches)	Shear (Pounds)
$\frac{1}{2}$	4	350		
$\frac{5}{8}$	4	500	12	200
$\frac{3}{4}$	5	750	15	300
$\frac{7}{8}$	6	1000	18	400
1	7	1250	21	500
$1\frac{1}{8}$	8	1500	24	600

Sections 2414-2416

(e) **Lap in Vertical Bars.** Deformed bars in masonry columns shall be lapped at least 40 bar diameters.

Plain bars in masonry columns shall be lapped at least 50 bar diameters.

Flexural Members

Sec. 2415. (a) General. Every masonry flexural member shall be designed and constructed as required for reinforced concrete flexural members by the provisions of Chapter 26 and shall conform to the additional requirements of this Chapter.

(b) **Distance Between Lateral Supports.** The clear distance between lateral supports of every masonry flexural member shall not exceed 24 times the least width of the compression flange.

Bolts

Sec. 2416. Bolts which are embedded in masonry shall be grouted in place and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 24-G.

CHAPTER 25—WOOD

(Quality and Design)

Sec. 2501. The quality and design of all wood except finish and millwork, used in the construction of all buildings shall conform to the requirements of this Chapter. **General**

All members shall be so framed, anchored, tied and braced together as to develop the strength and rigidity necessary for the purpose for which they are used. No member shall be stressed in excess of the strength of its details and connections.

In no case shall reinforced concrete or masonry, other than tile or concrete floor finishes not more than three inches (3") in thickness, be supported on wood construction, except wood piling as specified in Section 2803.

Sec. 2502. All wood structural members shall be of sufficient size and strength to carry their imposed loads safely and without exceeding the allowable working stresses as specified in Section 2503. **Determination of Required Sizes**

In determining the safe load which a member will sustain or in determining the required size of a member the following provisions shall govern:

(a) **Rough Lumber.** Where rough lumber is designated on the plans and in the specifications, the full nominal size of the member may be used for determining cross sectional area.

(b) **Surfaced Lumber.** Where surfaced lumber is designated on the plans and in the specifications, the minimum surfaced dressed sizes corresponding to nominal dimensions as indicated in regional lumber manufacturers' association grading rules as listed in Table No. 25-A shall be used unless actual dressed sizes are indicated on plans.

(c) **Unspecified Lumber.** Where nominal dimensions of lumber are indicated on plans and specifications, without reference to surfacing, the minimum surfaced sizes corresponding to such nominal dimensions shall be used for determining the cross sectional area.

Sec. 2503. (a) Classification of Lumber. For the purpose of assigning allowable unit stresses to lumber used where its strength is the controlling consideration, two general classes of lumber shall be recognized, namely, "Structural Lumber" and "Yard Lumber." **Allowable Unit Stresses**

(b) **Structural Lumber.** 1. Structural lumber is that conforming to the requirements for the several grades in specifications or grading rules designated in Table No. 25-A which are based on the grading procedure of American Lumber Standards, as set forth in "Wood Handbook," U. S. Department of Agriculture, September, 1935. The grade of structural lumber shall be determined by the Building Inspector upon evidence furnished him or shall be identified by the grade mark of, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent.

2. For long-time loading conditions the maximum allowable stresses for lumber qualifying as "Structural Lumber" for

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		300	1400	120	1,200,000	Southern Cypress Mfgs. Assn., Jacksonville, Fla., dated Jan. 1, 1941
	1100 # f Tidewater Red Cypress	....		1100	100		
	1200 # c Tidewater Red Cypress	1200		....	...		
	1000 # c Tidewater Red Cypress	1000		....	...		
Douglas Fir (Coast Region)	Deuce Select Structural— 210 ^{1a} , 214 ^a , 218 ^{2a}	1300	380	1800	120	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
	Select Structural—210 ¹ , 214, 218 ²	1200	345	1600	100		
	No. 1 Timbers—200 ¹	1100	325	....	...		
	1400f—215 ^a or 219 ^{2a}	1100	380	1400	120		
	1200f—215 or 219 ²	1000	325	1200	100		
	900f—216 ²	900	325	900	90		
	1200f—498, 500 ¹	900		1200	85		
West Coast Hemlock	900f—499 ²	700	300	900	75	1,400,000	
	No. 1 Timbers—503 ²	900		....	...		
Douglas Fir (Inland Empire)	Select Structural	1466	350	1800	120	1,600,000	Western Pine Assn., Portland, Ore., dated July 1, 1942
	Structural	1175	335	1600	85	1,500,000	
	Common Structural	1050	315	1200	80	1,500,000	
Larch	Select Structural	1466	380	1800	133	1,300,000	
	Structural	1200	345	1600	100		
	Common Structural	1100	325	1200	90		

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. Mfgs. 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 ^c
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:

^aThis grade not intended to be used in bending.^bNumbers refer to paragraph numbers, W.C.B.L.G.I.—Standard Grading and Dressing Rules No. 12.^cWith slope of grain not more than one inch (1") in ten inches (10").^dSouthern Pine Inspection Bureau adopted "1939 Standard Specification for Southern Pine Lumber" in May, 1940.^eFor other shear values see paragraphs 368 and 450 of S.P.I.B. grading rules.

Section 2503

Allowable Unit Stresses (Cont'd.)

the species listed in Table No. 25-A, shall not exceed the values therein given. For species and grades not given in Table No. 25-A, the working stresses therefor shall be established by the Building Inspector in accordance with the principles in the "Guide to the Grading of Structural Timbers and the Determination of Working Stresses" (Miscellaneous Publication No. 185 of the U. S. Department of Agriculture).

(c) **Yard Lumber.** Yard lumber, for the purpose of this Code, shall consist of grades not specifically designated as structural lumber and shall comply with Section 2502. The grade of yard lumber shall be determined in the same manner as is above provided for structural lumber.

(d) **Plywood.** The term "Plywood" as used in this Code shall mean a built-up board or piece of wood made of three or more plies of veneer joined with glue and so laid that the grain of adjoining plies is at right angles. An odd number of plies shall be used. For the purpose of this Code all plywood shall conform to the U. S. Commercial Standard CS 45-42.

(e) **Decrease of Unit Stresses for Various Conditions of Exposure.** The various allowable unit stresses named in this Section are assigned for lumber used in continuously dry locations. For the condition of occasionally wet and quickly dried, the allowable unit stresses of Table No. 25-A shall be multiplied by the following reduction factors expressed in percentages:

Extreme fiber in bending.....	87.5 %
Compression perpendicular to grain.....	70 %
Compression parallel to grain.....	92 %
Horizontal Shear.....	100 %

For other conditions of exposure, allowable unit stresses of Table No. 25-A shall be reduced as may be required by the Building Inspector.

(f) **Unit Stresses—Intermittent Live 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 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.

(g) **Supplementary Provisions.** For joists spiked to studding and supported on a ribbon board gained into the studding the allowable unit stress in compression perpendicular to the grain may be increased 50 per cent above that specified elsewhere in this Section, provided that the vertical load shall be considered to be transferred directly to the ribbon. For other conditions of bearing such unit stresses may 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 the timber:

Length of bearing (inches)	1/2	1	1 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 plate the factor of increase may be taken as for a bearing the length of which equals the diameter of the washer.

(h) **Joint Details.** In designing joint details the maximum allowable unit horizontal shear stress values set forth in Table No. 25-A may be increased not to exceed 50 per cent.

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:

**Horizontal
Shear**

$$H = \frac{3R}{2bh}$$

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.

Horizontal shear for notched members shall be computed in accordance with stress values given in Section 2521.

Sec. 2505. Columns, including struts and other members in compression parallel to grain, shall be designed structurally as follows:

Columns

(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 shown in Table No. 25-A, i.e.:

$$\frac{P}{A} = c$$

Sections 2505-2506

(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

$\frac{P}{A}$

= working stress or maximum load per square inch

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 $\frac{l}{d}$ at the point of tangency of the parabolic and Euler curves, at which point

$$\frac{P}{A} = \frac{2c}{3} \qquad K = \frac{\pi}{2} \sqrt{\frac{E}{6c}}$$

Columns shall be limited in maximum length between points of lateral support to $l=50d$, except as provided 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.

**Combined
Stresses**

Sec. 2506. Members subject to both axial and bending stresses shall be proportioned in accordance with the following formula:

$$\frac{P/A}{c_1} + \frac{M/S}{f_1} \text{ equals or is less than 1.}$$

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, September, 1935, 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.

(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,

Section 2508

Bolted
Joints
(Cont'd.)

the safe load shall be determined in accordance with the formula:

$$n = \frac{p q}{p \sin^2 \theta + q \cos^2 \theta}$$

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 mem- ber, in inches*	Diameter of Bolt in Inches						
	½	⅝	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 mem- ber, in inches*	Diameter of Bolt in Inches						
	½	⅝	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.

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(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 "Wood Handbook," U. S. Department of Agriculture, September, 1935. **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 "Wood Handbook" published by U. S. Department of Agriculture, September, 1935.

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 Inspector. 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," published by the U. S. Department of Agriculture, September, 1935.

Lag Screws

Sec. 2511. (a) **Penetration.** Lag screws shall penetrate into the farther member not less than one and one-half times the thickness of the side member.

(b) **Safe Lateral Strength.** The safe lateral strength shall be equal to 75 per cent of the single shear value of a bolt of the same diameter in a main member of thickness equal to one and one-half times the thickness of the side member.

(c) **Screws with Side Plates.** Where lag screws are used with steel side plates the safe load shall be determined as for bolts in single shear with a wood side plate, considering the thickness of main member to be two-thirds of the penetration of lag screws into the timber member.

(d) **Placing.** All lag screws shall be screwed and not driven into place.

In placing lag screws in wood, a hole shall first be bored of the same diameter and depth as the shank, after which the hole shall be continued to a depth equal to the length of the lag screw with a diameter equal to the diameter of the screw at the root of the thread.

(e) **Holes.** Holes for lag screws in steel plates shall be drilled to a diameter one-thirty-second of an inch larger than the nominal diameter of the lag screw.

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

**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 inspector.						

**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 inspector.				

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.

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. **Nails**

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.

(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.

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**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	68	82	98	106	123	155	188	220	250	295
Other Species	As determined by the building inspector.									

**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 inspector.									

(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 and 2505.

All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to

Sections 2515-2517

hold securely the column or post in position and to protect its base from deterioration; 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; shall not rest directly or indirectly on floor beams except in cases where there is no column below.

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.

Sec. 2516. 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

Built-Up Columns or Compression Members

having a slenderness ratio $\frac{l}{d}$ based on the least overall dimension of the composite member.

Specially designed spaced compression members shall be based upon design principles acceptable to the Building Inspector.

Sec. 2517. Where joists enter stud walls, either exterior or interior, in which the studs are not cut off and capped underneath the joists thus giving bearing support thereto, such joists shall be connected to the studs in an approved manner or may be supported on a wooden ribbon not less than one inch by four inches (1"x4") set snugly into the studs. In the latter case design shall be in accordance with Section 2503 (f).

Horizontal Members

Joists under bearing partitions and running parallel thereto shall be doubled and well spiked or separated by solid bridging not more than sixteen inches (16") on centers to permit the passage of pipes.

The bearing surfaces of masonry on which wooden structural members are to rest shall be finished to give true and even support. When less than three feet (3') from the ground, the bearing surfaces of wooden joists, beams, girders, built-up girders, or rafters over six inches (6") in width of bearing, which would otherwise rest directly upon masonry or concrete shall be protected in an approved manner against damage by moisture or other injurious conditions.

Every wooden joist, rafter, beam or girder entering any masonry or reinforced concrete wall shall be separated from

Sections 2517-2521

any wood members entering the opposite side of said wall by at least four inches (4") of solid masonry.

Ends of wood members entering masonry or concrete walls shall be treated with approved preservative or shall be provided with metal wall boxes affording one-half inch ($\frac{1}{2}$ ") air space on each side or shall be provided with at least one inch (1") of air space at top and sides.

Header beams shall be placed not closer than twenty inches (20") from the face of a chimney. All spaces between chimneys and wood joists or beams shall be filled with loose incombustible materials placed in an incombustible support, or a metal collar connected to the chimney and fastened to the joists, beams or flooring to form an effective fire stop.

All joists shall have a minimum bearing of two inches (2") except when supported on a ribbon board and nailed securely to the adjoining stud.

Cutting of wood girders, beams or joists shall be limited to that permitted in Sections 2506 and 2521.

**Wall
Anchors
and Tiles**

Sec. 2518. When timber construction is used in connection with masonry or reinforced concrete walls, the walls shall be tied to the interior timber construction at each floor and roof at horizontal intervals as required by design loads and stresses.

Where the joists, rafters or beams are supported by wooden girders, such girders shall be anchored to the walls so as to furnish resistance as required by the design loads and stresses.

**Header
and Tail
Joists**

Sec. 2519. 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.

Bridging

Sec. 2520. Wooden cross bridging or metal cross bridging of equal strength shall be placed between joists if the span of the joists is greater than eight feet (8'). The distance between bridging or between bridging and bearing shall not exceed eight feet (8'). Each member of wood cross bridging shall be not less than two inches by three inches (2"x3") nominal.

Solid bridging shall be placed between joists at all points of support, except when resting on ribbons, and at the edges of openings where the flooring is not continued.

**Cutting
and
Notching**

Sec. 2521. 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 value 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. 2522. 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. 2523. Every member of a solid or laminated floor, consisting of members set closely together on edge, shall be firmly nailed with two nails at each end and at intervals along its length not greater than eighteen inches (18"). The nails used shall be of a length equal to two and one-half times the thickness of a single lamination. Devices of equivalent strength may be used in lieu of nails.

**Laminated
Floors**

In the case of laminated floors in structures of more than one span, at least two-thirds of the members shall pass over the supports. In any three consecutive members, no two splices shall be nearer to each other than one-quarter of a span length. No member shall be spliced more than once in a distance equal to a span length.

In all single span laminated floors the members forming the floor shall be full length and free from joints.

When laminated floors bear on a masonry wall, suitable anchorage shall be provided capable of resisting the design forces. (See also Section 3104.)

Sec. 2524. (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

Section 2524**Stud Walls
and
Partitions
(Cont'd.)**

means for giving equal lateral support to the studs. Herring-bone bridging may serve as fire-stopping as required in Section 2526.

(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.

(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 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 (1½") 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.

(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

Sections 2524-2526

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.

Sec. 2525. The wooden framework of all buildings shall be connected together in a secure manner, and the connections between the various parts shall be such that all forces will be adequately resisted. The sheathing and the sub-flooring shall be fastened to the studs, rafters or joists with nails which shall be in length at least two and one-half times the nominal thickness of the sheathing or subflooring. The nailing shall have an average spacing not more than four inches (4") along each stud, rafter or joist.

**Nailing
and
Fastening**

Exception: For plywood sheathing or subflooring nails shall be not less than sixpenny and shall be spaced not more than six inches (6") along the edges of panels and twelve inches (12") along intermediate supports and shall be at least three-eighths inch ($\frac{3}{8}$ ") from the edge of panel.

Sec. 2526. 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:

Fire Stops

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. Spaces between chimneys and wood framing; these shall be solidly filled with mortar, loose cinders or other incombustible material placed in incombustible supports.
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.

Sections 2527-2529**Foundation
Ventilation**

Sec. 2527. 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 ($\frac{1}{2}$ ") 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").

**Wood
Diaphragms**

Sec. 2528. 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 Inspector, 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" published by the U. S. Forest Products Laboratory.

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. 2529. For additional termite and fungus precautions, see Appendix.

CHAPTER 26—REINFORCED CONCRETE

(Quality and Design)

Sec. 2601. The quality of the materials used in reinforced concrete and the quality of reinforced concrete shall conform to the physical and chemical properties as specified in Sections 2604, 2605 and 2606. **Quality**

Sec. 2602. The design of reinforced concrete shall conform to the rules and principles specified in this Chapter. **Design**

Sec. 2603. The following definitions give the meaning of certain terms as used in this Chapter. **Definitions**

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.

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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.

Gunite—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.

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.

Panched 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.

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.

Sections 2604-2605

Sec. 2604. (a) Portland Cement. Portland cement shall **Materials** conform to the A.S.T.M. "Standard Specifications for Portland Cement," (C150-42).

(b) Concrete Aggregates. Concrete aggregates, except lightweight aggregates, shall conform to the A.S.T.M. "Standard Specifications for Concrete Aggregates," (C33-42) 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 Inspector.

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)¹ or the A.S.T.M. "Standard Specifications for Rail-Steel Bars for Concrete Reinforcement" (A16-35)¹ or the A.S.T.M. "Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement" (A82-34)¹; 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.

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 or reinforced concrete work the **Tests** Building Inspector 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

¹See "Specification Documents".

Sections 2605-2606

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 Inspector, 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 competent persons approved by the Building Inspector and copies of the results shall be kept on file in the office of the Building Inspector 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 Storing Specimens of Concrete in the Field," (C31-42).

Load Tests

The Building Inspector 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.

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:

$$D = \frac{.001 L^4}{12l} \dots \dots \dots (1)$$

WHERE:

L is the span, l 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.

Quality of Concrete

Sec. 2606. For the design of reinforced 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 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.

**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.
7 ½	1.00	2000
6 ¾	.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.

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 in Table No. 26-A. Method 2 shall be employed when artificial aggregates or admixtures are used.

**Strength—
Quality of
Materials**

Method 2—Controlled Concrete—Proportions of the materials and water-content, other than those shown in Table No. I 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 Tests for Compressive Strength of Concrete," (C39-42). 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 four 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 20 per cent greater than that called for on the plans, for concrete of a compressive strength less than 2500 pounds per square inch and 15 per cent greater for concrete of a compressive strength of 2500 pounds per square inch or more. 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.

Sections 2607-2609

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 Inspector, 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. "Tentative Specifications for Ready Mixed Concrete," (94-42T).

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.

Control of Proportions

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 Inspector 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 shown 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.

Mixing and Placing Concrete

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. "Tentative Specifications for Ready Mixed Concrete," (C94-42T).

(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 Inspector.

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**Mixing and
Placing
Concrete
(Cont'd.)**

(c) **Removal of Water From Excavations.** Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Building Inspector. Any flow of water into an excavation shall be diverted through proper side 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. Whenever the temperature of the surrounding air is below 40 degrees Fahrenheit all concrete placed in the forms shall have a temperature of between 70 degrees Fahrenheit and 100 degrees Fahrenheit, and adequate means shall be provided for maintaining a temperature of 50 degrees Fahrenheit for not less than 72 hours after placing or for as much more time as is necessary to insure proper curing of the concrete. 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 cleaned and wetted surfaces of the hardened concrete, including vertical and inclined

Sections 2609-2610

surfaces, shall first be slushed with a coating of 1:2 cement mortar against which the new concrete shall be placed before the mortar has attained its initial set.

Forms and Details of Construction

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.

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 Inspector 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 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 one and one-half times the diagonal for square bars. The minimum clear distance between bars and forms shall be the diameter of round bars and the diagonal of square bars. If the ends of bars are anchored as specified in Section 2618, the clear spacing may be made equal to the diameter of round bars or to the diagonal of square bars, but in no case shall the spacing between bars be less than one inch (1"), nor 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 Sec. 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.

**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 Inspector. Splices, where permitted, shall provide sufficient lap to transfer the stress between bars by bond and shear. In such splices the bars shall be spaced at the minimum distance specified in paragraph (d) of this Section.

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 paragraph (h) of Section 2609.

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

Sections 2610-2612

may be considered as replacing structurally the displaced concrete, provided they are not exposed to rusting or other deterioration, 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.

Assumptions for Design

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:

- (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.

Symbols and Notations

Sec. 2612. The symbols and notations used in these regulations are defined as follows:

- 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; the span length between opposite supports in one direction (floors with supports on four sides).
- 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_t = 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 .
- B = Span at right angles to span A (floors with supports on four sides).
- 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).

**Symbols
and
Notations
(Cont'd.)**

- 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.
- $\left. \begin{matrix} e_A \\ e_B \end{matrix} \right\}$ = Plate action factors for spans A and B respectively. (Floors with supports on four sides.)
- E_c = 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.).
- 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'_w = Tensile unit stress in web reinforcement.
- F_A = Ratio of the distance between assumed inflection points of the span A to span B in an isolated strip extending the entire width of the structure when a uniformly distributed load is applied to span A only (floors with supports on four sides).
- P_B = Ratio as defined above, but applying to Span B (floors with supports on four sides).
- $\left. \begin{matrix} F_{AA} \\ F_{BB} \end{matrix} \right\}$ = The distances, assumed for purposes of load distribution, between inflection points in spans A and B respectively (floors with supports on four sides).
- 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); the stiffness factor, that is, the moment of inertia divided by the span (floors with supports on four sides.)
- K_A = Stiffness factor $\left(\frac{I}{A} \right)$ for span A of panel AB (floors with supports on four sides).
- K_B = Stiffness factor $\left(\frac{I}{B} \right)$ for span B of panel AB (floors with supports on four sides).
- $\left. \begin{matrix} K_{AR} \\ K_{AL} \end{matrix} \right\}$ = Stiffness factor for spans to right and left respectively of span A (floors with supports on four sides).

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**Symbols
and
Notations**
(Cont'd.)

- K_{BR} = Stiffness factor for spans to right and left respectively of span B (floors with supports on four sides).
- K_{BL} = 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 = Bending moment or moment of resistance in general.
- 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 = The sum of the lengths of those edges of panel AB supporting continuous adjacent spans (floors with supports on four sides).
- 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_s = 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 along column.
- r_a = Permissible unit working stress in concrete over the loaded area of a pedestal, pier, or footing.
- r_A = Load distribution factors, that is, the proportion of total load ($w'AB$) carried in the directions A and B respectively (floors supported on four sides).
- 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.
- 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 (floors supported on four sides).
- 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. As specified in Section 2606, the structural drawings and plans shall show the ultimate strength of concrete for which the several parts of the structures were de- **Working Stresses**

**TABLE NO. 26-B—ALLOWABLE UNIT STRESSES
IN CONCRETE**

Description		For Any Strength of Concrete as Fixed by Test in Accordance with Sec. 2606 $n = \frac{30000}{f_c}$	Allowable Unit Stresses			
			When Strength of Concrete is Fixed by the Water-Content in Accordance with Sec. 2606			
			$f'_c =$ 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_c						
Extreme fiber stress in compression	f_c	0.40 f'_c	800	1000	1200	1500
Extreme fiber stress in compression adjacent to supports of continuous or fixed beams or of rigid frames	f_c	0.45 f'_c	900	1125	1350	1688
Shear: v						
Beams with no web reinforcement and without special anchorage of longitudinal steel	v_c	0.02 f'_c	40	50	60	75
Beams with no web reinforcement, but with special anchorage of longitudinal steel	v_c	0.03 f'_c	60	75	90	113
Beams with properly designed web reinforcement but without special anchorage of longitudinal steel	v	0.06 f'_c	120	150	180	225
Beams with properly designed web reinforcement and with special anchorage of longitudinal steel	v	0.12 f'_c	240	300	360	450
Flat slabs at distance d from edge of column capital or dropped panel	v_c	0.03 f'_c	60	75	90	113
Footings where longitudinal bars have no special anchorage	v_c	0.02 f'_c	40	50	60	75
Footings where longitudinal bars have special anchorage	v_c	0.03 f'_c	60	75	90	113
Bond: u						
In beams and slabs and one-way footings:						
Plain bars or structural shapes	u	0.04 f'_c	80	100	120	150
Deformed bars	u	0.05 f'_c	100	125	150	188
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_p						
On full area	f_p	0.25 f'_c	500	625	750	938
On one-third area*	f_p	0.375 f'_c	750	938	1125	1405
Pedestals (see Sec. 2611e)	f_p					

*The allowable bearing stress on an area greater than one-third but less than the full area shall be interpolated between the values given.

Sections 2613-2614

signed. 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 Storing Specimens of Concrete in the Field," (C31-42) and A.S.T.M. "Standard Methods of Tests for Compressive Strength of Concrete," (C39-42). Guniting test cylinders shall be made in a manner that will permit the blast of air to compact firmly the materials and provide proper 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 shown in Table No. 26-B where f'_c equals the minimum ultimate compressive strength at 28 days.

Allowable Unit Stresses in Reinforce- ment

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 ¼ 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.

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.

Flexural Computations

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 moments:

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Negative moment at face of first interior support:

Flexural
Computations
(Cont'd.)

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

$$\text{End spans} \quad \frac{1}{10} w l'^2$$

$$\text{Interior spans} \quad \frac{1}{12} w l'^2$$

Shear in end members at first interior support $1.20 \frac{w l'}{2}$

Shear at other supports $\frac{w l'}{2}$

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.

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.

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**Flexural
Computations
(Cont'd.)**

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 bd

For steel having a minimum yield point of 56,000 lb. per sq. in..... .002 bd

(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.

Section 2614**T-Beams**

(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.

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 (1½") in thickness, nor less in thickness than one twelfth of the clear distance between ribs. Shrinkage reinforcement in the slab shall be provided as required in Section 2615.

Sections 2614-2616

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.** Where it is necessary to introduce steel in compression in girders, beams, or slabs, such steel shall be thoroughly anchored by ties or stirrups not less than one-fourth inch ($\frac{1}{4}$ ") in size which shall be spaced not more than eight inches (8") apart over the distance where the compression steel is required.

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 concrete 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) **Factors.** The values of the factors to be used in computations are as follows:

1. For simple spans

$$F_A = F_B = 1$$

2. For end spans, continuous at one end only

$$F_A = 1 - \left[\frac{.25}{1 + \frac{7 K_A}{8 K_{AR}}} \right] \dots \dots \dots (2)$$

$$F_B = 1 - \left[\frac{.25}{1 + \frac{7 K_B}{8 K_{BR}}} \right] \dots \dots \dots (3)$$

3. For interior continuous spans

$$F_A = \frac{1}{2} \sqrt{1 - U_{AR}} + \frac{1}{2} \sqrt{1 - U_{AL}} \dots \dots \dots (4)$$

$$F_B = \frac{1}{2} \sqrt{1 - U_{BR}} + \frac{1}{2} \sqrt{1 - U_{BL}} \dots \dots \dots (5)$$

in which

$$U_{AR} = \frac{1}{1.5 + \frac{7 K_A}{8 K_{AR}}}$$

and

$$U_{AL} = \frac{1}{1.5 + \frac{7 K_A}{8 K_{AL}}}$$

4. For strips rigidly anchored to the supports

$$e_A = \frac{2}{4 - D_B} \text{ (for span A)} \dots \dots \dots (6)$$

$$e_B = \frac{2}{4 - D_A} \text{ (for span B)} \dots \dots \dots (6a)$$

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Two-Way
Slabs
(Cont'd.)

in which

$$D_A = \frac{F_{AB}}{F_{BB}}$$

$$D_B = \frac{F_{BA}}{F_{BB}}$$

5. For strips not rigidly anchored at one or both ends, and for ribbed construction without filler blocks

$$e_A = 1.0 \text{ (for span } A \text{)}$$

$$e_B = 1.0 \text{ (for span } B \text{)}$$

6. Load distribution factor

$$r_A = \frac{1}{1 + D_A^3} \text{ (for span } A \text{)} \dots \dots \dots (7)$$

$$r_B = 1 - r_A \text{ (for span } B \text{)} \dots \dots \dots (7a)$$

(c) **Slab Thickness.** The minimum thickness of the slab which shall not be less than 4 inches shall be computed by formula. (8).

$$t_s = \frac{A + B - 0.10 \cdot N}{72} \sqrt[3]{\frac{2000}{f'_c}} \dots \dots \dots (8)$$

(d) **Bending Moments.** The bending moments at any section of any strip one foot wide, extending the full length of the continuous slab, shall be determined on the basis of the recognized principles of mechanics relating to continuous beams for those conditions of loading which cause maximum moment at any section, using an equivalent uniform load of $e_A r_A w$ in the A direction, and $e_B r_B w$ in the B direction.

(e) **Supporting Beams.** (1) For span A, the maximum bending moments in the supporting beams may be determined from an equivalent uniformly distributed load per linear foot equal to

$$w \frac{B}{2} (1 - e_A r_A) \dots \dots \dots (9)$$

(2) For span A, the maximum shear in the supporting beams may be determined by formula (10).

$$w \frac{BA}{4} (1 - r_A) \dots \dots \dots (10)$$

(3) For the purpose of computing shear and bending moments at intermediate points for the supporting beams of span A, the total load from a two-way panel AB, carried on the beam of span A shall at least be equal to

$$\text{Total Load} = w \frac{BA}{2} (1 - r_A), \text{ considered uniformly varying in intensity}$$

$$\text{from } w \frac{B}{2} (1 + 2r_A - 3e_A r_A) \text{ at the center} \dots \dots \dots (11)$$

$$\text{to } w \frac{B}{2} (1 - 4r_A + 3e_A r_A) \text{ at the supports} \dots \dots \dots (11a)$$

(4) For span B , in the foregoing formulas, replace A with B , B with A ; r_A with r_B , and e_A with e_B . **Two-Way
Slabs
(Cont'd.)**

(f) **Panels of Approximately Uniform Stiffness.** When the ratio of the stiffness factor of the span under consideration to that of each adjacent span is at least $\frac{1}{2}$ and at most $\frac{3}{2}$, F_A or F_B , may be taken as 0.76 for interior spans, 0.87 for end spans and 1.0 for simple spans.

(g) **Shear in Slab.** 1. For purposes of determining shear in the strip one foot wide carrying the maximum load, the total load for the length of span A shall be

$$\begin{aligned} \text{Total Load} &= r_{Aw}A, \text{ considered uniformly varying in intensity} \\ &\text{to } r_{Aw}(3e_A - 2) \text{ at the center of the span} \dots\dots\dots (12) \\ &\text{to } r_{Aw}(4 - 3e_A) \text{ at the supports} \dots\dots\dots (12a) \end{aligned}$$

2. Similarly, the total load carried on a strip one-foot (1') wide for the length of span B shall be

$$\begin{aligned} \text{Total Load} &= r_{Bw}B, \text{ considered uniformly varying in intensity} \\ &\text{to } r_{Bw}(3e_B - 2) \text{ at the center of the span} \dots\dots\dots (13) \\ &\text{to } r_{Bw}(4 - 3e_B) \text{ at the supports} \dots\dots\dots (13a) \end{aligned}$$

(h) **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 (14): **Shear and
Diagonal
Tension**

$$v = \frac{V}{bjd} \dots\dots\dots (14)$$

For beams of I or T section b' shall be substituted for b in formula (14).

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 (14) exceeds the shearing unit stress (v_s) permitted

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Shear and
Diagonal
Tension
(Cont'd.)

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 (15).

$$A_s = \frac{V's}{f_s j d} \quad (15)$$

Inclined stirrups shall be proportioned by formula (17).

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 (16).

$$A_s = \frac{V'}{f_s \sin \alpha} \quad (16)$$

In formula (16) 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 (17).

$$A_s = \frac{V's}{f_s j d (\sin \alpha + \cos \alpha)} \quad (17)$$

When bent bars having a radius of bend of not more than two times the diameter of the bar are used alone as web reinforcement, the allowable shearing unit stress shall not exceed $0.060f'_c$. This shearing unit stress may be increased at the rate of $0.01f'_c$ for each increase of four bar diameters in the radius of bend until the maximum allowable shearing unit stress is reached. (See Section 2613).

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. **Shear and Diagonal Tension (Cont'd.)**

(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 resist more than $\frac{2V'}{3}$.

(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 $0.06\sqrt{f_c}$ 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 (14) (in which d shall be taken as $t_1 - 1\frac{1}{2}$ inches):

1. $0.03\sqrt{f_c}$, when at least 50 per cent of the total negative reinforcement in the column strip passes directly over the column capital.

2. $0.025\sqrt{f_c}$, 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 $0.03\sqrt{f_c}$ when computed by formula (14) 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 (14) on the critical section [see Section 2621 (d)], shall not exceed $0.02\sqrt{f_c}$ for footings with straight bars, nor $0.03\sqrt{f_c}$ for footings in which the bars are anchored at both ends by adequate hooks or as otherwise specified in Section 2618.

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 (18). **Bond and Anchorage**

$$u = \frac{V}{\sum_o jd} \dots \dots \dots (18)$$

in which V is the shear at that section.

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Bond and
Anchorage
(Cont'd.)

Adequate end anchorage shall be provided for the tensile reinforcement in all flexural members to which formula (18) 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.
4. Standard hook plus embedment in the compression area of the beam, which embedment exclusive of the hook shall be sufficient to develop by bond a stress of not less than 10,000 pounds per square inch at a bond stress of not more than $0.04f'_c$ on plain bars nor $0.05f'_c$ on deformed bars.

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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.

Bond and Anchorage
(Cont'd.)

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).

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

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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, 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 Inspector.

(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.

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:

*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.

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

$$(l + l_n)$$

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The width of the column head section for compression shall be taken as the width of the dropped panel (b_1), 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-C 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-C 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_o) 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-C—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 a 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_u	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), (l_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-D—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	$-M_u$	ft. lb.	$0.50M_u$	$0.0325Wl$
Column Strip, Positive Moment	$+M_u$	ft. lb.	$0.20M_u$	$0.0130Wl$
Middle Strip, Negative Moment	$-M_u$	ft. lb.	$0.15M_u$	$0.00975Wl$
Middle Strip, Positive Moment	$+M_u$	ft. lb.	$0.15M_u$	$0.00975Wl$
TWO-WAY SYSTEM WITHOUT DROPPED PANEL				
Column Strip, Negative Moment	$-M_u$	ft. lb.	$0.46M_u$	$0.030Wl$
Column Strip, Positive Moment	$+M_u$	ft. lb.	$0.22M_u$	$0.0142Wl$
Middle Strip, Negative Moment	$-M_u$	ft. lb.	$0.16M_u$	$0.0104Wl$
Middle Strip, Positive Moment	$+M_u$	ft. lb.	$0.16M_u$	$0.0104Wl$
FOUR-WAY SYSTEM WITH DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip, Negative Moment	$-M_u$	ft. lb.	$0.54M_u$	$0.0351Wl$
Column Strip, Positive Moment	$+M_u$	ft. lb.	$0.19M_u$	$0.0124Wl$
Middle Strip, Negative Moment	$-M_u$	ft. lb.	$0.08M_u$	$0.0052Wl$
Middle Strip, Positive Moment	$+M_u$	ft. lb.	$0.19M_u$	$0.0124Wl$
(MOMENTS BY BANDS)				
Direct Band, Negative Moment	$-M$	ft. lb.	$0.307M_u$	$0.0206Wl$
Direct Band, Positive Moment	$+M$	ft. lb.	$0.19M_u$	$0.0134Wl$
Diagonal Band, Negative Moment	$-M$	ft. lb.	$0.163M_u$	$0.0109Wl$
Diagonal Band, Positive Moment	$+M$	ft. lb.	$0.134M_u$	$0.0087Wl$
Cross Band, Negative Moment	$-M$	ft. lb.	$0.03M_u$	$0.0052Wl$
FOUR-WAY SYSTEM WITHOUT DROPPED PANELS (MOMENTS BY STRIPS)				
Column Strip, Negative Moment	$-M$	ft. lb.	$0.59M_u$	$0.0325Wl$
Column Strip, Positive Moment	$+M$	ft. lb.	$0.20M_u$	$0.0130Wl$
Middle Strip, Negative Moment	$-M$	ft. lb.	$0.10M_u$	$0.0063Wl$
Middle Strip, Positive Moment	$+M$	ft. lb.	$0.20M_u$	$0.0130Wl$
(MOMENTS BY BANDS)				
Direct Band, Negative Moment	$-M$	ft. lb.	$0.30M_u$	$0.0195Wl$
Direct Band, Positive Moment	$+M$	ft. lb.	$0.20M_u$	$0.0130Wl$
Diagonal Band, Negative Moment	$-M$	ft. lb.	$0.141M_u$	$0.0092Wl$
Diagonal Band, Positive Moment	$+M$	ft. lb.	$0.141M_u$	$0.0092Wl$
Cross Band, Negative Moment	$-M$	ft. lb.	$0.10M_u$	$0.0063Wl$

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TABLE NO. 26-E—MOMENTS TO BE USED IN DESIGN OF Flat Slabs (Cont'd.)
AN EXTERIOR PANEL OF FLAT SLAB

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 column 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 $\epsilon = .225$
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.	$0.10M_u$	$0.0065W_l$
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.	$0.485M_u$	$0.0315W_l$
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.	$0.28M_u$	$0.016W_l$
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.	$0.25M_u$	$0.0163W_l$
Middle Strip Negative Moment at discontinuous edge	$-M$	ft. lb.	$0.062M_u$	$0.004W_l$
Middle Strip Positive Moment	$+M$	ft. lb.	$0.23M_u$	$0.016W_l$
(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.	$0.19M_u$	$0.0117W_l$
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 given in Table No. 26-F.

(f) Limitations (Applicable to Tables No. 26-D, 26-E and 26-F). 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.

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Flat Slabs
(Cont'd.)**TABLE NO. 26-F—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.	.125 M_o	.115 M_o	.135 M_o	.125 M_o	Neg.	.25 M_o	.23 M_o	.27 M_o
	Pos.	.03 M_o	.035 M_o	.0475 M_o	.05 M_o	Pos.	.10 M_o	.11 M_o	.095 M_o
(c) Negative Moment to be used in Design of Middle Strip continuous over Beam or Wall.		Neg.	.195 M_o	.205 M_o	.104 M_o	.13 M_o	Neg.	.15 M_o	.16 M_o
								.085 M_o	.10 M_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-E 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 given in Table No. 26-G.

(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-G—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 of total band steel)	$l - b_c + (2' \text{ or } 40d)$	$.65l + (2' \text{ or } 40d)$	.75l	.75l
Length of bent bars (not less than .4 total band steel)	$1.5l + .5c†$	$1.635l†$	$1.44l + .66c†$	$1.50l†$
Length of additional straight bars over column head (if required)	$.5l + .6c$	.635l	$.44l + .66c$	.50l
Point of top bend in bent bars (from column center)	.25l	.25l	.25l	.25l
MIDDLE STRIP				
Length of straight bars (not more than .5 total band steel)	.65l	.65l	.7l	.7l
Length of bent bars (not less than .5 total band steel)	$1.5l†$	$1.5l†$	$1.5l†$	$1.6l†$
Point of top bend in bent bars (from column centers)	.175l	.175l	.15l	.15l
FOUR-WAY FLAT SLAB (COLUMN STRIP)				
Length of straight bars (not less than .4 total band steel)	$l - b_c + (2' \text{ or } 40d)$	$.65l + (2' \text{ or } 40d)$	.75l	.75l
Length of bent bars (not less than .4 total band steel)	$1.5l + .6c†$	$1.635l†$	$1.44l + .66c†$	$1.50l†$
Length of additional straight bars over column head (if required)	$.5l + .8c$	.635l	$.44l + .66c$	.50l
Point of bend for bent bars (from column centers)	.2l	.2l	.2l	.2l
DIAGONAL BAND				
Length of straight bars (not more than .6 total band steel area)	$l - b_c + (2' \text{ or } 40d)$	$.65l + (2' \text{ or } 40d)$	.75l	.75l
Length of bent bars (not less than .4 total band steel area)	$2.21l†$	$2.21l†$	$2.21l†$	$2.21l†$
Point of bend for bent bars (from column centers)	.33l	.33l	.33l	.33l
Length of additional straight bars over column head (if required)	.8l	.8l	.8l	.8l
Top band across middle of direct band (length of straight bars)	.5l	.5l	.5l	.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 sections 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 (22).

$$P = A_g (0.225f'_c + f_s p_s) \quad (22)$$

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. 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.

Section 2620

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 (23), 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.

$$p' = 0.45 (R - 1) \frac{f'_c}{f'_s} \dots \dots \dots (23)$$

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).

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 of 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 one and one-half inches ($1\frac{1}{2}$ ") outside the column spiral or as a square or rectangle of which the sides are one and one-half inches

¹See "Specification Documents".

(1½") outside the spiral. The value of A_g thus defined shall be used in both Formulas (22) and (23). 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 (22). 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 (⅝"). 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 (¼") 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_e) not less than one-half of the total area may be used in applying the provisions of Subsection (d), paragraph (1).

(e) **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 (24).

$$P = 0.225A_c f'_c + f_s A_s + f_r A_r \quad (24)$$

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) and (4). 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 (24) at any point; in addition to this, the reinforced concrete portion shall be designed to carry, in accordance with Formula (22), all floor loads brought onto the column at levels between the metal brackets or connections. In applying Formula (22), the value of A_c 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 $0.35 f'_c A_c$. 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 ($2\frac{1}{2}$ ") thick over all metal (except rivet heads) reinforced as hereinafter specified, shall be computed by Formula (25).

$$P = A_s f'_s \left(1 + \frac{A_s}{100 A_c} \right) \dots \dots \dots (25)$$

WHERE

A_s = cross-sectional area of steel column.

f'_s = permissible stress for unencased steel column.

A_c = 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 (the equivalent of) welded wire mesh having wires of No. 10 W. & M. gage, 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-

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 (26).

$$P = 0.225f'_c A_c + f'_r A_r \quad (26)$$

The value of f'_r shall be that given by Formula (27).

$$f'_r = \left(18,000 - 70 \frac{h}{K} \right) F \quad (27)$$

WHERE

f'_r = average unit stress in metal core.

h = unsupported length of column.

K = least radius of gyration of metal core section.

(yield point of pipe)

$$F = \frac{\quad}{45,000}$$

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 (28).

**Long
Columns**

$$P' = P \left(1.3 - .03 \frac{h}{d} \right) \quad (28)$$

where P is the permissible axial load on a short column as given by Formulas (22) and (24).

The maximum permissible load P' on eccentrically loaded columns in which $\frac{h}{d}$ exceeds 10 shall also be given by Formula

(28), 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 effects 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:

Section 2620

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 (29).

$$f_c = \frac{P}{A_t} \left(\frac{1}{1 + (n-1) p_t} + \frac{ec}{R^2} \right) \dots \dots \dots (29)$$

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.

$30,000$

$n = \frac{30,000}{f'_c}$

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 $p_t n$ is 0.3 or more.

The term $\frac{ec}{R^2}$ 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 (30).

$$f_c = f_a \frac{1 + \frac{ec}{R^2}}{1 + C \frac{ec}{R^2}} \quad (30)$$

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

$$f_a = \frac{0.225f'_c + f_a p_g}{1 + (n-1)p_g} \quad (31)$$

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-H.

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

$$\left[1 - \left(\frac{h}{30d} \right)^3 \right] 0.2f'_c$$

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-H—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	0	
	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 eight inches (8") 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 ($1\frac{1}{2}$ ") 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 ($\frac{3}{4}$ ") and not more than one-third the thickness of the wall from the interior surface. Bars shall be not less than three-eighths inch ($\frac{3}{8}$ ") 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 Section 2617, Subsection (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 Section 2620, Subsection (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 (32).

$$r_a = 0.25 f'_c \sqrt[3]{\frac{A}{A'}} \quad (32)$$

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 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.

Sections 2622-2624

Precast Concrete Joists

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 and one-half inches ($2\frac{1}{2}$ ") for floors nor less than two inches (2") for roofs and not less than one and one-half inches ($1\frac{1}{2}$ ") over the joists. The slab shall have not less than 0.2 per cent reinforcement at right angles to the span 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.

Precast joists shall be bridged as provided in Section 3102.

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 ($1\frac{1}{2}$ ") 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.

Bolts

Sec. 2624. Bolts shall be solidly embedded in 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. 24-G.

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 Inspector and copies of such tests shall be filed in the office of the Building Inspector. 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 Inspector. 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

Section 2702

**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

$$\text{greater than } 120 \dots\dots\dots \frac{18,000}{1 + \frac{P}{18,000}} \left\{ 1.6 - \frac{l}{200r} \right\}$$

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

$$40 \dots\dots\dots 22,500$$

$$1 + \frac{l^2}{1800 b^2}$$

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

Sections 2702-2703

(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 Inspector 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**

Sections 2703-2704

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 countersunk 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

$$\frac{h}{t} > \frac{8000}{\sqrt{S}}$$

Section 2704

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:

Sections 2704-2707

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 3316 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 $\frac{1}{8}"$, provided that no projecting part of any compression member shall be less in thickness than $\frac{1}{8}$ of the unsupported width of the outstanding leg or projecting part.

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-

Sections 2707-2708

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 in accordance with 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

Section 2708

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 prescribed 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 provided in Section 2706.

The minimum distance from the center of any rivet or bolt hole to any edge shall be that given 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	$\frac{7}{8}$	$\frac{3}{4}$ *
$\frac{5}{8}$	$1\frac{1}{8}$	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
$\frac{1}{2}$	$1\frac{1}{4}$

The minimum distance between centers of rivet holes shall be three diameters of the rivet; but the distance shall be not less than shown 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 permitted under 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.

Sections 2709-2711

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).....	13,000 lbs. per sq. in.
Shear in weld metal (fillet welds).....	11,300 lbs. per sq. in.
Compression in weld metal.....	18,000 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

Sections 2712-2715

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 effec-

Section 2715

**Light
Steel
Construction
(Cont'd.)**

tively arc or resistance welded together. For such steel studs the ratio l/r shall not exceed 180.

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
Cellular steel walls, floor and roof panels—18 gauge
Roof decks supported on ribs—20 gauge

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 joist 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

Sections 2715-2717

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 ($\frac{1}{8}$ "). 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

Section 2717

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 ($\frac{1}{50}$ ") 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 holes. 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 beld 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 Inspector 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

Sections 2717-2719

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 Inspector.

Erection

Sec. 2719. The frame of all steel skeleton buildings shall be carried up true and plumb, and temporary bracing shall be introduced wherever necessary to take care of all loads to which the structure may be subjected, including erection equipment, and the operation of same. Such bracing shall be left in place as long as required for safety or deemed necessary by the Building Inspector.

As erection progresses the work shall be securely bolted up to take care of all dead load, wind and erection stresses.

Wherever piles of material, erection equipment, or other loads are carried during erection, proper provision shall be made to take care of the resulting stresses.

No riveting or welding shall be done until the structure has been properly aligned.

Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

In the setting or erecting of steel work the individual pieces shall be considered plumb or level when the error does not exceed 1 to 500. For exterior columns and columns adjacent to elevator shafts of multiple story buildings the error shall not exceed 1 to 1000 of the total height of the column.

Field painting shall be considered a phase of maintenance, not covered herein, and shall include spot painting of field rivet heads and all abrasions of the shop coat, and so forth.

PART VII

DETAILED REGULATIONS

CHAPTER 28—EXCAVATIONS, FOOTINGS AND FOUNDATIONS

Sec. 2801. All excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property. All permanent excavations shall have retaining walls of masonry or reinforced 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 reinforced concrete and shall in all cases extend below the frost line. Masonry units used in foundation walls and footings shall be laid up in portland cement mortar. The base areas of all footings and foundations shall be proportioned as specified in Section 2311. **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..... $\frac{1}{2}$ ton

Where the bearing capacity of the soil is not definitely known or is in question, the Building Inspector 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.

Creosoted piles of Douglas fir or Southern pine when treated with Grade 1 creosote under pressure with the full-cell creosote treatment complying with Specification No. 41-b or No. 39-a of the American Wood Preservers Association in such a manner as to provide a final retention of not less than 12 pounds per cubic foot in Douglas fir piling and not less than 15 pounds per cubic foot in Southern pine piling may be used as follows:

Section 2803**Piles**
(Cont'd.)

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.

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 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. The diameter of piles cast in place shall be not less than eight inches (8") at the point and shall have 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 in conformity with the requirements of 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 in conformity with the requirements of Section 2803 (f).

(e) **Concrete-Filled Steel Pipe Piles.** Concrete-filled steel pipe piles shall have a nominal outside diameter of not less than

Section 2803

Piles

(Cont'd.)

ten and three-quarters inches (10¾") 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 (¾"). 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 in conformity with the requirements of 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 provided in this Section:

Safe load = $R/4$ for all piles,

WHERE:

$$R \text{ (for steel piles)} = \frac{12 W_h \frac{W + 0.25P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

$$R \text{ (for other piles)} = \frac{12 W_h \frac{W + 0.1P}{W + P}}{S + \frac{RL 24,000}{AE}}$$

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

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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 Inspector. 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 θ = 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 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.

**Special
Requirements
for Glass
Veneer**

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.

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.

Stairway, Ramp, and Elevator Enclosures

Sec. 3002. When stairways or ramps are required to be enclosed such enclosures shall extend from the lowest point to the highest point required and shall also include a complete passageway not less in width at any point than the required width of such stairway or ramp and such enclosure. All doors opening into such enclosures shall be of metal or shall be metal-clad doors as set forth in Section 4304, and all windows shall be of wire glass and metal frames and sash; except that when such openings face directly on a street or court and are not within ten feet (10') of an adjacent lot line such protection may be omitted. All such doors shall be self-closing and be kept normally closed.

Walls and partitions enclosing stairways, ramps or 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 joists shall be solidly bridged for lateral support as follows: One row of concrete bridging shall be placed in clear spans of fifteen feet (15') to twenty-four feet (24'); two rows of bridging shall be placed in all clear spans of twenty-four feet (24') or more. Bridging shall be reinforced continuously top and bottom with not less than one-half inch ($\frac{1}{2}$ ") round rod or the equivalent area in other shapes. Such bridging shall be the full depth and width of the joists. **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

Sections 3103-3104

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.

**Mill
Constructed
Floors**

Sec. 3104. 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

**TABLE NO. 31-A—ALLOWABLE SPANS
FOR FLOOR JOISTS**

Size of Joists (Inches)	Spacing of Joists, Center to Center (Inches)	Maximum Allowable Span (Feet and Inches)	
		Plastered Ceiling Below	Without Plastered Ceiling Below
2 x 6	12	10- 0	12- 0
	16	9- 1	10- 0
	24	8- 0	8- 7
2 x 8	12	13- 0	15-11
	16	12- 1	13-11
	24	10- 8	11- 5
2 x 10	12	16- 8	19-11
	16	15- 3	17- 4
	24	13- 5	14- 5
2 x 12	12	20- 1	23-11
	16	18- 5	20-11
	24	16- 2	17- 5
2 x 14	12	23- 5	27- 8
	16	21- 5	24- 4
	24	18-11	20- 3
3 x 6	12	11- 8	15- 0
	16	10- 8	13- 1
	24	9- 4	10-10
3 x 8	12	15- 4	19- 8
	16	14- 0	17- 4
	24	12- 4	14- 4
3 x 10	12	19- 3	24- 7
	16	17- 8	21- 8
	24	15- 7	18- 0
3 x 12	12	23- 1	29- 4
	16	21- 3	25-11
	24	18- 9	21- 8
3 x 14	12	26-11	30- 0
	16	24-10	30- 0
	24	22- 1	25- 2

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 2523 for detailed requirements.

Sec. 3105. 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.

**Wood
Joisted
Floors**

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.

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.

CHAPTER 32—ROOF CONSTRUCTION AND COVERING

General

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.

Construction

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 and one-half inches (2½") nominal in thickness and except that concrete or gypsum roof slabs shall be not less than two inches (2") in thickness.

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.

Design

Sec. 3203. The design of the roof construction shall be in accordance with engineering regulations for the materials used.

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—MAXIMUM ALLOWABLE SPANS FOR
CEILING JOISTS AND ROOF RAFTERS.**

Size of Joists (Inches)	Spacing of Joists, Center to Center (Inches)	Maximum Allowable Span (Feet and Inches)	
		For Ceiling Joists	Rafters For Roof
2 x 4	12	11- 0	11- 8
	16	10- 0	10- 1
	24	8-11	8- 4
	32	7-10	7- 2
2 x 6	12	16- 7	17- 8
	16	15- 4	15- 6
	24	13- 8	12- 9
	32	12- 0	10- 8
2 x 8	12	21- 8	23- 2
	16	20- 2	20- 4
	24	18- 0	16-11
	32	15-10	14- 9
2 x 10	12	26-10	28-11
	16	25- 0	25- 6
	24	22- 6	21- 3
	32	19- 6	18- 8

using a 1200/ grade, surfaced four sides to American Lumber Standards sizes.

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.

Sec. 3204. Roof covering shall be required over all combustible roof construction and shall be of one of the classes set forth in Section 4305 as required under Occupancy in Part III, Location in Part IV and Type of Construction in Part V.

Roof Coverings

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 two feet by three feet (2'x3') and shall be located in the hallway or corridor of all Type III and V buildings three stories or more in height.

Attics: Access and Areas

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 or of 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.

Sec. 3206. Roofs of all buildings shall be sloped so that they will drain to gutters and downspouts which shall be connected with conductors to carry the water down from the roof underneath the sidewalk to and through the curb. Overflows shall be installed at each low point of the roof to which the water drains.

Roof Drainage

CHAPTER 33—STAIRS AND EXITS

General Requirements

Sec. 3301. All exits as required for buildings in this Code shall comply with the requirements specified in this Chapter for a stairway, ramp or smokeproof tower. Wherever stairways are mentioned, ramps may be substituted when constructed as specified in Section 3310. A smokeproof tower constructed as specified in Section 3315 shall be considered as a required stairway as specified in Section 3309. Such smokeproof towers may be substituted for stairways wherever the latter are required in this Code.

All stairways shall be constructed of materials permitted for floors as specified under Types of Construction in Part V for that type of building in which such stairways are located, except as specified in Sections 3315 and 3316. All stairways of wood construction shall be protected on the under side by not less than one-hour fire-resistive construction as specified in Chapter 43. Metal stairways entirely enclosed as specified in this Chapter shall not be required to be fire-protected as required for floors in Part V of this Code. The provisions of this Chapter shall not apply to Group I occupancies except as specifically stated in Sections 3302, 3307 and 3314.

General Design

Sec. 3302. All stairways and all platforms, landings and balconies forming a part of such stairway shall be designed to sustain an assumed live load of not less than 100 pounds per square foot.

There shall be no variation in the width of treads in any flight and the variation in heights of risers in any flight shall not exceed three-sixteenths inch (3/16"). All treads shall have a nosing of not less than one inch (1").

The surface material of stair treads and landings shall be such as not to involve danger of slipping.

An arrangement of treads known as winders shall be permitted in Group I occupancies or for monumental stairways which are not serving as a required means of exit but in no case shall any tread have a width at any point less than eight inches (8") exclusive of nosing.

Stairways and intermediate landings shall continue with no decrease in width along the direction of exit travel, except that when three or more stairways are required, one-half the required number of stairways may be combined at the second floor level with such combined width extending to the first floor level.

Arrangement and Access

Sec. 3303. One-half of the required number of stairways shall be continued their full width to and through the roof by means of a penthouse in all buildings three stories or more in height; provided, that not more than one stairway shall be required to continue to and through the roof when the roof has a slope of more than six inches (6") for each twelve inches (12") of horizontal projection. In two-story buildings scuttles not less than two feet by three feet (2' x 3') shall be provided to and through the roof. Stairways leading to roofs of buildings shall have signs conspicuously placed with letters not less than four

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inches (4") high indicating such access at the ground floor level.

All stairways shall lead to the street directly or by means of a yard, court or fire-resistive passageway having a width at least equal to the aggregate widths of all the exits discharging into it; provided, that not to exceed one-half of the required number of stairs may terminate at the second floor level provided they lead directly to a street or alley front of the building and are provided with a balcony on the exterior of the building not less than three feet (3') wide and five feet (5') long. Such balcony shall be constructed of incombustible materials and when the floor of such balcony is located more than twelve feet (12') above the sidewalk directly below, such balcony shall be equipped with an approved counterbalanced stairway or ladder.

Where stairways discharge through the fire-resistive passageways such passageways shall be not less than seven feet (7') in clear height and with a width at least equal to the stairway or stairways served by such passageways. All openings into such passageways shall be protected by one-hour fire-resistive doors.

All exits shall be so arranged as to make clear the direction of egress to the exterior of the building and shall be so located that they are readily accessible and visible. When not visible to all occupants, adequate signs shall be provided to indicate their location. For buildings with sleeping rooms, schools and places of detention, exits shall be so arranged that it is possible to go in either direction at any point in a corridor to an exit.

Stairways shall abut on not more than one side of an elevator enclosure.

No portion of any building shall be more than one hundred fifty feet (150') (along the line of travel) from the nearest exit, and no corridor exit door shall be more than one hundred feet (100') (measured along the line of travel) from the nearest exit. In Group D and H occupancies all doors providing egress from public hallways and all doors providing egress from the building shall open in the direction of exit travel, except sliding doors as provided in Section 3304.

Soc. 3304. Doors shall not open immediately on a flight of stairs but on a landing at least equal to the width of the door.

Doors giving access to stairways shall swing with the direction of exit travel but where swinging doors are not practicable sliding doors approved by the Building Inspector may be permitted. Vertical sliding doors and rolling shutters shall not be used. There shall be no obstructions on stairways or landings nor to the full swing of doors. Swinging doors in their swing shall not reduce the effective width of stairways or landings to less than thirty inches (30") nor when open interfere with the full use of the stairs.

All doors in exit enclosures or providing access to exterior stairways shall be self-closing and be kept normally closed and shall be of not less than one-hour fire-resistive construction, except that doors facing a street and at street level may be of unprotected wood. Doors shall be tight-fitting and constructed and installed in a workmanlike manner.

Sections 3304-3307

All doors used in connection with exits shall be so arranged as to be opened readily from the side from which egress is made or from both sides when the building is occupied. Locks if provided shall not require a key to operate from the inside.

Railings

Sec. 3305. All stairways shall have walls or well secured balustrades or guards on each side and handrails shall be placed on at least one side of every stairway and stairways exceeding forty-four inches (44") in width shall have handrails placed on each side. Stairways over seven feet (7') wide shall be provided with one or more continuous intermediate handrails substantially supported and the number and position of intermediate handrails shall be such that there is not more than sixty-six inches (66") between adjacent handrails.

Handrails and railings shall be placed thirty inches (30") above the nosing of treads and ends of handrails shall be returned to the wall.

Lighting

Sec. 3306. Every stairway or other means of exit into corridors and passageways appurtenant thereto shall be provided with an adequate system of lighting, either natural or artificial. Lights in the exit signs shall be kept burning at all times that the building served by such stairways or exits is being used or occupied.

Detailed Requirements

Sec. 3307. Stairways and landings, returns and passageways serving such stairways shall be not less than forty-four inches (44") wide; except, that for dwellings and when serving mezzanines or not more than one family or one apartment in buildings not exceeding two stories in height the required width may be reduced to not less than three feet (3'). All such widths shall be clear of all obstructions; except that handrails attached to walls may project within the required width not more than three and one-half inches (3½") at each side when the stairway is forty-four inches (44") or more in width and on one side when the stairway width is less than forty-four inches (44"). If newels project above tops of rails a minimum clear width of not less than that specified in this paragraph shall be provided between the face of the newel and the face of the wall or newel opposite.

The rise of stairway shall be not more than seven and one-half inches (7½") and the tread exclusive of the nosing not less than ten inches (10") (maximum pitch 37 degrees), and there shall be not more than 17 risers in any one run between landings; provided, that stairways in dwellings and stairways serving mezzanine floors may have a rise of not more than eight inches (8") and a tread exclusive of the nosing of not less than nine inches (9").

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.

Every required stairway including stairways in Group I occupancies shall have a head room clearance of not less than six feet six inches (6' 6") measured vertically from the nearest nosing to the nearest soffit.

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Sec. 3308. All required stairways and ramps in buildings three stories or more in height, including landings and parts of floors between stairways which lie in the path of travel shall be enclosed as specified under Occupancy in Part III, under Types of Construction in Part V, and in Chapter 30; except that monumental stairways leading only from the street floor level to the second floor or basement which do not constitute required means of exit in public buildings or stores shall be exempted from the enclosure requirements.

Exit enclosures shall not be used for storage in any manner whatsoever and shall not contain any material or equipment liable to cause fire, explosion or panic.

At the top of every stairway enclosure a ventilating skylight with a horizontal area of not less than eight square feet (8 sq. ft.) shall be installed as specified in Section 3402, or in lieu of such skylight an equivalent window opening glazed with plain glass may be provided in the penthouse walls. Fixed openings not less than five hundred square inches (500 sq. in.) in area shall be provided at the top of each stairway enclosure for ventilation.

Sec. 3309. The number of stairways provided for each use or occupancy shall be as required in Table No. 33-A for three-story buildings. For two-story buildings the allowable areas may be increased 50 per cent. For buildings four stories or more in height the allowable areas shall be decreased two per cent per floor for each floor above the third floor to and including the eighth floor and shall be decreased one per cent for each additional floor above the eighth floor; provided, that in no case shall there be less than two stairways serving each floor for each building three stories or more in height. Where the entire building is sprinklered in accordance with the provisions of Chapter 38 the allowable areas in Table No. 33-A may be increased 33-1/3 per cent.

**TABLE NO. 33-A—BASIC AREAS FOR COMPUTING
REQUIRED NUMBER OF STAIRWAYS**

No. of Stair- ways Re- quired	Maximum Areas for Types I and II Buildings (Sq. Ft.)				
	Group D Buildings	Group E Buildings	Group F Buildings	Group G Buildings	Group H Buildings
1	Up to 3,000	Up to 4,000	Up to 5,000	Up to 6,000	Up to 3,000
2	Up to 8,000	Up to 9,000	Up to 12,000	Up to 12,000	Up to 9,000
3	Up to 18,000	Up to 20,000	Up to 25,000	Up to 25,000	Up to 20,000
4	Up to 28,000	Up to 30,000	Up to 40,000	Up to 40,000	Up to 30,000
5	Up to 40,000	Up to 40,000	Up to 57,000	Up to 60,000	Up to 42,000
6	Up to 54,000	Up to 50,000	Up to 76,000	Up to 85,000	Up to 56,000
7	Up to 70,000	Up to 60,000	Up to 97,000	Up to 115,000	Up to 72,000
8	Up to 88,000	Up to 70,000	.....	.....	Up to 90,000
9	Up to 108,000	Up to 80,000	.....	.....	Up to 110,000
10	.....	Up to 90,000	.....	.....	.....
	Maximum Areas for Types III, IV and V Buildings (Sq. Ft.)				
	Group D Buildings	Group E Buildings	Group F Buildings	Group G Buildings	Group H Buildings
1	Up to 3,000	Up to 4,000	Up to 5,000	Up to 6,000	Up to 3,000
2	Up to 8,000	Up to 9,000	Up to 12,000	Up to 12,000	Up to 9,000
3	Up to 15,000	Up to 17,000	Up to 21,000	Up to 24,000	Up to 17,000
4	Up to 24,000	Up to 27,000	Up to 32,000	Up to 38,000	Up to 26,000
5	Up to 35,000	Up to 38,000	Up to 45,000	Up to 55,000	Up to 37,000
6	Up to 48,000	Up to 52,000	Up to 60,000	Up to 79,000	Up to 50,000
7	Up to 63,000	Up to 68,000	Up to 77,000	Up to 108,000	Up to 65,000
8	Up to 80,000	Up to 86,000	Up to 96,000		Up to 82,000

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The number of required stairways for Group A, B and C occupancies is specified in Chapters 6, 7 and 8, respectively.

Where a cellar or basement in a Group D, E, F, G and H occupancy is used for other than storage or furnace room purposes, exits, stairs or ramps shall be provided as for the same occupancies on the second floor, except that any basement used by the public or any basement to be used by more than 20 employees simultaneously shall have not less than two stairways.

Exceptions: 1. Group D occupancies shall be provided with not less than one smokeproof tower constructed as specified in Section 3315 when such building exceeds two stories in height.

2. Group E—In automobile storage garages, where a system of ramps continuous from the ground floor to the top floor is used to transport automobiles from floor to floor, the number of stairways required shall be not less than one-half that shown in Table No. 33-A.

3. Where one horizontal exit is provided, the allowable areas tabulated may be increased 15 per cent and where more than one such exit is provided, such areas may be increased not to exceed 25 per cent.

Ramps

Sec. 3310. Wherever stairways are required by this Code, ramps with a slope not greater than one foot (1') in eight feet (8') may be substituted.

Ramps shall comply with all the requirements for stairways as to construction, width, enclosures, landing, lighting and ventilation.

Ramps shall be surfaced with an approved non-slip material.

Handrails shall not be required where the slope of the ramp is less than one foot (1') in ten feet (10').

Horizontal Exits

Sec. 3311. A horizontal exit shall consist of one or more protected openings through or around an exterior wall or occupancy separation or of one or more bridges connecting two buildings or parts of buildings entirely separated by occupancy separations.

Openings used in connection with horizontal exits shall be protected by one-hour fire-resistive doors as specified in Section 4304. If swinging doors are used there shall be adjacent openings with doors swinging in opposite directions, with signs on each side of the wall indicating the exit door which swings with the travel from that side.

Such doors shall be kept continuously unlocked whenever the building is occupied and be normally closed or be self-closing and equipped with fusible links.

Signs and Lighting

Sec. 3312. Signs having white letters not less than five inches (5") high on a green field indicating location of exits shall be provided not only at the exit but at other points in the building wherever necessary to clearly indicate the direction of egress. Lights shall be kept burning during all times that the building is used or occupied.

Passageways and Corridors

Sec. 3313. Safe and continuous passageways, aisles, or corridors leading to exits and so arranged as to provide convenient access to exits for every occupant shall be maintained at all

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times on all floors and in all buildings. The minimum clear width of any passageway, aisle or corridor shall be three feet (3') at the narrowest point and doors swinging into such passageway shall not restrict the effective width at any point during their swing to less than the minimum width herein required.

Sec. 3314. Stairways in Group I occupancies, stairways serving only one apartment not above the second floor level, or stairways leading to mezzanine floors not exceeding one thousand square feet (1,000 sq. ft.) in area are exempted from the width, rise, tread and enclosure provisions in this Chapter but in no case shall such stairways have a rise of more than eight inches (8") and a tread exclusive of the nosing of less than nine inches (9"). **Exceptions**

Sec. 3315. (a) Where Required. A smokeproof tower consisting of a stairway with exterior access, entirely enclosed by masonry walls of not less than four-hour fire-resistive construction and floors and ceilings of not less than two-hour fire-resistive construction and constructed as specified in this Section shall be required in every building of Group D, E, F, G and H occupancies five stories or more in height. Smokeproof towers shall be installed in Group A, B and C occupancies as specified in Chapters 6, 7 and 8, respectively. **Smokeproof Towers**

(b) **Construction.** The stairways, landings, platforms and balconies of smokeproof towers shall be constructed as required for stairways, except that they shall be of incombustible materials throughout, except for handrails which may be of wood. The enclosure shall extend from the street level to a penthouse on the roof of the building and shall be roofed over with incombustible materials. Light and ventilation shall be provided at the top of every such enclosure as required for stairways.

Balustrades on the vestibules and balconies shall be not less than three feet six inches (3' 6") in height. Exit lights shall be provided as required in Section 3312.

(c) **Access and Egress.** Access to the smokeproof tower shall be provided from each story by means of vestibules open to the outside on an exterior wall or by means of balconies overhanging an exterior wall but not subject to severe fire exposure. Every such vestibule, balcony or landing shall have an unobstructed length not less than the combined required width of exit doors opening upon such balcony or landing and shall be directly open to a street, alley or yard or to an enclosed court open at the top and not less than fifteen feet (15') in width and six hundred square feet (600 sq. ft.) in area.

Access from the building to vestibules or balconies and to the enclosure shall be through doorways not less than thirty inches (30") wide nor less than seventy-five inches (75") in clear height. These openings shall be provided with self-closing fire doors of not less than one-hour fire-resistive construction as specified in Section 4302, swinging in the direction of exit travel; provided that clear wire glass not exceeding seven hundred and twenty square inches (720 sq. in.) in area shall be provided in all such doors giving access to the enclosure from the balcony or vestibule. Where locks or latches are provided they shall be of

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an approved pressure-release type and shall be so designed as to provide access from the building at every floor and roof level.

Stairways of smokeproof towers shall provide continuous uniform egress from the roof and all stories to street grade. Egress shall be provided at the ground floor level either directly or through a passageway not less than forty-four inches (44") in clear width and eight feet (8') in clear height to a street, yard or alley not less than ten feet (10') in width. The walls of such passageway shall be of not less than four-hour fire-resistive construction and the ceiling and floor of not less than two-hour fire-resistive construction. The walls of any such passageway shall be unpierced throughout their entire length.

(d) **Location.** Every smokeproof tower required by this Code shall be located so as to furnish the best means of egress for the occupants of the building and access shall be provided thereto by means of a public room, public hall or passageway not less than thirty-six inches (36") in clear width and in no case shall access thereto be through another apartment, guest room, office or private room of any nature.

Outside Stairways

Sec. 3316. Outside stairways of the return platform or straight-run type may be used as a required means of exit for buildings not exceeding five stories or fifty-five feet (55') in height but in no case shall such stairways constitute more than 50 per cent of the required exit capacity. All outside stairways shall be located so as to lead directly to a street or alley or to a yard directly connected with a street or alley.

The stairways, landings, platforms and balconies shall be constructed as specified for stairways in this Chapter, except that they shall be of incombustible materials throughout; provided that stairways serving only the second floor may be constructed of combustible material. Structural metal shall be not less than one-quarter inch ($\frac{1}{4}$ ") thick and shall be so framed as to permit ready access for inspection and painting. All windows and other openings adjacent to such stairways shall be provided with fixed metal covered sash and frames and wire glass or be provided with shutters or doors of one-hour fire-resistive construction.

No part of any such outside stairway shall be within ten feet (10') of a lot line which does not form the boundary of a street or alley.

CHAPTER 34—DOORS, WINDOWS AND SKYLIGHTS

Sec. 3401. Fire doors where required shall be as specified in Section 4304. All such doors shall be self-closing and if not kept normally closed shall be arranged to close automatically with the fusing of an approved fusible link.

Doors and Windows

Windows required to have metal frames shall be constructed either of steel or wrought iron rolled shapes or of hollow galvanized sheet iron, as specified in Section 4304.

When wire glass is required, it shall mean glass the thickness of which at the thinnest point shall be not less than one-fourth inch ($\frac{1}{4}$ ") and in which a wire netting is embedded. Wire glass shall be set with putty and metal stops.

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.

Section 3501

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 AND HEATING APPARATUS

Chimneys

Sec. 3701. Chimneys shall be constructed in conformance with "A Standard Ordinance for Chimney Construction" recommended by the National Board of Fire Underwriters, Third Edition, revised 1927¹, except as specified in this Chapter.

The walls of all chimneys whether used for appliances using coal, coke, wood, or oil shall be built of brick, concrete, stone, hollow tile of clay or concrete or of concrete blocks; provided that a metal smokestack or a patent chimney as specified in Sections 3702 and 3704, respectively, may be used.

Flue linings shall be made of fire clay or of other suitable refractory clays adapted to withstand reasonably high temperatures and flue gases and shall have a softening point not lower than 1994 degrees Fahrenheit. Flue linings shall be not less than five-eighths inch ($\frac{5}{8}$ ") in thickness and shall be built in as the outer walls of the chimney are constructed. All joints and spaces between the masonry and lining shall be thoroughly slushed and grouted full as each course of masonry is laid. Cracked, broken or otherwise defective linings shall not be used. Flue linings shall start from a point not less than eight inches (8") below the center line of smoke pipe intakes or in the case of fireplaces from the apex of the smoke chamber and shall be continuous to a point not less than four inches (4") above the enclosing walls. Flue lining may be omitted in brick chimneys for Group I occupancies provided the walls of the chimneys are not less than eight inches (8") thick and that the inner course shall be of fire brick with a fire resistance equal to that required for flue linings.

The walls of brick chimneys shall be not less than three and three-fourths inches ($3\frac{3}{4}$ ") thick and shall be lined except as provided above. All brick work shall be laid with full mortar joints, and shall be struck smooth where exposed to the weather. No mortar lining shall be permitted.

Concrete chimneys cast in place shall be suitably reinforced vertically and horizontally. The walls shall be not less than three and three-fourths inches ($3\frac{3}{4}$ ") thick and shall have a flue lining as specified in this Section; provided, that flue linings may be omitted in reinforced concrete chimneys for Group I occupancies when the walls of such chimneys are not less than six inches (6") thick.

Hollow blocks or hollow tile of clay or concrete shall not be used for the walls of an independent chimney but may be used for chimneys built in connection with exterior or party walls of hollow units for buildings not exceeding three stories in height. The outer eight inches (8") of such a wall may serve as the outside wall of the chimney.

Chimneys shall extend at least three feet (3') above flat roofs and not less than two feet (2') above the ridge of gable and hip roofs or the high point of mansards irrespective of the distance of the chimney from such obstruction to draft.

Chimneys shall be built upon solid masonry or reinforced concrete foundations properly proportioned to carry the weight imposed without settlement or cracking. The chimney shall

¹See "Specification Documents".

carry no load except its own weight and such load shall be transmitted to the foundation in such manner as to prevent the shearing or falling off of any part of the chimney. The footing for an exterior chimney shall start below the frost line.

Flues shall be built as nearly vertical as possible and in no case at an angle greater than 30 degrees from the vertical.

When any single flue has an effective area exceeding two hundred square inches (200 sq. in.) the wall shall be not less than eight inches (8") thick and shall have flue lining as specified in this Section, except that when flues become too large for fire clay flue lining, such flues shall be lined with fire brick for a distance of at least twenty-five feet (25') from the point of intake.

There shall be but one connection to a flue irrespective of whether the fuel used be coal, coke, wood, or oil. Ordinary and low pressure heating devices burning solid fuels shall have a minimum effective flue area of not less than the following, and such area shall be provided by a flue having its short dimension not less than two-thirds the long dimension.

Small special stoves and heaters.....	28 sq. in.
Stoves, ranges and room heaters.....	40 sq. in.
Fireplaces (at least 1/12 the fireplace opening).....	50 sq. in.
Warm air furnaces, steam and hot water boilers.....	70 sq. in.

All flues to which large ranges, heating furnaces, boilers, automatic gas water heaters or fireplaces are to be connected shall be subjected to a smoke test before acceptance but the test shall not be made until the mortar has thoroughly seasoned. Such test shall be made in the presence of the Building Inspector.

Sec. 3702. Steel or iron smokestacks may be used in place of brick chimneys specified in Section 3701, in which case the thickness of the metal shall be not less than one-fourth inch ($\frac{1}{4}$ "). Such stacks when used for manufacturing, for high pressure boilers, furnaces or other similar heating or manufacturing appliances shall be lined with fire brick for a distance of not less than twenty-five feet (25') from the place where the smoke pipe enters and shall be protected on the outside up to and through the roof of the building with eight inches (8") of masonry or a No. 18 U. S. gauge sheet-metal shield which provides an eight-inch (8") ventilated air space between such shield and the steel or iron stack; provided, that a metal smokestack when located inside of a vent shaft having masonry enclosing walls not less than eight inches (8") thick and having a two-inch (2") air space between the walls and the stack on all sides may have such masonry or metal shield protection omitted. All stacks shall be properly guyed when the height of the stack exceeds 15 times its least diameter.

Smokestacks constructed of not less than No. 10 U. S. Gauge steel, with either welded or riveted joints, may be mounted directly upon industrial, heating or power boilers which are designed to support the stack load. A clearance of not less than six inches (6") shall be maintained at all times around such smokestack and any flammable material within twelve inches (12") of such smokestack shall be protected by one-fourth inch ($\frac{1}{4}$ ") of asbestos covered by sheet metal.

Sections 3703-3704

**Gas
Vents**

Sec. 3703. Gas furnaces, gas water heaters and other gas appliances which are required to be vented, may in lieu of the chimney required in Section 3701, be provided with a vent of unglazed fire clay or concrete tile pipe not less than one-half inch ($\frac{1}{2}$ ") in thickness and having a sleeve or flange not more than twenty-four inches (24") apart and at every joint in such vent pipe. Such sleeves or flanges shall project at least three-fourths inch ($\frac{3}{4}$ ") beyond the outer surface of the joint and shall securely join the sections of such vent and all joints shall be well cemented. The sleeves or flanges shall be securely attached to the portions of the building or structure adjoining such vents and act as a spacer to provide an air space around such vent, or such vent may be entirely enclosed in a galvanized iron pipe with such sleeves or flanges separating the outer pipe at least one-half inch ($\frac{1}{2}$ ") from the clay or concrete vent. The area of any flue or vent shall be not less than the area of the largest vent connection inlet plus 50 per cent of the areas of all other additional inlets, provided that no gas flue or vent shall have an area of less than twelve square inches (12 sq. in.), and shall be not less than two inches (2") in any internal dimension. No vent connection inlet shall be located at the bottom of any gas vent, and any two inlets must be offset or staggered so that it will be impossible for any horizontal plane to pass through any part of both inlets.

A single galvanized or copper bearing metal vent connection exposed to view in a room throughout its entire length may be used to connect the appliance to the vent. Such metal vent connection shall be not less in diameter than the connection on the appliance and shall be maintained not less than six inches (6") distant from any combustible portion of the building or the combustible material shall be protected by not less than one-hour fire-resistive construction. Every portion of a vent connection shall have a rise of not less than one inch (1") to the foot from the appliance to the chimney and the length of such connection shall be no greater than the height of the vent from the point at which the vent connection enters to the top of the vent.

Every vent shall extend in as nearly a vertical position as possible and be continuous from the gas appliance to the outside of the building and extend at least two feet (2') above any portion of the roof within fifteen feet (15') of said vent.

No vent connection connected to any gas appliance having pilot provision for automatic or remote control, shall be connected to any chimney flue which is used as a smoke flue for any stove, boiler, heater or other apparatus designed to burn wood, coal, oil or other fuel other than gas unless such pilot provision is so designed that the supply of gas to the main burners in connection therewith will be automatically shut off when combustion of gas is not taking place at the pilot.

**Patent
Chimneys**

Sec. 3704. Patent chimneys may be used, except for oil burners, when complying with the requirements of this Code.

All patent chimneys shall be constructed with a flue lining enclosed in a metal outer casing which is so arranged as to provide not less than a one inch (1") air space between the flue lining and the casing. The flue lining shall be made of fire clay or suitable refractory clays adapted to withstand reasonably

high temperatures and flue gases, shall have a softening point not lower than 1994 degrees Fahrenheit and shall be not less than one inch (1") in thickness. Such chimneys shall be built up from the floor level on which they are used and in no case shall a stove pipe enter the bottom of a patent chimney.

When such chimneys are erected on the outside of a building they shall be supported by a substantial iron bracket attached to the studs or framework of the building with through-bolts. When erected on the inside of a building such patent chimneys shall be provided with a smokeproof clean-out of approved design at or near the floor. The floor on which they are placed shall be protected by not less than eight inches (8") of masonry or terra cotta set on a one-fourth inch ($\frac{1}{4}$ ") metal plate. Partitions enclosing patent chimneys shall have an opening opposite the clean-out on the chimney for the purpose of cleaning the flue.

When such chimneys are used with fireplaces, they shall be supported by a metal plate embedded in mortar at the throat of the fireplace. The metal plate shall provide a means of keeping the one inch (1") air space between flue lining and casing.

All patent chimneys shall be built plumb and without bends. All joints in such chimneys shall be made with cement mortar and the bands covering the joints shall be of not less than 24 U. S. Gauge galvanized iron. All patent chimneys shall be braced every six feet (6') in their height by not less than 16 gauge wire secured to the chimney by locks or collars and extending in at least three directions.

Not more than two inlets for smoke pipes will be permitted in any patent chimney. When only one inlet is provided the flue shall be not less than six inches (6") in diameter and shall be not less than eight inches (8") in diameter where two inlets are provided.

All galvanized iron used for the casing of patent chimneys shall be of 24 U. S. Gauge riveted together with rivets not more than three inches (3") apart or seamed and with such seams secured with rivets at the top and bottom of each section. There shall be not less than one inch (1") clearance between the chimney and the casing at all points and such casing shall be ventilated by not less than six one inch (1") holes punched near the top of the chimney above the roof and in each inlet to the chimney.

Sec. 3705. All smoke pipes shall be as short and straight as possible. Smoke pipes for furnaces, boilers or apparatus burning solid or liquid fuel shall be constructed of black iron of not less than 24 U. S. Gauge or masonry and shall fit tightly into the chimney. Galvanized iron shall not be used.

Smoke pipes shall enter the side of chimneys through a fire clay or metal thimble or a flue-ring of masonry. The top of smoke pipe intakes shall be set not less than eighteen inches (18") below sheet metal ceilings, wood lath and plaster or exposed wood framing. Neither the intake pipe nor the thimble shall project into the flue. No wood-work shall be placed within six inches (6") of the thimble. When a smoke pipe enters a chimney breast through a studded-off chimney partition the thimble shall be kept six inches (6") clear of all woodwork.

**Pipes
and
Thimbles**

Sections 3706-3707

Fire-places

Sec. 3706. All fireplace walls shall be not less than eight inches (8") thick and if built of stone or hollow units shall be not less than twelve inches (12") thick. The faces of all such minimum thickness walls exposed to fire shall be lined with fire brick, soap stone, cast iron or other suitable fire-resistive material. When lined with four inches (4") of fire brick such lining may be included in the required minimum thickness. All fireplaces shall be connected to a regulation chimney as specified in Section 3701, or to a patent chimney as specified in Section 3704.

All fireplaces and chimney breasts shall have trimmer arches or other approved fire-resistive construction supporting hearths. The arches and hearths shall be not less than twenty inches (20") wide measured from the face of the chimney breast and not less than twelve inches (12") wider than the fireplace opening on each side. The arches shall be of brick, stone or hollow tile not less than four inches (4") thick. A flat stone or reinforced concrete slab may be used to carry the hearth instead of an arch if it be properly supported and a suitable fill provided between it and the hearth. Hearths shall be of brick, stone, tile or concrete. Wood centering under a trimmer arch shall be removed after the masonry has thoroughly set.

False fireplaces for gas or electrical heaters shall not be constructed in imitation of fireplaces unless complying with all the requirements for fireplaces. Gas and electrical space heaters may be installed in recesses not more than six inches (6") in depth, provided the entire recess is constructed of incombustible material. Such recesses shall be labeled by means of a metal plate bearing the words "For Gas and Electrical Appliances Only."

No heater burning solid or liquid fuel shall be placed in a fireplace which does not comply with the requirements of this Section. No such heaters shall be connected to a gas vent flue. No wood shall be placed within eight inches (8") of the jambs or within twelve inches (12") of the top or arch of any fireplace opening.

Warm Air Furnaces

Sec. 3707. Warm air furnaces designed to burn solid or liquid fuel shall be encased in a double metal shield with an air space between and shall be protected with at least three inches (3") of sand on top and shall rest on masonry or concrete floors. No wood partitions shall be built within seven feet (7') of the front or four feet (4') of the sides of the outer shield of such furnaces, but the distance to the partitions at the side may be reduced to two feet (2') if they are covered with sheet metal or metal lath and plaster. The distance from the top shield of such furnace to any ceiling or framing of wood above shall be not less than twenty-four inches (24") unless such wood ceiling or framing is protected with not less than one-hour fire-resistive construction as specified in Section 4302.

Every furnace designed to burn solid or liquid fuel shall set upon a masonry floor or be placed on a bed of not less than four inches (4") of masonry and every portion thereof including the smoke pipe shall be at least two feet (2') 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 (1½")

Sections 3707-3709

from such combustible construction or shall be entirely covered by one-hour fire-resistive construction. Any such furnace set in masonry shall be completely and tightly covered with at least four inches (4") of brick, concrete, tile, sand or a combination of such materials. Every such furnace shall be connected to a regulation chimney as specified in Section 3701.

Every gas furnace other than single pipe floor furnaces shall be set in a furnace room upon a masonry floor or shall be set upon not less than two inches (2") of masonry on asbestos board not less than one-half inch ($\frac{1}{2}$ ") in thickness covered with No. 20 U. S. Gauge galvanized iron or steel. The top of such furnace shall be not less than nine inches (9") from protected combustible material nor less than eighteen inches (18") from unprotected combustible material. Gas furnaces shall not be installed in any location inaccessible for inspection and repair. An opening or door not less than thirty by thirty-six inches (30"x36") shall be provided for access to the room or space in which any gas furnace is installed. Every such furnace shall be vented into a regulation chimney as specified in Section 3701 or as provided in Section 3703.

An air supply for combustion shall be provided for every warm air furnace. Such supply shall be from outside the building into the furnace space through one or more openings. Such openings shall have a net area of not less than four hundred square inches (400 sq. in.). No obstruction of any kind shall be placed over such openings except wire netting with openings not less than one-half inch ($\frac{1}{2}$ ") square. 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 by means of ducts of incombustible material.

The furnace room or rooms shall be located in the basement or cellar of any building having a gravity system and the least horizontal dimension of such room shall be six feet (6'). The floor of the furnace room shall be not less than seven feet (7') in the clear below the bottom of the lowest joists of any floor under which lateral heat pipes from the furnace or furnaces are taken and such floor shall be constructed of incombustible materials.

Sec. 3708. Steam hot water heating plants, for not more than 15 pounds pressure, and hot water heaters using solid or liquid fuel, shall rest upon masonry or reinforced 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**

Sec. 3709. 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 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 and shall be well ventilated to prevent the temperature rising above 125 degrees Fahrenheit. Steel, cast iron or concrete columns ad-

Boilers

Sections 3709-3712

jacent 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.

Stoves

Sec. 3710. 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.

All such stoves shall be connected by a smoke pipe conforming to the requirements of Section 3705 and to a chimney meeting the requirements of Section 3701.

Gas Ranges, Domestic Water Heaters, and Hot Plates

Sec. 3711. Gas ranges, domestic hot water heaters and hot plates shall be supported at least six inches (6") above any wood floor or other combustible material and where burners are not provided with a shield below, the wood or other combustible material shall be protected with a double metal shield with a one inch (1") air space between or with a one-half inch ($\frac{1}{2}$ ") pad of metal and asbestos. Combustible partitions or walls within six inches (6") of any gas range, hot plate or ordinary domestic hot water heater, and within three inches (3") of any approved domestic automatic storage hot water heater shall be protected by one-fourth inch ($\frac{1}{4}$ ") of asbestos, covered with a 26 U. S. gauge metal covering or shall have not less than a one-hour fire-resistive protection, provided that approved domestic gas ranges of the fully insulated type shall be exempt from the foregoing requirements. Wood ceiling or other combustible materials shall be at least three feet (3') above such installations. All water heaters shall be connected to a vent pipe meeting the requirements of Section 3703 or to a regulation chimney as specified in Section 3701.

In the kitchen of every building hereafter erected there shall be provided a chimney as provided in Section 3701, a vent as provided in Section 3703 or in lieu of such chimney or vent, when approved by the Building Inspector, there may be installed in the wall or ceiling approximately over the gas outlet, a ventilating opening with an area of not less than six inches by eight inches (6" x 8"), connected to a ventilating duct leading to the outside air, such duct for each kitchen to be not less than twenty-four square inches (24 sq. in.) in cross sectional area. An approved system of forced draft ventilation may be substituted for the natural draft ventilating system.

Gas Ranges for Restaurants and Hotels

Sec. 3712. Gas ranges for restaurants, bakeries or hotels 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 or such ranges may rest on a steel and masonry support. Such ranges shall not be placed nearer to any wood partitions or other combustible material than six inches (6") and if nearer than twelve inches (12") such par-

titions shall be protected with a metal or asbestos shield. The distance from any such range to any 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 one inch (1") of metal lath and portland cement plaster or one inch (1") of asbestos. Hood and ventilating flues from such ranges may be of sheet metal or masonry and if of sheet metal shall be protected from all wood or other combustible materials by four inches (4") of concrete, gypsum or terra cotta tile or an eight inch (8") air space and a metal shield. Such ventilating flues shall not be carried through wood floors or up combustible partitions unless protected by at least four inches (4") of masonry or concrete.

Sec. 3713. Stoves, furnaces and other heating or power apparatus in which oil burners are installed shall be constructed and erected as required for similar apparatus using solid fuel.

**Oil
Burners**

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 National Board of Fire Underwriters for the "Construction and Installation of Oil Burning Equipment and for the Storage and Use of Oil Fuels in Connection Therewith" recommended by the National Fire Protection Association, Edition of 1934, with amendments of 1936¹.

Sec. 3714. Other sources of heat and flame not specifically mentioned herein shall be constructed and so protected as to prevent heating any wood or other combustible material used in the construction of floors, ceilings, partitions or other parts of a building to a temperature of over 125 degrees Fahrenheit, when in full operation, and shall be so constructed as not to be liable to undue corrosion or deterioration and not subject to accidental overturn or other disarrangement conducive to dangerous conditions.

**Other
Sources
of Heat**

Sec. 3715. 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 such length shall not exceed forty feet (40'). All such pipes under first floor joists shall have a uniform rise of at least one inch (1") per lineal foot of horizontal run. 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 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.

**Warm Air
Duets and
Appurtenances**

Registers shall be located in or near the wall of the room nearest the furnace. No register shall be located in outside walls except in cases of absolute necessity. 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. When necessary to install appurtenances in an outside

¹See "Specification Documents".

Sections 3715-3716

wall at least the weather side shall be covered with air-cell asbestos paper.

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.

All riser pipes shall be braced or 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.

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.

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 14 inches (14") clear space in continuous horizontal runs and/or vertical risers from the furnace to the register served.

Incinerators

Sec. 3716. All incinerators which are built as an integral part of the building shall have the enclosing walls of the fire boxes or combustion chamber of solid masonry or reinforced concrete not less than eight inches (8") in thickness where the horizontal area does not exceed fifteen square feet (15 sq. ft.) and not less than twelve inches (12") in thickness where the combustion chamber is of greater area. The inner four inches (4") of such combustion chamber walls shall be of fire brick laid in fire clay or cement mortar, except that the walls surrounding the ash chamber below the fire grate need not be so lined. The inner walls of any combustion chamber shall not be offset in excess of one inch (1") for every three inches (3") of rise in the height of the wall unless supported by reinforced concrete or structural steel.

The chimney for every incinerator shall be constructed as specified in Section 3701, with an approved spark arrester placed over the top of the chimney.

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 working 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.
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. Every automatic sprinkler system required by this Code shall comply in all respects with the regulations of the National Board of Fire Underwriters recommended by the National Fire Protection Association for the "Installation of Sprinkler Equipment" Edition of 1940.

**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

¹See "Specification Documents".

Sections 3802-3804

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 Inspector. 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.

Sections 3804-3806

(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 permanent 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.

(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 hose 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").

**Detailed
Requirements**

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 Inspector 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 Inspector. In Group C, D, E, F, G, and H occupancies the location of all interior wet standpipes shall be approved by the Building Inspector.

(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 power 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

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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 Inspector 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

Sec. 3809. Where it is desired to require flame-protection of all stage scenery provisions will be found in the Appendix.

**Flame
Protection**

CHAPTER 39—STAGES AND PLATFORMS

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:

Stage Ventilators

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 Inspector.

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.

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.

Gridirons

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.

Sec. 3903. In buildings having a working 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."

Rooms Accessory to Stage

In buildings having any stage other than a working stage, 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."

Sec. 3904. A working 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.

Proscenium Walls

Sections 3904-3908

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 working stage shall be protected on each side by one-hour fire-resistive 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.

Stage Floors

Sec. 3905. All parts of working stage floors shall be of Type I 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 door 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.

Platforms

Sec. 3906. Walls and ceilings of a platform in an assembly room shall be protected on the platform side with lath and plaster as approved for one-hour fire-resistive construction.

Any usable space under a raised platform of an assembly room shall be of one-hour fire-resistive construction throughout.

Stage Exits

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.

Miscellaneous

Sec. 3908. A protecting hood shall be provided over the full length of the stage switchboard.

CHAPTER 40—MOTION PICTURE MACHINE BOOTHS

Sec. 4001. Every motion picture machine using flammable 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 booth large enough to permit the operator to walk freely on either side or in back of the machine and shall be not less than seven feet (7') high and have a floor area of not less than fifty square feet (50 sq. ft.) to each motion picture machine in such booth.

Motion Picture Machine Booths

The floor of such booth shall be constructed of masonry or reinforced concrete or shall be covered with not less than two inches (2") of masonry. The walls and ceiling shall be of not less than one-hour fire-resistive construction.

The entrance to booth shall be equipped with a tight-fitting self-closing fire door of Types 4, 5 or 6 as specified in Section 4304. Such door shall open outwardly and shall not be equipped with any latch.

Machine and observation ports in machine booth walls shall be of three kinds; projection ports, observation ports, and combination observation and spot light ports. These ports shall be limited in size and number as follows: There shall be not more than one projection port for each machine head, including stereopticon machines. The area of each projection port shall be not more than one hundred twenty square inches (120 sq. in.). There shall be not more than one observation port for each projection port and their area shall not exceed one hundred fifty square inches (150 sq. in.) each. There shall be not more than three combination observation and spotlight ports and they shall not exceed thirty inches (30") by twenty-four inches (24"). Where the openings in the front wall of the projection booths are larger than the ports specified, they may be reduced to the required size by bolting No. 10 U. S. gauge steel plate over the opening on the booth side of the wall, in such a manner that they cannot be readily removed or moved on the slides. These steel plates shall have the openings of the required size cut in them. There shall be not less than one foot (1') of wall space between openings for combination ports. In no case shall the openings which are to be reduced in size by the steel plate be larger than thirty-six inches (36") square. Each port opening in the projection booth wall shall be completely covered with a single pane of plate glass. Each such opening together with any fresh air inlets, shall be provided with a shutter of not less than No. 10 U. S. gauge sheet metal large enough to overlap at least one inch (1") on all sides of such opening and arranged to slide without binding. These shutters shall be held normally open by means of small chains fastened to a 160 degree Fahrenheit fusible link, the whole so arranged that the shutters may be easily released and closed either by hand or automatically when released by the fusible link and shall be so designed as to effect a weight of not less than eight pounds on each fusible link. Pieces of film shall not be used in place of fusible links. The shutters shall be so hung that the operation of closing shall be

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smooth and without noise. The closing of all shutters shall be effected in five seconds.

Every booth shall be equipped with a ventilating inlet not less than thirty square inches (30 sq. in.) in area placed near the floor on each of three sides, and protected by wire netting. At the top of every booth there shall be at least a ten inch (10") diameter vent for each motion picture machine. Such vent shall be constructed of sheet metal not less than No. 24 U. S. gauge and shall connect into a masonry flue or go directly through the roof and twelve inches (12") above, and shall be provided with an exhaust fan which will produce a complete change of air in the booth every 10 minutes. No wood or other combustible material shall be allowed to come within four inches (4") of the vent. There shall be not more than one elbow or change in direction of this metal vent in any attic space. No such vent shall pass through any occupied room unless encased in not less than four inches (4") of solid masonry.

All shelves, furniture and fixtures within the booth shall be constructed of metal or other incombustible material. Every motion picture machine shall be securely fastened to the floor to prevent overturning.

All films not in actual use shall be stored in metal cabinets or boxes constructed of galvanized iron or steel with metal partitions and shelves. Each such compartment shall have a capacity not in excess of 10 reels of film, and shall have tight self-closing doors of iron or steel. No solder shall be used in the construction of such metal boxes or cabinets.

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 Inspector, 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

Sections 4103-4104

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 Inspector 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 Inspector.

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-eighths-inch (⅜") turn-

Section 4104

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.

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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 Inspector.

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 board (or lath) and plaster.
- Hollow clay tile
- Metal
- Metal and asbestos
- Metal lath and plaster
- Portland cement concrete (plain or reinforced)
- Sand-lime brick

Sec. 4203. All fire-resistive construction of burned clay, concrete or gypsum units or other similar units shall be solidly bedded and laid in gypsum mortar, lime-cement mortar or cement mortar; provided, that gypsum units shall be laid in gypsum mortar only. All such units shall be thoroughly bonded together by broken joints in alternate courses or by sufficient metal ties or bonds.

Fire-Resistive Construction

All concrete, gunite, 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.

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. Guniting 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 shown 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 given 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 gunite 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
	Gunitite	2	1½	1	¾
	Brick of clay, shale, concrete or sand-lime	3¾	3¾	2¾	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
Webs of Steel Beams and Girders	Grade A concrete	2	1½	1	1
	Grade B concrete	3	2½	1½	1
	Gunitite	2	1½	1	¾
	Brick of clay, shale, concrete or sand-lime	3¾	2¾	2¾	2¾
	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
Reinforcing Steel in Reinforced Concrete Columns, Beams, Girders and Trusses	Grade A concrete	1½	1½	1½	1
	Grade B concrete	2	1½	1½	1
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
	Gunitite	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 ¼ in. air space between.

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The structural requirements of the masonry and reinforced concrete walls shown in Table No. 43-B are specified in Chapters 24 and 29 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 reinforced 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	1 1/4-in. face Shells	Unplastered	8	4†
			Plastered one side	8 1/2	4 1/2†
		1 1/4-in. face Shells	Unplastered	12**	8
			Plastered each side	9	
	Other Aggregates—	2 1/4-in. face Shells	Unplastered	8	
			Unplastered	8	4†
		1 1/2-in. face Shells	Plastered each side	9	5†
		1 1/4-in. face Shells	Unplastered	12	8
Solid Concrete		2 1/4-in. face Shells	Plastered each side	9	
			Unplastered	8	
Solid Concrete	Reinforcement not less than 0.2% in each direction		6	5*	4*
Solid Gunitite	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*	3*
Hollow Wall of Reinforced Gunitite	Outer shell 2-in. thick for 10-in. wall and 1 1/4-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. 3/4-in. plaster on each side				3*
Hollow Stud Partition with Gypsum or Portland Cement Plaster or Gunitite on Each Side	Incombustible studding with metal or wire lath. 1-in. plaster on each side			2* & 4 1/2*	
	Wood studs with metal or wire lath. Fire-stopped. 3/4-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 1/2-in. perforated gypsum lath. Fire-stopped. 1/2-in. gypsum plaster each side				3* or 5

*Shall be used for non-bearing purposes only.

**8 in. for Expanded Slag.

†1 1/2 in. Face Shells.

Section 4303

**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 reinforced 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 protected with fire-resistive materials of the kind and thickness shown 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 reinforced 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 protected with fire-resistive materials of the kind and thickness shown 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 reinforced 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 protected with fire-resistive materials of the kind and thickness shown 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. Reinforced 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 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 the lowest floor joists over usable space.

4. Wood-joisted construction with a double floor on top [the

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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.

Fire-Resistive Floor, Roof and Ceiling Construction (Cont'd.)

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) Fire-Resistive Doors. One-hour fire-resistive doors shall be constructed as specified for one of the following types, 1, 2 or 3, or any door which will successfully pass the one-hour fire test specified in Section 4201, and all such doors to receive the one-hour rating, shall be hung in place as specified in this Section.

Fire Doors, Shutters, and Windows

TABLE NO. 43-C—MINIMUM PROTECTION FOR STEEL JOISTS
(Based on Time Periods for Various Insulating Materials)

FIRE RESISTANCE PERIOD (in hours)	THICKNESS OF INCOMBUSTIBLE SLAB ABOVE JOISTS (in inches)	THICKNESS OF PROTECTION UNDER JOISTS (in inches)				CONCRETE, BURNED CLAY PRODUCTS OR GYPSUM (in inches)
		PLASTER ON METAL OR WIRE LATH (As specified in Chapter 47)				
		Gonite	Neat Wood-Fibered Gypsum	Sanded Gypsum	Portland Cement	
4	2 1/2	1 1/2	2	2	2	2
3	2 1/2	1	1	1 1/2	1 1/2	1 1/2
2	2 1/4	3/4	3/4	3/4	1	1
1	2	3/4	3/4	3/4	3/4	3/4

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Fire Doors, Shutters, and Windows (Cont'd.)

Fire-resistive doors used for openings in stairway enclosures, smokeproof towers, corridors and passageways, moving picture booths, room partitions; exterior walls facing streets or more than twenty-five feet (25') from adjacent property lines and for "Ordinary Occupancy Separations" as specified in Section 503, shall be constructed as specified for one of the following types: 1, 2, 3, 4, 5 or 6 or any door which will provide equivalent protection against fire when hung in place as specified in this Section.

1. Tin-clad wood-core doors with the core made of three plies of wood one inch (1") nominal in thickness and covered with sheet metal, the door to be constructed in accordance with the "Underwriters' Standard for Tin-Clad Fire Doors and Shutters," Edition of December, 1941.

2. Sheet metal doors constructed of two sheets of not less than No. 26 U. S. Gauge corrugated sheet metal, one sheet on each side of a structural steel frame, corrugations vertical on one side and horizontal on the other and having not less than one-sixteenth inch ($\frac{1}{16}$ ") of asbestos placed in between the two metal sheets.

3. Sheet metal doors constructed of two sheets of metal of not less than No. 26 U. S. Gauge fastened to a structural steel frame in such manner as to leave a one inch (1") space in the panels, which space shall be filled with asbestos and with a one-eighth inch ($\frac{1}{8}$ ") asbestos covering on the stiles and structural steel frame.

4. Tin-clad wood-core doors made of two plies of wood one inch (1") nominal in thickness and covered with sheet metal, the door to be constructed in accordance with the "Underwriters' Standard for Tin-Clad Fire Doors and Shutters," Edition of December, 1941.

5. Sheet metal doors as specified in paragraph 3 above, but with one-fourth inch ($\frac{1}{4}$ ") of asbestos placed between the metal sheets in the panels and with no asbestos required on the stiles and structural frame.

6. Metal-clad doors which shall be wood panel doors with frame not less than one and three-fourths inches ($1\frac{3}{4}$ ") in thickness and with wood panels not less than three-fourths inch ($\frac{3}{4}$ ") in thickness, the whole door covered with not less than No. 26 U. S. Gauge metal. The panels of such doors shall fit into the frame not less than three-fourths inch ($\frac{3}{4}$ ") and all joints of metal shall be lapped and nailed tightly to the wood frame.

In all cases metal shall be fastened to the wood or metal frame by nailing, bolting or riveting and no solder shall be used on any door except for filling of joints.

Glass panels of one-fourth inch ($\frac{1}{4}$ ") wire glass shall be permitted in any of the above doors except when such doors are used on all openings for the stage portion of any Group A occupancy or for openings in "Special Occupancy Separations" as specified in Section 503. Such glass panels shall be not more

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than seven hundred and twenty square inches (720 sq. in.) in area, nor exceed fifty-four inches (54") in height or forty-eight inches (48") in width. Grooves not less than three-fourths inch ($\frac{3}{4}$ ") in depth and three-eighths inch ($\frac{3}{8}$ ") in width providing not less than five-eighths inch ($\frac{5}{8}$ ") of bearing for the glass shall be required.

**Fire Doors,
Shutters, and
Windows**
(Cont'd.)

Fire doors bearing the label of the Underwriters' Laboratories, Incorporated, shall be accepted as meeting the requirements of any of the above doors.

Hardware for sheet metal and tin-clad fire doors referred to in paragraphs No. 1, 2, 3 and 4, shall be made of good quality malleable iron not less than one-fourth inch ($\frac{1}{4}$ ") thick or of flat rolled structural steel not less than three-eighths inch ($\frac{3}{8}$ ") thick; provided, that tubular steel track made of at least one-eighth inch ($\frac{1}{8}$ ") steel may be used. Sliding tracks shall be supported so that a wall fastening is directly opposite each door hanger when door is in a closed position. Hangers supporting doors shall be fastened to the door with not less than three one-half inch ($\frac{1}{2}$ ") bolts extending through the door. Latches for fire doors shall be not less than two and one-half inches by three-eighths inch ($2\frac{1}{2}$ " x $\frac{3}{8}$ "), and latch bars shall be not less than one and one-half inches by one-fourth inch ($1\frac{1}{2}$ " x $\frac{1}{4}$ ").

Hardware for swinging hollow metal and metal-clad doors as referred to in paragraphs 5 and 6 shall be made as follows:

Hinges. For doors not exceeding eight feet (8') in height the hinges shall be of steel or bronze. If made of steel they may be either full, half surfaced, or butt hinges four and one-half inches by four and one-half inches ($4\frac{1}{2}$ " x $4\frac{1}{2}$ ") and not less than one-eighth inch ($\frac{1}{8}$ ") in thickness. If made of bronze they shall be butt hinges four and one-half by four and one-half inches ($4\frac{1}{2}$ " x $4\frac{1}{2}$ ") and not less than three-sixteenths inch ($\frac{3}{16}$ ") in thickness. When bronze hinges are used a steel stud and socket shall be provided at each hinge. The studs shall be attached to the rear jamb and shall engage a socket at least three-fourths inch ($\frac{3}{4}$ ") deep in the rear edge of the door.

Locks. Doors shall be provided with a mortise or unit lock which has a latch bolt with a throw of not less than three-fourths inch ($\frac{3}{4}$ ").

When mounted in pairs the normally standing door shall have a push bolt at the top and at the bottom which has a throw of not less than three-fourths inch ($\frac{3}{4}$ ").

Special locking devices shall be provided as required in Part III under Occupancy, and as provided in Sections 3304, 3311 and 3315.

Astragals. Swinging fire doors mounted in pairs shall be provided with at least one astragal attached to one door and overlapping the opposite door at least three-fourths inch ($\frac{3}{4}$ "). The above provision need not apply when the doors meet on a mullion.

Fire doors required by this Code shall be installed in the manner prescribed in the "Regulations for the Protection of

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Openings in Walls and Partitions Against Fire," of the National Board of Fire Underwriters, recommended by the National Fire Protection Association, Edition of January, 1939.¹

All fire doors shall be so hung that when closed they will fit tightly into place against the wall or frame so as to prove an effective stop for fire and smoke. Space around fire doors necessary for their operation shall at all times be kept unobstructed and when deemed necessary by the Building Inspector a screen or railing protection shall be installed to insure no storing or placing of material against any fire door which would prevent its operation in case of emergency.

(b) **Fire-Resistive Shutters.** One-hour fire-resistive shutters shall be constructed as specified for any one of the types of fire-resistive doors specified in part (a) of this Section.

(c) **One-Hour Fire-Resistive Windows.** One-hour fire-resistive windows shall have frames and sash of solid metal bars or hollow metal forms fabricated by pressing, welding or crimping together but not by the use of solder or other fusible alloy. All glass used in fire-resistive windows shall be wire glass and shall be not less than one-fourth inch ($\frac{1}{4}$ ") in thickness and no one light shall exceed seven hundred and twenty square inches (720 sq. in.) in area. Grooves three-fourths inch ($\frac{3}{4}$ ") in depth shall be provided and glass so arranged as to have not less than five-eighths inch ($\frac{5}{8}$ ") of bearing in hollow metal frames and with grooves not less than one-half inch ($\frac{1}{2}$ ") and with glass provided with not less than three-eighths inch ($\frac{3}{8}$ ") of bearing in windows of solid metal section. Continuous glazing angles shall be provided on the inside. Fire-resistive windows with hollow metal frames shall be limited to a maximum size of sixty square feet (60 sq. ft.) with a six-foot (6') maximum width and a ten-foot (10') maximum height for double hung and counterbalanced windows and to a maximum size of seventy square feet (70 sq. ft.) with a seven-foot (7') maximum width and ten-foot (10') maximum height for stationary windows. Solid metal section windows shall be limited to a maximum size of eighty-four square feet (84 sq. ft.) in area with a maximum dimension in either direction of twelve feet (12'). Multiple section windows of these above sizes may be used when hollow metal or solid section mullions are provided. Hollow metal mullions shall be limited to a maximum length of twelve feet (12') and shall be used for non-bearing purposes only. Solid section mullions when used in lengths exceeding twelve feet (12') shall be fire-protected as required in Section 4301 in accordance with the fire-resistive construction of the building in which they are placed. Where fire-resistive windows are required by this Code, wood sash and plain glass may be substituted when protected as specified in Subsections (a) and (b) of this Section.

Fire-resistive windows bearing the label of the Underwriters' Laboratories, Incorporated, shall be accepted as one-hour fire-resistive windows.

Roof Coverings

Sec. 4305. (a) General. Roof coverings for all buildings shall be either "Fire Retardant" or "Ordinary" roofings as specified.

¹See "Specification Documents".

cifically 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," (D146-38T)¹.

(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. 43-D, equals

¹See "Specification Documents".

Section 4305**Roof Coverings (Cont'd.)**

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

TABLE NO. 43-D
MINIMUM PHYSICAL PROPERTIES AND FIRE-RETARDANT VALUE OF ROOFING MATERIALS

Reference Number	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					
No. 15	Roofing Felt (Rag).....	14	5.6	140	3
No. 14	Roofing Felt (Asbestos).....	14	9.5	40	5
No. 18	Felt Membrane (Asbestos).....	18	8.5	50	5
No. 20	Felt Membrane (Rag).....	20	5.0	120	3
No. 40	Roll Roofing (Rag).....	37	7.5	140	6
No. 42	Roll Roofing (Rag).....	40	10.0	150	6
No. 30	Roofing Felt (Rag).....	26	10.0	150	6
(b) CAP SHEETS (MAY BE USED AS BASE SHEETS)					
No. 116	Split Sheet Roofing (2 layers min.).....	58 (each)	10.0 (each)	150	15
No. 41	Roll Roofing (Asbestos).....	40	13.0	50	9
No. 43	Built up Felt (Asbestos).....	41	6.4 (each)	40	9
No. 90	Mineral Surfaced (Rag).....	87	10.0	150	10
No. 14	(2 layers) Roofing Felt (Asbestos).....	.....	.....	.....	10
No. 55	Roll Roofing Black Top (Asbestos).....	50	17.5	50	10
No. 35	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).

Roof Coverings
(Cont'd.)

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 given in Table No. 43-D 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 given in Table No. 43-D equal to not less than six, unless otherwise required because of location as specified in Parts IV and V of this Code.

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 Inspector 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 light 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**

Sections 4405-4406

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 required 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.

The walkway over the evacuated 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.

Protection of Sidewalk Excavations

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. No part of any marquee shall be less than two feet (2') from the curb line.

No part of any marquee extending more than two-thirds of the distance from the property line to the curb line shall be less than twelve feet (12') above the ground or pavement below.

No part of any marquee extending not more than two-thirds of the distance from the property line to the curb line shall be less than eight feet (8') above the ground or pavement below.

(c) Length. The length of a marquee which projects more than two-thirds the distance from the property line to curb shall not exceed twenty-five feet (25') along the direction of the street.

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(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.

(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 incumbustible 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 Inspector.

The Building Inspector 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 Hydrated Lime for Structural Purposes," (C6-31).

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, (C150-42), 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," (A-42, 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 ($\frac{3}{16}$ ") 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	3.0	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.	16 ga. with $\frac{3}{8}$ " flanges
Up to 3 feet	1"	410 lb./1000 ft.	16 ga. with $\frac{3}{8}$ " flanges
Up to 4 feet	1 $\frac{1}{4}$ "	650 lb./1000 ft.	16 ga. with $\frac{3}{8}$ " flanges

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 gunite 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 gunite 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 gunite 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	$\frac{3}{4}$ " 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

**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:

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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				3.0
Woven netting	1"	1 "	18	1.0
Woven netting	1"	1½"	17	1.4
Woven netting	1"	2 "	10	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 sticking. 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.

(c) **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 ($\frac{1}{4}$ ") 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

TABLE NO. 47-F—EXTERIOR PORTLAND CEMENT PLASTER

COAT	MAXIMUM VOLUME OF SAND PER VOLUME OF CEMENT	MINIMUM THICKNESS	MINI- MUM PERIOD MOIST CURING	MINIMUM INTERVAL BEFORE APPLICATION OF SUCCEEDING COAT
First or scratch	3 $\frac{1}{4}$	$\frac{1}{4}$ "**	48 hrs.	7 days
Second or brown	4 $\frac{1}{4}$	(1st & 2nd coats) $\frac{1}{4}$ "	48 hrs.	7 days
Third or finish	2**	$\frac{1}{4}$ "		

*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 ($\frac{1}{8}$ ") clipped teeth and grooves not more than one-half inch ($\frac{1}{2}$ ") deep.

The second coat shall be rodded and water floated, with no variation greater than one-quarter inch ($\frac{1}{4}$ ") 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

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 rodged 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 290.

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 290.

Refrigeration

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 49 Uniform Building Code

<i>Author Organization's Designation</i>	<i>Subject</i>	<i>Section</i>
American Society of Refrigerating Engineers:		
April, 1939	Safety Code for Mechanical Refrigeration. Approved by A.S.A.	4901

Section 6002

American Society for Testing Materials:		Section
A7-42	Standard Specification for Steel for Bridges and Buildings.	2701
A15-39	Standard Specification for Billet-Steel Bars for Concrete Reinforcement.	2604(d)
A16-35	Standard Specification for Rail-Steel Bars for Concrete Reinforcement.	2604(d)
A27-42	Standard Specification for Carbon-Steel Castings for Miscellaneous Industrial Uses.	2701
A48-41	Standard Specification for Gray Iron Castings.	2701
A53-42	Standard Specification for Welded and Seamless Steel Pipe.	2701
A82-34	Standard Specification for Cold-Drawn Steel Wire for Concrete Reinforcement.	2604(d), 2620(c)
C5-26	Standard Specification for Quicklime for Structural Purposes	2402, 4702
C6-31	Standard Specification for Hydrated Lime for Structural Purposes.	2402, 4702
C19-41	Standard Methods of Fire Tests of Building Construction and Materials.	4201
C22-41	Standard Specification for Gypsum.	2402
C28-40	Standard Specification for Gypsum Plasters.	4702
C31-42	Standard Method of Making and Storing Compression Test Specimens of Concrete in the Field.	2605, 2613
C33-42	Standard Specification for Concrete Aggregates.	2604(b)
C34-41	Standard Specification for Structural Clay Load-Bearing Wall Tile.	2402
C35-39	Standard Specification for Sand for Use in Plaster.	4702
C37-42	Standard Specification for Gypsum Lath.	4702
C39-42	Standard Method of Test for Compressive Strength of Concrete.	2606, 2613
C52-41	Standard Specification for Gypsum Partition Tile or Block.	2402
C56-41	Standard Specification for Structural Clay Non-Load-Bearing Tile.	2402
C61-40	Standard Specification for Keene's Cement.	4702
C62-41T	Tentative Specification for Building Brick.	2402
C67-41	Standard Methods of Sampling and Testing Brick.	2411(d)
C90-39	Standard Specification for Hollow Load-Bearing Concrete Masonry Units.	2402
C94-42T	Tentative Specification for Ready-Mixed Concrete.	2607, 2609
C130-42	Standard Specification for Lightweight Aggregates for Concrete.	2604(b)
C144-42T	Tentative Specification for Aggregates for Masonry Mortar.	2402
C145-40	Standard Specification for Solid Load-Bearing Concrete Masonry Units.	2402
C150-42	Standard Specification for Portland Cement.	2402, 2604(a), 4702
D146-38T	Tentative Methods of Testing Felted and Woven Fabrics Saturated with Bituminous Substances for Use in Waterproofing and Roofing.	4305(b)

American Standards Association:

A42, 1-1938	Gypsum Plastering, including Requirements for Lathing and Furring.	4702

American Welding Society:

1941 Edition (Tentative)	Code for Arc and Gas Welding in Building Construction, Sections 2, 3, 4.	2710

Sections 6002-6004

Board of Fire Underwriters of the Pacific:		Section
Sept. 10, 1930	Schedule for Rating of Theaters and Motion Picture Halls.	4102
Building Standards Monthly:		
June, 1943	Tests Indicate Design Methods for Earthquake-Proof Timber Floors.	2528
National Board of Fire Underwriters:		
1927	Standard Ordinance for Chimney Construction.	3701
July 15, 1930	Storage and Handling of Photographic and X-Ray Nitrocellulose Films.	4802
July 1, 1939	Regulations for Nitrocellulose Motion Picture Film.	4803
1934	Building Code, Appendix P, Fifth Edition Revised.	4102
1940 Edition	Automatic Sprinkler Equipment.	3802
April, 1941	Regulations for Oil-Burning Equipment.	3713
1943	Recommended Fire Prevention Ordinance.	908,
	1008, 1108, 1208, 1308, 1508	

National Fire Protection Association:

January, 1939	Protection of Openings in Walls and Partitions Against Fire.	4304

Underwriters' Laboratories, Inc.

December, 1941	Roofs, Class C Coverings.	4305(b & d)
December, 1941	Standard for Tin-Clad Fire Doors and Shutters.	4304

United States Department of Agriculture:

Sept., 1935	Wood Handbook.	2503(b), 2508(a & d), 2509, 2510
Misc. Pub. No. 185	Guide to the Grading of Structural Timbers and Determination of Working Stresses.	2503(b)

United States Department of Commerce, Bureau of Standards:

CS31-42	Wood Shingles.	4305(d)
CS45-42	Plywood.	2503(d)

United States Federal Government:

LL1-F-321a	Federal Specifications for Insulating Fiberboard.	4702(g)

United States Forest Products Laboratory:

October, 1929	Rigidity and Strength of Frame Walls.	2528

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 280-290, 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 Inspector.

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). Whenever 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

Section 2205

Sec. 2205. (c) Wall Coverings. 5. Exterior Plaster. (1) Exterior Plaster 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 of 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				3.0
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	½"	48 hrs.	7 days
Second or brown	4½	(1st & 2nd coats) ¾"	48 hrs.	7 days
Third or finish	2**	¼"		

*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.

Sections 2205 and 2301

**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 applied 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 floated 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

Section 2301

	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

Ceilings—

	Lbs. Per Sq. Ft.
Wood, lath and plaster.....	8
Metal lath and plaster suspended.....	10

Partitions—

2"x4" studs, wood lath, ½" plaster, both sides.....	16
2"x4" studs, plaster board, ½" 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 ¼".....	10
Tile and clay shingles.....	11 to 14
Roman tile, clay.....	12
Spanish tile, clay.....	19

Sections 2301-2312

	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. 2312. The following provisions are suggested for inclusion in the Code by cities located within an area subject to earthquake shocks. The design of buildings for earthquake shocks is a moot question but the following provisions will provide adequate additional strength when applied in the design of buildings or structures.

Lateral Bracing

Sec. 2312. (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 Inspector.

(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

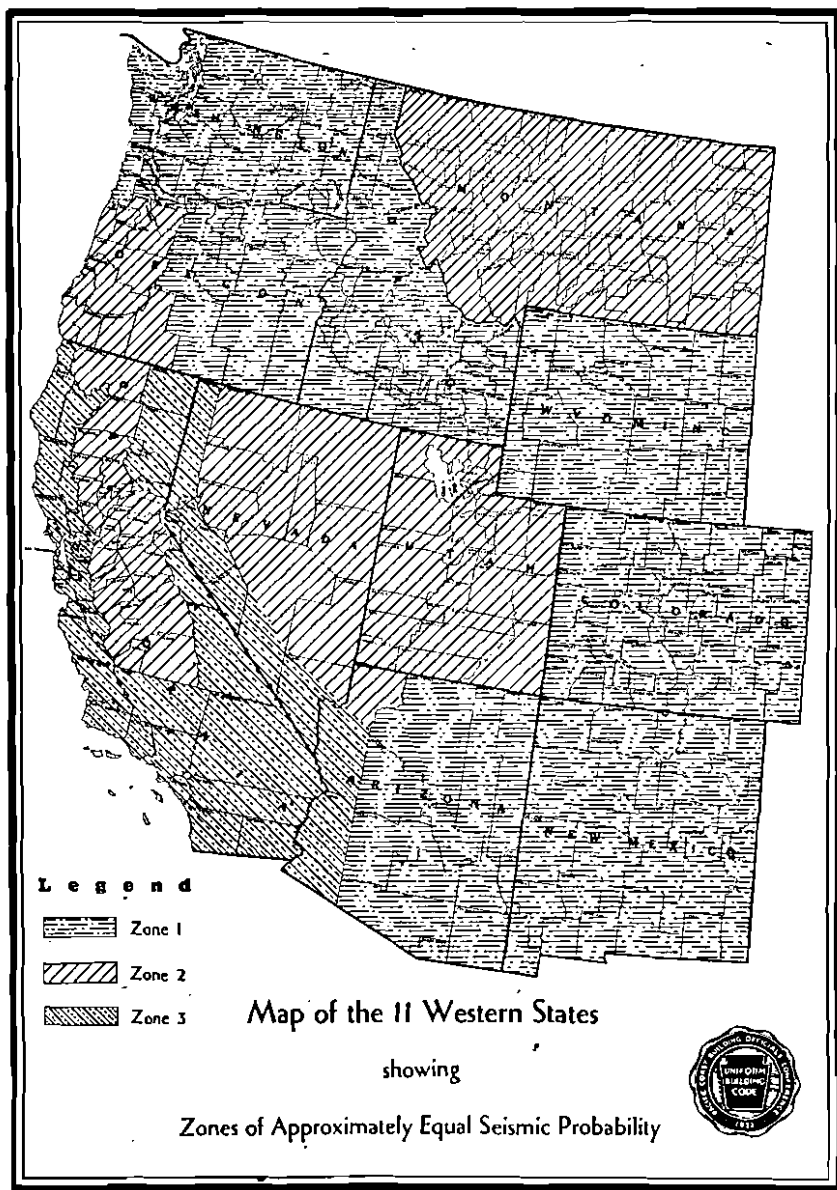
*See map on page 286 for zones. The values given "C" are minimum and should be adopted in locations not subject to frequent seismic disturbances as shown in Zone 1. For locations in Zone 2, "C" should be doubled. For locations in Zone 3, "C" should be multiplied by four.

**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

Section 2312



Section 2312

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.

Sections 2312 and 2529

Lateral Bracing (Cont'd.)

(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 Inspector in order that the intent shall be fulfilled.

Refer to Sec. 2529. The following precautions are recommended for territories where foundation timber is subject to special hazard of decay and termite damage.

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 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.

Sections 2529, 3809, and 4801

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 at 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.

Refer to Sec. 3809.

All combustible materials, fabrics and woodwork used as draperies or scenery on a stage, and all draperies in the assembly portion of Group A or B occupancies shall be made flame-proof to such an extent that when contacted by a Bunsen burner or gas flame they shall not show signs of fire, glow or smoldering nor will they communicate flame. The materials to be made flame-proof shall be impregnated and shall not be sprayed.

Where the flame-proofing process may change the color, finish or sheen of the drapery fabric, special permission shall be secured from the Building Inspector to attach a lining which has been made flame-proof.

Note: This special permission is not recommended and should be given only where the flame-proofing will greatly impair the draperies.

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

Sections 4801-4903

Classes of
Film
Excepted

Sec. 4801. The provisions of this Chapter do not apply to:

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.

General
Regulations

Sec. 4802. All regulations for the storage and handling of photographic and X-ray nitrocellulose films shall conform to the regulations of the National Board of Fire Underwriters for the "Storage and Handling of Photographic and X-ray Nitrocellulose Films," as recommended by the National Fire Protection Association, Edition of July 15, 1930¹.

Exceptions: Where definite fire-resistive materials are specified, materials of equal fire resistance as specified in this Code may be used.

Motion
Picture
Film

Sec. 4803. The storage and handling of nitrocellulose motion picture film shall conform to the "Regulations of the National Board of Fire Underwriters for Nitrocellulose Motion Picture Film," July 1, 1939.

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:

General

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, 1939¹, which is hereby declared a part of this chapter.

Definitions

Sec. 4902. "Approved." When this term is used to apply to systems, appliances and for 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 Inspector.

Scope

Sec. 4903. Regulations of this Chapter shall apply to all refrigeration systems hereafter installed and to alterations of and additions to such existing systems.

¹See "Specification Documents".

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