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*Source—Ord. 132, Series 1952, except where otherwise indicated.

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(f) Change of Occupancy. The use or occupancy of any existing building, or structure, shall comply with the provisions of sections 306 and 502.

(g) Moved Buildings. Buildings or structures into or within the City and County of Denver shall comply with the provisions of this code, subject to the approval of the Chief Building Inspector.

(h) Maintenance. All buildings or structures, both existing and new, and all parts thereof, shall be maintained in a safe and clean, healthful condition. All devices or safeguards in buildings and structures which are required by this code or which were required to have been erected or installed pursuant to any previous building code or ordinance relating to design, construction, or quality of materials shall be maintained in good working order. The owner shall be responsible for the maintenance of buildings and structures.

Section 105. Alternate materials and Methods of Construction. The provisions of this code are not intended to prevent the use of methods, materials, or equipment which, as a matter of fact, meet the reasonable safe standards of strength, safety, sanitation, and fire resistance required to be met in any building or structure to which this code applies, provided that any such alternate has been approved as provided herein below.

The Chief Building Inspector, after the approval of the Board of Appeals has been given, shall approve any such alternate construction provided the Board finds that the proposed design is satisfactory and complies with the provisions of the applicable technical portion of this code and that the methods, materials, equipment, or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in respect to strength, safety, sanitation, fire resistance, quality and durability. Where national standards have not been incorporated in the applicable technical portions of this code the Chief Building Inspector, with the approval of the Board of Appeals may require that sufficient evidence for proof be submitted to substantiate any claims that may be made regarding proposed alternates.

Section 106. Tests. Whenever there is evidence that any method, material, equipment or construction does not conform to the requirements of this code or in order that claims for such alternate method of construction may be substantiated, the Chief Building Inspector may require tests as proof of compliance to be made at the expense of the owner by an approved agency. Test methods shall be as specified by this code for the method, material, equipment, or construction in question. If there are no appropriate test methods specified in this code, the Chief Building Inspector, with the approval of the Board of Appeals, after appropriate consultation with that examining committee responsible for examining the craft concerned, shall define appropriate standards demonstrable by simple physical and chemical tests which establish criteria of strength, safety, sanitation and fire resistance within limits of reasonable variation. A record of the results of all such tests shall be kept on file permanently.
CHAPTER 1 – TITLE AND SCOPE

Section 101. Title. This ordinance, ordinance number 140 of the series of 1949, as amended by ordinances numbers 124 and 286 of the series of 1950 and ordinances numbers 94, 233, 234, 248, and 249 of the series of 1951; ordinance number 205 of the series of 1950 as amended by ordinance number 257 of the series of 1950 and ordinance number 93 of the series of 1951; ordinance number 236 of the series of 1949; ordinance number 259 of the series of 1950; and number 265 of the series of 1951, and as amended by ordinance number 140 of the series of 1951, shall be known as the “Building Code,” may be cited as such and will be referred to herein as “this code.”

Section 102. Purpose. The purpose of this code is to provide minimum standards to safeguard life and limb, health, property, and public welfare by regulating and controlling the design, construction quality of materials, use and occupancy, location and maintenance of all buildings, structures and equipment specifically regulated by this code within the City and County of Denver.

Section 103. Scope. New buildings and structures hereafter erected in the City and County of Denver and buildings and structures moved into or within the City and County of Denver shall conform to the requirements of this Code.

Additions, alterations, repairs, and changes of use or occupancy in all buildings and structures shall comply with the provisions for new buildings and structures except as otherwise provided in Sections 104, 306, and 502 of this code. Where, in any specific case, different sections of this code specify different materials, methods of construction or other requirements, the most restrictive provisions shall govern.

The provisions of this code shall not apply to any public utility company nor its employees engaged in providing any utility product, transportation, or service which it is franchised or authorized by public authority to provide within the City and County of Denver, insofar as the provisions hereof relate to the installation, repair or maintenance of any equipment or facilities owned, maintained, and operated by such utility and essential to it in providing such utility product, transportation, or service, provided however, the exemptions specified in this paragraph shall not apply to construction, installation, replacement, or removal of buildings and structures of such utility companies which are used by employees or the public, and, provided, further, that this exemption shall not apply to the construction, installation, replacement, repair or removal of plumbing, heating, boilers, elevators, and electric building wiring, (except wiring specifically used in the provision of said public utility product, transportation, or service) in such buildings and structures and sanitary sewers connected thereto.

Section 104. Application to Existing Buildings.

(a) General. Except as provided in Chapter 16 of the building code, existing buildings or structures to which additions, alterations, or repairs are made shall be made to comply with all the requirements for new buildings or structures unless otherwise specifically provided in this section.

(b) Additions, Alterations and Repairs; More than 50%.

Any existing building or structure which is for any reason whatsoever added to, altered, or repaired within any 12-month period in excess of 50% of the value thereof, shall be made to conform to the requirements of this code or shall be demolished. Repair work done to maintain the structural integrity of the foundations will not be included in the 50% allowable valuation.

(c) Additions,Alterations and Repairs not exceeding 50%. Additions, alterations or repairs not exceeding 50% of the value of an existing building or structure shall comply with the more restrictive provisions of this code for new buildings or structures insofar as is practicable considering the particular building or structure in respect to the particular work to be done.

(d) Non-structural Alterations and Repairs not exceeding 15%. Alterations or repairs not exceeding 15% of the value of an existing building or structure, which are non-structural and do not affect any member or part of the building or structure having required fire resistance, may be made with the same materials of which the building or structure are constructed.

(e) Repairs: Roof Covering. Not more than 25% of the roof covering of any building or structure shall be replaced in any 12-month period unless the entire roof covering is made to conform to the requirements of this code for new buildings or structures.
icles or abandoned parts, machinery or machin- (2) which are not provided with adequate egress, or (3) which constitute a fire hazard, or
(4) which are otherwise dangerous to life and
limb, health, property, and public welfare by reason of their design, construction, quality of
materials, or, (5) which in relation to use or oc-
occupancy constitute a hazard to safety or health
by reason of inadequate maintenance, dilapida-
tion or abandonment or otherwise are, for the
purposes of this code, denominated “unsafe
buildings.” All unsafe buildings are hereby de-
cclared to be nuisances and shall be abated by
repair, rehabilitation, or demolition in accord-
ance with the procedure of this section.

(b) Notice. The Chief Building Inspector
shall examine every building or structure sus-
pected to be dangerous and, if the same is
found to be an unsafe building, he may record
a notice of such finding with the Clerk and Re-
corder of the City and County of Denver and
shall give the owner a written notice stating the
defects thereof and directing the owner to safe-
guard the same by repair or rehabilitation or,
alternatively, where necessary to demolish the
same. In the event demolition is ordered any
lienholder of record as to such building shall
also be served with a copy of such notice. Each
such notice shall state the time in which the
required repairs or rehabilitation are completed,
inspected, and accepted by the Chief Building
Inspector.

Service of any such notice may be by per-
sonal service, as defined by the Colorado Rules
of Civil Procedure; alternatively, such service
may be made by registered or certified mail,
return receipt requested and service shall be
deed complete upon delivery. In the event
the address of a person to be notified is un-
known or the receipt of a notice which has been
mailed is returned unsigned, such notice may
be served by posting the same on a conspicu-
ous place on the premises upon which the un-
safe building is located, in which event service
shall be deemed complete as of the moment of
posting.

(c) Posting of Signs. When necessary to
protect life and limb, health and public wel-
fare the Chief Building Inspector shall post
about an unsafe building signs which prohibit
entry into, use or habitation of the unsafe build-
ning; provided, however, that in the manner oth-
erwise prescribed by this code, it shall be law-
ful to enter the building for the purpose of
effecting the required repairs, rehabilitation, or
demolition. It shall be unlawful to remove any

Section 203. Unsafe Buildings. (a) Use
of Term “Unsafe Buildings.” All buildings and
structures: (1) which are structurally unsafe, or
CHAPTER 2 - ORGANIZATION AND ENFORCEMENT

Sections 201-209. Building Department; Chief Building Inspector

Section 201. Creation of Building Department; Chief Building Inspector. There is hereby established, as a staff agency under the Mayor, a Building Department to be administered by a Chief Building Inspector who is to be appointed by the Mayor and whose powers and duties are hereinafter defined. The Chief Building Inspector shall be a professional engineer registered in the State of Colorado with experience in structural engineering or construction, or an architect licensed in the State of Colorado.

Section 202. (a) General Powers and Duties. The Building Department administered by the Chief Building Inspector shall administer and enforce this code and all other ordinances relating to building, construction, plumbing, electrical apparatus and wiring, heating, air conditioning, domestic appliances, refrigeration, gas, boiler and elevator installations and maintenance, smoke abatement, the Housing Code and the Zoning Chapter and the article on Trailer Parks of the Revised Municipal Code, and all other Ordinances and Codes assigned to his Department for enforcement and administration, and all other Codes and Ordinances providing minimum standards to safeguard life or limb, health, property, or public welfare by regulating or controlling the design, construction, quality of materials, use and occupancy, location and maintenance of buildings or structures in the City and County of Denver.

(b) Use of Term "Chief Building Inspector." The Chief Building Inspector may authorize or appoint any individual to carry out such duties and exercise such powers vested in him as may by him be set forth in such authorization or appointment.

(c) Valuation. The determination of value or valuation under any of the provisions of this code or any of the several codes or ordinances enforced and administered by the Building Department shall be made by the Chief Building Inspector and such value or valuation shall be based on the estimated current cost of replacing the particular building or structure involved without regard to any loss occasioned from fire or other cause.

(d) Reports and Records. The Chief Building Inspector shall keep a permanent, accurate account of all fees and other monies received by the Building Department, 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.

(e) Right of Entry, Search Warrants. For purposes of ascertaining violations of this code or any of the several codes, or ordinances or rules or regulations which are enforced and administered by the Building Department, and for purposes of conducting inspections, the right of entry at reasonable times or whenever work is in progress is hereby granted the Chief Building Inspector to conduct a reasonable inspection or investigation. It shall be lawful for any Municipal Judge of the Municipal Court of the City and County of Denver, upon written complaint made before him by the Chief Building Inspector, upon oath or affirmation, that he has just and reasonable grounds to suspect that the code or some one or more of the several codes or ordinances or rules or regulations which are enforced by the Building Department is or are being violated at or in a place or places in the City and County of Denver therein described, and that the right of entry in the daytime or when work was in progress for the purpose of ascertaining the existence of such violation or violations has been denied or refused, to issue a warrant, under his hand, commanding every such place or places to be searched in the daytime or when work is in progress thereat or therein; such warrant shall be directed to the Chief Building Inspector and shall authorize the search therein commanded to be made by the Chief Building Inspector in person or by any individual authorized or appointed by him to make the same; it shall be the duty of the police department to render such aid, assistance, and protection as may be required to accomplish the execution of such warrant; and every such warrant shall be returned to the Municipal Court within ten (10) days after the issuance thereof with endorsement or certificate thereon as to how the same shall have been executed.

(Ord. 185, Series 1954.)

(f) Stop Orders. Wherever any building work is being done contrary to the provisions of this code or any of the several codes or ordinances or rules or regulations promulgated thereunder which are enforced and administered by the Building Department, the Chief Building Inspector may order the work stopped by notice in writing served on any person engaged in such work or causing such work to be done. Said person or persons shall stop such work until authorized by the Chief Building Inspector to proceed.

(g) It shall be unlawful for any person to cause or permit junk, scrap metal, scrap lumber, waste paper products, discarded building materials, or any unused, abandoned vehicle, vehi-
under authority of this section shall be effective unless approved by the Manager of Safety and Excise as provided in the Article on General Licensing Provisions of the Revised Municipal Code.

Section 211. Organization, Term, and Salary. The Board of Examiners shall consist of all members of the various committees provided in Section 213 and shall meet en banc at least semi-annually.

The members of the Board shall be appointed by the mayor to serve a term of two (2) calendar years. One-half of the original appointments hereunder shall be for the balance of the current calendar year, plus the succeeding calendar year and the remainder of the original appointments shall be for the balance of the current calendar year so that the membership of succeeding Boards of Examiners will be appointed at alternate intervals.

The Chairman of the Board shall be designated annually by the Mayor and shall be responsible for the organization, management and operations of the Board of Examiners, but shall not be a regular member of the examining committee. The Chairman shall serve at an annual salary of One Thousand Two Hundred Dollars ($1,200.00). The designated chairman shall be a person whose occupation and interest are independent of the building and construction industries who shall serve as an ex-officio member of each Examining Committee with power to vote in cases of tie.

Every member of the Board of Examiners shall receive Twenty-Five Dollars ($25.00) per examination given in which he participates as a member of the examining committee; examinations in each committee shall be held not less often than once every two months.

Section 212. Rules of Procedure: By-Laws, Examination Standards. (a) Procedure and By-Laws. A quorum at all en banc meetings shall consist of a majority of the members of the Board of Examiners. A quorum of each committee of the Board of Examiners shall consist of a majority of the members of such committee. The Board of Examiners and each committee or division thereof is authorized to make rules of procedure and adopt by-laws necessary for the transaction of business not inconsistent with this code. To be effective, such rules of procedure and by-laws shall be approved by the Board of Examiners at an en banc meeting.

(b) Examination Standards. The Board of Examiners and each committee thereof shall examine and test applicants for licenses issued hereunder. The standards to be applied in the conduct of such examination shall be the protection of the public health and the public safety of the people of the City and County of Denver so that those who are recommended to be licensed under this Code are reasonably qualified in terms of their skills, knowledge, practical experience, and knowledge of pertinent law, to contract for or to do the work for which they seek to be licensed. Applicants who are so reasonably qualified shall be recommended to be licensed as provided herein. No examination hereunder shall be conducted until the Board of Examiners and each committee thereof shall have enumerated a list of subjects of inquiry in each examination and the order thereof and specified the weight attached to each subject and until this enumeration shall have been approved by the Board of Appeals.

Each examination shall be evaluated on the basis of 100%. Each phase of the required examinations shall be passed with a score of 70 % or more.

The financial statement required to be submitted and the applicant's experience in regard to bonding may be examined but no applicant may be denied recommendation on financial grounds unless insolvent.

Examinations shall fall into such of the following areas as may be applicable to the license being sought:

1. Experience Record. The applicant's qualifying experience record shall be examined in order to determine that the applicant possesses the minimum education and experience record.

2. Codes. The applicant shall be examined for his knowledge of the pertinent portions of the Denver Building Code together with other ordinances of the City and County of Denver and rules and regulations adopted and published thereunder.

3. Skills and Knowledge. The applicant shall be examined for his skills and knowledge within the limits of the subjects of inquiry, knowledge of Building Code of City and County of Denver excluded.

If other licenses or lawful requirements are imposed upon the applicant by other ordinances of the City and County of Denver, such prerequisites shall be deemed prerequisites to the recommendation of the issuance of a license.

(Ord. 2, Series 1955.)

Section 213. Committees of the Board of Examiners: Qualifications of Members.

The Board of Examiners shall be divided into committees. The qualifications of members of these respective committees shall be as follows:

(a) Building Committee: The Committee of the Board of Examiners responsible for examin-
such sign without written permission so to do from the Chief Building Inspector; it shall be unlawful to enter, use, or inhabit such unsafe building contrary to the terms of this section.

(d) Unlawful to Disobey Notice. It shall be unlawful for any person, firm, or corporation to fail to carry out the repairs, rehabilitation, vacation, or demolition required to be carried out by any such notice within the time specified in such notice.

(e) Demolition by City: Costs. If the owner of any unsafe building fails to carry out the repairs, rehabilitation, or demolition required to be carried out by any such notice within the time specified in such notice, the Chief Building Inspector may enter the unsafe building and where necessary cause such demolition work to be done as will entirely eliminate any hazard to life and limb, health, or other property. The costs and expenses of such demolition work shall be paid from any appropriation available for that purpose upon the order of the Chief Building Inspector and with the approval of the Mayor.

The Chief Building Inspector shall further serve notice upon the persons and in the manner provided in Section 203(b) as to the amount of such costs and expenses, and that he will at a time and place specified in the notice, hold a hearing when and where such persons will be required to show cause why said amount should not be paid and a lien placed upon the premises as hereinafter provided.

(Ord. 325, Series 1957.)

(f) City's Lien for Costs. In the event said persons fail to pay the costs and expenses of the demolition of an unsafe building, and fail to show cause as above provided, said amount shall constitute a lien against the real property upon which such building was or is situate, and the Chief Building Inspector may certify a statement thereof to the Manager of Revenue, who shall record a notice of such lien in the manner provided for the recordation of instruments affecting title to real property. The Manager of Revenue shall assess and charge the same against the property involved, and collect the sums due, together with interest at the rate of interest established by law for delinquent real property taxes. If necessary, the Manager of Revenue may sell the property involved in the manner prescribed for sales of property for delinquent property taxes.

(Ord. 325, Series 1957.)

(g) Lien Priority. The lien created hereby shall be superior and prior to all other liens, regardless of the nature and the dates of their respective recordations, except liens for general and special taxes.

(Ord. 325, Series 1957.)

Section 204. Violations. It shall be unlawful for any person, firm, or corporation to erect, construct, enlarge, alter, repair, move, improve, remove, convert, demolish, equip, use, occupy, or maintain any building or structure in the City and County of Denver, or cause the same to be done, contrary to or in violation of any of the provisions of this code, any other code or ordinance or any rule or regulation promulgated thereunder which is enforced and administered by the Building Department.

Whenever in any section of this code or any section of any ordinance or code enforced and administered by the Building Department or any rule or regulation promulgated pursuant thereto, the doing of any act is required, prohibited, or declared to be unlawful and no definite fine or penalty is provided for a violation thereof, any person, firm, or corporation who shall be convicted of a violation of any such section or rule or regulation, shall upon conviction for each offense, be fined in a sum not more than three hundred dollars ($300) or imprisoned not to exceed ninety (90) days, or both so fined and imprisoned. The suspension or revocation of any license, permit, or other privilege conferred by the City and County of Denver shall not be deemed a penalty for the purposes of this section.

Sections 210-219. Board of Examiners; Licensing Functions

Section 210. Board of Examiners; Licensing Functions. (a) Board of Examiners; Establishment; Licensing Functions. There is hereby established a Board of Examiners which shall act as an examining agency for the Manager of Safety and Excise in respect to the renewal, suspension, and revocation of licenses required by this code in conformity with the Article on General Licensing Provisions of the Revised Municipal Code. The Board of Examiners shall, insofar as is consistent with the duties, powers and functions prescribed by this code, assume duties, powers and functions delegated to analogous boards by other codes and ordinances.

(b) Chief Building Inspector—Licensing Functions. The Chief Building Inspector shall be the examining agent for the Manager of Safety and Excise in respect to the renewal, suspension, and revocation of licenses required by this code in conformity with the Article on General Licensing provisions of the Revised Municipal Code.

(c) Appeals from Chief Building Inspector's Decisions; Manager's Approval. The Chief Building Inspector's orders and decisions under this section are subject to appeal to the Board of Appeals; no such order or decision of the Chief Building Inspector or the Board of Appeals
Provisions of the Revised Municipal Code, every application for a license under this code shall contain the following information concerning each applicant:

1. The name of the person, firm, or corporation desiring such license;

2. The residence of such applicant, or of each of the individual members of such firm, or of each of the directing officers of such corporation and its principal place of business;

3. The kind of license desired;

4. The street address from where such applicant proposes to conduct his business, and the telephone number thereof;

5. The year for which such license is sought;

6. A statement of the applicant’s qualifying experience record, including an enumeration of several contracts and jobs performed by the applicant, if any;

7. A financial statement, and a statement of the applicant’s experience in regard to bonding, including an indication of whether the applicant has ever been refused a bond and an indication of the largest bond ever furnished by the applicant;

8. A complete enumeration of all unpaid liens and judgments outstanding against the applicant;

9. Suitable references from persons acquainted with the applicant’s qualifications;

10. A summary of the qualifying experience records of all supervisory staff required by this code for the particular license sought; and

11. Any other relevant information required by the Manager of Safety and Excise, the Chief Building Inspector, or the Board of Examiners.

(b) Fee. Each applicant shall pay an examination fee of fifteen dollars ($15.00) at the time of filing any application for a license issued under this code. Such fee shall not be refundable and shall not apply on the license fee in the event the applicant is granted a license under this code; such fee shall entitle the applicant to one examination only, and, if the applicant is re-examined for any reason whatever, an additional fee of fifteen dollars ($15.00) shall be required.

Sections 220-229. Board of Appeals

Section 220. Board of Appeals; Membership; Terms, Compensation. There is hereby created a Board of Appeals to consist of four (4) regular members and three (3) ex-officio members. The three ex-officio members shall be employees or officers of the City and County of Denver. The four regular members shall be

(1) a licensed architect, (2) a registered professional engineer, (3) a general contractor, Class A, licensed under this code, and (4) a private citizen whose occupation and interests are wholly independent of all phases of the building and construction industry. The ex-officio members of the Board of Appeals shall consist
ing applicants and Builders’ Licenses, Classes A, B-1, and B-2, and all Wreckers, Movers, Excavating, Blasting and Sign Contractors Licenses, as defined herein, shall be composed of a licensed architect or registered professional engineer; a Builder’s License Class A licensee; a Builder’s License Class B-2 licensee; and a person whose occupation and interests are independent of the building and construction industries.

(Ord. 446, Series 1958.)

(b) Specialty Trades Committee. Except for examination functions otherwise specifically assigned, the committee of the Board of Examiners responsible for examining applicants for any one of the trades or group of related trades licensed as Builder’s License Class C shall be composed of a licensed architect or registered professional engineer; a Builder’s License Class A licensee; a Builder’s License Class C licensee; and a person whose occupation and interests are independent of the building and construction industries. This committee shall define the types of work permitted to be done under each of the categories of licenses for which it examines.

(c) Domestic Appliance Committee. The committee of the Board of Examiners responsible for examining applicants for Domestic Appliance License Classes A and B shall be composed of a registered professional engineer with knowledge of sanitation; a Domestic Appliance License Class A licensee; a Domestic Appliance License Class B licensee holding no other license; and a person whose occupation and interests are independent of the building, construction, and appliance industries.

(d) Electrical Committee. The committee of the Board of Examiners responsible for examining applicants for licenses as Electrical licenses Class A, B, C and D shall be composed of a registered professional engineer with knowledge of electrical engineering; an Electrical License Class A licensee; an Electrical License Class B licensee; and a person whose occupation and interests are independent of the building, construction and electrical industries.

(e) Warm Air Heating, Ventilation and Air Conditioning, Gas Fitter, Refrigeration Committee. The Committee of the Board of Examiners responsible for examining applicants for Builder’s Class C-15 Refrigeration license, Class C-16 Warm Air Heating, Ventilation and Air Conditioning, and Gas Fitters shall be composed of a Colorado registered professional engineer experienced and qualified in one or more of the aforementioned professions; a Builder’s Class C-15 license holder; a Builder’s Class C-16 license holder, a Gas Fitter licensee holding no other license, and a person whose occupation and interests are independent of the building and mechanical trades.

(f) Plumbing Committee. The committee of the Board of Examiners responsible for examining applicants for Plumbers’ Licenses Classes A and B and C shall be composed of a registered professional engineer with knowledge of sanitation; a Plumber’s License Class A licensee; a Plumber’s License Class C licensee; and a person whose occupation and interests are independent of the building, construction and plumbing industries.

(g) Steam Heating Committee. The committee of the Board of Examiners responsible for examining applicants for licenses as Steam Heating Licensee’s Classes A and B, and Stationary Engineers’ Licenses shall be composed of a registered professional engineer, qualified in mechanical engineering with experience in the installation and operation of steam equipment; a Steam Heating Licensee Class A; a Stationary Engineer licensee; and a person whose occupation and interests are independent of the building, construction, and boiler equipment industries.

(h) Motion Picture Operators’ Committee. The committee of the Board of Examiners responsible for examining applicants for licenses as motion picture operators shall be composed of a registered professional engineer with knowledge of electrical engineering; a licensed motion picture operator; and a person whose occupation and interests are independent of the building construction, and electrical industries and the motion picture and theatrical industries.

(Ord. 228, Series 1955.)

Section 214. License Applications; Examination Fee.

(a) Applications. In addition to the requirements of the Article on General Licensing
(g) Decisions. The Board of Appeals shall have the power in all cases appealed to it from decisions or orders of the Chief Building Inspector or the Board of Examiners to reverse or affirm, or modify in whole or in part, the decision or order appealed from. No decision of the Board of Appeals shall vary or be inconsistent with the terms, provisions, and requirements of this code.

(h) Enforcement. Except as to those licensing matters wholly within the province of the Board of Examiners and the Manager of Safety and Excise, the Chief Building Inspector shall enforce and execute all decisions and orders of the Board of Appeals.

(i) Judicial Review. Within thirty (30) days after the entry of any decision or order of the Board of Appeals, any person, firm or corporation who is aggrieved by such decision or order may seek to review the same in a court of record of competent jurisdiction. Review shall not be extended further than to determine whether the Board of Appeals has exceeded its jurisdiction or abused its discretion.

The same provisions shall govern judicial review regarding licensing powers and duties conferred upon the Manager of Safety and Excise by this code, and in all judicial proceedings regarding licensing matters under this code, both the Manager of Safety and Excise and the Board of Appeals shall be made parties to the action.

(j) Approval of Materials and Methods. The Board of Appeals shall have the power to issue rules and regulations approving alternate and new materials, methods, devices, etc., in accordance with the applicable provisions of this code.

Sections 250-299. Licensing Provisions and License Fees

Section 250. Supervisors for License Holders. Except as otherwise specifically provided, all licenses enumerated herein shall be issued under authority of and in accordance with the terms and provisions of this code and shall be subject to the supervisory clauses contained in this section. The respective licensees, whether individuals, firms, or corporations, shall not be required to possess those skills and qualifying experience records required for the work they are permitted to do under the terms and provisions of their respective licenses, provided that they retain in their business a supervisor whose skills and qualifying experience record are such that he would be qualified to do all work in his principal's license category. The respective licensees' rights to do business shall be dependent upon the continued retention of the designated supervisors in active, full-time capacity. Whenever a designated supervisor terminates his connection with a licensee or otherwise becomes inactive, the licensee shall immediately notify the Manager of Safety and Excise through the Chief Building Inspector. In such event the license shall be deemed to be suspended. Should the supervisor be replaced or should his retention in the business of the licensee be renewed, such fact shall be made known to the Manager of Safety and Excise through the Chief Building Inspector. If the proposed replacement has been found by the Board of Examiners to meet the qualifications imposed by this code, the said license shall again be deemed in full force and effect without imposition of an additional license fee for the same calendar year.

No one individual shall be designated as supervisor for more than one licensee. Each individual who is to act as a supervisor shall be examined in accordance with the provisions of this code for the work proposed to be done.

Each individual who is to act as a supervisor shall be designated as such in each application for a license.

Section 251. Licenses: Classification of Licenses. Licenses shall be required for all types of work hereinafter specified and classified in accordance with the following:

(a) Builder's License Class A:

A Builder's License Class A shall entitle the licensee to contract for and to do the work of building or contracting for, or altering or adding to the structural portions of any building or structure or portion thereof of Types I, II, III, IV or V construction, where such work requires the issuance of a permit under this code. All such work shall be done in accordance with the terms and provisions of this code. A Builder's License Class A shall entitle the licensee to contract for and to do necessary demolition and wrecking work in connection with the work specified herein.

(b) Builders' Licenses Classes B-1 and B-2:

A Builder's License Class B-1 shall entitle the licensee to contract for and to do the work of building or contracting for, or altering or adding to the structural portions of any building or structure or portion thereof of Types III, IV or V construction, where such work requires the issuance of a permit under this code. All such work shall be done in accordance with the terms and provisions of this code. A Builder's License Class B-1 shall entitle the licensee to contract for and to do necessary demolition and wrecking work in connection with the work specified herein.

A Builder's License Class B-2 shall entitle the licensee to contract for and to do the work
of: (1) the Chief Building Inspector who shall act as secretary to the Board; [2] the Chief of the Fire Prevention Bureau of the Fire Department; and (3) the Manager of Health and Hospitals who may designate to sit for him an employee of his department who has qualifications and experience in sanitation and sanitary engineering. An ex-officio member shall be without voting power in every case in which an appeal has been taken from his order or decision.

The regular members of the Board of Appeals shall serve for terms of two (2) calendar years, and may not serve more than two (2) consecutive terms. The regular members of the Board of Appeals shall be appointed by the Mayor, and two of the original appointments hereunder shall be for the balance of the current calendar year; plus the succeeding calendar year, and two original appointments hereunder shall be for the balance of the current year only so that the membership of the succeeding Board of Appeals will be appointed at alternate intervals. Compensation of the Board of Appeals for members who are non-city employees or officers shall be $20 per meeting.

Section 221. Quorum and Voting; Rules of Procedure; By-Laws; Minutes and Records. A quorum for the transaction of business of the Board of Appeals shall consist of five (5) of its members. The Board of Appeals shall select from among the regular voting members a chairman who shall act as presiding officer of the Board, and who shall be responsible for the management and operation of the Board of Appeals. The chairman shall not serve as chairman for more than two (2) consecutive calendar years. The Board of Appeals shall adopt by-laws for the conduct of its business not inconsistent with this code and shall keep adequate minutes and records, and make such rules of procedure as it deems necessary.

The Board of Appeals shall insofar as is consistent with the duties, powers and functions prescribed by this code, assume duties, powers and functions delegated to analogous boards by other codes and ordinances.

(Ord. 155, Series 1953.)

Section 222. Appeals to the Board of Appeals.

(a) Parties. Any person, firm, or corporation aggrieved by any decision or order of the Chief Building Inspector or the Board of Examiners may appeal such decision or order to the Board of Appeals.

(b) Time. Every appeal must be perfected within thirty (30) days from the date of the decision or order appealed from. An appeal is perfected by filing a notice of appeal with the secretary of the Board of Appeals in the office of the Chief Building Inspector upon a form provided by the Board of Appeals. Such notice shall contain appropriate reference to the decision or order appealed from, as well as the grounds of the appeal. A duplicate copy of such notice of appeal shall be filed with the Chief Building Inspector in his office or with the Board of Examiners in the office of the Chief Building Inspector, as may be appropriate.

The Board of Appeals may extend the time within which an appeal may be taken where grounds for enlargement of time are shown. In cases where the decision or order appealed from pertains to a structure or building which can be demonstrated by the Chief Building Inspector to be unsafe or dangerous, the Chief Building Inspector may apply to the Board of Appeals to limit the time for such appeal in order to avoid any hazard to life or property.

(c) Fee. At the time of perfecting an appeal, the appellant shall be required to pay an appeal fee of $10.00, which fee may be returned to the appellant at the discretion of the Board of Appeals if the appellant is substantially sustained.

(d) Record. The Chief Building Inspector or the Board of Examiners shall transmit to the Board of Appeals all relevant records and data upon which the appeal was taken.

(e) Stay of Proceedings. An appeal shall stay all proceedings in connection with the decision or order appealed from unless and until the Chief Building Inspector shall have certified to the Board after notice of appeal has been perfected that a stay would cause hazard to life and property. In such case proceedings pursuant to the decision or order of the Chief Building Inspector shall not be stayed except by order of the Board of Appeals or by a restraining order issued by a court of record of competent jurisdiction. No such restraining order, whether temporary or otherwise, shall be granted without notice, as prescribed in the Rules of Civil Procedure, to the Chief Building Inspector and without due cause shown.

Any work done contrary to the order of the Chief Building Inspector after docketing of an appeal hereunder, pending determination of such appeal, shall be subject to abatement should the order be affirmed and may not be considered by the Board of Appeals as a mitigating or extenuating circumstance.

(f) Hearings. The Board of Appeals shall fix a reasonable time for the hearing of an appeal, giving notice in writing to the parties in interest, and shall reach its decision within a reasonable time thereafter. Parties may appear before the Board of Appeals in person, by agent, or by attorney. The Board of Appeals may require additional data and tests necessary for adequate consideration of the Appeal.
The Electrical License Class D shall entitle the individual license holder to repair and maintain any one person's, firm's, or corporation's property; all electrical wiring; and all apparatus which has been lawfully installed thereupon and all such work shall be done only in accordance with the terms and provisions of this code. The Electrical License Class D is an individual license and is not subject to the terms of Section 250 relating to supervisory license holders.

(k) Plumber's License Class A—Master:

A Plumber's License Class A shall entitle the holder thereof to contract for and to install all sanitary plumbing and potable water supply piping for which a permit is required under the provisions of this code. This license is not subject to the provisions of Section 250 relating to supervisors for license holders.

(l) Plumber's License Class B—Contractor:

A Plumber's License Class B shall entitle the holder thereof to contract for the installation of all sanitary plumbing and potable water supply piping for which a permit is required under the terms and provisions of this code. This license is not subject to the provisions of Section 250 relating to supervisory license holders. Where the installation of such requires a permit under the provisions of this code, all such work shall be done only in accordance with the terms and provisions of this code.

(m) Plumber's License Class C—Journeyman:

A Plumber's License Class C shall entitle the individual holder thereof to install all sanitary plumbing and potable water supply piping for which a permit is required under the terms and provisions of this code. This is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders. Licensees hereunder may perform the work which they are licensed only in the employ of a Plumber's License Class A licensee.

(n) Steam Heating License Class A:

A Steam Heating License Class A shall entitle the holder thereof to contract for and to install high and low pressure steam and hot water heating systems, processing pipes and similar commercial hot water and water vapor systems, and heating or steam power systems where the installation of such requires a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code.

(o) Steam Heating License Class B:

A Steam Heating License Class B shall entitle the individual license holder to install high and low pressure steam, hot water heating systems, processing pipes and similar commercial hot water and water vapor systems, and heating or steam power systems where the installation of such requires a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code.

(p) Domestic Appliance License, Class A:

A Domestic Appliance License Class A shall entitle the holder thereof to contract for and to install domestic appliances as defined in this code, where the installation of such requires a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code. This is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders. Licensees hereunder may perform the work for which they are licensed only in the employ of a Domestic Appliance License Class A licensee.

(q) Domestic Appliance License, Class B:

A Domestic Appliance License Class B shall entitle the individual license holder to install domestic appliances as defined in this code, where the installation of such requires a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code. This is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders. Licensees hereunder may perform the work for which they are licensed only in the employ of a Domestic Appliance License Class A licensee.

(r) Stationary Engineer's License:

(r-1) Class A. A Class A Stationary Engineer's License shall entitle the individual holder thereof to take charge of and operate all steam boilers and appurtenances thereto, steam pumps, steam turbines, and steam engines, and shall be required in installations where the steam pressure is in excess of 15 p.s.i. working pressure and where such equipment produces a total of 10 hp. or more. A Class A Stationary Engineer's license shall entitle the individual holder thereof to operate mechanical refrigeration systems as specified in the section below on Class SR-1 Stationary Engineer's licenses.

(r-2) Class B. A Class B Stationary Engineer's License shall entitle the individual holder thereof to take charge of and operate all steam boilers and appurtenances thereto, steam pumps, steam turbines, and steam engines and shall be required in installations where the steam pressure is in excess of 15 p.s.i. working pressure...
of building; or contracting for, or altering or adding to the structural portions of any residential building or structure or portion thereof used or to be used for groups I or J occupancy, of Types III, IV or V construction, where such work requires the issuance of a permit under this code. All such work shall be done in accordance with the terms and provisions of this code.

A Builder’s License Class B shall entitle the licensee to contract for and to do necessary demolition and wrecking work in connection with the work specified herein.

(c) Builder’s License Class C:

A Builder’s License Class C shall entitle the licensee individually to contract for and to do the work involving any of the following trades or group of related trades as specified in each particular license.

Such work shall be done only in accordance with the terms and provisions of this code:

(1) Acoustical
(2) Carpentry
(3) Concrete
(4) Elevator
(5) Excavating
(6) Fire Protection Contractor
   (Ord. 186, Series 1953.)
(7) Insulating
(8) Lathing and Plastering
   (Ord. 216, Series 1954.)
(9) Roofing, Shingling, Siding and Waterproofing
   (Ord. 216, Series 1954.)
(10) Glass and Glazing
(11) Steel and Iron Erection
(12) Tile and Marble
(13) Blasting
(14) Boiler Setting
(15) (Ord. 282, Series 1959.)
(16) (Ord. 282, Series 1959.)
(17) Masonry
(18) Washing and Pointing (Masonry)
(19) Well Drilling
(20) Foundation and Caisson
(21) General Jobbing
   (No single job to exceed $3,000.00)
(22) Television and Radio Antennae

(d) Mover’s License Class A:

Mover’s License Class A shall entitle the licensee to contract for and to do the work of moving any building or structure or portion thereof, where such moving requires the issuance of a permit under the provisions of this code. All such work shall be done in accordance with the terms and provisions of this code.

(e) Wrecker’s License Class A:

A Wrecker’s License Class A shall entitle the licensee to contract for and to do the work of demolishing or wrecking any building or structure or portion thereof; where such demolition or wrecking requires the issuance of a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code.

(f) Wrecker’s License Class B:

A Wrecker’s License Class B shall entitle the licensee to contract for and to do the work of demolishing or wrecking any building or structure not exceeding two and one-half stories in height or portion thereof where such demolition or wrecking requires the issuance of a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code. This license shall entitle the licensee to sell second-hand building materials after the materials have been removed from the site of the work to the establishment of the licensee.

(g) Electrical License Class A:

An Electrical License Class A shall entitle the licensee to contract for the installation of electrical wiring or any electrical apparatus where such installation requires the issuance of a permit under the provisions of this code. All such work shall be done only in accordance with the terms and provisions of this code, and only by or under direct supervision of an Electrical License Class B licensee.

(h) Electrical License Class B:

An Electrical License Class B shall entitle the individual holding such license to install any electrical wiring or any electrical apparatus where such installation requires the issuance of a permit under the provisions of this code. The Electrical License Class B is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders. Licensees hereunder may perform the work for which they are licensed only as or in the employ of an Electrical License Class A licensee.

(i) Electrical License Class C:

An Electrical License Class C shall entitle the licensee to do the installation and maintenance of signal and communication systems and automatic controls which operate on an electrical potential not exceeding 48 volts. All such work shall be done only in accordance with the terms and provisions of this code.

The electrical license Class C is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders.
(3) Ground signs not to exceed 150 square feet in area.

(4) Cloth signs;

(5) Unilluminated projecting signs not to exceed 25 square feet.

(Ord. 446, Series 1958.)

(w) Refrigeration License:

A Refrigeration License shall entitle the holder thereof to contract for and install refrigeration systems and appurtenances and appurtenant cooling towers (excluding unit systems of one and one-half (1 1/2) tons or less, when installed for comfort cooling). All electrical work shall be performed by a licensed electrical contractor. All work shall be done only in accordance with the terms and provisions of this Code.

(Ord. 282, Series 1959.)

(x) Warm Air Heating, Ventilation and Air Conditioning License:

A Warm Air Heating, Ventilation and Air Conditioning License shall entitle the holder thereof to contract for and install warm air heating, ventilation, air conditioning and their appurtenances. All electrical work shall be performed by a licensed Electrical Contractor and all refrigeration work shall be performed by a licensed Refrigeration Contractor. All work shall be performed only in accordance with the terms and provisions of this Code.

(Ord. 282, Series 1959.)

Section 260. Annual License Fees. The annual license fees applicable to the licenses hereinbefore enumerated shall be in accordance with the following table. Annual payments and renewals shall be made in accordance with the Article on General Licensing Provisions of the Revised Municipal Code.

<table>
<thead>
<tr>
<th>License Class</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Builder's License Class A</td>
<td>$200.00</td>
</tr>
<tr>
<td>Builder's License Class B-1</td>
<td>125.00</td>
</tr>
<tr>
<td>Builder's License Class B-2</td>
<td>75.00</td>
</tr>
<tr>
<td>Builder's License Class C</td>
<td>50.00</td>
</tr>
<tr>
<td>Domestic Appliance License Class A</td>
<td>50.00</td>
</tr>
<tr>
<td>Domestic Appliance License Class B</td>
<td>10.00</td>
</tr>
<tr>
<td>Electrical License Class A</td>
<td>100.00</td>
</tr>
<tr>
<td>Electrical License Class B</td>
<td>10.00</td>
</tr>
<tr>
<td>Electrical License Class C</td>
<td>10.00</td>
</tr>
<tr>
<td>Electrical License Class D</td>
<td>10.00</td>
</tr>
<tr>
<td>Gas Fitter's License</td>
<td>10.00</td>
</tr>
<tr>
<td>Motion Picture Operators</td>
<td>10.00</td>
</tr>
<tr>
<td>Mover's License Class A</td>
<td>50.00</td>
</tr>
<tr>
<td>Plumber's License Class A Master</td>
<td>100.00</td>
</tr>
<tr>
<td>Plumber's License Class B Contractor</td>
<td>100.00</td>
</tr>
</tbody>
</table>

*Sign Contractor's License Class A... 100.00
*Sign Contractor's License Class B... 35.00
Stationary Engineer's License... 10.00
Steam Heating License Class A... 100.00
Steam Heating License Class B... 10.00
Warm Air Heating, Ventilating and Air Conditioning... 100.00
Wrecker's License Class A... 100.00
Wrecker's License Class B... 50.00

*A Class A Sign contractor shall also furnish a bond fulfilling the requirements of Section 902.5 of the Revised Municipal Code in the amount of $10,000.00, and a Class B Sign contractor shall furnish such bond in the amount of $2,000.00, the bonds conditioned upon saving harmless the City and County of Denver, its officers and employees, for the acts and omissions of any person responsible for the maintenance and display of any sign, where such acts and omissions result in damage to persons or property.

(Ord. 285, Series 1959.)

Section 261. Licensee Responsibility. All licensees shall be responsible for contracts and undertakings they assume for work requiring a permit under this code, and they shall be responsible for all subcontractors engaged to assist in such contracts or undertakings.

It shall be unlawful for any licensee hereunder to commit any of the following acts:

(a) Abandonment of any contract or undertaking without good cause; or, material departure from the plans and specifications for any contract or undertaking;

(b) Violation of any provisions of this code; violation or refusal to obey any order issued under authority of this code; or neglect or refusal to pay any fee assessed under authority of this code;

(c) Fraudulent use of a license to obtain permits for another person, firm or corporation;

(d) Carelessness or negligence in providing minimum safety measures, including appliances, apparatus, and equipment to protect workmen and the public, or failure to observe any other state law or municipal ordinance prescribing measures for the safety of workmen and of the public; or

(e) Failure to obtain inspection services when the same are required by this code; or failure to obtain a permit when the same is required by this code.
An Engineer's License shall entitle the individual holder thereof to take charge of and operate all steam boilers and appurtenances thereto, and shall be required in installations where the steam pressure is between 15 and 100 p.s.i. and where such equipment produces a total of between 10 and 100 hp.

Class SR-1. A Class SR-1 Stationary Engineer's License shall entitle the individual holder thereof to take charge of, operate, and make needful adjustments and maintenance repairs, on refrigeration installations of all sizes and types. Refrigeration systems for which a Class SR-1 Stationary Engineer's license shall be required are described as follows:

1. Refrigeration systems utilizing Group II or Group III refrigerants as defined in Chapter 49 of the Building Code, have charges of 200 pounds or more;
2. Refrigeration systems having manual or semi-automatic controls with charges of 400 pounds or more of Group I refrigerants; or
3. Refrigeration systems with fully automatic controls with charges of 1500 pounds or more of Group I refrigerants;

Class SR-2. A Class SR-2 Stationary Engineer's License shall entitle the individual holder thereof to operate specific mechanical refrigeration equipment in a designated building or plant and shall be required if such equipment is described below:

1. Refrigeration equipment has manual or semi-automatic controls with charges between 200 and 400 pounds of Group I refrigerants; or
2. Refrigeration equipment has fully automatic controls with charges between 750 and 1500 pounds of Group I refrigerants;

Class C. A Class C Stationary Engineer's License shall entitle the individual holder thereof to take charge of and operate all steam boilers and appurtenances thereto, and shall be required in installations where the steam pressure is between 15 and 100 p.s.i. and where such equipment produces a total of 10 hp or more.

Class SR-1 and Class SR-2 Stationary Engineers shall report to the Building Department any change of employment for which a licensed Stationary Engineer is in attendance. Refrigeration plants, which are licensed only under the supervision and in the employ of the following licensees:

- Gas Fitter's License;
- Plumber's Licensee Classes A & B;
- Steam Heating License Class A;
- Domestic Appliance License Class A;
- Warm Air Heating & Ventilation License Class C;
- Refrigeration License Class C.

Motion Picture Operators' License: A Motion Picture Operator's License shall entitle the individual holder thereof to operate and maintain moving picture projection equipment, spot and flood lights used in theatrical productions, and other electrical and lighting equipment associated with motion picture, stage, and theatrical productions, which equipment is located in a projection booth. This is an individual license and is not subject to the terms of Section 250 relating to supervisors for license holders. An individual licensee shall be personally in attendance and shall personally operate all such equipment whenever the same is utilized.

Sign Contractor's License Class A:

A Class A Sign Contractor's License shall entitle the holder thereof to erect or maintain, or to engage in the business of erecting or maintaining all types of signs.

Sign Contractor's License Class B:

A Class B Sign Contractor's License shall entitle the holder thereof to erect or maintain, or to engage in the business of erecting or maintaining the following types of signs only:

1. Wall signs painted directly on the wall;
2. Other wall signs not to exceed 200 square feet in area;
It shall be the duty of all licensees hereunder to report promptly to the Chief Building Inspector any injury to or death of any person, or any damage to any building or structure, caused by accident occurring in any construction or undertaking over which the Chief Building Inspector and the Building Department have jurisdiction.

Section 262. Sanitary Toilet Facilities. All Class A, Class B-1, and Class B-2 licensees engaged in the construction of any building classified according to its use or the character of its occupancy as a building of Group A, B, C, D, E, F, G, H, or I, as outlined in Table No. 5-A and as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, and 14, respectively, shall maintain on such construction projects adequate and conveniently located toilet facilities for the use of the workmen employed on or engaged in such construction project. Such toilet facilities shall be completely enclosed in a fly-proof weather-tight vented unit, the doors and screens thereto and thereof shall be tight-fitting and self-closing, and the toilets therein shall have seats and covers and shall be of smooth and easily cleanable construction. All such toilets and units shall be maintained odorless, clean, free from flies and other insects and from vermin, and shall be supplied with toilet paper, and the toilet fixtures shall be conventional water closets or urinals installed under and in accordance with Chapter 50 hereof, or of the chemical storage type meeting the standards above set forth, or sanitary pit privies constructed and maintained in accordance with the provisions and requirements of Article 765 of the Revised Municipal Code.

(Ord. 87, Series 1956.)
fications for a building or structure of a public
or semi-public nature or for any other building
or structure exceeding one story or 20' in
height, excepting buildings hereinafter desig-
nated as industrial or heavily loaded buildings
or structures. A building of a public or semi-
public nature is a building frequented by the
public, or into which the public is invited for
business, recreational, educational, religious, or
other similar purposes. Examples of public and
semi-public buildings include office buildings,
stores, apartment houses, hotels, hospitals,
churches, schools, museums, libraries, art gal-
leries, theaters, assembly halls, and govern-
mental buildings. A licensed architect who is
employed by the owner shall be responsible for
the supervision of the construction of the build-
ings or structures to which such plans and spec-
ifications pertain.

Only a professional engineer registered in
the State of Colorado and qualified in the field
of structural engineering or an architect licensed
by the State of Colorado may prepare and sub-
mit plans and specifications for a heavily load-
ed building or structure or an industrial build-
ing or structure irrespective of the height
thereof. An industrial building is a building or
structure devoted largely to manufacturing,
processing, storage, or other similar purposes.
Examples of industrial buildings include ware-
houses, storage plants, public garages, factories,
power houses, laboratories, refineries, packing
plants, refrigeration plants, dyeing and cleaning
plants, laundries, freight depots, grain, coal and
mineral elevators, water works buildings, and
water treatment and sewage disposal plant
buildings. A registered professional engineer
or licensed architect who is employed by the
owner shall be responsible for the supervision
of the construction of the buildings or struc-
tures to which such plans and specifications
pertain.

Plans and specifications where required by
this code to have been prepared by an archi-
tect or engineer, shall bear the seal and signa-
ture of the licensed architect or professional en-
gineer responsible for their preparation.

Exceptions:

(1) Buildings for Groups I and J occu-
pancy.

(2) Buildings of construction type III not
defined as public or semi-public buildings, or
additions thereto, one story not more than 20' in
height, measured from finished grade to plate
line, and which do not exceed 30' width meas-
ured center to center of footings, provided, how-
ever, such buildings are of standardized pre-
fabricated construction; in accordance with Sec-
tion 2715 of this code.

(4) Buildings of construction type IV not
defined as public or semi-public buildings, or
additions thereto, one story not more than 20'
in height, measured from finished grade to plate
line, of standardized prefabricated construction
over 30' in width, measured center to center of
footings, provided however, the plans and
specifications for the first of any such buildings
shall bear the signature and seal of a profes-
ional engineer or architect registered in the
State of Colorado.

(5) No provision herein contained shall
operate to restrict the practice of a licensed
architect or a registered professional engineer
qualified in the field of structural engineering,
if such provision is in conflict with state laws
governing such practice.

Applications under these exceptions shall
be processed as are all other applications, and
permits shall be issued only if the plans are in
accordance with those portions of this Code
which relate to such structures and other tech-
nical code requirements.

(f) Work Not Requiring Permit. No per-
mit shall be required for the installation of
store fixtures, counters, painting or decorating,
or for minor alterations and repairs not affec-
ting the structure of the building or the safety
of the occupants and property therein, where
such work does not involve a change in the
character of use or occupancy.

No permit shall be required of a public
utility duly franchised or authorized as such in
the City and County of Denver for the mainte-
nance and repair of its equipment and facilities
required in the production, distribution, and
utilization of such utility product or service, or
for the emergency maintenance and repair of
customer facilities utilizing such utility product
or service when necessary for sustaining such
service or protecting life or property. Where
emergency maintenance and repair of customer
facilities is authorized herein, belated permits
shall be secured as provided in Section 303(b).

(g) Retention of Plans. One set of ap-
proved plans, specifications and computations
shall be retained by the Chief Building Inspect-
or 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 specifica-
tions shall be returned to the applicant, which
set shall be kept on the site of such building
or work at all times during which the work
authorized thereby is in progress.

Plans submitted for review for which no
CHAPTER 3 – PERMITS AND INSPECTIONS: GENERAL AND TRANSITIONAL PROVISIONS

Sections 301-390. Permits and Inspections

Section 301. – (a) Permits Required; To Whom Issued. No person, firm, or corporation nor the Federal, State, County, or municipal government or any agency, sub-division or department thereof shall erect, construct, enlarge, remodel, alter, repair, move, improve, remove, convert, demolish, occupy or change occupancy of any building or structure in the City and County of Denver, or do any other work, or cause the same to be done, without first having obtained a separate permit for the specific work to be done for each such operation or a certificate of occupancy from the Chief Building Inspector.

(b) Application. To obtain a permit the applicant shall first file an application therefor in writing on a form furnished by the Building Department. Every such application shall:

1. Describe the land on which the proposed work is to be done, by lot, block, tract, and street address, or such similar description that will readily identify and definitely locate the site of the proposed work;
2. Show the use or occupancy of all parts of the building or structure;
3. Be accompanied by plans and specifications as required in sub-section (c) of this section. Where an excavation is proposed which extends within one foot (1') of the angle of repose or natural slope of the soil under any public sidewalk, street, alley, or other public property, the application shall be accompanied by a bond protecting city property, in an amount determined adequate by the City Engineer, and by a certificate of insurance from the contractor’s insurer, naming the City as co-insured on the contractor’s public liability policy.

(c) Plans and Specifications. Each application for a permit shall be accompanied by two sets of plans and specifications which have previously been approved by the Chief Building Inspector, and which have the Department stamp of approval or stamp of approval on the first page thereof.

Exception. At the discretion of the Chief Building Inspector, plans and specifications need not be submitted for alterations and repairs not affecting the structure of the building or the safety of the occupants.

(d) Information on Plans and Specifications. Plans and specifications shall be drawn to scale upon substantial paper or cloth and shall be of sufficient clarity to indicate the nature and extent of the work proposed and show in detail that it will conform to the provisions of this code and all relevant laws, ordinances, and rules and regulations. The first sheet of each set of plans shall give the exact address and location of the work to be done and the name and address of the owner and signature and seal if any of the person who prepared such plans and specifications. Plans shall include a plot plan showing the location of the proposed building and of every existing building on the property. Computations, stress diagrams, and other data sufficient to show the correctness of the plans, shall be submitted when required by the Chief Building Inspector.

(e) Plans and Specifications—Responsible for Design and Supervision of Construction. Only an architect licensed by the State of Colorado may prepare and submit plans and speci-
(d) **Blasting Permit Fees:**

<table>
<thead>
<tr>
<th>Time Required</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each five (5) day period or fraction thereof</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

(e) **Building Permit Fees:**

<table>
<thead>
<tr>
<th>Valuation of Work To Be Performed</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>$300 or less</td>
<td>$4.00</td>
</tr>
<tr>
<td>$301 to $2,000</td>
<td>$8.00</td>
</tr>
<tr>
<td>$2,001 to $15,000</td>
<td>$8.00 plus $3.50 per each $1,000 valuation or fraction thereof over $2,000.00.</td>
</tr>
<tr>
<td>$15,001 to $100,000</td>
<td>$53.50 plus $3.00 per each $1,000 valuation or fraction thereof over $15,000.</td>
</tr>
<tr>
<td>$100,001 and over</td>
<td>$308.50 plus $2.50 per each $1,000 valuation or fraction thereof over $100,000.</td>
</tr>
</tbody>
</table>

(f) **Domestic Appliance Permit Fees:**

<table>
<thead>
<tr>
<th>Number of Appliances</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or less</td>
<td>$4.00 per each</td>
</tr>
<tr>
<td>6 and over</td>
<td>$20.00 plus $2.00 per each additional appliance over 5.</td>
</tr>
</tbody>
</table>

(The valuation of each appliance shall be included in the permit application.)

(g) **Electrical Permit Fees:**

<table>
<thead>
<tr>
<th>Valuation of Work To Be Performed</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50 or less</td>
<td>$4.00</td>
</tr>
<tr>
<td>$51 to $200</td>
<td>$8.00</td>
</tr>
<tr>
<td>$201 to $1,000</td>
<td>$12.00</td>
</tr>
<tr>
<td>$1,001 to $5,000</td>
<td>$12.00 plus $4.00 per each $1,000 valuation or fraction thereof over $1,000.</td>
</tr>
<tr>
<td>$5,001 and over</td>
<td>$28.00 plus $3.00 per each $1,000 valuation or fraction thereof over $5,000.</td>
</tr>
</tbody>
</table>

(The valuation of each unit shall be included in the permit application.)

(h) **Elevator Permit Fees:**

<table>
<thead>
<tr>
<th>Valuation of Work To Be Performed</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>$300 or less</td>
<td>$4.00</td>
</tr>
<tr>
<td>$301 to $2,000</td>
<td>$8.00</td>
</tr>
<tr>
<td>$2,001 to $15,000</td>
<td>$4.00 per each $1,000 valuation or fraction thereof.</td>
</tr>
<tr>
<td>$15,001 and over</td>
<td>$60.00 plus $3.00 per each $1,000 valuation or fraction thereof over $15,000.</td>
</tr>
</tbody>
</table>

(i) **Gas Fitting Permit Fees:**

For the following work pertaining to gas fitting:
- Ranges and Plates
- Coffee Urns
- Deep Fat Fryers
- Dipping or Melting Pots
- Portable Burners
- Piping
- Conversion Burners
- Laundry Equipment
- Industrial Equipment
- Candy Cookers
- Warming Tables
- Griddles (Commercial)
- Toasters (Commercial)
- Bake Ovens (Commercial)
- Outlets and Service Extensions
- Controls (Wiring excluded)
- Incinerators
- Broilers
- Others—not listed
permit is issued and on which no action is taken by the applicant for 90 days, may be destroyed by the Chief Building Inspector; to renew action on said plans, the same shall be resubmitted to the Chief Building Inspector in the manner provided above.

(h) Validity. The issuance or granting of a permit or the approval of plans and specifications shall not be construed to be a permit for, nor an approval of, any violation of the provisions of this Code or any other code or ordinance enforced by the Chief Building Inspector. No permit presuming to give authority to violate, vary, or cancel the provisions of this code or any other ordinance or law or rule or regulation, shall be valid, except insofar as the work or use which it authorizes is lawful.

The issuance of a permit based upon plans and specifications shall not prevent the Chief Building Inspector from thereafter requiring the correction of errors in said plans and specifications, or from stopping unlawful building operations being carried on thereunder.

(i) Expiration. Every permit issued by the Chief Building Inspector under the provisions of this code shall expire, 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 for a period of 60 days at any time after the work is commenced. Before such work can be recommenced, a new permit shall be first obtained, and the fee therefor shall be one-half the amount required for an original permit for such work; provided, however, 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. If the permittee can demonstrate that the suspension or abandonment was occasioned by agencies beyond his control and that it would be an injustice to require a fee for a new permit, the same may be issued at the discretion of the Chief Building Inspector without charge.

Section 303. General Permits and Inspections.

(a) General. The following tables and schedules prescribe fees payable to the City and County of Denver for permits issued under this code. All items of construction and work for which a permit is required under this code shall be inspected by the Chief Building Inspector. All items of construction and work for which a permit is required shall, conform to the technical specifications of this code, and, as such, shall be “accepted” by the Chief Building Inspector; items of construction and work for which a permit is required which do not upon first inspection so conform shall be corrected, and, as properly corrected, “accepted” by the Chief Building Inspector; and, items of construction and work for which a permit is required which do not so conform and are not so corrected shall be deemed to constitute a violation of this code, and the person, firm, or corporation responsible for the same shall be guilty of a violation of this code. The term “accepted,” as used herein, connotes that the particular items of construction and work which have been inspected by the Chief Building Inspector pursuant to a permit issued under this code conform to the applicable technical specifications of this code. Such “acceptance” shall not be presumed to authorize any violation or variance in the provisions of this code or any other ordinance or law or rule or regulation.

(b) Fees for Late Permits. Items of work and construction for which a permit is required under this code which are commenced before a permit is secured shall be assessed fees in twice the amounts prescribed in the schedules and tables herein below, and shall, in the event of a repeated violation, subject the licensee to suspension or revocation of his license.

Exception: For items of work and construction performed on an emergency basis to restore or maintain an existing service or to protect an existing installation, building, or structure, or to protect life, health and safety, the above penalties shall not apply if such permits are applied for within 72 hours after commencement of the emergency work.

(c) Permits Not Requiring Fees. The City and County of Denver, the State of Colorado, and the United States of America, and all agencies and departments thereof, shall be exempt from payment of any fee for work performed on buildings and structures owned wholly by such agencies and departments and exclusively devoted to governmental use.
Double faced ground signs—1 ½ times the above fixed fees.

**Exception:** For signs painted directly on the wall, for poster display cases, and for marque signs the fee at the time of the initial painting or hanging shall be $4.00.

(2) Roof Signs:
- Under 50 sq. ft. ............................................. $4.00
- 51 to 100 sq. ft. ............................................. $8.00
- For each additional 100 square feet or fraction thereof ............................................. $3.00

Double faced roof signs—1 ½ times the fees fixed above.

(3) Projecting Signs:
- Under 50 sq. ft. ............................................. $4.00
- 51 to 100 sq. ft. ............................................. $8.00
- For each additional 100 sq. ft. or fraction thereof ............................................. $3.00

(4) Remodelling: Fees for inspection services and sign permits accorded for remodeling work shall be one-half (½) of the fees fixed for inspection services charged at the original inspection, provided, however, that the minimum service fee shall be $3.00.

(c) Water Heater Permit Fees:
- Each Appliance ............................................. $4.00 each
  (The valuation of each appliance shall be included in the permit application.)

(p) Wrecking Permit Fees:
  - Total Floor Area of Structure  
    - To Be Wrecked  
    - Fee
    - 500 sq. ft. or less ............................................. $4.00
    - 501 to 2,000 sq. ft. ............................................. $8.00
    - 2,001 sq. ft., over ............................................. $8.00 plus $3.00 per each 1,000 square feet or fraction thereof over 2,000 square feet.

(Ord. 286, Series 1959.)

Section 304. Inspections.

(a) Periodic or Continuous Inspections. All construction work under this code shall be subject to inspection by the Chief Building Inspector, and certain types of work shall have continuous inspection by privately employed qualified inspectors as specified in Section 305 hereinafter.

(b) Inspection Record Card. Work requiring a permit issued under this code by the Chief Building Inspector shall not be commenced until the permit holder or his agent shall have posted an inspection record card in a conspicuous place so as to allow the Chief Building Inspector conveniently to make the required entries thereon regarding inspection of the work. This card shall be maintained in such position until the work has been approved and the card removed by the Chief Building Inspector.

(c) Approvals Required. No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the Chief 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 inspections required in subsection (d) below. There shall be a final inspection and approval on every building and structure when the same is complete and ready for occupancy or use.

(d) No foundation work, reinforcing steel or structural framework of any part of any building or structure shall be covered or concealed in any manner whatever without first obtaining the approval of the Chief Building Inspector.

The Chief Building Inspector upon notification from the permit holder or his agent shall make the following inspections of buildings, and shall either approve that portion of the
Number of Appliances: Fee
5 or less ........................................ $4.00 each
6 and over ................................ $20.00 plus $2.00 per each additional appliance
(The valuation of each appliance shall be included in the permit application.)

(j) Mechanical Permit Fees:
For work pertaining to the following:
- Warm Air Heating Systems and Appurtenances
- Ventilating Systems and Appurtenances
- Air Conditioning Systems and Appurtenances
- All Ductwork
- Fire Protection Systems and Standpipes
- Hot Water Heating Systems and Appurtenances
- Evaporative Cooling and Appurtenances
- Exhaust Systems and Appurtenances
- Hood Systems and Appurtenances
- Cooling Towers
- Steam Heating Systems and Appurtenances
- Oxygen Systems
- Oil Heating and Oil Standby Systems
- Others—not listed.

<table>
<thead>
<tr>
<th>Valuation of Work To Be Performed</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>$200 or less</td>
<td>$4.00</td>
</tr>
<tr>
<td>$201 to $800</td>
<td>$8.00</td>
</tr>
<tr>
<td>$801 to $2,000</td>
<td>$12.00</td>
</tr>
<tr>
<td>$2,001 to $15,000</td>
<td>$12.00 plus $4.00 per each $1,000 valuation or fraction thereof over $2,000.</td>
</tr>
<tr>
<td>$15,001 and over</td>
<td>$64.00 plus $3.00 per each $1,000 valuation or fraction thereof over $15,000.</td>
</tr>
</tbody>
</table>

(k) Moving Permit Fees:
Total Floor Area of Structure To Be Moved Fee
Total floor area ................................ $4.00 per each 1,000 square feet or fraction thereof.

(l) Plumbing Permit Fees:
Valuation of Work To Be Performed Fee
$100 or less ................................ $4.00
$101 to $800 ................................ $8.00
$801 to $2,000 .............................. $12.00
$2,001 to $10,000 ........................ $12.00 plus $4.00 per each $1,000 valuation or fraction thereof over $2,000.
$10,001 and over ........................... $44.00 plus $3.00 per each $1,000 valuation or fraction thereof over $10,000.
(For each additional 100 square feet or fraction thereof $1.00)

(m) Refrigeration Permit Fees:
Valuation of Work To Be Performed Fee
$500 or less ................................ $4.00
$501 to $2,000 .............................. $8.00
$2,001 to $10,000 ........................ $4.00 per $1,000 valuation or fraction thereof.
$10,001 and over ........................... $40.00 plus $3.00 per each $1,000 valuation or fraction thereof over $10,000.

(n) Sign Permit Fees:
(1) Ground Signs and Wall Signs:
25 sq. ft. or less ................................ $2.00
26 to 50 sq. ft. .............................. $4.00
51 to 100 sq. ft. ............................. $6.00
For each additional 100 square feet or fraction thereof $1.00

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Section 306. Certificate of Occupancy.

(a) Use or Occupancy. No new building or structure in Groups A to I, inclusive, shall be used or occupied, and no change in the existing occupancy classification of a building or structure portion thereof shall be made until the owner or his agent has applied for and the Chief Building Inspector has issued a Certificate of Occupancy therefor as provided herein.

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


Section 390. General Provisions. The Council of the City and County of Denver hereby finds and determines that the continuous and effective administration of the Building Department and of this code are essential to the protection of life and property and a vital police function of the City and County of Denver.

This code shall be enforced by the Chief Building Inspector, the Board of Examiners, and the Board of Appeals, in a manner that will accomplish the transition from older codes and ordinances to this code smoothly and efficiently without undue hardship or disruption in the building and construction industry.

Section 391. Re-Examination of Licensees. The Board of Examiners, with the approval of the Manager of Safety and Excise, by appropriate rules and regulations shall designate that the licenses issued under codes and ordinances repealed by this code shall remain in full force and effect and be regarded as the corresponding and analogous licenses defined in this code.

The Board of Examiners may re-examine all licensees in order to test current qualifications and fitness according to the criteria of this code, but in the case of holders of licenses repealed by this code failure to pass such re-examination shall not be the sole cause for a recommendation to suspend or revoke such license.

Except as otherwise expressly provided herein, this code shall not be construed to require the duplication or re-issuance of any license within the same calendar year, the duplication of any examination, nor the duplication of any payment of any license fee for a particular grade of license within the same calendar year. All persons, firms, and corporations in the building and construction industries, presently licensed under former codes and ordinances shall be deemed to be appropriately licensed hereunder. Any such licensee under a former code or ordinance who fails to re-apply for a license at the conclusion of the calendar year shall surrender his license and the same shall be deemed to be null and void.

Section 392. Inspections and Permits. All monies paid under codes and ordinances repealed by this code for permits and inspection services covering construction or work not completed as of the effective date hereof shall be deemed to have been paid under the terms and provisions of this code. Insofar as is possible, such permits and authorizations for inspection services shall be deemed to have been issued under authority of this code. Except as otherwise expressly provided herein, this code shall not be construed to require the duplication or reissuance of any permit or of any inspection.

Section 393. Membership of Boards. Eligibility for membership on the Board of Examiners and the Board of Appeals, as created and defined by this code, shall be in no wise affected or limited by membership on any former Board of Examiners, Board of Appeals, or Board of Examiners and Appeals.
work as completed, or shall notify the permit holder or his agent wherein the same fails to comply with the law.

1. Footing Inspection: To be made after trenches are excavated, forms erected and reinforcing steel, if any, placed and before any footings are poured.

2. Foundation Inspection: To be made after all foundation is poured, forms removed, and before waterproofing is commenced.

3. Waterproofing Inspection: To be made when waterproofing is completed and before backfill is placed.

4. Frame Inspection: To be made after all the floors, roof, bearing masonry, framing, fire-blocking, and bracing are in place and all pipes, chimneys, and vents are complete and before lathing is commenced.

5. Lath Inspection: To be made after all lathing, interior and exterior, is in place, but before any stucco or plaster is applied.

6. Plumbing Inspection: First inspection to be made on all rough work before it is covered. Inspection of building sewer is to be made before it is covered. Final inspection to be made when all fixtures are set.

7. Electrical Inspection: First inspection to be made on all rough work before it is covered. Final inspection to be made when all fixtures are hung.

8. Heating and Gas Fitting Inspection: First inspection to be made when all duct and pipework is in place before it is covered. Final inspection to be made when the system is ready to operate.

9. Air Conditioning: First inspection to be made when all duct and pipework is in place before it is covered. Final inspection to be made when system is ready to operate.

10. Refrigeration: Inspection to be made when all pipework is in place before it is covered and when all machinery is in place. Final inspection to be made when the system is ready to operate.

(e) Other Inspections: In addition to the called inspections as specified above, the Chief Building Inspector may require and make any other inspections of any work covered by this code to ascertain compliance with the provisions of this code and other codes, ordinances, and rules and regulations which are enforced and administered by the Building Department.

Section 305. (a) General. In addition to the inspections to be made as specified in Sec-

tion 304, the owner or his agent shall privately employ a qualified inspector during construction on the following types of work:

1. Concrete: On all reinforced structural concrete work, including forms and the placement of reinforcement.

2. Masonry: On plain masonry when the design is based on a strength of masonry (Fm) in excess of 1000 pounds per square inch.

3. Structural Steel: At all times during the erection of structural steel or when field bolting, riveting, or structural welding is being carried on.

4. Light Weight Construction. At all times when cast-in-place structural reinforced gypsum or other lightweight aggregate concretes are being mixed or deposited.

5. Special Cases: On special construction work or work involving unusual hazards or requiring constant inspection the Chief Building Inspector may require a privately employed qualified inspector.

EXCEPTION: The Chief Building Inspector may waive the requirement for the employment of a privately employed qualified inspector if he finds that the construction or work is such that no unusual hazard exists.

EXEMPTIONS: The following buildings and structures are exempt from the provisions of this section except where structural reinforced concrete is employed:


2. Types III, IV (when prefabricated) and V buildings and structures.

(b) Qualifications: Every privately employed inspector shall be qualified for the work he is employed to do. Such inspector shall be:

1. A registered professional engineer with experience in structural engineering; or,

2. A licensed architect; or,

3. A person in the employ of and subject to direct supervision of a person in category (1) or (2) above or,

4. A person under the personal and direct supervision and control of a person in category (1) or (2) above.

5. The names and qualifications of Inspectors proposed to be employed under (3) and (4) above shall be submitted to the Chief Building Inspector for approval prior to their assignment on the work.
Section 394. Severability. If any provision of this code or its application to any person, firm or corporation, or any circumstance is held to be invalid, such invalidity shall not affect other provisions or applications of this code. The City Council hereby declares that in these regards the provisions of this code are wholly severable.

Section 395. Re-Examination of Motion Picture Licensees. Persons licensed as motion picture operators at the time this section takes force and effect shall be regarded as motion picture operators duly licensed hereunder, and shall not be required to duplicate or obtain re-issuance of their license during this calendar year to perform such work or to duplicate any examination or payment of any license fee. All motion picture operators presently licensed under provisions repealed hereby shall be deemed to be appropriately licensed hereunder. Any such licensee under a former licensing enactment who fails to reapply for a license at the conclusion of this calendar year shall be deemed to have surrendered his license, and the same shall be null and void.

The motion picture operators committee of the board of examiners may re-examine all persons licensed under former licensing enactments repealed hereby in order to test current qualifications and fitness according to the criteria of this code, but in the case of holders of licenses under provisions repealed hereby, failure to pass such re-examination shall not be the sole cause for a recommendation to suspend or revoke such license.

(Ord. 228, Series 1955.)
TECHNICAL PROVISIONS*

*Source—Ord. 140, Series 1949, except where otherwise indicated.
CURTAIN WALL (See "WALL, CURTAIN")

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

DWELLING (One-Family) shall mean a detached building arranged, intended or designed to be occupied, or which is occupied, by not more than one family and which has not more than one kitchen.

DWELLING (Two-Family) shall mean a detached building arranged, intended or designed to be occupied, or which is occupied, by two families living independently of each other and which has not more than two kitchens.

DWELLING (Multiple) shall mean a building arranged, intended or designed to be occupied, or which is occupied, by three or more families or groups of individuals living independently of each other in separate housekeeping units or apartments. The term "Multiple Dwelling" shall include the term "Apartment House," "Apartment Hotel," "Apartment Court," "Bungalow Court," "Row House," "Terrace," and "Tenement House.

(e) ENCLOSURE WALL (See "WALL, ENCLOSURE")

EXISTING BUILDING (See "BUILDING, EXISTING")

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

(f) FACED WALL (See "WALL, FACED")

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.

FIRE WALL (See "WALL, FIRE")

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

FLUE is a passage in a chimney through which smoke, gas, or fumes ascend. Each passage is called a flue; and one or more flues, together with surrounding materials and jackets, when present, make up the chimney.

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

FOUNDATION means a wall or pier below first floor serving as support for a wall, pier, column, or other structural parts of a building.

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

GARAGE is a building or portion thereof in which a motor vehicle is stored, repaired or kept.

GARAGE, PRIVATE (A) A building or portion of a building designed or used for the storage only of not more than three (3) motor driven vehicles.

GARAGE, STORAGE (B) A building other than a private garage, used exclusively for housing motor driven vehicles.

GARAGE, PUBLIC (C) A building other than a private or storage garage, used for storage, equipping, repairing, hiring or selling of motor driven vehicles.

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), when used in connection with lumber for structural purposes, means a classification with respect to strength and suitability for use as a structural member.

Height of Building is the vertical distance from the "Grade" to the highest point 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.

HEIGHT, STORY, means the vertical distance from the surface of a floor to the surface of the next floor above, or to the ceiling of the top story.

HEIGHT, WALL, means the vertical distance to the top, measured from the foundation wall or from a girder or other immediate support of the wall.

HOLLOW WALL (See "WALL, HOLLOW")

(i) INCOMBUSTIBLE MATERIAL is a material which will not ignite at or below a temperature of 1200° F. and will not continue to burn or glow at that temperature.

INTERIOR WALL (See "WALL, INTERIOR")

(i) No definitions.

(k) No definitions.

(l) LIVE LOADS are all imposed, fixed, or transient loads other than "Dead Loads."
LINTEL is the beam or girder placed over an opening in a wall, and which supports the wall construction above.

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

MASONRY is that form of construction composed of stone, brick, concrete, gypsum, hollow day 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. Unless otherwise specifically provided, plain monolithic (non-reinforced) concrete shall be considered as Masonry for the purpose of this Code.

MASONRY, SOLID, is masonry built without hollow spaces.

MAY, as used in this Code, is permissive.

MEZZANINE or MEZZANINE FLOOR is an intermediate floor placed in any story or room. When the total area of any such "Mezzanine Floor" exceeds thirty-three and one-third per cent (33 1/3%) 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) NON-BEARING WALL (See "WALL, NON-BEARING")

(o) OCCUPANCY means 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 unless the new use of the building would classify it in a different occupancy group.

ORIEL WINDOW (See "WINDOW, ORIEL")

(p) PANEL WALL (See "WALL, PANEL")

PARAPET WALL (See "WALL, PARAPET")

PARTY WALL (See "WALL, PARTY")

PENTHOUSE is a structure built above a roof to enclose wholly or in part a stairway, tank or other equipment, or space that affords passage for air or light. If the aggregate area of all penthouses and other roof structures exceeds fifty per cent (50%) of the area of the roof, they shall be considered as an additional story.

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.

PIER is an isolated column of masonry. A bearing wall not bonded at the sides into associated masonry shall be considered a pier when its horizontal dimension measured at right angles to the thickness does not exceed four (4) times its thickness.

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

PORCH is a roofed structure projecting from a building and separated from the building by the walls thereof.

An open porch shall have no enclosing features (except screen) higher than forty-two inches (42") above the floor except the roof and roof supports.

An enclosed porch shall have at least fifty per cent (50%) of the horizontal section of the exterior walls in glass.

PUBLIC BUILDING means a building in which persons congregate for civic, political, educational, religious, social, or recreational purposes; including, among others, court houses, schools, colleges, libraries, museums, exhibition buildings, lecture halls, churches, assembly halls, lodge rooms, dance halls, theatres, bath houses, armories, recreation piers, stadiums, passenger stations, bowling alleys, skating rinks, gymnasiums, city halls, grandstands, motion picture theatres, auditoriums, clubs, restaurants.

Office buildings, stores, and similar buildings shall be considered as semi-public buildings.

(q) No definitions.

(r) REPAIR means 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.

REVIEWING WALL (See "WALL, RETAINING")

(s) SEATING CAPACITY of a theatre, auditorium, or any room or place of public assembly in which seats are not fixed, shall be determined on the basis of seven square feet (7 sq. ft.) of floor, balcony, and/or 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 eighteen inches (18") of pew or bench length.

SHAFT means a vertical opening through a building for an elevator, a dumb waiter, light, ventilation, or similar purposes.

SHALL, as used in this Code, is mandatory.

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


STORY means that portion of a building included between the upper surface of any floor and the upper surface of the next floor, except basements, and 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 ceiling over a basement is more than four feet (4') above grade, such basement shall be considered a story.

STREET shall mean a public thoroughfare, not less than twenty feet (20') in width, which affords principal means of access to abutting property. The term "street" shall include the terms "place," "way," "boulevard," "parkway," "avenue," "circle," "court," and "drive."

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. The term "structure" shall include "building."

(t) No definitions.
(u) No definitions.
(v) VALUE of a building shall be the estimated cost to replace the building in kind.

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

VENEERED WALL (See "WALL, VENEERED")

(w) WALLS shall be defined as follows:

BEARING WALL is a wall which supports any load other than its own weight.

CAVITY WALL is a wall built of masonry units or of plain concrete, or a combination of these materials, so arranged as to provide an air space within the wall, and in which the facing and backing of the wall are tied together with masonry metal ties or bonded together with masonry or concrete.

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

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

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

FIRE WALL means a wall which subdivides a building or separates buildings to restrict the spread of fire, and which starts at the foundation and extends continuously through all stories to and above the roof, except where the roof is fireproof and the wall is carried up tightly against the underside of the roof slab. Fire walls shall be built of brick, concrete, or other approved materials or assemblies of materials, and shall have a fire-resistive rating of not less than four (4) hours, and shall meet all other requirements for structural stability and thickness set forth in this Code for walls of various materials.

HOLLOW WALL is a wall built of masonry units laid in and so constructed as to provide an air space within the wall. When hollow walls are built in two (2) or more vertical separated withes, these withes shall be bonded together so as to exert common action under load.

INTERIOR WALL is a wall entirely surrounded by the exterior walls of the building.

NON-BEARING WALL is a wall which supports no load other than its own weight.

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

PARAPET WALL is that part of any wall entirely above the roof line.

PARTY WALL is a wall used or adapted for joint service between two buildings.

RETAINING WALL is any wall used to resist the lateral displacement of any material.

VENEERED WALL means a wall having a masonry facing which is attached to the backing but not so bonded as to exert common action under load.

WINDOWS shall be defined as follows:

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

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

(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.

(z) No definitions.
CHAPTER 5 - CLASSIFICATION OF ALL BUILDINGS BY USE OR OCCUPANCY AND GENERAL REQUIREMENTS FOR ALL OCCUPANCIES

Section 501. OCCUPANCY - CLASSIFIED. Every building, whether existing or hereafter erected, shall be classified by the Chief 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 outlined in Table No. 5-A and as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15, respectively.

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

The Types of Construction referred to in this Code are:

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

and are defined in Chapters 18, 19, 20, 21, and 22, respectively.

Section 502. CHANGE IN USE AND CERTIFICATE OF OCCUPANCY.

(a) General. 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 Chief 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.

(b) Existing Buildings. 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.

(c) Certificate of Occupancy. No new building or structure shall be used or occupied, and no change in the existing occupancy classification of any building or structure, or portion thereof, shall be made until the Chief Building Inspector has issued a Certificate of Occupancy therefor as provided herein.

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

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

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

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

Section 503. MIXED OCCUPANCY.

(a) General. When a building is used for more than one occupancy purpose and the occupancy portions are completely separated by fire walls, as defined in Section 401, each occupancy may be treated as a separate building for the purpose of this Code.

Where the occupancies are not so separated by fire walls, the building shall be considered a mixed occupancy and shall be subject to the most restrictive requirements for the occupancies concerned. Each portion shall be separated as specified in Subsections (b), (c), and (d) of this Section.

(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 Separations. Occupancy separations shall be classed as "Absolute," "Special," and "Ordinary." Fire doors required in this Section are defined in Section 4306.

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

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

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

(d) Fire Ratings for Occupancy Separations. Occupancy separations shall be provided between the various groups and divisions of occupancies as set forth in Table No. 5-B, except that in no case need the separation be more fire-resistive than the exterior walls of the building in which the separation occurs, unless such walls are less than one-hour fire-resistive construction. Where any occupancy separation is required, the minimum shall be an "Ordinary Occupancy Separation," except 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 inch (1 3/8") in thickness, or equivalent construction, shall be permitted for separation between Group I and J occupancy.

Section 504. LOCATION WITHIN CITY AND ON PROPERTY SITE. (a) Zoning. In order to determine where a building may be located within the territorial limits of the City and County of Denver, as well as on a particular property site, it is necessary to consult Fire Zone regulations and District Zone regulations. Fire Zone regulations appear in Chapter 16 of this Code and are based on the fire hazard of occupancies within particular Types of Construction in areas designated as Fire Zones No. 1, No. 2, No. 3, and No. 4. District Zone regulations appear in the Building Zone Ordinance (Ord. No. 14, Series of 1925, as amended) and are based on a classification of building use by district as residential, business, commercial, and industrial. Included in both are restrictions which, within a particular Fire or District Zone, may modify general provisions herein contained with respect to building heights, areas, and property setbacks.

(b) Fire Resistance Requirements and Protection of Openings. The specific requirements given in Section 603, 703, 803, 903, 1003, 1103, 1203, 1303, and 1503, regulating the construction of exterior walls and the protection of openings therein with respect to adjacent property lines, shall apply to buildings erected on the same property, but with reference to an imaginary property line located between such buildings and parallel to the face of either building.

Exception: In Group J, Division I, occupancies, which are accessory to Group I, occupancies on the same property, the requirements for occupancy separations, as specified in Section 503, may be substituted in lieu thereof.

Section 505. ALLOWABLE FLOOR AREAS. (a) General. Basement and cellar areas need not be included in the total allowable areas.

Buildings shall adjoin a yard, public space or street on not less than one side.

For the purpose of this Chapter, a yard shall be on the property on which a building is located, permanently maintained as an integral part thereof, and free of all obstructions from the ground up.

(b) One-Story Areas. The floor area of every building shall be determined by the character of the occupancy, the Type of Construction, and the location. Table No. 5-C and notes thereto outline the basic allowable floor areas for buildings of one story in height. Increases are permitted in accordance with Section 506.

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

Section 506. ALLOWABLE AREA INCREASES. (a) General. The increases of floor areas permitted in this Section may be additive when applicable.

Exception: Increases for one-hour fire-resistant construction or for automatic sprinkler installations shall not apply when other provisions of this Code require such construction or sprinkler installation.

It shall be unlawful to occupy a building in which the area was increased under the provisions of Subsections (d), (e), (f), (g), or (h) of this Section, where the required space allowances or sprinkler systems are not fully maintained.
(b) Fire Zones. Buildings of Group F or G occupancy, Construction Type II, III, or IV, may be increased one hundred per cent (100%) in Fire Zone No. 2, No. 3, or No. 4.

Building of Group H occupancy, Construction Type II or III, may be increased fifty per cent (50%) in Fire Zone No. 2, No. 3, or No. 4.

(c) One-Hour Fire-Resistance. For buildings having at least one-hour fire-resistive construction throughout, the areas specified in Section 505 for Types III, IV, and V may be increased one-third (1/3).

(d) Separation on Two Sides. Where yards, public space or streets, 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 one and one-fourth per cent (1 1/4 %) for each foot by which the minimum width exceeds twenty feet (20’), but the increase shall not exceed fifty per cent (50%).

(e) Separation on Three Sides. Where yards, public space or streets, 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 two and one-half per cent (2 1/2 %), for each foot by which the minimum width exceeds twenty feet (20’), but the increase shall not exceed one hundred per cent (100%).

(f) Separation on All Sides. Where yards, public space or streets, 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 (5 %) for each foot by which the minimum width exceeds twenty feet (20’). Such increases shall not exceed one hundred per cent (100%).

Exceptions: 1. Areas of Group E, Division 2 (Aircraft Repair Hangars) may be increased five hundred per cent (500%).

2. Increases in one- and two-story buildings of Group G occupancy shall not be limited.

3. Increases in one-story buildings housing aircraft storage hangars shall not be limited.

(g) Unlimited Area. The area of any one- or two-story building of Group F, G, or E, Division 2, occupancy shall not be limited if the building is provided with automatic sprinklers throughout, as specified in Chapter 38, and entirely surrounded by yards, public space or streets not less than sixty feet (60’) in width.

Exception: The area of any one-story Type II or Type IV building of Group G occupancy housing storage and sales rooms of incombustible and non-explosive materials shall not be limited if the building is entirely surrounded by a yard, public space or street, not less than sixty feet (60’) in width.

(h) Sprinklers. The areas specified in Section 505 may be tripled in one-story buildings, and doubled in buildings of more than one story, if the building is provided with automatic sprinklers throughout, as specified in Chapter 38.

Section 507. MAXIMUM HEIGHTS OF BUILDINGS. (a) General. The height of every building shall be determined by the character of the occupancy, the Type of Construction, and the location.

(b) Height in Stories. Table No. 5-D and notes thereto outline the maximum number of stories allowed.

(c) Height in Feet. The maximum height, in feet, of any building shall not exceed the limitations specified under Types of Construction.

For restrictions in District Zones see District Zone regulations (Ord. No. 14, Series of 1925, as amended).

Exception: The height, in feet, of one-story aircraft hangars shall not be limited by construction type, if the building is provided with automatic sprinklers throughout, as specified in Chapter 38, and is entirely surrounded by yards, public space or streets, not less in width than one hundred fifty per cent (150%) of the height of the building.

Section 508. Food Waste Disposal Mandatory. New structures erected after March 1, 1957, designed, arranged or intended to be used for purposes which cause, result in, produce or develop food wastes in the direct preparation of food, occupancies such as: dwellings, restaurants, hotels, boarding houses, hospitals, and similar occupancies, shall provide and use approved food waste disposal equipment for such purposes within the premises thereof. Existing structures, converted or altered to the uses as described above, need not meet the requirements as set forth in the preceding paragraph unless such structure is provided with a new kitchen. Such kitchen only shall be provided with a food disposal unit.

(Ord. 43, Series 1957.)
TABLE NO: 5-A—GROUPS OF OCCUPANCY

<table>
<thead>
<tr>
<th>Chapter Reference</th>
<th>Group</th>
<th>OCCUPANCY</th>
</tr>
</thead>
</table>
| 6                 | A     | 1. Any assembly building with an occupant load of 1,000 or more in the building.  
|                   |       | 2. Any theater, with a stage, having an occupant load of 500 or more in the building. |
| 7                 | B     | 1. Any assembly building, not equipped with a stage, having an occupant load of less than 1,000 persons in the building.  
|                   |       | 2. Any theater, with or without a stage, having an occupant load of less than 500 persons in the building.  
|                   |       | 3. Stadiums, reviewing stands, and amusement park structures not included within Group A and Divisions 1 and 2 of Group B. |
| 8                 | C     | Any building used for school purposes, involving assemblage for instruction, education or recreation. |
| 9                 | D     | 1. Jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.  
|                   |       | 2. Nurseries for children under six; hospitals, sanitariums, and similar buildings (each accommodating six or more persons). |
| 10                | E     | 1. 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.  
|                   |       | 2. Aircraft repair hangars.  
|                   |       | 3. Public garages, storage of hazardous and highly flammable or explosive materials and liquids. |
| 11                | F     | 1. 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.  
|                   |       | 2. Aircraft hangars where no repair work is done except exchange of parts and maintenance requiring no open flame welding or the use of highly flammable liquids. |
| 12                | G     | Ice plants, power plants, pumping plants, cold storage, and creameries. Factories and workshops using incombustible and non-explosive materials.  
|                   |       | Storage and sales rooms of incombustible and non-explosive materials. |
| 13                | H     | 1. Homes for aged, orphanages, dormitories for children over six (each accommodating six or more persons).  
|                   |       | 2. Hotels, apartment houses, dormitories, lodging houses, convents, monasteries (each accommodating 10 or more persons). |
| 14                | I     | Dwellings. |
| 15                | J     | 1. Private garages, sheds and minor buildings used as accessories only when not over one thousand square feet (1,000 sq. ft) in area.  
|                   |       | 2. Fences, watertanks and towers. |
### TABLE NO. 5-B—REQUIRED SEPARATIONS IN BUILDINGS OF MIXED OCCUPANCY

(Ord. 62, Series 1956.)

<table>
<thead>
<tr>
<th>Chapter Reference</th>
<th>Group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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</tbody>
</table>

*Gasoline filling and service stations shall have special separations from all other groups except public garages.

**Provided that lath and plaster as approved for one-hour fire-resistant construction on the garage side and a self-closing, tight-fitting solid slabwood door one and three-eighths inches (1 3/8") in thickness, or equivalent construction, shall be permitted.

†Separation between Group B, Division 1 and Group F may be Ordinary.
**TABLE NO. 5-C**

**BASIC ALLOWABLE FLOOR AREA FOR BUILDINGS ONE STORY IN HEIGHT**
(In Square Feet)

<table>
<thead>
<tr>
<th>TYPES OF CONSTRUCTION</th>
<th>OCCUPANCY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>I</td>
<td>Unlimited</td>
</tr>
<tr>
<td>II</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>III</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>IV</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>V</td>
<td>Not Permitted</td>
</tr>
</tbody>
</table>

**NOTES TO TABLE**

1. For Group J Occupancy, see Chapter 15.
2. Fire Zone restrictions on buildings of Types III, IV, and V Construction appear in Sections 1602, 1603, and 1604.
3. Special Provisions Affecting Divisions Within Occupancy Groups:
   - **Group B**
     - Division 1 and 2: Fire-resistive construction required. (See Sec. 702)
     - Division 3: Open skeleton frame type unlimited in area. (See Sec. 702)
   - **Group C**
     - Construction Types II, III, IV, and V permitted as provided in Sec. 802.
   - **Group E**
     - Division 2 and 3: Requirements for fire-resistive construction contained in Sec. 1002.
   - **Group F**
     - Division 1: Type V construction limited to storage sheds. (See Sec. 1102)
     - Division 2: Fire-resistive construction required for aircraft hangars. (See Sec. 1102)
   - **Group G**
     - Type V construction limited to storage sheds. (See Sec. 1202)
   - **Group H**
     - Construction Types II, III, and IV restricted. (See Sec. 1302)
     - Division 2: Fire-resistive construction required. (See Sec. 1302)
CHAPTER 6 — REQUIREMENTS FOR GROUP A OCCUPANCIES

Section 601. GROUP A OCCUPANCIES DEFINED. Group A occupancies shall be:

Division 1. Any assembly building with an occupant load of 1,000 or more in the building.

Division 2. Any theater, with a stage, having an occupant load of 500 or more in the building.

For occupancy separations see Table 5-B.

For computing occupant load see Section 3301.

Section 602. CONSTRUCTION, HEIGHT, AND AREA ALLOWABLE. (a) General. Buildings classified in Group A shall be of Type I Construction and shall not be limited in seating capacity, height, or floor area.

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

The slope of the main floor of the assembly room shall not exceed one (1) in five (5).

Section 603. LOCATION. (a) In City. Buildings housing Group A occupancies shall not be located as to location in Fire Zones.

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. 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 entrance and exit of such building. The main assembly floor shall be located at or near the adjacent ground level. For property setbacks, see District Zone Regulations, supra.

(c) Exterior Wall and Opening Protection. Exterior walls shall be constructed as specified in Section 1805. Except on street fronts, exterior walls or parts of walls which are less than five feet (5') from adjacent property lines shall have no openings therein. Openings, except on street fronts, which are five feet (5') to ten feet (10') from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

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

Section 604. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

Section 605. LIGHT, VENTILATION, AND SANITATION. 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 sky-

lights with an area not less than one-eighth (1/8) 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, wired glass, or tempered glass.

All registers or vents supplying air back-stage 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 and outside the vent or duct.

There shall be provided in an approved location at least one (1) lavatory for each two (2) toilets for each sex, and at least one (1) drinking fountain for each floor level. Toilet rooms shall have non-absorbent interior finish on floors and on walls from floor level to a height not less than four feet (4').

Section 606. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 33, Section 3308.

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

Section 607. FIRE EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 33.

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

Chimneys and vents shall be constructed in conformance with Chapter 37.

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

Every gas service to the stage portion of the building shall be separately from any other service to the building, and each gas service
For regulating adjacent buildings on the same property, see Section 504.

Section 704. "EXIT FACILITIES. (a) General. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

(b) Amusement Structures. Stairs and exits for Division 3 amusement structures shall be provided as required in Chapter 33, subject to the approval of the Chief Building Inspector. Where required by the Chief Building Inspector, exit signs shall be installed as specified in Section 3312.

Section 705. LIGHT, VENTILATION, AND SANITATION. 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 required in Section 605.

Section 706. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 33; Section 3308. All elevator shafts, vent shafts, and other vertical openings shall be enclosed; and the enclosure shall be as specified under Types of Construction.

Section 707. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 708. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with Chapter 37.

Section 709. EXCEPTIONS AND DEVIATIONS. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

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

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

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

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

Every boiler room or room containing a 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 Separation."

Section 709. EXCEPTIONS AND DEVIATIONS. Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.

In gymnasiu ms one inch (1") nominal tight tongue and grooved wall covering may be used on the gymnasium side in lieu of fire-resistant plaster.
CHAPTER 8 — REQUIREMENTS FOR GROUP C OCCUPANCIES

Section 801. GROUP C OCCUPANCIES DEFINED. Group C occupancies shall be:

Any building, used for school, pre-school, or day-care purposes more than four hours per week, involving assemblage for instruction, education, or recreation, and not classified in Group A or B occupancies.

For occupancy separations see Chapter 5.

For computing occupant load see Chapter 33. (Ord. No. 424, Series of 1959).

Section 802. CONSTRUCTION, HEIGHT, AND ALLOWABLE AREA.

(a) General. Buildings classed in Group C shall be of Type I construction and shall not be limited as to height or floor area.

Exceptions: 1. Gymnasiums and auditoriums may omit the fireproofing from the structural members of the roof.

2. School buildings not more than one story in height may be of one-hour fire-resistant construction, provided that the exterior walls and the floors are of incombustible construction, and provided further, that each room used for instruction or assembly has at least two exit doors, one of which shall be in the exterior wall and shall be equipped with an approved panic device. The total floor area permitted shall be 15,000 square feet in Fire Zone 2 and 20,000 square feet in Fire Zones 3 and 4, plus increases provided in Section 506, paragraphs (d), (e) and (f).

3. School buildings, or portions thereof, not more than one story in height may be of Type IV construction, provided that the roof shall be of incombustible material and provided that each room used for instruction or assembly has at least two exit doors, one of which shall be in the exterior wall and shall be equipped with an approved panic device. The total floor area permitted shall be 10,200 square feet in Fire Zone 2 and 13,600 square feet in Fire Zones 3 and 4, plus increases provided in Section 506, paragraphs (d), (e) and (f).

(b) Special Provisions. All curtains, drapes, and drops shall be flameproofed. Stages and enclosed platforms shall be constructed in accordance with requirements of Chapter 39.

For attic space partitions and draft stops, see Chapter 32. (Ord. No. 424, Series of 1959).

Section 803. LOCATION. (a) In City. Type I buildings housing Group C occupancies are not limited as to location in Fire Zones. See exceptions under Section 802 (a), above, for limitations applicable to other types of construction. See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. 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. For property setbacks, see District Zone regulations, supra.

(c) Exterior Wall and Opening Protection. Exterior walls shall be constructed as required for the type of construction, provided that in Type IV buildings exterior walls within twenty (20) feet of the property line, except on street fronts, shall be two-hour fire resistive construction, and exterior walls twenty (20) to thirty (30) feet from the property line, except on street fronts, shall be one-hour fire resistive construction. There shall be no openings in exterior walls or parts of walls, except on street fronts, which are less than five (5) feet from adjacent property lines. Openings in exterior walls, except on street fronts, which are five (5) feet to ten (10) feet from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

For regulating adjacent buildings on the same property, see Section 504. (Ord. 424, Series of 1959).

Section 804. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

Section 805. LIGHT, VENTILATION AND SANITATION. All portions of Group C occupancies shall be provided with light and ventilation, either natural or artificial, as required by Section 605.

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

<table>
<thead>
<tr>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Schools</td>
<td>1:35</td>
</tr>
<tr>
<td>Secondary Schools</td>
<td>1:45</td>
</tr>
</tbody>
</table>

In addition, urinals shall be provided for boys on a basis of 1:80.

There shall be provided at least one (1) lavatory for each two (2) toilets or urinals for each sex, and at least one (1) drinking fountain on each floor. Shower rooms shall have non-absorbent interior finish on floors and walls. Toilet rooms shall have non-absorbent interior finish on floors and walls from floor level to a height not less than four feet (4).

Section 806. ENCLOSURES OF VERTICAL OPENINGS. Exits shall be enclosed as required
in Chapter 33, Section 3308. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

Section 807. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 808. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with 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 protected by Class "E" or "F" fire doors or windows.

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

Section 809. EXCEPTIONS AND DEViations. 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 groove wall covering may be used on the gymnasium side in lieu of fire resistive plaster.

Roof covering shall be a "Fire Retardant" roofing. See Section 3204 for specifications.

Arcades connecting buildings and used exclusively as passageways need not be considered as adjacent buildings for the purpose of this Chapter, provided:

1. That the walls of the buildings adjoining the arcades are finished with the same construction as required for the exterior walls of the buildings, with no communicating openings, except doors, between the arcades and the buildings;

2. 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

Section 901. GROUP D OCCUPANCIES DEFINED. Group D occupancies shall be:

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

Division 2. Nurseries for children under six (6); hospitals, sanitariums, and similar buildings (each accommodating six or more persons).

For occupancy separations see Table No. 5-B.

For computing occupant load see Section 3301.

Section 902. CONSTRUCTION; HEIGHT AND AREA ALLOWABLE. (a) General. Buildings classed in Group D shall be of Type I Construction and shall not be limited as to height or floor area.

(b) Special Provisions. For attic space partitions and draft stops, see Section 3205.

Section 903. LOCATION. (a) In City. Buildings housing Group D occupancies are not limited as to location in Fire Zones.

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. Buildings housing Group D occupancies shall adjoin a yard, public space or street on not less than one side. For property setbacks, see District Zone regulations, supra.

(c) Exterior Wall and Opening Protection. Exterior walls shall be constructed as specified in Section 1805. Except on street fronts, exterior walls or parts of walls which are less than five feet (5') from adjacent property lines shall have no openings therein. Openings, except on street fronts, which are five feet (5') to ten feet (10') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

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

Section 904. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

Section 905. LIGHT, VENTILATION, AND SANITATION. 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 (1/8) 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.

Toilet rooms, shower, or bathrooms shall have non-absorbent interior finish on floors and walls.

Section 906. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 33, Section 330B. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified in Section 1807.

Section 907. FIRE EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 908. SPECIAL HAZARDS. (a) Chimneys, vents and incinerators shall be constructed in conformance with Chapter 37.

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

(c) Any gas service to a Group D Occupancy shall be provided with an approved outside shut-off conspicuously marked.

(d) Any room containing heating equipment shall be separated from other portions of the building with not less than an "Ordinary Occupancy Separation". (For incinerator requirements see Section 3712 (l)).

(e) Auxiliary Power Plants. Auxiliary power plans to be used for lighting or power purposes, may be located in boiler or heating equipment rooms if the fuel to be used is natural gas or diesel fuel. If the fuel to be used is gasoline, such equipment shall be located on the exterior of the building and shall be housed by not less than eight (8) inch masonry walls. The use of liquefied petroleum gas for fuel is prohibited.

(Ord. 306, Series 1955.)

Section 909. REQUIREMENTS FOR ANESTHESIA STORAGE ROOMS, ALL ANESTHETIZING LOCATIONS, OBSTETRICAL ROOMS AND WARDS, OPERATING ROOMS, X-RAY ROOMS, AND RADIO-ACTIVE MATERIAL STORAGE ROOMS.

(a) Definitions.

1. Anesthesia Storage Rooms. An anesthesia storage room is a room or place where explosive or flammable gases or liquids or powders which are used as anesthesia agents are stored or kept. The term shall include the
room or place where machines used in the administering of these agents are stored or kept. (See Standards 4601 (d) ).

2. Anesthetizing Locations. An anesthetizing location in any area in which any combustible anesthetic agent is administered in the course of examination or treatment, and shall include operating rooms, obstetrical rooms, anesthesia storage rooms, corridors, utility rooms and other areas if used for induction of anesthesia with combustible anesthetic agents. In an anesthetizing location the hazardous area is to be considered to extend five (5) feet above the floor.

NOTE: Corridors serving anesthetizing locations but not used to administer combustible anesthetic agents present electrostatic hazards which require conductive floor surfacing. If corridors or recovery rooms are used or intended to be used as anesthetizing locations all applicable safeguards are required.

3. Anesthetizing Room. An anesthetizing room is a room where potentially explosive anesthetizing agents are used. (See Standards 4601 (d) ).

4. Fracture Room. A fracture room is a room where surgery or manipulation is performed for the setting of bones. (See Standards 4601 (d) ).

5. Obstetrical Room. An obstetrical room is a room for the delivery of babies. (See Standards 4601 (d) ).

6. Operating Room. An operating room is a room in which surgery is performed. (See Standards 4601 (d) ).

7. Radio-Active Material. A radio-active material is one which emits ionizing radiation, such as alpha rays, beta rays or gamma rays.

8. Recovery Room. A recovery room is a room set aside for use of patients immediately following surgery. (See Standards 4601 (d) ).

9. X-Ray Room. An x-ray room is any room in which x-ray equipment is permanently installed. (See Standards 4601 (d) ).

(b) Radiation.

1. Radiation Protection Requirements. Upon completion of the installation of the x-ray equipment in the x-ray room, a survey shall be made by the Manager of Health and Hospitals in order to determine that adequate protective devices against radiations are available in the x-ray rooms to protect the health of persons who operate the X-ray equipment and that persons occupying areas outside the X-ray installations cannot receive radiations which are hazardous to health. Reports of such surveys shall be submitted in writing to the Chief Building Inspector. A Certificate of Occupancy shall not be issued by the Chief Building Inspector unless such report indicates that a health hazard does not exist. The Board of Health and Hospitals is hereby authorized to adopt and the Department of Health and Hospitals to promulgate rules and regulations to protect health with relation to such installations.

2. Radio-Active Materials Storage Rooms, Vaults or Containers. Radio-active materials shall not be placed in a room, vault or containers in such a manner that persons in areas outside the installation cannot receive radiations which are hazardous to health. Adequate protective devices against radiations shall be available to protect the health of persons working with the radio-active materials. Vaults, rooms or containers shall be constructed of not less than four (4) hour fire resistive materials. Such rooms, vaults, or containers shall be identified with lettering which shall state "Danger—Radio-Active Material Stored in This Room—[Container]."

3. Inspection of radio-active materials, storage rooms, vaults or containers shall be conducted by the Manager of Health and Hospitals.

4. The Board of Health and Hospitals may adopt and promulgate rules and regulations which the Department of Health and Hospitals shall promulgate governing the handling, storage and disposal of radio-active materials in order to protect the health of the people.

(c) Conductive Flooring.

1. Conductive flooring shall be provided in anesthetizing locations as defined in Section 909 (a)-2.

2. Anesthetizing Locations. Conductive flooring shall be provided to prevent the accumulation of electrostatic charges. A resistance not exceeding five (5) to ten (10) megohms between the objects or persons shall be considered generally sufficient to prevent dangerous voltages. The floor limit of one million ohms resistance shall be sufficient as meeting this requirement. (See Standards Section 4601 (d) ).

(d) Heating and Cooling. Heating and cooling systems and equipment shall conform to the requirements of Chapters 37, 49, 51 and 52 of the Building Code.

(e) Standards. Unless as otherwise provided in this Code, the Standard as set forth in Section 4601 (d) relating to Section 909 shall prevail.

(Ord. 306, Series 1955.)
CHAPTER 10 — REQUIREMENTS FOR GROUP E OCCUPANCIES

Section 1001. GROUP E OCCUPANCIES DEFINED. Group E occupancies shall be:

Division 1. Paint or petroleum storage, dry cleaning plants using flammable liquids; paint shops, and spray painting rooms and shops.

Plating mills, box factories, woodworking and mattress factories.

Division 2. Aircraft repair hangars.

Division 3. Public garages, storage of hazardous and highly flammable or explosive materials and liquids.

For occupancy separations see Table No. 5-B.

For computing occupant load see Section 3301.

Section 1002. CONSTRUCTION, HEIGHT AND AREA ALLOWABLE. (a) General. Buildings classed as Group E shall be of Type I, II, III, or IV Construction, and shall not exceed in area or height the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Dry cleaning plants in which combustible solvents are used or stored shall be of Type I Construction, and shall not exceed one story in height. All partitions shall be of four-hour fire-resistive construction, except for the necessary openings for the vent ducts, piping, and shafting. 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.

Aircraft repair hangars shall have exterior walls of not less than one-hour fire-resistive construction, or shall be surrounded by yards, public space or streets not less than sixty feet (60') in width.

The area increases allowed by Section 506 (e) shall not exceed five hundred per cent (500 %) for aircraft repair hangars.

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

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

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

Section 1003. LOCATION. (a) In City. Buildings housing Group E occupancies are not permitted in Fire Zone No. 1.


2. Where permitted by Article 234 of the Revised Municipal Code, those service stations described in Section 1009.

3. Buildings of Type III or IV construction, one (1) story in height, and less than four hundred square feet (400 sq. ft.) in area.

(Ord. 94, Series 1958.)

(b) On Property. Buildings housing Group E occupancies shall adjoin a yard, public space or street on not less than one side. For property setbacks; see District Zone regulations, supra.

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

Exception: Dry Cleaning Plants in Which Combustible Solvents Are Used. There shall be no openings, except on street fronts, in exterior walls less than five feet (5') from adjacent property lines. Openings in exterior walls, other than wall vents, on street fronts, as well as those more than five feet (5') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

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

Section 1004. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

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

Section 1005. LIGHT, VENTILATION AND SANITATION. (a) Light and Ventilation. All portions of Group E occupancies shall be provided with light and ventilation by means of windows or skylights, one-half (1/2) of which
shall be openable, and with an area equal to one-eighth (1/8) of the total floor area or shall be provided with artificial light and a mechanically operated ventilating system conforming to Chapter 52 of this Code. Such system shall supply at least four air changes per hour and shall be kept continuously in operation while the building is occupied.

Exceptions: Every building, or portion thereof, housing a dry cleaning plant or used for the storage or handling of automobiles operated under their own power, shall be provided with a system of ventilation conforming to Chapter 52 of this Code.

(b) Sanitation. Every building, or portion thereof, where persons are employed shall be provided with at least one toilet located in such building or conveniently in a building adjacent thereto and where both sexes are employed, at least two (2) such toilets shall be provided. Toilet rooms shall have non-absorbent interior finish on floors and on walls from floor level to a height not less than four feet (4').

(Ord. 94, Series 1958.)

Section 1006. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 39, Section 3308. All elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

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

Section 1007. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 1008. SPECIAL HAZARDS. (a) Chimneys, vents, and heating apparatus shall be constructed and installed in conformance with Chapters 37, 51 and 52.

(b) Rooms or areas in which flammable or volatile liquids are used or stored shall not have any appliance which will burn or glow.

(c) Every 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 a fire or explosion occur in the machine.

(d) Every boiler room or room containing a heating plant shall be separated from other portions of the building by not less than a "Special Occupancy Separation."

(Ord. 94, Series 1958.)

Section 1009. SERVICE STATIONS INSIDE BUILDINGS. (a) General. For the purpose of this Chapter, a service-station shall mean one dispensing flammable liquids, used as motor fuel when the dispensing devices are located anywhere in the building. For requirements for outside service stations, see Chapter 11 of this Code and see Article 234, Revised Municipal Code, for additional requirements.

(b) Construction. Such service stations shall be provided with an enclosure of not less than 2-hour fire-resistive walls and ceiling. Two class "B" swinging exit doors equipped with automatic self-closures shall be provided, remote from each other, and such doors shall swing out from the enclosure. In addition an overhead door shall be provided at any opening intended for vehicular access, such door to be power operated and equivalent to a Class "B" fire door. A two inch (2") sill shall be provided, liquid tight, at all door openings.

(c) Ventilation. See Chapter 52.

(d) Power and Control.

1. All electrical equipment, fans, blowers, switches, etc., shall be installed in accordance with the requirements of the Electrical Code.

(e) Fire Protection System. A carbon dioxide system shall be provided for the service station enclosure. It shall be controlled with a 15 second delay and shall be equipped with an audible alarm located on both the interior and exterior of the enclosure. The fire protection system shall be interlocked with the ventilating system and the overhead door or doors so that, in the event of fire, the ventilating system will automatically shut off and the overhead door or doors will close.

When an enclosure is a part of a particular floor, the entire floor area shall be provided with automatic fire sprinklers in conformity with Chapter 38 of this Code.

(f) Supervision. All gasoline dispensing stations shall be supervised during the hours when gasoline is dispensed.

(g) Fuel pumps shall not be equipped with nozzles which are automatic or capable of being locked in an open or operating position.

(Ord. 94, Series 1958.)
CHAPTER 11 — REQUIREMENTS FOR GROUP F OCCUPANCIES

Section 1101. GROUP F OCCUPANCIES DEFINED. Group F occupancies shall be:

Division 1. 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.

Division 2. Aircraft hangars where no repair work is done except change of parts and maintenance requiring no open flame welding or the use of highly flammable liquids.

For occupancy separations see Table No. 5-B.

For computing occupant load see Section 3301.

For computing occupant load see Section 3301.

Section 1102. CONSTRUCTION, HEIGHT, AND AREA ALLOWABLE. (a) General. Buildings classed as Group F shall be of Type I, II, III, or IV Construction. Buildings used as storage sheds for lumber or similar materials may be of Type V construction, provided that one side of the structure is open and the building is not less than twenty feet (20'), except on street fronts, from adjacent buildings or property lines.

Buildings classed as Group F shall not exceed, in floor area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions. Aircraft hangars shall have exterior walls, or parts of walls, within twenty feet (20') of a property line, or within forty feet (40') of buildings on the same property, of not less than one-hour fire-resistive construction with all openings protected by Class "E" or "F" fire doors or windows.

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

Section 1103. LOCATION. (a) In City. Buildings of Type III or IV Construction over twenty feet (20') or one story in height, and/or in excess of four hundred square feet (400 sq. ft.) in area, are not permitted in Fire Zone No. 1. Buildings of Type V Construction housing Group F occupancies are not permitted in Fire Zone No. 1 and No. 2 (Sections 1602-1603).

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. Buildings housing Group F occupancies shall adjoin a yard, public space or street on not less than one side. For property setbacks, see District Zone regulations, supra.

(c) Exterior Wall and Opening Protection. 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 four feet (4') to eight feet (8') from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

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

Section 1104. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

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.

Section 1105. LIGHT, VENTILATION, AND SANITATION. 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 (1/8) 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 (4) changes of air per hour be provided.

Every building, or portion thereof, where persons are employed shall be provided with at least one toilet. Every building, and each subdivision thereof, where both sexes are employed shall be provided with access to at least two (2) toilets located either in such building or conveniently in a building adjacent thereto. Toilet rooms shall have non-absorbent interior finish on floors and on walls from floor level to a height not less than four feet (4').

Such toilet rooms in connection with food establishments where food is prepared, stored, or served, shall have a non-absorbent interior finish on floors, walls, and ceilings; shall be separated from such food establishments with close-fitting, tight doors with a vestibule between; shall have hand washing facilities therein or adjacent thereto, and shall be provided with an exterior window at least three square feet (3 sq. ft.) in area, fully openable, or a vertical duct not less than forty-eight square inches (48 sq. in.) in area, leading to the exterior.

Section 1106. ENCLOSER OF VERTICAL OPENINGS. Exit shall be enclosed as required in Chapter 33, Section 3308. All elevator shafts,
vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as specified under Types of Construction.

Section 1107. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 1108. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with Chapter 37.

Devices generating a glow or flame capable of igniting gasoline vapor shall not be installed or used within twenty-four inches (24") of the floor in any room in which volatile flammable liquids are used or stored.
CHAPTER 12 — REQUIREMENTS FOR GROUP G OCCUPANCIES

Section 1201. GROUP G OCCUPANCIES DEFINED. Group G occupancies shall be:

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

For computing occupant load see Section 3301.

Section 1202. CONSTRUCTION, HEIGHT, AND AREA ALLOWABLE. (a) General. Buildings classed as Group G shall be of Type I, II, III, or IV Construction. Storage sheds for incombustible and non-explosive materials may be of Type V Construction provided the building is not less than twenty feet (20'), except on street fronts, from adjacent buildings or property lines.

Buildings classed as Group G shall not exceed, in floor area or height, the limits specified in Sections 505, 506, and 507.

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

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

Section 1203. LOCATION. (a) In City. Buildings of Type III or IV Construction over twenty feet (20') or one story in height, and/or in excess of four hundred square feet (400 sq. ft.) in area, are not permitted in Fire Zone 1. Buildings of Type V Construction housing Group G occupancies are not permitted in Fire Zones 1 and 2 (Sections 1602-1603).

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. Buildings housing Group G occupancies shall adjoin a yard, public space or street on not less than one side. For property set backs, see District Zone regulations, supra.

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

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

Section 1204. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as required in Chapter 33.

Passageways direct to outside exits, free of all obstructions and at least seven feet (7') in width, clearly defined by floor markings and overhead signs, shall be maintained permanently.

Section 1205. LIGHT, VENTILATION, AND SANITATION. All portions of Group G occupancies customarily used by human beings shall be provided with adequate light and ventilation.

Every building or portion thereof where persons are employed shall be provided with at least one (1) toilet. Every building, and each subdivision thereof, where both sexes are employed shall be provided with access to at least two (2) toilets located either in such building or conveniently in a building adjacent thereto. Toilet rooms shall have non-absorbent interior finish on floors and on walls from floor level to a height not less than four feet (4').

Section 1206. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 33, Section 3308. Other vertical openings are not required to be enclosed.

Section 1207. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 1208. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with 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.
CHAPTER 13 – REQUIREMENTS FOR GROUP H OCCUPANCIES

Section 1301. GROUP H OCCUPANCIES DEFINED. Group H occupancies shall be:

Division 1. Homes for aged, orphanages, dormitories for children over six (each accommodating six or more persons).

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

For occupancy separations see Table No. 5-B.

For computing occupant load see Section 3301.

Section 1302. CONSTRUCTION, HEIGHT, AREA ALLOWABLE, AND OCCUPANCY. (a) General. Buildings classified as Group H shall be of Type I, II, III, or IV Construction and shall not exceed, in floor area or height, the limits specified in Sections 505, 506, and 507.

(b) Special Provisions: One story buildings of Division 1 shall be of one-hour fire-resistive construction throughout; buildings over one story in height shall be of Type I Construction. Division 2 occupancies more than one story in height shall be of not less than one-hour fire-resistive construction throughout.

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

(c) Basement Apartments. In buildings housing Group H occupancies there shall be no apartments or sleeping rooms in the basement unless the exterior finished grade adjacent to such proposed occupancy is 3 feet 6 inches or less above the floor and the floor and the top of any area wall, retaining wall or sloping bank is at or below a line intersecting the lowest window sill and sloping 45 degrees upwards from the horizontal. If an adjacent building falls within the angle of 45 degrees described by the intersection of this line with the lowest window sill the apartment or sleeping rooms may be permitted provided the ratio of window area to floor area is increased one per cent for every four (4) degrees by which the adjacent building or buildings encroach upon this angle.

Basement living quarters shall have not less than two approved means of egress and shall be separated from all other basement rooms by not less than an ordinary occupancy separation for fire protection purposes. There shall be no obstructions overhead closer than 7 feet to the floor. In all other respects, remodeling, use or occupancy shall comply with all pertinent provisions of the Building Code for new buildings.

(d) Openings Into Garages. No room used for sleeping purposes shall open directly into a garage.

(Ord. 261, Series 1953.)

Section 1303. LOCATION. (a) In City. Buildings of Type III or IV Construction, over twenty feet (20') or one story in height, and/or in excess of four hundred square feet (400 sq. ft.) in area, are not permitted in Fire Zone No. 1. (Section 1602.)

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. Buildings housing Group H occupancies shall adjoin a yard, public space, or street on not less than one side. For property setbacks, see District Zone regulations, supra.

(c) Exterior Wall and Opening Protection. 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 three feet (3') to five feet (5') from adjacent property lines, shall be protected by Class "E" or "F" fire doors or windows.

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

Section 1304. EXIT FACILITIES. Stairs, exits, and smokeproof enclosures shall be provided as 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.

Buildings more than one story in height shall have no transoms or ventilating apparatus opening from rooms used for human occupancy into corridors.

Doors opening from rooms used for human occupancy into corridors shall be incombustible or of wood not less than three-fourths inch (3/4") thick at any point.

Section 1305. LIGHT, VENTILATION AND SANITATION. (a) Windows. All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with an area not less than twelve
square feet (12 sq. ft.) nor one-eighth (1/8) of the floor area of such rooms. The window area in bathrooms, water-closet compartments, and other similar rooms shall be not less than three square feet (3 sq. ft.), unless adequate mechanical ventilation is provided. Not less than one-half (1/2) of the required window area shall be openable.

Required windows shall open on a court, yard, or street, either directly or through a porch with a minimum clear height of not less than seven feet (7') and a depth of not more than seven feet (7'). Such porch shall be at least fifty per cent (50%) open on at least two (2) sides.

The width of such courts or yards shall be not less than three feet (3') when such courts or yards are not more than two (2) stories high, measured down from the top of the building, and shall be increased at the rate of six inches (6") for each additional story in height. If such court is entirely surrounded by the building, it shall have a width at least fifty per cent (50%) greater than that otherwise required.

(b) Room Sizes and Ceiling Heights. Every room required to have windows by Subsection (a) shall have a ceiling height of not less than seven feet six inches (7' 6") in at least fifty per cent (50%) of its area. Rooms used for living, eating, or sleeping purposes shall have an area of not less than seventy-two square feet (72 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

(c) Sanitation. Every building shall be provided with at least one (1) toilet. Every hotel where both sexes are accommodated shall be provided with at least two (2) toilets located in such building, which shall be conspicuously marked; one (1) for each sex. Not less than one (1) toilet shall be provided for each fifteen (15) persons, or major fraction thereof, that such building is designed to accommodate.

One (1) toilet shall be provided for each apartment.

A kitchen sink shall be installed in every kitchen.

Section 1306. ENCLOSURE OF VERTICAL OPENINGS. Exits shall be enclosed as required in Chapter 33, Section 3308.

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

Section 1307. FIRE-EXTINGUISHING APPARATUS. Automatic sprinklers, standpipes, and basement pipe inlets shall be installed as required in Chapter 38.

Section 1308. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with Chapter 37.

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

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

Exception: Such furnaces may be used without an "Occupancy Separation" in buildings not more than two (2) stories in height.
CHAPTER 14 — REQUIREMENTS FOR GROUP I OCCUPANCIES

Section 1401. GROUP I OCCUPANCIES DEFINED. Group I occupancies shall be Dwellings for not more than two families.

For occupancy separations see Table No. 5-B.

Section 1402. CONSTRUCTION, HEIGHT, AND AREA ALLOWABLE. (a) General. Buildings classed as Group I shall be of Type I, II, III, IV, or V Construction and shall not exceed in height the limits specified in Section 507. The floor area shall not be limited.

(b) Special Provisions. No room used for sleeping purposes shall open directly into a garage.

Section 1403. LOCATION. (a) In City. For restrictions on Types II, IV, and V Construction in Fire Zone No. 1, and restrictions on Type V Construction in Fire Zones No. 2 and No. 3, see Sections 1602, 1603, and 1604.

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. Buildings housing Group I occupancies shall adjoin a yard, public space, or street on not less than one side. See District Zone regulations for setback requirements (Ord. No. 14, Series of 1925, as amended).

Section 1404. STAIRWAYS. (a) Width. Stairways shall be not less than thirty inches (30") wide. Trim and handrails may project three and one-half inches (3 1/2") into the required width.

(b) Rise and Run. The rise of every step in a stairway shall not exceed seven and one-half inches (7 1/2") and the run shall be not less than ten inches (10"). The maximum variations in the height of risers and the width of treads in any one flight shall be three-sixteenths inch (3/16").

Exceptions:

1. In stairways serving basements, the rise may be eight inches (8") and the run may be nine inches (9"), with a one inch (1") nosing, making the total tread width ten inches (10").

2. Winders may be used if the required width of run is provided at a point not more than twelve inches (12") from the side of the stairway where the treads are narrower, but in no case shall any width of run be less than eight inches (8") at any point.

(Ord. 13, Series 1956.)
(b) Room Sizes and Ceiling Heights. Rooms required to have windows by Subsection (a), as well as bathrooms, shall have ceiling heights of not less than seven feet six inches (7'-6") in at least fifty per cent (50\%) of the required area, with no portion less than five feet (5') in height. Rooms used for living, eating, or sleeping purposes shall have an area of not less than seventy-two square feet (72 sq. ft.). Kitchens shall have an area of not less than fifty square feet (50 sq. ft.).

Section 1406. ENCLOSURE OF VERTICAL OPENINGS. Stairways need not be enclosed. Dumbwaiter shafts, clothes chutes, and other similar vertical openings shall be protected as specified in Chapter 30 and shall be enclosed.

Section 1408. SPECIAL HAZARD. Chimneys and vents shall be constructed in conformance with the requirements of Chapter 37.

Section 1409. EXCEPTIONS AND DEVIATIONS. 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.
CHAPTER 15 REQUIREMENTS FOR GROUP J OCCUPANCIES

Section 1501. GROUP J OCCUPANCIES DEFINED. 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, water tanks, and towers. See District Zone regulations for setback requirements (Ord. No. 14, Series of 1925, as amended).

Section 1502. CONSTRUCTION, HEIGHT AND AREA ALLOWABLE. (a) General. Buildings classified as Group J shall be of Type I, II, III, IV, or V 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 (1) story.

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

(b) Special Provisions. No room used for sleeping purposes shall open directly into a private garage.

Section 1503. LOCATION. (a) In City. For restrictions on Types III, IV, and V Construction in Fire Zone No. 1, and restrictions on Type V Construction in Fire Zones No. 2 and No. 3, see Sections 1602, 1603, and 1604.

See District Zone regulations for restrictions in District Zones (Ord. No. 14, Series of 1925, as amended).

(b) On Property. See District Zone regulations for setback requirements (Ord. No. 14, Series of 1925, as amended).

(c) Exterior Wall and Opening Protection. Buildings of Type IV or V Construction shall comply with the following:

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

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

Section 1504. STAIRWAYS. Stairways in Division 1 occupancies shall comply with the provisions of Section 1404.

Section 1505. ENCLOSURE OF VERTICAL OPENINGS. Vertical openings need not be enclosed.

Section 1506. FIRE-EXTINGUISHING APPARATUS. Fire-extinguishing apparatus shall be installed as required in Chapter 36. Where more than three (3) automobiles are stored in any private garage, there shall be installed not less than one two and one-half (2½) gallon chemical extinguisher for each five (5) cars or major fraction thereof.

Section 1507. SPECIAL HAZARDS. Chimneys and vents shall be constructed in conformance with the requirements of Chapter 37.

Section 1508. FENCES AND RETAINING WALLS. (a) Classification. Fences and retaining walls shall be classified as follows:

1. Masonry walls
2. Ornamental iron
3. Wood picket (more than 50% open)
4. Woven wire
5. Solid fences (wood or metal less than 50% open)
6. Hedges

(b) Fences in residence and business districts and fences enclosing plots used for dwelling purposes in all districts shall conform to the following requirements:

1. Fences erected in front of the front building line shall be of Class 2, 3, 4, or 6, and shall not exceed a height of three feet six inches (3' 6").

2. Side yard fences back of the front building line shall be of any class, but shall not exceed a height of three feet six inches (3' 6") to the rear of the neighborhood dwelling, provided that not more than the rear twenty-five feet (25') of the lot may be fenced to a height of six feet (6').

3. Rear yard fences may be of any class, but shall not exceed a height of six feet (6'), except that fences of Class 5 shall not exceed a height of four feet (4').

4. For buildings located on corner lots, the restrictions for fences in the yard facing on the side street shall be the same as in paragraph 1 for front yard fences.

5. No barbed wire or other sharp pointed fence, and no electrically charged fence, shall be erected or maintained.

6. In case of a fence erected on top of a retaining wall, the height shall be measured from the grade of the low side; provided that in any case a fence of Class 2, 3, 4, or 6 may be erected on top of a retaining wall to a height not to exceed three feet six inches (3' 6") above the grade of the high side.
7. On corner lots no fence, retaining wall, shrub, tree, or similar obstruction shall be erected or maintained which obstructs the traffic vision.

8. Any dilapidated, unsightly, or dangerous fence shall be removed when so ordered by the Chief Building Inspector.

9. Retaining walls shall be adequately designed and drained so as to resist all lateral pressure to which they may be subject. Retaining walls shall not be erected in any front yard when, in the opinion of the Chief Building Inspector, such retaining wall would be unsightly or detrimental to adjoining property.

10. When, in his judgment, the public health, safety and welfare will be substantially served and the neighboring property will not be materially damaged, or when a certified copy of an agreement between neighboring property owners is filed in his office, the Chief Building Inspector may, at his discretion, vary the requirements of this Section.

(c). In Commercial and Industrial Zones no fence erected in the front yard space required by the Zoning Ordinance shall exceed a height of three feet six inches (3' 6") and such fence shall be of Class 2, 3, 4, or 6 construction. In other than required front yards, fences may be of any height or type of construction. Barbed wire or similar materials may be used at a height of not less than six feet (6') above grade. No electrically charged fence shall be erected or maintained. Fences shall be kept in repair, and any dilapidated, dangerous, or unsightly fence shall be removed or repaired when so ordered by the Chief Building Inspector.
PART IV
REQUIREMENTS BASED ON LOCATION IN FIRE ZONES
CHAPTER 16 - RESTRICTIONS IN FIRE ZONES

Section 1601. FIRE ZONES DEFINED. For the purpose of this Code, the entire City and County of Denver is hereby declared to be and is hereby established a Fire District, and said Fire District shall be known and designated as Fire Zones Nos. 1, 2, 3, and 4. Whenever reference is made to any Fire Zone, it shall be construed to mean one of the four Fire Zones as indicated on the Official Fire District map on file in the Office of the City Clerk of the City and County of Denver and duly authenticated by, and certified to, by the Chief Building Inspector of the City and County of Denver.

Section 1602. RESTRICTIONS IN FIRE ZONE NO. 1. (a) No building or structure of Type V Construction shall be erected or constructed in or moved into Fire Zone No. 1.

(b) No building or structure of Type III or Type IV Construction, having an area greater than four hundred square feet (400 sq. ft.), nor more than one (1) story or twenty feet (20') in height, shall be erected, constructed, enlarged, or moved into Fire Zone No. 1.

(c) Any existing building or structure in Fire Zone No. 1 which is enlarged, raised, or built upon to an extent exceeding an expenditure of twenty per cent (20%) of the value of such building, shall be made to comply in full with the requirements of a Type I or II building.

(d) Any building or structure moved into Fire Zone No. 1 shall comply with all of the requirements for new buildings in Fire Zone No. 1.

(e) No building of Type III or Type IV Construction in excess of four hundred square feet (400 sq. ft.) in area, or more than one (1) story or twenty feet (20') in height, and no 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 building may be entirely demolished.

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

3. Changes, alterations, and repairs to the interior of such building or to the front facing a public street may be made, provided such changes shall not increase, in the opinion of the Chief Building Inspector, the fire hazard of such building.

4. Roofs of such buildings may be covered only with a "Fire-Retardant" roof as specified in Section 3204.

(f) Temporary buildings such as reviewing stands, structures in connection with the Denver Centennial Celebration, and other miscellaneous structures conforming to the requirements of this Code, or approved alternatives thereto, and sheds, canopies, or fences used for the protection of the public around and in conjunction with construction work, may be moved into or erected in Fire Zone No. 1 by special permit from the Chief Building Inspector for a limited period of time, and such structures shall be completely removed upon the expiration of the time limit in such permit.

(Ord. 460, Series 1958.)

(g) Openings. The sum of the widths of openings in exterior walls, except on street fronts, within twenty feet (20') of adjacent property lines or other buildings on the same property shall be limited to fifty per cent (50%) of the total length of the walls affected in each story. Openings in such walls, and openings within fifty feet (50') of the opposite side of a street or public space, and openings into courts which are less than twenty feet (20') in least dimension, shall be protected by Class "E" or "F" fire doors or windows.

(h) No Group E occupancy buildings, except public garages, shall be constructed or erected in Fire Zone No. 1, and no existing building not now so occupied shall be used or occupied in any manner whatsoever by Group E occupancies except as public garages.

(i) All roof coverings in Fire Zone No. 1 shall comply with the requirements for a "Fire-Retardant" roof, as specified in Section 3204.

Section 1603. RESTRICTIONS IN FIRE ZONE NO. 2. (a) No building or structure of Type V Construction shall be erected or constructed in or moved into Fire Zone No. 2.

(b) Any existing building in Fire Zone No. 2 which is enlarged, altered, raised, or built upon to an extent exceeding twenty per cent (20%) of the value of such building shall be made to comply with the requirements of Type I, II, III, or IV buildings.

(c) Any building or structure moved into Fire Zone No. 2 shall comply with all the requirements for new buildings in Fire Zone No. 2.
(d) No building of Type V Construction shall hereafter be altered, raised, enlarged, added to, or moved, except as follows:

(1) Such buildings may be entirely demolished.

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

(3) Changes, alterations, and repairs may be made provided such changes do not increase the fire hazard of such building.

(4) Roofs of such buildings may be covered only with a "Fire-Retardant" roof as specified in Section 3204; except that roofs may be repaired to an extent not exceeding twenty-five percent (25%) in any twelve (12) month period, with "Ordinary" roof covering.

(f) Temporary buildings such as reviewing stands, structures in connection with the Denver Centennial Celebration, and other miscellaneous structures conforming to the requirements of this Code, or approved alternatives thereto, and sheds, canopies, or fences used for the protection of the public around and in conjunction with construction work, may be moved into or erected in Fire Zone No. 2 by special permit from the Chief Building Inspector for a limited period of time, and such structures shall be completely removed upon the expiration of the time limit in such permit.

(Ord. 460, Series 1958.)

(g) Openings. Openings, except on street fronts, which are less than ten feet (10') from adjacent property lines shall be protected by Class "E" or "F" fire doors or windows.

(h) All roof coverings in Fire Zone No. 2 shall comply with the requirements for a "Fire-Retardant" roof as specified in Section 3204.

Section 1604. RESTRICTIONS IN FIRE ZONE NO. 3. (a) No building or structure of Type V Construction shall be erected or constructed in, or moved into, Fire Zone No. 3.

Exceptions: 1. Sheds, chicken houses, and similar accessory buildings to a residential use and not exceeding one hundred square feet (100 sq. ft.) in area, may be of Type V Construction, provided, the exterior walls thereof are covered with incombustible materials, and, provided, that only one accessory building of like nature shall be allowed on any one building plot.

2. Existing dwellings of Type V Construction may have additions built of similar construction, not to exceed twenty percent (20%) of the area existing at the time of passage of this Code.

3. Storage sheds conforming to Sections 1102 and 1202 may be of Type V Construction.

4. Temporary buildings such as reviewing stands, structures in connection with the Denver Centennial Celebration, and other miscellaneous structures conforming to the requirements of this Code, or approved alternatives thereto, if a special permit is obtained for a limited period of time from the Chief Building Inspector. (Ord. 460, Series 1958.)

(b) Any building or structure moved into Fire Zone No. 3 shall comply with all of the requirements for new buildings in Fire Zone No. 3.

Section 1605. RESTRICTIONS IN FIRE ZONE NO. 4. Any building complying with the requirements specified in this Code may be erected or moved into Fire Zone No. 4.
PART V
REQUIREMENTS BASED ON TYPES OF CONSTRUCTION

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

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

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

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

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

Type I—FIRE-RESISTIVE Construction
Type II—HEAVY TIMBER Construction
Type III—ORDINARY MASONRY Construction
Type IV—LIGHT INCOMBUSTIBLE FRAME Construction
Type V—WOOD FRAME Construction

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

Section 1703. EXTERIOR WALLS—WHEN REQUIRED. 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

Section 1801. DEFINITION. In 'Type I Buildings', the structural frame shall be of structural steel or iron which shall be fire-protected; of concrete or reinforced masonry; or bearing walls may be used as set forth in Section 1805. 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-resistant construction.

Section 1802. HEIGHT ALLOWABLE. The height of Type I buildings shall not be limited.

Section 1803. AREA ALLOWABLE. The floor area of Type I buildings shall not be limited.

Section 1804. FOUNDATIONS. See Chapter 28.

Section 1805. EXTERIOR AND INNER COURT WALLS. Exterior walls shall be of not less than four-hour fire-resistive construction.

Exception: Walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1, or thirty feet (30') in Fire Zone Nos. 2, 3, and 4 may be of incompatible construction with all structural members fire-protected as required in Section 1809.

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

Exception: In Groups F and G occupancies, exterior and inner court walls may be as follows:

Bearing Walls—Two-hour fire-resistant where openings are permitted.

Non-Bearing Walls—One-hour fire-resistant where unprotected openings are permitted and two-hour fire-resistant where fire protection of openings is required.

Masonry bearing walls shall not be permitted in buildings housing Group A or Group B, Division 1, occupancy. For the purpose of this Section, reinforced concrete walls with reinforced members and slabs rigidly attached thereto shall not be considered to be masonry.

Section 1806. PARTITIONS. Partitions shall be constructed of incombustible materials and shall be of not less than one-hour fire-resistive construction.

Exceptions: 1. Partitions between tenants in Type I office buildings shall be of incombustible construction and may have a heat transmission limit on the unexposed side of the partition not to exceed 430 degrees Fahrenheit above room temperature when tested in accordance with the requirements set forth in Section 4302(b). For the purpose of this exception, office buildings shall not include those buildings where hazardous materials are used or handled.

2. Temporary partitions dividing portions of stores, offices, or similar places occupied by one tenant only, and which do not establish a corridor, may be constructed of:

(a) Incombustible materials;

(b) 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 partitions constructed of glass.

(Ord. 49, Series 1958.)

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

Exit enclosures shall be constructed as required in Section 3308.

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

Section 1808. STRUCTURAL FRAMEWORK. 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, or of reinforced masonry as specified in Chapter 24.

The structural frame shall be considered to be the columns and the girders, beams, trusses, and spandrels having direct connections to the columns and members which are essential to the stability of the building as a whole. The members of floor or roof panels which have no connection to the columns shall be considered secondary members.
Section 1809. FIRE PROTECTION OF STRUCTURAL MEMBERS. (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 (8) 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 lug 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 spaced at proper intervals from a structural beam or girder which is fire-protected on all sides. For openings in masonry bearing walls not exceeding four feet (4') in width, an angle or similar member supported by masonry and not fire-protected on the under side may be used.

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

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

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

Section 1810. FLOOR CONSTRUCTION. 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 (8) stories or eighty-five feet (85') in height, and of not less than two-hour fire-resistive construction for all other buildings.

Where wood sleepers are used for laying wood floors, the space between the floor slab and the under side 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.

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

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

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

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

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

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

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

Exceptions: 1. The provisions of this Section shall not apply to doors, windows, and other openings which face directly upon, and are not within fifty feet (50') in Fire Zone No. 1 or are not within thirty feet (30') in Fire Zones No. 2 and 3, of the opposite side of a public street or other public place, this distance to be measured at right angles to the plane of the wall in which such openings occur.
2. The provisions of the first paragraph of this Section shall not apply to openings in an outer court twenty feet (20') or more in width parallel to and facing upon a street or public place, provided such openings are not within twenty feet (20') of an adjacent property line.

Section 1814. PROJECTIONS FROM THE BUILDING. Bays, oriel, 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.

Exception: 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 (1-5/8") 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.

Section 1815. PENTHOUSES AND SKYLIGHTS. Exterior walls and roofs of penthouses which are five feet (5') or more from the face of the exterior walls of the building may be of one-hour fire-resistant construction.

Skylights shall be of incombustible construction. See Chapter 34.

Section 1816. COMBUSTIBLE MATERIALS REGULATED. 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 thirty-three and one-third per cent (33-1/3 %) 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-resistant 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 inches (2 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-resistant construction.
CHAPTER 19 - TYPE II BUILDINGS
(Heavy Timber Construction)

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

Section 1902. HEIGHT ALLOWABLE. (a) Height in Feet. Type II buildings shall not exceed a height of sixty-five feet (65'); provided, that the height of a building erected on sloping ground may be sixty-five feet (65) 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 seventy-five feet (75') above the adjacent finished ground level. Towers, spires, and steeples erected as a part of the building and not used for habitation or storage may extend not to exceed twenty feet (20') above such height limit.

(b) Height in Stories. See Table No. 5-D.

Section 1903. AREA ALLOWABLE. The floor area of Type II buildings shall be limited according to occupancy as required in Chapter 5 of this Code. See Sections 505 and 506.

Section 1904. FOUNDATIONS. See Chapter 28.

Section 1905. EXTERIOR AND INNER COURT WALLS. (a) Exterior Walls. Exterior walls shall be of not less than four-hour fire-resistive construction.

Exception: Walls fronting on streets having a width of at least fifty feet (50') in Fire Zone No. 1, or thirty feet (30') in Fire Zone No. 2, No. 3, and No. 4, may be of incombustible construction, with columns and beams fire protected as specified in Section 1909.

(b) Parapet 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 walls of such building.

(c) Inner Court Walls. Inner court walls shall be the same as exterior walls or shall be of not less than four-inch (4") solid wood laminated construction protected on the weather side thereof by incombustible fire-resistive materials as provided in Chapter 43.

(d) Masonry bearing walls shall not be permitted in buildings housing Group B, Division 1, occupancy. For the purpose of this Section, reinforced concrete walls with reinforced members and slabs rigidly, attached thereto shall not be considered to be masonry.

Section 1906. PARTITIONS. Interior partitions shall be of solid wood construction formed by not less than two layers of one-inch (1") nominal matched boards, or laminated construction three and five-eighths inches (3-5/8") thick, or shall be of one-hour fire-resistive construction fire-stopped at floor and ceiling.

Temporary partitions as specified in Section 1806 may be used.

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

Exit enclosures shall be constructed as required in Section 3308.

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

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

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

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

Section 1909. FIRE-PROTECTION OF STRUCTURAL MEMBERS. (a) Structural Steel and Concrete Members. All structural steel and concrete members (not including frames and structural members for elevators and elevator enclosures) shall be thoroughly fire protected with not less than one-hour fire-resistive protection.

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

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

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

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

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

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

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

A space of one-half inch (½") shall be required between the wood flooring and adjoining walls to allow for expansion due to wetting. This space shall be covered by a molding secured to the wall only, or masonry may be corbeled under the floor to cover this space.

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

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

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

Section 1912. STAIR CONSTRUCTION. Stairs shall be constructed with wood treads and risers of not less than two-inch (2") nominal thickness, except where built on laminated or plank inclines as required for floors, when they may be built of one-inch (1") nominal thickness, or may be constructed as required in Type I buildings.

In buildings four or more stories in height, stairs and stair construction shall be as required for Type I buildings.
Stairs and exits shall be designed and constructed as specified in Chapter 33.

Section 1913. DOORS AND WINDOWS.
Doors, windows, and other openings in the exterior walls shall be protected by Class "E" or "F" fire doors or windows.

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

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

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

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

Section 1915. PENTHOUSES AND SKYLIGHTS.
Penthouses shall be constructed as required in Chapter 36.

Skylights shall be of incombustible construction. See Chapter 34.

Section 1916. COMBUSTIBLE MATERIALS REGULATED. No wood lath or wood furring shall be allowed, and no incombustible furring shall pass through any wall, partition, or floor. Unprotected steel and iron or wood may be used in the following places:

1. Mezzanine floor construction, provided that there shall be not more than two such mezzanines in any room of any building, and, provided further that no such mezzanine floor or floors shall cover more than thirty-three and one-third per cent (33 1/3%) of the area of the room where located.

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

3. Trim, handrails, show window backing, temporary partitions as specified in Section 1906, picture molds, chair rails, wainscoting, baseboards, and doors, except in stair, elevator, and other shaft enclosures, or where not specifically prohibited under Occupancy in Part III.
CHAPTER 20 – TYPE III BUILDINGS  
(Ordinary Masonry)

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

Section 2002. HEIGHT ALLOWABLE. (a) Height in Feet. Type III buildings shall not exceed a height of forty-five feet (45’); provided, that the height of a 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, and provided, further, that towers, spires, and steeples erected as a part of such building and not used for habitations or storage may extend not to exceed fifteen feet (15’) above such height limit.

(b) Height in Stories. See Table No. 5-D.

Section 2003. AREA ALLOWABLE. The floor area of Type III buildings shall be limited according to occupancy as required in Part III.


Section 2005. EXTERIOR AND INNER COURT WALLS. (a) Exterior Walls. Exterior walls shall be not less than four-hour fire-resistive construction.

Exceptions: 1. Walls fronting on streets having a width of at least fifty feet (50’) in Fire Zone No. 1, or thirty feet (30’) in Fire Zone No. 2, No. 3, or No. 4, may be of incombustible construction with all structural members having not less than one-hour fire-resistive protection.

2. In Fire Zone No. 3 or No. 4, exterior walls may conform to the following:

(a) Brick veneer, constructed in conformance with Sections 2901 and 2902, may be used in buildings housing Group I or J occupancy.

(b) Walls meeting the minimum thickness requirements set forth in Section 2404 may be used in buildings housing Group I or J occupancy.

(c) In buildings housing Group I occupancy, Type IV or V Construction may be used above the plate line, which, for the purpose of this Section, shall be at the bearing of the joists or rafters immediately above the first floor ceiling.

(b) Parapet Walls. 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.

Exception: 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.

(c) Inner Court Walls. 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.

(d) Masonry bearing walls shall not be permitted in buildings housing Group B, Division 1, occupancy. For the purpose of this Section, reinforced concrete walls with reinforced members and slabs rigidly attached thereto shall not be considered to be masonry.

Section 2006. PARTITIONS. 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.

Section 2007. ENCLOSURE OF VERTICAL OPENINGS. Enclosures for elevator shafts, vent shafts, and other vertical openings, when required because of occupancy in Part III, shall be of not less than one-hour fire-resistive construction. See Chapter 30.

Exit enclosures shall be constructed as required in Section 3308. Stairways in dwellings need not be enclosed.

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.

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

Section 2009. FIRE-PROTECTION OF STRUCTURAL MEMBERS. 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.

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

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

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 2517. Ventilation shall be provided between the ground and a wood floor as required in Section 2523.

Section 2011. ROOF DECK CONSTRUCTION. Roof construction shall be of any Type of Construction permitted for floors except where otherwise required because of occupancy in Part III.

In Fire Zones 1 and 2, roof covering shall be "Fire-Retardant" as specified in Section 3204.

Section 2012. STAIR CONSTRUCTION. Stairs may be of steel, iron, concrete, masonry, or wood and, except in Group I or J occupancy, shall be designed and constructed as specified in Chapter 33. See Section 1404 for design and construction in Group I or J occupancy.

Section 2013. DOORS AND WINDOWS. 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.

Section 2014. PROJECTIONS FROM THE BUILDING. (a) Bays and Oriel s. Bays, oriel s, and similar projections shall be constructed of combustible materials with walls, floors, and roofs as specified in this Chapter and in Chapter 35.

(b) Porches and Exterior Balconies. Porches and exterior balconies shall be constructed of combustible materials. Structural steel or iron members need not be fire-protected.

Exceptions: 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 (15/8") thick. Such wood construction shall not be carried through the exterior walls.

2. Buildings of Group I or J occupancy may have open porches and exterior balconies, not over two (2) stories in height, of Type IV or V construction. Enclosed porches not over one story in height may be of Type IV or V construction. A second story enclosed porch may be of Type IV or V construction provided the first story is of Type I, II, or III construction.

(c) Cornices. Cornices and similar appendages shall be constructed of incombustible materials and in conformance with Chapter 45.

Exception: Such appendages on buildings of Group I or J occupancy may be of Type IV or V construction where such appendages do not project into any public street or alley.

Section 2015. PENTHOUSES AND SKYLIGHTS. Penthouses and other roof structures shall be of not less than one-hour fire-resistive construction. See Chapter 36.

Skylights shall be of incombustible construction. See Chapter 34.

Section 2016. COMBUSTIBLE MATERIALS REGULATED. 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. "Blanket, batt, loose or reflective type insulating materials, including vapor seals, wrappings, and envelopes, shall be permitted in a building of Type III construction, except where wood is specifically prohibited under Occupancy in Part III or Location in Part IV. Such insulating materials, including vapor seals, wrappings, and envelopes, shall not be installed so as to increase the flame-spread characteristics of that part of the building or structure of which they are applied, or so as to increase the flame-spread characteristics of the building or structure generally. The application of any blanket, batt, loose or reflective type insulating materials, including vapor seals, wrappings, and envelopes, with flame-spread characteristics or combustibility greater than that of 200, as determined under Section 4601 of this Code is
hereby prohibited, except that a vapor barrier of greater flame-spread characteristics may be used when installed adjacent to and facing a fire-resistive surface as required by this Code, and not more than three-fourths (3/4) of an inch from such surface. No such insulating materials, including vapor seals, wrappings, and envelopes, may be applied without approval both of the material and the method of application thereof in accordance with the procedures established by Sections 105 and 106 hereof. No application of insulating materials shall interfere with required fire blocking or fire separations.

Each application of insulating materials shall be identified by an appropriate tag or card permanently affixed in a conspicuous place near the insulated areas. Such tag or card shall be in form approved by the Chief Building Inspector and shall express the following information: Manufacturer's name; name and trade name of materials used; date of approval of materials and method of application and approval number; applicator's name and address.

(Ord. 137, Series 1953)
CHAPTER 21 — TYPE IV BUILDINGS
(Light Incombustible Frame)

Section 2101. DEFINITION. In "Type IV Buildings": the structural framework shall be of steel, iron, masonry, or concrete, and exterior walls shall be of incombustible materials. Partition, floor, and roof construction shall be of incombustible materials except as specified in this Chapter. Foundations shall be of masonry or concrete.

Section 2102. HEIGHT ALLOWABLE. (a) Height in Feet. Type IV buildings shall not exceed a height of forty-five feet (45'); provided that the height of a 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.

See District Zone regulations (Ord. No. 14, Series of 1925, as amended) for restrictions in District Zones.

(b) Height in Stories. See Table No. 5-D.

Section 2103. AREA ALLOWABLE. The floor area of a Type IV building shall be limited as specified under Occupancy in Part III and Location in Part IV. See Sections 505, 506, and 1602.

Section 2104. FOUNDATIONS. See Chapter 28.

Section 2105. EXTERIOR WALLS. Exterior wall covering shall provide suitable protection from the elements and shall be of incombustible material of such thickness and strength, and be 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.

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 (1 1/2") in thickness reinforced in two directions with not less than three-tenths percent (0.3%) 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 manner as to resist effectively the stresses developed. The unit stresses for such reinforced plaster shall not be more than fifty per cent (50%) of those allowed for composite beams in Table No. 26-B, based on a compressive strength of such plaster of fifteen hundred (1500) pounds per square inch.

See District Zone regulations (Ord. No. 14, Series of 1925, as amended) for restrictions in District Zones.

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

Section 2107. ENCLOSURE OF VERTICAL OPENINGS. Enclosures for elevator shafts and other vertical openings, when required because of Occupancy in Part III, shall be of not less than one-hour incombustible fire-resistant construction. See Chapter 30.

Exit enclosures shall be constructed as required in Section 3308. Stairways in dwellings need not be enclosed.

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.

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

Section 2109. FIRE - PROTECTION OF STRUCTURAL MEMBERS. 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.

Section 2110. FLOOR CONSTRUCTION.
Floor construction shall be of incombustible material; provided, however, that a wood wearing surface or finish may be applied over such incombustible material.

Section 2111. ROOF CONSTRUCTION.
Roof construction may be of any type of construction permitted by this Code.

Section 2112. STAIR CONSTRUCTION.
Stairs shall be of any type permitted by this Code and, except in Group I or J occupancy, shall comply with the requirements of Chapter 33. See Section 1404 for design and construction in Group I or J occupancy.

Section 2113. DOORS AND WINDOWS.
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.

Section 2114. PROJECTIONS FROM THE BUILDING.
(a) Bays and OrIeils. Bays, orielis, and similar projections shall be constructed of incombustible materials with walls, floors, and roofs as specified in this Chapter and in Chapter 35.

Exceptions: 1. Buildings of Groups I and J occupancies may have such projections of Type V construction.

2. A loading platform, not including the roof of roof structure thereof, may be constructed of wood as specified in Section 1914.

(b) Porches and Exterior Balconies. Porches and exterior balconies shall be constructed of incombustible materials.

Exception: Buildings of Group I or J occupancy may have open porches and exterior balconies, not over two stories in height, of Type V construction. Enclosed porches not over one story in height may be of Type V construction. A second story enclosed porch may be of Type V construction provided the first story is of Type I, II, or III construction.

(c) Cornices. Cornices, marquees, canopies, and all other similar projections shall be constructed of incombustible material and in conformance with Chapter 45.

Exception: Such appendages on buildings of Group I or J occupancy may be of Type V construction when such appendages do not project into any public street or alley.

Section 2115. PENTHOUSES AND SKYLIGHTS.
Penthouses and other roof structures shall be constructed as required for the main portion of the building. See Chapter 36.

Skylights shall be of incombustible construction. See Chapter 34.
CHAPTER 22 – TYPE V BUILDINGS
(Wood Frame)

Section 2201. DEFINITION. In "Type V Buildings," enclosing walls, interior walls, partitions, floors, and roof 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.

Section 2202. HEIGHT ALLOWABLE. (a) Height in Feet. 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.

See District Zone regulations (Ord. No. 14, Series 1925, as amended) for restrictions in District Zones.

(b) Height in Stories. See Table No. 5-D.

Section 2203. AREA ALLOWABLE. The maximum floor area allowable for a Type V building shall in no case exceed that specified under Occupancy in Part III (See Table No. 5-C, Section 506) or Location in Part IV.

Section 2204. FOUNDATIONS. See Chapter 28.

Section 2205. EXTERIOR WALLS AND WALL COVERINGS. (a) Construction. Exterior walls may be of any materials permitted by this Code.

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

(b) Sheathing. Sheathing shall be required over studs for buildings of Group I occupancy.

Buildings, three stories in height housing other occupancies, shall have all exterior walls of the first story covered with sheathing. Such sheathing, when of wood, shall be applied diagonally.

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

Wood not less than five-eighths inch (5/8') thick.

Approved fiber board not less than seventeen-sixteenths inch (7/16') thick.

Approved gypsum sheathing not less than one-half inch (1/2') thick.

Approved plywood not less than five-sixteenths inch (5/16') thick.

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

2. Weatherboarding. Studs or sheathing shall be covered on the outside face with one layer of building paper as specified in Section 2217. Weatherboarding, when in place, shall have an average thickness of not less than five-eighths inch (5/8") and a minimum thickness of not less than three-eighths inch (3/8"). Such weatherboarding shall be placed over the paper and shall be securely nailed to the studs 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, or such weatherboarding shall be laid shingle fashion and lapped not less than one-half inch (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 (19/32") and a minimum thickness of not less than three-eighths inch (3/8"). Bevel siding shall have a minimum thickness, measured at the butt section of not less than twenty-one thirty-seconds inch (21/32") and a tip thickness of not less than one-quarter inch (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 (3/8") thick. 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 (3/8").

5. Exterior Plastering. See Chapter 47.


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

Section 2206. INTERIOR PARTITIONS. Interior partitions may be of any material permitted for exterior walls in this Code. If of wood, interior partitions shall be constructed, framed, and fire-stopped 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 (2x3") studs, sixteen inches (16") on centers, may be used.

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

Exit enclosures shall be constructed as specified in Section 3308. Stairways in dwellings need not be enclosed.

Section 2208. STRUCTURAL FRAMEWORK. Structural framework may be of any Type of Construction permitted in this Code.

Section 2209. FIRE PROTECTION OF STRUCTURAL MEMBERS. Fire-protection of structural framework shall not be required except as provided under Occupancy in Part III.

Section 2210. FLOOR CONSTRUCTION. Floors may be of any Type of Construction permitted in this Code.

Section 2211. ROOF AND CEILING CONSTRUCTION. 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.

All buildings may have "Ordinary" roof covering. Wherever a composition roofing is used, the roof construction shall be solidly sheathed with wood, sheathing to be not less than twenty-five thirty-seconds inch (25/32") thick, or with plywood not less than that set forth in Table No. 31-B.

Section 2212. STAIR CONSTRUCTION. Stair construction may be of any Type permitted in this Code and shall conform to the requirements of Chapter 33.

Section 2213. DOORS AND WINDOWS. Doors and windows may be of any Type permitted in this Code.

Section 2214. PROJECTIONS FROM BUILDING. Any projections from the building shall conform to the requirements for exterior walls.

Section 2215. PENTHOUSES AND SKYLIGHTS. Penthouses and skylights may be of any material permitted in Chapters 34 and 36 of this Code.

Section 2216. COMBUSTIBLE MATERIALS REGULATED. Blanket, batt, loose or reflective type insulating materials, including vapor seals, wrappings, and envelopes, shall be permitted in a building of Type V construction except where wood is specifically prohibited under Occupancy in Part III or Location in Part IV. Such insulating materials, including vapor seals, wrappings, and envelopes, shall be so installed so as to increase the flame-spread characteristics of that part of the building or structure to which they are applied, or so as to increase the flame-spread characteristics of the building or structure generally. The application of any blanket, batt, loose or reflective type insulating materials, including vapor seals, wrappings, with flame-spread characteristics or combustibility greater than that of 200, as determined under Sec. 4601 of this Code, is hereby prohibited, except that a vapor barrier of greater flame-spread characteristics may be used when installed adjacent to and facing a fire resistive surface as required by this Code, and not more than three-fourths (3/4) of an inch from such surface. No such insulating materials, including vapor seals, wrappings, and envelopes, may be applied without approval both of the material and the method of application thereof in accordance with the procedures established by Sections 105 and 106 hereof. No application of insulating materials shall interfere with required fire blocking or fire separations.

Each application of insulating materials shall be identified by an appropriate tag or card permanently affixed in a conspicuous place near the insulated areas. Such tag or card shall be in form approved by the Chief Building Inspector and shall express the following information: Manufacturer's name; name and trade name of materials used; date of approval of materials and method of application and approval number; applicator's name and address.

(Ord. 137, Series 1953.)
Section 2217. WEATHER PROTECTION.

(a) Building Paper. On exterior walls on frame construction, except where the building is not intended for human occupancy, a substantial waterproof building paper (not a vapor barrier) shall be applied directly over the outer face of the sheathing, except that where approved water-repellent panels are used in lieu of wood sheathing, such waterproof building paper may be omitted.

(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.
ENGINEERING REGULATIONS – QUALITY AND DESIGN OF THE MATERIALS OF CONSTRUCTION

CHAPTER 23 – LIVE AND DEAD LOADS

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

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

Section 2302. LOADS. (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 two thousand (2000) pounds placed upon any space two and one-half feet (2 ½') square wherever this load upon an otherwise unloaded floor would produce stresses greater than those caused by a uniformly distributed load of fifty (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 to one-twelfth (1/12) 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.

Section 2303. METHOD OF DESIGN. Any system or method of construction to be used shall admit of a rational analysis in accordance with well-established principles of mechanics.

Section 2304. UNIT LIVE LOADS. The unit loads set forth in Table No. 23-A shall be taken as the minimum live loads in pounds per square foot of horizontal projection to be used in the design of buildings for the occupancies listed, and loads at least equal shall be assumed for uses not listed in this Section but which create or accommodate similar loadings.

All ceiling joists shall be designed for not less than ten (10) pounds per square foot total load exclusive of weight of joists and other framing.

Railings of interior balconies in places of public assembly shall be designed to withstand a lateral pressure at any point of one hundred pounds (100 lbs.) per linear foot applied at the top of such railings.

Section 2305. ROOF LOADS. Roofs shall sustain, within the stress limitations of this Code, all “dead loads” plus unit “live loads” set forth in Table No. 23-B. The live loads shall be assumed to act vertically upon the area projected upon a horizontal plane.

Greenhouses, lath houses, and farm accessory buildings shall be designed for a vertical live load of not less than ten (10) pounds.
<table>
<thead>
<tr>
<th>Description</th>
<th>Live Loads Per Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armories</td>
<td>150</td>
</tr>
<tr>
<td>Bleachers: Grandstands and temporary grandstands</td>
<td>100</td>
</tr>
<tr>
<td>Church Auditorium: with fixed seats, including aisles, sanctuary or chancel,</td>
<td>50</td>
</tr>
<tr>
<td>sacristies, choirs and chapels</td>
<td></td>
</tr>
<tr>
<td>Class Rooms: in schools and colleges, not exceeding 900 sq. ft. in area, or</td>
<td>50</td>
</tr>
<tr>
<td>larger size rooms where fixed seats are used; and school laboratories</td>
<td></td>
</tr>
<tr>
<td>Corridors: in theatres and serving assembly halls and school buildings</td>
<td>100</td>
</tr>
<tr>
<td>Other corridors: same loading as heaviest occupancy to which they provide</td>
<td></td>
</tr>
<tr>
<td>access.</td>
<td></td>
</tr>
<tr>
<td>Domestic Occupancy: All parts of private dwellings, rooms and suites in</td>
<td>40</td>
</tr>
<tr>
<td>apartment houses, lodging houses and clubs; private, ward or dormitory</td>
<td></td>
</tr>
<tr>
<td>rooms in hospitals, asylums, educational and religious institutions,</td>
<td></td>
</tr>
<tr>
<td>including corridors giving access thereto; and bedrooms of hotels.</td>
<td></td>
</tr>
<tr>
<td>Drill rooms</td>
<td>150</td>
</tr>
<tr>
<td>Driveways: over areaways or basement.</td>
<td>100</td>
</tr>
<tr>
<td>Fire Escapes and Exterior Balconies</td>
<td>100</td>
</tr>
<tr>
<td>Garages: for vehicles no heavier than passenger automobiles, all floors</td>
<td>100</td>
</tr>
<tr>
<td>For vehicles larger than passenger automobiles the structure shall be</td>
<td></td>
</tr>
<tr>
<td>designed for the loading to which building is to be subjected.</td>
<td></td>
</tr>
<tr>
<td>Libraries: Reading Rooms</td>
<td>60</td>
</tr>
<tr>
<td>Stack Rooms</td>
<td>125</td>
</tr>
<tr>
<td>Manufacturing: Load to be determined from proposed use or occupancy, but</td>
<td>100</td>
</tr>
<tr>
<td>never less than</td>
<td></td>
</tr>
<tr>
<td>Marquees</td>
<td>50</td>
</tr>
<tr>
<td>Office Buildings: first and basement floors</td>
<td>100</td>
</tr>
<tr>
<td>Office Occupancy: above first floor in office buildings, offices in other</td>
<td>50</td>
</tr>
<tr>
<td>buildings, including corridors</td>
<td></td>
</tr>
<tr>
<td>Printing Plants: Load to be determined from proposed use or occupancy, but</td>
<td>150</td>
</tr>
<tr>
<td>never less than</td>
<td></td>
</tr>
<tr>
<td>Public Occupancy: Lobbies, foyers, vestibules and similar public spaces of</td>
<td></td>
</tr>
<tr>
<td>hotels, theatres, churches, clubs and public buildings; assembly halls,</td>
<td></td>
</tr>
<tr>
<td>including class and lecture rooms exceeding 900 sq. ft. in area, without</td>
<td></td>
</tr>
<tr>
<td>fixed seats; dance halls, public dining rooms and restaurants, public</td>
<td></td>
</tr>
<tr>
<td>rooms for social purposes, gymnasiums</td>
<td>100</td>
</tr>
<tr>
<td>Sidewalks: over areaways or basement.</td>
<td>250</td>
</tr>
<tr>
<td>Skating Rinks</td>
<td>120</td>
</tr>
<tr>
<td>Stairs (except in dwellings)</td>
<td>100</td>
</tr>
<tr>
<td>Storage: Light storage</td>
<td>125</td>
</tr>
<tr>
<td>Heavy: Load to be determined from proposed use or occupancy, but never less</td>
<td>250</td>
</tr>
<tr>
<td>than</td>
<td></td>
</tr>
<tr>
<td>Stores, Light Merchandise: for floors up to and including first</td>
<td>100</td>
</tr>
<tr>
<td>Above first floor, including mezzanine</td>
<td>75</td>
</tr>
<tr>
<td>Theatre Auditoriums and Assembly Halls: with fixed seats, including aisles</td>
<td>75</td>
</tr>
<tr>
<td>and passageways</td>
<td></td>
</tr>
<tr>
<td>Theatre Stages, gridirons and fly galleries</td>
<td>100</td>
</tr>
</tbody>
</table>

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TABLE NO. 23-B
ROOF LIVE LOADS IN POUNDS PER SQUARE FOOT

<table>
<thead>
<tr>
<th>Roof Member</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat or rise less than four (4) inches per foot.</td>
<td></td>
</tr>
<tr>
<td>Arch or dome with rise less than one-eighth (1/8) of the span</td>
<td>30</td>
</tr>
<tr>
<td>Rise four (4) inches per foot to less than twelve (12) inches per foot.</td>
<td></td>
</tr>
<tr>
<td>Arch or dome with rise one-eighth (1/8) span to less than three-eighths (3/8) span or with radius three-fourths (3/4) or greater of the span</td>
<td>25</td>
</tr>
<tr>
<td>Rise twelve (12) inches per foot and greater.</td>
<td></td>
</tr>
<tr>
<td>Arch or dome with rise three-eighths (3/8) span or greater, or radius less than three-fourths (3/4) of the span</td>
<td>15</td>
</tr>
</tbody>
</table>

Trusses and arches shall be designed to resist the stresses caused by unit live loads on one-half of the span if such loading results in reverse stresses, or stresses greater in any portion than the stresses produced by the required unit live load upon the entire span. For roofs whose structure is composed of a stressed shell, framed or solid, wherein stresses caused by any point loading are distributed throughout the area of the shell, the requirements for unbalanced unit live load design may be reduced fifty percent (50%).

When the form factor, as determined by wind tunnel tests or other recognized methods, indicates vertical or horizontal loads of lesser or greater severity than those produced by the loads herein specified, the roof structure may be designed accordingly.

Snow load, full or unbalanced, or wind load shall be considered in place of loads in Table No. 23-B, where such loading will result in larger members or connections.

Section 2306. REDUCTION OF LIVE LOADS.
The following reductions in assumed live loads shall be permitted in designing of columns, piers, walls, foundations, trusses, and girders.

1. A reduction of the total live load used in the design of horizontal members based on a certain tributary floor area shall be permitted as noted on 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 as warehouses or for storage purposes or for the design of roofs. A marginal beam which frames between columns, or between a column and a bearing wall, and supports flat slab construction reinforced in two directions, may be considered as a girder and live load reductions allowed on the same basis as given for girders.

<table>
<thead>
<tr>
<th>Reduction Allowed</th>
<th>Tributary Floor Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>100 sq. ft.</td>
</tr>
<tr>
<td>10%</td>
<td>200 sq. ft.</td>
</tr>
<tr>
<td>15%</td>
<td>300 sq. ft. or more</td>
</tr>
</tbody>
</table>

2. 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

<table>
<thead>
<tr>
<th>Carrying the roof</th>
<th>0 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrying 1 floor and roof</td>
<td>0 per cent</td>
</tr>
<tr>
<td>Carrying 2 floors and roof</td>
<td>5 per cent</td>
</tr>
<tr>
<td>Carrying 3 floors and roof</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Carrying 4 floors and roof</td>
<td>15 per cent</td>
</tr>
<tr>
<td>Carrying 5 or more floors and roof</td>
<td>20 per cent</td>
</tr>
</tbody>
</table>

Allowable Reductions for Manufacturing Buildings, Stores, and Garages

<table>
<thead>
<tr>
<th>Carrying the roof</th>
<th>0 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrying 1 floor and roof</td>
<td>0 per cent</td>
</tr>
<tr>
<td>Carrying 2 floors and roof</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Carrying 3 floors and roof</td>
<td>20 per cent</td>
</tr>
<tr>
<td>Carrying 4 or more floors and roof</td>
<td>30 per cent</td>
</tr>
</tbody>
</table>

Allowable Reductions for All Other Buildings

<table>
<thead>
<tr>
<th>Carrying the roof</th>
<th>0 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrying 1 floor and roof</td>
<td>0 per cent</td>
</tr>
<tr>
<td>Carrying 2 floors and roof</td>
<td>10 per cent</td>
</tr>
<tr>
<td>Carrying 3 floors and roof</td>
<td>20 per cent</td>
</tr>
<tr>
<td>Carrying 4 floors and roof</td>
<td>30 per cent</td>
</tr>
<tr>
<td>Carrying 5 floors and roof</td>
<td>40 per cent</td>
</tr>
<tr>
<td>Carrying 6 floors and roof</td>
<td>45 per cent</td>
</tr>
<tr>
<td>Carrying 7 or more floors and roof</td>
<td>50 per cent</td>
</tr>
</tbody>
</table>
Section 2307. WIND PRESSURE. (a) General. Building and structures, and every portion thereof, shall be designed and constructed to resist the wind pressure specified in this Section. All bracing systems, both horizontal and vertical, shall be designed and constructed to transfer the wind loads to the foundations.

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

The wind pressure upon roof tanks, roof signs, or other exposed roof structures and their supports shall be taken as not less than thirty (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 six-tenths (6/10) of the projected area.

On open framed structures, the area used in computing wind pressure shall be one and one-half (1 1/2) times the net area of the framing members in the side exposed to the wind.

(c) Design. The overturning moment calculated from the wind pressure shall in no case exceed two-thirds (2/3) 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 and the allowable loads on connections may be increased thirty-three and one-third per cent (33 1/3%) in excess of the values specified in Chapters 24, 25, 26, and 27. For members carrying wind stresses only, the allowable unit stresses may be increased thirty-three and one-third per cent (33 1/3%). In no case shall the section be less than required if the wind stress be neglected.

Section 2308. LIVE LOADS POSTED. The live loads for which each floor, or part thereof, of a commercial or industrial building is or has been designed, shall be conspicuously posted by the owner in that part of each story in which they apply. Durable metal signs shall be used, 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.

Section 2309. RETAINING WALLS AND BASEMENT FLOORS. Retaining walls shall be designed to resist the lateral pressure of the retained material in accordance with accepted engineering practice. Walls retaining drained earth may be designed for pressure equivalent to that exerted by a fluid weighing not less than thirty (30) pounds per cubic foot and having a depth equal to that of the retained earth. Any surcharge shall be in addition to the equivalent fluid pressure.

Section 2310. WALLS AND STRUCTURAL FRAMING. Walls and structural framing shall be erected true and plumb in accordance with the design. Bracing shall be placed during erection wherever necessary to take care of all loads to which the structure may be subjected.

Section 2311. FOOTING DESIGN. 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.
CHAPTER 24 — MASONRY

Section 2401. GENERAL. (a) Quality and Design. All masonry materials shall be of a quality established as safe for the intended purpose and shall conform to the minimum requirements specified in this Chapter. For method of determining quality safe for intended use, see Section 4601. Masonry units may be re-used when clean, sound, and conforming to the other requirements of this Chapter. Masonry construction shall conform to the detailed minimum requirements specified in this Chapter.

(b) Combination of Units. Where units of different types or strengths are used in combination, the maximum allowable stress for the combination shall not exceed that allowed for masonry of the units having the lowest allowable stress.

(c) Freezing. All masonry shall be protected against freezing for at least seventy-two (72) hours after being laid. No masonry shall be built upon frozen material.

(d) Dimensions. Dimensions given are nominal; actual dimensions of unit masonry may not be decreased by more than one-half inch (½").

Section 2402. MATERIALS. (a) Brick. Building brick of clay, shale, sand-lime, or concrete shall be of a quality at least equal to that specified in regulations issued pursuant to Section 4601. When in contact with the ground or where severe frost action occurs in the presence of moisture, the brick shall be of at least Grade MW for clay, shale, or sand-lime brick; or Grade A for concrete brick. Other solid masonry units of clay or shale shall meet the requirements for the physical properties of brick as specified in regulations issued pursuant to Section 4601.

*—For regulations covering PLAIN CONCRETE, see Section 2624.

(b) Concrete Masonry Units. Concrete masonry units shall be of a quality at least equal to that specified in regulations issued pursuant to Section 4601.

(c) Structural Clay Tile. Structural clay tile shall be of a quality at least equal to that required by regulations issued pursuant to Section 4601; Grade LB when used for bearing walls or piers, or Grade LBX when exposed to the weather or soil; or equal to that required by regulations issued pursuant to Section 4601 when used for interior non-load-bearing purposes or for floor construction.

(d) Cast Stone. Cast stone shall be of a quality at least equal to that specified in regulations issued in pursuant to Section 4601.

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

(f) Gypsum Units. Gypsum partition tile or block shall be of a quality at least equal to that specified in regulations issued pursuant to Section 4601.

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

(h) Glazed Building Units. Glazed building units shall conform to regulations issued pursuant to Section 4601, except that the requirements for finish shall not apply to salt-glazed building units.

(i) Cementitious Materials. Cementitious materials used in mortars shall be of a quality at least equal to the quality of materials specified in regulations issued pursuant to Section 4601.

(j) Aggregate. Aggregate for mortar shall be of a quality at least equal to that specified in regulations issued pursuant to Section 4601.

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

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

Mortar when applied shall have a flow after suction for one minute of not less than seventy per cent (70%) of that immediately before suction when determined by the method of the water retention test designated in regulations issued pursuant to Section 4601.

| TABLE NO. 24-A |
| TYPES OF MORTAR |

<table>
<thead>
<tr>
<th>Minimum Compressive Strength of 2-in. Cubes at 28 Days (Lb. per sq. in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
</tr>
<tr>
<td>Type B</td>
</tr>
<tr>
<td>Type C</td>
</tr>
</tbody>
</table>

Tests made to classify mortar by compressive strength shall be made as described in the regulations issued pursuant to Section 4601.
(b) **Strength.** Unless the strength classification of the mortar has been established by tests in accordance with this Section, mortars using the cementitious materials set forth in Table No. 24-B shall be assumed to meet the strength classification shown when mixed with aggregate in the proportions required by this Section.

The volume of aggregate in mortar shall be at least two (2) times but not more than three (3) times the sum of the volumes of cementitious materials or the amounts set forth in Table No. 24-B.

(c) **Gypsum Mortar.** Gypsum mortar shall be composed by weight of one (1) part of gypsum and not more than three (3) parts of mortar aggregate.

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

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

**Section 2404. GENERAL REQUIREMENTS FOR MASONRY.** (a) **General.** The following shall apply to all masonry walls but foundation walls. See Chapter 28 for foundation wall requirements. The thickness of masonry walls shall be sufficient at all points to withstand all vertical and horizontal loads as specified in Chapter 23, but in no case shall such thickness be less than that set forth in Table No. 24-C. The ratio of unsupported height or length of the wall (whichever is the lesser) to thickness shall not be greater than that set forth in Table No. 24-C, except as specified in Subsection (b).

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

**Exceptions:**
1. The top story walls of a building not exceeding three (3) stories or thirty-five feet (35') in height, or the walls of a one-story building may have a wall thickness equal to the least dimensions as set forth in Table No. 24-C.
2. In Group I or J buildings not more than three (3) stories in height, masonry walls may be of eight inches (8") nominal thickness when not over thirty-five feet (35') in height. Such walls in one-story single-family dwellings, one-story duplex dwellings, one-story multiple dwellings and one-story private garages, may be of six inches (6") nominal thickness when not over nine feet (9') in height, provided that when gable construction is used an additional six feet (6') is permitted to the peak of the gable.

Walls of six-inch (6") nominal thickness shall be furred on the inside with furring strips of three-quarter-inch (3/4") nominal thickness and finished.

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

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

(d) **Change in Thickness.** When a change in thickness due to minimum thickness requirements occurs between floor levels, the greater thickness shall be carried to the higher floor level.

(e) **Chases.** Chases in masonry walls shall not be deeper than one-third (1/3) the wall thickness nor longer than four feet (4') horizontally and shall have at least eight inches (8") of masonry nor longer than four feet (4') horizontally and shall have at least eight inches (8") of masonry in back of the chases and between chases and jambs of openings, provided, that in the buildings of Group I occupancy not over two (2) stories in height, chases not over four inches (4") deep, thirty inches (30") wide, and twenty-four inches (24") high, may be built in eight-inch (8") walls, and provided, that chases below windows may equal the width of the opening above. The back and sides of such chases in exterior walls shall be made water-resistant and insulated.

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

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

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

(h) **Anchorage.** Masonry walls that meet or intersect shall be securely bonded or anchored.
Wood joists or wood beams shall be securely anchored to masonry walls at intervals not exceeding four feet (4') by metal anchors having a minimum cross section of twenty hundreds of a square inch (0.20 sq. in.) and at least sixteen inches (16") long, securely fastened to the joists or beams at one end of the anchor by means of nailing or bolting or other approved method, and the other end of the anchor in the form of a T securely built into the masonry not less than three and one-half inches (3 ½") with the T vertical.

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

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

(i) Piers. The unsupported height of isolated piers shall not exceed ten (10) times their least dimension unless properly reinforced. Every pier whose width is less than three (3) times its thickness shall be designed and constructed as required for columns if such pier is a structural member. Piers of solid unit masonry shall be laid up in Type A or B mortar.

Walls in which the openings are of such an extent as to leave narrow sections two feet (2') or less in width shall have such narrow sections computed and constructed as for isolated piers.

Piers, columns, or pilasters shall be provided as may be required under points of concentrated loads.

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

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

---

**TABLE NO. 24-B**

MORTAR PROPORTIONS OF CEMENTITIOUS MATERIALS
(by volume)

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum Portland Cement</th>
<th>Maximum Hydrated Lime or Lime Putty</th>
<th>Masonry Cement Type II</th>
<th>Maximum Dry Loose Aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>1 part</td>
<td>¾ part</td>
<td></td>
<td>3 parts</td>
</tr>
<tr>
<td>Type B</td>
<td>1 part</td>
<td>½ part</td>
<td></td>
<td>4½ parts</td>
</tr>
<tr>
<td>Type C</td>
<td>1 part</td>
<td>1 part</td>
<td>1 part</td>
<td>6 parts</td>
</tr>
<tr>
<td>Type C</td>
<td></td>
<td></td>
<td>1 part</td>
<td>3 parts</td>
</tr>
</tbody>
</table>

---

**TABLE NO. 24-C**

MINIMUM THICKNESS OF MASONRY WALLS

<table>
<thead>
<tr>
<th>Type of Masonry</th>
<th>Maximum Ratio Unsupported Height or Length to Thickness</th>
<th>Nominal Minimum Thickness (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Solid Masonry</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>Grouted Brick Masonry</td>
<td>22</td>
<td>7</td>
</tr>
<tr>
<td>Reinforced Brick Masonry</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>Hollow Unit Masonry</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Cavity Wall Masonry</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Stone Masonry (Ashlar)</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Interior Non-Bearing</td>
<td>48</td>
<td>2</td>
</tr>
</tbody>
</table>
Section 2405. PLAIN SOLID MASONRY. (a) General. Plain solid masonry is that form of construction made with brick, solid load-bearing concrete masonry units, or stone in which the units are all laid and set in mortar placed with a trowel.

(b) Construction. Plain solid masonry shall be laid with header courses at least every seventh course or nineteen inches (19") clear vertically, or there shall be at least one (1) full header in every eighty-four square inches (84 sq. in.) of wall surface.

Brick shall be laid with full shoved mortar joints and all head, bed, and wall joints shall be solidly filled with mortar. At the time of laying, clay or shale units shall be clean, damp, and shall have sufficient moisture content so that the amount of water per square inch absorbed during the absorption test is not more than 0.030 ounce.

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

Exception: In the construction of one-story Group I or J buildings, or the top story of two- or three-story buildings housing these occupancies, approved non-corrosive metal ties shall be permitted in place of header courses. Ties shall be placed not farther apart than every alternate brick horizontally and every sixth course vertically, or the equivalent. Backing material shall be carried up to the level of the face course at each line of ties.

(c) Corbeling. Corbels may be built only into solid masonry walls twelve inches (12") or more in thickness. The projection for each course in such corbel shall not exceed one inch (1") and the maximum projection shall not exceed one-third (1/3) of the total thickness of the wall when used to support structural members and not more than six inches (6") when used to support a chimney built into the wall. The top course of all corbels shall be a header course.

Table No. 24-D

<table>
<thead>
<tr>
<th>Diameter of Bolt (Inches)</th>
<th>Embedment (Inches)</th>
<th>Plain Masonry</th>
<th>Grouted Masonry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>4</td>
<td>350</td>
<td>550</td>
</tr>
<tr>
<td>5/8</td>
<td>4</td>
<td>500</td>
<td>750</td>
</tr>
<tr>
<td>3/4</td>
<td>5</td>
<td>750</td>
<td>1100</td>
</tr>
<tr>
<td>7/8</td>
<td>6</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>1250</td>
<td>1850*</td>
</tr>
<tr>
<td>1-1/8</td>
<td>8</td>
<td>1500</td>
<td>2250*</td>
</tr>
</tbody>
</table>

*Permitted only with not less than 2500 p. s. i. units.

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

(b) Construction. All brick in the outer tiers shall be laid with full head and bed joints of Type A or B mortar and all interior joints shall be filled with grout. Brick in the interior tiers shall be placed or floated in grout poured between the two outer tiers. One of the outer tiers may be carried up not more than three (3) courses before grouting but the other shall be carried up not more than one (1) course above the grout. Each pour of grout shall be stopped at least one and one-half inches (1 ½") below the top and properly stirred. The longitudinal vertical joints shall not be less than three-fourths inch (3/4") wide. Head or end joints shall be not less than one-half inch (1/2") wide.

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

Section 2407: REINFORCED BRICK MASONRY. [a] General. The compressive strength of masonry, $f_{mau}$, shall be determined by tests on masonry prisms or may be assumed to be sixty per cent (60%) of the compressive strength of the brick used with grout and Type A mortar, or forty-five per cent (45%) of the compressive strength of the brick used with grout and Type B mortar, but such assumed compressive strength shall not exceed a value of two thousand (2000) pounds per square inch or fifteen hundred (1500) pounds per square inch respectively.
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>WORKING STRESSES POUNDS PER SQUARE INCH GROSS AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TYPE A MORTAR</td>
</tr>
<tr>
<td></td>
<td>Compression</td>
</tr>
<tr>
<td>Plain Solid Brick Masonry</td>
<td></td>
</tr>
<tr>
<td>4500 lb. p. s. i.</td>
<td>250</td>
</tr>
<tr>
<td>2500 lb. p. s. i.</td>
<td>175</td>
</tr>
<tr>
<td>1500 lb. p. s. i.</td>
<td>125</td>
</tr>
<tr>
<td>Grouted Brick Masonry</td>
<td></td>
</tr>
<tr>
<td>4500 lb. p. s. i.</td>
<td>350</td>
</tr>
<tr>
<td>2500 lb. p. s. i.</td>
<td>275</td>
</tr>
<tr>
<td>1500 lb. p. s. i.</td>
<td>225</td>
</tr>
<tr>
<td>Concrete Units—Solid</td>
<td></td>
</tr>
<tr>
<td>Type A</td>
<td>175</td>
</tr>
<tr>
<td>Type B</td>
<td>125</td>
</tr>
<tr>
<td>Hollow Unit Masonry</td>
<td>85</td>
</tr>
<tr>
<td>Cavity Wall Masonry</td>
<td></td>
</tr>
<tr>
<td>Solid Units</td>
<td>125*</td>
</tr>
<tr>
<td>Hollow Units</td>
<td>60*</td>
</tr>
<tr>
<td>Stone Masonry</td>
<td></td>
</tr>
<tr>
<td>Cast Stone</td>
<td>400</td>
</tr>
<tr>
<td>Natural Stone</td>
<td>125</td>
</tr>
<tr>
<td>Gypsum Masonry</td>
<td>20</td>
</tr>
</tbody>
</table>

* Net Area.
Tests made to determine the strength $f_m$ shall be made on not less than five (5) prisms built of the material called for by design, cured in moist atmosphere for fifteen (15) days, and then allowed to dry at least thirty (30) days before testing. Tests shall be made in accordance with the procedure required for testing concrete cylinders. The prisms for beams and slabs shall be approximately eight by eight by twenty-five inches ($8'' \times 8'' \times 25''$), built in a horizontal position with unselected brick laid as stretchers in running bond, two (2) bricks wide and three (3) courses high, with one-half-inch ($\frac{1}{2}''$) joints. Prisms representing walls shall be approximately eight by sixteen inches ($8'' \times 16''$) in plan and sixteen inches ($16''$) high. Those representing columns and pedestals shall be approximately eight by eight inches ($8'' \times 8''$) in plan and sixteen inches ($16''$) high. The bonding arrangement of the brick shall be similar to that in the structures represented. The comprehensive $f_m$ value shall be the average value of all prisms tested.

Reinforcement shall conform to the requirements of Section 2604.

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

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

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

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

In reinforced masonry walls, the minimum area of reinforcement shall be not less than 0.002 times the cross-sectional area of the wall, not more than two-thirds ($2/3$) of which may be used in either direction. A lesser amount of reinforcement may be used to resist tensile stresses if the masonry is designed under limitations and stresses specified for unreinforced masonry. No required vertical reinforcement shall be less than three-eighths inch ($3/8''$) in diameter.

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

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

(b) Construction. Hollow masonry units shall have full mortar coverage of the face shells in both horizontal and vertical joints. Where two (2) or more hollow units are used to make up the thickness of the wall, the stretcher courses shall be bonded at vertical intervals not exceeding thirty-four inches ($34''$) by lapping at least three and three-fourths inches ($3 \frac{3}{4}''$) over the unit below or by lap-ping with units at least fifty per cent ($50\%$) greater in thickness than the units below at vertical intervals not exceeding seventeen inches ($17''$). Where walls of hollow masonry units are decreased in thickness, a course of solid masonry not less than four inches ($4''$) in height shall be interposed between the wall section below such point and that next above, or special units or construction shall be used to transmit adequately the loads from the shells above to those below.
<table>
<thead>
<tr>
<th>TYPE OF STRESS</th>
<th>FOR ANY STRENGTH OF BRICK MASONRY $f_m$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression—Axial</td>
<td>0.18 $f_m$</td>
</tr>
<tr>
<td>Compression—Flexural</td>
<td>0.33 $f_m$</td>
</tr>
<tr>
<td>Shear—No shear reinforcement</td>
<td>0.02 $f_m^*$</td>
</tr>
<tr>
<td>With properly designed shear reinforcement taking 2/3 of entire shear</td>
<td>0.04 $f_m^*$</td>
</tr>
<tr>
<td>Bearing</td>
<td>0.25 $f_m$</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>1000 $f_m$</td>
</tr>
<tr>
<td>Modulus of Rigidity</td>
<td>400 $f_m$</td>
</tr>
<tr>
<td>Bond Type A Grout</td>
<td></td>
</tr>
<tr>
<td>Plain Bars</td>
<td>80</td>
</tr>
<tr>
<td>Deformed Bars</td>
<td>100</td>
</tr>
</tbody>
</table>

* 1500 $f_m$ maximum.

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

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

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

Section 2409. CAVITY WALL MASONRY.

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

Cavity walls ten inches (10"") in thickness shall not exceed twenty feet (20') in height, provided, that where gable construction is used an additional ten feet (10') shall be permitted to the peak of the gable.

(b) Construction. In cavity walls neither the facing nor the backing shall be less than four inches (4") in thickness and the cavity shall be not less than two inches (2") nor more than three inches (3") in width. The facing and backing of cavity walls shall be securely tied together with suitable non-corrosive bonding ties of adequate strength. There shall be at least one three-sixteenth inch (3/16") diameter steel rod or equivalent metal tie for each three square feet (3 sq. ft.) of wall surface placed in the horizontal mortar joints of the facing and backing. Where hollow masonry units are laid with cells vertical, rectangular ties shall be used. The ends of ties shall be bent to 90-degree angles to provide hooks not less than two inches (2") long. Additional bonding ties shall be placed around the perimeter of all openings and shall be spaced not more than three feet (3') apart and within one foot (1') of the opening.
Weepholes, approximately eight feet (8') on center, shall be provided by omitting the mortar and vertical joints in the fixed wall near the floor level.

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

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

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

(b) Construction. All ashlar stone masonry shall be so laid that there is at least one (1) bond stone extending through the wall for every five (5) stretchers. Such bond stones shall be uniformly distributed throughout the wall.

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

Section 2411. GYPSUM MASONRY. (a) General. Gypsum masonry is that form of construction made with gypsum block or tile in which the units are laid and set in gypsum mortar. Gypsum masonry shall not be used in any bearing wall, or where exposed directly to the weather, or where subject to frequent and continuous wetting.

TABLE NO. 24-G
MINIMUM ULTIMATE COMpressive STRENGTH
Reinforced Gypsum

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

Tests, when required, shall follow the procedures specified in regulations issued pursuant to Section 4601.

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

For precast floor and roof slabs which cannot be analyzed in accordance with established principles of mechanics, the safe load, uniformly distributed, shall be taken as one-fifth (1/5) of the total load causing failure in a full-size test panel with the load applied
along two (2) lines each distant one-fourth (1/4) of the clear span from the support.

The minimum thickness of reinforced gypsum in floors and roofs shall be two inches (2") except in the suspension system in which the thickness shall be not less than three inches (3"). Hollow precast reinforced gypsum units for roof construction shall be not less than three inches (3") thick and the shell not less than one-half inch (1/2") thick.

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

In floor or roof slabs of the suspension type, the reinforcement shall consist of wires with continuity through multiple spans and anchored at the ends. The wires shall be supported in the top of the slab by the roof or floor beams and shall be tightly drawn down as near to the bottom of the slab at mid-span as fire protection requirements will allow, but not closer than one-half inch (1/2"). Provisions shall be made in the framing of the end bays of this system for resisting the forces due to end anchorage of the wires. The wires shall be designed for a tension in pounds per foot width of slab equal to:

\[
\frac{wL^2}{8d}
\]

WHERE

\( w \) = the total load in pounds per square foot.

\( L \) = the clear span in feet.

\( d \) = the sag of the wires in feet.

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

| TABLE NO. 24-H |
| WORKING STRESSES |
| Reinforced Gypsum |

<table>
<thead>
<tr>
<th>TYPE OF STRESS</th>
<th>WORKING STRESS (Pounds per Sq. In.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class 1</td>
</tr>
<tr>
<td>Compression—flexural</td>
<td>350</td>
</tr>
<tr>
<td>Compression—bearing</td>
<td>200</td>
</tr>
<tr>
<td>Bond (Reinforced Anchored)</td>
<td>36</td>
</tr>
<tr>
<td>Shear (Reinforced Anchored)</td>
<td>36</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

Section 2413. GLASS MASONRY. (a) General. Masonry of glass blocks may be used in any non-bearing wall if designed and constructed in conformity with this Section.

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

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

(d) Expansion Joints. Every glass block panel shall be provided with one-half-inch (1/2") expansion joints between the edges of the panel and the jambs and head.

Section 2414. FACED WALLS. (a) Materials. Materials used in the backing and facing of faced walls shall conform in all respects to the regulations issued pursuant to Section 4601. The facing shall be not less than two and one-fourth inches (21/4") thick, and in no case less in thickness than one-eighth (1/8) the height of the unit.

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

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

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

Every projecting stone and, except when alternate courses are full bond courses, every stone not a bond stone, shall be securely anchored to the backing with substantial non-corrodible metal anchors with a cross section of not less than two-tenths of a square inch (0.2-sq. in.). There shall be at least one anchor to each stone and not less than two anchors for each stone more than two feet (2') in length and three square feet (3 sq. ft.) in superficial area. Facing stones not over twelve square feet (12 sq. ft.) in area shall have at least one anchor to each four square feet (4 sq. ft.) of superficial face area.

When walls of structural clay tile or hollow concrete masonry units are faced with hollow units, the facing units shall be bonded to the backing as required by Section 2408 (b).

Facing of grouted masonry construction as specified in Section 2406 need be neither bonded nor anchored, provided the bond of grout to facing unit will develop a strength in shear of not less than fifty (50) pounds per square inch.
CHAPTER 25 — WOOD

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

No wood, other than heartwood of a durable species or wood treated by an approved preservative to be decay resistant, shall be nearer than six inches (6") to any earth unless separated by concrete at least three inches (3") thick, except as provided in Section 2204.

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

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

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

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

(b) Size Defined. Minimum sizes of lumber members required by this Code refer to nominal sizes. Dressed sizes designated in regulations issued under Section 4601 shall be accepted as the minimum net sizes conforming to nominal sizes. Computations to determine the required sizes of members shall be based on the net dimensions (actual sizes) and not the nominal sizes. If rough sizes or finish sizes are used which exceed dressed sizes designated in regulations issued under Section 4601, computations may be predicated upon such actual sizes, provided they are specified on the plans. Nominal sizes may be shown on the plans.

Section 2503. ALLOWABLE UNIT STRESSES. (a) Working Stress—General. Stresses in pounds per square inch for normal loading shall not exceed the allowable working stresses, except as hereinafter modified, for the respective species and grades set forth in Table No. 25-A, provided, however, that other stress grades may be approved, and stresses for species and grades not given in the following tables shall be established by the Chief Building Inspector in accordance with Section 4601. Stresses that exceed those set forth in Table No. 25-A for the lowest structural grade of any species shall be used only when the higher grade of that species is identified by the grade mark or, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent.

Studding, posts, joists, rafters, planks, beams, stringers, and similar load-bearing members shall be not less in grade than No. 2 Douglas fir or comparable grades in other species.

(b) Duration of Load. Where a member is subject to the maximum design loading for more than three (3) years, either continuously or cumulatively by the maximum design load, the working stresses used in the design shall not exceed ninety per cent (90%) of those permitted in Table No. 25-A.

When the duration of the full maximum load does not exceed the following periods, the allowable unit stresses set forth in Table No. 25-A may be increased as follows:

- 15 per cent for two months' duration, as for snow;
- 25 per cent for seven days' duration;
- 33 1/3 per cent for wind;
- 100 per cent for impact.

Allowable unit stresses set forth in Table No. 25-A may be used without regard to impact if the stress induced by impact does not exceed the allowable unit stress for normal loading. The above increases are not cumulative. For combined loading, the resulting structural members shall not be smaller than required for the longer duration of loading. These adjustments apply to mechanical fastenings except as otherwise noted. Adjustments for durations of load do not apply to modulus of elasticity.

(c) Conditions of Exposure. The allowable stresses in Table No. 25-A and the adjustments thereof apply to lumber used under conditions continuously dry. They apply also to lumber impregnated by an approved process and preservative and to the heartwood of a durable species under dry or other conditions of use.

Where the conditions of the above paragraphs are not met or other adequate protective measures are not taken in permanent construction, appropriate modifications of the stresses in Table No. 25-A shall be made by the Chief Building Inspector.

(d) Working Stress—Joint Details. 1. Compression. Allowable unit compression stresses perpendicular to grain set forth in Table No. 25-A shall be increased in accordance with the following factors for bearings less than six inches (6") in length and located three inches (3") or more from the end of a timber.
<table>
<thead>
<tr>
<th>SPECIES AND COMMERCIAL GRADE</th>
<th>SYMBOL:</th>
<th>ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>c or p</td>
<td>q</td>
</tr>
<tr>
<td>CYPRESS, TIDEWATER RED:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1700 f Grade</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,425</td>
</tr>
<tr>
<td>1300 f Grade</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,125</td>
</tr>
<tr>
<td>1450 c Grade</td>
<td>P.&amp;T.</td>
<td>1,450</td>
</tr>
<tr>
<td>1200 c Grade</td>
<td>P.&amp;T.</td>
<td>1,200</td>
</tr>
<tr>
<td>DOUGLAS FIR, COAST REGION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dense Select Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,550</td>
</tr>
<tr>
<td>Select Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,450</td>
</tr>
<tr>
<td>1700 f.—Dense No. 1</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,325</td>
</tr>
<tr>
<td>1450 f.—No. 1</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>1,200</td>
</tr>
<tr>
<td>1100 f.—No. 2</td>
<td>J.&amp;P.</td>
<td>1,075</td>
</tr>
<tr>
<td>Dense Select Structural</td>
<td>P.&amp;T.</td>
<td>1,550</td>
</tr>
<tr>
<td>Select Structural</td>
<td>P.&amp;T.</td>
<td>1,450</td>
</tr>
<tr>
<td>Dense No. 1</td>
<td>P.&amp;T.</td>
<td>1,400</td>
</tr>
<tr>
<td>No. 1</td>
<td>P.&amp;T.</td>
<td>1,200</td>
</tr>
<tr>
<td>HEMLOCK, EASTERN:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
<td>850</td>
</tr>
<tr>
<td>Prime Structural</td>
<td>J.&amp;P.</td>
<td>775</td>
</tr>
<tr>
<td>Common Structural</td>
<td>J.&amp;P.</td>
<td>650</td>
</tr>
<tr>
<td>Utility Structural</td>
<td>J.&amp;P.</td>
<td>600</td>
</tr>
<tr>
<td>Select Structural</td>
<td>P.&amp;T.</td>
<td>850</td>
</tr>
</tbody>
</table>
### TABLE NO. 25-A—Continued

**ALLOWABLE UNIT STRESSES FOR STRESS-GRADE LUMBER**

Normal Loading—See also Section 2503(b), (c)

<table>
<thead>
<tr>
<th>SPECIES AND COMMERCIAL GRADE</th>
<th>ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SYMBOL:</td>
</tr>
<tr>
<td>HEMLOCK, WEST COAST:</td>
<td></td>
</tr>
<tr>
<td>1600 f.—Select Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>1450 f.—No. 1</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>1100 f.—No. 2</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 1 Hemlock Timbers</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>DOUGLASFIR, INLAND REGION:</td>
<td></td>
</tr>
<tr>
<td>Select Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Common Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Common Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>LARCH:</td>
<td></td>
</tr>
<tr>
<td>Select Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Common Structural</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Select Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Common Structural</td>
<td>P.&amp;T.</td>
</tr>
</tbody>
</table>
## TABLE NO. 25-A—Continued

ALLOWABLE UNIT STRESSES FOR STRESS-GRADE LUMBER

Normal Loading—See also Section 2503(b), (c)

<table>
<thead>
<tr>
<th>SPECIES AND COMMERCIAL GRADE</th>
<th>ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SYMBOL:</td>
</tr>
<tr>
<td></td>
<td>c or p</td>
</tr>
<tr>
<td>OAK, RED AND WHITE:</td>
<td></td>
</tr>
<tr>
<td>2150 f Grade</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>1900 f Grade</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>1700 f Grade</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>1450 f Grade</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>1300 f Grade</td>
<td>B.&amp;S.</td>
</tr>
<tr>
<td>1325 c Grade</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>1200 c Grade</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>1075 c Grade</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>PINE, SOUTHERN:</td>
<td></td>
</tr>
<tr>
<td>Dense Select Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Dense Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Dense Structural S. E. &amp; S.</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Dense No. 1 Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>No. 1 Dense</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 2 Dense</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 2</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 1</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 2</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Dense Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Dense Structural S. E. &amp; S.</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Dense No. 1 Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>SPECIES AND COMMERCIAL GRADE</td>
<td>SYMBOL:</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c or p</td>
</tr>
<tr>
<td>PINE, SOUTHERN LONGLEAF:</td>
<td></td>
</tr>
<tr>
<td>Select Structural Longleaf</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Prime Structural Longleaf</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Merchantable Structural Longleaf</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Structural S. E. &amp; S. Longleaf</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>No. 1 Structural Longleaf</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>No. 1 Longleaf</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>No. 2 Longleaf</td>
<td>J.&amp;P.</td>
</tr>
<tr>
<td>Select Structural Longleaf</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Prime Structural Longleaf</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Merchantable Structural Longleaf</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Structural S. E. &amp; S. Longleaf</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>No. 1 Structural Longleaf</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>REDWOOD:</td>
<td></td>
</tr>
<tr>
<td>Dense Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Heart Structural</td>
<td>J.&amp;P.-B.&amp;S.</td>
</tr>
<tr>
<td>Dense Structural</td>
<td>P.&amp;T.</td>
</tr>
<tr>
<td>Heart Structural</td>
<td>P.&amp;T.</td>
</tr>
</tbody>
</table>

**ABBREVIATIONS:**

- J.&P.:—Joists and Planks.
- B.&S.:—Beams and Stringers.
- P.&T.:—Posts and Timbers.
Section 2505. COLUMNS. Columns, including struts and other members in compression parallel to grain, shall be designed structurally as follows:

(a) Short Columns. The safe load, in pounds per square inch of net cross-sectional area, for columns and other members stressed in compression parallel to the grain, with a ratio of unsupported length to least dimension \( l/d \) not exceeding eleven (11) (short columns), shall not exceed the allowable unit compression stress parallel to grain for short columns, as set forth in Table No. 25-A, i.e.:

\[
\frac{P}{A} = \frac{c}{1 + \left( \frac{1}{3} \right) \left( \frac{1}{Kd} \right) \left( \frac{l}{d} \right)^{3/2}}
\]

(b) Intermediate Columns. For columns with a ratio of unsupported length to least dimension greater than eleven (11) (intermediate columns), the following formula shall be used until the reduction in allowable stress equals one-third \( \frac{1}{3} \) the stress permitted for short columns:

\[
\frac{P}{A} = \frac{\pi^2 E}{36 \left( \frac{1}{d} \right)^{2}} - \frac{0.274 E}{\left( \frac{1}{d} \right)^{2}}
\]

(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:

\[
\frac{P}{A} = \frac{2c}{A} \quad K = \frac{\pi}{2} \sqrt{\frac{E}{6e}}
\]

Columns shall be limited in maximum length between points of lateral support to \( l = 50d \), except for spaced columns as specified in Section 2516.

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

\[
\frac{P/A}{M/S} = \frac{c_1}{f_1} = \frac{1}{1} \quad \text{equals or is less than 1}
\]

WHERE

\[
P = \text{total axial load (in pounds)}
\]

\[
A = \text{area (in square inches) of net cross-section}
\]

\[
c_1 = \text{allowable unit axial stress permitted for members acting solely as a column (see Table No. 25-A and Section 2505).}
\]

\[
M = \text{total bending moment in inch pounds resulting from load causing flexure}
\]

\[
S = \text{section modulus (in inches cubed) for net cross section}
\]

\[
f_1 = \text{allowable unit fiber stress in bending permitted for member (see Table No. 25-A).}
\]

Section 2507. COMPRESSION ON INCLINED SURFACES. The unit stress normal to a plane inclined to the fiber of a wood member shall not exceed that determined from the formula:

\[
n = \frac{pq}{p sin^2 \theta + q cos^3 \theta}
\]

WHERE

\[
n = \text{allowable unit stress on inclined surface, pounds per square inch}
\]

\[
p = \text{allowable compressive unit stress parallel to grain (see Table No. 25-A)}
\]

\[
q = \text{allowable compressive unit stress perpendicular to grain (see Table No. 25-A)}
\]

\[
\theta = \text{angle between the direction of the load and the direction of the grain in degrees}
\]

Section 2508. BOLTED JOINTS. (a) Design on Bolted Joints. Bolted joints wherein bolts are used to resist stresses in wood structures shall be designed in accordance with the regulations issued pursuant to Section 4601, and in addition thereto shall comply with the requirements of this Section.

(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 tama-
rack, in joints consisting of three members in which the side members are one-half \( \frac{1}{2} \) the thickness of the main member, shall not exceed values set forth in Tables No. 25-C and No. 25-D.

(c) Loads at Angle to Grain. When a force is applied by means of a bolt at an angle with the fiber of a wood member, the safe load shall be determined in accordance with the formula:

\[
n = \frac{pq}{p \sin^2 \theta + q \cos^2 \theta}
\]

**TABLE NO. 25-C
HOLDING POWER OF BOLTS
Loads Parallel to Grain (p)**

<table>
<thead>
<tr>
<th>LENGTH OF BOLT IN MAIN MEMBER* (Inches)</th>
<th>DIAMETER OF BOLT (INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \frac{1}{2} )</td>
</tr>
<tr>
<td>2</td>
<td>960</td>
</tr>
<tr>
<td>3</td>
<td>1050</td>
</tr>
<tr>
<td>4</td>
<td>1050</td>
</tr>
<tr>
<td>5</td>
<td>105f()</td>
</tr>
<tr>
<td>6</td>
<td>1640</td>
</tr>
<tr>
<td>7</td>
<td>1640</td>
</tr>
<tr>
<td>8</td>
<td>1640</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

* This assumes full size lumber, i.e., not dressed sizes.
Safe loads on dressed sizes may be obtained by interpolation.

**TABLE NO. 25-D
HOLDING POWER OF BOLTS
Loads Perpendicular to Grain (q)**

<table>
<thead>
<tr>
<th>LENGTH OF BOLT IN MAIN MEMBER* (Inches)</th>
<th>DIAMETER OF BOLT (INCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \frac{1}{2} )</td>
</tr>
<tr>
<td>2</td>
<td>460</td>
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<tr>
<td>3</td>
<td>690</td>
</tr>
<tr>
<td>4</td>
<td>810</td>
</tr>
<tr>
<td>5</td>
<td>780</td>
</tr>
<tr>
<td>6</td>
<td>1110</td>
</tr>
<tr>
<td>7</td>
<td>1060</td>
</tr>
<tr>
<td>8</td>
<td>980</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

* This assumes full size lumber, i.e., not dressed sizes.
Safe loads on dressed sizes may be obtained by interpolation.
(d) **Bolts in Other Species of Wood.** For species of wood other than those specified in Subsection (b) of this Section, bolt values shall be derived in accordance with the regulations issued pursuant to Section 4601.

(e) **Joints Other Than Double Shear.** When a joint consists of two members (single shear) of equal thickness, one-half \( \frac{1}{2} \) 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 \( \frac{1}{2} \) 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 on each side of a wood member, tabulated bolt values may be increased one-quarter \( \frac{1}{4} \) 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 \( \frac{1}{4} \).

In locations “usually wet”, tabulated bolt values shall be reduced one-third \( \frac{1}{3} \).

(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 sixty (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 \( \frac{1}{3} \).

(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 inch \( \frac{1}{16} \) larger than the bolt, in which case allowable loads shall be reduced ten per cent \( 10\% \).

(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 \( 2\frac{1}{2} \) times the bolt diameter for an \( 1/d \) ratio of two, and not less than five \( 5 \) times the bolt diameter for \( 1/d \) 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 eighty per cent \( 80\% \) for softwoods, and one hundred per cent \( 100\% \) for hardwoods, of the total area in bearing under all bolts in 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 \( 7 \) times the bolt diameter for softwoods and five \( 5 \) times for hardwoods. End margin, for members in compression, shall be not less than four \( 4 \) 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 \( 4 \) times the bolt diameter. For members loaded parallel to grain, edge margin shall be at least one and one-half \( 1\frac{1}{2} \) times the bolt diameter.

Section 2509. **TIMBER CONNECTORS.** (a) General. Timber connectors, bolted in place, may be used to transmit stress between wood members and between wood members and metal members. The allowable loads and installation of timber connectors shall conform to regulations issued pursuant to Section 4601.

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.

(b) **Tension at Net Section.** The unit stress in tension based on the minimum net section through the joint shall not exceed the allowable basic stress for compression parallel to the grain for clear material specified in regulations issued pursuant to Section 4601. The net section shall be the area of the timber, with the projected area of the embedded portion of the connection device and that portion of the area of the bolt hole not within the connector projected area, deducted.

If knots are permitted to occur at the critical section, the cross-sectional area of the knots outside the area deducted for connectors and bolts shall also be deducted in determining the net section.

Section 2510. **CYLINDRICAL PINS.** 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.
Section 2511. LAG SCREWS. Connections involving the use of lag screws shall be designed in accordance with the regulations issued pursuant to Section 4601.

Section 2512. WOOD SCREWS. (a) Shear Connections. A wood screw used to fasten a metal plate to a wooden member, or a wooden member to a wooden member, shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wood screw as set forth in Table No. 25-E. Screws shall have an embedment into the farther member of at least six-tenths (0.6) of the length of the screw. The length of the screw shall be not less than seven (7) 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-F.

A wood screw inserted parallel to the grain of the wood shall not be allowed for resisting computed tensile stresses.

Section 2513. NAILS. (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-G.

A wire nail, inserted parallel to the grain of the wood, shall not be subjected to more than three-fourths (3/4) 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-H.

Nails, inserted parallel to the grain of the wood, shall not be allowed for resisting computed tensile stresses.

(c) Spacing and Penetration. Nails shall not be driven closer together than one-half (1/2) their length unless driven in bored holes, nor closer to the edge of the timber than one-quarter (1/4) 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 (1/2) the length of the nail.

Table No. 25-E
Safe Lateral Resistance of Wood Screws
In Pounds Per Screw

<table>
<thead>
<tr>
<th>KIND OF WOOD</th>
<th>GAUGE OF SCREW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Douglas Fir</td>
<td>159</td>
</tr>
<tr>
<td>Redwood</td>
<td>124</td>
</tr>
<tr>
<td>Other Species</td>
<td></td>
</tr>
</tbody>
</table>

Table No. 25-F
Safe Resistance of Wood Screws to Withdrawal
Inserted Perpendicular to Grain of Wood,
In Pounds per Linear Inch of Screw

<table>
<thead>
<tr>
<th>KIND OF WOOD</th>
<th>GAUGE OF SCREW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Douglas Fir</td>
<td>125</td>
</tr>
<tr>
<td>Redwood</td>
<td>75</td>
</tr>
<tr>
<td>Other Species</td>
<td></td>
</tr>
</tbody>
</table>

As determined by the Chief Building Inspector.
Table No. 25-G
Safe Lateral Strength of Common Wire Nails
Inserted Perpendicular to the Grain of the Wood,
in Pounds Per Nail

<table>
<thead>
<tr>
<th>KIND OF WOOD</th>
<th>SIZE OF NAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6d 8d 10d 12d 16d 20d 30d 40d 50d 60d</td>
</tr>
<tr>
<td>LENGTH OF NAIL</td>
<td>2&quot; 2½&quot; 3&quot; 3¼&quot; 3½&quot; 4&quot; 4½&quot; 5&quot; 5½&quot; 6&quot;</td>
</tr>
<tr>
<td>Douglas Fir or Southern Pine</td>
<td>70 100 120 130 160 190 230 270 310 360</td>
</tr>
<tr>
<td>Redwood</td>
<td>58 82 98 106 123 155 188 220 250 295</td>
</tr>
<tr>
<td>Other Species</td>
<td>As determined by the Chief Building Inspector.</td>
</tr>
</tbody>
</table>

Table No. 25-H
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

<table>
<thead>
<tr>
<th>KIND OF WOOD</th>
<th>SIZE OF NAIL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6d 8d 10d 12d 16d 20d 30d 40d 50d 60d</td>
</tr>
<tr>
<td>Douglas Fir or Southern Pine</td>
<td>27 29 35 35 39 48 52 56 61 67</td>
</tr>
<tr>
<td>Redwood</td>
<td>As determined by the Chief Building Inspector.</td>
</tr>
</tbody>
</table>

Section 2514. WASHERS. 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 (0.1) 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.

Section 2515. COLUMNS OR POSTS. (a) All wood columns and posts shall extend down to supports of such design as to hold the same securely in position and to protect the 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 thickness. No wood column or post used as a beam or girder support shall be deemed adequate unless such column or post is cut to the proper length to afford true bearing.

(b) Shimming and Grouting. Where the bearing surface of a foundation wall varies not more than three-quarters of an inch, wood floor joists may be leveled with shims cut to the exact width and depth of the joist bearing surface. Metal, slate, or hardwood shims shall be used for buildings other than those housing Group I or J Occupancy. Shims of plywood or similar approved material shall be used for buildings housing Group I or J Occupancy. All shims shall be made secure.

Where the variance in the bearing surface exceeds three-quarters of an inch, the foundation wall shall be grouted to the proper height with concrete.

Where wood floor joists bear upon beams or girders, shims of the materials specified above may be used to afford true level bearing. Where beams or girders bear upon masonry or concrete piers, level bearing shall be effected by grouting such piers with dry-packed concrete.

Where pipe columns are used as girder or beam supports, any inadequacy of length shall be cured by grouting the base of the pipe column upon its usual footing with dry-packed concrete. Such column shall be so lengthened not more than one inch (1 "). No wood column or post used as a beam or girder support shall
be deemed adequate unless the post or column is cut to the proper length to afford true bearing without shimming.

(c) Protection. 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 (2) sides.

Wood posts, where used as foundations below ground and as piles (except for minor structures), shall be pressure-treated with an approved preservative.

Section 2516. BUILT-UP COLUMNS OR COMPRESSION MEMBERS. (a) Built-up Columns. The compressive strength of built-up columns or compression members, when composed of two (2) 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 eighty per cent (80 %) of the compressive strength of long columns having a slenderness ratio $l/d$ based on the least over-all dimension of the composite member.

(b) Spaced Columns. Spaced columns or compression members shall be based upon design principles specified in regulations issued pursuant to Section 4601.

Section 2517. HORIZONTAL MEMBERS. (a) End Bearing. Every beam, girder and joist shall have end bearing in accordance with compression perpendicular to grain values set forth in Table No. 25-A, but the length of end bearing shall never be less than three inches (3") on masonry or concrete, or one and one-half inches (1½") on wood or metal, except that joists when nailed to the adjacent studs shall be supported on a one-inch (1") let-in ribbon.

Wood members bearing on or in contact with masonry or concrete at or below adjacent ground level shall be treated with an approved preservative or provided with a moisture-resistant separation over bearing or contact.

(b) Vertically Laminated Members. 1. Beams. Laminated built-up beams with laminations perpendicular to the plane of the neutral axes shall be considered as having the same resistance to bending moment as solid members of the same size and area, if the laminations are not cut between the ends of the members. Joints shall be butted only over supports.

2. Slabs. A laminated lumber slab built up of planks set on edge, when meeting the following requirements, may be designed as a solid floor or roof slab of the same thickness, and continuous spans may be designed on the basis of the full cross-section using the simple span moment coefficient:

   (1) Planks shall be driven up and spiked closely together with a row of nails near each edge at spaced intervals and staggered vertically. Nail spacing in each row shall not exceed eighteen inches (18") for two-by-eight-inch (2"x8") nominal plank and be proportional for other plank widths. Nail length shall be equal to two and one half (2½) times the net plank thickness.

   (2) A single span slab shall have all planks full length.

   (3) A continuous slab of two (2) spans shall have not more than each fourth plank spliced between supports.

   (4) A continuous slab of more than two (2) spans shall have not more than each third plank spliced between supports.

   (5) Joints shall be closely butted over supports or staggered across the slab but within the adjoining quarter-spans. No plank shall be spliced more than twice in any span. (See also Section 3104).

3. Other Types. Other types of built-up members may be designed and constructed pursuant to regulations issued under Section 4601.

(c) Floor Joist Bridging. Solid wood blocking of two-inch (2") nominal thickness, wood cross bridging of not less than one inch by four inches (1"x4"), or metal cross bridging of equal strength, shall be placed between joists where the joist span exceeds eight feet (8'). The distance between lines of bridging or between bridging and bearing shall not exceed eight feet (8'). Solid blocking shall be placed between joists at all points of support and at all points where flooring is not continuous, except that bridging at bearings may be omitted when the joists are nailed to studs. The lower ends of the cross bridging shall be driven up and nailed after the floor or sub-floor has been nailed.

(d) Double Joists. Joists under and parallel to bearing partitions shall be doubled and well spiked or may be separated by solid bridging spaced at not more than four-foot (4') intervals.

(e) Special Framing. Header joists over six feet (6') long and tail joists over twelve feet (12') long shall be hung in joist or beam hangers, or secured by other devices affording...
equivalent support. Trimmers and header joists more than four feet (4') long shall be doubled. Headers shall be not less than twenty inches (20") from face of chimney breast. Trimmers and headers shall be not less than two inches (2") from the flue or chimney.

Floor joists shall be supported by girders which bear on exterior walls or partitions except floor joists heading into stair wells or similar headers shall be supported by a two by four inch (2"x4") wood strip or cleat bolted to the header.

(f) Entering Masonry or Concrete. Wood members entering masonry or concrete walls shall not be more than four inches (4") from other wood members entering from opposite side of wall nor from the exterior face of wall, except on street fronts. Ends of wood members entering masonry or concrete walls, unless treated with an approved preservative, shall be provided with a one-half inch (1/2") air space on sides, top and end. Wood members, other than beams and girders shall be beveled so that the top edges do not enter masonry or concrete.

(g) Anchors and Ties. Interior wood floor framing above the first floor that abuts or joins masonry or concrete walls shall be securely anchored thereto at not more than four foot intervals.

(h) Ceiling Joists. When the live load does not exceed 50 lbs., ceiling joists that but into headers and trimmers shall be supported on a ledger strip two by four inches (2"x4") bolted to the header.

Section 2518. WOOD IN COMBINATION WITH MASONRY OR CONCRETE. No structural masonry or concrete shall be supported by wood members except wood piling as specified in Section 2817, except that wood may be combined structurally with masonry or concrete if provision is made for the different rigidities and other properties of the materials.

Section 2519. CUTTING AND NOTCHING. Girders, beams, or joists may be notched or bored in any part of the section within three (3) times the beam depth from either support. Such notches or holes shall not exceed one-fifth (1/5) 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 shear at such point shall not exceed the value calculated by the following formula:

\[ V = \frac{2}{3} \left( \frac{bd^3H}{h} \right) \]

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.

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.

Section 2520. DEFLECTION. Wood members 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 (1/360) of the span length.

Section 2521. STUD WALLS AND PARTITIONS. (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.

(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 the stud, or other means for giving equal lateral support to the studs. Herringbone bridging may serve as fire-stopping as required in Section 2522.

(d) Size and Height. Exterior stud walls and bearing partitions for buildings of two (2) stories or less shall consist of not less than two-inch by four-inch (2"x4") studs; for buildings of three (3) 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") on centers, except that in lieu of this requirement the studs and plates may be designed as a system of columns and beams, provided structural grade material is used, or such walls may be constructed of not less than
four-inch by four-inch (4"x4") posts spaced not more than five feet (5') on centers or of larger members designed as required in this Chapter, or may be of post and beam framing with plank sheathing not less than one and one-half inches (1 ½") thick or may be of laminated construction not less than four inches (4") nominal in thickness with the structural assembly properly designed to support all loads.

One-story buildings having a total floor area of not more than four hundred square feet (400 sq. ft.) may have exterior walls of vertical one-inch (1") boards and battens without studs.

(e) Base Plates. Stud walls resting on masonry shall have base plates or sills of foundation grade Douglas fir or equivalent. Such sills shall be bolted to the masonry at corners and between corners with bolts not less than one-half inch (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 joints 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 (1/8") thick and one and one-half inches (1 ½") wide shall be fastened to the plate across and to each side of the opening with not less than four 16d nails.

(h) Chimney Space. Wood lath, furring, or framing shall be placed not less than two inches (2") from any chimney and not less than four inches (4") from the back of any fireplace.

(i) Underpinning. The underpinning of bearing stud walls shall be so constructed as to resist the design forces.

Underpinning shall be not less in size than the studding above, and when exceeding four feet (4') in height, shall be of the size required for an additional story.

No underpinning shall be less than fourteen inches (14") in height. Underpinnings of bearing walls and partitions shall be thoroughly and effectively braced.

(j) Headers. All wall openings four feet (4') wide or less shall be provided with double headers not less than two inches (2") thick, placed on edge, securely fastened together, and such headers shall have two-inch (2") solid bearing to the floor or bottom plate. All openings more than four feet (4') wide shall be trussed or provided with lintels which shall have not less than two-inch (2") solid bearing at each end to the floor or bottom plate.

Section 2522. FIRE STOPS. Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal), and form an effective fire barrier between stories, and between a top story and the roof space. It shall be used in specific locations, as follows:

1. In exterior or interior stud walls, at ceilings and floor levels.
2. In all stud walls and partitions, including furred spaces, so placed that the maximum dimension of any concealed space is not over eight feet (8').
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 in line with run of stair adjoining such partition.
5. Around top, bottom, sides, and ends of sliding door pockets.
6. In spaces between chimneys and wood framing, loose incombustible materials shall be placed in incombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.
7. Any other locations not specifically mentioned above, such as holes for pipes, shafting, etc., which could afford a passage for flames.

Fire stops when of wood shall be two-inch (2") nominal thickness. If width of opening is such that more than one piece of lumber is necessary, there shall be two thicknesses of one-inch (1") material with joints broken.

Section 2523. FOUNDATION VENTILATION.
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 ventilating openings through foundation walls or exterior walls, which openings shall be covered with a corrosion-resistant wire mesh with openings in such mesh not greater than one-half inch (1/2") nor less than one-fourth inch (1/4") in any dimension. There shall be not less than four (4) ventilating open-
ings, the minimum total area of which shall be proportioned on the basis of one-half square foot (½ sq. ft.) for each twenty-five (25) linear feet or major fraction thereof of exterior walls. 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").

Exceptions: 1. Every furnace placed in the crawl space under the floor of a house shall be installed so that the minimum distance between the bottom of the floor joists and the top of the furnace shall be six (6") inches; and such furnace shall be installed on a four inch (4") concrete slab. Such slab shall be above the level of the surrounding ground in the crawl space.

2. If such furnace is placed below the level of the surrounding ground in the crawl space, it shall be installed on a four inch (4") inch concrete slab and be protected by vertical walls and curbing which extend at least four inches (4") above the surrounding ground in the crawl space. Adequate space must be provided for servicing. Walls shall be waterproofed.

Section 2524. WOOD DIAPHRAGMS. 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 approved by the Chief Building Inspector, or the assigned values for such properties elsewhere herein provided shall be used.

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.

Section 2525. TERMITE PROVISIONS. Where termite precautions are necessary, an approved wood preservative shall be used.

Section 2526. GLUES. (a) Definitions. Glued Built-Up Sections—Structural elements consisting of wood, plywood, or combinations of the two in which the grain is not parallel and in which all pieces are bonded together with glue.

Glued Laminated Structural Lumber—Lum-ber consisting of laminations in which the grain of all laminations is approximately parallel and where all laminations are bonded together with glue.

Joint—The contact surface between two (2) adjacent pieces of wood. An "edge or face joint" is parallel to the grain of the wood. An "end or butt joint" is at right angles to the grain of the wood. A "scarf joint" is a sloping or bevel joint, where pieces of wood are lapped together.

Moisture Content—The amount by weight of water in wood computed as a percentage of the oven-dry weight of the wood.

(b) General Requirements. Glues shall provide an adequate bond, shall subject the wood to no deleterious chemical reactions, and shall not support the growth of micro-organisms under any conditions of use. Glues used in a structural assembly of wood shall conform to the provisions of this Section and Section 2527.

(c) Use. Type I glue shall be used only in the interior of buildings where the moisture content of the wood is not permitted to exceed eighteen per cent (18%).

Type II glue may be used under any conditions of exposure.

(d) Fabrication. Structural gluing shall be done only by an approved fabricator.

Section 2527. TESTS FOR GLUES. (a) General. If sufficient evidence on the type of glue to be used is not available, the Chief Building Inspector may require tests to be made as specified in this Section.

(b) Test Samples. Each test series shall consist of a minimum of nine (9) samples. One test series shall be required for each type and brand of glue to be used and each species of wood to be used.

Samples shall be prepared in accordance with regulations issued pursuant to Section 4601.

(c) Tests for Type I Glue. Test samples shall be submerged in water at room temperature for a period of forty-eight (48) hours, followed by drying at a temperature not to exceed 100 degrees Fahrenheit for a period of twenty (20) hours. This cycle shall be repeated with the drying period extending until these samples attain a moisture content not to exceed eighteen per cent (18%). Test samples shall have an average shear resistance of at least five (5) times the allowable shear stress in wood. None of the samples shall show evidence of delamination after the submersion test.

(d) Tests of Type II Glue. Three (3) test samples shall be glued for each combination of glue and species of wood to be used. Each
shall consist of six (6) laminations of clear lumber, three-fourths inch (3/4"") thick by six inches (6"") wide by fifteen inches (15"") long. The laminations shall have a moisture content between eight per cent (8%) and twelve per cent (12%) at the time of gluing. Gluing shall be done in accordance with the glue manufacturer's instructions. After gluing and before testing, the samples shall be conditioned for not less than fourteen (14) days at a room temperature not higher than 85 degrees Fahrenheit.

Not less than ten (10) standard glue joint shear blocks shall then be cut from each sample (an equal number from each glue joint) and shall be tested at a moisture content of ten per cent (10%) to twelve per cent (12%). The average shear strength value for the glue joints from the three (3) beams shall be not less than ninety per cent (90%) of the average shear strength at twelve per cent (12%) moisture for the species of wood and the average wood failure shall be not less than seventy-five per cent (75%).

A section three inches (3"") along the grain shall be cut from each test sample and shall be tested as follows:

The test samples shall be immersed in water at room temperature under a vacuum of not less than twenty inches (20") for two (2) hours. A pressure of seventy-five (75) pounds per square inch shall then be applied for two (2) hours. Relieve pressure and repeat vacuum-pressure treatment. The immersion shall be continued at atmospheric pressure for sixteen (16) hours, making total soaking period of twenty-four (24) hours. The wet samples shall then be dried in a room at a relative humidity of thirty per cent (30%) or less and a temperature of 70 to 85 degrees Fahrenheit for three (3) days with forced circulation of air, making the total soaking-drying cycle of four (4) days.

At the end of three (3) such cycles, the glue joints shall show not more than ten per cent (10%) of delamination measured on the length of the glue joint exposed on the end grain faces of the test samples.

As an alternate to the foregoing soaking-drying cycle, the specimens may be placed in water at room temperature for not less than fifteen (15) days, after which they shall be dried in a room at a relative humidity of thirty per cent (30%) or less and a temperature of 70 to 85 degrees Fahrenheit for three (3) days and with forced circulation of air, making a total soaking-drying cycle of eighteen (18) days. Repeat soaking-drying cycle twice, for a total of three cycles (54 days).

(e) Shear Test Procedure. The shear test shall conform to regulations issued pursuant to Section 4601.

Section 2528. GLUED CONSTRUCTION. (a) General. Glued laminated lumber and built-up sections shall be constructed as required by this Section.

Exception: Subsections (b) and (c) of this Section shall not apply to glued laminated lumber in which the allowable working stresses do not exceed those specified in Section 2503.

(b) Laminations. In members subject to bending stresses, all laminations shall be approximately parallel to the neutral plane of the beam. Members shall consist of three (3) or more laminae.

(c) Thickness. Individual laminations shall be not more than two inches (2") in thickness.

(d) Variation in Laminae. Adjacent laminae shall not differ by more than thirty-five per cent (35%) in allowable stress, and all lumber shall be stress graded.

(e) Grading. Lumber shall be stress graded. In members for exterior use, the diameter of any knot appearing at a glue joint on a face of the member shall be limited to one inch (1").

(f) Moisture Content. The maximum moisture content of the wood at the time of gluing shall not exceed eighteen per cent (18%) and shall not be less than seven per cent (7%). No lamina shall have a moisture content differing by more than three per cent (3%) from the average moisture content of the assembly.

(g) Surfaces. Surfaces to be glued shall be free from dust, dirt, and grease. Individual laminae shall have machined surfaces with a maximum tolerance of one-sixty-fourth inch (1/64"). Lumber surfaces shall not be sanded before gluing.

Section 2529. ALLOWABLE STRESSES AND DESIGN IN GLUED CONSTRUCTION. (a) General. The allowable stresses in glued laminated structural lumber shall be as specified in this Section. Whenever glued laminated lumber is an integral part of glued built-up sections, it shall conform to all requirements and be subject to the same working stresses provided for glued laminated lumber in this Chapter. Stresses used to design the plywood members of glued built-up sections shall not exceed the values specified in Section 2503 (e).

(b) Columns. The formulas used in the design of solid wood columns shall apply to the design of glued laminated lumber columns.

(c) Compression. The allowable axial compressive stress parallel to the grain permitted in Section 2503 shall be increased forty per cent (40%) for glued laminated lumber of the same stress grade. Where the member is composed of laminations having different stress grades,
the compressive strength of the lowest stress grade shall govern.

The allowable compressive stress perpendicular to the grain shall be the same for glued laminated lumber as for solid lumber of the same stress grade.

(d) Flexure. The allowable extreme fiber stresses in bending may be increased twenty per cent (20%). When the lumber in the middle three-fifths (3/5) of the depth of cross-section in a glued laminated beam is of lower grade, the allowable unit stresses in bending for the grade in the outer two-fifths (2/5) shall apply without increase.

(e) Combined Bending and Compression. Combined bending and compression shall be determined according to Section 2506.

(f) Tension. Axial tension may be increased twenty per cent (20%) over that allowable for solid lumber of the same grade. Tension perpendicular to the grain shall be one-seventh (1/7) of the allowable compressive stress perpendicular to the grain.

(g) Shear. Horizontal shear shall be the greatest allowable unit shear allowed for lumber in this Code for a given species.

(h) Curved Portions. In curved portions, the allowable unit stress in bending shall be modified by multiplication by the following factor:

\[
1 - \frac{t^2}{2000 - \frac{r}{t}}
\]

WHERE

\(t\) = thickness of lamination in inches.
\(r\) = radius of curvature in inches.

All end joints in the laminations where the radius of curvature is less than one hundred and fifty (150) times the thickness of the laminations shall be scarfed.

(i) Allowable Stresses on Joints. For purposes of design, wood shall be assumed to be continuous across the edge of a face joint or across a scarf joint. End joints, and scarf joints sloping more than one (1) to twelve (12), shall not be assumed to carry stress.

(j) Scarfed Joints. In that portion of glued laminated lumber which is stressed to more than one-half (1/2) of its allowable axial stress, the end joints in lamination shall be scarfed. All scarfed joints shall approximate the slope of the grain of the lumber and shall be in the same general direction as the slope of the grain, but shall not be required to be flatter than one (1) to twelve (12).

Section 2530. STRESSED SKIN PANEL DESIGN. Stressed skin panels shall be designed in accordance with regulations issued pursuant to Section 4601.
CHAPTER 26 — CONCRETE

Reinforced Concrete

Section 2601. QUALITY. Concrete and materials used in concrete shall meet established technical standards of quality and strength required to produce safe structures. For specifications, see Section 4601.

Section 2602. DESIGN. The design of reinforced concrete shall conform to the rules and principles specified in this Chapter.

Section 2603. DEFINITIONS. The following definitions give the meaning of certain terms as used in this Chapter.

Aggregate—Inert material which is mixed with portland cement and water to produce concrete.

Column—An upright compression member, the length of which exceeds three (3) times its least lateral dimension.

Concrete—A mixture of portland cement, fine aggregate, coarse aggregate, and water.

Deformed Bar—A reinforcing bar conforming to the "Standard Specifications for Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement" (ASTM Designation: A305). Bars not conforming to these specifications shall be classed as plain bars. Wire mesh with welded intersections not farther apart than six inches (6") 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.

Effective Area of Concrete—The area of a section which lies between the centroid of the tensile reinforcement and the compression face of a flexural member.

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.

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.

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.

Pedestal—An upright compression member whose height does not exceed three (3) times its least lateral dimension.

Plain Concrete—Concrete without metal reinforcement, or reinforced only for shrinkage or temperature changes.

Pneumatically Placed Concrete—A mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator. It shall be considered as concrete for particulars of design as specified in this Chapter.

Portland Cement—The product obtained by finely pulverizing clinker consisting essentially of hydraulic calcium silicate, to which no additions have been made subsequent to calcination other than water or untreated calcium sulfate, except that additions not to exceed 1.0 per cent of other materials may be interground with the clinker at the option of the manufacturer, provided, such materials in the amounts indicated have been shown to be not harmful by tests.

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 member 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.

Section 2604. MATERIALS. (a) Portland Cement. For specifications of portland cement, see Section 4601.

(b) Concrete Aggregates. For specifications of concrete aggregates, including lightweight aggregates, and for specifications for methods of sampling and testing, see regulations issued pursuant to Section 4601. Aggregates that do not meet the specifications in Section 4601, but which 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 Chief Building Inspector.
The maximum size of the aggregate shall be not larger than one-fifth (1/5) of the narrowest dimension between forms of the member for which the concrete is to be used nor larger than three-fourths (3/4) 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. For specifications of metal reinforcement, see Section 4601.

All reinforcement bars lacking grade identification marks shall on delivery be accompanied by a manufacturer's guarantee of grade which will identify variations.

(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 deteriorated or has been damaged shall be immediately and completely removed from the work.

Section 2605. TESTS. On concrete work, the Chief 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 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 Chief 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 an approved agency, and copies of the results shall be kept on file in the office of the Chief Building Inspector for a period of not less than two years after the acceptance of the structure. 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 twenty-four (24) hours after the removal of the load the slabs or beams show a recovery of at least seventy-five per cent (75%) of the observed deflection.

Section 2606. QUALITY OF CONCRETE. For the design of concrete structures, the value of $F_0$ 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.

All concrete exposed to freezing and thawing weather shall have a minimum ultimate 28-day compressive strength of not less than three thousand (3,000) pounds per square inch.

The determination of the proportions of cement, aggregate, and water to attain the required strengths shall be made by one of the following methods:

Method 1—Concrete made from average materials—When no preliminary tests of the materials to be used are made, the water-content per sack of cement shall not exceed the values set forth in Table No. 26-A. Method 2 shall be employed when artificial aggregates or admixtures are used.
### TABLE 26-A—ASSUMED STRENGTH OF CONCRETE MIXTURES

<table>
<thead>
<tr>
<th>WATER-CONTENT U. S. GALLONS PER 94-LB. SACK OF CEMENT</th>
<th>ASSUMED COMPRESSIVE STRENGTH AT 28 DAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. S. Gallons</td>
<td>Pounds Per Square Inch</td>
</tr>
<tr>
<td>7 1/2</td>
<td>2000</td>
</tr>
<tr>
<td>6 3/4</td>
<td>2500</td>
</tr>
<tr>
<td>6</td>
<td>3000</td>
</tr>
<tr>
<td>5</td>
<td>3750</td>
</tr>
</tbody>
</table>

**Method 2 — Controlled Concrete**— Water-contents other than those set forth in Table No. 26-A may be used provided that the strength-quality of the materials proposed for use in the structure shall be established by tests which shall be made in advance of the beginning of operations, using the consistencies suitable for the work and in accordance with the standard methods specified under Section 4601. A curve representing the relation between the water-content and the average 28-day compressive strength or earlier strength at which the concrete is to receive its full working load, shall be established for a range of values including all the compressive strengths called for on the plans. The curve shall be established by at least three (3) points, each point representing average values from at least four (4) test specimens. The water-content used in the concrete for the structure as determined from the curve, shall correspond to a strength which is fifteen per cent (15%) greater than that called for on the plans. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

**Section 2607. PROPORTIONS AND CONSISTENCY.** 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 thirty per cent (30%) nor greater than fifty per cent (50%) of the total unless otherwise required by the Chief Building Inspector, except that these proportions do not necessarily apply to light-weight aggregates.

For specifications of the measurement of materials for ready mixed concrete, see regulations issued pursuant to Section 4601.

Admixtures of lime or finely pulverized inert materials may be added but not in excess of six per cent (6%) by volume of the cement used.

**Section 2608. CONTROL OF PROPORTIONS.**

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 Chief Building Inspector or his authorized representative. A tolerance of one-fourth (1/4) gallon of water per sack of cement in any batch of concrete will be allowed, provided, that the average for any ten (10) consecutive batches does not show a water content greater than that set forth in Table No. 26-A, or 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.

**Section 2609. MIXING AND PLACING CONCRETE.**

(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 specifications set forth pursuant to Section 4601.

(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.) Reinforcements 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 Chief Building Inspector.

(c) **Removal of Water from Excavations.** Water shall be removed from excavations before concrete is deposited, unless otherwise directed by the Chief Building Inspector.
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 re-handling 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 and without separation of the materials.

(e) Placing. Concrete shall be thoroughly compacted with suitable tools. Where 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 (7) days after being deposited for ordinary cement and three (3) days for high-early-strength cement.

(g) Depositing in Cold Weather. Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers, and ground with which the concrete is to come in contact, shall be free from frost. Wherever the temperature of the surrounding air is below 40 degrees Fahrenheit, all concrete when placed in the forms shall have a temperature of between 60 and 90 degrees Fahrenheit, and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least seventy-two (72) hours for normal concrete or twenty-four (24) hours for high-early-strength concrete, or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering, or other protection used in connection with curing shall remain in place and intact for at least twenty-four (24) hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing. Manure, when used for protection, shall not be applied directly to concrete.

(h) Bonding Fresh and Hardened Concrete. Before new concrete is deposited on or against concrete which has set, the forms shall be re-tightened, the surface of the set concrete shall be roughened, cleaned of foreign matter and laitance and thoroughly wetted but not saturated. The clean and wetted surfaces of the hardened concrete, including vertical and inclined surfaces, shall be slushed with a coating of neat cement grout against which the new concrete shall be placed before the grout has attained its set. For walls and columns, the grout may be omitted on the horizontal surfaces, but a layer of mortar having the composition of the mortar in the concrete shall be placed before resuming concreting.

Section 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.

Temporal openings shall be provided at the base of column and wall forms, and at other points where necessary, to facilitate cleaning and inspection. Complete forms shall be used on both sides of all continuous concrete foundation walls.

(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 Chief 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, except hooks, shall be made around a pin having a diameter not less than six (6) times the minimum thickness of the bar, except that for bars larger than one inch (1"), the pin shall be not less than eight (8) times the minimum thickness of the bar. All bars shall be bent cold.
(d) **Placing Reinforcement.** Metal reinforcement shall be accurately placed and adequately secured in position by concrete or metal and shall be supported by chairs or spacers. The minimum clear distance between parallel bars except in columns shall be equal to the nominal diameter of the bars. In no case shall the clear distance between bars be less than one inch (1") nor less than one and one-third (1 1/3) times the maximum size of the course aggregate. Where reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall be not less than one inch (1"), and the bars in the upper layers shall be placed directly above those in the bottom layer.

When wire or other reinforcement not exceeding one-fourth inch (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.

(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 Chief 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 in contact and wired together and the minimum distance specified in subsection (d) of this Section shall be maintained between bars or between wired splices and adjacent bars or splices.

Where changes in the cross section of a column occur, the longitudinal bars shall be offset in a region where lateral support is afforded. Where offset, the slope of the inclined portion shall not be more than one in six, 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 4303.

Exposed reinforcement bars intended for bonding with future extensions shall be protected from corrosion.

(g) **Construction Joints.** Joints not indicated on the plans shall be so made and located as least to impair the strength of the completed structure. Where a joint is to be made, any excess water and laitance shall be removed from the surface after concrete is deposited. Before depositing of concrete is resumed the hardened surface shall be treated as specified in Section 2609 (h).

At least two (2) 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 of the 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. In this last case, provisions shall be made for shear by use of inclined reinforcement.

Unless the member is especially designed, 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 imbedded 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 (4%) of the area of the cross section. Sleeves or other pipes passing through floors, walls, or beams shall not be of such size or in such location as unduly to impair the strength of the construction; such sleeves or pipes may be considered as replacing structurally the displaced concrete, provided, they are not exposed to rusting or other deterioration; are of uncoated iron or steel not thinner than standard wrought-iron pipe; have a nominal inside diameter not over two inches (2"), and are spaced not less than three (3) diameters on centers. Embedded pipes or conduits, other than those merely passing through, shall not be larger in outside diameter than one-third (1/3) the thickness of the slab, wall, or beam in which they are imbedded; shall not be spaced closer than three (3) 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.

Section 2611. ASSUMPTIONS FOR DESIGN. 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.

Section 2612. SYMBOLS AND NOTATIONS.

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

- $\phi =$ Angle between inclined web bars and axis of beam.
- $A_r =$ 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 section or width of flange of T or I sections.
- $b'$ = Width of web of I or T sections.
- $C =$ Ratio of permissible concrete fiber stress in axially loaded column to permissible fiber stress in flexure.
- $d =$ Depth from compression face of beam or slab to centroid of longitudinal tensile reinforcement.
- $e =$ Eccentricity of the resultant load on a column, measured from the gravity axis.
- $E_c =$ 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.).
- $f_c =$ Compressive unit stress in extreme fiber of concrete in flexure.
- $f'_c =$ Ultimate compressive strength of concrete usually at age of 28 days. (See Section 2606.)
- $f_s =$ Tensile unit stress in web reinforcement.
- $I =$ 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).
- $n =$ Ratio of modulus of elasticity of steel to that of concrete $= \frac{E_s}{E_c}$
- $\Sigma =$ Sum of perimeters of bars in one set.
- $R =$ Least radius of gyration of a section.
- $s =$ Spacing of stirrups or of bent bars in a direction parallel to that of the main reinforcement.
- $t_1 =$ Thickness of flat slab without drop panels, or the thickness of flat slab through the drop panels where such are used.
- $t_2 =$ Thickness of flat slab (with drop panels) at points outside the drop panel.
- $u =$ 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 per unit area of slab.

Section 2613. ALLOWABLE UNIT STRESSES IN REINFORCEMENT. The unit stresses in pounds per square inch on concrete to be used in the design shall not exceed the values set forth in Table No. 26-B where $f'_c$ equals the minimum ultimate compressive strength at 28 days, or at the earlier age at which the concrete may be expected to receive its full load.

The following unit stresses in reinforcing steel shall not be exceeded:

In Tension:
- Intermediate and hard grade billet or axle steel, rail steel, and cold drawn wire .......... 20,000 p.s.i.
- Structural grade bars and structural steel shapes .......... 18,000 p.s.i.
- For one-way slabs not exceeding 12 feet in span, steel reinforcement not exceeding 3/8 inch in diameter, 50 per cent of the minimum yield point specified in the standards set forth under Section 4601 for the particular kind and grade of steel used, but in no case to exceed ......................... 30,000 p.s.i.

In Compression:
- Structural steel section in composite columns ...................... 16,000 p.s.i.
- Cast-iron section in composite columns ............................ 10,000 p.s.i.

Section 2614. FLEXURAL COMPUTATIONS. 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 loads does not exceed three
(3) times the intensity of dead load, this is satisfied essentially by the following values:

Negative moment at face of first interior support:

For beams and girders and for slabs exceeding ten feet (10'):  
1 Two spans — \( wL^2 \)
8
1 More than two spans — \( wL^2 \)
10

For slabs not exceeding 10 feet in span:
1 Two spans — \( wL^2 \)
10
1 More than two spans — \( wL^2 \)
12

Negative moment at face of other interior supports:
1 More than two spans — \( wL^2 \)
12

Positive moment at center of span:
1 End spans — \( wL^2 \)
10
1 Interior spans — \( wL^2 \)
12

Shear in end members at
first interior support 1.20 — \( wL^2 \)
2
Shear at other supports — \( wL^2 \)
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 twenty per cent (20%). 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.

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 (3) times the slab thickness.

8. 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.

9. In structural 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: \( .0025 \text{ bd} \)

For steel having a minimum yield point of 50,000 lbs. per sq. in.: \( .002 \text{ bd} \)
### TABLE NO. 26-B

**ALLOWABLE UNIT STRESSES IN CONCRETE**

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ALLOWABLE UNIT STRESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For Any Strength of Concrete as Fixed by Test in Accordance with Sec. 2606</td>
</tr>
<tr>
<td></td>
<td>$f'_c$ = 2000 p.s.i.</td>
</tr>
<tr>
<td></td>
<td>$n = 30000$</td>
</tr>
</tbody>
</table>

| Flexure: $f_c$ | $f_c$ | 0.45$f'_c$ | 900 | 1125 | 1350 | 1688 |
| Extreme fiber stress in compression | | | | | |
| Extreme fiber stress in tension in plain concrete footings | $f_c$ | 0.03$f'_c$ | 60 | 75 | 90 | 113 |
| Shear: $v$ | $v_c$ | 0.03$f'_c$ | 60 | 75 | 90 | 113 |
| Beams with no web reinforcement | | | | | |
| Beams with properly designed web reinforcement | $v$ | 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** | $v_c$ | 0.03$f'_c$ | 60 | 75 | 75 | 75 |

| Bond: $u$ | $u$ | 0.07$f'_c$ but not to exceed 75 p.s.i. | 140 | 175 | 210 | 245 |
| Deformed bars | | | | | |
| Top bars | $u$ | 0.08$f'_c$ but not to exceed 245 p.s.i. | 160 | 200 | 240 | 280 |

**In 2-way footings (except top bars)** | $u$ | 0.10$f'_c$ but not to exceed 350 p.s.i. | 200 | 250 | 300 | 350 |

| All others | $u$ | 0.045$f'_c$ but not to exceed 158 p.s.i. | 72 | 90 | 108 | 126 |

| Plain Bars | $u$ | 0.03$f'_c$ but not to exceed 105 p.s.i. | 60 | 75 | 90 | 105 |
| Top bars (hooked) | | | | | |

| In 2-way footings (except top bars) | $u$ | 0.036$f'_c$ but not to exceed 126 p.s.i. | 72 | 90 | 108 | 126 |

| All others | $u$ | 0.045$f'_c$ but not to exceed 158 p.s.i. | 90 | 113 | 135 | 158 |

| Bearing: $f_c$ | $f_c$ | 0.25$f'_c$ | 500 | 625 | 750 | 938 |
| On full area | | | | | |
| On one-third area or less § | $f_c$ | 0.375$f'_c$ | 750 | 938 | 1125 | 1405 |

| Pedestals (See Sec. 2621e) | $f_c$ | 0.25$f'_c$ | 500 | 625 | 750 | 938 |

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

* See Section 2617(g).
** See Sections 2617(h), 2618(e) and 2624(e).
† Top bars are horizontal bars so placed that more than twelve inches (12") of concrete is cast in the member below the bar.
§ The allowable bearing stress on an area greater than one-third ($\frac{1}{3}$) but less than the full area shall be interpolated between the values given.
(b) Distance between Lateral Supports. The clear distance between lateral supports of a beam shall not exceed thirty-two (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 member. 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 (1/2") over that required by the design of the member.

(d) Requirements for T-Beams. 1. In T-beam construction the slab and beam shall be built integrally or otherwise effectively bonded together. The effective flange width to be used in the design of symmetrical T-beams shall not exceed one-fourth (1/4) of the span length of the beam, and its overhanging width on either side of the web shall not exceed eight (8) times the thickness of the slab nor one-half (1/2) 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 (1/12) of the span length of the beam, nor six (6) times the thickness of the slab nor one-half (1/2) 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 (5) 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 (1/2) the width of the web and a total flange width not more than four (4) 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 (3) times the width.

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 portions of the fillers may be included in the design calculations.

3. The concrete slab over the fillers shall not be less than one and one-half inches (1 1/2") in thickness, nor less in thickness than one-twelfth (1/12) of the clear distance between ribs. Shrinkage reinforcement in the slab shall be provides as specified in Section 2615.

4. Where removable forms or fillers, not complying with paragraph 2 of this subsection, are used, the thickness of the concrete slab shall not be less than one-twelfth (1/12) 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 fifty (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 (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 overall depth of such conduits or pipes at any point. Such conduits or pipes shall be so located as not to impair the strength of the construction.

(f) Compression Steel in Flexural Members. Compression steel in beams, girders, or slabs shall be anchored by ties or stirrups not less than one-fourth inch (1/4") in diameter, spaced no farther apart than sixteen (16) bar diameters or forty-eight (48) tie diameters. Such ties or stirrups shall be used throughout the distance where compression steel is required.

The effectiveness of compression reinforcement in resisting bending may be taken at twice the value indicated from calculations assuming a straight line relation between stress and strain and the modular ratio given in Section
2611, but not of greater value than the allowable stress in tension.

Section 2615. SHRINKAGE AND TEMPERATURE REINFORCEMENT. 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 \((5)\) 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

Section 2616. TWO-WAY SLABS. (a) General. This construction, consisting of floors reinforced in two directions and supported on four sides, includes solid reinforced concrete slabs, concrete joists with fillers of hollow concrete units or clay tile, with or without concrete top slabs; and, concrete joists with top slabs placed monolithically with the joists. The slab shall be supported by walls or beams on all sides and if not securely attached to supports, shall be reinforced as specified in subsection (b).

(b) Reinforcement. Where the slab is not securely attached to the supporting beams or walls, special reinforcement shall be provided at exterior corners in both the bottom and top of the slab. This reinforcement shall be provided for a distance in each direction from the corner equal to one-fifth \((1/5)\) the longest span. The reinforcement in the top of the slab shall be parallel to the diagonal from the corner. The reinforcement in the bottom of the slab shall be right angles to the diagonal or may be of bars in two directions parallel to the sides of the slab. The reinforcement in each band shall be of equivalent size and spacing to that required for the maximum positive moment in the slab.

(c) Design. The slab and its supports shall be designed by approved methods which shall take into account the effect of continuity at supports, the ratio of length to width of slab and the effect of two-way action.

(d) Slab Thickness. In no case shall the slab thickness be less than four inches \((4")\) nor less than the perimeter of the slab divided by one hundred and eighty \((180)\). The spacing of reinforcement shall be not more than three \((3)\) times the slab thickness and the ratio of reinforcement shall be at least 0.0025.

(e) Details. The details of design of two-way slabs shall conform to the requirements set forth in Section 4601.

Section 2617. SHEAR AND DIAGONAL TENSION. (a) Shearing Unit Stress. The shearing unit stress \(v\) in reinforced concrete flexural members shall be computed by formula \((2)\):

\[ v = \frac{V}{bd} \]  

For beams of I or T section \(b'\) shall be substituted for \(b\) in Formula \((2)\).

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 \((2)\) exceeds the shearing unit stress \(v_d\) permitted on the concrete of an unreinforced web (see Section 2613), web reinforcement shall be provided to carry the excess.

(b) Types of Web Reinforcement. Web reinforcement may consist of:

1. Stirrups or web reinforcement bars perpendicular to the longitudinal steel.

2. Stirrups or web reinforcement bars welded or otherwise rigidly attached to the longitudinal steel and making an angle of 30 degrees or more thereto.

3. Longitudinal bars bent so that the axis of the inclined portion of the bar makes an angle of 15 degrees or more with the axis of the longitudinal portion of the bar.

4. Special arrangements of bars with adequate provisions to prevent slip of bars or splitting of the concrete by the reinforcement (See Subsection (d), last paragraph).

Stirrups or other bars to be considered effective as web reinforcement shall be anchored at both ends, according to the provisions of Section 2618.

(c). Stirrups. The area of steel required in stirrups, placed perpendicular to the longitudinal...
inal reinforcement shall be computed by Formula (3).

\[ A_v = \frac{V'}{f'c d} \]  \hspace{1cm} \text{(3)}

Inclined stirrups shall be proportioned by Formula (5).

Stirrups placed perpendicular to the longitudinal reinforcement shall not be used alone as web reinforcement when the shearing unit stress \( v \) exceeds 0.08\( f'c \).

(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 (4).

\[ A_v = \frac{V' \sin \alpha}{f'c d (\sin \alpha + \cos \alpha)} \]  \hspace{1cm} \text{(4)}

In Formula (4) \( V' \) shall not exceed 0.040\( f'c \) \( b/d \).

Only the center three-fourths (3/4) 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 (5).

\[ A_v = \frac{V'}{f'c d (\sin \alpha + \cos \alpha)} \]  \hspace{1cm} \text{(5)}

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 0.060\( f'c \). This shearing unit stress may be increased at the rate of 0.01\( f'c \) for each increase of four bar diameters in the radius 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.

(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 \( \frac{2 V'}{3} \).

(f) **Spacing of Web Reinforcement.** Where web reinforcement is required it shall be so spaced that every 45-degree line (representing a potential crack) extending from the mid-depth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement. If a unit shearing stress in excess of 0.06\( f'c \) is used, every such line shall be crossed by at least two such lines of web reinforcement.

(g) **Shearing Stress in Flat Slabs.** In flat slabs, the shearing unit stress on a vertical section which lies at a distance \( t \)—1 1/2 inches beyond the edge of the column capital and parallel with it, shall not exceed the following values when computed by Formula (2) (in which \( d \) shall be taken as \( t \)—1 1/2 inches):

1. 0.03\( f'c \) when at least fifty per cent (50%) of the total negative reinforcement in the column strip passes directly over the column capital.
2. 0.025\( f'c \) when twenty-five per cent (25%) 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 1/2 inches beyond the edge of the dropped panel and parallel with it shall not exceed 0.03\( f'c \) when computed by Formula (2) in which \( d \) shall be taken as \( t \)—1 1/2 inches. At least fifty per cent (50%) 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 (2) on the critical section (see Section 2621 (d)), shall not exceed 0.02\( f'c \) for footings with straight bars, nor 0.03\( f'c \) for footings in which the bars are anchored at both ends by adequate hooks or as otherwise specified in Section 2618.

Section 2618.—**BOND AND ANCHORAGE.**

(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 (6).

(b) **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, whether required for positive or negative reinforcement, shall be extended at least twelve (12) diameters beyond the point at which it is no longer needed to resist stress. The maximum tension in any bar must be developed by bond on a sufficient straight or bent embedment or by other anchorage. If preferred, the bar may be bent across the web at an angle of not less than 15 degrees with the longitudinal portion of the bar and be made continuous with the reinforcement which resists moment of opposite sign.

Of the positive reinforcement in continuous beams not less than one-fourth (1/4) the area shall extend along the same face of the beam into the support a distance of six (6) inches.

In simple beams, or at the freely supported end of continuous beams, at least one-third (1/3) the required positive reinforcement shall extend along the same face of the beam into the support a distance of six (6) inches.

(c) Plain Bars in Tension. 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 above or below the mid-depth of the beam on the compression side, a distance sufficient to develop the stress to which the bar will be subjected at a bond stress of not to exceed 0.045f'c on plain bars nor 0.10f'c on deformed bars.

4. Standard hook, considered as developing 10,000 pounds per square inch, plus embedment sufficient to develop by bond the remainder of the stress to which the bar is subjected. The unit bond stress shall not exceed that set forth in Table No. 26-B. The effective embedded length shall not be assumed to exceed the distance between the mid-depth of the beam and the tangent of the hook.

The extreme ends of bars forming Simple U or multiple stirrups shall be anchored by one of the methods of Sub-section (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 twelve (12) diameters of the stirrup bar.

The loops or closed ends of such stirrups shall be anchored by bending around the longitudinal reinforcement through an angle of at least 90 degrees, or by being welded or otherwise rigidly attached thereto. Hooking or bending stirrups or separate web reinforcement bars around the longitudinal reinforcement shall be considered effective only when these bars are perpendicular to the longitudinal reinforcement.

Longitudinal bars bent to act as web reinforcement shall, in a region of tension, be continuous with the longitudinal reinforcement. The tensile stress in each bar shall be fully developed in both the upper and the low 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 0.045f'c on plain bars nor 0.10f'c on deformed bars, plus a bend of radius not less than two times the diameter of the bar, plus an extension of the bar parallel to the upper or lower surface of the beam, of not less than twelve (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 0.045f'c on plain bars nor 0.10f'c on deformed bars, plus a bend of radius not less than twice the diameter of the bar, plus an extension of the bar, parallel to the upper or lower surface of the beam, of not less than twelve (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.

V. The tensile unit stress at the beginning of a bend may be increased from 10,000 pounds per sq. inch when the radius of the bend is two bar diameters, at the rate of 1,000 pounds per sq. inch tension for each increase of one and one-half (1 1/2) bar diameters in the radius of the 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 Sub-section (d) III.

In all cases web reinforcement shall be carried as close to the compression surface of the beam as fireproofing regulations will permit.

Section 2619. FLAT SLABS. (a) Scope. The term "flat slab" shall mean a reinforced concrete slab supported by columns with or without flaring heads or column capitals, with or without depressed or drop panels and generally without beams or girders. Recesses or pockets in flat slab ceilings, located between reinforcing bars and forming cellular or two-way ribbed ceilings, whether left open or filled with perma-
nent fillers, shall not prevent a slab from being considered a flat slab; but allowable unit stresses shall not be exceeded.

(b) Design of Flat Slabs as Continuous Frames. Any type of flat slab construction may be designed by application of the principles of continuity.

(c) Design of Flat Slabs by Moment Coefficients. Arbitrary coefficients may be used when the construction conforms with the following:

1. The ratio of length to width of panel does not exceed 1.33.
2. The slab is continuous for at least three panels in each direction.
3. The successive span lengths in each direction differ by not more than twenty per cent (20%) of the shorter span.

(d) Details. The details of the design and construction of flat slabs shall conform to the requirements set forth in Section 4601.

Section 2620. REINFORCED CONCRETE COLUMNS AND WALLS. (a) Limiting Dimensions. The following subsections on reinforced concrete and composite columns except Subsection (g) apply to a short column, for which the unsupported length is not greater than ten (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 unreinforced 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. 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 (7).

\[
P = A_e \left(0.225 f_c + f_e p_e \right)
\]

WHERE

A_e = the gross area of the column.

f_c = compressive strength of the concrete.
f_e = nominal working stress in vertical reinforcement, to be taken at forty per cent (40%) 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_e = ratio of the effective cross-sectional area of vertical reinforcement to the gross area, A_e.

2. Vertical Reinforcement. The ratio \(p_e\) 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 (5/8"). The center to center spacing of bars within the periphery of the column core shall be not less than two and one-half times the diameter for round bars or three times the side dimension for square bars. The clear spacing between bars shall be not less than one and one-half inches (1 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.

Nominal working stresses for reinforcement of higher yield point may be established at forty per cent (40%) 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. If this is done, the lengths of splice required by Section 2620 (c) shall be increased accordingly.
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 an ultimate strength of 3,000 pounds per square inch or above, twenty (20) diameters of bar of intermediate or hard grade steel. For bars of higher yield point, the amount of lap shall be increased one (1) diameter for each 1,000 p.s.i. by which the allowable stress exceeds 20,000 p.s.i. When the concrete strengths are less than 3,000 pounds per square inch for concrete strengths greater than the values given above.

II. For plain bars the minimum amount of lap shall be twice 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-half inches (1 1/2"). 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 longitudinal bars are offset at a splice, the slope of the inclined portion of the bar with the axis of the column shall not exceed 1 in 6, and the portions of the bar above and below the offset shall be parallel to the axis of the column. Adequate horizontal support at the offset bends shall be treated as a matter of design, and may be provided by metal ties, spirals or parts of the floor construction. Metal ties or spirals so designed shall be placed near (never more than 8 bar diameters from) the point of bend. The horizontal thrust to be resisted may be assumed as 1 1/2 times the horizontal component of the nominal stress in the inclined portion of the bar.

Offset bars shall be bent before they are placed in the forms. No field bending of bars partially embedded in concrete shall be permitted.

4. Spiral Reinforcement. The ratio of spiral reinforcement (p'), shall be not less than the value given by Formula (8).

\[
p' = 0.45 \frac{p_e}{f_s} \tag{8}
\]

WHERE

\[
p' = \text{ratio of volume of spiral reinforcement to the volume of the concrete core (out to out of spirals)}.
\]

\[
R = \text{ratio of gross area to core area of column, } A_g/A_c.
\]

\[
f_s = \text{useful limit stress of spiral reinforcement, to be taken as 40,000 pounds per square inch for hot rolled rods of intermediate grade, 50,000 pounds per square inch for hard grade, and 60,000 pounds per square inch for cold drawn wire.}
\]

The spiral reinforcement shall consist of evenly spaced continuous spirals held firmly in place and true to line by vertical spacers using at least two for spirals twenty inches (20") or less in diameter, three for spirals twenty inches (20") to thirty inches (30") in diameter and four for spirals more than thirty inches (30") in diameter or composed of spiral rods five-eighths inch (5/8") or larger in size. The spirals shall be of such size and so assembled as to permit handling and placing without being distorted from the design dimensions. The material used in spirals shall have a minimum diameter of one-fourth inch (1/4") for rolled bars or No. 4 W. & M. gauge for drawn wire. 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 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 1/2") nor less than one and one-half times the maximum size of the coarse aggregate, nor shall it be less than required by the fire protection and weathering provisions specified in Section 2610 (f).

6. Limits of Column Section. For columns built monolithically with concrete walls or piers, the outer boundary of the column section shall be taken either as a circle at least one and one-half inches (1 1/2") outside the column spiral or as a square or rectangle of which the sides are at least one and one-half inches (1 1/2") outside the spiral. The value of A_g thus defined shall be used in both Formulas (7) and (8). 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 eighty per cent (80%) of that given by Formula (7). The ratio, \( p_d \), 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 inch \((5/8\,\text{"})\). Splices in reinforcing bars shall be made as described in Subsection (c)-3.

2. Lateral Ties. Lateral ties shall be at least one-fourth inch \((1/4\,\text{"})\) in diameter and shall be spaced apart not over sixteen \((16\) bar diameters, forty-eight \((48\) 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 \(A'_{c}\) not less than one-half of the total area may be used in applying the provisions of Subsection (d)-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 (9).

\[
P = 0.225 A_e f'_c + f_s A_r + f_s A_r\text{.} ..................................................(9)
\]

WHERE

\(A_e = \text{net area concrete.}
\)

\(A_e = A_e - A_s - A_r\)

\(A_s = \text{cross-sectional area of longitudinal bar reinforcement.}
\)

\(A_r = \text{cross-sectional area of the steel or cast-iron core.}
\)

\(f_s = \text{permissible unit stress in metal core, not to exceed 16,000 pounds per square inch for a steel core; or 10,000 pounds per square inch for a cast-iron core.}
\)

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 twenty per cent (20%) of the gross area of the column. If a hollow metal core is used it shall be filled with concrete. The amounts of longitudinal and spiral reinforcement and the requirements as to spacing of bars, details of splices and thickness of protective shell outside the spiral shall conform to the limiting values specified in Subsection (c), paragraphs 2, 3, 4, and 5. A clearance of at least three inches \((3\,\text{"})\) shall be maintained between 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 \((2\,\text{"})\).

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. 26.8. 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 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 (9) at any point; in addition to this, the reinforced concrete portion shall be designed to carry, in accordance with Formula (7), all floor loads brought onto the column at levels between the metal brackets or connections. In applying Formula (7), the value of \(A_e\) 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 \(0.35f'_c A_e\). 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.

(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 \((2\frac{1}{2}\,\text{"})\) thick over all metal (except rivet heads) reinforced as hereinafter specified, shall be computed by Formula (10).

\[
P = A_e f'_c \left(1 - \frac{A_e}{100A_r}\right) ..................................................(10)
\]
WHERE

- Ar = cross-sectional area of steel column.
- f'r = permissible stress for unencased steel column.
- Ag = total area of concrete section.

The concrete used shall develop a compressive strength of at least 2,000 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. gauge, 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 entire 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 (11):

\[ P = 0.225 f'_c A_c + f'r A_r \]  (11)

The value of \( f'_r \) shall be that given by Formula (12).

\[ f'_r = \left( \frac{18,000}{h} \right) \frac{F}{K} \]  (12)

WHERE

- \( f'_c \) = average unit stress in metal core.
- \( h \) = unsupported length of column.
- \( K \) = least radius of gyration of metal core section.

\( (\text{yield point of pipe}) \)

\[ F = \frac{45,000}{h} \]

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 (13).

\[ P' = P \left( 1.3 - \frac{0.03}{d} \right) \]  (13)

where \( P \) is the permissible axial load on a short column as given by Subsections (c), (d) and (e).

The maximum permissible load \( P' \) on eccentrically loaded columns in which \( h/d \) exceeds 10 shall also be given by Formula (13) 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. 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 computing moments in columns, the far ends may be considered fixed. Columns shall be designed to resist the axial forces from loads on all floors, plus the maximum bending due to load on a single adjacent span of the floor under consideration.

(i) Determination of Combined Axial and Bending Stresses. In a reinforced concrete column, designed by the methods of this Chapter, which is (1) symmetrical about two perpendicular planes through its axis and (2) subject to an axial load, \( N \), combined with bending in one or both of the planes of symmetry (but with the ratio of eccentricity to depth, \( e/t \), no greater than 1.0 in either plane), the combined fiber stress in compression may be computed on the basis of recognized theory applying to uncracked sections, using Formula (14).

\[ f_c = \frac{C \frac{D e}{A_r}}{1 + \frac{1}{t} \left( \frac{1}{n - 1} \right) f_r} \]  (14)

WHERE

- \( D = \frac{t^2}{2R^2} \) = a factor, usually varying from 3 to 9.
- \( (\text{The term } R \text{ as used here is the radius of gyration of the entire column section}) \)

\( t = \text{overall depth of column section.} \)

Equating this calculated stress, \( f_c \), to be the allowable stress, \( f_r \), in Formula (16) it follows that the column can be designed for an equivalent axial load, \( P \), as given by Formula (15).

\[ P = N \left( 1 + \frac{1}{t} \frac{C D e}{A_r} \right) \]  (15)*

*For approximate or trial computations, \( D \) may be taken as eight for a circular spiral column and as five for a rectangular tied or spiral column.
WHERE

\[ C = \text{ratio of allowable concrete stress, } f_c, \text{ in axially loaded column to allowable fiber stress for concrete in flexure.} \]

When bending exists on both axes of symmetry, the quantity \[ \frac{t}{D} \] shall be computed as the numerical sum of the \[ \frac{t}{D} \] quantities in the two directions.

For columns in which the load, \( N \), has an eccentricity, \( e \), greater than the column depth, \( t \), or for beams subject to small axial loads, the determination of the fiber stress \( f_c \) shall be made by use of recognized theory for cracked sections, based on the assumption that no tension exists in the concrete. For such cases the tensile steel stress shall also be investigated.

(i) Allowable Combined Axial and Bending Stress. For spiral and tied columns, eccentrically loaded or otherwise subjected to combined axial compression and flexural stress, the maximum allowable compression stress, \( f \), is given by Formula (16).

\[
f_p = f_c \left[ 1 + \frac{D}{t} \right] \left[ 1 + \frac{C}{t} \right] = f_c \left[ 1 + \frac{D + C}{t + D + C} \right]
\]

WHERE

\[ D = \frac{t^2}{2R^2} \]

\( D \) = a factor, usually varying from 3 to 9.

\( t \) = overall depth of column section.

\( f_c \) = average allowable stress in the concrete of an axially loaded reinforced concrete column.

\( C \) = ratio of \( f_c \) to the allowable fiber stress for members in flexure.

Thus

\[
f_c = \frac{0.225F_c - f_s t_s}{1 + (n - 1)t_s}
\]

for spiral columns and 0.8 of this value for tied columns, and

\[
f = \frac{0.45f_c}{C}
\]

For tied columns which are designed to withstand combined axial and bending stresses, the limiting total steel ratio of 0.04 prescribed in Subsection (d) may be increased to 0.08, provided that the amount of steel spliced by lapping shall not exceed a steel ratio of 0.04 in any three-foot (3') length of column. The size of the column designed under this provision shall in no case be less than that required to withstand axial load alone as specified in Subsection (d).

(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 bearing 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-C.

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

\[
\left[ 1 - \left( \frac{h}{30d} \right)^3 \right] 0.21f_c
\]

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 wall stresses, concentrated loads may be assumed to be distributed over a maximum length of wall not exceeding the center to center distance between loads nor five times the width of the bearing.

Reinforced concrete walls shall be reinforced with an area of steel in each direction, both vertical and horizontal, at least equal to 0.0025 times the cross-sectional area of the wall. Walls more than ten inches (10") in thickness shall have the reinforcement for each direction placed in two layers parallel with the faces of the wall. One layer consisting of not less than one-half and not more than two-thirds the total required reinforcement shall be placed not less than one and one-half inches (1 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 (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 (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.

<table>
<thead>
<tr>
<th>MAXIMUM HEIGHT IN FEET</th>
<th>STORY</th>
<th>LIMITING RATIO-DISTANCE BETWEEN SUPPORTS TO WALL THICKNESS</th>
<th>MINIMUM THICKNESS IN INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>3</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Basement</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

(1) **Non-Bearing Partitions.** Non-bearing partitions of reinforced concrete shall have a thickness of not less than one forty-eighth (1/48) of the distance between their supports nor less than two inches (2").

Section 2621. **FOOTINGS.** *(a) Loads and Reactions.* Footings shall be proportioned to sustain the applied loads and induced reactions without exceeding the allowable stresses as prescribed in Section 2613, and as further provided in this Section.

In cases where the footing is concentrically loaded and the member being supported does not transmit any moment to the footing, computations for moments and shears shall be based on an upward reaction assumed to be uniformly distributed per unit area or per pile and a downward applied load assumed to be uniformly distributed over the area of the footing covered by the column, pedestal, wall, or metallic column base.

In cases where the footing is eccentrically loaded or the member being supported transmits a moment to the footing, proper allowance shall be made for any variation that may exist in the intensities of reaction and applied load consistent with the magnitude of the applied load and the amount of its actual or virtual eccentricity.

In the case of footings on piles, computations for moments and shears may be based on the assumption that the reaction from any pile is concentrated at the center of the pile.

(b) **Sloped or Stepped Footings.** In sloped of stepped footings, the angle of slope or depth and location of steps shall be such that the allowable stresses are not exceeded at any section.

In sloped or stepped footings, the effective cross section in compression shall be limited by the area above the neutral plane.

Sloped or stepped footings shall be cast as a unit.

(c) **Bending Moment.** The external moment on any section shall be determined by passing through the section a vertical plane which extends completely across the footing, and computing the moment of the forces acting over the entire area of the footing on one side of said plane.

The greatest bending moment required in the design of an isolated footing shall be the moment so computed at sections located as follows:

1. At the face of the column, pedestal or wall, for footings supporting a concrete column, pedestal or wall.
2. Halfway between the middle and the edge of the wall, for footings under masonry walls.
3. Halfway between the face of the column or pedestal and the edge of the metallic base, for footings under metallic bases.

The width resisting compression at any section shall be assumed as the entire width of the top of the footing at the section under consideration.

In one-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to the moment computed as specified in this section, and the reinforcement thus determined shall be distributed uniformly across the full width of the section.

In two-way reinforced footings, the total tensile reinforcement at any section shall pro-
vide a moment of resistance at least equal to eighty-five per cent (85\%) of the moment computed as specified in this Section, and the total reinforcement thus determined shall be distributed across the corresponding resisting section in the following manner:

In two-way square footings, the reinforcement extending in each direction shall be distributed uniformly across the full width of the footing.

In two-way rectangular footings, the reinforcement in the long direction shall be distributed uniformly across the full width of the footing. In the case of the reinforcement in the short direction that portion determined by Formula (18) shall be uniformly distributed across a band-width (B) centered with respect to the center line of the column or pedestal and having a width equal to the length of the short side of the footing. The remainder of the reinforcement shall be uniformly distributed in the outer portion of the footing.

\[
\text{Reinforcement in band-width (B)} = \frac{2}{1} \left( \frac{S+1}{S} \right) 
\]

Total reinforcement in short direction (S+1)

where "S" is the ratio of the long side to the short side of the footing.

(d) Shear and Bond. The critical section, for shear to be used as a measure of diagonal tension, shall be assumed as a vertical section obtained by passing a series of vertical planes through the footing, each of which is parallel to a corresponding face of the column, pedestal, or wall and located a distance therefrom equal to the depth for footings on soil, and one-half the depth for footings on piles.

Each face of the critical section shall be considered as resisting an external shear equal to the load on an area bounded by said face of the critical section for shear, two diagonal lines drawn from the column or pedestal corners and making 45 degree angles with the principal axes of the footing, and that portion of the corresponding edge or edges of the footing intercepted between the two diagonals.

Critical sections for bond shall be assumed at the same planes as those prescribed for bending moment in Sub-section (c); also at all other vertical planes where changes of section or of reinforcement occur.

Computation for shear to be used as a measure of bond shall be based on the same section and loading as specified for the determination of external bending moment in Sub-section (c).

The total tensile reinforcement at any section shall provide a bond resistance at least equal to the bond requirement as computed from the following percentages of the external shear at the section:

1. In one-way reinforced footings, 100 per cent.
2. In two-way reinforced footings, 85 per cent.

In computing the external shear on any section through a footing supported on piles, the entire reaction from any pile whose center is located six inches (6") or more outside the section shall be assumed as producing shear on the section; the reaction from any pile whose center is located six inches (6") or more inside the section shall be assumed as producing no shear on the section. For intermediate portions of the pile center, the portion of the pile reaction to be assumed as producing shear on the section shall be based on straight line interpolation between full value at six inches (6") outside the section and zero value at six inches (6") inside the section.

Shearing and bond stresses shall not exceed those specified in Sections 2613, 2617, and 2618.

(e) Transfer of Stress at Base of Column. The stress in the longitudinal reinforcement of a column or pedestal shall be transferred to its supporting pedestal or footing either by extending the longitudinal bars into the supporting member, or by dowels.

In case the transfer of stress in the reinforcement is accomplished by extension of the longitudinal bars, they shall extend into the supporting member the distance required to transfer to the concrete, by allowable bond stress, their full working value.

In cases where dowels are used, their total sectional area shall be not less than the sectional area of the longitudinal reinforcement in the member from which the stress is being transferred. In no case shall the number of dowels per member be less than four and the diameter of the dowels shall not exceed the diameter of the column bars by more than one-eighth inch (1/8").

Dowels shall extend up into the column or pedestal a distance at least equal to that specified in Section 2620 (c)-3, for lap of longitudinal column bars and down into the supporting pedestal or footing the distance required to transfer to the concrete, by allowable bond stress, the full working value of the dowel.

The compressive stress in the concrete at the base of a column or pedestal shall be considered as being transferred by bearing to the top of the supporting pedestal or footing. The unit compressive stress on the loaded area shall not exceed the bearing stress allowable for the
quality of concrete in the supporting member as limited by the ratio of the loaded area to the supporting area.

Bearing stresses shall not exceed those set forth in Table No. 26-B.

In sloped or stepped footings, the supporting area for bearing may be taken as the top horizontal surface of the footing, or assumed 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 area actually loaded, and having side slopes of one vertical to not more than two horizontal.

(f) Footings Supporting Round Columns. In computing the stresses in footings which support a round or octagonal concrete column or pedestal, the "face" of the column or pedestal shall be taken as the side of a square having an area equal to the area enclosed within the perimeter of the column or pedestal.

(g) Minimum Edge-Thickness. In reinforced concrete footings, the thickness 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.

Section 2622. PRECAST CONCRETE JOISTS. 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 (1/24) of the span length.

The thickness of the top slab shall be not less than one-twelfth of the clear span between joists nor less than two inches (2") for roofs or floors and not less than one and one-half inches (1-1/2") 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 joists, the construction may be considered as a T-beam with the top slab the web.

Section 2623. COMPOSITE BEAMS. 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 beams; provided that the top of the beam is at least one and one-half inches (1-1/2") 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.

Section 2624. PLAIN CONCRETE. (a) General. Plain concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 2,000 pounds per square inch, and material, proportioning, and placing shall conform to the requirements of this Code, except as this may be reduced by the provision for other proper support.

Provisions shall be made to care for temperature and shrinkage stresses either by use of reinforcement or by means of joints.

Plain concrete construction shall conform to the detailed minimum requirements specified in this Chapter. Where Section 2312 is applicable, plain concrete shall also be designed in accordance with the allowable stresses specified in this Chapter.

(b) Wall Thickness. The thickness of plain concrete walls may be two inches (2") less than required by Section 2404 for plain masonry walls, but in no case less than seven inches (7"), and the ratio of unsupported height or length (whichever is the lesser) to thickness, shall not be greater than 22.

(c) Design. Plain concrete walls shall be designed to withstand all vertical and horizontal loads as specified in Chapter 23.

(d) Stresses. The allowable working stresses in plain concrete walls shall not exceed the following percentages of ultimate strength:
Compression ..................... .25f'c
Tension ........................... 0.01f'c
Shear .............................. 0.02f'c

(e) Pedestals and Footings (Plain Concrete). The allowable compressive unit stress on the gross area of a concentrically loaded pedestal shall not exceed 0.25f'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 0.03f'c, and the average shearing stress shall not exceed 0.02f'c, taken on critical sections as determined for reinforced concrete footings. The thickness at the edge shall be not less than eight inches (8") for footings on soil, nor less than fourteen inches (14") above the tops of the piles for footings on piles.

Section 2625. PNEUMATICALLY PLACED CONCRETE. (a) General. For the purpose of this Chapter, all pneumatically placed concrete shall consist of a mixture of fine aggregate and cement pneumatically applied by suitable mechanism, and to which water is added immediately prior to discharge from the applicator.

Except as specified in the following subsections of this Section, all pneumatically placed concrete shall conform to the regulations of this Chapter for concrete.

(b) Proportions. The proportions of cement to aggregate, in loose dry volumes, shall be not less than one to four and one-half.

(c) Water. The water content at the time of discharge, including any moisture in the fine aggregate, shall not exceed three and one-half gallons per sack of cement.

(d) Mixing. The cement and aggregate shall be thoroughly mixed prior to the addition of water. At the time of mixing, the fine aggregate shall contain not less than three per cent (3%) moisture.

(e) Rebound. Any rebound or accumulated loose aggregate shall be removed from the surface to be covered prior to placing the initial or any succeeding layers of pneumatically placed concrete. Rebound may be re-used if it conforms to the requirements for aggregate, but not in excess of twenty-five per cent (25%) of the total aggregate in any batch.

(f) Joints. Unfinished work shall not be allowed to stand for more than 30 minutes unless all abrupt edges are sloped to a thin edge. Before resuming work, this sloped portion shall be cleaned and wetted.

(g) Damage. Any pneumatically placed concrete which subsides after placement shall be removed.

Section 2626. BOLTS. Bolts shall be solidly embedded in plain or reinforced concrete, and the connection shall be designed so that the shear on every bolt is not more than the values set forth in Table No. 26-D.

<table>
<thead>
<tr>
<th>DIAMETER (In Inches)</th>
<th>EMBEDMENT (In Inches)</th>
<th>SHEAR (In Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>4</td>
<td>750</td>
</tr>
<tr>
<td>5/8</td>
<td>4</td>
<td>1000</td>
</tr>
<tr>
<td>3/4</td>
<td>5</td>
<td>1500</td>
</tr>
<tr>
<td>7/8</td>
<td>6</td>
<td>2000</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>2500</td>
</tr>
<tr>
<td>1-1/8</td>
<td>8</td>
<td>3000</td>
</tr>
<tr>
<td>1-1/4</td>
<td>9</td>
<td>3500</td>
</tr>
</tbody>
</table>
CHAPTER 27 – STEEL AND IRON
(Quality and Design)

Section 2701. MATERIAL. (a) Structural Steel. Steel and iron used structurally shall con­form to established technical standards of quality required to produce safe structures. For specifications, see Section 4601.

(b) Stock Material. Stock material shall be of a quality equal to that called for by paragraph (a). Mill test reports shall constitute sufficient record as to the material taken from stock.

Unidentified stock material, if free from surface imperfections, may be used for short sections of minor importance, or for small un­important details, where the precise physical properties of the material would not affect the strength of the structure.

(c) Filler Metal. Arc-welding electrodes shall conform to the specifications issued under Section 4601. Electrodes shall be of Classifica­tion Numbers E6010, E6011, E6012, E6013, E6020 or E6030 and shall be suitable for the positions and other conditions of intended use.

With each container of electrodes the manufacturer shall furnish instructions giving recommended voltage and amperage (and polarity if direct current) for all uses and welding positions for which the electrode is suitable.

(d) Tests. All structural steel, cast steel and cast iron shall be tested in accordance with the above specifications when deemed necessary by the Chief Building Inspector, and copies of such tests shall be filed in the office of the Chief 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 Chief Building Inspector. All such tests shall be made by an approved testing laboratory.

(e) Design. 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.

(f) Damaged Material. 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.

Section 2702. ALLOWABLE UNIT STRESSES. Except as provided in this Section under paragraphs (c), (h), (i), (j), and (k), all parts of the structure shall be so proportioned that the unit stress in pounds per square inch shall not exceed the following values:

(a) Tension

<table>
<thead>
<tr>
<th>Material</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Steel, net section</td>
<td>20,000</td>
</tr>
<tr>
<td>Butt welds, section through throat</td>
<td>20,000</td>
</tr>
<tr>
<td>Rivets, on area based on nominal diameter</td>
<td>20,000</td>
</tr>
<tr>
<td>Bolts and other threaded parts, on nominal area at root of thread</td>
<td>20,000</td>
</tr>
</tbody>
</table>

(b) Compression

Columns, gross section

For axially loaded columns with values of $1/r$ not greater than $120 - \frac{17,000}{0.485 r}$

For axially loaded columns (bracing and other secondary members) with values of $1/r$ greater than 120

The ratio of unbraced length to least radius of gyration $\frac{I}{r}$ shall not exceed:

For main compression members (except, see next paragraph).............120

For bracing and other secondary members in compression .............200

For cast iron columns .................70

in which $I$ is the unbraced length of the column, and $r$ is the corresponding radius of gyration of the section, both in inches.

The slenderness of a main compression member may exceed 120, but not 200, provided that it is not ordinarily subject to shock or vi­bratory loads and provided that its unit stress under full design loading shall not exceed the
following fraction of that stipulated above for its actual ratio $1/r$:

\[
\frac{1}{1.6 - \frac{1}{200r}}
\]

Plate Girder Stiffeners, gross section .................................. 20,000

Webs of Rolled Sections at toe of fillet Crippling, see Section 2704 (h) ...................... 24,000

Butt Welds — Section through throat (crushing) ...................... 20,000

(c) Bending.

Tension on extreme fibers of rolled sections, plate girders, and built-up members: See Section 2704 (a) ...................... 20,000

Compression on extreme fibers of rolled sections, plate girders, and built-up members.

\[
\frac{L}{b_t}
\]

With — not in excess of 600. 20,000

\[
\frac{L}{b_t}
\]

With — in excess of 600. 12,000,000

\[
\frac{L}{b_t}
\]

in which $L$ is the unsupported length and $d$ the width, of the member; $b_t$ is the depth, and $t$ the thickness, of its compression flange; all in inches; except that $L$ shall be taken as twice the length of the compression flange of a cantilever beam not fully stayed at its outer end against translation or rotation.

Stress on extreme fibers of pins............30,000

Fiber stresses in butt welds, due to bending, shall not exceed the values prescribed for tension and compression, respectively.

Fully continuous beams and girders may be proportioned for negative moments which are maximum at interior points of support, at a unit bending stress twenty per cent (20%) higher than above stated; provided that the section modulus used over supports shall not be less than that required for the maximum positive moments in the same beam or girder, and provided that the compression flange shall be regarded as unsupported from the support to the point of contraflexure.

For columns proportioned for combined axial and bending stresses, the maximum unit bending stress $F_{b_r}$, Section 2703 (a) may be taken at 24,000 pounds per square inch, when this stress is induced by the gravity loading of fully or partially restrained beams framing into the columns.

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 steel separators rigidly joining such members together shall be considered as lateral support if the ratio of the members between separators does not exceed 600.
(c) Shearing.

Rivets .......................................................... 15,000
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
Weld metal
   on section through throat of fillet weld, or on faying surface
   area of plug or slot weld .................................. 13,600
   on section through throat of butt weld .................. 13,000

(Stress in a fillet weld shall be considered as shear on the throat, for any direction of applied stress. Neither plug nor slot welds shall be assigned any values in resistance to stresses other than shear.)

(e) Bearing.

<table>
<thead>
<tr>
<th></th>
<th>Double Shear</th>
<th>Single Shear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivets</td>
<td>40,000</td>
<td>32,000</td>
</tr>
<tr>
<td>Turned Bolts in reamed or drilled holes</td>
<td>40,000</td>
<td>32,000</td>
</tr>
<tr>
<td>Unfinished bolts</td>
<td>25,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Pins</td>
<td>32,000</td>
<td></td>
</tr>
<tr>
<td>Contact Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milled stiffeners and other milled surfaces</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Fitted Stiffeners</td>
<td>27,000</td>
<td></td>
</tr>
</tbody>
</table>
| Expansion rollers and rockers  
   (pounds per linear inch), | 600d |         |
   in which d is diameter of roller or rocker in inches.

(f) Cast Steel

Compression and Bearing, same as for Structural Steel.
Other Unit Stresses, 75 per cent of those for Structural Steel.

(g) Masonry Bearing

<table>
<thead>
<tr>
<th>Material</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granite</td>
<td>800</td>
</tr>
<tr>
<td>Sandstone and Limestone</td>
<td>400</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>600</td>
</tr>
<tr>
<td>Hard Brick in Cement Mortar</td>
<td>250</td>
</tr>
</tbody>
</table>

(h) Reversal of Stress. The sectional area of the portion between connections of members subject to reversal of stress need not be increased by reason of the reversal, but shall be sufficient in area and disposition to provide for the maximum tension separately.

The sectional area of members subject to loads (other than wind loads) producing alternating tensile and compressive stresses, shall be augmented at the approach to a connection by riveting or welding on additional material so that the augmented section shall comply with the following rule:

To the net total compressive stress and to the net total tensile stress, add arithmetically 50% of the smaller of these two, and proportion the connected material and the connecting bolts, rivets, pins or welds for each of the two increased stresses thus separately obtained at the unit stresses prescribed in this Section.
(See also Section 2703.)

(i) Members Carrying Wind Load. (See Section 2307.)

(j) Allowable Unit Stresses for Used Steel.
The allowable unit stresses assigned by the Chief Building Inspector to used steel shall in no case be more than eighty per cent (80%) of the stresses given in Section 2702. In designs where used steel is provided for, proper allowances shall be made for holes, reduction in section by rust or other defects.

(k) Allowable Unit Stresses in Light Metal.
(See Section 2715.)

(l) Effective Areas of Weld Metal. The effective area of butt and fillet welds shall be considered as the effective length of weld times the effective throat thickness.

The effective shearing area of plug and slot welds shall be considered as the nominal cross-sectional area of the hole or slot, in the plane of the faying surface.
The effective area of fillet welds in holes and slots shall be computed as above specified for fillet welds, using for the effective length, the length of center line of the weld through the center of the plane through the throat. However, in the case of overlapping fillets, the effective area shall not exceed the nominal cross-sectional area of the hole or slot, in the plane of the faying surface.

The effective length of a fillet weld shall be the overall length of full-size fillet, including returns.

The effective length of a butt weld shall be the width of the part joined, when ends of the weld are made as specified in Section 2716 (k), final paragraph. A transverse skewed butt weld shall not be assumed in computations to be longer than the width of the joint or piece perpendicular to the direction of stress.

The effective throat thickness of a fillet weld shall be the shortest distance from the root to the face of the diagrammatic weld. (The effective throat thickness of an equal leg 45° fillet weld is 0.707 times the nominal size of the weld.)

The effective throat thickness of a complete-penetration butt weld (i.e., a butt weld conforming to the requirements of Section 2716 (k), second paragraph) shall be the thickness of the thinner part joined.

The effective throat thickness of an incomplete-penetration butt weld (i.e., a butt weld not conforming to the requirements of Section 2716 (k), second paragraph, but conforming to same Section, third paragraph) shall, for design purposes, be considered as seventy-five per cent (75%) of the thickness of the thinner part joined.

Section 2703. COMBINED STRESSES. (a) Axial and Bending. Members subject to both axial and bending stresses shall be so proportioned that the quantity:

\[ \frac{f_a}{F_a} \cdot \frac{f_b}{F_b} \]

shall not exceed unity, in which

- \( f_a = \) axial unit stress that would be permitted by this Specification if axial stress only existed.
- \( f_b = \) bending unit stress that would be permitted by this Specification if bending stress only existed.
- \( f_a = \) axial unit stress (actual) = axial stress divided by area of member.
- \( f_b = \) bending unit stress (actual) = bending moment divided by section modulus of member.

(b) Shear with Tension or Compression. Rivets, bolts, and welds subject to shearing and externally applied tensile or compressive forces shall be so proportioned that the combined unit stress will not exceed the unit stress allowed for shear in Section 2702 (d).

Section 2704. PLATE GIRDERS AND ROLLED BEAMS. (a) Proportioning. Riveted and welded plate girder, 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 2706, exceeds fifteen per cent (15%) of the gross flange area, the excess shall be deducted. If such members contain other holes, as for bolts, pins, countersunk rivets, or plug or slot welds, 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.

(b) Web. Plate girder webs shall have a thickness of not less than \( 1/170 \) of the unsupported distance between flanges.

(c) Flanges. The thickness of outstanding parts of flanges shall conform to the requirements of Section 2705 (c).

Each flange of welded plate girders should in general consist of a single plate rather than two or more plates superimposed. The single plate may comprise a series of shorter plates, laid end to end and butt welded at their junctions.

Unstiffened cover plates on riveted girders shall not extend more than sixteen (16) times the thickness of the thinnest outside plate beyond the outer row of rivets connecting them to the angles. The total cross-sectional area of cover plates of riveted girders shall not exceed seventy per cent (70%) of the total flange area.

If the girder is subjected to substantial fluctuations in loading, stiffeners, lateral plates, or other appurtenant material shall not be welded to the tension flange, except at points where the maximum flange stress is less than half the allowable.

(d) Flange Development. Rivets and welds connecting flange to web, or cover plates to flange, shall be proportioned to resist maximum horizontal shear at the plane in question, resulting from the bending forces on the girder. Additionally, rivets and welds connecting flange to web shall be proportioned to transmit any loads applied directly to the flange.

(e) Stiffeners. Bearing stiffeners shall be placed in pairs on the webs of plate girders at
unframed ends and at points of concentrated loads. Such stiffeners shall have a close bearing against the loaded flanges, and shall extend as closely as possible to the edge of the flange plates or flange angles. They shall be designed as columns subject to the provisions of Section 2702; assuming the column section to comprise the pair of stiffeners and a centrally located strip of the web equal to not more than twenty-five (25) times its thickness at interior stiffeners or a strip equal to not more than twelve (12) times its thickness when the stiffeners are located at the end of the web. The column length shall be taken as not less than three-fourths (3/4) of the length of the stiffeners in computing the ratio l/r. Only that portion of the stiffener outside of the angle fillet or the flange-to-web welds shall be considered effective in bearing. Angle bearing stiffeners shall not be cramped.

Rivets connecting stiffeners to the girder web shall be spaced not over eight (8) times their diameter, or more closely if so required in order to transmit the stress due to concentrated loads. If intermittent fillet welds are used, their spacing shall conform to the provisions of Section 2710 (i).

(f) Splices. Web splices in plate girders and in beams shall be proportioned to transmit the full shearing and bending stresses in the web at the point of splice. Web splices in welded girders shall preferably be complete penetration butt welds.

If the flanges are spliced, the splices shall either develop the full effective strength of the material or they shall develop the strength required by the total stresses, but in no case shall the strength developed be less than fifty per cent (50%) of the effective strength of the material spliced, nor shall butt-welded joints be only partially welded.

(g) Horizontal Forces. The flanges of plate girders supporting cranes or other moving loads shall be proportioned to resist the horizontal forces produced by such loads. (See Section 2704 (i).)

(h) Web Crippling of Beams. Rolled beams shall be so proportioned that the compressive stress at the web toe of the fillets, resulting from concentrated loads not supported by bearing stiffeners, shall not exceed the value of 24,000 pounds per square inch allowed in Section 2702. The governing formula shall be:

\[ h \leq \frac{64,000,000}{(h/t)'} \]

where \( v \) exceeds \( (h/t)' \), in which

- \( h \) = the clear depth between flanges, in inches.
- \( t \) = the thickness of the web, in inches.
- \( v \) = the greatest unit shear in the panel, in pounds per square inch, under any condition of complete or partial loading.

The clear distance between intermediate stiffeners, when stiffeners are required by the foregoing, shall not exceed eighty-four inches (84") or that given by the formula

\[ d = \frac{11,000 t}{\sqrt{v}} \]

where

- \( d \) = the clear distance between stiffeners, in inches.

Intermediate stiffeners may be applied in pairs, one on each side of the web, or, if preferred, may alternate on opposite side of the web.

Intermediate angle stiffeners may be crimped over the flange angles. Intermediate stiffeners employed to stay the web plate against buckling, and not for the transfer of concentrated loads from flange to web, shall be of a section not less than that required by the formula

\[ I_w = 0.00000016 H', \]

in which

- \( H' \) = the total depth of web.
- \( I_w \) = moment of inertia of the stiffeners or stiffener (figured with a common axis at the centerline of web for stiffeners in pairs and with the axis at the interface between stiffener and web for single stiffeners).

For interior loads \( R = \text{not over } 24,000 \)

\[ t (N + 2k) \]

For end-reactions \( R = \text{not over } 24,000 \)

\[ t (N + k) \]

WHERE

- \( R \) = concentrated interior load or end reaction, in pounds.
- \( t \) = thickness of web, in inches.
- \( N \) = length of bearing, in inches.
- \( k \) = distance from outer face of flange to web toe of fillet, in inches.

(i) Crane Runway Girders. The lateral force on crane runways to provide for the effect of moving crane trolleys shall be not less than twenty per cent (20%) of the sum of the weights of the lifted load and of the crane trolley (but
exclusive of other parts of the crane), applied at the top of rail one-half on each side of runway; and shall be considered as acting in either direction normal to the runway rail.

The longitudinal force shall be not less than ten per cent (10%) of the maximum wheel loads of the crane applied at the top of rail.

The live load carried on crane runway girders and their connections shall be increased not less than twenty-five per cent (25%) as a provision for impact.

(j) Effective Span Length. Beams, girders, and trusses shall be designed for a shorter effective span length than that they connect, shall be designed to carry the load to all other forces without exceeding, at any point, the unit stresses specified in Section 2702.

(k) Composite Beams. The term "composite beam" shall apply to any rolled or fabricated steel floor beam entirely encased in a poured concrete haunch 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 (1-1/2") 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 due regard for any temporary support provided, and that the concrete haunch has adequate mesh, or other reinforcing steel, throughout its whole depth and across its soffit.

Composite beams may be figured on the assumption that:

1. The steel beam carries unassisted all dead loads prior to the hardening of concrete, with due regard for any temporary support provided, and

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. (Section 2702 (a)).

The maximum stresses in the 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 the end connections of the steel beam shall be designed to carry the total dead and live load, except as this may be reduced by the provision of other proper support.

Section 2705. MINIMUM THICKNESS OF MATERIAL. (a) Exterior Steelwork. Exterior steelwork exposed to rain or snow, or encased in a non-impervious material, shall have a minimum thickness of one-fourth inch; except members made of pipe or tubing with closed ends shall have a minimum thickness of three-sixteenths inch.

Exterior purlins, girts, trusses and bracing members sheltered from direct exposure to rain and snow shall have a minimum thickness of three-sixteenths inch.

The controlling thickness of rolled shapes shall be taken as a mean thickness of their flanges, regardless of web thickness. The minimum thickness required for protection against crippling, buckling, and shear are prescribed in paragraphs (c) and (d) of this section, and in paragraph (b) of Section 2704, respectively.

Exceptions: 1. Steelwork exposed to industrial fumes or vapor more corrosive than rain or fog shall be suitably increased in thickness or be given special protection.

2. Signs, exterior stairs, joists, skylight bars, non-bearing walls and partitions, suspended ceilings, studs, and similar steel shapes, and light steel construction, shall not be limited by the above thickness requirements except as provided in Section 2715.

(Ord. 62, Series 1956)

(b) Interior Steelwork. Interior steelwork exposed to conditions no more corrosive than indoor atmosphere controlled for human comfort shall be limited in thickness only by the requirements for protection against crippling, buckling and shear, prescribed in paragraphs (c) and (d) of this section, and in paragraph (b) of Section 2704, respectively.

Interior steelwork subject to atmospheric exposure more corrosive than that mentioned in the preceding paragraph shall have its minimum thickness governed by the requirements for exterior steelwork, paragraph (a) of this section.

(Ord. 62, Series 1956)

(c) Projecting Elements Under Compression. Projecting elements of members subjected to axial compression or compression due to bending shall have ratios of width to thickness not greater than the following:
Single-angle struts ................................12
Double-angle struts, angles, or plates projecting from girders, columns or other compression members; compression flanges of beams; stiffeners on plate girders; flanges or stems of tees ..................................................16

The width of plates shall be taken from the free edge to the first row of rivets or welds; the width of legs of angles, channels and tees, and of the stems of tees, shall be taken as the full nominal dimension; the width of flanges of beams and tees shall be taken as one-half the full nominal width. The thickness of a sloping flange shall be measured halfway between a free edge and the corresponding face of the web.

When a projecting element exceeds the width-to-thickness ratio prescribed in the preceding paragraph, but would conform to same and would satisfy the stress requirements with a portion of its width considered as removed, the member will be considered acceptable without the actual removal of the excess width.

(d) Compression Members. In compression members the unsupported width of web, cover, or diaphragm plates between the nearest lines of rivets or welds, or between the roots of the flanges in case of rolled sections, shall not exceed forty (40) times the thickness.

When the unsupported width exceeds this limit, but a portion of its width no greater than forty (40) times the thickness would satisfy the stress requirements, the member will be considered acceptable.

The unsupported width of cover plates perforated with a succession of access holes, only the least net width across holes being assumed available to resist compression, may exceed forty (40), but shall not exceed fifty (50) times the thickness.

Section 2706. GROSS AND NET SECTIONS.
(a) Definitions. The gross section of a member at any point shall be determined by summing the products of the thickness and the gross width of each element as measured normal to the axis of the member. The net section shall be determined by substituting for the gross width the net width computed in accordance with paragraphs (c) to (g) of this Section.

(b) Application. 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 (a).

In determining the net section across plug or slot welds the weld metal shall not be considered as adding to the net area.

(c) Net Width. 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, for each gauge space in the chain, the quantity

\[ \frac{s^2}{4g} \]

where

\[ s = \text{longitudinal spacing (pitch) in inches of any two successive holes.} \]

\[ g = \text{transverse spacing (gauge) in inches of the same two holes.} \]

The critical net section of the part is obtained from that chain which gives the least net width.

(d) Angles. For angles, the gross width shall be the sum of the widths of the legs less their thickness. The gauge for holes in opposite legs shall be the sum of the gauges from back of angles less the thickness.

(e) Splice Members. For splice members, the thickness considered shall be only that part of the thickness of the member which has been developed by rivets or welds beyond the section considered.

(f) Size of 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.

(g) Pin Holes. In pin connected tension members, other than forged eyebars, the net section across the pin hole, transverse to the axis of the member, shall be not less than one hundred thirty-five per cent (135%), and the net section beyond the pin hole, parallel with the axis of the member, not less than ninety per cent (90%), 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 not exceed eight (8) times the thickness of the member at the pin, unless lateral buckling is prevented.

Section 2707. CONNECTIONS. (a) Minimum Connections. Connections carry calculated stresses, except for lacing, sag bars, and girts, shall be designed for not less than 10,000 pounds, if welded; or if riveted or bolted, shall have no fewer than two rivets or two bolts.

(b) Eccentric Connections. Members meeting at a point shall have their gravity axes meet at a point if practicable; if not, provisions shall be made for bending stresses due to the eccentricity.
(c) Placement of Rivets and Welds. The rivets or welds at the ends of any member transmitting stresses into that member should preferably have their centers of gravity on the gravity axis of the member; otherwise, 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) Unrestrained Members. Except as otherwise indicated by the designer, all connections of beams, girders, or trusses shall be designed as flexible, and may ordinarily be proportioned for the reaction shears only. If, however, the eccentricity of the connection is excessive, provision shall be made for the resulting moment.

Flexible beam connection shall permit the ends of the beam to rotate sufficiently to accommodate its deflection by providing for a horizontal displacement of the top flange as determined as follows:

\[ e = 0.007d \text{ if the beam is designed for full uniform load and for live load deflection not exceeding } 1/360 \text{th of the span.} \]

\[ f \times L \text{ if the beam is designed for full uniform load} \]

where \( e \) = the horizontal displacement between the top and bottom of the beam at its end, in inches.

\( f \) = the flexural unit stress in the beam at mid span; p.s.i.

\( d \) = the depth of the beam, in inches.

\( L \) = the span of the beam, in feet.

(e) Restrained Members. When beams, girders, or trusses are subject both to reaction shear and end moment, due to full or partial end restraint, or, to continuous or cantilever construction, their connections shall conform to the requirements of Section 2703 (b).

(f) Fillers. In riveted construction, when rivets carrying computed stress pass through fillers, the fillers shall be extended beyond the connected member and the extension secured by enough rivets to distribute the total stress in the member uniformly over the combined sections of the member and filler.

Fillers under the stiffeners on riveted plate girders, at end bearings or at points of concentrated loads, shall be secured by sufficient rivets to prevent excessive bending and bearing stresses.

In welded construction, when a filler is used between two parts connected in shear, there shall be sufficient welding to transfer the shearing stress from one part to the filler and from the filler to the other part. Fillers of less than one-quarter inch (1/4") thickness shall not be used to transfer stress, but shall be trimmed flush with the welded edges of stress-carrying element and the sizes of the welds along the edges shall be increased over the required sizes by an amount equal to the thickness of the filler.

(g) Connections of Tension and Compression Members in Trusses. The connections at ends of tension or compression members in trusses shall either develop the full effective strength of the material, or they shall develop the strength required by the total stresses; but in no case shall such strength developed be less than fifty per cent (50\%) of the effective strength of the material connected.

(h) Milled Joints in Compression Members. Where compression members are in full-milled bearing on base plates, and, where full-milled tier-building columns are spliced, there shall be sufficient rivets, bolts, or welds to hold all parts securely in place.

Where other compression members are spliced by full-milled bearing, the splice material and its riveting or welding shall be arranged to hold all parts in line and shall be proportioned for fifty per cent (50\%) of the computed stress.

All the foregoing joints shall be proportioned to resist any tension that would be developed by specified wind forces acting in conjunction with seventy-five per cent (75\%) of the calculated dead load stress and no live load, if this condition will produce more tension than with full dead load and live load applied.

(i) Combinations of Welds. If two or more of the general types of weld (butt, fillet, plug, slot) are combined in a single joint, the effective capacity of each shall be separately computed with reference to the axis of the group, in order to determine the allowable capacity of the combination.

Section 2708. Rivets and Bolts. (a) Diameter. In proportioning and spacing rivets, the nominal diameter of the undriven rivet shall be used.

(b) Effective Bearing Area. 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.

(c) Double and Single Shear Bearing. Only that portion of a rivet or bolt shall be considered in double shear bearing which lies between two portions which share the reaction therefrom. The remainder of the rivet or bolt shall be considered in single shear bearing.
(d) Long Grips. Rivets which carry calculated stress, and the grip of which exceeds five diameters, shall have their number increased one per cent (1%) for each additional one-sixteenth inch (1/16") in the rivet grip. Special care shall be used in heating and driving such rivets.

(e) Unfinished Bolts. If unfinished bolts are provided with washers under nuts, and, have unthreaded shanks extending completely through the joined parts, the shearing and bearing values elsewhere prescribed for unfinished bolts may be increased one-eighth (1/8).

(f) Rivets or welds 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 (2-1/2) times the minimum horizontal dimension at the ground line.

In all connections in structures one hundred feet (100') or less in height where the height is more than four (4) 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.

(g) Special Bolts in Lieu of Rivets. Turned bolts in close fitting holes as specified in Section 2716 (e) or special bolts with ribbed shanks may be used in shop or field work in lieu of rivets. The shank shall be long enough to provide full bearing, and washers shall be used under the nuts of turned bolts to give full grip when the nuts are turned tight.

The term "turned bolts," as used in this Specification, embraces all bolts regardless of the manufacturing process, which have a tolerance on the nominal diameter of 0.006 inch under, and which have "regular semi-finished" heads conforming to the standards set forth under Section 4601.

Section 2709. SPACING OF RIVETS. (a) Minimum Pitch. The minimum distance between centers of rivet holes shall preferably be not less than three times the diameter of the rivet.

(b) Maximum Pitch in Compression Members. The maximum pitch in line of stress of compression members composed of plates and shapes shall not exceed sixteen (16) times the thickness of the thinnest outside plate or shape, nor twenty (20) times the thickness of the thinnest enclosed plate or shape, with a maximum of twelve inches (12").

At right angles to the direction of stress, the distance between lines of rivets shall not exceed thirty-two (32) times the thickness of the thinnest plate where there is more than one ply. For angles in built-up sections with two gauge lines, with rivets staggered, the maximum pitch in the line of stress in each gauge line shall not exceed twenty-four (24) times the thickness of the thinnest plate with a maximum of eighteen inches (18").

(c) End Pitch in Compression Members. The pitch of rivets at the ends of built compression members shall not exceed four diameters of the rivets for a length equal to one and one-half (1-1/2) times the maximum width of the member.

(d) Two-Angle Members. 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 1/r for each angle between rivets shall be not more than three-quarters (3/4) of that for the whole member.

(e) Minimum Edge Distance. The minimum distance from the center of any punched rivet hole to any edge shall be that given in Table 27-A.
TABLE NO. 27-A

<table>
<thead>
<tr>
<th>Rivet Diameter, Inches</th>
<th>MINIMUM EDGE DISTANCE (Inches) FOR PUNCHED HOLES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In Sheared Edge</td>
</tr>
<tr>
<td>1/2</td>
<td>1</td>
</tr>
<tr>
<td>5/8</td>
<td>1-1/8</td>
</tr>
<tr>
<td>3/4</td>
<td>1-1/4</td>
</tr>
<tr>
<td>7/8</td>
<td>1-1/2</td>
</tr>
<tr>
<td>1</td>
<td>1-3/4</td>
</tr>
<tr>
<td>1-1/8</td>
<td>2</td>
</tr>
<tr>
<td>1-1/4</td>
<td>2-1/4</td>
</tr>
</tbody>
</table>

*May be decreased 1/8 inch when holes are near end of beam.

(f) Minimum Edge Distance in Line of Stress. The distance from the center of any rivet under computed stress, and that 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 stress.

(g) Maximum Edge Distance. The maximum distance from the center of any rivet to the near edge shall be twelve (12) times the thickness of the plate, but shall not exceed six inches (6").

Section 2710. WELDS. (a) Types of Welds. Butt, fillet plug or slot welds, or a combination of these types, may be used in making joints and joining component parts.

(b) Qualification of Weld Details. The details of all joints (including for butt welds the groove form, root face, root spacing, etc.) to be employed under this specification without qualification shall comply with all of the requirements for joints which are accepted without qualification test under the standards set forth under Section 4601. No joint form, not included in the foregoing, shall be employed unless approved by the Chief Building Inspector.

(c) Minimum Size of Fillet Welds. The relation between weld size and the maximum thickness of material on which various sizes of fillet welds may be used shall, where practicable, conform to the following table:

<table>
<thead>
<tr>
<th>Size of Fillet (Inches)</th>
<th>Maximum Thickness of Part (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16</td>
<td>1/2</td>
</tr>
<tr>
<td>1/4</td>
<td>3/4</td>
</tr>
<tr>
<td>5/16</td>
<td>1-1/4</td>
</tr>
<tr>
<td>3/8</td>
<td>2</td>
</tr>
<tr>
<td>1/2</td>
<td>6</td>
</tr>
<tr>
<td>5/8</td>
<td>Over 6</td>
</tr>
</tbody>
</table>

(d) Maximum Effective Size of Fillet Welds. The maximum size of a fillet weld that may be assumed in the design of a connection shall be such that the stresses in the adjacent base material do not exceed the values allowed in Section 2702.

The maximum size fillet weld, applied to a nominally square edge of plate of section, shall be one-sixteenth inch (1/16") less than the nominal thickness of the edge; and the size of fillet weld used along the toe of an angle or the rounded edge of a flange shall not exceed three-fourths (3/4) the nominal thickness of the angle leg or three-fourths (3/4) the nominal edge thickness of the flange, except that when required by the design conditions and specially designated on the drawings, fillet welds equal in size to the edge of a plate or rolled section may be used, provided, that the weld is built out in such a manner as to insure full throat thickness, full fusion area, and no injury to the base metal that will reduce its thickness adjacent to the weld.

(e) Length of Fillet Welds. The minimum effective length of a strength fillet weld shall be not less than four times the nominal size, or else the size of the weld shall be considered not to exceed one-fourth (1/4) of its effective length.
The effective length of any segment of intermittent fillet weldings shall be not less than four times the weld size with a minimum of one and one-half inches (1-1/2"").

If the longitudinal fillet welds are used alone in end connections, the length of each fillet weld shall be not less than the perpendicular distance between them.

(f) End Returns of Fillet Welds. Side or end fillet welds terminating at ends or sides, respectively, or parts or members shall, wherever practicable, be returned continuously around the corners for a distance not less than twice the nominal size of the weld. This provision shall apply to side and top fillet welds connecting brackets, beam seats and similar connections, at the tension side of such connections, on the plane above which bending moments are applied. End returns shall be indicated on the design and detail drawings.

(g) Plug and Slot Welds. Plug or slot welds, or fillet welds in holes or slots, may be used in plates not more than one inch thick, where subjected principally to shearing stresses or where needed to prevent buckling of lapped parts.

The diameter of the holes for plug welds and the width of slot welds shall not be less than the thickness of the part containing the hole or slot, plus five-sixteenths inch (5/16") rounded to the next greater odd sixteenth. The diameter of plug welds and the width of slot welds shall not be greater than two and one-quarter (2-1/4) times the thickness of the weld metal.

The maximum length of slot welds shall not exceed ten (10) times the thickness of the part containing the slot.

(h) Longitudinal Fillet Weld Spacing. The transverse spacing of longitudinal fillet welds used in end connections shall not exceed eight inches (8") unless the design otherwise prevents excessive transverse bending in the connection.

(i) Intermittent Fillet Weld Spacing. Intermittent fillet welds may be used to transfer calculated stress across a joint or faying surfaces when the strength required is less than that developed by a continuous fillet weld of the smallest practical size. The clear spacing in the direction of stress, between the effective lengths of such segments at the edges of plates and at the unsupported edges of rolled shapes carrying calculated stress, shall not exceed the following number times the thickness of the thinner part joined: for compression, sixteen (16); for tension, twenty-four (24); and shall in no case be more than twelve inches (12"). The effective length of longitudinal fillet welds at the ends of built-up members shall be not less than the width of the component part joined.

(j) Lap Joints. The minimum width of laps, on lap joints, shall be five times the thickness of the thinner part joined and not less than one inch (1"). Lap joints joining plates or bars subjected to axial stress shall be fillet welded along the edge of both lapped parts except where deflection of the lapped parts is sufficiently restrained to prevent opening of the joint under maximum loading.

(k) Slot Welds. The clear distance from the edge of a slot to the adjacent edge of the slotted part, and the clear distance between adjacent slots, measured in a direction perpendicular to that of the main stress, shall be not less than five times the thickness of the slotted part nor less than twice the width of the slot.

(l) Stitch Welds. If two or more plates or rolled shapes are used to build up a member, sufficient stitch welding (of the fillet, plug or slot type) to make the parts act in unison shall be provided as follows, except where transfer of calculated stress between the parts joined requires closer spacing.

(1) For plates, the longitudinal clear spacing between stitch welds shall not exceed the provisions of paragraph (b) of this section and the transverse spacing shall not exceed thirty-two (32) times the thickness of the thinner plate joined.

(2) For members composed of two or more rolled shapes, in contact one with another, the longitudinal spacing of stitch welds shall not exceed twenty-four inches (24") or the limits prescribed in (3).

(3) For members composed of rolled shapes, separated one from the other by a gusset plate, the component parts shall be stitched together at intervals such that the critical ratio 1/r, for each component, between stitching, shall not exceed three-fourths (3/4) the critical ratio for the whole member.

(m) Rivets and Bolts in Combination with Welds. In new work, rivets or bolts in combination with welds shall not be considered as sharing the stress, and welds shall be provided to carry the entire stress for which the connection is designed.

In making welded alterations to structures, existing rivets may be utilized for carrying stresses resulting from existing dead loads, and the welding need be adequate only to carry all additional stress.

Section 2711. SEPARATORS. (a) Separators. Where two or more rolled beams or channels are used to form a girder, they shall be connected together at intervals of not more
than five feet (5'). Through-bolts and separators may be used, provided, that in beams having a depth of twelve inches (12") or more, no fewer than two (2) bolts shall be used with each separator. When concentrated loads are carried from one beam to the other, or distributed between the beams, diaphragms shall be used designed with sufficient stiffness to distribute the load. Where beams are exposed, they shall be sealed against corrosion of interior surfaces, or spaced sufficiently far apart to permit cleaning and painting.

Section 2712. **Tie Plates.** *(a) Compression Members.* The open sides of compression members built up from plates or shapes 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 stress the end tie plates shall have a length of not less than the distance between the lines of rivets or welds connecting them to the segments of the member, and intermediate ones of not less than one-half (1/2) of this distance. The thickness of tie plates shall be not less than one-fifteenth of the distance between the lines of rivets or welds connecting them to the segments of the members. In riveted construction, the rivet pitch in tie plates shall be not more than six (6) diameters and the tie plates shall be connected to each segment by at least three rivets. In welded construction, the welding on each line connecting a tie plate shall aggregate not less than one-third (1/3) the length of the plate.

*(b) Tension Member.* Tie plates shall be used to secure the parts of tension members built up from plates or shapes. They shall have a length not less than two-thirds (2/3) of the length specified for tie plates in compression members. Otherwise they shall conform to the requirements of Section 2712 (a).

*(c) Spacing of Lacing Bars.* Lacing bars (which term comprehends for the purpose of this Section flat bars, angles, channels, or other shapes employed as lacing) of compression members shall be so spaced that the ratio 1/r of the flange included between their connections shall be not over three-fourths (3/4) of the critical ratio for 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 (2%) of the total compressive stress of the member.

Lacing bars shall preferably be arranged in single system, for which the ratio 1/r shall not exceed one hundred forty (140). For double lacing this ratio shall not exceed two hundred (200). Double lacing bars shall be joined at their intersections.

In determining the section required for lacing bars, the compression formula shall be used, I being taken as the unsupported length of the lacing bar between rivets or welds connecting it to the segments, for single lacing, and seventy per cent (70%) of that distance for double lacing.

*(e) Inclination of Lacing Bars.* The inclination of lacing bars to the axis of the member shall preferably be not less than sixty degrees (60°) for single lacing and forty-five degrees (45°) for double lacing. When the distance between the lines of rivets or welds in the flanges is more than fifteen inches (15''), the lacing shall preferably be double or be made of angles.

*(f) Perforated Cover Plates.* The function of tie plates and lacing may be assumed to be performed by the material in continuous cover plates perforated with a succession of access holes, the net width of which plates across holes is assumed available to resist axial stress, provided that: the ratio of length (in direction of stress) to width of hole shall not exceed two (2); the clear distance between holes in the direction of stress shall be not less than the transverse distance between nearest lines of connecting rivets of welds; and the periphery of the holes at all points shall have a minimum radius of one and one-half inches (1 1/2").

Section 2713. **Column Bases and Anchorages.** *(a) Loads.* Proper provision shall be made to transfer the column loads, and moments, if any, to the footings and foundations.

*(b) Alignment.* Column bases shall be set level and to correct elevation with full bearing on the masonry.

*(c) Finishing.* 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, provided a satisfactory contact bearing is obtained; rolled steel bearing plates, over two inches (2") but not over four inches (4") in thickness, may be straightened by pressing; or, if presses are not available, by planing on all bearing surfaces, to obtain a satisfactory contact bearing; rolled steel bearing plates, over four inches (4") in thickness, shall be planed on all bearing surfaces (except as noted under 3).

2. Column bases other than rolled steel bearing plates shall be planed on all bearing surfaces (except as noted under 3).

3. The bottom surfaces of bearing plates and column bases which rest on
masonry foundations and are grouted to insure full bearing contact need not be planed.

(d) **Anchor Bolts.** Anchor bolts shall be designed to provide resistance to all conditions of tension and shear at the bases of columns, including the net tensile components of any bending moments which may result from fixation of columns.

**Section 2714. EXPANSION.** Proper provision shall be made for expansion and contraction.

**Section 2715. LIGHT STEEL CONSTRUCTION AND STEEL JOISTS.** (a) **General.** Steel studs, steel joists, steel floors, wall and roof panels and other framing members used in the structural frame of light steel construction, shall be light weight rolled sections or sections made of commonly-accepted or specially-formed light gauge flat rolled sheets, or a combination of both used alone or in combination with other materials of construction. Such studs, joists, or framing members may be of a determinate truss design with elements effectively joined together by arc or resistance welding or by rivets. In expanded sections, a portion of the metal may be left intact to form a connection. For steel studs the ratio of I/r shall not exceed one hundred eighty (18). The specifications set forth under Section 4601 shall be accepted as recognized engineering practice for the design of light steel structural members, except as otherwise specifically provided in this Code.

Steel bar joists shall conform to the standard specifications set forth pursuant to Section 4601.

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:

| Load-bearing studs, floor, wall and roof panels and joists of formed sheet metal | 18 gauge |
| Ribbed sheet steel panels for roofs | 22 gauge |
| Ribbed sheet steel panels for floors | 20 gauge |
| Ribbed sheet steel walls, load-bearing | 22 gauge |
| Ribbed sheet steel walls, non-load-bearing | 24 gauge |

All connections shall be riveted, bolted, or welded. Metal screws may be used if tests are submitted to show that such screws will carry the load required with a factor of safety of two (2), based on the yield point. 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.

Bridging shall be provided between steel bar joists and joists of light steel construction sufficient to laterally stay the joists and to hold each joist in a vertical plane and to transmit any horizontal forces perpendicular to the direction of the joists for all construction loads and permanent loads. Any row of bridging shall be capable of transferring five hundred (500) pounds from each joist to the adjoining joists. One row of bridging shall be provided for spans up to fourteen feet (14'), two rows for spans from fourteen feet (14') to twenty-one feet (21'), and three rows for spans from twenty-one feet (21') to thirty-two feet (32').

(b) **Stresses.** The unit design stress in structural members of light steel shall not exceed the minimum yield strength of the steel divided by 1.85. For steel conforming to Grade C (minimum yield point 33,000 pounds per square inch) of the specifications set forth under Section 4601, the maximum working stress shall not exceed 18,000 pounds per square inch. Steel of higher strength than Grade C shall be suitably identified as to yield point and ultimate strength.

The unit design stresses for light weight rolled sections (such as Junior Beams and Channels and wide-flange Light Beams and Joists) shall not exceed those specified in Section 2702.

(c) **Construction Details.** Steel studs or other steel supporting members used in the structural frame of light steel construction and steel joists shall be connected to the supporting beams, girders, foundations, or other steel supporting members by arc or resistance welding, riveting, bolting or other approved methods. All such welds, in light steel construction, shall be made on two sides or two edges of each bearing in such a manner as to resist effectively the stresses developed. Resistance welding shall develop the full strength of the member welded.

Steel floor and roof members supported on masonry and reinforced concrete shall have end bearings at least four inches (4") in length and the ends of such members resting on masonry or reinforced concrete shall be provided with approved joist anchors thoroughly embedded therein.

Bearing plates, when required by design, shall be securely welded, bolted, or riveted to
such floor and roof members, studs or other supporting members.

Bearing studs or other vertical bearing members shall rest on a sole or plate having an effective width equal to the depth of such member and having a thickness of not less than 14-gauge but in no case less than that of the vertical member resting thereon unless each such vertical bearing member is thoroughly embedded in the concrete foundation. Such soles or plates shall be effectively anchored to the foundation and all splices and intersections shall develop the full strength of the members connected.

When bearing studs or other vertical bearing members are spliced, the full strength of such members shall be developed in the splice.

Where studs do not continue full length from one story through the next story above, a cap plate or steel member shall be provided on top of the lower story studs or a sill plate on the upper story. Such cap plate or sill plate shall be of sufficient strength to distribute adequately the loads from the upper story studs to the lower story studs.

All horizontal or diagonal ties or bracing in exterior walls and bearing partitions shall be effectively arc welded, bolted, or riveted to the structural frame or effectively anchored to supporting masonry.

Where plumbing, heating, or other pipes or conduits are placed in or partly in an exterior wall or bearing partition necessitating the cutting of soles or plates, bracing or structural member in said wall, such members shall be reinforced so as to provide sufficient strength to resist the stresses imposed thereon or proper provisions shall be made to transfer such stresses to the points of support.

Section 2716. WORKMANSHIP. (a) General. All workmanship shall be equal to the best practice in modern structural shops.

(b) Straightening. All material shall be clean and straight. If straightening or flattening is necessary, it shall be done by a process and in a manner that will not injure the material. Sharp kinks or bends shall be cause for rejection.

(c) Gas Cutting. The use of a cutting torch is permissible if the metal being cut is not carrying substantial stress during the operation. Gas-cut edges which will be subjected to substantial tensile stress shall be cut by a mechanically-guided torch, or, if hand cut shall be carefully examined and any nicks removed. The radii of re-entrant gas-cut fillets shall be as large as practicable, but never less than one inch (1")}. Edges or grooves may be prepared for welding by gas cutting, as defined in Section 2716 (h).

(d) Planing of Edges. Planing or finishing of sheared edges of plates or shapes, or of edges gas-cut with a mechanically-guided torch, will not be required unless specifically called for on the drawings, or included in a stipulated edge preparation for welding.

(e) Riveted Construction—Holes. Holes for rivets or unfinished bolts shall be one-sixteenth inch (1/16") larger than the nominal diameter of the rivet or bolt. If the thickness of the material is not greater than the nominal diameter of the rivet or bolt plus one-eighth inch (1/8"), the holes may be punched. If the thickness of the material is greater than the nominal diameter of the rivet or bolt plus one-eighth inch (1/8"), the holes shall be either drilled from the solid, or sub-punched and reamed. The die for all sub-punched holes and the drill for all sub-drilled holes shall be at least one-sixteenth inch (1/16") smaller than the nominal diameter of the rivet or bolt.

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.

Holes for turned bolts shall be drilled or reamed truly cylindrical and not more than one-fiftieth inch (1/50") larger than the external diameter of the bolt. Drilling or reaming for turned bolts shall be done after the parts to be connected are assembled; except that if such drilling or reaming after assembly is impractical, it may be done through steel templates with hardened bushings.

(f) Riveted Construction—Assembling. All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting done during assembling shall not distort the metal or enlarge the holes.

(g) Riveting. Rivets shall be driven by power riveters, of either compression or manually-operated type, employing pneumatic, hydraulic, or electric power. After driving they shall be tight and their heads shall be in full contact with the surface.

Rivets shall ordinarily be hot-driven, in which case their finished heads shall be of approximately hemispherical shape and shall be of uniform size throughout the work for the same size rivet, full, neatly finished, and concentric with the holes. Hot-driven rivets shall be heated uniformly to a temperature not exceeding 1950°F; they shall not be driven after their temperature has fallen below 1000°F.

Rivets may be driven cold if approved measures are taken to prevent distortion of the riveted material. The requirements for hot-driven rivets shall apply except as modified by specifications set forth under Section 4601.
(h) Welded Construction — Preparation of Material. Surfaces to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material, except that mill scale which withstands vigorous wire brushing, may remain. A light film of linseed oil may be disregarded. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done with a mechanically-guided torch.

(i) Welded Construction — Assembling. Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated more than three-sixteenths inch (3/16”). If the separation is one-sixteenths inch (1/16”) or greater, the size of the fillet welds shall be increased by the amount of the separation. The separation between faying surfaces of lap joints shall not exceed one-sixteenth inch (1/16”). The fit of joints at contact surfaces which are not completely sealed by welds, shall be close enough to exclude water after painting.

Abutting parts to be butt welded shall be carefully aligned. Misalignments greater than one-eighth inch (1/8”) shall be corrected and, in making the correction, the parts shall not be drawn into a sharper slope than two degrees (2°) seven-sixteenths inch (7/16”) in twelve inches (12”).

The work shall be positioned for flat welding whenever practicable.

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member.

(j) Welded Construction — Temperatures. No welding shall be done when the temperature of the base metal is lower than 0° Fahrenheit. At temperatures between 32° F. and 0° F., the surface of all areas within three inches of the point where a weld is to be started, shall be heated to a temperature at least warm to the hand before welding is started.

When welds are being made in parts thicker than one and one-half inches (1-1/2”), the temperature of the base material adjacent to the welding shall be at least 70° Fahrenheit.

(k) Welding. The technique of welding employed, the appearance and quality of welds made, and the methods used in correcting defective work, shall conform to the standards issued pursuant to Section 4601.

All complete-penetration butt welds, except when produced with the aid of backing material or welded in the flat position from both sides in square-edge material not more than five-sixteenths inch (5/16”) thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged or chipped out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire intended cross section. Butt welds made with the use of a backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips may be removed by means of gas cutting, after welding is completed, provided no injury is done to the base and weld metal and the weld surface is left flush or slightly convex, with full throat thickness.

Incomplete-penetration butt welds shall be made with as nearly complete penetration and internal soundness as the formation of the joint and the method of welding will permit. (See Section 2702 (1), final paragraph.)

To insure soundness, the ends of butt welds that carry stresses approaching the maximum allowable working stress shall be extended past the edges of the parts joined, by means of short extension bars providing a similar joint preparation and having a width not less than the thickness of the thicker part joined. Where the metal is not more than three-fourths inch (3/4”) in thickness, the extension bars may be omitted if the ends of the butt weld are chipped or cut down to solid metal and side welds are applied to fill out the ends to the same reinforcement as the faces of the weld. If extension bars are removed upon completion of the weld, the ends of the weld shall be left smooth and flush with the edges of the abutting parts.

(l) Welded Construction—Peening. Where required, multiple-layer welds may be peened with light blows from a power hammer, using an elongated round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling, flaking, or cold working of weld and base metal from over-peening.

(m) Finishing. Compression joints depending upon contact bearing shall have the bearing surfaces machined to a common plane after the members are completed.

(n) Lacing Bars. The ends of lacing bars shall be neat and free from burrs.

(o) Tolerances. 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.

A variation of one thirty-second inch (1/32") is permissible in the overall length of members with ends milled.

Members without milled ends, which are to be framed to other steel parts of the structure may have a variation from the detailed length not greater than one-sixteenth inch (1/16") for members thirty feet (30') or less in length, and not greater than one-eighth inch (1/8") for members over thirty feet (30') in length.

(p) Castings. Steel castings shall be annealed.

Section 2717. SHOP PAINTING. (a) Shop Coat. After inspection and approval and before leaving the shop, all steel work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust, spatter, slag or flux deposit, oil, dirt, and other foreign matter. Except where encased in concrete, and excepting edges and surface areas adjacent to edges, to be field welded, all steel work shall be given one coat of approved metal protection, applied thoroughly and evenly and well worked into the joints and other open spaces. All paint shall be applied to dry surfaces.

(b) Inaccessible Parts. Parts inaccessible after assembly shall be given two coats of shop paint, preferably of different colors.

(c) Contact Surfaces. Contact surfaces shall be cleaned, by effective means, before assembly, but not painted.

(d) Finished Surfaces. Machine-finished surfaces shall be protected against corrosion by a suitable coating.

(e) Surfaces to be Field Welded. Surfaces which are to be welded after erection shall, where practicable, not receive a shop coat of paint. If painted, such paint shall be removed before field welding, for a distance of at least two inches (2") on either side of the joint.

Section 2718. ERECTION. (a) Bracing. The frame of 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 equipment, and the operation of same. Such bracing shall be left in place as long as may be required for safety.

(b) Adequacy of Temporary Connections. As erection progresses, the work shall be securely bolted up, or welded, to take care of all dead load, wind and erection stresses.

(c) Erection Stresses. Wherever piles of material, erection equipment or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from the same.

(d) Alignment. No riveting or welding shall be done until as much of the structure as will be stiffened thereby has been properly aligned.

(e) Field Connections. Bolted or riveted field connections shall comply with the requirements of Section 2708 (e), (f), and (g).
CHAPTER 28 — WRECKING, EXCAVATIONS, FOUNDATIONS, FOOTINGS, AND RETAINING WALLS

Section 2800. WRECKING AND REMOVAL OF STRUCTURES. (a) General. Any person demolishing a structure, except those housing Group I or J occupancies, shall give notice in writing to the owners of adjoining buildings not less than ten (10) days before such demolition is started and shall send a copy of such notice to the Chief Building Inspector.

A wrecking contractor, prior to issuance of any permit, shall have a copy of a certificate of liability insurance on file in the office of the Building Inspection Department. Such insurance shall be valid and shall cover bodily injury and property damage to the public and to his employees for such operations. The minimum insurance shall be as follows:

Public Liability
Class A Wrecker $50,000/$100,000
Class B Wrecker $25,000/$50,000

Property Damage
Class A Wrecker $10,000/$25,000
Class B Wrecker $10,000/$25,000

When any other permittee performs such work, he shall be required to show proof of insurance in the same amounts as required above for wrecking contractors.

No wrecking or removal of any structure shall be commenced until every precaution for the protection of the public has been taken. Protection for demolition work shall be as required by the terms and provisions of Article 337 of the Revised Municipal Code.

Before the wrecking of any structure is commenced, the contractor shall have all utilities to such building or structure disconnected and all openings properly plugged or capped at the property line. Utility disconnection, except for building sewers, shall be performed or supervised by the proper utility company or agency affected. Disconnection of sewers shall be performed by a licensed drain layer or plumber after the issuance of a permit by the Manager of Public Works, and such work shall be inspected and approved by the City Engineer.

It shall be unlawful to sell or to advertise for sale used building material at the site of wrecking operations.

(b) Wrecking and Removal Procedure. In wrecking any building or part thereof, the contractor shall remove one story therefrom at a time, commencing at the highest story. No material shall be stored upon a floor of any building in the course of wrecking. The brick, timbers, and other parts of each story shall be lowered to the ground immediately upon displacement. No material shall be dropped to the ground.

It shall be unlawful for any contractor to burn paper, refuse, waste, or other materials at the site of any wrecking operation, except that a heating device approved for safety by the Chief Building Inspector may be provided on the job site for the comfort of the workmen in cold weather.

All dust resulting from operations shall be settled by wetting the same with water.

Adequate and conveniently located toilet facilities shall be provided on the job site, for the use of workmen employed on or engaged in demolition work. Such facilities shall be the equivalent of those required in Section 262 of this Code.

Trucks and other equipment used by the contractor shall not interfere with or block either vehicular or pedestrian traffic. Where it becomes necessary to transport units of a wrecked or removed structure through city streets or other public ways and places, permission to do such moving shall be secured through the Building Department from the City Traffic Engineer.

(c) Clearing of Site. In clearing a site, all excavations shall be filled so as to be level with the adjoining grade. Plaster, brick and other incombustible materials may be used to fill such excavations, provided, however, the top one (1) foot of fill shall be clean earth. The filling of such excavations shall not be required when a building permit has been issued for a new building on the site and the construction thereof is to be started within sixty (60) days after the completion of wrecking operations. In such event, the holder of the building permit shall provide such excavation with a substantial fence protecting the excavation on all sides of a height specified for safety by the Chief Building Inspector.

All adjacent streets, alleys, and other public ways and places shall be kept free and clear of all rubbish, refuse, and loose material resulting from the wrecking and removal operations.

(d) Damage to Public Property. As a condition of obtaining a permit to wreck or remove any structure, the permittee assumes liability for any damage to public property occasioned by such wrecking or removal operations.

(Ord. 199, Series 1959.)
Sections 2801. EXCAVATIONS. (a) General. Excavations for buildings and excavations accessory thereto shall be protected and guarded against danger to life and property. Permanent excavations shall have retaining walls of masonry, concrete, or such alternate materials of construction as may be approved by the Board of Appeals, and 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 or public sidewalk, street, alley, or other public property, unless such footing or foundation or public property is first properly underpinned or protected against settlement.

All excavations made below grade shall be protected so that the soil of adjoining property will not cave or settle. The person or persons making, or causing an excavation to be made, shall give notice in writing, not less than ten (10) days before such excavation is started to the owners of adjoining buildings, that the excavation is to be made and shall send a copy of such notice to the Chief Building Inspector.

(b) Footings. Whenever an excavation for footings is carried below the planned depth, the space so excavated below the proposed footing shall be filled solidly with concrete. The maximum projection of a footing shall not exceed the thickness of the footing unless reinforcement is provided to resist bending.

(c) Inspection. To allow for proper inspection of footings, foundations and the waterproofing thereof, all excavations shall extend at least two feet (2') beyond the exterior of foundation walls.

(Ord. 262, Series 1953.)

Section 2802. (a) General. The foundation of every permanent structure shall be supported by satisfactory bearing materials such as natural deposits of rock, gravel, sand, rock flour (inorganic silt), clay, or any combination there-of which does not contain an appreciable amount of organic matter.

No footing or foundation shall be placed on frozen soil. Unless adequately protected, footings or foundations shall not be laid in freezing weather.

(b) Different Levels. Where footings are supported at different levels, or at different levels from footings of adjacent structures, foundation plans shall include vertical sections showing, to true scale, all such variations in grade. The effect of such differences in footing levels on the bearing materials shall be considered in the design.

Section 2803. MATERIALS AND CONSTRUCTION. (a) General. Footings shall be of solid masonry as specified in Chapter 24, or of concrete as specified in Chapter 26, and shall be designed as specified in Section 2311 and this Chapter. Foundation walls shall be of masonry or concrete as specified in Chapters 24 and 26, and shall be designed in accordance with the provisions of this Chapter.

Exception: One-story buildings of Type V Construction (except Group I occupancy) which do not exceed four hundred square feet (400 sq. ft.) in area, may be constructed without a masonry or concrete foundation if the walls are supported on wood mudsills.

(b) Post and Girder Construction. In buildings housing Group I occupancy, exterior grade beams in post and girder construction shall be not less than six inches (6") in thickness and shall extend not less than six inches (6") above finished grade and not less than twelve inches (12") below finished grade.

(c) Piles. Foundations may be of piles constructed in conformance with this Chapter.

For design of footings see Section 2813 (a).

(d) An outside means of access, conforming to the following, shall be provided to the crawl space under basementless structures: The opening shall be not less than twenty-four inches (24") in width and eighteen inches (18") in height, and shall be protected by an area well securely rodded to the foundation wall. Such area well shall have a minimum wall thickness of six inches (6"), shall be not less than three feet (3') in depth, thirty inches (30") in height, and thirty-six inches (36") in width. The opening shall be protected by an attached, tight fitting cover placed at the top of the area well or by a sash attached to the opening.

Section 2804. DEPTH. Depth. Foundations, footings, and grade beams of permanent structures, except when founded on rock, and except as otherwise provided in this Section, shall be carried down below the frost line. Foundations of buildings of Types IV and V Construction may be carried to the depth designated in Table No. 28-B, except where soil conditions require greater depth.
TABLE NO. 28-A
MINIMUM FOUNDATION REQUIREMENTS FOR TYPE III BUILDINGS

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Thickness of Foundation Wall in Inches</th>
<th>Width of Footing in Inches</th>
<th>Thickness of Footing in Inches</th>
<th>Depth of Foundation Below Natural Surface of Ground and Finish Grade in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>12</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>12</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>12</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

NOTES:
For design of footings see Section 2813(a).
For reinforced concrete see Section 2620 and Table No. 26-C.

TABLE NO. 28-B
MINIMUM FOUNDATION REQUIREMENTS FOR TYPES IV AND V BUILDINGS

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Thickness of Foundation Wall in Inches</th>
<th>Width of Footing in Inches</th>
<th>Thickness of Footing in Inches</th>
<th>Depth of Foundation Below Natural Surface of Ground and Finish Grade in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>8</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>12</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>12</td>
<td>18</td>
<td>6</td>
</tr>
</tbody>
</table>

NOTES:
For design of footings see Section 2813(a).
For reinforced concrete see Section 2620 and Table No. 26-C.

Section 2805. CONCRETE SLABS. Concrete Slabs. Accessory buildings (Group J) and buildings housing pumping plants, work shops using incombustible and non-explosive materials, storage rooms, and sales rooms may be supported on concrete slabs laid on the earth. Such slabs shall be not less than four inches (4") thick with thickened edges. Footings for isolated columns and piers shall be as specified in Sections 2306, 2621, and this Chapter. A building housing Group I occupancy of Type IV or V Construction, not over seven hundred twenty square feet (720 sq. ft.) in area, may be supported on a concrete slab with thickened edges. Such edges shall extend at least six inches (6") above finished grade and twelve inches (12") below finished grade. The slab shall rest on a porous fill of select materials not less than four inches (4") in depth.

Section 2806. HEIGHT ABOVE THE GROUND. Foundation walls supporting wood members shall extend at least six inches (6") above the finished grade.

Section 2807. WATERPROOFING. All foundation walls and footings be-
low finished grade shall be waterproofed by the application of an approved waterproofing material.

Suitable insulation shall be installed under boilers, furnaces, and other heat-producing apparatus to protect the waterproofing against damage by heat.

When masonry units are used in foundation walls below grade, the exterior surfaces shall be plastered with not less than one-quarter inch (1/4") cement plaster before the application of waterproofing. Where loads are concentrated, solid units shall be used.

Section 2523. Exteriors. Where loads are concentrated, solid units shall be used.

Section 2808. Foundation Ventilation. See Section 2523.

Section 2809. VENTILATION BORINGS AND TEST PITS. (a) General. Before issuing a permit for erection or alteration of a permanent structure, the Chief Building Inspector in the absence of satisfactory data, shall require the owner to dig pits or make borings at such locations and carried to such depths as will disclose the character of the materials underlying the site of the proposed structure. When it is proposed to support a structure directly on bedrock, loading the rock to more than twenty thousand (20,000) pounds per square foot, the Chief Building Inspector may require a drill hole or a core boring to be made at each pier or footing location carried into the rock a sufficient depth to prove that sound bedrock has actually been reached.

(b) Boring Logs and Samples. Copies in duplicate of the results of all borings and pits made or started shall be filed with the Chief Building Inspector. Samples, properly protected from evaporation, representing the various classes of materials, shall be available to the Chief Building Inspector for examination when requested. Washed or bucket samples shall not be accepted.

Section 2810. CLASSIFICATION OF LOADS AND MATERIALS. (a) Classification. The terms used in the following classification shall be interpreted in accordance with generally accepted geological and engineering nomenclature. Certain terms shall, for the purpose of this Chapter, have more specific interpretation, as follows:

1. Rocks:

Shale — A laminated, fine-textured, soft rock composed of consolidated clay or silt, which cannot be molded without the addition of water, but which can be reduced to a plastic condition by moderate grinding and mixing with water.

Slate — A dense, very fine textured, soft rock which is readily split along cleavage planes into thin sheets and which cannot be reduced to a plastic condition by moderate grinding and mixing with water.

Schist — A fine textured, laminated rock with a more or less wavy cleavage containing mica or other flaky materials.

2. Granular Soil:

Gravel — An uncedent mixture of mineral grains one-quarter inch (1/4") or more in diameter.

Sand — A type of soil possessing practically no cohesion when dry and consisting of mineral grains smaller than one-quarter inch (1/4") in diameter.

Coarse Sand — A sand consisting chiefly of grains which will be retained on a sixty-five (65) mesh sieve.

Fine Sand — A sand consisting chiefly of grains which will pass a sixty-five (65) mesh sieve.

Compact Gravel, Compact Sand — Deposits requiring picking for removal and offering high resistance to penetration by excavating tools.

Loose Gravel, Loose Sand — Deposits readily removable by shoveling only.

3. Cohesive Soil:

Hardpan — A thoroughly compact mixture of clay, sand, gravel, and boulders, for example, boulder clay.

Clay — A fine grained inorganic soil possessing sufficient cohesion when dry to form hard lumps which cannot be readily pulverized by the fingers.

Hard Clay — A clay requiring picking for removal, a fresh sample of which cannot be molded in the fingers.

Medium Clay — A clay which can be removed by spading, a fresh sample of which can be molded by a substantial pressure of the fingers.

Soft Clay — A clay which, when freshly sampled, can be molded under relatively slight pressure of the fingers.

Rock Flour (Inorganic Silt) — A fine grained inorganic soil consisting chiefly of grains which will pass a two hundred (200) mesh sieve, and possessing sufficient cohesion when dry to form lumps which can be readily pulverized with the fingers.

Adobe — A calcareous cemented material ranging in texture from coarse sand to clay, to which hardpan, gravel, or cobblestones have been added.

(b) Allowable Bearing Pressure. The maximum pressure on soils under foundations shall not exceed the allowable bearing values set forth in Table No. 28-C, except when deter-
mined in accordance with the provisions of Sections 2811 and 2812.

(c) The tabulated bearing values for rocks of Classes 1 to 4 inclusive shall apply where the loaded area is less than two feet (2') below the lowest adjacent surface of sound rock. Where the loaded area is more than two feet (2') below such surface these values may be increased twenty per cent (20%) for each foot of additional depth but shall not exceed twice the tabulated values.

(d) The allowable bearing values of materials of Classes 5 to 10 inclusive may exceed the tabulated values by two and one-half per cent (2-1/2%) for each foot of depth of the loaded area below the lowest ground surface immediately adjacent, but shall not exceed twice the tabulated values. For areas of foundations smaller than three feet (3') in least lateral dimension, the allowable bearing values shall be one-third (1/3) of the allowable bearing values multiplied by the least lateral dimension, in feet.

(e) The tabulated bearing values for Classes 12 to 14 inclusive apply only to pressures directly under individual footings, walls and piers. When structures are founded on or are underlain by deposits of these classes, the total load over the area of any one bay or other major portion of the structure, minus the weight of the excavated material, divided by the area, shall not exceed one-half (1/2) the tabulated bearing values.

(f) Where the bearing materials directly under a foundation overlie a stratum having smaller allowable bearing values, these smaller values shall not be exceeded at the level of such stratum. Computation of the vertical pressure in the bearing materials at any depth below a foundation shall be made on the assumption that the load is spread uniformly at an angle of sixty degrees (60°) with the horizontal; but the area considered as supporting the load shall not extend beyond the intersection of sixty degrees (60°) planes of adjacent foundations.

(g) Where portions of the foundation of an entire structure rest directly upon or are underlaid by medium or soft clay or rock flour, and other portions rest upon different materials, or where the layers of such softer materials vary greatly in thickness, the magnitude and distribution of the probable settlement shall be investigated, as specified in Section 2812, paragraph (f), and, if necessary, the allowable loads shall be reduced or special provisions be made in the design of the structure to prevent dangerous differential settlements.
### TABLE NO. 28-C
ALLOWABLE SOIL PRESSURE

<table>
<thead>
<tr>
<th>CLASS</th>
<th>MATERIAL</th>
<th>Allowable Bearing Value (kips per square foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Massive bedrock, without laminations such as granite, diorite and other</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>granitic rocks; and also gneiss, trap rock, felsite and thoroughly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cemented conglomerates, all in sound condition (sound condition</td>
<td></td>
</tr>
<tr>
<td></td>
<td>allows minor cracks)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Laminated rocks as slate and schist in sound condition (minor cracks</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>allowed)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sandstone, limestone and other soft sedimentary rocks in sound</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>condition (other than shale)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Shale in sound condition (minor cracks allowed)</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>Residual deposits of shattered or broken bedrock of any kind except</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>shale</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Hardpan</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Gravel, sand-gravel mixtures, compact</td>
<td>8c</td>
</tr>
<tr>
<td>8</td>
<td>Gravel, sand-gravel mixtures, loose; sand coarse compact</td>
<td>6c</td>
</tr>
<tr>
<td>9</td>
<td>Sand, coarse, loose; sand, fine compact</td>
<td>5c</td>
</tr>
<tr>
<td>10</td>
<td>Sand, fine loose</td>
<td>4c</td>
</tr>
<tr>
<td>11</td>
<td>Adobe</td>
<td>*</td>
</tr>
<tr>
<td>12</td>
<td>Hard Clay</td>
<td>6**</td>
</tr>
<tr>
<td>13</td>
<td>Medium Clay</td>
<td>4**</td>
</tr>
<tr>
<td>14</td>
<td>Soft Clay</td>
<td>1**</td>
</tr>
<tr>
<td>15</td>
<td>Rock flour, shattered shale, or any natural deposit of unusual</td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>character not provided for herein</td>
<td></td>
</tr>
</tbody>
</table>

* Shall have same bearing value as soil of same character without calcareous binding agent.

** May be determined by laboratory test as 0.75 times the average unconfined compressive strength.

*** Value to be fixed by the Chief Building Inspector.

c An approved penetration test procedure will be acceptable for determining the density of the material in these Classes.

(h) Inflow of Water in Excavation. Whenever in an excavation an inward or upward flow of water develops in an otherwise satisfactory bearing material, special methods satisfactory to the Chief Building Inspector shall be immediately adopted to stop or control the flow to prevent disturbance of the bearing material. If such flow of water seriously impairs the structure of the bearing material, the allowable bearing value shall be reduced to that of the material in loose condition.

Section 2811. FOUNDATION LOAD TESTS.

(a) Foundation Load Tests. Whenever the allowable load on a bearing material or a pile is in doubt, the Chief Building Inspector may require tests to be made to enable him to determine such load as, in his opinion, will not cause dangerous or objectionable settlements. The load so determined shall be taken as the allowable load.

(b) The proposed testing apparatus and
specifications of the procedure shall receive the approval of the Chief Building Inspector before it is used. Loads shall be applied by direct weight or by means of hydraulic jack pressure that is automatically maintained constant. Tests shall be under the supervision of the Chief Building Inspector. Settlement readings shall be referred to a bench mark established at a sufficient distance from the test to be unaffected by it and they shall be made by a method which assures accuracy to the degree herein-after specified.

Section 2812. LOAD TESTS OF BEARING MATERIALS: (a) Load Tests of Bearing Materials. For bearing materials of Classes 1 to 6 inclusive, the loaded area shall be at least one square foot (1 sq. ft.) and for other classes at least four square feet (4 sq. ft.). For materials of Classes 7 to 15, inclusive, the loaded area shall be the full size of the pit and at such depth that the ratio of the width of the loaded area to its depth below the immediately adjacent ground surface is the same as the larger of the following two values:

1. Ratio of the width of any footing to its depth below the immediately adjacent ground surface.

2. Ratio of the width of the entire foundation or group of footings to its depth below the average surrounding ground surface.

(b) When loading tests are made on materials of Classes 12 to 15 inclusive, suitable methods shall be used to prevent evaporation from the materials being tested.

(c) A load test shall be applied which will produce a unit pressure equal to that for which the proposed foundations are designed. This load shall be allowed to remain undisturbed until no measurable settlement occurs during a period of twenty-four (24) hours. The load shall then be doubled in increments not exceeding twenty-five per cent (25%) of the designed load. At least four (4) hours shall elapse between the application of successive increments. The total load shall be allowed to remain undisturbed until no measurable settlement occurs during a period of twenty-four (24) hours.

(d) Measurements of settlement shall be accurate to one thirty-second inch (1/32") and shall be taken and recorded every hour during the first six (6) hours after each increment and at least once every twelve (12) hours thereafter.

(e) When the design load upon bearing materials of Classes 1 to 12 inclusive causes settlement of less than three-eighths inch (3/8") and twice the design load cause settlement of less than one inch (1"), the design load shall be allowed; but if medium or soft clay underlies these materials the vertical pressure in such clay shall not exceed that allowed in Section 2810.

(f) Whenever the proposed foundation rests on or is underlain by bearing materials of Classes 12 to 15, inclusive, the results of the loading tests must be interpreted in conjunction with accurate soil profiles showing magnitude and variation of the thickness of these strata. If this information, in the opinion of the Chief Building Inspector, is not sufficient to determine whether the design load will cause excessive settlement, as might occur due to a thick stratum of clay, or dangerous differential settlement, as might occur when the underlying clay stratum varies considerably in thickness, the Chief Building Inspector may require an analysis to be made of the probable magnitude, rate and distribution of settlement of the proposed structure. Such analysis may be based upon:

1. A study of settlement records of nearby structures having essentially the same foundation conditions.

2. Consolidation tests and other investigations of undisturbed samples of the compressible materials.

(g) When loading tests are made on Class 11 materials, provision shall be made to determine the effect of saturation on the bearing capacity of the soil.

Section 2813. DESIGN OF FOOTINGS. (a) Footings. The base areas of all footings shall be proportioned as specified in Section 2621.

(b) Structural Design. Except for special provisions of Section 2815 covering the design of piles all portions of footings shall be designed in accordance with the structural provisions of this Code.

Section 2814. PROTECTION OF STEEL IN GRILLAGE FOOTINGS. When grillage footings of structural steel shapes are used on soils, they shall be completely embedded in concrete with at least six inches (6") on the bottom and at least four inches (4") at all other points.

Section 2815. PILES (a) General. The allowable axial-and/or lateral loads on piles shall be determined by an approved formula, by load tests, or by a foundation investigation by an approved agency. A foundation investigation shall be made if required by the Chief Building Inspector.

(b) Allowable Loads. The allowable pile loading shall be limited by the provision that the vertical pressures in the bearing materials at or below the points of the piles produced by the loads on all piles in a foundation shall not exceed the allowable bearing values of such materials as specified in Sections 2810, 2811, and 2812. Piles or pile groups shall be assumed to transfer their loads to the bearing
materials by spreading the load uniformly at an angle of sixty degrees (60°) with the horizontal, starting at a polygon circumscribing the piles at the top of the satisfactory bearing stratum in which they are embedded, but the area considered as supporting the load shall not extend beyond the intersection of the sixty degree (60°) planes of adjacent piles or pile groups.

(c) The allowable load on each pile shall further be limited by the requirement that such load shall not cause excessive movement of the pile relative to the soil. Satisfactory proof of this load for all soil conditions and all types of piles can be obtained from load tests conducted in accordance with Section 2818. In the absence of such proof of the supporting capacity, the load on any pile shall not exceed the allowable value determined in accordance with paragraphs (d) to (h) inclusive, of this Section.

(d) The allowable load on each pile shall be determined only when the hammer is operating at the maximum number of blows per minute as scheduled in the manufacturer's specifications.

W = weight of striking part of hammer in pounds

h = height of fall of striking part of hammer in feet

s = average penetration per blow, in inches, for the last five blows

R = allowable pile load in pounds

1. R = \( \frac{2Wh}{s+1.0} \) for drop hammers

2. R = \( \frac{2Wh}{s+0.1} \) for steam hammers

in which

Section 2816. GENERAL DESIGN REQUIREMENTS. (a) A detached column supported by piles shall rest upon not less than three (3) piles, but a column connected to a permanent construction, which provides adequate lateral support to the top of the piles, may rest upon a single pile or upon two piles.

(b) A foundation wall of a building not more than one story nor more than twenty feet (20') high, if supported laterally by masonry, reinforced concrete or steel construction at intervals not exceeding twenty feet (20') may be supported by a single row of piles. If the distance between such lateral supports exceeds ten feet (10'), the capping shall be continuous and shall consist of a structural steel grillage or reinforced concrete at least two feet (2') wide in which the number of square inches of longitudinal steel reinforcement near each vertical face is at least one-eighth (1/8) times the length in feet between lateral supports. Other foundation walls supported upon piles shall rest upon at least two rows of piles. The outer rows shall be at least two feet (2') apart on centers under buildings up to thirty feet (30') in height and at least three feet (3') apart under buildings higher than thirty feet (30').

(c) The excavation for pile foundations, whenever practicable shall be completed to pile cut-off grade, or lower, before piles are driven. In no case shall piles be driven through more than three feet (3') of unexcavated material above pile cut-off grade.

(d) The method of driving shall be such as not to impair the strength of the pile and shall meet with the approval of the Chief Building Inspector. A steel or iron follower may be used, subject to his approval. It shall be equipped with a suitable socket encasing the pile head sufficiently to prevent damage while
driving. Shattered, broomed, or otherwise damaged pile heads shall be cut back to sound material before driving with the follower. If a wooden driving block is used, it shall, at the time it is used for measuring the penetration, be of sound hard wood equal to oak, not more than twelve inches (12") in height, with the grain parallel to the axis of the pile, and shall be enclosed in a steel casing of adequate strength to resist lateral distension.

(e) Piles shall not be jetted without specific approval of the Chief Building Inspector. After jetting, piles shall be driven to the required resistance.

(f) Additional piles shall be driven to replace piles injured during driving, and to supplement piles having capacity less than required by the design.

(g) Protection of Pile Materials. Where the boring records of site conditions indicate possible deleterious action on pile materials because of soil constituents, changing water levels or other factors, such materials shall be adequately protected by methods or processes approved by the Chief Building Inspector. The effectiveness of such methods or processes for the particular purpose shall have been thoroughly established by satisfactory service records or other evidence which demonstrates the effectiveness of such protective measures.

(h) Types of piles not specifically provided for in this Chapter shall meet such additional requirements as may be prescribed by the Chief Building Inspector.

Section 2817: STRUCTURAL REQUIREMENTS FOR PILES. (a) Structural Strength of Piles and Limiting Values of Stresses. The allowable compressive stresses on all piling materials shall not exceed the value as specified below except that stresses may be increased on submission of satisfactory data for specially protected, selected, or high strength material.

1. Concrete—225 f'c

2. Structural steel — 9,000 pounds per square inch

3. Wood—The allowable stress in compression parallel to the grain of round wood piles shall not exceed 60 per cent of the basic stress for clear material as designated in regulations issued pursuant to Section 4601, and in no event shall the stress exceed 1000 p.s.i.


The full load shall be assumed as carried on the pile cross-section located at the upper surface of the soil supporting the pile.

Where the influence of subsiding fills is considered as imposing loads in the pile, the above stresses may be increased if satisfactory substantiating data are submitted.

(b) Round Wood Piles. 1. Quality. Every wood pile shall conform to the specification for Class A or Class B piles as designated in regulations issued pursuant to Section 4601.

2. Treated Piles. Creosoted piles of Douglas fir or of Southern pine shall be treated with Grade 1 creosote in accordance with regulation issued pursuant to Section 4601, with final retention of not less than twelve (12) pounds per cubic foot for Douglas fir, nor less than fifteen (15) pounds per cubic foot for Southern pine.

(c) Pre-Cast Concrete Piles. 1. Quality. Precast concrete piles shall be cast in one piece and prior to driving and at twenty-eight (28) days after pouring shall develop an ultimate compressive strength (f'c) of at least three thousand pounds per square inch (3000 p.s.i.).

2. Reinforcement Ties. The longitudinal reinforcement in driven pre-cast concrete piles shall be laterally tied with steel ties or wire spirals. Ties and spirals shall be spaced not more than three inches (3") apart, center to center, for a distance of two feet (2') from the ends and not more than eight inches (8") elsewhere.

3. Diameter. The diameter of ties and spirals shall be as follows:

   For piles having a diameter of sixteen inches (16") or less, wire shall not be smaller than No. 5 gauge.

   For piles having a diameter of more than sixteen inches (16") and less than twenty inches (20"), wire shall not be smaller than No. 4 gauge.

   For piles having a diameter twenty inches (20") and larger, wire shall not be smaller than one-quarter inch (1/4") round or No. 3 gauge.

4. Stresses. Precast concrete piling shall be designed to resist stresses induced by handling and driving as well as by loads.

(d) Uncased Cast-in-Place Friction Piles. 1. Quality. Concrete piles cast-in-place against earth in drilled or bored holes shall be made in such a manner as to insure the exclusion of any foreign matter and to secure a full-sized shaft. The length of such pile shall be limited to not more than thirty (30) times the average diameter. Concrete shall have an ultimate compressive strength (f'c) of not less than 2500 p.s.i.

2. Friction. Any uncased cast-in-place pile may be assumed to develop a frictional resistance equal to one-sixth (1/6) of the bearing value of the soil material at minimum depth.
as stipulated in Table No. 28-C but not to exceed 500 p.s.i. unless a greater value is prescribed by the Chief Building Inspector after a soil investigation as specified in Section 2811. 

3. Combined Friction and Bearing Prohibited. Frictional resistance and bearing resistance shall not be assumed to act simultaneously.

(e) Metal-Cased Concrete Piles. 1. Dimensions. Every metal casing for a concrete pile shall have a sealed tip with a diameter of not less than eight inches (8"").

Concrete piles cast in place in metal shells shall have shells driven for their full length in contact with the surrounding soil and left permanently in place. The shells shall be sufficiently strong to resist collapse and sufficiently watertight to exclude water and foreign material during the placing of the concrete.

2. Concrete. All concrete used in metal-cased concrete piles shall have an ultimate compressive strength (f'c) of not less than 2,500 pounds per square inch.

3. Order of Driving. Piles shall be driven in such order and with such spacing as to ensure against distortion of or injury to piles already in place. No pile shall be driven within four and one-half (4-1/2) average pile diameters of a pile filled with concrete less than twenty-four hours old unless approved by the Chief Building Inspector.

(f) Concrete Filled Steel Pipe Piles. 1. Steel Pipe. Steel pipe piles shall conform to regulations issued pursuant to Section 4601. If it is desired to use pipe of other material, satisfactory substantiating data must be submitted.

2. Concrete. The concrete used in concrete filled steel pipe piles shall have an ultimate compressive strength (f'c) of not less than 2,500 pounds per square inch.

3. Allowable Loads. The allowable load on concrete-filled steel pipe piles shall not exceed 9,000 pounds per square inch on the steel plus .225 of the ultimate compressive strength (f'c) of the concrete. The net steel area to be considered shall be the area based on the actual thickness minus one-sixteenth inch (1/16") of thickness.

(g) Rolled Structural Steel Piles. 1. Material. Structural steel piles shall conform to regulations issued pursuant to Section 4601.

No section shall have a nominal thickness of metal less than three-eighths inch (3/8").

Section 2818. PILE LOADING TESTS. (a) Pile Loading Tests. A pile to be tested shall be loaded to at least twice the proposed working load, the load being applied in increments of not over ten thousand (10,000) pounds. At least four hours shall elapse between the addition of successive increments. Measurements of the settlement, accurate to one thirty-second inch (1/32") shall be taken and recorded immediately before and after each increment of load is added. In determining the settlement, proper deduction shall be made for elastic compression of the pile under the test load.

(b) The allowable pile load shall not exceed one-half (1/2) of that causing a total settlement of one-half inch (1/2") which remains constant for forty-eight (48) hours, but the load on the bearing materials at the level of the points or upon any lower stratum shall not exceed the bearing values specified in Sections 2810 and 2815.
CHAPTER 29 - VENEERED WALLS

Section 2901. GENERAL. (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 (5/8") or less in thickness.

Section 2902. VENEER COMPOSED OF MA-SONRY UNITS. (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 (4) 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.

Section 2903. VENEER COMPOSED OF NON-STRUCTURAL UNITS. (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.

Exception: Approved units, or units of flat tile, stone, or terra cotta which are manufactured with scored surface may be cemented to a masonry or concrete wall or to exterior plaster with Type A Portland cement mortar, provided the mortar bond is sufficient to withstand a shear stress of fifty (50) pounds per square inch after curing for twenty-eight (28) days.

(d) In all cases, before applying masonry veneer, a substantial waterproof paper of asphalt-saturated felt, weighing not less than fourteen (14) pounds per one hundred square feet (100 sq. ft.), shall be applied weatherboard fashion directly over the sheathing. All wood frame shall be sheathed diagonally with one inch (1") board securely nailed to the studs.

Section 2904. SPECIAL REQUIREMENTS FOR GLASS VENEER. (a) General. In addition to the general requirements of this Chapter, all veneer of glass shall comply with the regulations in this Section.

Glass veneer shall not be attached to any exterior wall at a point more than thirty-five feet (35') above the adjoining ground elevation.

(b) Dimension. Glass veneer units shall be not less than one-eighth inch (1/8") in thickness. Units less than three-sixteenths inch (3/16") in thickness shall be not larger in area than one square foot (1 sq. ft.). Units not more than one-quarter inch (1/4") nor less than three sixteenths inch (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 (1/2) of the area of the unit after the unit has been set in place and shall be neither less than one-quarter inch (1/4") nor more than one-half inch (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 (4) 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 (1/32") in thickness. There shall be at least one-sixty-fourth inch (1/64") clearance between bolts and the adjacent glass.
CHAPTER 30 – ENCLOSURE OF VERTICAL OPENINGS

Section 3001. ENCLOSURES: WHEN REQUIRED. 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.

Section 3002. ELEVATOR ENCLOSURES. Walls and partitions enclosing elevators shall be of not less than the fire-resistive construction required under Types of Construction in Part V. Enclosing walls of elevator shafts may consist of wire glass set in metal frames on the entrance side only. Elevator shafts extending through more than two stories shall be equipped with an approved means of adequate ventilation to and through the main roof of the building.

Section 3003. OTHER VERTICAL OPENINGS. 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.

Section 3004. AIR DUCTS. Air ducts passing through a floor shall be enclosed in a shaft. The shaft shall be as required for vertical openings in Part V. Dampers shall be installed where ducts pierce the shaft enclosure walls. Dampers shall conform to regulations issued pursuant to Section 4601. Air ducts in Group I Occupancies need not be enclosed in a shaft if conforming to regulations issued pursuant to Section 4601.
CHAPTER 31 – FLOOR CONSTRUCTION

Section 3101. GENERAL. Floor construction shall be of materials and construction as specified under Occupancy in Part III and under Types of Construction in Part V.

All floors shall be so framed and tied into the framework and supporting walls as to form an integral part of the whole building.

The types 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 specified in Sections 3102 and 3103.

Fire-resistive standards of floor construction are specified in Section 4305.

Section 3102. CONCRETE FLOORS. Concrete slab floors laid directly on earth shall be not less than four inches (4") thick with thickened edges. Other 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 (1/2") into the slab.

Section 3103. STEEL JOISTED FLOORS. 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 4305, 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.

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.

Bridging shall be provided during the period of construction to support adequately 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 stay the joists laterally and to transmit any horizontal forces in either direction perpendicular to the 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 five hundred pounds (500 lbs.) from each joist to the adjoining joists.

Section 3104. CELLULAR STEEL FLOORS. (a) General. Cellular steel floor construction shall consist of sheet or strip steel formed into an integrated system of parallel steel beams which combine the function of load-bearing members and a continuous deck spanning between main supporting girders, beams, or walls.

When used in fire-resistive construction, steel floors shall have a minimum of two inches (2") of concrete fill on top and shall be protected with a fire-resistive ceiling suspended from the underside.

(b) Physical Properties. The steel used in the manufacture of steel floor units shall conform to regulations issued pursuant to Section 4601.

(c) Minimum Thickness. The thickness of the steel used in the manufacture of steel floors shall be not less than U. S. Standard Gauge No. 18.

(d) Design. Cellular steel floors shall admit of a rational analysis, and such floor assemblies shall have been tested and certified by a recognized testing agency to substantiate stress values used.

Flexural stress values shall not exceed sixty per cent (60 %) of the yield point specified for the grade steel permitted in Subsection (b) of this Section.

When plastered ceilings are suspended from steel sub-floor units, the maximum permissible deflection due to the full live load after the plaster is applied shall not exceed one three-hundred-sixtieth (1/360) of the span.

Section 3105. WOOD FLOORS. (a) Wood Joisted Floors. Wood joisted floors shall be framed and constructed and anchored to supporting wood stud or masonry walls as specified in Chapter 25. Wood joists floors need not be fire-protected on the under side except where specifically required under Occupancy in Part III, Location in Part IV, or Type of Construction in Part V.

Girders supporting first floor joists in residence buildings shall be not less than four inches by four inches (4"x4") for spans and five feet (5') or less, or not less than four inches by six inches (4"x6") (placed on edge) for spans not more than seven feet (7').
Where the joists are not designed as specified in Chapter 25, Table No. 31-A gives the maximum allowable spans for floor joists of a grade not less than 1100f or No. 2 Douglas fir or comparable grades in other species surfaced four (4) sides to sizes conforming to regulations issued pursuant to Section 4601, and based on live load of forty (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 doubled and 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.

In wood frame floor construction where suspended ceilings occur, the space between the ceiling and the floor above shall be divided into areas not exceeding one thousand square feet (1,000 sq. ft.) in a manner required for partitioning attic space in Section 3205.

(b) Plywood Flooring. Where used as flooring, plywood shall be of the minimum thicknesses specified in Table No. 31-B.

Section 3106. MILL CONSTRUCTED FLOORS. Mill constructed floors shall be not less than three inches (3") nominal splined or tongued and grooved plank covered with one-inch (1") nominal flooring laid crosswise or diagonal. Top flooring shall not extend closer than one-half inch (1/2") to walls to allow for swelling in case the floor becomes wet. Such one-half-inch (1/2") space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinking movements of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.

If laminated floors are used, at least two laminations at the wall shall be omitted until after glazing and roofing has been completed.

See Section 2517 (b) for detailed requirements.
### TABLE NO. 31-A
ALLOWABLE SPANS FOR FLOOR JOISTS

<table>
<thead>
<tr>
<th>SIZE (Inches)</th>
<th>SPACING CENTER TO CENTER (Inches)</th>
<th>MAXIMUM ALLOWABLE SPAN (Feet and Inches)</th>
<th>Without Plastered Ceiling Below</th>
<th>Plastered Ceiling Below</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 6</td>
<td>12</td>
<td>10-5</td>
<td>11-6</td>
<td>10-0</td>
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<tr>
<td></td>
<td>16</td>
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<td>24</td>
<td>7-8</td>
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<td>2 x 8</td>
<td>12</td>
<td>13-10</td>
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<td>16</td>
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<td>2 x 10</td>
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<td></td>
<td>24</td>
<td>12-6</td>
<td>13-9</td>
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<tr>
<td>2 x 12</td>
<td>12</td>
<td>20-11</td>
<td>22-11</td>
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<td>24</td>
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<td>16-7</td>
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<tr>
<td>2 x 14</td>
<td>12</td>
<td>24-4</td>
<td>26-7</td>
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<td>3 x 6</td>
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<td>3 x 12</td>
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<td>12</td>
<td>28-7</td>
<td>30-6</td>
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<td>23-1</td>
<td>24-2</td>
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</tr>
</tbody>
</table>

### MINIMUM THICKNESS OF PLYWOOD

<table>
<thead>
<tr>
<th>PLYWOOD THICKNESS (Inches)</th>
<th>LIVE LOADS (lbs. per sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>5/16</td>
<td>18 inch span</td>
</tr>
<tr>
<td>3/8</td>
<td>22 inch span</td>
</tr>
<tr>
<td>1/2</td>
<td>27 inch span</td>
</tr>
<tr>
<td>5/8</td>
<td>33 inch span</td>
</tr>
</tbody>
</table>

Panels shall extend lengthwise (direction of face grain) across supports.
CHAPTER 32—ROOF CONSTRUCTION AND COVERING

Section 3201. GENERAL. 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.

Section 3202. CONSTRUCTION. The general requirements for construction of floors as specified in Chapter 31 shall apply to roofs except that in Type II buildings the roof sheathing shall be not less than two inches (2") nominal in thickness and except that concrete or gypsum roof slabs shall be not less than two inches (2") in thickness.

Roof trusses shall have all joints well fitted and shall have all tension members well tightened before any load is placed on the truss. Diagonal and sway bracing shall be used to brace all roof trusses. The allowable working stresses of materials in trusses shall be as specified in Chapters 25 and 27. The minimum net section of the members after framing shall be used in determining the strength of the truss at any point.

Plywood roof sheathing, unless of exterior type, shall have no surface or edge exposed to weather.

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

Where the roof is not designed as specified in Chapter 25, Table No. 32-A gives the maximum allowable spans for ceiling joists and roof rafters of a grade not less than 1100F or No. 2 Douglas fir or comparable grades in other species, surfaced four (4) sides to sizes conforming to regulations issued pursuant to Section 4601, and based on the live loads specified in Section 2305.

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 spans 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.

Section 3204. ROOF COVERINGS. (a) General. Roof coverings for all buildings shall be either “Fire-Retardant” or “Ordinary” roof coverings as specifically required either by Location in Part IV or by Type of Construction in Part V. The roof covering shall be securely fastened to the supporting roof construction.

(b) Composition Roofing Materials. For purposes of this Section, certain terms are designated as follows:

Felt—Roofing felt made from organic or asbestos fibers saturated with bituminous compound.

Cap Sheet—Roofing made of organic or asbestos fibers saturated and coated on both sides with a bituminous compound and surfaced with mineral granules, mica, talc, ilmenite, asbestos fibers, or similar materials, except on the unexposed portions of split cap sheets.

Cementing Materials—Built-up composition roof shall be thoroughly mopped solid between layers with bituminous compound using not less than twenty (20) pounds of hot asphalt or not less than one and one-half (1-1/2) gallons of cold bituminous compound in accordance with roofing manufacturer's published specifications or hot coal tar pitch, using thirty (30) pounds per one hundred square feet (100 sq. ft.) of roof area.
### TABLE NO. 32-A
ALLOWABLE SPANS FOR CEILING JOISTS AND ROOF RAFTERS

<table>
<thead>
<tr>
<th>SIZE (Inches)</th>
<th>SPACING CENTER TO CENTER (Inches)</th>
<th>CEILING JOISTS</th>
<th>MAXIMUM ALLOWABLE SPAN (Feet and Inches)</th>
<th>RAFTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Slope of Less Than 4 in 12</td>
<td>Slope of 4 in 12 to 12 in 12</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Group I*</td>
<td>Group II*</td>
</tr>
<tr>
<td>2 x 4</td>
<td>12</td>
<td>11-0</td>
<td>8-5</td>
<td>9-1</td>
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<tr>
<td></td>
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<td>10-1</td>
<td>7-4</td>
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<td>24</td>
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<td>32</td>
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<td>2 x 6</td>
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<td>32</td>
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<td>2 x 8</td>
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<td>32</td>
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<td></td>
<td>32</td>
<td>20-8</td>
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</tbody>
</table>

* Group I—Dead Load—Weight of roof joist.
  Weight of roof sheathing (2.5 pounds per square foot).
  Weight of roof coverings (2.5 pounds per square foot).

* Group II—Dead Load—Weight of roof joist.
  Weight of roof sheathing (2.5 pounds per square foot).
  Weight of roof coverings (8 pounds per square foot).
Spot Cementing—Intermittent application of asphalt sealing agent in an amount not less than ten (10) pounds per one hundred square feet (100 sq. ft.) of roof area at points not more than twelve inches (12") apart.

Base Sheets—One or more layers of saturated felt or saturated and coated roofing products over which is placed a cap sheet, asbestos shingles, composition shingles, gravel surfacing, ceramic, or other similar surfacing materials.

(c) Materials. All materials shall be delivered in original packages bearing manufacturer's label. Mineral surfaced cap sheets, asphalt shingles, and smooth surface cap sheets shall bear the label of the Underwriters' Laboratories, Inc., for Class A, B, or C roofing.

Nails for composition roof shall not be smaller than twelve (12) gauge, with heads not less than three-eighths inch (3/8") in diameter for shingle application and nine-sixteenths inch (9/16") for built-up roofs and shall be long enough fully to penetrate the sheathing with a maximum three-fourths inch (3/4"). Smaller head nails may be substituted providing metal discs are used with them. Exposed nails and shingle nails shall be corrosion resistant.

(d) Application. Base sheets shall be nailed to the roof sheathing using not less than one nail to each one and one-third square feet (1-1/3 sq. ft.) of roof area, or base sheets may be spot cemented to an existing composition roof, or spot cemented or fully mopped to a suitable deck.

Asphalt shingles shall be nailed according to manufacturer's printed specifications, but for strip shingles of square tab type, weighing approximately two hundred ten (210) pounds per square and measuring twelve inches by thirty-six inches (12"x36"), no less than six nails shall be used per each strip.

Hot asphalt shall be applied at a temperature of not less than three hundred seventy-five degrees Fahrenheit (375°F.) and shall in no case be heated to a temperature higher than four hundred twenty-five degrees Fahrenheit (425°F.) at the kettle.

Coal tar pitch shall not be heated above three hundred seventy-five degrees Fahrenheit (375°F.).

(e) Fire-Retardant Roof Covering. A fire-retardant roof covering 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 roof assembly bearing the label of the Underwriters' Laboratories, Inc., for Class A or B roofing.

1. Any built-up composition roofing consisting of materials whose fire-retardant values as set forth in Table No. 32-B equal not less than fifteen (15) points including a top covering selected from parts (b), (c), or (d) of said Table.

2. Hydraulic compressed rigid shingles not less than one-eighth inch (1/8") thick, composed of Portland cement and asbestos fibers, laid over a layer of saturated felt weighing not less than fourteen (14) pounds to the one hundred square feet (100 sq. ft.) or hydraulic compressed rigid sheets not less than seven thirtyseconds inch (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 not less than two hundred (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. 30 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. & S. gauge copper wire, with nails of such length as to provide not less than three-fourths inch (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 thirty (30) pounds to one hundred eight square feet (108 sq. ft.).

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") and galvanized iron nails may be used, and provided further that the tile with projection lugs need not be nailed or wired in place. Wire shall be not smaller than No. 14 B. & S. gauge. Nails shall penetrate the supporting roof construction not less than three-fourths inch (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 (4) 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 (5) representative tile tested shall be not less than four hundred (400) pounds and the breaking load for any individual tile tested shall be not less than three hundred fifty (350) pounds.

Roof tile shall not absorb more than fifteen per cent (15%) of the dry weight of the tile during a forty-eight (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 (14) pounds to one hundred square feet (100 sq. ft.), solidly mopped between and surfaced with asphalt.

(f) Ordinary Roofings. "Ordinary" roofing shall be any roof covering which meets the requirements specified for any one of the following roofings, 8 to 10 inclusive, or shall be any roofing meeting the Class C Specifications of the Underwriters' Laboratories, Inc.

8. Any composition roofing or any built-up composition roofing consisting of layers of roofing felt, roll roofing, felt membrane, or gravel, the sum of whose fire-retardant values as set forth in Table No. 32-B equals not less than ten (10).

9. Asphalt shingles laid in one or more layers.

10. Wood shingles and shakes of clear vertical grain all-heart wood, not less in thickness than five (5) shingles to two inches (2") at the butt, laid with the following exposures.

<table>
<thead>
<tr>
<th>Total Length of Shingle or Shake</th>
<th>Permissible Exposed Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 in.</td>
<td>5 in.</td>
</tr>
<tr>
<td>18 in.</td>
<td>5-1/2 in.</td>
</tr>
<tr>
<td>24 in.</td>
<td>7-1/2 in.</td>
</tr>
<tr>
<td>32 in.</td>
<td>9-1/2 in.</td>
</tr>
<tr>
<td>36 in.</td>
<td>11 in.</td>
</tr>
</tbody>
</table>

Where such shingles or shakes are laid over not less than two (2) fifteen-pound layers or one (1) thirty-pound layer of felt, the exposed length to the weather shall not be limited.

All wood shingles shall be nailed firmly with copper, zinc, zinc-coated, or galvanized steel nails of at least 14 B. & S. gauge and not less than one and one-fourth inch (1-1/4") long. Each shingle shall be nailed with two (2) nails driven substantially into the supporting roof construction.

Wood shingles bearing the label of any recognized inspection agency, certifying compliance with regulations issued pursuant to Section 4601, may be accepted as meeting the requirements of this Code.

(g) Roofing for Group J Occupancies. On buildings housing Group J, Division 1 occupancies any composition roofing having a fire-retardant value equal to not less than six (6), as set forth in Table No. 32-B, may be used unless otherwise required because of Location as specified in Parts IV and V of this Code.
### TABLE NO. 32-B
FIRE RETARDANT VALUES OF ROOFING MATERIALS

<table>
<thead>
<tr>
<th>Shipping Weight (In lbs.)</th>
<th>Base Sheets Only</th>
<th>Min. Wt. Per 100 Sq. Ft. Of Roof Area (In lbs.)</th>
<th>Fire Retardant Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Asphalt Saturated Felt</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>30</td>
<td>Asphalt Saturated Felt</td>
<td>28</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>Asphalt Saturated and Coated Dampcourse</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>40</td>
<td>Asphalt Smooth Surfaced Roofing</td>
<td>37</td>
<td>6</td>
</tr>
<tr>
<td>15</td>
<td>Asphalt Saturated Asbestos Felt</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>Asphalt Saturated Asbestos Felt</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>Asphalt Saturated Asbestos Felt</td>
<td>41</td>
<td>9</td>
</tr>
<tr>
<td>55</td>
<td>Asphalt Saturated Asbestos Felt</td>
<td>50</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>Asphalt Saturated Asbestos Felt (minimum 2 layers)</td>
<td>28</td>
<td>10</td>
</tr>
<tr>
<td>(c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Mineral Surfaced Split Sheets (minimum 2 layers)</td>
<td>106</td>
<td>12</td>
</tr>
<tr>
<td>58</td>
<td>Ilmenite Surfaced Split Sheets (minimum 2 layers)</td>
<td>106</td>
<td>12</td>
</tr>
<tr>
<td>58</td>
<td>Ilmenite Surfaced Roofing</td>
<td>55</td>
<td>7</td>
</tr>
<tr>
<td>90</td>
<td>Mineral Surfaced Asphalt Cap Sheet</td>
<td>83</td>
<td>10</td>
</tr>
<tr>
<td>75</td>
<td>Smooth Surfaced Cap Sheet</td>
<td>68</td>
<td>9</td>
</tr>
<tr>
<td>65</td>
<td>Smooth Surfaced Cap Sheet</td>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td>55</td>
<td>Smooth Surfaced Cap Sheet</td>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>39</td>
<td>Asphalt Saturated Asbestos Roofing (White Top)</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>55</td>
<td>Asphalt Saturated Asbestos Roofing (White Top)</td>
<td>52</td>
<td>10</td>
</tr>
<tr>
<td>(d)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gravel, Ceramic and Other Similar Surfacing Materials</td>
<td>400</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Slab 1/4&quot; to 1/2&quot; in size</td>
<td>300</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1/8&quot; to 1/2&quot; in size</td>
<td>300</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1400</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(h) **Attic Ventilation.** In buildings housing group I occupancies adequate ventilation shall be provided in all spaces between the roof and top floor ceiling by means of louvres or other approved vents. The net area of each ventilation opening shall be not less than one hundred forty-four square inches (144 sq. in.) and such openings shall be so located as to provide effective cross ventilation.

Corrosion resistant screening shall be provided over such openings, the mesh of which shall not be less than sixteen (16) per inch.

Section 3205. **ATTICS: ACCESS AND AREAS.**
All buildings shall have access provided to the attic space by means of a stairway or permanent ladder or a scuttle. The openings provided through the ceiling for such access into the attic space shall be not less than twenty-two inches by thirty inches (22"x30") and shall be located in the hallway or corridor of all Type III and Type V buildings three (3) stories or more in height.

Type III or V buildings, one or two stories in height, shall have scuttle holes into the attic.
space which are not less than eighteen inches (18") square.

In wood frame roof construction where ceilings occur the attic spaces or spaces between ceilings and the under side of roofs shall be divided into horizontal areas of not more than twenty-five hundred square feet (2500 sq. ft.) with tight one-inch (1") partitions of matched wood, one-half inch (1/2") thick exterior type plywood, or approved incombustible materials. All openings through these partitions shall be protected by self-closing doors of the same thickness and materials as the partition.

**Exception:** Where the attic is fully sprinklered the divided horizontal area may be tripled.

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.

**Section 3206. ROOF DRAINAGE.** (a) All buildings shall be provided with proper gutters and downspouts, which shall discharge upon concrete blocks placed under the downspouts which blocks shall have minimum dimension of twelve inches (12") wide by thirty-six inches (36") long. The roofs of all buildings shall be kept in good repair and all water drained therefrom so as not to flow upon or against any wall, along any foundation of any building, or upon the property of other than the owner of the building.

(Ord. 14, Series 1956.)

(b) No waters shall be discharged from any conductor pipes upon any sidewalk, but shall be conducted underneath the walk in iron or tile pipes.

(c) No water shall be discharged into any alley or other public way or place during freezing weather and at no time at a point higher than one foot (1') above the surface. Such discharge shall not be permitted to flow against any adjoining wall, into any alleyway, or upon any private property other than that of the owner of the building from which the water is conducted.
CHAPTER 33 - STAIRS AND EXITS

Section 3301. GENERAL. (a) Purpose. The purpose of this Chapter is to provide minimum standards of egress facilities for occupants of buildings.

(b) Scope. All buildings except those housing Group I or J occupancy, shall be provided with exits as required by this Chapter. See Section 1404 for Group I or J occupancy. Where there is conflict between a general requirement and a specific requirement for an individual occupancy, the specific requirement shall be applicable.

(c) Definitions. "Occupant load" is the total number of persons actually occupying a building or portion thereof at any one time, but shall never be assumed to be less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A for the occupancy housed therein.

"Panic Bar" is a bar which extends across at least half the width of each door leaf and which will open the door if subjected to pressure.

Room Capacity. The occupant load of a room or building shall be the actual number of seats but not less than the result obtained by dividing the floor area by the square feet per occupant set forth in Table No. 33-A.

Benches. Where benches or pews are used, the number of seats shall be based on one person for each eighteen inches (18") of length of the pews or benches.

Mixed Occupancies. The capacity of a building containing mixed occupancies shall be determined by adding the number of occupants of the various portions as set forth in Table No. 33-A, except that where additional exit facilities are provided the occupancy load may be increased in accordance with Section 3302 (a) and (c).

(g) More Than One Occupancy. The capacity of a room or building which is used for different occupancies at different times shall be determined by the occupant load which gives the largest number of persons.

(h) Exit Obstruction. No obstruction shall be placed in the required width of an exit.
If two or more exits are required, they shall be arranged a reasonable distance apart so that if one becomes blocked the other will be available.

(d) Distance from Exit. No point in any building shall be more than one hundred fifty feet (150') from an exterior exit, a horizontal exit, an enclosed stairway, or a fire-resistant passageway, measured along the line of travel.

Section 3303. DOORS. (a) General. This section shall apply to every exit door serving an occupant load of more than ten (10), and from hazardous rooms or areas.

(b) Swing. Exit doors shall swing in the direction of exit travel when serving an occupant load of fifty (50) or more.

(c) Operation. Exit doors shall be openable from the inside without the use of key or any special knowledge or effort.

(d) Width. The required width of a door opening shall not be reduced more than three inches (3") by any projections.

No required doorway shall be less than thirty-six inches (36") in width.

(e) Door Leaf Width. No leaf of an exit door shall exceed four feet (4') in width.

(f) Revolving Doors. Revolving doors shall not be used unless exit doors of required width are installed adjacent thereto.

(g) Egress From Door. Every door shall open into a corridor, enclosed stairway, exterior stairway where permitted as a required exit, an exterior exit court, or public way.

(h) Doors Opening into Stairway. Every door opening into a stairway shall open on a landing within two inches (2") of the floor level. The clearance between the outer edge of the door, when fully opened, and the first riser shall be not less than six inches (6").

Section 3304. CORRIDORS. (a) General. This section shall apply to every corridor serving as a required exit for an occupant load of more than ten (10). Exits shall conform to Section 3302 of this code.

(b) Width. Every such corridor shall be not less in width than forty-four (44) inches.
(c) Projections. The required width of corridors shall be unobstructed.

Exceptions: 1. Trim and handrails may project three and one-half (3-1/2) inches.

2. Doors, when fully open, may project six (6) inches.

(d) Access to Exits. Floors below finished ground level or above the first floor shall have exits arranged so that it is possible to go in either direction from any point in a corridor to a stairway.

Exception: In Type I buildings, a dead end in a corridor may be permitted when the distance from the opening in the required stairway does not exceed twelve (12) feet and the area served by such corridor does not exceed an occupant load of fifteen (15). A stairway shall not serve more than one dead end in a corridor.

(e) Construction. Walls and ceilings shall be not less than one (1) hour fire-resisting construction. Doors shall be Class C fire doors or a one and three-quarters (1-3/4) inch solid core wood door. Louvers shall not be installed in doors. Where louvers are to be installed in walls, they shall be provided with an approved fire damper and a fusible link which will melt at a temperature of 140 degrees Fahrenheit. Other interior openings shall be of one-fourth (1/4) inch wire glass set in steel frames. Openings, other than doors, shall not exceed twenty-five (25) per cent of the combined wall and door area.

Exceptions. 1. One-story buildings, without basements, housing Group F or G occupancies.

2. In Type I office buildings, such walls shall be of incombustible construction and the heat transmission limit on the unexposed side of the partition shall not exceed 490 degrees Fahrenheit above room temperature when tested in accordance with the requirements as set forth in Section 4302(b). For the purposes of this exception, office buildings shall not include those buildings where hazardous materials are used or handled. Doors may be of incombustible construction. Louvers may be installed in doors. Twelve and one-half (12-1/2) per cent of the combined wall and door area may be of at least one-fourth (1/4) inch ordinary glass.

(Ord. 50, Series 1958.)

Section 3305. STAIRS. (a) Width. Every stairway shall be not less in width than forty-four inches (44").

Exceptions: 1. Stairways serving an occupant load of ten (10) or less may be thirty inches (30") wide.

2. Trim and handrails may project three and one-half inches (3-1/2") into the required width of any stairway.

(b) Rise and Run. The rise of every step in a stairway shall not exceed seven and one-half inches (7-1/2"), and the run shall be not less than ten inches (10"). The maximum variations in the height of risers and the width of treads in any one flight shall be three-sixteenths inch (3/16").

Exceptions: 1. In stairways serving an occupant load of fifty (50) or less the rise may be eight inches (8") and the run may be nine inches (9"), with a one inch (1") nosing, making the total tread width ten inches (10").

2. In outside stairways used as a secondary means of egress, and stairs serving temporary reviewing stands, the rise may be eight inches (8") and the run may be nine inches (9").

(Ord. 13, Series 1956.)

(c) Winders. In monumental unrequired stairways, winders may be used if the required width of run is provided at a point not more than twelve inches (12") from the side of the stairway where the treads are the narrower, but in no case shall any width of run be less than six inches (6") at any point.

(d) Landings. Every intermediate landing shall have a dimension measured in the direction of travel equal to the width of the stairway, but such dimension need not exceed four feet (4').

In Groups A and B occupancies the walls at the outer corners of landings shall be curved on a radius of at least two feet (2'), or 45-degree play not less than twenty inches (20") wide shall be provided to eliminate right-angle corners.

(e) Basement Stairways. Where a basement stairway and a stairway to an upper story terminate in the same vestibule or other space, the basement stairway shall be cut off by a one-hour fire-resistive partition and a self-closing Class "B" fire door.

(f) Distance Between Landings. There shall be not more than twelve feet (12') vertically between landings nor less than two risers.

(g) Handrails. Stairways shall have handrails on each side, and every stairway more than eighty-eight inches (88") in width shall
have intermediate handrails dividing the stairway into portions not more than sixty-six inches (66") in width.

Handrails shall be placed not less than thirty inches (30") nor more than thirty-four inches (34") above the nosing of treads, and ends of handrails shall be returned to the wall in Groups A, B, and C occupancies.

Exceptions: 1. Stairways three feet (3') or less in width may have one handrail.

2. Handrails shall not be required for exterior monumental stairways.

(h) Exterior Stairways. Every opening in the exterior wall of a building served by an exterior stairway used as a required exit shall be protected by an automatically closing Class "B" or "E" fire door or window if the opening is within twenty feet (20') of the stairway.

Exception: Openings above or level with the highest portion of the stairway may be unprotected if not nearer than ten feet (10') to the stairway.

(i) Space Under Stairways. The underside of interior stairways of wood construction and enclosed usable spaces under all stairways shall be protected with lath and plaster approved for one-hour fire-resistive construction except in Group I occupancies.

(j) Stairway Construction—Interior. Interior stairways shall be constructed as specified in Part V of this Code.

(k) Stairway Construction—Exterior. Exterior stairs shall be of incombustible material or of wood not less than two inches (2") in nominal thickness.

(l) Stairway to Roof. In every building more than three stories in height, one stairway shall extend to the roof surface unless the roof has a slope greater than four (4) in twelve (12).

(m) Headroom. Every required stairway shall have headroom clearance of not less than six feet six inches (6'6") measured vertically from the nearest nosing to the nearest soffit.

Section 3306. RAMPS. (a) General. A ramp conforming to the requirements of this Section may be used as an exit. Aisles need not conform to this Section.

(b) Width. The width of ramps shall be as required for corridors.

(c) Slope. The slope of a ramp shall not exceed one (1) in eight (8).

(d) Handrails. A ramp with slope exceeding one in ten shall have handrails as required for stairways.

(e) Construction. Ramps shall be constructed as required for stairways. Right-angle turns shall be rounded with a minimum radius of ten feet (10').

(f) Surface. The surface of ramps shall be roughened or shall be of non-slip material.

Section 3307. HORIZONTAL EXITS. (a) Definition. A horizontal exit is a horizontal passageway or ramp into another building or into another section of the same building through an "Ordinary Occupancy Separation."

(b) Used as a Required Exit. If conforming to the provisions of Section 3303 and of this Section, a horizontal exit may be considered as a required exit.

(c) Discharge Areas. A horizontal exit shall lead into a floor area having capacity for an occupant load not less than the occupant load served by such exit. The capacity shall be determined by allowing three square feet (3 sq. ft.) of net clear floor area per occupant. The area into which the horizontal exit leads shall be provided with exits as required by Section 3302, at least one of which shall lead directly to a public way.

Section 3308. EXIT ENCLOSURES. (a) General. Every interior stairway, ramp, or escalator shall be enclosed as specified in this Section.

Exceptions: 1. In occupancies other than Group C, D, or H, Division 1, an enclosure shall not be required for a stairway, ramp, or escalator serving only the second floor and not connected with corridors or stairways serving floors above the second floor.

2. In sprinklered buildings of Type 1 construction housing Group F and G occupancies, enclosures shall not be required for escalators.

(b) Enclosure Construction. Enclosure walls shall be of not less than one-hour fire-resistive construction.

Exception: In all buildings housing Group A, C, D, or H, Division 1, and in other buildings three (3) stories or more in height, enclosure walls shall be of not less than two-hour fire-resistive construction.

(c) Openings into Enclosures. There shall be no openings into exit enclosures except exit doorways and openings in exterior walls. Every exit door in an exit enclosure shall be a self-closing Class "B" fire door. Every opening in an exterior wall forming part of an exit enclosure shall be protected by a Class "E" or "F" fire door or window unless opening into a public way at least sixteen feet (16') wide.

(d) Extent of Enclosure. Stairway enclosures shall include the necessary landings between flights and shall also include any corridors or passageways necessary for continuous exit to the exterior of the building. Enclosed corridors or passageways are not required from unenclosed stairways.
Section 3309. SMOKEPROOF ENCLOSURES.
(a) General. A smokeproof enclosure shall consist of a continuous stairway enclosed from the highest point to the lowest point by walls of two-hour fire-resistive construction. The supporting structural frame shall be of four-hour fire-resistive construction.
(b) Where Required. In buildings five stories or more in height, one of the required exits shall be a smokeproof enclosure.
(c) Construction. Stairs in smokeproof enclosures shall be of incombustible construction.
(d) Access. There shall be no opening directly into the interior of the building. Access shall be through a vestibule open to the outside having an exit door from the interior of the building and an exit door leading to the smokeproof enclosure. In lieu of a vestibule, access may be by way of an exterior open balcony of incombustible materials.
(e) Doors. Exit doors to smokeproof enclosures shall be self-closing Class "B" fire doors.
(f) Outlet. A smokeproof enclosure shall exit into a public way or into a passageway leading to a public way. The passageway shall be without other openings and shall have walls of two-hour fire resistance and floors and ceilings of two-hour fire resistance.
(g) A smokeproof enclosure stair shall not continue below grade level exit unless a barrier is provided at the ground floor level to prevent persons from continuing on into the basement.

Section 3310. EXIT OUTLETS. Every exit shall discharge into a public way or exit court.

Section 3311. EXIT COURTS. (a) Discharge. Every exit court shall discharge into a public way or passageway leading to a public way. The passageway shall be without other openings and shall have walls, floors, and ceilings of the same period of fire resistance as the walls, ceilings and floors of the building, but shall be not less than one-hour construction.
(b) Width. Every exit court shall be not less in width than the required total width of the tributary exits.
(c) Slope. The slope of exit courts shall not exceed one in ten.
(d) Openings. Openings between a Group A and B occupancy and an exit court less than sixteen feet (16') wide shall be protected by Class "E" or "F" fire doors or windows.
Exception: Openings more than twenty feet (20') above the floor of the exit court may be unprotected.
(e) Obstructions. The required width of exit courts shall be unobstructed except for trim and handrails which may project not more than three and one-half inches (3-1/2") into the required width.
At any point where the width of an exit court is reduced from any cause, the reduction in width shall be effected gradually by a guard rail at least three feet (3') high. The guard rail shall make an angle of not more than 30 degrees with the axis of the exit court.

Section 3312. EXIT SIGNS AND ILLUMINATION. Exit Illumination. Exit signs shall be illuminated with light having an intensity of not less than one foot candle at floor level.

Exit lights shall have white letters not less than four inches (4") high on a green field indicating the location of exits, and shall be provided in all buildings except "I" and "J" occupancies, except that in buildings of Groups "E", "F", and "G" occupancies which are not occupied at night; painted exit signs may be used in places of lights. Exit lights and lights shall be placed at all exits and at such additional points as may be necessary to indicate the direction of exit when such exit is not visible from all points in the corridor. In Groups "A", "B", and "C" buildings, lights shall be kept burning at all times during which the building is occupied. In other buildings requiring exit lights, such lights shall be kept burning from sunset to sunrise when the building is occupied.

Section 3313. AISLES. (a) General. Every portion of every building with an occupant load of more than fifty (50) persons in which are installed seats, tables, or equipment, shall be provided with aisles leading to an exit.
(b) Width. Every aisle shall be not less than three feet (3') wide if having seats on only one side and not less than three feet six inches (3'6") wide if having seats on both sides. Such minimum width shall be measured at the end farthest from the foyer and shall be increased by one and one-half inches (1-1/2") for each five feet (5') in length toward the foyer.

Exception: In Group B, Division 3, occupancies, aisles need not be over three feet six inches (3'6") wide.
(c) Distances to Nearest Exit. In areas occupied by seats, and in Group A and B occupancies without seats, the line of travel to an exit door by an aisle shall not be more than one hundred and fifty feet (150').
(d) Aisle Spacing. Aisles shall be located so that there will be not more than six intervening seats between any seat and the nearest aisle.

Exception: There may be twenty (20) intervening seats between any seat and the nearest side in Group B, Division 3 occupancies.
Section 3314. SEATS. (a) Spacing. The spacing of rows of seats from back to back shall be not less than thirty-three inches (33") nor less than twenty-seven inches (27") plus the sum of the thickness of the back and inclination of the back.

Exception: In Group B, Division 3 occupancies, the spacing of rows of seats without backs may be twenty-four inches (24").

(b) Width. The width of any seat shall be not less than eighteen inches (18").

Section 3315. EXITS: GROUP A OCCUPANCIES. (a) Main Exit. Every group A occupancy shall be provided with a main exit.

The main exit shall be of sufficient width to accommodate one-half (1/2) the total occupant load but shall not be less than the total width of all aisles and stairways leading thereto and shall connect to a stairway or ramp leading to a public way.

Steps may be used if separated from the main exit by a landing not less in area than the foyer.

(b) Side Exits. Every auditorium and balcony of a Group A occupancy shall be provided with exits on each side. The exits on each side of the auditorium or balcony shall be of sufficient width to accommodate one-third (1/3) of the total occupant load served. Side exits shall open directly into an exit court or a ramp leading to an exit court, except that the side exits from a balcony may lead to a stairway, and side exits from balconies above the first balcony shall be by way of a stairway or ramp in a smokeproof enclosure. Side exits shall be accessible from a cross aisle or side aisle.

(c) Panic Bars. An exit door from any Group A occupancy if provided with a latch shall be equipped with a panic bar if the exit door serves an occupant load of more than fifty (50).

Section 3316. EXITS GROUP B OCCUPANCIES. (a) Group B, Divisions 1 and 2. Divisions 1 and 2 occupancies shall have exits as required by Section 3315.

(b) Group B, Divisions 3 and 4. An exit door from any Group B occupancy, Divisions 3 and 4, if provided with a latch, shall be equipped with a panic bar if the exit door serves an occupant load of more than one hundred (100).

Section 3317. EXITS GROUP C OCCUPANCIES. (a) Corridors. The width of a corridor in a Group C occupancy shall be the width required by Section 3302 plus two feet (2'), but no corridor shall be less than six feet (6') wide.

Corridor walls and ceilings shall be of not less than one-hour fire-resistive construction.

There shall be no change of elevation of less than two feet (2') in a corridor unless ramps are used.

(b) Corridors Serving Auditoriums. An exit serving both an auditorium and other rooms need provide only for the capacity of whichever requires the greater width if the auditorium is not to be used simultaneously with the other rooms.

(c) Stairs. Each floor above or below the ground floor level shall have not less than two stair exits 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.

Exception: This Subsection does not apply to rooms used for maintenance, storage, and similar purposes.

(d) Doors. The width of exit doors from corridors, halls, and stairs shall be not more than two feet (2') narrower than the required width of such corridors, halls, or stairs.

Exit doors in schoolrooms shall swing in the direction of egress.

(e) Corridor Dead End. Repealed. (Ord. 280, Series 1957).

(f) Exterior Exit. Any room, the floor of which is below grade and which is used by pupils, shall have at least one exit leading directly to the exterior of the building, and such exit shall be not less in width than one-half the required aggregate width of exits from such room.

(g) Panic Bars. Panic bars shall be installed on exit doors, if provided with a latch, from rooms having an occupant load of more than one hundred (100), and from corridors.

Section 3318. EXITS: GROUP D OCCUPANCIES. (a) Separate Exits. Every room in a Group D occupancy shall have access to two (2) separate exits.

(b) Corridor Dead Ends. Repealed. (Ord. 280, Series 1957).
(c) **Corridors.** There shall be no change of elevation of less than two (2) feet in a corridor unless ramps are used. The corridors shall be not less than eight (8) feet wide in occupancies where bedridden patients are housed. (Ord. 280, Series 1957).

(d) **Basement Exits.** One exit from every room below grade shall be to the exterior.

(e) **Ramps.** Every portion of a Group D occupancy, Division 2, in buildings of Types II, III, IV, and V housing bedridden patients, shall have access to a horizontal exit or a ramp leading to the exterior.

(f) **Doors.** Exit doors serving areas housing bedridden patients shall be not less than three feet six inches (3'6") in width.

(g) **Locks.** No exterior door shall be lockable from the inside, except in sanitariums for mental patients.

(h) **Places of Detention.** No requirements of this Chapter shall be so construed as to prohibit the construction of cell blocks in jails or prevent the use of any locks or safety devices in buildings where it is necessary forcibly to restrain the inmates.

(i) **Exceptions.** Where construction meets the requirements of Section 902 (b), the exterior doors may be fastened with locks, provided that room doors shall not be fastened from the corridor side by other means that door-knobs or similar devices which can be opened readily from the inside without the use of keys.

**Section 3319.** **EXITS: GROUP E OCCUPANCIES.** Every portion of a Group E occupancy having a floor area of two hundred square feet (200 sq. ft.) or more shall be served by at least two (2) separate exits.

**Section 3320.** **SPECIAL HAZARDS.**

(a) **Boiler Rooms.** Every boiler room and every room, except in Group I occupancies, containing an oil-fired furnace or incinerator shall be provided with at least two means of exit, one of which may be a ladder.

(b) **Cellulose Nitrate Handling.** Film laboratories, projection rooms, and nitrocellulose processing rooms shall have not less than two (2) exits.

**Section 3321.** **BLEACHER SEATS.**

(a) **General.** Roll-away, telescoping, and fold-up bleacher seats without backs shall conform to the requirements of this section.

(b) **Rows.** Bleacher sections shall contain not more than twenty (20) rows of seats.

(c) **Spacing.** Spacing of seats back to back shall be not less than twenty-two (22) inches.

(d) **Aisles.** Bleacher sections shall be provided with aisles, not less than three feet six inches (3'6") in width, with no more than nine (9) seats between any seat and an aisle, and the width of cross aisles and aisles to exitways shall be as specified in Section 3313.

**Exception:** Bleachers with not more than eleven (11) rows of seats need not be provided with aisles if the vertical distance between seats does not exceed twelve (12) inches.

(e) **Platforms.** Where bleacher sections are placed on platforms above the main floor, a cross aisle and guard railing shall be provided at the front of such sections.

(f) **Railings.** Open end sections shall be provided with railings for that portion above the fourth row of seats. Where the back of a bleacher section is not placed against a wall, a railing shall be provided at the back of that section.

(g) **Additional Exits.** Any increase of occupant load because of the addition of bleachers shall require additional exit facilities in accordance with Section 3302.

(Ord. 365, Series 1957).
CHAPTER 34—DOORS, WINDOWS, AND SKYLIGHTS

Section 3401. DOORS AND WINDOWS. Fire doors and windows, where required, shall be as specified in Section 4306.

Section 3402. SKYLIGHTS. 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 forty-five degrees (45°) 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.

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 (1/8) 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. & 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 No. 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 (1/2") in thickness. Any such glass over sixteen square inches (16 sq. in.) in area, shall have wire mesh embedded in the same or shall be provided with a wire screen underneath as specified for skylights in this Section. All portions of the floor lights or sidewalk lights shall be of the same strength as is required by this Code for floor or sidewalk construction, except in cases where the floor is surrounded by a railing not less than three feet six inches (3'6") in height, in which case the construction shall be calculated for not less than roof loads.
CHAPTER 35 – BAYS AND BALCONIES

Section 3501. CONSTRUCTION. Construction of walls and floors in bay and oriel windows shall be of incombustible materials except that bays and oriel in buildings, housing Group I or J occupancy, of Type III, IV, or V Construction may be of frame construction. 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 of Types I and II buildings shall have brackets or beams constructed of steel, concrete, or other incombustible material. All railings for balconies or porches above the ground floor shall be not less than three feet six inches (3’6”) in height above the floor of such balcony or porch. Balconies attached to dwellings shall be designed to support, in addition to their own weight, a live load of not less than fifty (50) pounds per square foot. Other balconies shall be designed to support, in addition to their own weight, a live load of not less than one hundred (100) pounds per square foot. Railings of balconies shall be designed to support a horizontal thrust of not less than twenty (20) pounds per lineal foot of railing uniformly distributed along its length.
CHAPTER 36 – PENTHOUSE AND ROOF STRUCTURES

Section 3601. PENTHOUSES AND ROOF STRUCTURES. No penthouses or other projection above the roof in structures of other than Type I Construction 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 twenty per cent (20%) of the area of the roof. No penthouses, bulkhead or any other similar projection above the roof shall be used for manufacturing or storage.

Roof structures of Type I buildings shall be constructed with walls, floors and roof as required for the main portion of the building.

Exception: Exterior walls and roofs of penthouses which are five feet (5') or more from the face of the exterior walls of the building may be of one-hour fire-resistant construction.

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-resistant construction. The restrictions of this paragraph shall not prohibit the placing of wood flagpoles or similar structures on the roof of any building.

Section 3602. TOWERS AND SPIRES. 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 (1600 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.

Skeleton towers used as radio masts placed on the roof of any building shall be constructed entirely of incombustible materials when more than twenty-five feet (25') in height and shall be directly supported on an incombustible framework to the ground. They shall be designed to withstand a wind load from any direction as specified in Section 2307 in addition to any other loads.
CHAPTER 37 – CHIMNEYS, VENTS, FIREPLACES AND INCINERATORS

Section 3700. DEFINITIONS. (a) Chimney. Chimney is a vertical masonry or reinforced concrete shaft enclosing one or more flues designed for the purpose of removing the products of combustion of solid, liquid, liquified petroleum gases, or natural gas fumes to the outside atmosphere.

(b) Combustible Material. A combustible material is one which will ignite at or below a temperature of 1200° F. and will continue to burn or glow at that temperature.

(c) Combustible Material, Protected. See Chapters 43 and 52.

(d) Draft Hood or Draft Diverter. 1. Is a device attached to or made a part of the vent outlet from an appliance and is designed to (a) insure the ready escape of the products of combustion, in the event of no draft, backdraft, or stoppage in the vent beyond the draft hood; (b) prevent a backdraft from entering the appliance; (c) neutralize the effect of stack action of the flue upon the operation of the appliance.

2. "Automatic Draft Regulator" is a device attached to or made a part of the vent outlet from an appliance, and is designed to govern the effect of stack action of the flue upon the operation of the appliance.

(e) Flue—Type A. Lined chimneys or metal smoke stacks as provided for in Sections 3702, 3703, 3704 and 3705.

(f) Flue—Type B. Approved flue piping of non-combustible, corrosion-resistive material of adequate strength and heat insulating value and having acceptable joints and capable of withstanding continuous temperatures not in excess of 550° F.

(g) Flue—Type B.W. Type B.W. gas flues are special flues with special installation requirements for venting only approved vented recessed wall heaters.

(h) Flue—Type D-1. Approved flue and vent piping of non-combustible, corrosion resistant materials capable of withstanding a continuous temperature of 1000° F. or an intermittent temperature of 1400° F.

(i) Vent. A pipe designed to convey the products of combustion from an appliance to a flue or chimney.

Section 3701. (a) Scope. Chimneys, flues, vents, fireplaces, and incinerators, and their connections, carrying products of combustion, shall conform to the requirements of this Chapter.

Section 3702. TYPE A CHIMNEYS OR FLUES. (a) Design. Chimneys shall be reinforced and anchored as required in this Chapter and shall be designed to resist the loads specified in Chapters 23 and 28. Each chimney shall be provided with an accessible cleanout door.

(b) Materials. Flue linings used in connection with solid or liquid fuel and bricks used in lieu of such flue linings shall have a softening point of not less than 1994° F. Chimneys used for devices generating flue gas temperatures regardless of the type of fuel used in excess of 1400° F. shall be subject to the approval of the Chief Building Inspector. Existing chimneys to be used for the venting of gas appliances, shall be provided with an approved metal liner, continuous from the appliance to its outlet above the roof and shall be provided with an approved cowl cap. A suitable storm collar shall be provided at the top of the chimney to seal the space between the liner and chimney.

(c) Area. No chimney used in connection with solid or liquid fuel shall be smaller in area than the flue connection on the appliance attached thereto, and in no case shall the flue area be less than as set forth in Table 37-A.

(d) Height. Every chimney shall extend to a point not less than twenty-four (24) inches from any portion of a building and not less than ten (10) feet in a horizontal direction from any of that portion of a building or structure which extends at an angle of more than forty-five (45) degrees upward from the horizontal.

(e) Inlets. Every inlet from a solid or liquid fuel appliance to any chimney shall enter the side thereof and shall be of not less than sixteen (16) U.S. Standard Gauge metal, with a melting point of not less than 1400° F. Every inlet shall be at least six (6) inches from any combustible material.

(f) Loads. No chimney shall support any load other than its own weight.

* Source—Ord. 205, Series 1954, Except where otherwise indicated.
TABLE 37-A
FLUE AREA FOR SOLID OR LIQUID FUELS

<table>
<thead>
<tr>
<th>Type of Equipment</th>
<th>Lined</th>
<th>Unlined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Round</td>
<td>Rectangle</td>
</tr>
<tr>
<td>Small Stoves</td>
<td>28 sq. in.</td>
<td>36 sq. in.</td>
</tr>
<tr>
<td>and heaters</td>
<td>28 sq. in.</td>
<td>36 sq. in.</td>
</tr>
<tr>
<td>Ranges and room heaters</td>
<td>40 sq. in.</td>
<td>50 sq. in.</td>
</tr>
<tr>
<td>Fireplaces</td>
<td>1/12 of opening</td>
<td>1/10 of opening</td>
</tr>
<tr>
<td></td>
<td>- minimum</td>
<td>- minimum</td>
</tr>
<tr>
<td>Warm air furnaces</td>
<td>50 sq. in.</td>
<td>64 sq. in.</td>
</tr>
<tr>
<td>or boilers</td>
<td>70 sq. in.</td>
<td>90 sq. in.</td>
</tr>
</tbody>
</table>

(g) **Anchorage.** Chimneys in wood frame buildings shall be anchored laterally at each floor and ceiling line which is more than six (6) feet above grade.

(h) **Cleanouts.** An accessible approved clean-out opening with a tight-fitting cover shall be provided at least twelve (12) inches below the lowest vent inlet into any chimney and shall be provided with a tag marked "Cleanout"; provided, however, that no cleanout shall be required for Type B or B.W. flues with cowl caps conforming to Section 3709 (a) and (b).

Section 3703. CONSTRUCTION. (a) **Flue Lining.** Masonry chimneys shall be lined with fire-resistive clay tile flue lining of not less than five-eighth (5/8) inch thick and set with high temperature, moisture proof mortar. The lining shall extend from eight (8) inches below the lowest inlet to four (4) inches above enclosing walls.

(b) **Wall Thickness.** Walls shall be not less than eight (8) inches in thickness, except that, where flue lining is used, the thickness of brick may be reduced to four (4) inches. Division walls separating flues shall be at least three (3) inches in thickness including the flue lining.

(c) **Chimneys of Hollow Clay Tile.** Chimneys shall not be built of hollow clay tile units unless such chimneys are an integral part of a wall or such units. Eight (8) inches of such wall may serve as the wall of the chimney.

(d) **Support.** Masonry chimneys shall be supported on foundations designed as required in Chapters 23 and 28.

(e) **Protection.** No combustible material shall be placed within two (2) inches of masonry chimneys.

Section 3704. TERRA COTTA CHIMNEYS. Subject to the approval of the Chief Building Inspector or the Board of Appeals, Terra Cotta chimneys may be installed in buildings of Group I occupancy and shall comply with the requirements of this Chapter.

Section 3705. METAL SMOKESTACKS. (a) **Thickness.** Metal smokestacks shall be constructed of material of not less than one-eighth (1/8) inch in thickness.

(b) **Location.** Metal smokestacks shall not be less than twenty-four (24) inches from any combustible materials.

(c) **Support.** Metal smokestacks shall be supported directly on their own foundation or may be supported upon boilers which are designed to support them.

(d) **Interior Smokestacks.** Interior metal smokestacks extending through any story or roof space shall be enclosed in a vertical shaft of two-hour (2) fire-resistive construction. The shaft shall provide at least six (6) inches of clearance of all sides of stack. Every opening into the shaft, other than openings for inlet thimbles and for ventilation at top and bottom, shall be protected with a non-combustible one-hour (1) locked fire resistive door. The shaft shall have ventilating openings at both top and bottom.

(e) **Flue Linings.** When flue gas temperatures exceed 1000° F., flue linings shall be used.

Section 3706. VENT PIPES FOR SOLID OR LIQUID FUELS. (a) **General.** Vent pipes are pipes used in connecting fire boxes or combustion chambers with chimneys or smokestacks.

(b) **Materials.** Every vent pipe connecting a fire box or combustion chamber with a chimney or smokestack, shall be of metal with a melting point of not less than 1400° F.

(c) **Location.** Combustible material within twelve (12) inches of any vent pipe shall be pro-
Section 3707. FIREPLACES. (a) Wall. Fireplace and smoke chamber walls shall be of solid masonry of not less than eight (8) inches thick. The face of such walls exposed to fire shall be lined with material meeting the requirements of Section 3702 (b). Where four (4) inches of firebrick are used for lining, they may be included in the eight (8) inches minimum thickness. Approved metal heat circulators may be installed in fireplaces.

(b) lintel. Masonry over the fireplace opening shall be supported by a non-combustible lintel.

c) Hearth. Every fireplace shall be provided with a non-combustible hearth slab of at least twelve (12) inches wider on each side than the fireplace opening and projecting at least twenty (20) inches therefrom. This slab shall be not less than four (4) inches thick and shall be supported by non-combustible material or reinforced to carry its own weight and all imposed loads. Combustible forms and centering shall be removed.

d) Combustible Materials. No wood or other combustible materials shall be placed within six (6) inches of the fireplace opening. No such combustible material within (12) inches of the fireplace opening shall project more than one-eighth (1/8) inch for each one-inch clearance from such opening.

e) Imitation Fireplaces. The maximum depth of the recess of any imitation fireplace or recess for heating equipment shall be six (6) inches unless such recess meets the requirements for fireplaces. The surface of the recess shall be fire-resistant plaster or masonry. Location of combustible materials shall be as required for fireplaces in Subsection (d). No flue other than a Type B flue shall be installed within the recess opening, and such flue shall be continuous from the appliance to the exterior of the building.

(f) Dampers. The throat of all fireplaces designed for burning solid fuels shall be provided with a mechanical damper located not less than six and one-half (6-1/2) inches above the lintel and damper opening shall be not less in area, when fully opened, than the required flue area.

Section 3708. GAS FLUES. (a) General. All chimneys and flues to which gas appliances are vented, shall be constructed and installed in accordance with the requirements of this Chapter.

(b) Type A Flue Uses. Type A flues may be used to vent any gas burning appliance producing flue gas temperatures not in excess of 1400° F. For higher temperature flues see Section 3702 (b). Type B flue pipe shall be used only with approved gas appliances producing gas flue temperatures not in excess of 550° F., at the outlet of the draft hood. Type B flues and vents must be plainly and permanently marked, tagged or labeled as follows:

**TAG**

TYPE B—FLUE
FOR VENTING ONLY APPROVED GAS-FIRED APPLIANCES THIS FLUE SHALL NOT BE USED FOR VENTING INCINERATORS OR APARATUS BURNING LIQUID OR SOLID FUELS.

This tag or label shall be permanently attached to each flue inlet connection or the adjacent structure, be plainly visible, and shall not be removed as long as such flue is in place.

(d) Type B Flue Uses. Type B flues shall be used only in the interior of structures except that six (6) feet may be exterior to carry the flue gases to the proper elevation. Whenever more than six (6) feet of Type B flue is exterior, it shall be insulated with one (1) inch of rock wool or its equivalent and encased in a watertight enclosure.

e) Type B.W. Flue Uses. Type B.W. gas flues are special approved flues with special installation requirements for venting only approved vented recessed wall heaters. Minimum clearance shall be no less than 3/8 inch from any material, combustible or non-combustible.

(f) Type D-1 Flue Uses. Type-D-1 flues may be used for the venting of gas-fired appliances or gas-fired incinerators, none of which produce a continuous flue gas temperature of 1000° F. or intermittent flue gas temperature of 1400° F.

Section 3709. LOCATION AND CONSTRUCTION. (a) Height. Every gas appliance flue, other than a masonry chimney, shall extend in a vertical direction without bends and shall be continuous from the inlet to the flue to its outlet above the roof. The outlet of every flue shall be equipped with an approved cowl cap open on all sides and shall have an ventilating area of not less than the cross-sectional area of the flue and so constructed as to prevent entry of or blocking by birds or rodents.
Exception: Not more than one portion of any such flue may extend at an angle of not less than thirty (30) degrees from the horizontal.

(b) Cowl Cap Location. Any opening in any flue cowl cap shall be not less than twenty-four (24) inches from any portion of a building and not less than ten (10) feet in a horizontal direction from any of that portion of a building or structure which extends at an angle of more than forty-five (45) degrees upward from the horizontal.

(c) Starting Level and Support. Flues other than type A may start at any desired level. Flues shall be securely anchored to the building so that they cannot be moved in any direction. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of not more than five (5) feet, and at every change in direction.

(d) Offset Inlets. Where two or more inlets are provided in any flue, such inlets shall be offset in such a manner that no section of any inlet shall be opposite to other inlets.

(e) Capping Non-Used Inlets. Vent inlets not in use shall be tightly closed by means of approved caps or plugs.

(f) Rectangular and Elliptical Flues. Rectangular or elliptical flues may be used for appliances where input will not exceed 50,000 B.T.U. Denver rated, and provided further, the flue gas carrying capacity of such flue equals the capacity of round pipe for which it is substituted and the ratio of its internal dimension is not greater than 3 to 1. Transition to round Type B and B.W. flue shall be made at the ceiling plate or ceiling joist of the room in which the heater is located, unless such pipe is specifically approved for other methods of installation.

(g) Safety Thimbles and Roof Jacks. Approved safety thimbles shall be used on all inside flue pipes, except Type B or B.W. Type B metal flues shall have not less than one inch (1") clearance to combustible materials. Approved roof jacks shall be used on all flues except Type A. See Section 3711 (h).

Section 3710. FLUE SIZES. (a) Area. The total area of any chimney or flue shall either be not less than the area of the largest vent connection inlet plus 50 per cent of the area of all additional inlets or the total area shall be not less than seventy-five (75) percent of the combined areas of all connected appliance vents, whichever is the greater. No chimney or flue shall have an area of less than the equivalent of a three (3) inch round pipe. Whenever chimney or flue is other than round, its area shall be such as to provide the same flue gas carrying capacity as round pipe as specified above. (See Section 3709). (b) Commercial. The size of chimneys or flues for commercial, industrial and large heating boiler equipment shall be adequate to handle the volume of flue products produced by such equipment. (See Section 5136).

Section 3711. GAS VENTS. (a) Approved Materials. Vents and vent fittings shall be constructed of any of the following materials: Galvanized or lead coated iron or steel, stainless steel, monel, aluminum 2-51/2H, none of which shall be less than No. 26 U. S. Standard Gauge; copper not less than sixteen (16) ounces per square foot, or any other material, metallic or non-metallic, of standard construction and weight and approved by the Chief Building Inspector. Such pipe shall be formed by means of a locked seam, and a rivet or other approved locking device of like material shall be placed at the female end of the seam in each length of pipe or fitting used. Each joint shall be lapped not less than one and one-half (1 1/2) inches. Vents from gas ranges, or water heaters in domestic kitchens may be constructed of sheet iron or steel not lighter than No. 28 U. S. Standard Gauge. Vents located in non-habitable areas shall be of Type B construction.

(b) Location and Construction. A vent pipe shall be so installed as to avoid sharp turns or other constructional features as would create excessive resistance to the flow of gaseous products. Vents shall be securely anchored to the building so that they cannot be moved in any direction. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of not more than five (5) feet, and at every change in direction. Gas vents in excess of six (6) feet in length shall be of one-piece construction or the connecting joints shall be held together by means of rivets or other approved locking devices.

(c) Connections to Masonry. All vent pipe connections to a masonry chimney or flue shall be made with a slip joint, the thimble to be cemented into chimney and not to extend into the chimney beyond the chimney lining. Before making the vent connection, the chimney shall be examined to ascertain that it is properly constructed, clear, and will normally conduct the products of combustion to the outer air.

(d) Termination Below Ceiling. Chimneys which terminate a few feet below the ceiling of the first floor of a building, commonly called shelf or bracket chimneys, shall not be used to vent any appliance regardless of fuel used.

(e) New Chimneys and Flues Required. In buildings where the existing chimney is in such a location that it is necessary to crawl to the chimney to inspect and clean it, a new chimney or flue shall be constructed.
(f) **Vent Area.** The area of any vent shall be not less than the area of the appliance vent connection. When additional vents from other appliances are connected, the vent area shall be equal to the vent area of the appliance having the largest vent and shall be increased at least fifty (50) percent of the areas of all additional smaller appliance vents or when all vent areas of such multiple connected appliances are substantially equal, the total vent area shall be not less than 75 percent of the combined areas of all connected appliance vents whichever is the greater area.

(g) **Horizontal Runs.** Horizontal runs of gas vents depending on natural draft shall not exceed seventy-five (75) percent of the vertical height of the flue and in no case exceed fifteen (15) feet in length, except by special authorization of the Chief Building Inspector.

(h) **Metal Vents.** Metal vents from approved domestic and house-heating appliances shall be not less than six (6) inches from combustible material and shall not pass through combustible walls, doors, ceiling or partitions, unless they are guarded at point of passage by approved metal ventilated thimbles.

(i) **Type B Vent Clearance.** Type B vent shall be installed with a clearance to combustible material or construction whether plastered or unplastered, of not less than one (1) inch, provided that for vents of floor furnaces, such clearances shall be not less than three (3) inches for a distance of not less than three (3) feet from the outlet of the draft hood, measured along the center line of the vent piping.

(j) **Commercial Vents.** Vents from commercial, industrial and large heating boiler equipment shall be approved material and shall have approved clearances from combustible material in accordance with the type of appliance being vented. (See Chapter 51).

(k) **Gas Appliance Vent Pipe Connections.** A gas appliance vent pipe may be connected to the vent pipe from another gas appliance through a suitable "Y" junction fitting provided proper increase in vent size is made to accommodate the increased volume of flue gases. The junction fitting shall be made so that the angle at which the two vents intersect shall not exceed forty-five (45) degrees between the inlets. The horizontal portion of all gas appliance vents shall have a uniform rise of not less than one-fourth (1/4) inch per each linear foot of run, and shall be free of dips or sags.

(l) **Multiple Connections.** A gas appliance vent shall not be connected to the vent or smoke pipe from an appliance burning other fuels but may be connected into the same chimney or flue through separate openings, provided the vent from the gas-burning appliance shall enter flue above the point of entrance of such solid or liquid fuel appliance vent pipe.

(m) **Dampers.** No dampers or other obstructions to free flow shall be installed or left in the vent pipe from any approved domestic or house-heating appliance or any other appliance where a draft hood or automatic draft regulator is used, unless otherwise approved by the Chief Building Inspector.

(n) **Draft Hoods.** Draft hoods and automatic draft regulators. (See Chapter 51).

**Section 3712. INCINERATORS.**

(a) **Walls.** Walls of incinerators having nine (9) square feet of grate area or less shall be constructed of four (4) inches of common brick and four (4) inches of refractory material. Over the incinerator combustion chamber, roof construction shall be of arched firebrick and four (4) inches of brick laid all on edge or an equivalent slab of reinforced concrete.

1. Walls of incinerators of nine (9) square feet to fifteen (15) square feet of grate area shall be of eight (8) inch common brick and four (4) inch refractory lining. Roof construction similar to paragraph (a), except a one and one-half (1-1/2) inch air space shall be maintained between refractory material and exterior brick. Greater than fifteen (15) square feet of grate area shall have walls of twelve (12) inch brick and four (4) inch refractory lining. Steel outer casing may be used if approved by the Chief Building Inspector or the Board of Appeals.

2. All firebrick shall be laid in refractory mortar.

(b) **Flue or Chimneys.**

1. Flues for incinerators shall be as required for chimneys in Section 3702.

2. Flues shall be of a minimum size as required by Table I.

3. All flues shall be perpendicular for their full height without slopes or offsets. Top of flues shall have an approved removable spark arrester.

(c) **Grates.**

1. Incinerators shall be equipped with horizontal iron grates. Minimum grate areas are stated in Table I, Section 3712(g).

2. Grates of metal or brick construction shall be provided to permit the free passage of air around and over the material on the grates. Clear space between the chamber walls and sides of grates shall be not less than three (3) inches.

(d) **Doors.**

1. Loading doors shall be provided in the front of all incinerators. Such doors
shall be set in an iron frame built firmly into the masonry with no part projecting into the incinerator.

(e) Service Opening.

1. The area of a service opening into the incinerator shall not exceed one-third (1/3) of the flue area.

(f) Combustion Air.

1. A fixed means of supplying air under the grates for combustion shall be provided and sufficient outside air shall be provided to room or enclosure in which incinerators are located for combustion purposes.

(g) Grate Area.

1. The following Table for Minimum grate area and cubical content shall be as follows:

| TABLE 1 |
|------------------|------------------|------------------|
| Minimum Grate Area | Minimum Cubical Content | Minimum Flue Size |
| Residences of not more than 6 rooms | 2.22 sq. ft. | 7.00 cu. ft. | 12"x12" |
| Residences of 7 and not more than 10 rooms | 4.70 sq. ft. | 14.10 cu. ft. | 12"x12" |
| Residences of 11 and not more than 12 rooms. For duplex 2 family buildings. For up to 16 kitchenette apartments of not more than 32 rooms. | 6.67 sq. ft. | 20.01 cu. ft. | 12"x12" |
| Not more than 24 kitchenette apartments. Other apartments containing not more than 50 rooms. Residences greater than 12 rooms. | 8.22 sq. ft. | 24.66 cu. ft. | 16"x16" up to 4-story buildings 20"x20" |
| 25 to not more than 36 kitchenette apartments. Other apartments not more than 90 rooms. Hospitals not more than 35 beds. Schools of not more than 500 pupils. | 9.50 sq. ft. | 33.25 cu. ft. | " " |
| 37 to not more than 60 kitchenette apartments. Other apartments 91 to not more than 130 rooms. Hospitals from 36 to not more than 60 beds. Schools 501 to not more than 800 pupils. | 12.22 sq. ft. | 42.77 cu. ft. | 20"x20" |
| 61 to not more than 80 kitchenette apartments. Other apartments 131 to not more than 170 rooms. Hospitals from 61 to not more than 80 beds. Schools from 801 to not more than 1000 pupils. | 14.13 sq. ft. | 49.45 cu. ft. | 24"x24" |
| More than 81 kitchenette apartments. Other apartments more than 170 rooms. Hospitals more than 80 beds. Schools more than 1000 pupils. | 18.00 sq. ft. | 63.00 cu. ft. | 24"x24" |
Section 3713. DETACHED AND PORTABLE INCINERATORS AND THEIR LOCATION ON PROPERTY. (a) Location. An outside detached incinerator shall be located on the rear ten (10) feet of the depth of the lots and at least five (5) feet from the side property line and shall be so placed that it will not constitute a fire hazard to adjacent buildings or structures, and not less than twenty-five (25) feet from any street, avenue or public way or place, except public alley. If said incinerator is attached to any building or structure it shall conform to the applicable portions of Section 3702 and Section 3714, and provided further that for gas-fired incinerators an approved chimney may be used but shall conform to Section 3702. Provided, however, that free standing incinerators, when approved by the Chief Building Inspector or the Board of Appeals, need not meet the requirements of Section 3702 and Section 3714.

(b) Air for Combustion and Ventilation.

1. Sufficient air for combustion and ventilation shall be supplied to the area in which the incinerator is installed.

2. When incinerator, not to exceed four-bushel capacity, is installed in a confined area and when air is supplied from ventilated adjacent areas to the room housing the incinerator, two openings, one near the floor and one near the ceiling, each with a minimum free area on one hundred square inches shall be provided in the room door or walls.

3. When adjacent areas do not have sufficient air infiltration, air shall be supplied from outdoors directly to the room housing the incinerator through opening or openings with a total net free area of one hundred (100) square inches for incinerators not to exceed four (4) bushel capacity.

(c) Chimneys and Vents.

1. Incinerators shall be directly vented and only to a Type A, D-1, or other approved chimney or flue and through a Type D-1 vent or vent pipe of not less than twenty-four (24) U. S. Standard Gauge iron with joints and supports complying with other provisions of this Code. Shelf or bracket type chimneys are prohibited.

(d) Chimney Connection. Vent pipes from an incinerator shall enter the chimney or flue below the lowest connection from any other gas-fired appliance to that chimney or flue.

(e) Cleanout. A cleanout of not less than
six (6) inches in its smallest dimension, tightly sealed but readily removable and accessible, shall be provided in the chimney or flue venting an incinerator and the top edge of such clean-out shall be not less than twelve (12) inches below the bottom edge of the lowest vent pipe connection to such chimney or flue.

(f) Clearance. Incinerators, having a capacity rating not in excess of 4-bushel, shall have a clearance to woodwork or other combustible material of not less than twelve (12) inches at sides and rear, and not less than thirty (30) inches at front, thirty-six (36) inches above and not less than eighteen (18) inches from vent pipe thereof.

Exception: 1. Incinerators approved for installation with lesser clearance than here-in specified may be installed in accordance with the conditions of such approval.

2. Incinerators may be installed with side and rear clearances to woodwork and other combustible material as shown in the following table, if such woodwork or material is protected in conformity with this Table.

<table>
<thead>
<tr>
<th>Type of Protection</th>
<th>Required clearance without protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied to combustible material and covering all surfaces within the distance specified as the required clearance.</td>
<td></td>
</tr>
<tr>
<td>1/4&quot; asbestos millboard spaced out 1 inch*</td>
<td>18&quot; 12&quot;</td>
</tr>
<tr>
<td>28 gauge galvanized sheet metal on 1/4&quot; inch asbestos millboard</td>
<td>12&quot; 6&quot;</td>
</tr>
<tr>
<td>28 gauge sheet metal on 1/8 inch asbestos millboard spaced out 1 inch*</td>
<td>9&quot; 4&quot;</td>
</tr>
</tbody>
</table>

* Spacers shall be noncombustible material and the air space shall be ventilated.

3: No clearance required to masonry construction of four (4") inches or more thickness except on service side. (See Section 5126 (F-1))

(g) Draft Hoods, Prohibited. The use of draft hoods as defined in Chapter 51 of this Code is prohibited.

(h) Automatic Draft Regulators. The use of automatic draft regulators is permitted provided it is of a single swing type that is designed to swing inward with the updraft but will not swing outward in the event of backdraft. Such draft regulator shall be the same size as the incinerator vent.

(i) Floors. Incinerators shall be mounted or set on masonry floors.

Exception: 1. Incinerators approved for installation on combustible floors may be installed in accordance with the conditions of such approval, provided however, that such floors be covered with sheet metal of not less than twenty-four (24) inch U.S. Standard Gauge and extending at the sides and back not less than the required clearance to combustible material and extending not less than thirty (30) inches beyond the front.

(j) Locations, Prohibited. See prohibited locations.

(k) Other Incinerators. Incinerators in excess of 4-bushel capacity and not of the free standing type, are covered by other sections of this code and shall be subject to the approval of the Chief Building Inspector.

(l) Piping. All gas supply piping shall be not less than Standard weight wrought iron or steel pipe, and sized and installed in compliance with other provisions of this code. (See Chapter 51.)

(m) Prohibited Locations. Installation of incinerators in garages or in areas containing explosive or flammable liquids, is expressly prohibited unless separated therefrom by not less than an "absolute separation". (See Section 503 (a) 1.)

(n) Use of Safety Thimbles. For incinerator vent or flue connectors, the exterior diameter of the thimble shall be twelve (12) inches larger than the flue or vent connection diameter.

(o) Vents. (See Chimneys and Vents.)

(p) Additional Regulation. Gas-fired incinerators shall also conform to regulations issued pursuant to Section 4601.

(Ord. 44, Series 1957)

Section 3715. PROHIBITIONS. It shall be unlawful after the effective date of the enactment of this section to erect or build any ashpit to be used for other than the storage of ashes, cans, or rubbish, and in no case shall any such ashpit constructed after the effective date of this section, be used for the incineration of any combustibles.

(a) It shall be unlawful to erect or construct any type of flue-fed incinerator within the corporate limits of the City and County of Denver.

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CHAPTER 38—FIRE PROTECTION SYSTEMS*

Section 3800. BASIC REQUIREMENTS.

Intent:

(a) Fire Protection Systems required by this chapter shall be suitable for the fire protection purposes for which they are intended for use in the premises in which they are installed in conjunction with the Denver Fire Department's fire fighting equipment and shall comply with the technical requirements set forth in rules and regulations promulgated under authority of this code consistent with the standards. (See Sections 3811 and 4601 (d) of this Code.)

Single Water Supply

(b) A single water supply equal to the primary supply required may be accepted as complying with the requirements of this code. The connection to such supply shall be not less than four (4) inches in diameter.

Combined Water Supply

(c) Where both sprinklers and standpipes are required in a building see Section 3807 for combined water supply requirements.

Definition: Fire Protection Systems

(d) Fire protection systems shall include: Automatic sprinkler systems, standpipes, special extinguishing systems, water supplies or other extinguishing agents and the necessary appurtenances thereof.

Section 3801. AUTOMATIC SPRINKLERS.

Automatic Sprinklers: Where Required

(a) Automatic sprinklers shall be installed as specified in this chapter in the following places:

1. In every story, basement or cellar of a building of A, B, C, D, F, G or H occupancy when the floor area exceeds fifteen hundred (1500) square feet and there is not provided at least twenty (20) square feet of window area above grade along every fifty (50) lineal feet or fraction thereof of exterior wall in such story or basement or cellar on at least two (2) sides of the building. For the purpose of this Chapter a window or window opening shall provide a glazed or glass-covered area not more than ¼" thick and having vertical and horizontal minimum dimensions of not less than thirty (30) inches. For the purposes of this Chapter the bottom of areaways, window wells, or open excavations shall not be considered grade.

2. Stages of any size or enclosed platforms having a floor area in excess of five hundred (500) square feet: under the gridiron, under the stage or platform floor, under all fly and tie galleries and in all dressing rooms, storerooms, property rooms, carpenter shops, paint shops, passageways and all appurtenant rooms. Stages shall be equipped with a line of open sprinklers spaced not more than six (6) feet on center controlled by manually operated quick opening valves and shall be installed on the stage side of and immediately back of the proscenium arch or curtain and not more than five (5) feet above the proscenium arch. Manually operated control valves shall be located on both sides of the proscenium opening.

3. In spray painting rooms, booths or shops or any area where painting, brushing, dipping or mixing is regularly conducted using flammable paints or liquids.

4. In all E occupancies and including but not necessarily restricted to mattress factories, box factories, planing mills, furniture manufacturing, upholstering and re-upholstering plants; tar manufacturing or storage, textile manufacturing, rubber products manufacture or storage, pulp or paper mills; aircraft hangars, chemical works, lacquer or varnish works or storage, combustible plastic manufacture or storage, magnesium processing or storage, rag or waste paper storage or plants using rags or waste paper in a manufacturing process.

5. In all buildings used for the manufacture, storage or use of hazardous or highly flammable or explosive materials or liquids, or in occupancies where a severe fire hazard exists, a sprinkler system or special extinguishing equipment may be required by the Chief Building Inspector and the Chief of the Fire Department.

6. Buildings containing five thousand (5000) square feet or more on any one floor, if other than Type I or II construction, which are used exclusively for housing motor driven vehicles. "For Off Street Parking Structures" (see Article 379, Revised Municipal Code).

7. Buildings containing five thousand (5000) square feet or more on any one

*Source—Ord. 203, Series 1956, Except where otherwise indicated.
floor which are used for equipping, repairing or servicing motor driven vehicles.

8. Garage areas located in buildings in which one (1) or more stories or parts thereof are occupied for other purposes (mixed occupancies) when such garages have a capacity of four (4) or more passenger automobiles, or three (3) or more commercial vehicles.

9. Enclosed loading or unloading docks or terminals having a floor area in excess of two thousand (2000) square feet, unless of Type I or Type II construction, which are used for storage of motor vehicles.

10. Where the floor area of the building is less than (1500) square feet and where Section 3801 (a) 1, does not apply, sprinklers shall be installed in group A, B, C, D, or H occupancy as follows: In boiler or heating and ventilating equipment rooms below grade, and in all portions of basements or cellars used for storage or maintenance work rooms 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 workrooms except where the entire construction is as required for Type I buildings.)

11. Unenclosed vertical openings between floors, where permitted by other sections of this code in sprinklered buildings, shall be provided with non-combustible draft curtains as follows:

Draft curtains shall enclose the perimeter of the unenclosed opening and shall extend from the ceiling downward not less than twelve (12) inches on all sides. Automatic sprinklers shall be provided around the perimeter of the opening and within 2'0" of the draft curtain. The distance between sprinklers shall not exceed 6'0" center to center.

Section 3802. DETAILED REQUIREMENTS.

Scope

(a) Automatic Sprinkler systems shall include Fire Department connections, alarm valves, alarm gongs or other approved alarm attachments.

Fire Department Connections

(b) Fire Department connections shall be arranged so that any one connection will serve all the sprinkler systems within the building.

All sprinkler systems shall be connected to not less than one (1) two-way Fire Department Connection.

Fire Department Connections shall be located on a street front and such connection shall be not less than one foot-six inches (1'6") nor more than three foot-six inches (3'6") in elevation measured from ground level to the center line of inlets. Alarm gongs shall be located within twenty-five (25) feet of Fire Department connections. Fire Department inlet connections shall be fitted with check valves, ball drip valves and caps or suitable plugs and chains. Where the Fire Department connections would project beyond the property line, or into the public way, a flush type Fire Department connection shall be provided. Hose threads shall not be recessed.

Threads

(c) All hose threads shall be "Denver Threads", as required by the Denver Fire Department.

Signs

(d) An iron or bronze sign with raised letters at least one (1) inch high shall be mounted on all Fire Department connections and such signs shall be suitably marked "AUTOMATIC SPRINKLERS".

Control Valves

(e) All control valves shall be sealed in a normal operating position.

Partial Sprinklers

(f) Partial Sprinklers Where Permitted.

1. Where partial sprinklers are permitted, a maximum of ten (10) sprinklers may be supplied from the domestic water system, provided, however, that not more than two (2) sprinkler heads are located in any one enclosed area and the enclosure is of at least one (1) hour fire resistive construction.

2. Alarm attachments, alarms, and Fire Department connections shall not be required for partial sprinkler systems as defined in paragraph (f) 1.

Special Extinguishing Systems

(g) In lieu of sprinkler systems as required by this code, special extinguishing systems may be installed if approved by the Chief Building Inspector and the Chief of the Fire Department.

Fire Hydrants

(h) Fire hydrants installed on public or private property shall be located as directed by the Chief of the Denver Fire Department and shall conform to the standards of the Denver Water Board and the Denver Fire Department.
Section 3803. WET STANDPIPES.

Wet Standpipes: Where Required

(a) Every group A or B occupancy of any height and every group C, D, E, F, G, or H occupancy, three (3) or more stories in height, and any area or place of assemblage having a stage or enclosed platform and an occupant load of five hundred (500) or more shall be equipped with one (1) or more wet standpipes in accordance with the schedule set forth in the succeeding paragraphs. Floor area is the area included within surrounding walls of a building. Buildings completely equipped with approved automatic sprinkler systems shall meet the provisions of Section 3804 (g).

Number Required

(b) Every building requiring standpipes in accordance with this section shall be equipped with a sufficient number of standpipes so that any portion of the building can be reached therefrom with a hose not exceeding seventy-five feet (75') in length, allowing an additional twenty feet (20') for the stream of water.

Location

(c) Risers and outlets shall be located as follows:

1. Standpipe risers shall be located in stairway enclosures, pipe shafts or smoke proof enclosures and shall be installed so as to prevent mechanical injury or fire damage.

2. Standpipe outlets, hose valves and hose equipment shall be located in a stairway enclosure, or within ten (10) feet of the opening to such enclosure, and not more than ten feet (10') from the standpipe riser.

3. In groups A, B or C occupancies additional outlets with one and one-half (1-1/2) inch hose equipment shall be located on each side of the stage or platform on each side of the rear of the auditorium or place of assemblage, and on each side of the rear of the balconies.

Section 3804. DETAILED REQUIREMENTS.

Scope

(a) Standpipe systems shall include Fire Department connections, alarm valves and alarm gongs or other approved alarm attachments.

Fire Department Connections

(b) All standpipes shall be connected to not less than one (1) two-way Fire Department connection. Fire Department connection shall be located on the street front and shall be not less than one foot six inches (1'6") nor more than three feet six inches (3'6") in elevation measured from ground level to center line of inlets.

Alarm gongs shall be located within twenty-five (25) feet of Fire Department connection. Fire Department inlet connection shall be fitted with check valves, ball drip valves and caps or suitable plugs and chains. Where the Fire Department connection would project beyond the property line or into the public way a flush type Fire Department connection shall be provided. In no case may the hose threads be recessed.

Fire Department connections shall be so arranged that any one connection will serve all the standpipes within the building. The size of the pipe from the Fire Department inlet connection to the base of each standpipe shall be not less than the size of the standpipe itself.

Size

(c) Height of Buildings.

1. Buildings or portions thereof, less than four (4) stories and less than fifty feet (50') in height shall be equipped with one (1) or more two and one-half (2-1/2) inch standpipes extending from the lowest cellar or basement to the uppermost story.

2. Buildings or portions thereof, four (4) or more stories or over fifty feet (50') in height shall be equipped with one (1) or more four (4) inch standpipes, extending from the lowest cellar or basement to and through the roof.

3. Buildings or portions thereof seven (7) or more stories or over seventy-five (75') feet in height shall be equipped with one (1) or more six (6) inch standpipes extending from the lowest cellar or basement to and through the roof.

Material

(d) Standpipes shall be constructed of wrought iron or steel, and all pipe, fittings and valves shall be of extra heavy pattern when the working pressure will exceed one hundred seventy-five (175) pounds per square inch.

Capacity

(e) Pressure and Flow.

1. Two and one-half inch (2-1/2") standpipe systems shall be capable of discharging seventy (70) gallons per minute with a residual pressure at the highest outlet of not less than thirty (30) pounds per square inch.

2. Standpipe systems, four (4) inch or larger, shall be capable of discharging not less than 250 gallons per minute where one (1) standpipe is required, or not less than 400 gallons per minute where more than one (1) standpipe is required, with a residual pressure at the highest outlet of not less than thirty (30) pounds per square inch.
Outlets

(f) Location

1. At each floor level and not over five (5) feet above the floor there shall be connected to each two and one-half (2-1/2) inch standpipe a one (1) one and one-half (1-1/2) inch hose valve; seventy-five (75) feet of one and one-half (1-1/2) inch unlined linen hose and a one-half (1/2) inch nozzle coupled in place and stored on an approved semi-automatic hose rack.

2. At each floor level and not over five (5) feet above the floor there shall be connected to each four (4) inch or six (6) inch standpipe one (1) two and one-half (2-1/2) inch hose valve with cap and chain. On all floors except the roof and not over five (5) feet above the floor there shall also be connected to each standpipe one (1) one and one-half (1-1/2) inch hose outlet and one (1) one and one-half (1-1/2) inch hose valve.

3. On every standpipe extending through the roof, a hydrant or manifold shall be installed with two (2) two and one-half (2-1/2) inch outlets with independent hose gate valves and caps and chains. The main control valve on a roof hydrant or manifold shall be located in a heated area and equipped with automatic drain. The operation of such valves shall be accomplished above the main roof line.

Standpipes in Sprinklered Buildings

(g) Buildings completely equipped with automatic sprinkler systems as provided in this code may omit all requirements for one and one-half (1-1/2) inch outlets as specified in paragraph (f).

Section 3805. STANDPIPES FOR BUILDINGS UNDER CONSTRUCTION.

Standpipes: Buildings Under Construction—

Scope

(a) Standpipes required under this section, either temporary or permanent, shall conform in all respects as to number, size and construction and all of the provisions of this chapter except as to water supply.

Height

(b) A standpipe system, either temporary or permanent in nature shall be installed in all buildings under construction which will exceed four (4) stories or fifty (50) feet in height. Commencing at the fourth (4) floor the standpipe system shall be installed and ready for use as each floor progresses.

Fire Department Connections

(c) At the street level there shall be provided for each temporary or permanent standpipe at least one (1) two way Fire Department connection for attaching hose lines from Fire Department pumper or other source of high pressure water supply. Fire Department connections shall be prominently marked and ready and easily accessible to the Fire Department at all times.

Outlets

(d) Standpipe Outlets.

1. At each floor level and at each standpipe there shall be provided one (1) two and one-half (2-1/2) inch hose outlet and one (1) one and one-half (1-1/2) inch hose valve with cap and chain. At each floor level and at each standpipe there shall be provided one (1) one and one-half (1-1/2) inch hose outlet and one (1) one and one-half (1-1/2) inch hose valve.

2. Standpipes shall be carried up with each floor and securely capped at the top. Top hose outlets shall at all times be not more than one (1) floor below the highest forms, staging or similar combustible material.

3. At the highest hose outlets on each standpipe there shall be maintained a substantial metal box in which there shall be kept seventy-five (75) feet of one and one-half (1-1/2) inch hose, a one-half (1/2) inch nozzle and two (2) spanner wrenches.

Temporary—In Service

(e) If the standpipes installed under this section are of a temporary nature, they shall remain in service until the permanent standpipe installation is fully completed and in service.

Section 3806. WATER SUPPLIES.

Water Supplies: Size of Service

(a) Every standpipe shall be connected to a street water main equal to or greater than the size of the largest standpipe within the building itself. The size of all pipe between the street water main and the base of the standpipe risers shall be not less than the size of the standpipe itself. Where both sprinklers and standpipes are required in a building see Section 3807 for combined water supply requirements.

Base Connection

(b) The required water supply shall be connected to the base of each standpipe and where
more than one (1) standpipe is required such standpipes shall be interconnected at their bases.

**Insufficient Pressure**

(c) When the City water pressure is insufficient to produce the required volume and pressure in accordance with Section 3804, an approved fire pump or booster pump of adequate capacity and pressure shall be installed and maintained in operating condition at all times.

**Fire Pumps and Booster Pumps**

(d) Fire pumps or booster pumps shall be of centrifugal type, electrically driven, having a rated capacity sufficient to produce and maintain the volumes and pressures required in Section 3804. Fire pumps or booster pumps shall be equipped with a controller which will provide both automatic and manual operation. Fire pumps or booster pumps shall take suction from an approved (see Section 4601 (d)) water supply. Fire pumps or booster pumps taking suction from a street water main shall be installed on a by-pass. Electric wiring to the pump motor shall be in rigid conduit and shall be on a separate circuit, independent of house switches and main circuit breakers. All fire pumps or booster pumps shall be installed in a separate non-combustible room or pump house of not less than one (1) hour fire resistive construction, with floor drain and curbed door opening. Every opening to the pump room shall have an automatic self-closing Class "B" fire door.

Section 3807. COMBINED WATER SUPPLY.

**Combined Water Supply Common Connection**

(a) Where both sprinklers and standpipes are installed throughout or in parts of any building they shall have a common connection to the street water main as their combined source of supply. The connection shall be not less than four (4) inches in diameter and connection shall not be made to any City water main less than four (4) inches in diameter.

**Size**

(b) The largest connection required for either the standpipes or automatic sprinkler system shall be the size of the common water supply for both.

**Alarm**

(c) Combined water supply to both sprinkler system and standpipe system shall be through an approved alarm valve or other approved alarm attachments so that operation of either system will sound a local audible alarm.

Section 3808. BASEMENT PIPE INLETS.

**Basement Pipe Inlets Location**

(a) Basement pipe inlets shall be installed in the first floor of all E, F, or G occupancies, where there are cellars or window-less basements under some except where in such cellars or basements there is installed an automatic sprinkler system as specified by this code.

**Size**

(b) All basement pipe inlets shall be not less than eight (8) inches in diameter.

**Type and Location**

(c) Basement pipe inlets shall be approved by the Chief Building Inspector and Chief of the Fire Department as to the type and accessibility and shall remain accessible at all times to the Fire Department.

Section 3809. APPROVAL.

**Approval Plans and Specifications.**

(a) Plans and specifications of all Fire Protection Systems shall be approved by the Chief Building Inspector and the Chief of the Fire Department in accordance with the Standards set forth and the rules and regulations adopted and promulgated under this code. (See Sec. 4601).

**Shop Drawings.**

(b) Shop drawings for all proposed installations of Fire Protection Systems shall be submitted to and approved by the Chief Building Inspector and the Chief of the Fire Department before commencing installation. Neither shop drawings nor permit applications shall be approved unless they accompany one another.

**Test Certification.**

(c) Upon completion of any fire protection system, Contractor's Test Certificates covering all materials, labor, methods and tests incorporated in the particular installation shall be furnished the Chief Building Inspector.

Section 3810. EXTRA HAZARDS.

**Extra Hazards.**

(a) Any building which presents a fire hazard may be required by the Chief Building Inspector in conjunction with the Chief of the Fire Department to provide special extinguishing equipment. (See Section 4601).

Section 3811. STANDARDS.

**Standards**

Unless as otherwise specified in other sections of this code or Chapter, the Standards as set forth in Section 4601 (d) of this Code, shall apply.
CHAPTER 39—STAGES AND PLATFORMS

Section 3901. STAGE VENTILATORS. 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 (5%) of the floor area within the stage walls. The entire equipment shall conform to the following requirements or their equivalent:

1. Doors shall open by force of gravity sufficient to overcome the effects of neglect, rust, dirt, frost, snow or expansion by heat or warping of the framework.

2. Glass, if used in ventilators, must be protected against falling on the stage. A wire screen, if used under the glass, must be so placed that if clogged it cannot reduce the required ventilating area or interfere with the operating mechanism or obstruct the distribution of water from the automatic sprinklers.

3. The doors and other covers shall be arranged to open instantly after the outbreak of fire, by the use of approved automatic fusible links which will fuse and separate at not more than 160 degrees Fahrenheit. A manual control must also be provided by a cord running down to the stage at a point on each side of the stage designated by the Chief Building Inspector.

4. The fusible link and the cord must hold the doors closed against a force of at least thirty (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.

Section 3902. GRIDIRONS. Gridirons, flying to the requirements of Section 3901, near galleries and pin-rails shall be constructed of incombustible materials and fire-protection of steel and iron may be omitted. Gridiron and fly galleries shall be designed to support not less than seventy-five (75) pounds live load per square foot.

The main counter-weight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load equal to not less than five (5) pounds per square foot over the area of the gridiron directly back of the proscenium opening.

Section 3903. ROOMS ACCESSORY TO STAGE. In buildings having a stage, the dressing room sections, workshops, and storerooms shall be located on the stage side of the proscenium wall and shall be separated from each other and from the stage by not less than a "Special Occupancy Separation."

Section 3904. PROSCENIUM WALLS. A stage as defined in Section 401 shall be completely separated from the auditorium by a proscenium wall of not less than four-hour fire-resistant construction. The proscenium wall shall extend not less than four feet (4') above the roof over the auditorium.

Proscenium walls may have, in addition to the main proscenium opening, one opening at the orchestra pit level and not more than two openings at the stage floor level, each of which shall be not more than twenty-five square feet (25 sq. ft.) in area.

Openings in the proscenium wall of a stage shall be protected on each side by Class "A" fire doors. The proscenium opening, which shall be the main opening for viewing performances, shall be provided with a self-closing fire-resistant curtain as provided in Chapter 41.

Section 3905. STAGE FLOORS. All parts of stage floor shall be of Type I Construction except the part of the stage extending back from the foot light and the full width of the proscenium opening, which may be constructed of steel or heavy timbers covered with a wood floor not less than two inches (2") nominal thickness. No part of the combustible construction except the floor finish shall be carried through the proscenium opening. All parts of the stage floor shall be designed to support not less than one hundred twenty-five (125) pounds per square foot.

Opening through stage floors shall be equipped with tight-fitting trap doors of wood not less than two inches (2") nominal thickness.

Section 3906. PLATFORMS. (a) Ventilators. There shall be one or more ventilators, conforming to the requirements of Section 3901, near the center and above the highest part of every enclosed platform having a floor area of five hundred square feet (500 sq. ft.) or more.

(b) Construction. Walls and ceilings of an enclosed platform in an assembly room shall be of not less than one-hour fire-resistant construction.

Any usable space having headroom of four feet (4') or more under a raised platform of an assembly room shall be of not less than one-hour fire-resistant construction.

(c) Accessory Rooms. In buildings having an enclosed platform, the dressing room section, workshops, and storerooms shall be sep-
Section 3907. STAGE EXITS. At least one exit two feet 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 Sub-section need not be enclosed.

Section 3908. MISCELLANEOUS. A protective hood shall be provided over the full length of the stage switchboard.

Section 3909. FLAME-PROOFING REQUIREMENTS. No combustible scenery, drops, props, decorations, or other combustible effects shall be placed on any stage or enclosed platform unless it is treated with an effective fire-retardant solution and maintained in a non-inflammable condition as approved by the Fire Department.
CHAPTER 40—MOTION PICTURE PROJECTION ROOMS

Section 4001. GENERAL. (a) Scope. The provisions of this Chapter shall apply only where nitrocellulose film is used.

(b) Projection Room Required. Every motion picture machine using nitrocellulose films, together with all electrical devices, rheostats, sewing machines and all such films present in any Group A, B, or C occupancy, shall be enclosed in a projection room large enough to permit the operator to walk freely on either side and back of the machine.

Section 4002. CONSTRUCTION. Every projection room shall be of not less than one-hour fire-resistive construction throughout and the walls and ceiling shall be finished with incombustible material.

The ceiling shall be not less than eight feet (8') from the finished floor. The room shall have a floor area of not less than eighty square feet (80 sq. ft.) and forty square feet (40 sq. ft.) for each additional machine.

Section 4003. EXITS. Every projection room shall have at least two doorways separated by not less than one-third the perimeter of the room, each at least thirty inches (30") wide and eighty inches (80") high.

The entrance to the projection room shall be protected by Class "C" fire doors as specified in Section 4304. Such doors shall open outward and lead to proper exits as required in Chapter 33 and shall not be equipped with any latch. The maximum width of such door need be no more than thirty inches (30").

Section 4004. PORTS AND OPENINGS. (a) Types. Ports in projection room walls shall be of three kinds: projection ports; observation ports; and combination ports used for both observation and for stereopticon, spot, or flood-light machines.

(b) Ports Required. There shall be provided for each motion picture projector not more than one projection port, which shall be limited in area to one hundred and twenty square inches (120 sq. in.), and not more than one observation port, which shall be limited in area to two hundred square inches (200 sq. in.). There shall be not more than three combination ports, each of which shall not exceed thirty inches (30") by twenty-four inches (24"). Each port opening shall be completely covered with a single pane of glass not less than one-quarter inch (1/4") in thickness.

(c) Shutters. Each port and every other opening in projection room walls, including any fresh-air inlets but excluding exit doors and exhaust ducts, shall be provided with a shutter of not less than No. 10 U. S. gauge sheet metal or its equivalent. Large enough to overlap at least one inch (1") on all sides of such opening. Shutters shall be arranged to slide without binding in guides constructed of material equal to the shutters in strength and fire resistance. Each shutter shall be equipped with a 160-degree Fahrenheit fusible link, which when fused by heat will cause closure of the shutter by gravity. There shall also be a fusible link located over the upper magazine of each projector, which, upon operating, will close all the shutters. In addition, there shall be provided suitable means for manually closing all shutters simultaneously from any projector head and from a point within the projection room near each exit door. Shutters on openings not in use shall be kept closed.

Section 4005. VENTILATION. (a) Inlets. A fresh-air inlet from the exterior of the building not less than one hundred and forty-four square inches (144 sq. in.) and protected with wire netting shall be installed within two inches (2") of the floor in every projection room, the source of which shall be remote from other outside vents or flues.

(b) Outlets. Ventilation shall be provided by one or more mechanical exhaust systems which shall draw air from each arc lamp housing and from one or more points near the ceiling. Systems shall exhaust to outdoors either directly or through a non-combustible flue used for no other purpose. Exhaust capacity shall be not less than fifteen cubic feet (15 cu. ft.) nor more than fifty cubic feet (50 cu. ft.) per minute for each arc lamp plus two hundred cubic feet (200 cu. ft.) per minute for the room itself. Systems shall be controlled from within the enclosure and have pilot lights to indicate operation. The exhaust system serving the projection room may be extended to cover rooms associated therewith such as rewind rooms. No dampers shall be installed in such exhaust systems.

Ventilation of these rooms shall not be connected in any way with ventilating or air-conditioning systems serving other portions of the building.

(c) Exhaust Ducts. Exhaust ducts shall be of incombustible material, and shall either be kept one inch (1") from combustible material or covered with one-half inch (1/2") of incombustible heat-insulating material.

Section 4006. REGULATION OF EQUIPMENT. (a) Shelves and Fixtures. All shelves, fixtures, and fixed equipment in a projection room shall be constructed of incombustible materials.
(b) Films. All films not in actual use shall be stored in metal cabinets having individual compartments for reels, or shall be in I.C.C. shipping containers. Metal used in the construction of cabinets shall be not less than U.S.S.G. No. 18. No solder shall be used in the construction of such metal cabinets.

Section 4007. SANITARY REQUIREMENTS.
Every projection room shall be provided with an unenclosed water closet and lavatory.
CHAPTER 41 - PROSCENIUM CURTAINS

Section 4101. GENERAL REQUIREMENTS. 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 (30) seconds, but the last five feet (5') of travel shall require not less than five (5) seconds.

Section 4102. CURTAIN COVERINGS. A proscenium curtain 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 (3-1/4) pounds per square yard.

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 crysotile 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 (3) 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 one hundred sixty (160) pounds per inch of width of warp and fifty-two (52) pounds per inch of filling.

The asbestos fiber of yarns may contain cotton or other combustible fiber not to exceed twenty per cent (20%) of the weight of the asbestos. The total carbon content of the cloth shall not exceed ten per cent (10%) of the total weight of the fiber. When required by the Chief 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 (4) parts of casein in each ten (10) parts of silicate of soda. This paint shall be well brushed into the cloth so that no light or smoke can come through.

Section 4103. DESIGN AND CONSTRUCTION. 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.

The curtain shall be wide enough to extend into steel smoke grooves on each side of the proscenium opening at least eight inches (8") and shall overlap the top and sides of the proscenium opening at least twelve inches (12").

Six-inch (6") pockets shall be sewed in the top and the bottom of the curtain to hold the pipe battens; the sides shall be hemmed at least six inches (6") deep. A two-inch (2") pipe batten shall be placed at the top and a one and one-half inch (1-1/2") batten at the bottom. For stage openings up to twenty feet (20') in width the bottom batten shall be not less than two and one-half inches (2-1/2") 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 (3) bolts or rivets.

No. 16 U. S. gauge galvanized metal shall be bent and placed vertically along each side hem of the curtained 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 smoketight 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.

Section 4104. OPERATING EQUIPMENT. Smoke grooves which protect the sides of the curtain shall be of structural steel shapes and plates not less than one-quarter inch (1/4") 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 Chief Building Inspector and Fire Chief for approval.

Steel tracks shall be built into the smoke grooves upon which shall travel the roller cur-
tain 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 (1/4") flexible steel cable for curtains forty feet (40') or less in width, and three-eighths-inch (3/8") flexible steel cable 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 Chief 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 (3/8") turnbuckles 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.

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 (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 one hundred fifty (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 overweight 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.

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 (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 (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 one hundred fifty (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.

Section 4105. TESTS. 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 Chief Building Inspector.

Section 4106. NEW DESIGNS. 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 (5) minutes unless failure shall have occurred previously. The unexposed face of the curtain shall not glow within a period of five (5) minutes nor shall there be any passage of smoke or flame through the curtain.
CHAPTER 42—RELATING TO GENERAL REQUIREMENTS AND FLAME-SPREAD CLASSIFICATION OF INTERIOR WALL FINISH, CEILING FINISH AND DECORATIONS*

Section 4201. General. Interior wall and ceiling finish shall mean interior wainscotting, paneling, or other finish applied structurally or for decoration, acoustical correction, surface insulation or similar purposes, (including draperies, blinds, or combustible decorations of any type.) Requirements for finishes shall not apply to trim, doors, windows or their frames, nor to materials which are less than one-twenty-eight inch (0.036") in thickness cemented to the surface of walls or ceilings, if these materials have flame-spread characteristics no greater than paper of this thickness cemented to an incombustible backing.

Section 4202. Approval and Testing. Approved materials as specified in Section 4201 shall possess flame-spread characteristics as set forth in Table 42-A. Such flame-spread characteristics shall be determined by and meet the requirements of testing as set forth in Section 4601 (d) of this Code.

Testing of Class D materials shall be in conformity with Federal Test SS-A 118 b as shown in Section 4601 (d) of this Code.

Exception: The test duration for Class D materials shall be 8 minutes, with gas supply regulated to permit following the time-temperature requirements of Table III of the Federal Test SS-A-118 b as shown in Section 4601 (d). If the flame does not reach the angle frame at any point during the 8 minute test period, the material shall be considered as Class D.

(a) Classification. There shall be three classes of interior finish materials based upon their flame-spread characteristics as set forth in Table 42-A.

        TABLE NO. 42-A
FLAME-SPREAD CLASSIFICATION  (Federal
                        Standard Test)
CLASS         FACTOR    CLASSIFICATION
   I     0- 30   A-B
   II    31- 75   C
   III   76-200  D

        TABLE NO. 42-B MINIMUM INTERIOR FINISH
CLASSIFICATION

<table>
<thead>
<tr>
<th>Occupancy Group</th>
<th>Enclosed Vertical Exitways</th>
<th>Other Exitways</th>
<th>Rooms or Areas</th>
</tr>
</thead>
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<tr>
<td>A</td>
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<td>II</td>
<td>II*</td>
</tr>
<tr>
<td>B</td>
<td>I</td>
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<td>II</td>
<td>III</td>
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<tr>
<td>H-Division 1</td>
<td>I</td>
<td>II</td>
<td>III**</td>
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<tr>
<td>H-Division 2</td>
<td>I</td>
<td>II</td>
<td>III*</td>
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<tr>
<td>J</td>
<td>See Sections 2016-2216</td>
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</tbody>
</table>

*No room or area shall contain more than 5000 square feet of Class III material.

**Over two stories shall be no greater than Class II.

2. Any finish material, applied to walls or ceilings which are required to be incombustible or fire-resistive by any provision of this Code, shall be applied directly against such incombustible or fire-resistive surfaces, or to furring strips not exceeding one and three-quarters inches (1-3/4") applied directly to such incombustible or fire-resistive surfaces where the intervening spaces are filled with an incombustible material or are fire-stopped not to exceed eight feet (8') in any direction.

3. Where walls and ceilings are required to be incombustible or fire-resistive and walls are set out or ceilings are dropped distances greater than as specified in paragraph 2 of this Section, incombustible materials shall be used except where the finish materials are either pro-

*Source—Ord. 313, Series 1955, Except where otherwise indicated.
ected on both sides by automatic sprinklers or are attached to an incombustible backing or to furring strips installed as specified in paragraph 2 of this Section, applied directly to an incombustible backing so provided and installed so as to control fire draft in any concealed spaces.

4. Wall and ceiling finish materials of all classes as permitted in this Chapter may be installed directly against the wood decking or planking of heavy-timber construction or to wood furring strips applied directly to the wood decking or planking if installed and firestopped as specified in paragraph 2 of this Section.

5. All interior wall or ceiling finish other than Class I materials which is less than one-quarter inch (1/4") in thickness shall be applied directly against an incombustible backing.

Section 4204. Finishes Based on Occupancy. The minimum flame-spread classification of interior finish as determined by tests under Section 4601 of this Code, shall be based on use or occupancy as set forth in Table No. 42-B.

Exceptions: 1. Tack and bulletin boards covering not more than five percent of the wall area may be of Class III materials.

2. Where approved full fire-extinguishing system protection is provided, the flame-spread classification rating may be reduced one classification; but in no case shall materials having a classification greater than Class III be used.

3. The exposed faces of Type III building, structural members and Type III building, decking and planking where otherwise permissible under this Code are excluded from flame-spread requirements.

4. Where wainscoating is permitted by other portions of this Code, such wainscoating shall be no greater than four (4) feet in height from the floor and the flame-spread classification shall not exceed Class III.

Section 4205. Draperies, Blinds and Decorations. Draperies, blinds and decorations of all types in buildings of Group A, B, C, D and E occupancies, and Group F and H occupancies in rooms or areas over 3500 square feet, shall meet the requirements as set forth in Section 4601 of this Code.

Section 4206. Approval. All materials shall be subject to approval by the Chief Building Inspector or Board of Appeals.
PART VIII
FIRE-RESISTIVE STANDARDS FOR FIRE PROTECTION
CHAPTER 43—FIRE-RESISTIVE STANDARDS

Section 4301. GENERAL. In addition to all the other requirements of this Code, fire-resistant materials shall meet the requirements for life-resistant construction given in this Chapter.

Section 4302. FIRE-RESISTIVE MATERIALS.
(a) General. Materials used for fire-resistant purposes shall be limited to those specified in this Chapter unless accepted under the procedure given in Section 4302 (b).

(b) Tests. For the purpose of determining the degree of fire resistance afforded, the materials of construction listed in this Chapter shall be assumed to have the fire-resistance ratings indicated. Any material or assembly of materials of construction tested in accordance with the methods required by Section 4601 shall be rated for fire resistance in accordance with the results of such tests, provided that it also meets the performance standards as specified in Section 105.

(c) Lath. Gypsum lath shall be not less than three-eighths inch (3/8") in thickness and shall be perforated with holes not less than three-fourths inch (3/4") in diameter. There shall be one hole for not more than each sixteen square inches (16 sq. in.) of lath surface. Application shall be as specified in Section 4703.

Exception: In two-inch (2") solid partitions, plain gypsum lath shall be used.

Metal lath shall be as specified in Section 4703.

(d) Plaster. Plaster shall be gypsum or Portland cement plaster not less than one-half inch (1/2") thick and shall conform to Chapter 47.

(e) Concrete. Grade A Concrete is concrete in which at least sixty per cent (60%) of the coarse aggregate consists of pumice, limestone, calcareous gravel, trap rock, blast furnace slag, or burned clay or shale.

Grade B Concrete is concrete in which at least sixty per cent (60%) of the coarse aggregate consists of granite, sandstone, cinders, or a mixture of any of these aggregates with aggregates for Grade A Concrete.

Grade C Concrete is any concrete not classed as Grade A or B.

Where the classification is in doubt, concrete shall be assumed to be Grade C unless tests on the aggregates by an approved agency prove otherwise.

(f) Pneumatically Placed Concrete. Pneumatically placed concrete without coarse aggregate shall be classified as Grade A, B, or C Concrete in accordance with the aggregate used.

Section 4303. PROTECTION STRUCTURAL MEMBERS. (a) Protective Coverings. 1. Thickness of Protection. The thickness of fire-resistant materials for protection of structural members shall be not less than that set forth in Table No. 43-A, except as modified in this Section. The figures shown shall be the net thickness of the protecting materials and shall not include any hollow space back of the protection.

2. Unit Masonry Protection. Unit masonry protection for metal columns shall have metal ties imbedded in each transverse joint, where joints are more than sixteen inches (16") apart, and shall be spaced not more than sixteen inches (16") in other cases. Soffit tile protecting beam and girder flanges shall be tied to the flange. Ties shall have a cross-sectional area equal to that of No. 8 gauge wire.

3. Reinforcement for Cast-In-Place Protection. Cast-in-place protection for metal structural members shall be reinforced at the edges of such members with wire or mesh with a maximum spacing of six inches (6") wound around or attached to the member. The sum of the cross-sectional area in each direction shall be not less than 0.025 square inches per foot.

4. Embedment of Pipes. Conduits and pipes shall not be imbedded in required fire protection of structural members.

5. Column Jacketing. Where the fire-resistant covering on columns is exposed to injury from moving vehicles, the handling of merchandise, or by other means, it shall be jacketed to a minimum height of six feet (6') from the floor with an adequate protective covering.

(b) Protected Members. 1. Attached Metal Members. The edges of lugs, brackets, rivets, and bolt heads attached to structural members may extend to within one inch (1") of the surface of the fire-protection.

2. Reinforcing. Thickness of protection for concrete or masonry reinforcement shall be measured to the outside of the reinforcement, except that stirrups and ties may project not more than one-half inch (1/2") into the protection.

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3. Steel Studs and Joists. Steel studs and joists are not required to have individual protection when part of an assembly which has a fire-resistive rating.

Section 4304. WALLS AND PARTITIONS. (a) General. Fire-resistive walls and partitions shall have the ratings set forth in Table No. 43-B.

(b) Combustible Members. Combustible members framed into a wall shall be protected at their ends by not less than one-half the required fire-resistive thickness of such wall.

Section 4305. FLOORS AND CEILINGS. (a) General. Fire-resistive floors, or ceilings shall have the ratings set forth in Table No. 43-C.

(b) Ceilings. 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 fire-protection of structural members may be reduced one-half inch (1/2") but in no case shall the slab thickness be less than two inches (2").

(c) Unusable Space Above or Below. In one-hour fire-resistive construction the ceiling may be omitted over unusable space and flooring may be omitted where unusable space occurs above.

Section 4306. FIRE-RESISTIVE ASSEMBLIES FOR PROTECTION OF OPENINGS. (a) Where Required. Class “A” fire doors shall be installed when required in Sections 501, 503 (c), and 3904.

Class “B” fire doors shall be installed when required in Sections 503 (c), 1807, 3305 (e), 3308 (d), and 3309 (d).

Class “C” fire doors shall be installed when required in Sections 503 (c), 1308, and 4003.

Class “D,” “E,” and “F” fire doors shall be installed when required in Sections 501, 504, 608, 708, 808, 1008, 1102, 1602 (c), 1603 (c), 1807, 1813, 1815, 1913, 3305 (h), 3308 (d), 3311 (d), and 3316.

Fire doors and windows are not required in fire-resistive walls or partitions unless specified elsewhere in this Code.

(b) Scope. Fire doors and windows wherever specified in this Code shall meet the requirements of this Section.

(c) Classification of Openings. Openings requiring fire doors or windows shall be classified as follows:

“Class ‘A’ openings” are openings in three-hour fire-resistive “Special Occupancy Separation.”

“Class ‘B’ openings” are openings in “Ordinary Occupancy Separation” and in enclosures to vertical shafts.

“Class ‘C’ openings” are in corridor or room partitions.

“Class ‘D’, ‘E’, and ‘F’, openings” are in exterior walls which have severe, moderate, or light fire exposure, respectively.

(d) Class “A” Openings. Class “A” openings shall be protected by two automatic Class “A” fire doors, one on each side of the opening and interconnected.

Each Class “A” fire door shall have a fire resistance time period of three (3) hours and shall be without glazed openings.

(e) Class “B” Openings. Class “B” openings shall be protected by one automatic or self-closing Class “B” fire door.

A Class “B” fire door shall have a fire resistance time period of one and one-half (1-1/2) hours.

Glass panels in a Class “B” fire door shall be limited to one observation panel not exceeding twelve inches (12") in width or height and one hundred square inches (100 sq. in.) in area. Where doors are hung on each jamb of a Class “B” opening, an observation panel may be installed in each of the two doors.

(f) Class “C” Openings. Class “C” openings shall be protected by one self-closing Class “C” fire door.

A Class “C” fire door shall have a fire resistance time period of one hour, except that doors with glass panels larger than one hundred square inches (100 sq. in.) may have a fire resistance time period of forty-five (45) minutes.

Individual glass lights in glazed openings shall be limited in area to twelve hundred and ninety-six square inches (1296 sq. in.).

(g) Class “D” Openings. Class “D” openings shall be protected by one automatic closing Class “D” fire door.

Class “D” fire door shall have a fire resistance time period of one and one-half (1-1/2) hours and shall have no glazed openings.

(h) Class “E” and “F” Openings. Class “E” and “F” openings shall be protected by a Class “E” or “F” fire door or fire window. Self-closing devices shall not be required.

Class “E” and “F” fire doors and fire windows shall have a time period of fire resistance of forty-five (45) minutes.

Individual glass lights shall be limited to fifty-four inches (54") in height, forty-eight
inches (48") in width, and seven hundred and twenty square inches (720 sq. in.) in area.

Class "E" and "F" fire windows shall be limited in area to eighty-four square feet (84 sq. ft.) with neither width nor height exceeding twelve feet (12').

Double hung fire windows shall be not more than six feet (6') wide nor more than twelve feet (12') high.

(i) Glass. Glass used in fire doors or fire windows shall be not less than one-fourth inch (1/4") thick and shall be reinforced with wire mesh, 24 gauge or heavier, with openings not larger than one inch (1") square.

Glass shall be held in place by metal glazing angles, except that in casement windows wire clips may be used.

(j) Closing Devices. Automatic fire doors shall be designed to close automatically when the temperature of a heat-actuated device reaches 165 degrees Fahrenheit or 50 degrees above the maximum room temperature under normal conditions. Heat-actuated devices shall be installed, one on each side of the wall at the top of the opening and one on each side of the wall at ceiling height where the ceiling is more than three feet (3') above the opening.

Interconnected doors shall be designed so that both doors will close automatically by the action of any of the heat-actuated devices.

Self-closing doors shall be designed to close by gravity or by the action of a mechanical device. Self-closing doors shall have no attachments capable of preventing the operation of the closing devices.

(k) Fire Resistance Tests. The fire resistance time rating of every type of required fire protection assembly shall be determined in accordance with regulations issued under Section 4601. A minimum transmitted temperature end point shall not be required.

(l) Label. Every fire door and fire window shall bear the label or other identification thereof. The following labels of the Underwriters' Laboratories, Inc. shall be approved labels within the meaning of this Section:

Label marked "Fire Door for Opening in Fire Wall" shall be approved for Class "A" fire doors.

Label marked "Fire Door for Opening in Vertical Shaft" shall be approved for Class "B" fire doors.

Label marked "Fire Door for Opening in Corridor or Room Partition" shall be approved for Class "C" fire doors.

Label marked "Fire Door for Opening in Corridor or Room partition", for Class "D", "E" and "F" fire doors.

Label marked "Fire Window Frame for Light Exposures" shall be an approved label for fire windows when glazed with wired glass conforming to Sub-section (h).

Exception: Unlabeled passenger elevator hoistway doors may be installed if the panels are of equivalent fire resistance.

(m) Tin-Clad Doors. If constructed as specified in regulations issued pursuant to Section 4601, tin-clad fire doors shall be considered as meeting the requirements of this Section, provided each door bears the label of an approved inspection agency showing the classification thereof.

(n) Installation. Fire doors and fire windows shall be installed as designated in Section 4601.

Section 4307. ROOF COVERINGS. Fire-resistive roof coverings shall be as specified in Section 3204.
<table>
<thead>
<tr>
<th>STRUCTURAL PARTS TO BE PROTECTED</th>
<th>INSULATING MATERIAL USED</th>
<th>MINIMUM THICKNESS OF MATERIAL IN INCHES FOR THE FOLLOWING FIRE RESISTIVE PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4 hr.</td>
</tr>
<tr>
<td>Grade A concrete</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Grade B concrete</td>
<td></td>
<td>2½</td>
</tr>
<tr>
<td>Grade C concrete</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Brick of clay, shale, concrete or sand-lime</td>
<td></td>
<td>3¼</td>
</tr>
<tr>
<td>Clay tile, clay tile and concrete or concrete block (see note 2)</td>
<td></td>
<td>4 or 2 pl.</td>
</tr>
<tr>
<td>Solid gypsum blocks</td>
<td></td>
<td>2 pl.</td>
</tr>
<tr>
<td>Hollow gypsum blocks</td>
<td></td>
<td>3 pl.</td>
</tr>
<tr>
<td>Poured gypsum</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Metal lath and portland cement plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal lath and gypsum plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal lath and gypsum-vermiculite plaster**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A concrete</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Grade B concrete</td>
<td></td>
<td>2½</td>
</tr>
<tr>
<td>Grade C concrete</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Brick of clay, shale, concrete or sand-lime</td>
<td></td>
<td>3¾</td>
</tr>
<tr>
<td>Clay tile, clay tile and concrete or concrete block</td>
<td></td>
<td>3 or 2 pl.</td>
</tr>
<tr>
<td>Solid gypsum block</td>
<td></td>
<td>2 pl.</td>
</tr>
<tr>
<td>Hollow gypsum block</td>
<td></td>
<td>3 pl.</td>
</tr>
<tr>
<td>Poured gypsum</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Metal lath and gypsum-vermiculite plaster</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Metal lath and gypsum or portland cement plaster</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Webs of Steel Beams and Girders.

Reinforcing Steel in Reinforced Concrete Columns, Beams, Girders and Trusses

Grade A or B concrete | 1½ | 1½ | 1½ | 1
Grade C concrete | 2 | 1½ | 1½ | 1
### Reinforcing Steel in Reinforced Concrete Joists

<table>
<thead>
<tr>
<th>Material</th>
<th>Grade A or B concrete</th>
<th>Grade C concrete</th>
<th>1½</th>
<th>1¾</th>
<th>1</th>
<th>¾</th>
</tr>
</thead>
</table>

### Ceiling Protection for Steel Roof Members including Steel Proof Trusses and Secondary Trusses

<table>
<thead>
<tr>
<th>Material</th>
<th>Metal or wire lath and gypsum or cement plaster, concrete, burned clay products or gypsum</th>
<th>2</th>
<th>1½</th>
<th>1</th>
<th>¾</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Suspended metal lath and gypsum-Vermiculite plaster</td>
<td>1</td>
<td>¾</td>
<td>¾</td>
<td>¾</td>
</tr>
</tbody>
</table>

### Reinforcing and Tie Rods in Floor and Roof Slabs

<table>
<thead>
<tr>
<th>Material</th>
<th>Grade A or B concrete</th>
<th>Thickness includes gypsum or cement plaster</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 1½ 1 ¾</td>
<td>1 1 ¾ ¾</td>
</tr>
<tr>
<td></td>
<td>Grade C concrete</td>
<td>1 1 1 ¾</td>
</tr>
<tr>
<td></td>
<td>Gypsum</td>
<td>1 1 ¾ ¾</td>
</tr>
</tbody>
</table>

**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 layers with ½ in. air space between.
   ** Column protected with 1" Vermiculite plaster on metal lath.
   Lath spaced 1½" from column. Space behind lath on flange faces filled with plaster.
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONSTRUCTION</th>
<th>Minimum Finished Thickness face to face (including plaster where mentioned) in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick of Clay, Shale, Sand-Lime or Concrete, and Plain Concrete</td>
<td></td>
<td>4-hr.</td>
</tr>
<tr>
<td>Solid unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow (rowlock) unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow (rowlock) plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. One cell in wall thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in 8-in. or less thickness. Unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in 8-in. or less thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow Clay Tile Wall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. One cell in wall thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in 8-in. or less thickness. Unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in 8-in. or less thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow Clay Tile, Load Bearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in wall thickness. Unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Two cells in wall thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Three cells in 8-in. or less thickness. Unplastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Three cells in 8-in. or less thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End or side construction. Three cells in 8-in. or less thickness. Plastered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination of Brick and Load-Bearing Tile, or Hollow Concrete Block or Tile.</td>
<td>4-in. brick and 4-in. tile. Plastered one side (tile side)</td>
<td></td>
</tr>
<tr>
<td>MATERIAL</td>
<td>CONSTRUCTION</td>
<td>Minimum Finished Thickness face to face (including plaster where mentioned) in inches</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>4-hr. 3-hr. 2-hr. 1-hr.</td>
<td></td>
</tr>
<tr>
<td><strong>Concrete Block or Tile</strong></td>
<td>Unplastered 1¼-in. face Shells</td>
<td>8 4*</td>
</tr>
<tr>
<td></td>
<td>Unplastered 1½-in. face Shells</td>
<td>8 4½ 8*</td>
</tr>
<tr>
<td></td>
<td>Plastered one side</td>
<td>8 4½ 8*</td>
</tr>
<tr>
<td><strong>Aggregate—</strong></td>
<td>1¼-in. face Shells</td>
<td></td>
</tr>
<tr>
<td>Expanded Slag, Burned Clay or Shale, Cinders</td>
<td>Plastered each side</td>
<td>9</td>
</tr>
<tr>
<td><strong>Concrete Block or Tile</strong></td>
<td>Unplastered 2½-in. face Shells</td>
<td>8</td>
</tr>
<tr>
<td><strong>Other Aggregates—</strong></td>
<td>Unplastered 1½-in. face Shells</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Plastered each side</td>
<td>9 5*</td>
</tr>
<tr>
<td></td>
<td>1¾-in. face Shells</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unplastered 2½-in. face Shells</td>
<td>8</td>
</tr>
<tr>
<td><strong>Solid Concrete</strong></td>
<td>Plastered each side</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Unplastered</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Plastered each side</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>2¼-in. face Shells</td>
<td></td>
</tr>
<tr>
<td><strong>Hollow Gypsum Blocks</strong></td>
<td>Reinforcement not less than 0.2% in each direction</td>
<td>6 5 4 2*</td>
</tr>
<tr>
<td></td>
<td>Unplastered</td>
<td>6* 5* 4* 3*</td>
</tr>
<tr>
<td></td>
<td>Plastered each side</td>
<td>5* 4* 4* 3*</td>
</tr>
<tr>
<td><strong>Hollow Wall of Reinforced</strong></td>
<td>Outer shell 2-in. thick for 10-in. wall and 1½-in. thick for 8-in. wall</td>
<td>10* 8*</td>
</tr>
<tr>
<td><strong>Pneumatically Placed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concrete</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
TABLE NO. 43-B—Continued
RATED FIRE-RESISTIVE PERIODS FOR VARIOUS WALLS AND PARTITIONS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONSTRUCTION</th>
<th>Minimum Finished Thickness face to face (including plaster where mentioned) in inches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solid Gypsum or Portland Cement Plaster</strong></td>
<td>Incombustible studding with metal or wire lath</td>
<td>2*</td>
</tr>
<tr>
<td></td>
<td>Incombustible studding with metal or wire lath, neat wood fiber gypsum plaster</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Studless partition, incombustible runners, 3/8-in. or 3/8-in. plain gypsum lath, gypsum plaster*# each side</td>
<td></td>
</tr>
<tr>
<td><strong>Hollow Stud Partition with Gypsum or Portland Cement Plaster on each Side or Gypsum Wallboard</strong></td>
<td>Incombustible studding with metal or wire lath. 3/8-in. plaster on each side</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Incombustible studding with metal or wire lath. 1-in. plaster on each side</td>
<td>4 1/2</td>
</tr>
<tr>
<td></td>
<td>Wood studs with metal or wire lath. Fire stopped. 3/4-in. plaster on each side</td>
<td>3* or 5</td>
</tr>
<tr>
<td></td>
<td>Wood studs with metal or wire lath. Fire stopped. 1-in. neat wood fiber plaster platter each side</td>
<td>5*</td>
</tr>
<tr>
<td></td>
<td>Wood studs with 3/8-in. perforated gypsum lath. Fire-stopped. 1/2-in. gypsum plaster each side</td>
<td>3* or 5</td>
</tr>
<tr>
<td></td>
<td>Wood studs with space between filled with mineral wool bats*** nailed to studs, one-half inch (1/2&quot;) gypsum wallboard each side</td>
<td>4 1/2</td>
</tr>
<tr>
<td></td>
<td>Wood studs with two layers of one-half inch (1/2&quot;) gypsum wallboard each side, joints staggered</td>
<td>5 1/2</td>
</tr>
<tr>
<td><strong>Wood Stud Wall</strong></td>
<td>Exterior—Drop siding over 1/2-in. gypsum sheathing. Interior—1/2-in. gypsum plaster over 3/8-in. perforated gypsum lath</td>
<td>5 5/8</td>
</tr>
<tr>
<td></td>
<td>Exterior—Drop siding over 1/2-in. gypsum sheathing. Interior—two thicknesses of 1/2-in. gypsum wallboard</td>
<td>5 3/4</td>
</tr>
</tbody>
</table>

* Shall be used for non-bearing purposes only.
** 8-in. for Expanded Slag.
*** Mineral or slag wool bats shall weigh not less than 1.0 lb. and glass wool bats not less than 0.6 lb. per sq. ft. of wall surface.
* 3/8-in. Face Shells.
*** One part gypsum to one part sand by weight for scratch coat and one part gypsum to two parts sand by weight for brown coat.
<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CONSTRUCTION</th>
<th>MINIMUM THICKNESS OF FLOOR OR ROOF SLAB IN INCHES</th>
<th>MINIMUM THICKNESS OF CEILING IN INCHES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>4 hr.</td>
<td>3 hr.</td>
</tr>
<tr>
<td>Solid masonry, concrete or gypsum</td>
<td>Slab or arch</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Hollow masonry</td>
<td>Slab or arch</td>
<td>4*</td>
<td>3½*</td>
</tr>
<tr>
<td>Reinforced concrete joists</td>
<td>Slab</td>
<td></td>
<td>2½</td>
</tr>
<tr>
<td>Steel joist or light steel construction, with attached or suspended ceiling of metal or wire lath</td>
<td>Concrete or gypsum slab</td>
<td>2½</td>
<td>2½</td>
</tr>
<tr>
<td></td>
<td>Ceiling, gypsum plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concrete or gypsum slab</td>
<td>2½</td>
<td>2½</td>
</tr>
<tr>
<td></td>
<td>Ceiling, gypsum vermiculite plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concrete or gypsum slab</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ceiling, portland cement plaster**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T. &amp; G. wood flooring on wood striping</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ceiling, gypsum plaster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATERIAL</td>
<td>MINIMUM THICKNESS OF FLOOR OR ROOF SLAB IN INCHES</td>
<td>MINIMUM THICKNESS OF CEILING IN INCHES</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Steel roof deck on steel framing with suspended ceiling of metal or wire lath</td>
<td>1 1/4 1</td>
<td>7/8 3/4</td>
<td></td>
</tr>
<tr>
<td>Fiberboard insulation or wood fiber and cement binder on top of deck</td>
<td>1 1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling, gypsum plaster sanded 1:2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood sheathing or fiberboard insulation on top of deck</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceiling, gypsum or portland cement plaster**</td>
<td>3/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel or pre-cast concrete joists with attached or suspended ceiling of metal or wire lath</td>
<td>1 1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Double wood floor with building paper between</td>
<td>1 1/2</td>
<td>3/4</td>
<td></td>
</tr>
<tr>
<td>Ceiling, gypsum or portland cement plaster**</td>
<td>3/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-floor of 1&quot; nom. boarding or 3/8&quot; plywood, a layer of building paper and 3/8&quot; T. &amp; G. flooring</td>
<td>1 1/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attached ceiling of gypsum lath and gypsum plaster</td>
<td>3/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attached or suspended ceiling of metal lath and gypsum or portland cement plaster**</td>
<td>3/4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE:
* Requires top covering of solid masonry equal to 1/2 thickness of slab or arch.
** Portland cement plaster with 15 pounds of hydrated lime and 3 pounds of asbestos fiber per bag of portland cement.
† All joints reinforced with 3" strips of metal lath.
†† Neat wood fiber gypsum plaster.
PART IX
REGULATIONS FOR USE OF PUBLIC STREETS AND PROJECTIONS OVER PUBLIC PROPERTY

CHAPTER 44—PROTECTION OF PEDESTRIANS DURING CONSTRUCTION OR DEMOLITION
(ARTICLE 337—REVISED MUNICIPAL CODE)

Section 1. SCOPE OF CHAPTER. It shall be unlawful for any person, firm, or corporation to place or store any material or equipment necessary for construction or demolition work on any alley, public sidewalk, or other public property except in accordance with the provisions of this chapter and in pursuance of a permit issued under Section 3 hereof.

It shall be unlawful for any person, firm, or corporation to perform any work on any building or structure in such manner as to endanger persons and property on the street or public property. Protection shall be provided as specified in this chapter.

Section 2. PLACES OF STORAGE; WAIVER; INDEMNITY.—(a) Places of Storage. Material or equipment required for construction or demolition work shall be stored on the premises whenever feasible, but if such storage is not feasible, may be placed or stored on public property in the following locations:

(1) In the Alley. In the alley adjoining the building site, provided that a clear and unobstructed roadway of not less than ten feet (10') in width is maintained through such alley along the building site.

(2) Public Sidewalk in Front of Building Site. If access is not feasible from the alley adjoining the building site, then on any portion of the public sidewalk adjoining the building site, except on the walkway required to be maintained.

(b) Waiver Required. A waiver of claim against the City and County of Denver for damages on account of such placement or storage shall be filed in the office of the Manager of Improvements and Parks before such materials or equipment are placed or stored upon public property.

(c) Indemnity. Every person, firm, or corporation to whom permission has been granted by the Manager of Improvements and Parks under the terms of this chapter to utilize public property for the placement and storage of materials or equipment utilized in construction or demolition work shall at all times assume full responsibility for such placement and storage. Such permission shall be further conditioned that any person, firm, or corporation shall, as a consideration for the use of public property at all times release, hold harmless, and indemnify the City and County of Denver, the Manager of Improvements and Parks, the Chief Building Inspector, and all of their agents and employees from any and all responsibility, liability, loss, or damage resulting to any person or property caused by or incidental to the placement or storage as aforesaid. The placement or storage of any materials or equipment by any person, firm, or corporation upon any public property shall be itself an acknowledgement that the conditions herein set forth are accepted. Under conditions of unusual hazard the Manager of Improvements and Parks may require liability insurance for the protection of persons and property on the public property.

Section 3. PERMIT. It shall be unlawful for any person, firm, or corporation to place or store any materials or equipment used in or required for construction or demolition work, or to erect any walkway, barricade, canopy, railing, or fence upon any public property without having first obtained a permit in writing from the Manager of Improvements and Parks.

Where such construction or demolition is required to be done under a building permit, the application for the said building permit shall, before the issuance of the said building permit, be submitted to the Manager of Improvements and Parks for endorsement of approval as to the placement or storage of such materials or equipment, and such endorsement of approval shall be and constitute the permit required hereunder. No building permit shall be issued by the Building Department until there shall have been obtained such permit from the Manager of Improvements and Parks.

The Building Department shall enforce the provisions hereof with relation to the construction and safety of walkways, barricades, canopies, railings, or fences, and prior to the erection thereof under permit of the Manager of Improvements and Parks, plans and specifications therefor shall be filed in the Building Department.

Section 4. PROTECTION OF UTILITIES. Materials or equipment used in or required for construction or demolition work shall not be placed or stored on public property so as to ob-
structure 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. Every street lamp, utility box, fire or police alarm box, fire hydrant, and every catch basin and manhole that may be damaged by any work being done or by the placement or storage of any materials and equipment upon the public property shall be protected adequately against such damage. This protection shall be maintained as long as is necessary and shall be completely removed as soon as the status of the work permits.

Section 5. MIXING MORTAR OR CONCRETE ON PUBLIC PROPERTY. The mixing of mortar or concrete on public property shall be done in a mechanical mixer or in a tight box in such manner as to prevent dripping or splashing on the public property.

Section 6. MINIMUM PROTECTION REQUIREMENT. (a) Walkway Required. 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 or demolition work.

(b) Type of Protection Required. Protection shall be provided for pedestrians and property on public property in accordance with the following minimum requirements:

<table>
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<tr>
<th>Height of Construction</th>
<th>Distance From Construction to Walkway</th>
<th>Required Protection</th>
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<tbody>
<tr>
<td>Eight feet or less</td>
<td>Less than six feet</td>
<td>Railing</td>
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<tr>
<td></td>
<td>Six feet or more</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Less than six feet</td>
<td>Fence and canopy</td>
</tr>
<tr>
<td>More than eight feet</td>
<td>Six feet or more and one-quarter height of construction or less</td>
<td>Fence and canopy</td>
</tr>
<tr>
<td></td>
<td>Six feet or more and one-quarter to one-half height of construction</td>
<td>Fence</td>
</tr>
<tr>
<td></td>
<td>Six feet or more and at least one-half height of construction</td>
<td>None</td>
</tr>
</tbody>
</table>

Such protection shall be maintained in place and kept in good order for the entire length of time pedestrians on the public property abutting the building site may be endangered and shall be completely removed as soon as the status of the work permits.

(c) Railings. Railings shall be substantially built to a height not less than three feet (3')

(d) Fences and Barricades. Solid fences or barricades shall be substantially built to a height not less than eight feet (8') above grade, placed on the side of the walkway nearest to the construction or demolition work. Fences or barricades shall extend the entire length of the building site and end shall be turned and extended to the building line.

Doorways may be cut in such fences or barricades to provide ingress and egress, provided, however, that such doorways shall be protected by sturdy doors which are kept closed when not in use.

(e) Protective Canopies. The protective canopy or barricade roof shall have a height not less than eight feet (8') above the walkway. Such roof shall be leakproof and shall have a fence built along its entire length on the side 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 line.

The entire structure shall be designed to carry the live and dead loads to be imposed on it, provided that every such structure shall be designed to carry a minimum live load of not less than thirty-five (35) pounds per square foot, uniformly loaded.

If materials are placed or stored or work is done upon the canopy or barricade roof, the street sides and ends of the canopy or barricade 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 or barricade roof over the walkway and the approaches thereto shall be kept well lighted with artificial lighting continuously between sunset and sunrise.

(f) Increased Protection. The Manager of Improvements and Parks may, as a condition of the granting of any permit for the erection of walkways, barricades, canopies, railings, or fences, require heights, widths, distances, or specifications greater than those provided in Section 6 (a) to 6 (e) inclusive if reasonably necessary for the protection of the public in the use of public ways and places.
Section 7. PROTECTION OF SIDEWALK EXCAVATIONS. When the area or portion thereof occupied by a public sidewalk is to be excavated the holder of the building permit shall construct a substantial temporary walkway of a width to be prescribed by the Manager of Improvements and Parks, but not less than four feet (4') wide, for pedestrian travel over or around the areas to be excavated.

The walkway over the excavated area shall be designed for a uniform live load of one hundred fifty (150) pounds per square foot. The walkway shall be provided with suitable ramps or stairs at each end with a handrail not less than three feet (3') high along each side or with a railing on one side and a fence or barricade 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 or barricade on the excavation side of the walkway.
CHAPTER 45 — PERMANENT OCCUPANCY OF PUBLIC PROPERTY

Section 4501. GENERAL. 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.

Section 4502. PROJECTION INTO ALLEYS. 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.

Section 4503. SPACE BELOW SIDEWALK. 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 so to 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.

Section 4504. BALCONIES AND APPENDAGES. Oriel windows, balconies, unroofed porches, cornices, and belt courses and appendages such as water-tables, 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').

Section 4505. MARQUEES. (a) General. For the purpose of this Section a marquee shall include any object or decoration attached to or a part of said marquee.

(b) Projection and Clearance. The horizontal clearance between a marquee and the curb line shall be not less than two feet (2').

A marquee projecting more than two-thirds (2/3) of the distance from the property line to the curb line shall be not less than twelve feet (12') above the ground or pavement below.

A marquee projecting less than two-thirds (2/3) of the distance from the property line to the curb line shall be not less than eight feet (8') above the ground or pavement below.

(c) Length. A marquee projecting more than two-thirds (2/3) the distance from the property line to the curb line shall not exceed twenty-five (25') in length along the direction of the street.

(d) Thickness. The maximum height or thickness of a marquee measured vertically from its lowest to its highest point shall not exceed three feet (3') when the marquee projects more than two-thirds (2/3) 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 (2/3) of the distance from the property line to the curb line.

(e) Construction. A marquee shall be supported entirely from the building and constructed as specified under Types of Construction and shall be of incombustible material or of not less than one-hour fire-resistant construction.

(f) Roof Construction. The roof or any part thereof may be a skylight provided wire glass is used not less than one-fourth inch (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 electrolaters.

Section 4506. MOVABLE AWNINGS OR HOODS. Movable awnings or hoods may have combustible coverings supported on incombustible frames attached to the building.

Such awning or hood may extend over the public property not more than two-thirds (2/3)
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.

Section 4507. DOORS. 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 the property line is permitted. Doors in Fire Zone No. 3, that swing over the property line, shall be maintained normally closed.
CHAPTER 46 - RULES AND REGULATIONS

Section 4601. (a) Intent. The provisions of this Code are not intended to prevent the use of methods, materials, or equipment which, as a matter of fact, will meet the reasonably safe standards of strength, safety, sanitation, and fire resistance required to be met in any building or structure to which the Code applies.

(b) Rules and Regulations. To enable him to administer the Code, and to assist users of the Code in the selection of methods of construction, materials, and equipment which will meet the required standards set forth in the Code, the Chief Building Inspector, with the approval of the Board of Examiners and Appeals, shall compile a set of "Rules and Regulations." The Rules and Regulations shall consist of a list of materials, methods, and equipment which are acceptable as meeting the requirements of this Code, together with pertinent technical and engineering data. All persons may use the materials, methods of construction, and equipment allowed in this Code and listed in Rules and Regulations promulgated in accordance hereafter.

(c) Authorities. Rules and Regulations shall be based on the published findings of nationally recognized technical and engineering authorities and laboratories insofar as such findings are applicable to local physical conditions and are not in conflict with this Code.

(d) Rules and Regulations, and amendments thereto, shall become effective upon compliance with the following:

1. Public hearings shall be held.

2. Notice of the time and place of the hearings shall be given at least ten (10) days prior to the date thereof in a newspaper of general circulation, and in writing to registered architects, engineers, and licensed contractors.

3. A copy of Rules and Regulations, including copies of publications to which such Rules and Regulations conform or refer, shall be at all times on file and available for public inspection in the office of the City Clerk and in the office of the Chief Building Inspector.

NAMES OF ORGANIZATIONS AND PUBLICATIONS WHICH SHALL BE CONSIDERED AS AUTHORITATIVE SOURCES OF TECHNICAL AND ENGINEERING INFORMATION FOR THE COMPILATION OF RULES AND REGULATIONS

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**LEGEND**

- **A.C.I.**—American Concrete Institute
- **A.I.A.**—American Institute of Architects
- **A.I.S.I.**—American Iron and Steel Institute
- **A.S.A.**—American Standards Association
- **A.S.H.A.E.**—American Society of Heating and Air Conditioning Engineers Guide
- **A.S.M.E.**—American Society of Mechanical Engineers
- **A.S.T.M.**—American Society for Testing Materials
- **I.C.C.**—Interstate Commerce Commission
- **N.B.F.U.**—National Board of Fire Underwriters
- **N.F.P.A.**—National Fire Protection Association
- **U.B.C.**—Uniform Building Code Standards
- **U.L.**—Underwriters’ Laboratories
PART X
PLASTERING

CHAPTER 47 – LATHING AND PLASTERING

Section 4701. GENERAL. Lathing and plastering shall be done in a manner and with materials conforming to established standards of safety and strength and shall comply with the provisions of this Chapter, rules and regulations issued pursuant to Section 4601, and, when required for fire protection, shall also comply with the provisions of Chapter 43.

No plaster shall be applied until the lathing has been inspected and approved by the Chief Building Inspector.

The Chief 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 twenty-four (24) hours in advance of the time of making such test.

On all foundation walls below grade and in the other places where subject to moisture, plaster, if used, shall be portland cement as provided for exterior plastering.

Section 4702. MATERIALS. (a) Aggregate. Sand shall be washed sand conforming to regulations issued pursuant to Section 4601, 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 ten per cent (10%) nor more than thirty per cent (30%).

Vermiculite shall conform in particle size to the regulations issued pursuant to Section 4601 for sand for use in plaster and shall weigh not less than seven and one-half (7 ½) nor more than ten (10) pounds per cubic foot.

(b) Gypsum Plaster. Gypsum plaster shall conform to regulations issued pursuant to Section 4601.

(c) Lime. Lime shall conform to regulations issued pursuant to Section 4601.

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 regulations issued pursuant to Section 4601.

(e) Portland Cement. Portland cement shall be of Type I, II, or III, conforming to regulations issued pursuant to Section 4601, except with respect to insoluble residue.

Approved types of plasticity agents may be added to portland cement, Type I or II, in the manufacturing process or when mixing the plaster, but in no case shall the amount of plasticity agent exceed ten per cent (10%) of the volume of cement in the plaster mixture.

(f) Wood Lath. Wood lath shall conform to regulations issued pursuant to Section 4601.

(g) Fiber Insulation. Fiber insulation lath shall be manufactured from wood or other vegetable fiber in accordance with regulations issued pursuant to Section 4601.

(h) Gypsum Lath. Gypsum lath shall conform to regulations issued pursuant to Section 4601, 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 regulations issued pursuant to Section 4601.

Section 4703. INTERIOR PLASTERING: LATHING. (a) Distance Between Supports. For gypsum, wood, and fiber insulation laths, the distance between supports shall not exceed sixteen inches (16”).

Internal angles, external angles, coves, arches and junctures between wood, fibre insulation, gypsum lath, and other plaster bases shall be reinforced with cornerite, except where metal or wire lath is carried around such intersections. Cornerite shall be fastened only sufficiently to retain position during plastering and shall not be rigidly attached to the wood framing.

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 (1-1/8”), three-eighths inch (3/8”) flat head, galvanized or blued nails and shall be secured to horizontal or vertical 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 lath shall be spaced not more than one-quarter inch (1/4”) apart.

(c) Wood Lath. Wood lath shall be spaced not less than one-quarter inch (1/4”) or more than three-eighths inch (3/8”) apart.
at edges, one-quarter inch (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 (4-1/2") with nails of the following sizes, placed not less than three-eighths inch (3/8") from the ends, and not less than one-half inch (1/2") from shiplapped, tongued and grooved, or interlocking edges:

For one-half inch (1/2") lath—One and one-eighth inch (1-1/8") fiberboard nails or 4d box nails.

For one-inch (1") lath—One and three-fourths inch (1-3/4") fiberboard nails or 6d box nails.

End joints, except in interlocking type lath, shall be not less than three-sixteenths inch (3/16") wide. Shiplapped, tongued and grooved, or interlocking edges shall be fitted to contact.

(e) **Metal and Wire Lath.** 1. The weight of metal and wire lath and the spacings of supports shall conform to the requirements set forth in Table No. 47-A.

2. Metal and wire lath shall be lapped at least one mesh at side and ends, but need not exceed one inch (1").

3. Metal and wire lath shall be attached to vertical wood supports at not to exceed six-inch (6") spacing with not less than 4d common nails driven to a penetration of at least three-quarters inch (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 (1-1/2"), 11-gauge, barbed nails with a head 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.

Section 4704. **REINFORCED NON-BEARING PARTITIONS.** Where a reinforced plaster or pneumatically placed plaster partitions are used they shall have vertical steel or iron channels with a depth of not less than one-third (1/3) the thickness of the partition, made of not less than No. 16 U. S. gauge metal and spaced not more than twenty-four inches (24") on center. They shall be securely fastened and anchored to adjoining framing members.

Hollow non-bearing partitions of reinforced plaster or pneumatically placed plaster shall have a shell thickness of not less than three-fourth inch (3/4").

Metal reinforcing shall be as set forth in Table No. 47-A, and gypsum lath shall not be less than three-eighths inch (3/8") in thickness. The minimum thickness of metal lath and plaster, or pneumatically placed plaster partitions shall be not less than two inches (2") nor one eighty-fourth (1/84) of the distance between supports. Studless solid partitions of metal lath and plaster or gypsum lath and plaster shall be not more than twelve feet (12') in height.

Section 4705. **INTERIOR PLASTERING: SUSPENDED AND FURRED CEILINGS.** (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 ten (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.

(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 not less than one-quarter-inch (1/4") bolts to runner channels, or bent tightly around runners and bolted to the main part of the hanger.

Section 4706. **INTERIOR PLASTERING: NUMBER OF COATS AND THICKNESS.** (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 when three-coat work is required by this Section.

Exception: Plastering with gypsum, hardwall, lime or cement plaster, when applied over metal and wire lath, may be a scratch coat and a brown coat when the finish surfaces are to be obtained by use of acoustical material or other similar methods. The brown coat shall be brought to a true and even surface and full out to the ground.

(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 (3/8) of the first coat on masonry surfaces (except monolithic concrete) and the second coat in all three-coat work shall be mixed in the proportion of one hundred (100) pounds of gypsum plaster to not more than two (2) parts of sand by volume.

The base coats shall be mixed and proportioned in accordance with the following procedure:

1. Gypsum or Hardwood Plaster. First coat on all types of lath shall be mixed in the proportions of one (1) part gypsum or hardwall plaster to not more than two (2) parts of sand, by weight.

First coat of masonry surfaces (except monolithic concrete, see Section 4708 (c) and second or brown coat in all three-coat work shall be mixed in the proportions of one (1) part of gypsum or hardwall plaster to not more than three (3) parts of sand, by weight.

When vermiculite is used in place of sand, the first coat on all types of lath shall be mixed in the proportion of one hundred (100) pounds of gypsum plaster to not more than two and one-half cubic feet (2-1/2 cu. ft.) of vermiculite; the first coat on masonry surfaces (except monolithic concrete) and the second coat in all three-coat work shall be mixed in the proportion of one hundred (100) pounds of gypsum plaster to not more than three and one-half cubic feet (3-1/2 cu. ft.) of vermiculite.

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 five hundred (500) pounds of hydrated lime, one hundred fifty (150) pounds of Keene’s cement and six (6) 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 four hundred fifty (450) pounds of hydrated lime, one hundred fifty (150) pounds of Keene’s cement and four (4) 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 (1) part gypsum gauging plaster or Keene’s cement to three (3) parts lime putty by volume, or a prepared gypsum trowel finish.

2. Sand-float finish, mixed in the proportion of one (1) part gypsum neat unfibered plaster to not more than two (2) parts sand by weight, or one and one-half (1-1/2) parts of Keene’s cement to two (2) parts of lime putty and not more than four and one-half (4-1/2) parts of sand by volume, or a prepared gypsum sand-float finish.

3. Keene’s cement finish, mixed in the proportions of three (3) parts Keene’s cement to one (1) part lime putty, by volume.

4. Lime sand-float finish shall be mixed in the proportion of one (1) part of gypsum gauging plaster or Keene’s cement to three (3) parts of lime putty, and three (3) parts of sand by volume.

5. Interior stucco finish shall be mixed in the proportion of one (1) part of Keene’s cement, two (2) parts of lime putty, and three (3) parts of white sand by volume, or a prepared color finish.

(c) Finish Coat for Portland Cement Plaster. Finish coats for interior portland cement plaster may be:

1. As required for the third coat of exterior stucco.

2. A gauged cement plaster mixed in the proportions of one (1) part portland cement to not more than two and one-half (2-1/2) parts of lime putty and not more than four (4) parts of sand by volume.
### TABLE NO. 47-A
WEIGHTS OF METAL AND WIRE LATH

<table>
<thead>
<tr>
<th>WEIGHT (Lbs. per sq. yd.)</th>
<th>TYPE OF LATH</th>
<th>MAXIMUM SPACING OF SUPPORTS</th>
<th>For Walls</th>
<th>For Ceilings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>Flat Expanded metal lath</td>
<td></td>
<td>16&quot;</td>
<td>0</td>
</tr>
<tr>
<td>3.4</td>
<td>Flat Expanded metal lath</td>
<td></td>
<td>16&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>2.75</td>
<td>Flat Rib metal lath</td>
<td></td>
<td>16&quot;</td>
<td>16&quot;</td>
</tr>
<tr>
<td>3.4</td>
<td>Flat Rib metal lath</td>
<td></td>
<td>24&quot;</td>
<td>24&quot;</td>
</tr>
<tr>
<td>3.4</td>
<td>3/8&quot; Rib metal lath *</td>
<td></td>
<td>24&quot;</td>
<td>24&quot;</td>
</tr>
<tr>
<td>4.5</td>
<td>Sheet metal lath</td>
<td></td>
<td>24&quot;</td>
<td>24&quot;</td>
</tr>
<tr>
<td>2.48</td>
<td>Wire lath</td>
<td></td>
<td>16&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>**</td>
<td>Wire fabric</td>
<td></td>
<td>16&quot;</td>
<td>16&quot;</td>
</tr>
</tbody>
</table>

* Rod-stiffened or V-stiffened flat expanded metal lath of equal rigidity and weight is permissible on the same spacings as 3/8-inch rib metal lath.

** Paper-backed wire fabric, No. 16 gauge wire, 2" x 2" mesh, with stiffener.

### TABLE NO. 47-B
SIZES OF MAIN RUNNERS IN SUSPENDED AND FURRED CEILINGS

<table>
<thead>
<tr>
<th>DISTANCE CENTER TO CENTER OF HANGERS</th>
<th>SIZE</th>
<th>MAIN RUNNERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hot Rolled</td>
</tr>
<tr>
<td>Up to 2 feet</td>
<td>3/4&quot;</td>
<td>300 lb./1000 ft.</td>
</tr>
<tr>
<td>Up to 3 feet</td>
<td>1&quot;</td>
<td>410 lb./1000 ft.</td>
</tr>
<tr>
<td>Up to 4 feet</td>
<td>1 1/2&quot;</td>
<td>650 lb./1000 ft.</td>
</tr>
</tbody>
</table>

### TABLE NO. 47-C
SIZES OF CROSS FURRING IN SUSPENDED AND FURRED CEILINGS

<table>
<thead>
<tr>
<th>DISTANCE CENTER TO CENTER OF MAIN RUNNER</th>
<th>SIZE OF CROSS FURRING</th>
<th>MAXIMUM SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2 feet</td>
<td>3/8&quot; pencil rods</td>
<td>12&quot;</td>
</tr>
<tr>
<td>Up to 3 feet</td>
<td>3/4&quot; channels</td>
<td>24&quot;</td>
</tr>
<tr>
<td>Up to 4 feet</td>
<td>3/4&quot; channels</td>
<td>16&quot;</td>
</tr>
</tbody>
</table>

### TABLE NO. 47-D
REQUIRED THICKNESS OF INTERIOR PLASTER

<table>
<thead>
<tr>
<th>TYPE OF LATH</th>
<th>THICKNESS OF PLASTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal or wire lath</td>
<td>5/8&quot; minimum</td>
</tr>
<tr>
<td>All other types allowed in Chapter 47</td>
<td>3/4&quot; minimum</td>
</tr>
</tbody>
</table>
3. Smooth white finish, mixed in the proportion of not less than one (1) part gypsum gauging plaster or Keene’s cement to three (3) parts lime putty by volume.

4. Keene’s cement finish, mixed in the proportions of three (3) parts Keene’s cement to one (1) part lime putty, by volume.

5. Lime sand-float finish shall be mixed in the proportion of one (1) part gypsum gauging plaster or Keene’s cement, three (3) parts of lime putty, and three (3) parts of sand by volume.

6. Interior stucco finish shall be mixed in the proportion of one (1) part of Keene’s cement, two (2) parts of lime putty, and three (3) 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.

Section 4708. INTERIOR PLASTERING: APPLICATION OF PLASTER. (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 twelve (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 twenty-four (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 or 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).

(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 rich gypsum plaster with a maximum of one (1) part sand to one (1) part gypsum 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 rich gypsum plaster with maximum of one (1) part sand to one (1) part gypsum 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).

Section 4709. INTERIOR PLASTERING: STAFF. Staff. Staff shall be soaked before sticking. Lugs shall be of pure fiber and plaster of paris. Rust-resistant fastenings of sufficient strength to anchor the staff to the support shall be not less than No. 14 B. & S. gauge copper wire.

Section 4710. EXTERIOR PLASTERING: BACKING. (a) Backing. 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. This shall not be required with metal lath or paper-backed wire fabric.

(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 as set forth in Table No. 47-E.

Metal reinforcement shall be furred out from the backing at least one-quarter inch (1/4”) by an approved furring method, and...
shall be nailed with galvanized nails or approved furring devices driven to at least three-quarters inch (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 (1) 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 No. 18 W. & M. gauge galvanized annealed tie wire.

Section 4711. EXTERIOR PLASTERING: APPLICATION.

(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 (2) minutes, and shall be applied in three (3) 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 (1/8") clipped teeth and grooves not more than one-half inch (1/2") deep.

The second coat shall be roddeed and water floated, with no variation greater than one-quarter inch (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.

Section 4712. PNEUMATICALLY PLACED PLASTER.

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 twenty-five percent (25%) of the total sand in any batch.

Pneumatically placed cement plaster shall consist of a mixture of one (1) part cement to not more than five (5) 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 (2) coats to a minimum total thickness of seven-eighths inch (7/8"). The first coat shall be roddeed 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.
### TABLE NO. 47-E
EXTERIOR PLASTER REINFORCEMENT

<table>
<thead>
<tr>
<th>TYPE OF REINFORCEMENT</th>
<th>MINIMUM GAUGE</th>
<th>MINIMUM WEIGHT (lbs. per sq. yd.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expanded Metal</td>
<td></td>
<td>1.8</td>
</tr>
<tr>
<td>Metal Lath</td>
<td></td>
<td>3.4</td>
</tr>
<tr>
<td>Welded or Woven Wire Netting</td>
<td>18</td>
<td>1.4</td>
</tr>
<tr>
<td>Welded Wire Fabric</td>
<td>16</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### TABLE NO. 47-F
EXTERIOR PORTLAND CEMENT PLASTER

<table>
<thead>
<tr>
<th>COAT</th>
<th>MAXIMUM VOLUME OF SAND PER VOLUME OF CEMENT</th>
<th>MINIMUM THICKNESS</th>
<th>MINIMUM PERIOD BEFORE CURING</th>
<th>MINIMUM INTERVAL BEFORE APPLICATION OF SUCCEEDING COAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>First or scratch</td>
<td>3½</td>
<td>¼&quot;*</td>
<td>48 hrs.</td>
<td>1 day</td>
</tr>
<tr>
<td>Second or brown</td>
<td>4½</td>
<td>(1st and 2nd coats)</td>
<td>¾&quot;*</td>
<td>7 days</td>
</tr>
<tr>
<td>Third or finish</td>
<td>2**</td>
<td>½&quot;*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Measured from backing to crest of scored plaster.

** Approved prepared finish coats containing not less than ½ by weight of portland cement may be used.
CHAPTER 48—FILM STORAGE

Section 4801. CLASSES OF FILM EXCEPTED.
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 film, 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.

Section 4802 GENERAL REGULATIONS. The Board of Examiners and Appeals shall have the power to issue regulations on the storage and handling of motion picture, photographic and X-ray nitro-cellulose films in conformance with Section 4601. Where such regulations require fire-resistant materials, materials of equal fire resistance as specified in this Code may be used.
CHAPTER 49
MECHANICAL REFRIGERATION CODE*

SECTION 4901—SCOPE AND PURPOSE

4901.1 Scope. The application of this Code is intended to insure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which is vaporized and is normally liquified in its refrigerating cycle, when employed under the occupancy classifications listed in Section 4903. The provisions of this Code are not intended to apply to the use of water or air as a refrigerant nor to refrigerating systems installed on railroad cars, motor vehicles, motor drawn vehicles or on shipboard.

4901.2 Purpose. This Code is intended to provide reasonable safeguards to life, limb, health, and property; to correct certain practices which are inconsistent with safety; and to prescribe standards of safety which will properly influence future progress and developments in refrigerating systems. Equipment listed by an approved, nationally recognized testing laboratory as defined in 4902.3.1, is deemed to meet the design, manufacture and factory test requirements of this Code or equivalent, for the refrigerant or refrigerants for which such equipment is designed.

4901.3 Application. This Code shall apply to refrigerating systems installed subsequent to its adoption and to parts replaced or added to systems installed prior or subsequent to its adoption.

4902.1 Absorber (Adsorber) is that part of the low side of an absorption system used for absorbing (adsorbing) vapor-refrigerant.

4902.2 Absorption System—See 4904.48.1.

4902.3 Approved means acceptable to the Chief Building Inspector and the Board of appeals (as shown in Section 4601).

4902.3.1 An Approved Nationally Recognized Testing Laboratory is one acceptable to the Board of Appeals and Chief Building Inspector, that provides uniform testing and examination procedures under established standards, is properly organized, equipped and qualified for testing, and has a follow-up inspection service of the current production of the listed products.

4902.4 Brazed Joint, for the purpose of this Code, is a gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 1000° F but less than the melting temperatures of the joined parts.

4902.5 Brine is any liquid, used for the transmission of heat without a change in its state, having no flash point or a flash point above 150° F as determined in an approved manner. (See Standards, Section 4601).

4902.6 Compressor is a specific machine, with or without accessories, for compressing a given refrigerant vapor.

4902.7 Compressor Unit is a condensing unit less the condenser and liquid receiver.

4902.8 Condenser is a vessel or arrangement of pipe or tubing in which vaporized refrigerant is liquefied by the removal of heat.

4902.9. Condensing Unit is a specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

4902.10 Container is a cylinder for the transportation of refrigerants.

4902.11 Department Store is the entire space occupied by one tenant or more than one tenant in an individual store where more than 100 persons commonly assemble on other than the street-level floor for the purpose of buying personable wearables and other merchandise.

4902.12 Design Working Pressure is the maximum allowable working pressure for which a specific part of a system is designed.

4902.13 Direct System—See 4904.2

4902.14 Double Indirect Vented Open-Spray System—See 4904.3.4

4902.15 Double (or Secondary) Refrigerant System—See 4904.4

4902.16 Duct is a tube or conduit used for conveying or encasing purposes as specifically defined below:

(a) Air Duct is a tube or conduit used for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

(b) Pipe Duct is a tube or conduit used for encasing pipe.

(c) Wire duct is a tube or conduit used for encasing either moving or stationary wire, rope, etc.

* Source—Ord. 65, Series 1954, except where otherwise indicated.
4902.17 Entrance is a confined passageway immediately adjacent to the door through which people enter a building.

4902.18 Evaporator is that part of the system in which liquid refrigerant is vaporized to produce refrigeration.

4902.19 Exit is a confined passageway immediately adjacent to the door through which people leave a building.

4902.20 Expansion Coil is an evaporator constructed of pipe or tubing.

4902.21 Fusible Plug is a device having a predetermined-temperature fusible member for the relief of pressure.

4902.22 Generator is any device equipped with a heating element used in the refrigerating system to increase the pressure of refrigerant in its gas or vapor state for the purpose of liquefying the refrigerant.

4902.23 Hallway is a corridor for the passage of people.

4902.24 High Side means the parts of a refrigerating system under condenser pressure.

4902.25 Humanly Occupied Space is a space normally frequented or occupied by people but excluding machinery rooms and walk-in coolers used primarily for refrigerated storage.

4902.26 Indirect Closed-Surface System—See 4904.3.2

4902.27 Indirect Open-Spray System—See 4904.3.1

4902.28 Indirect System—See 4904.3

4902.29 Indirect Vented Closed-Surface System—See 4904.3.3

4902.30 Liquid Receiver is a vessel permanently connected to a system by inlet and outlet pipes for storage of a liquid refrigerant.

4902.31 Lobby is a waiting room, or large hallway serving as a waiting room.

4902.32 Low Side means the parts of a refrigerating system under evaporator pressure.

4902.33 Machinery is the refrigerating equipment forming a part of the refrigerating system including any or all of the following: compressor, condenser, generator, absorber (adsorber), liquid receiver, connection pipe, or evaporator.

4902.34 Machinery Room as required by Section 4906 is a room in which a refrigerating system is permanently installed and operated but not including evaporators located in a cold storage room, refrigerator box, air cooled space, or other enclosed space. Closets solely contained within, and opening only into a room shall not be considered machinery rooms but shall be considered a part of the machinery room in which they are contained or open into. It is not the intent of this definition to cause the space in which a self-contained system is located to be classified as a machinery room. (See 4908.11)

4902.35 Machinery Room, Class T as required by Section 4906 is a room having machinery but no flame-producing apparatus permanently installed and operated and also conforming to the following:

(a) Any doors, communicating with the building, shall be approved self-closing, tight-fitting fire doors as required by the Building Code.

(b) Walls, floor, and ceiling shall be tight and shall be of such fire resistive construction as required by the Building Code.

(c) Exit doors shall be provided and shall open directly to the outer air or through a vestibule type exit equipped with self-closing, tight-fitting doors.

(d) Exterior openings, if present, shall not be under any fire escape or any open stairway.

(e) All pipes piercing the interior walls, ceiling, or floor of such room shall be tightly sealed to the walls, ceiling, or floor through which they pass.

(f) Emergency remote controls to stop the action of the refrigerant compressor shall be provided and located immediately outside the machinery room.

(g) Mechanical means shall be provided for ventilation (See 4908.11.3).

(h) Emergency remote controls for the mechanical means of ventilation shall be provided and located outside the machinery room.

4902.36 Manufacturer is, for the purpose of this code, the company or organization which evidences its responsibility by affixing its name or nationally registered trade-mark or trade name to the refrigeration equipment concerned.

4902.37 Mechanical Joint for the purpose of this code, is a gas-tight joint, obtained by the joining of metal parts through a positive-holding mechanical construction.

4902.38 Nonpositive Displacement Compressor is a compressor in which increase in vapor pressure is attained without changing the internal volume of the compression chamber.

4902.39 Piping means the pipe or tubing, or interconnecting the various parts of a refrigerating system.
4902.40 **Positive Displacement Compressor** is a compressor in which increase in vapor pressure is attained by changing the internal volume of the compression chamber.

4902.41 **Pressure Imposing Element** is any device or portion of the equipment used for the purpose of increasing the refrigerant vapor pressure.

4902.42 **Pressure Limiting Device** is a pressure responsive mechanism designed to automatically stop the operation of the pressure-imposing element at a predetermined pressure.

4902.43 **Pressure-Relief Device** is a pressure-actuated valve or rupture member designed to automatically relieve excessive pressure.

4902.44 **Pressure Relief Valve** is a pressure-actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

4902.45 **Pressure Vessel** is any refrigerant-containing receptacle of a refrigerating system other than evaporators (each separate section of which does not exceed 1/2 cubic foot of refrigerant-containing volume), expansion coils, compressors, controls, headers, pipe, and pipe-fittings.

4902.46 **Receiver**—See 4902.30.

4902.47 **Refrigerant** is a substance used to produce refrigeration by its expansion or vaporization.

4902.48 **Refrigerating System** is a combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat. (See Section 4904 for classification of refrigerating systems by type.)

4902.48.1 **Absorption System** is a refrigerating system in which the gas evolved in the evaporator is taken up by an absorber or adsorber.

4902.48.2 **Sealed Absorption System** is a unit system for Group 2 refrigerants only in which all refrigerant-containing parts are made permanently tight by welding or brazing against refrigerant loss. (This is a restrictive definition for the purpose of this code as used in 4906.1.2 and 4906.3.1) (See 4902.48.1).

4902.48.3 **Self-contained System** is a complete factory made and factory tested system in a suitable frame or enclosure which is fabricated and shipped in one or more sections and in which no refrigerant-containing parts are connected in the field other than by companion or block valves.

4902.48.4 **Unit System** is a self-contained system which has been assembled and tested prior to its installation and which is installed without connecting any refrigerant-containing parts. A unit system may include factory-assembled companion or block valves.

4902.49 **Rupture Member** is a device that will rupture at a predetermined pressure.

4902.50 **Shall.** Where "shall" is used for a provision specified that provision is intended to be mandatory.

4902.51 **Shall Not.** Where "shall not" is used for a provision specified that provision is intended to be mandatory.

4902.52 **Sealed Absorption System**—See 4902.48.2

4902.53 **Self-Contained System**—See 4902.48.3

4902.54 **Soldered Joint, for the purpose of this code, is a gas-tight joint obtained by the joining of metal parts with metallic mixtures or alloys which melt at temperatures below 1000° F and above 400° F.

4902.55 **Stop Valve** is a shut-off for controlling the flow of refrigerant.

4902.56 **Tenant, as herein used, shall be construed as a person, firm, or corporation possessed with the legal right to occupy premises.**

4902.57 **Unit System**—See 4902.48.4

4902.58 **Welded Joint, for the purpose of this code, is a gas tight joint, obtained by the joining of metal parts in the plastic or molten state.**

**SECTION 4903—BUILDING OCCUPANCY CLASSIFICATION**

4903.1 **Locations** governed by this code in which refrigerating systems may be placed are grouped by occupancy as follows:

4903.2 **Institutional Occupancy** shall apply to that portion of a building in which persons are confined to receive medical, charitable, educational, or other custodial care or treatment, or in which persons are held or detained by reason of public or civic duty, including among others, hospitals, asylums, sanitariums, police stations, jails, court houses with cells, and similar occupancies.

4903.3 **Public Assembly Occupancy** shall apply to that portion of the premises in which persons congregate for civic, political, educational, religious, social, or recreational purposes; including among others, armories, assembly rooms, auditoriums, ball rooms, bus terminals, broadcasting studios, churches, colleges, court houses without cells, dance halls, department stores, exhibition halls, fraternity halls, libraries, lodge rooms, mortuary chapels,
museums, passenger depots, schools, skating rinks, subway stations, theaters, and similar occupancies.

4903.4 **Residential Occupancy** shall apply to that portion of a building in which sleeping accommodations are provided for two or more families, or more than twelve persons. Residential occupancy shall include club houses, convents, dormitories, hotels, lodging houses, multiple story apartments, studios, tenements, and similar occupancies.

4903.5 **Commercial Occupancy** shall apply to that portion of a building used for the trans- action of business; for the rendering of professional services; for the supply of food, drink, or other bodily needs and comforts; for manufacturing purposes or for the performance of work or labor (except as included under 4903.6 Industrial Occupancy) including among others, bake shops, fur storage, laboratories, loft buildings, markets, office buildings, professional buildings, restaurants, stores other than department stores, and similar occupancies.

4903.6 **Industrial Occupancy** shall apply to an entire building or to that portion of a building used for manufacturing, processing, or storage of materials or products, including among others, chemical, food, candy, and ice cream factories, ice making plants, meat packing plants, refineries, perishable food warehouses and similar occupancies, provided the entire building is occupied by a single tenant.

4903.7 **Mixed Occupancy** shall apply to a building occupied or used for different purposes in different parts. When the occupancies are cut off from the rest of the building by tight partitions, floors, and ceilings and protected by self-closing doors, the requirements for each type of occupancy shall apply for its portion of the building. For example, the cold storage spaces in retail frozen food lockers, hotels and department stories in buildings occupied by a single tenant might be classified under Industrial Occupancy, whereas other portions of the building would be classified under other occupancies. When the occupancies are not so separated, the occupancy carrying the more stringent requirements shall govern.

**SECTION 4904—REFRIGERATING SYSTEM. CLASSIFICATION BY TYPE**

4904.1 Refrigerating Systems (see 4902.48) shall be divided into classes, descriptive of the method employed for extracting heat as follows in 4904.2 to 4904.4, inclusive. The direct and various indirect systems referred to are illustrated in Figure 1.

4904.2 **Direct System** is one in which the evaporator is in direct contact with the material or space refrigerated or is located in air-circulating passages communicating with such spaces.

4904.3 **Indirect System** is one in which a liquid, such as brine or water, cooled by the refrigerant, is circulated to the material or space refrigerated or is used to cool air so circulated. Indirect systems which are distinguished by the type or method of application are as given in the following paragraphs:

4904.3.1 **Indirect Open-Spray System** is one in which a liquid, such as brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to such cooling chamber and is sprayed therein.

4904.3.2 **Indirect Closed-Surface System** is one in which a liquid, such as brine or water, cooled by an evaporator located in an enclosure external to a cooling chamber is circulated to and through such a cooling chamber in pipes or other closed circuits.

4904.3.3 **Indirect Vented Closed-Surface System** is one in which a liquid, such as brine or water, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to and through such cooling chamber in pipes or other closed circuits.

4904.3.4 **Double Indirect Vented Open-Spray System** is one in which a liquid, such as brine or water, cooled by an evaporator located in a vented enclosure, is circulated through a closed circuit to a second enclosure where it cools another supply of a liquid, such as brine or water, and this liquid in turn is circulated to a cooling chamber and is sprayed therein.

4904.4 **Double (or Secondary) Refrigerant System** is one in which an evaporative refrigerant is used in a secondary circuit. For the purpose of this Code, each system enclosing a separate body of an evaporative refrigerant shall be considered as a separate direct system.
FIG. 1
SECTION 4905—REFRIGERANT CLASSIFICATION

4905.1 General. Refrigerants are, for the purpose of this Code, divided into groups as follows:

4905.1.1 Group 1
Carbon dioxide \( \text{CO}_2 \)
Dichlorodifluoromethane (Freon-12) \( \text{CCl}_2\text{F}_2 \)
Dichlorodifluoromethane, 73.8% \( \text{CCl}_2\text{F}_2 \)
and Ethylidene Fluoride, 26.2% \( \text{CH}_3\text{CHF}_2 \)
(Carrene 7)
Dichloromethane (Carrene No. 1)
(Methylene chloride) \( \text{CH}_2\text{Cl}_2 \)
Dichloromonofluoromethane (Freon-21)
Dichlorotetrafluoroethane (Freon-114)
Monochlorodifluoromethane (Freon-22)
Trichloromonofluoromethane (Freon-11) (Carrene No. 2)
Trichlorotrifluoroethane (Freon-113)

4905.1.2 Group 2
Ammonia \( \text{NH}_3 \)
Dichloroethylene \( \text{C}_2\text{H}_4\text{Cl}_2 \)
Ethyl chloride \( \text{C}_2\text{H}_5\text{Cl} \)
Methyl chloride \( \text{CH}_3\text{Cl} \)
Methyl formate \( \text{HCOOCH}_3 \)
Sulphur dioxide \( \text{SO}_2 \)

4905.1.3 Group 3
Butane \( \text{C}_4\text{H}_10 \)
Ethane \( \text{C}_2\text{H}_6 \)
Ethylene \( \text{C}_2\text{H}_4 \)
Isobutane \( (\text{CH}_3)_2\text{CH} \)
Propane \( \text{C}_3\text{H}_8 \)

SECTION 4906—REQUIREMENTS FOR INSTITUTIONAL, PUBLIC ASSEMBLY, RESIDENTIAL, AND COMMERCIAL OCCUPANCIES

4906.1 General

4906.1.1 Public Stairway, Stair Landing, Entrance, or Exit. No refrigerating system shall be installed in or on a public stairway, stair landing, entrance or exit.

4906.1.2 Public Hallway or Lobby. No refrigerating system shall interfere with free passage. No group 2 refrigerant shall be permitted in public hallways or lobbies of Institutional or Public Assembly Occupancies. Refrigerating systems installed in a public hallway or lobby shall be limited to:

(a) Unit Systems containing not more than the quantities of a Group 1 refrigerant specified in Table I, or

(b) Sealed Absorption Systems containing not more than 3 pounds of Group 2 refrigerant when in Residential and Commercial Occupancies.

4906.1.3 Refrigerant Piping Through Floors. Refrigerant piping shall not be carried through floors except as follows:

(a) It may be carried from the basement to the first floor or from the top floor to a machinery penthouse or to the roof.

(b) For the purpose of connecting to a condenser on the roof, it may be carried through an approved, rigid and tight continuous fire-resisting pipe duct or shaft having no openings on intermediate floors, or it may be carried on the outer wall of the building provided it is not located in an air shaft, closed court, or in other similar open spaces enclosed within the outer walls of the building.

(c) In systems containing Group 1 refrigerants, the refrigerant piping may also be carried through floors, intermediate between the first floor and the top floor, provided it is enclosed in an approved, rigid and tight continuous fire-resisting pipe duct or shaft where it passes through intermediate spaces not served by the system. Piping of direct systems, as governed by 4906.2.1, need not be enclosed where it passes through spaces served by that system. The pipe duct or shaft shall be vented to the outside or to a space served by the system.
Table 1
Maximum Permissible Quantities of Group 1 Refrigerants for Direct Systems

<table>
<thead>
<tr>
<th>Refrigerant name</th>
<th>Chemical formula</th>
<th>Maximum Quantity in lb. per 1000 cu. ft. of humanly occupied space*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>CO₂</td>
<td>11</td>
</tr>
<tr>
<td>Dichlorodifluoromethane (Freon-12)</td>
<td>CCl₂F₂</td>
<td>31</td>
</tr>
<tr>
<td>Dichlorodifluoromethane—73.8% and Ethylidine Fluoride—26.2% (Carrene No. 7)</td>
<td>Cl₂F₂ and CH₃CHF₂</td>
<td>26</td>
</tr>
<tr>
<td>Dichloromethane (Methylene chloride), (Carrene No. 1)</td>
<td>CH₂Cl₂</td>
<td>6</td>
</tr>
<tr>
<td>Dichloromonofluoromethane (Freon-21)</td>
<td>CHCl₃F</td>
<td>13</td>
</tr>
<tr>
<td>Dichlorotetrafluoromethane (Freon-114)</td>
<td>C₂Cl₄F₄</td>
<td>44</td>
</tr>
<tr>
<td>Monochlorodifluoromethane (Freon-22)</td>
<td>CHClF₂</td>
<td>22</td>
</tr>
<tr>
<td>Trichloromonofluoromethane (Freon-11)</td>
<td>CCl₃F</td>
<td>35</td>
</tr>
<tr>
<td>Trichlorotrifluoroethane (Freon-113)</td>
<td>C₂Cl₃F₃</td>
<td>24</td>
</tr>
</tbody>
</table>

*Volatile charge in a control shall not be considered as refrigerant.

4906.2 Group 1 Refrigerants

4906.2.1 Direct Systems. The maximum permissible quantity of a Group 1 refrigerant in a direct system is specified in Table 1 except Institutional Occupancies where further limited by 4906.2.1.1.

4906.2.1.1 Direct System in Institutional Occupancies shall be limited to unit systems each containing not more than 20 pounds of Group 1 refrigerants, except in kitchens, laboratories, and mortuaries. (See 4906.2.4.)

4906.2.1.2 When the refrigerant-containing parts of a system are located in one or more enclosed spaces, the cubical content of the smallest enclosed humanly occupied space other than the machinery room, shall be used to determine the permissible quantity of refrigerant in the system. Where a refrigerating system has evaporator coils serving individual stories of a building, the story having the smallest volume shall be used to determine the maximum quantity of refrigerant in the entire system.

4906.2.1.3 When the evaporator is located in an air duct system, cubical content of the smallest humanly occupied enclosed space served by the air duct system shall be used to determine the permissible quantity of refrigerant in the system; however, if the air flow to any enclosed space served by the air duct system cannot be shut off or reduced below one-quarter of its maximum, the cubical contents of the entire space served by the air duct system may be used to determine the permissible quantity of refrigerant in the system.

4906.2.1.4 In Institutional and Public Assembly Occupancies, direct expansion coils or evaporators used for air conditioning and located downstream from, and in proximity to, a heating coil, or located upstream within 18 inches of a heating coil, shall be fitted with a pressure relief device discharging to the outside of the building in an approved manner; except that such a relief device shall not be required on unit or self-contained systems if the internal volume of the low side of the system which may be shut off by valves, divided by the total weight of refrigerant in the system less the weight of refrigerant vapor contained in the other parts of the system of 110° F exceeds the specific volume of the refrigerant at critical conditions of temperature and pressure.

(Note: The above exemption is also stated in formula form below.)

\[
\frac{V_1}{W_1} - \frac{V_2}{W_2}
\]

Where

- \(V_1\) = low side volume, cu. ft.
- \(V_{sp}\) = specific volume at critical conditions of temperature and pressure, cu. ft. per lb.
- \(W_1\) = total weight of refrigerant in system, lb.
- \(W_2\) = weight of refrigerant vapor (lb.) at 110° F in \(V_{sp}\), or

\(\frac{V_2}{W_2}\) = specific volume of refrigerant, in cu. ft. per lb., at 110° F, where \(V_2\) = total volume of system less \(V_1\), cu. ft.
4906.2.2 Indirect System. A system containing more than the quantity of a Group 1 refrigerant allowed in Table 1 shall be of the indirect type with all refrigerant-containing parts, excepting parts mounted outside the building, and piping installed in accordance with Paragraph 4906.1.3, installed in a machinery room used for no other purpose than for mechanical equipment.

4906.2.3 Open Flames in Machinery Rooms. No open flame or apparatus to produce an open flame shall be installed in a machinery room where any refrigerant other than carbon dioxide is used unless the flame is enclosed and vented to the open air. The use of matches, cigarette lighters, halide leak detectors, and similar devices shall not be considered a violation of this paragraph or of 4906.2.4.

4906.2.4 Open Flames in Institutional and Public Assembly Occupancies. In Institutional and Public Assembly Occupancies, when more than 1 pound of a Group 1 refrigerant, other than carbon dioxide, is used in a system any portion of which is in a room where there is an apparatus for producing an open flame, then such refrigerant shall be classed in Group 2 unless the flame-producing apparatus is provided with a hood and flue capable of removing the products of combustion to the open air.

4906.3 Group 2 Refrigerants

4906.3.1 Direct Systems. Direct systems containing Group 2 refrigerants shall not be used for air conditioning for human comfort. For other applications, the maximum permissible quantity of Group 2 refrigerants in a direct system is shown in Table 2.

**TABLE 2**

**MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR DIRECT SYSTEMS**

<table>
<thead>
<tr>
<th>Type of refrigerating system</th>
<th>Institutional</th>
<th>Public</th>
<th>Residential</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealed Absorption Systems:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) In public hallways or lobbies</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>(b) In other than public hallways or lobbies</td>
<td>0*</td>
<td>6</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Self-contained or Unit Systems:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) In public hallways or lobbies</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(b) In other than public hallways or lobbies</td>
<td>0*</td>
<td>6</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

*Six pounds allowed when installed in kitchens, laboratories, and mortuaries.

4906.3.2 Indirect Systems. The maximum permissible quantity of Group 2 refrigerant in any indirect system is shown in Table 3. Such systems shall be of the following type:

(a) **Institutional and Public Assembly Occupancies**—Indirect vented closed-surface, or double indirect vented open spray.

(b) **Residential and Commercial Occupancies**—Indirect vented closed-surface, or double indirect vented open spray, or primary circuit of double refrigerant type.

4906.3.2.1 Machinery Rooms for Indirect Systems. Group 2 Refrigerants

4906.3.2.1.1 Indirect Systems using Group 2 refrigerants not in excess of the quantities shown in Column 1 of Table 3 shall have all refrigerant-containing parts, excepting parts mounted outside the building, and piping installed in accordance with Paragraph 4906.1.3, installed in a machinery room, used for no other purpose than for mechanical equipment.

**TABLE 3**

**MAXIMUM PERMISSIBLE QUANTITIES OF GROUP 2 REFRIGERANTS FOR INDIRECT SYSTEMS**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column 1 Machinery Rooms (See 4902.34), Max. lb.</td>
<td>Column 2 Class T Machinery Rooms (See 4902.35)</td>
</tr>
<tr>
<td>Institutional</td>
<td>0</td>
</tr>
<tr>
<td>Public Assembly</td>
<td>0</td>
</tr>
<tr>
<td>Residential</td>
<td>Not more than 300 lb.</td>
</tr>
<tr>
<td>Commercial</td>
<td>Not more than 600 lb.</td>
</tr>
</tbody>
</table>
4906.3.2.1.2 Indirect Systems using Group 2 refrigerants not in excess of the quantities shown in Column 2 of Table 3 shall have all refrigerant-containing parts installed in a Class T machinery room.

4906.3.2.1.3 Flame-Producing Devices, Hot Surfaces, and Electrical Equipment in Machinery Rooms. Where a machinery room is required by this code to house a refrigerating system containing any Group 2 refrigerant other than sulphur dioxide, no flame-producing device or hot surface above 800°F shall be permitted in such room and all electrical equipment in the room shall conform to the requirements of Hazardous Locations Class I. (See Standards, Section 4601.) The use of matches, cigarette lighters, halide leak detectors, and similar devices shall not be considered a violation of this paragraph.

4906.4 Group 3 Refrigerants

4906.4.1 Group 3 refrigerants shall not be used in Institutional, Public Assembly, Residential, or Commercial Occupancies except in laboratories for commercial Occupancies. In such laboratory installations only unit systems containing not more than 6 pounds shall be used unless the number of persons does not exceed one person per 100 square feet of laboratory floor area, in which case the requirements for Industrial Occupancy shall apply.

SECTION 4907—REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES

4907.1 General. There shall be no restriction on the quantity or kind of refrigerant used in an Industrial Occupancy, except as specified in 4907.2 and 4908.10.

4907.2 Number of Persons. When the number of persons in a refrigerated space, served by a direct system, on any floor above the first floor (ground level or deck level) exceeds one person per 100 square feet of floor area, the requirements of Commercial Occupancy shall apply unless that refrigerated space containing more than one person per 100 square feet of floor area above the first floor is provided with the required number of doors opening directly into approved building exits. Such refrigerated space shall be cut off from the rest of the building by tight construction with tight-fitting doors. (See Standards, Section 4601.)

NOTE: The above does not prohibit openings for the passage of products from one refrigerated space to another refrigerated space.

SECTION 4908—INSTALLATION REQUIREMENTS

4908.1 Foundations and Supports for condensing units or compressor units shall be of substantial and non-combustible construction when more than 6 inches high. (See 4908.3.)

4908.2 Moving Machinery shall be guarded in accordance with accepted safety standards. (See Standards, Section 4601.)

4908.3 Clear Space adequate for inspection and servicing of condensing units or compressor units shall be provided.

4908.4 Condensing Units or Compressor Units with enclosures shall be readily accessible for servicing and inspection.

4908.5 Water Supply and Discharge Connections shall be made in accordance with Chapter 50. (Also see Standards, Section 4601.)

4908.5.1 Discharge water lines shall not be directly connected to the waste or sewer system. The waste or discharge from such equipment shall be over and above a trapped and vented plumbing fixture.

4908.6 Illumination adequate for inspection and servicing of condensing units or compressor units, if installed, shall be in accordance with the Electrical Code. (See Standards, Section 4601.)

4908.7 Electrical Equipment and Wiring shall be installed in accordance with the Electrical Code. (Also see Standards, Section 4601.)

4908.8 Gas Fuel Devices and Equipment used with refrigeration systems shall be installed in accordance with Chapters 51 and 52. (Also see Standards, Section 4601.)

4908.9 Open Flames. When the quantity of flammable refrigerants in any one refrigerating system exceeds the amount given in Table 4 for each 1000 cubic feet of room volume in which the system or any part thereof is installed, then no flame-producing device or hot surface above 800°F shall be permitted in such room and all electrical equipment in the room shall conform to the requirements of Hazardous Locations, Class I and the Electrical Code. (Also see Standards, Section 4601.)

TABLE 4
MAXIMUM PERMISSIBLE QUANTITIES OF FLAMMABLE REFRIGERANTS

<table>
<thead>
<tr>
<th>Name formula</th>
<th>Chemical</th>
<th>Maximum quantity in lb. per 1000 cu. ft. of room volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₄H₁₀</td>
<td>Butane</td>
<td>2½</td>
</tr>
<tr>
<td>C₃H₈</td>
<td>Ethane</td>
<td>2½</td>
</tr>
<tr>
<td>C₂H₆</td>
<td>Ethylene</td>
<td>6</td>
</tr>
<tr>
<td>C₂H₅Cl</td>
<td>Ethylene chloride</td>
<td>6</td>
</tr>
<tr>
<td>(CH₃)₂CH</td>
<td>Isobutane</td>
<td>2½</td>
</tr>
<tr>
<td>CH₂Cl</td>
<td>Methyl chloride</td>
<td>10</td>
</tr>
<tr>
<td>CH₃</td>
<td>Propane</td>
<td>2½</td>
</tr>
<tr>
<td>HCOOCH₃</td>
<td>Methyl formate</td>
<td>7</td>
</tr>
</tbody>
</table>
4908.10 Flammable Refrigerants as listed in Table 4 shall not be used in a refrigerating system in excess of 1000 pounds unless approved by the Chief Building Inspector.

4908.11 Machinery Room Requirements (See Definitions 4902.34 and 4902.35).

4908.11.1 Each refrigerating machinery room shall be provided with tight-fitting door or doors and have no partitions or openings that will permit the passage of escaping refrigerant to other parts of the building.

4908.11.2 Each refrigerating machinery room shall be provided with means for ventilation to the outer air. The ventilation shall consist of windows or doors opening to the outer air of the sizes shown in Table 5, or of mechanical means capable of removing the air from the room in accordance with Table 5. The amount of ventilation for refrigerant removal purposes shall be determined by the refrigerant content of the largest system in the machinery room.

4908.11.3 Mechanical Ventilation, when used, shall consist of one or more power-driven exhaust fans, which shall be capable of removing from the refrigerating machinery the amount of air specified in Table 5. The inlet to the fan, or fans, or air duct connection shall be located near the refrigerating equipment. The outlet from the fan, or fans, or air duct connections shall terminate outside of the building in an approved manner. When air ducts are used either on the inlet or discharge side of the fan, or fans, they shall have an area not less than specified in Table 5. Provisions shall be made for the inlet of air to replace that being exhausted.

4908.11.4 Class T Machinery Rooms in basements or sub-basements (See Definition 4902.35) shall have as specified in Table 5, mechanical ventilation operating continuously.

4908.12 Air Duct Systems of air conditioning equipment for human comfort using mechanical refrigeration shall be installed in accordance with accepted safety standards. (See Standards, Section 4601 and Chapter 52 of the Building Code.)

SECTION 4909—REFRIGERANT PIPING, VALVES, FITTINGS, AND RELATED PARTS

4909.1 General. Refrigerant piping, valves, fittings, and related parts used in the construction and installation of refrigerating systems shall conform to the Building Code. (See Standards, Section 4601.)
<table>
<thead>
<tr>
<th>Weight of refrigerant in system, lb</th>
<th>Mechanical discharge of air, cfm</th>
<th>Duct area, sq ft</th>
<th>Open window or door area, sq ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 20</td>
<td>150</td>
<td>$\frac{1}{4}$</td>
<td>4</td>
</tr>
<tr>
<td>50</td>
<td>250</td>
<td>$\frac{1}{2}$</td>
<td>6</td>
</tr>
<tr>
<td>100</td>
<td>400</td>
<td>$\frac{3}{4}$</td>
<td>10</td>
</tr>
<tr>
<td>150</td>
<td>550</td>
<td>$\frac{3}{4}$</td>
<td>12½</td>
</tr>
<tr>
<td>200</td>
<td>680</td>
<td>$\frac{3}{4}$</td>
<td>14</td>
</tr>
<tr>
<td>250</td>
<td>800</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>300</td>
<td>900</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>400</td>
<td>1,100</td>
<td>$1\frac{1}{4}$</td>
<td>20</td>
</tr>
<tr>
<td>500</td>
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<td>22</td>
</tr>
<tr>
<td>600</td>
<td>1,450</td>
<td>$1\frac{1}{2}$</td>
<td>24</td>
</tr>
<tr>
<td>700</td>
<td>1,630</td>
<td>$1\frac{1}{2}$</td>
<td>26</td>
</tr>
<tr>
<td>800</td>
<td>1,800</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>900</td>
<td>1,950</td>
<td>2</td>
<td>30</td>
</tr>
<tr>
<td>1,000</td>
<td>2,050</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td>1,250</td>
<td>2,250</td>
<td>$2\frac{1}{4}$</td>
<td>33</td>
</tr>
<tr>
<td>1,500</td>
<td>2,500</td>
<td>$2\frac{1}{4}$</td>
<td>37</td>
</tr>
<tr>
<td>1,750</td>
<td>2,700</td>
<td>$2\frac{1}{4}$</td>
<td>38</td>
</tr>
<tr>
<td>2,000</td>
<td>2,900</td>
<td>$2\frac{1}{4}$</td>
<td>40</td>
</tr>
<tr>
<td>2,500</td>
<td>3,300</td>
<td>$2\frac{3}{4}$</td>
<td>43</td>
</tr>
<tr>
<td>3,000</td>
<td>3,700</td>
<td>3</td>
<td>48</td>
</tr>
<tr>
<td>4,000</td>
<td>4,600</td>
<td>$3\frac{3}{4}$</td>
<td>55</td>
</tr>
<tr>
<td>5,000</td>
<td>5,500</td>
<td>$4\frac{1}{4}$</td>
<td>62</td>
</tr>
<tr>
<td>6,000</td>
<td>6,300</td>
<td>5</td>
<td>68</td>
</tr>
<tr>
<td>7,000</td>
<td>7,200</td>
<td>$5\frac{1}{2}$</td>
<td>74</td>
</tr>
<tr>
<td>8,000</td>
<td>8,000</td>
<td>$5\frac{3}{4}$</td>
<td>80</td>
</tr>
<tr>
<td>9,000</td>
<td>8,700</td>
<td>$6\frac{1}{2}$</td>
<td>85</td>
</tr>
<tr>
<td>10,000</td>
<td>9,500</td>
<td>$6\frac{1}{2}$</td>
<td>90</td>
</tr>
<tr>
<td>12,000</td>
<td>10,900</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td>14,000</td>
<td>12,200</td>
<td>$7\frac{1}{2}$</td>
<td>109</td>
</tr>
<tr>
<td>16,000</td>
<td>13,300</td>
<td>$7\frac{3}{4}$</td>
<td>118</td>
</tr>
<tr>
<td>18,000</td>
<td>14,300</td>
<td>8</td>
<td>125</td>
</tr>
<tr>
<td>20,000</td>
<td>15,200</td>
<td>$8\frac{3}{4}$</td>
<td>130</td>
</tr>
<tr>
<td>25,000</td>
<td>17,000</td>
<td>$8\frac{3}{4}$</td>
<td>140</td>
</tr>
<tr>
<td>30,000</td>
<td>18,200</td>
<td>9</td>
<td>145</td>
</tr>
<tr>
<td>35,000</td>
<td>19,400</td>
<td>$9\frac{1}{4}$</td>
<td>150</td>
</tr>
<tr>
<td>40,000</td>
<td>20,500</td>
<td>$9\frac{3}{4}$</td>
<td>155</td>
</tr>
<tr>
<td>45,000</td>
<td>21,500</td>
<td>$9\frac{3}{4}$</td>
<td>160</td>
</tr>
</tbody>
</table>
4909.2 Metal Enclosures or Pipe Ducts for Soft Copper Tubing. Rigid or flexible metal enclosures shall be provided for soft, annealed copper tubing used for refrigerant piping erected on the premises and containing other than Group 1 refrigerants. No enclosures shall be required for connections between condensing unit and the nearest riser box, provided such connections do not exceed 6 feet in length.

4909.3 Specific Minimum Requirements for Refrigerant Pipe and Tubing.

4909.3.1 Standard wall steel or wrought iron pipe may be used for design working pressures not exceeding 300 psi, provided lap-welded, electric resistance welded, or seamless pipe is used for sizes 2 inches and larger, and extra strong wall pipe is used for liquid lines for sizes 1 ½ inches and smaller conforming to accepted standards. (See Standards, Section 4601.)

4909.3.2 Standard iron pipe size copper and red brass (not less than 80 percent copper) pipe and tubing may be used and shall conform to specifications of accepted standards. (See Standards, Section 4601.)

4909.3.3 Watertube size hard copper tubing used for refrigerant piping erected on the premises shall conform to accepted standards for dimensions and specifications, except that copper tubing with outside diameters of 1/4 inch and 3/8 inch shall have a minimum nominal wall thickness of not less than 0.030 inches and 0.032 inches, respectively. (See Standards, Section 4601.)

4909.3.4 Soft annealed copper tubing used for refrigerant piping erected on the premises shall not be used in sizes larger than 7/8 inch outside diameter (3/4 inch nominal). It shall conform to accepted standards. (See Standards, Section 4601.) Minimum nominal wall thicknesses of soft annealed copper tubing shall be as follows:

<table>
<thead>
<tr>
<th>Outside Diameter—</th>
<th>Inches wall thickness</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>0.032</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>0.032</td>
<td></td>
</tr>
<tr>
<td>5/8</td>
<td>0.035</td>
<td></td>
</tr>
<tr>
<td>3/4</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>7/8</td>
<td>0.045</td>
<td></td>
</tr>
</tbody>
</table>

4909.3.5 Sweat joints on copper tubing used in refrigerating systems containing Group 2 or Group 3 refrigerants shall be brazed joints. Soldered joints shall not be used in such refrigerating systems.

4909.4 Joints and Refrigerant-Containing Parts in Air Ducts. Joints and all refrigerant-containing parts of a refrigerating system located in an air duct of an air conditioning system for human comfort shall be constructed to withstand, without leakage, a temperature of 1000° Fahrenheit.

4909.5 Exposure of Refrigerant Pipe Joints. Refrigerant pipe joints erected on the premises shall be exposed to view for visual inspection prior to being covered over or enclosed.

4909.6 Stop Valves

4909.6.1 General Requirements. All systems containing more than 50 pounds of a Group 1 refrigerant or 6 pounds of a Group 2 or 3 refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves installed as follows:

(a) Each inlet of each compressor, compressor unit, or condensing unit;

(b) Each discharge outlet of each compressor, compressor unit, or condensing unit, and of each liquid receiver.

4909.6.2 Systems Containing 100 Pounds or More of Refrigerant. All systems containing 100 pounds or more of a refrigerant, other than systems utilizing nonpositive displacement compressors, shall have stop valves, in addition to those in 4909.6.1, on each inlet of each liquid receiver and each branch liquid and suction line except that none shall be required on the inlet of a receiver in a condensing unit nor on the inlet of a receiver which is an integral part of a condenser.

4909.6.3 Stop Valves used with soft annealed copper tubing or hard drawn copper tubing 3/4 inch nominal size or smaller shall be securely mounted, independent of tubing fastenings or supports.

4909.6.4 Stop Valves shall be suitably labeled if it is not obvious what they control. Numbers may be used to label the valves provided a key to the numbers is located near the valves.

4909.7 Location of Refrigerant Piping

4909.7.1 Refrigerant piping crossing an open space which affords passageway in any building shall be not less than 7 1/2 feet above the floor unless against the ceiling of such space.

4909.7.2 Free passageway shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object, or in any shaft which has openings to living quarters or to main exit hallways. Refrigerant piping shall not be placed in public hallways, lobbies, or stairways, except that such refrigerant piping may pass across a public hallway if there are no joints in the section in the public hallway, and provided nonferrous tubing of 1
inch nominal diameter (1.1/8 inch outside diameter) and smaller be contained in a rigid metal pipe.

SECTION 4910—DESIGN AND CONSTRUCTION OF EQUIPMENT (Also see Section 4911 for pressure vessels)

4910.1 General

4910.1.1 Every part of a refrigerating system, with the exception of pressure gages and control mechanism, shall be designed, constructed, and assembled to be capable of withstanding a test pressure not less than the minimum refrigerant leak field test pressure specified in Table 6 without being stressed beyond one-third of its ultimate strength. (See 4910.2.)

NOTE: This paragraph establishes a minimum design working pressure in terms of the field test pressure so that the minimum refrigerant leak field test pressure, specified in Table 6, can be safely applied. Rules governing pressure relief devices, pressure-limiting devices, etc., shall be based on the design working pressure selected.

4910.1.2 All materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. No material shall be used that will deteriorate because of the refrigerant, or the oil, or the combination of both.

NOTE: Many refrigerants are corrosive to the usual materials when moisture or air, or both, are present and it is assumed in approving these materials that the system will be charged and operated in accordance with accepted practice, to prevent or minimize this corrosion.

4910.1.3 Aluminum, Zinc, or Magnesium shall not be used in contact with methyl chloride in a refrigerating system. Magnesium alloys shall not be used in contact with any Freon refrigerant.

4910.2 Minimum Test Pressures. Every refrigerant-containing part of every system, including pressure gages and control mechanism, shall be tested and proved tight by the manufacturer at not less than the minimum refrigerant leak field test pressure, specified in Table 6. (See 4910.3.)

4910.2.1 The test pressure applied to either the high or low side of each refrigerating system shall be equal to the design working pressure of the pressure vessels in the high or low side of the system, respectively, or to the setting of the pressure relief device protecting the respective pressure vessels, whichever is lower, but not less than the minimum refrigerant leak field test pressures specified in Table 6. Any components connected to said pressure vessels shall be of sufficient strength to conform to the design requirements of Paragraph 4910.1.1.

4910.3 Equipment Listed by an Approved Nationally Recognized Testing Laboratory having a follow-up inspection service shall be deemed as meeting the intent of the requirements of 4910.1 and 4910.2. (See 4901.2 and 4902.3.1.)

4910.4 Pressure-Limiting Devices

4910.4.1 Pressure-limiting devices shall be provided on all systems containing more than 20 pounds of refrigerant and operating above atmospheric pressure, and on all water cooled systems so constructed that the compressor or generator is capable of producing a pressure in excess of the test pressure; except water cooled unit systems containing not more than 3 pounds of a Group 1 refrigerant, providing the operating pressure developed in the system with the water supply shut off does not exceed one-fifth the ultimate strength of the system, or providing an overload device will stop the action of the compressor before the pressure exceeds one-fifth the ultimate strength of the system.

4910.4.2 The maximum setting to which a pressure limiting device may readily be set by use of the adjusting means provided shall not exceed 90% of the setting of the pressure relief device, 90% of the refrigerant leak field test pressure actually applied, or 90% of the design working pressure of the high side of the system, whichever is smallest. The pressure limiting device shall stop the action of the pressure imposing element at a pressure no higher than this maximum setting. In determining this maximum setting for systems erected on the premises and leak field tested in accordance with 4910.1.1, 90% of the leak test pressures in Table 6 may be utilized in lieu of the field test pressure actually applied. (See 4914.1 and 4914.1.1 for minimum refrigerant leak field test pressures.)

4910.4.3 Pressure-limiting devices shall be connected, with no intervening stop valves, between the pressure-imposing element and any stop valve on the discharge side.

4910.5 Liquid Level Gage Glasses, except those of the bull's-eye or reflex type, shall have automatic closing shut-off valves, and such glasses shall be adequately protected against injury.

4910.6 Dial of Pressure Gage, when the gage is permanently installed on the high side of a refrigerating system, shall be graduated up to approximately double the operating pressure, but in no case less than 1.2 times the design working pressure.

4910.7 Nameplate. Each separately sold condensing unit and each compressor or com-
pressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, identification number, and the name of the refrigerant for which it is designed.

SECTION 4911—REFRIGERANT-CONTAINING PRESSURE VESSELS

4911.1 Refrigerant-Containing Pressure Vessels Exceeding 6 Inches Inside Diameter, except those having a maximum allowable internal or external working pressure 15 psig or less, shall comply with accepted standards, covering the requirements for the design, fabrication, and inspection during construction of unfired pressure vessels. (See Standards, Section 4601.)

4911.1.1 Certification for ASME "UM" Stamped Pressure Vessels. Certification requirements on pressure vessels which are built in accordance with accepted standards and stamped with the "UM" symbol, can be met by keeping a production series record of material used and tests made. Certification for individual vessels, where required, may be made by abstracting data from the series record on Data Report Form U-3. (See Standards, Section 4601.)

4911.2 Refrigerant-Containing Pressure Vessels Not Exceeding an Inside Diameter of 6 Inches, irrespective of pressure, shall be listed either individually or as part of refrigeration equipment, by an approved nationally recognized testing laboratory having a follow-up inspection service. Vessels not so listed shall be constructed according to Paragraph 4911.1 and 4911.1.1. (See 4901.2 and 4902.3.1.)

4911.3 Relief Devices. All pressure vessels, irrespective of size of pressure, shall be equipped with relief devices in accordance with the requirements of Section 4913 of this Code.

4911.4 Standard Hydrostatic Tests. Fusion welded pressure vessels shall be tested in accordance with accepted standards. (See Standards, Section 4601.) (Also see 4911.4.1.)

4911.4.1 Pneumatic Tests. Vessels for use in services which cannot tolerate the presence of a testing liquid and which cannot be readily dried, and the parts of which have been previously tested by hydrostatic pressure to not less than 1½ times the design working pressure of the vessels, may be given a pneumatic test in accordance with accepted standards. (See Standards, Section 4601.)

SECTION 4912—RELIEF DEVICES IN GENERAL

4912.1 General. Every refrigerating system shall be protected by a pressure-relief device unless so constructed that pressure due to fire conditions will be safely relieved by soldered joints, lead gaskets, fusible plugs, or other parts of the system.

4912.1.1 No stop valve shall be located between any automatic pressure-relief device or fusible plug and the part or parts of the system protected thereby, except when the parallel relief devices mentioned in 4913.2 are so arranged that only one can be rendered inoperative at a time for testing or repair purposes.

4912.1.2 All pressure-relief devices shall be connected as nearly as practicable directly to the pressure vessel or other parts of the system protected thereby, above the liquid refrigerant level, and installed so that they are readily accessible for inspection and repair and so that they cannot be readily rendered inoperative. Fusible plugs may be located above or below the liquid refrigerant level.

4912.1.3 The seats and discs of pressure-relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used.

4912.1.4 The rated discharge capacity of a pressure-relief valve for a refrigerant-containing vessel, expressed in pounds of air per minute, shall be determined at a pressure at the inlet of the relief valve equal to 110 percent of the valve setting in accordance with accepted standards. (See Standards, Section 4601.)

4912.1.5 The rated discharge capacity of a rupture member or fusible plug in pounds of air per minute shall be determined by the following formulas:

$$ C = 0.6 \frac{P_1 d^2}{P_1} $$

or

$$ d = 1.29 \sqrt{\frac{C}{P_1}} $$

where $C$ = minimum required discharge capacity, in lb. of air per min.

where $d$ = minimum diameter of bore of fusible plug or internal diameter of inlet pipe to rupture member in inches.

For rupture members:

$$ P_1 = \text{bursting pressure, equal to design working pressure, except that for 13.7 the bursting pressure equals 1.20 times design working pressure, psig.} $$

For fusible plugs:

$$ P_1 = \text{saturation pressure, corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, psig.} $$

NOTE: This paragraph is not intended to apply to gas bulk storage tanks that are not permanently connected to a refrigeration system.
4912.1.6 All pressure relief devices (not fusible plugs) shall be directly pressure-actuated.

4912.1.7 The size of the discharge pipe from the pressure-relief device shall be not less than the size of the relief device outlet. The discharge from more than one relief device may be run into a common header, the area of which shall be not less than the sum of the areas of the pipes connected thereto.

4912.1.8 The length of discharge piping permitted to be installed on the outlet of a relief valve, rupture member, or fusible plug shall be determined as follows:

\[ C = \frac{3Pd^{3/2}}{L^{1/2}} \]

or

\[ d = \sqrt[3]{\frac{C^{2}L}{3P^{2}}} \]

where \( C \) = minimum required discharge capacity in pounds of air per minute.

\( d \) = internal diameter of pipe in inches.

\( L \) = length of discharge pipe in feet

\( P = 0.25P_{1} \) (\( P_{1} \) is defined under Equation 1.)

(See Table 7 for computations derived from preceding formula.)

4912.2 Pressure-Relief Devices for Positive Displacement Compressors. Positive displacement compressors operating above 15 pounds per square inch gage and having a displacement exceeding 50 cubic feet per minute, shall be equipped by the manufacturer with a pressure-relief device of adequate size and pressure setting to prevent rupture of the compressor, located between the compressor and stop valve in the discharge side. The discharge from such relief device may be vented to the atmosphere or into the low pressure side of the system.

4912.3 Discharge of pressure-relief devices and fusible plugs on all systems containing more than 6 pounds of Group 2 or Group 3 refrigerants shall be to the outside of the building in an approved manner. Discharge of pressure-relief devices and fusible plugs on all systems containing more than 100 pounds of Group 1 refrigerants unless installed in a Machinery Room, used for no purpose other than to house mechanical equipment and complying with the provisions as specified in 4908.11, shall be to the outside of the building in an approved manner.

4912.3.1 Pressure relief devices may discharge into the low side of the system, provided the pressure relief devices are of a type not appreciably affected by back pressures and provided the low side of the system is equipped with pressure relief devices. The relief devices on the low side of the system shall have sufficient capacity to protect the pressure vessels that are relieved into the low side of the system, or to protect all pressure vessels on the low side of the system, whichever relieving capacity is the largest, as computed by the formula in Paragraph 4913.5. Such low side pressure relief devices shall be set in accordance with Paragraph 4913.6 and vented to the outside of the building in an approved manner.

4912.4 Ammonia Discharge. Where ammonia is used, the discharge may be into a tank of water which shall be used for no purpose except ammonia absorption. At least 1 gallon of fresh water shall be provided for each pound of ammonia in the system. The water used shall be prevented from freezing without the use of salt or chemicals. The tank shall be substantially constructed of not less than 1/8 inch or No. 11 U.S. gage iron or steel. No horizontal dimension of the tank shall be greater than one-half the height. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure relief valves shall discharge the ammonia in the center of the tank near the bottom.

4912.5 Sulphur Dioxide Discharge. Where sulphur dioxide is used, the discharge may be into a tank of absorptive brine which shall be used for no purpose except sulphur dioxide absorption. There shall be 1 gallon of standard dichromate brine (2-1/2 pounds sodium dichromate per gallon of water) for each pound of sulphur dioxide in the system. Brines made with caustic soda or soda ash may be used in place of sodium dichromate provided the quantity and strength give the equivalent sulphur dioxide absorbing power. The tank shall be substantially constructed of not less than 1/8 inch or No. 11 U.S. gage iron or steel. The tank shall have a hinged cover, or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure-relief valve shall discharge the sulphur dioxide in the center of the tank near the bottom.

SECTION 4913—RELIEF DEVICES FOR PRESSURE VESSELS

4913.1 General. The rules of this section are based upon the rules given in Paragraphs UG-125 to UG-134 inclusive, of Section VIII of the 1952 Edition of the ASME Boiler and Pressure Vessel Code, with such additional modifi-
4913.2 Pressure Vessels Over 3 Cubic Feet. Each pressure vessel containing liquid refrigerant with internal gross volume exceeding 3 cubic feet, except as specified in 4913.4, and which may be shut off by valves from all other parts of a refrigerating system, shall be protected by a pressure-relief device having sufficient capacity to prevent the pressure in the pressure vessel from rising more than 10 percent above the setting of the pressure relief device. (See 4913.5.)

4913.2.1 Pressure Vessels Over 3 Cubic Feet, But Less Than 10 Cu. Ft. Under conditions specified in 4913.2, a single relief valve (relief valve or rupture member) may be used on pressure vessels having less than 10 cubic feet gross volume.

4913.2.2 Pressure Vessels of 10 Cubic Feet or Over. Under conditions specified in 4913.2, a pressure relief valve in parallel with a rupture member or second pressure relief valve shall be provided on pressure vessels having a gross volume of 10 cubic feet or over. Each pressure relief valve or rupture member shall have sufficient capacity to prevent the pressure in the pressure vessel from rising more than 10 percent above the setting of the pressure relief device.

4913.2.2.1 Relief Valves Discharging Into Low Side of the System. Under conditions permitted in 4912.3.1, a single relief valve (not a rupture member) of the required relieving capacity may be used on vessels of 10 cubic feet or over.

4913.2.3 Relief Devices in Parallel on Large Vessels. In cases where large pressure vessels containing liquid refrigerant except as specified in 4913.4, require the use of two or more pressure-relief devices in parallel to obtain the capacity required by 4913.5, the battery of pressure-relief devices shall be considered as a unit, and therefore as one pressure-relief device.

4913.3 Pressure Vessels with Gross Volume of 3 Cubic Feet or Less. Each pressure vessel having a gross volume of 3 cubic feet or less, containing liquid refrigerant, except as specified in 4913.4, and which may be shut off by valves from all other parts of a refrigerating system, shall be protected by a pressure-relief device, or fusible plug. A fusible plug is permitted only on the high side of a refrigerating system. Pressure vessels of less than 3" in. D. are exempt from these requirements.

4913.3.1 Relief Valves on Pressure Vessels with Gross Volume of 3 Cubic Feet or Less. If a relief valve or rupture member is used to protect a pressure vessel the ultimate bursting pressure so protected shall be at least 2-1/2 times the pressure setting of the pressure relief valve or rupture member.

4913.3.2 Fusible Plugs on Pressure Vessels with Gross Volume of 3 Cubic Feet or Less. If a fusible plug is used, the ultimate bursting pressure of the pressure vessel so protected shall be at least 2-1/2 times the refrigerant saturation pressure, psig, corresponding to the stamped temperature on the fusible plug, or at least 2-1/2 times the critical pressure of the refrigerant used, whichever is smaller.

4913.4 Relief Device for Pressure Vessels Used As, or As Part of Evaporator. Pressure vessels having internal diameters greater than 6" used as, or as part of, evaporators insulated or installed in insulated space, and which may be shut off by valves from all other parts of a refrigerating system shall be protected by a pressure-relief device in accordance with the provisions of Paragraphs 4913.2 and 4913.3 except that the provisions of Paragraph 4913.2.2, requiring a second parallel relief device, shall not apply. Pressure vessels used as evaporators, having internal diameters of 6" or less, are exempt from pressure relief valve requirements.

4913.5 Required Capacity. The minimum required rated discharge capacity of the pressure-relief device or fusible plug for a refrigerant-containing vessel shall be determined by the following formula:

\[
C = fDL
\]

(3)

where C=minimum required discharge capacity of the relief device in lb. of air per min.

D=outside diameter of the vessel in ft.

L=length of the vessel in ft.

f=factor dependent upon kind of refrigerant, as follows:

<table>
<thead>
<tr>
<th>Kind of Refrigerant</th>
<th>Value of f</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>0.5</td>
</tr>
<tr>
<td>Freon-12, Freon-22,</td>
<td>1.6</td>
</tr>
<tr>
<td>Carrene-7</td>
<td>1.0</td>
</tr>
<tr>
<td>All other Refrigerants</td>
<td>1.0</td>
</tr>
</tbody>
</table>

4913.6 Pressure-relief Device Setting. Except as permitted in 4913.3.1, all pressure-relief devices shall be set to start to function at a pressure not to exceed the design working pressure of the pressure vessel as determined by the manufacturer and stamped on the pressure vessel or system.

4913.7 Rupture Member Setting When Used in Parallel with Relief Valves. Rupture members used in parallel with pressure-relief valves on refrigerant-containing vessels shall
function at a pressure not to exceed 20 per cent above the design working pressure of the vessel.

4913.8 Other Rupture Member Setting. All other rupture members used in lieu of, or in series with, a relief valve, shall function at a pressure not to exceed the design working pressure of the vessel and the conditions of application shall conform to accepted requirements. (See Standards, Section 4601)

4913.9 Marking of Relief Devices.

4913.9.1 All pressure-relief valves for the refrigerant-containing vessels shall be set and sealed by the manufacturer with the data required. (See Standards, Section 4601)

4913.9.2 Each rupture member for refrigerant-containing pressure vessels shall be marked with the information required by accepted standards. (See Standards, Section 4601)

SECTION 4914—FIELD TESTS

4914.1 General. Every refrigerant-containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, and control mechanisms that are factory tested, shall be tested and proved tight after complete installation, and before operation, at not less than the minimum refrigerant leak field test pressures shown on Table 6, or in accordance with 4914.1.1.

4914.1.1 Systems erected on the premises using Group 1 refrigerant and with copper tubing not exceeding 5/8 inch O.D. with wall thickness as required by paragraphs 4909.3.3 and 4909.3.4 may be tested by means of the refrigerant charged into the system at the saturated-vapor pressure of the refrigerant at 70° F. or higher.

4914.2 Test Medium. No oxygen or any combustible gas or combustible mixture of gases shall be used within the system for testing.

4914.2.1 The Means used to build up the test pressure shall have either a pressure limiting device or a pressure reducing device and a gage on the outlet side.

4914.3 Posting of Tests. A dated declaration of test should be provided for all systems containing 50 lb. or more of refrigerant, where required by 4914.1. The declaration should be mounted in a frame, protected by glass, and posted in the machinery room and should give the name of the refrigerant and the field refrigerant leak test pressures applied to the high side and the low side of the system. The declaration of test should be signed by the installer and, if an inspector is present at the tests, he should also sign the declaration. When requested, copies of this declaration shall be furnished to the enforcing authority. The leak test pressure requirements of Table 6 are not intended to apply to gas bulk storage tanks that are not permanently connected to a refrigeration system.

SECTION 4915—INSTRUCTIONS

4915.1 Signs. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the refrigerant leak field test pressure applied.

4915.2 Metal Signs for Systems Containing More Than 100 Pounds of Refrigerant. Systems containing more than 100 pounds of refrigerant shall be provided with metal signs having letters not less than 1/2 inch in height designating the main shut-off valves to each vessel, main steam or electrical control, remote control switch, and pressure-limiting device. On all exposed high pressure and low pressure piping in each room where installed outside the machinery room, shall be signs, as specified above with the name of the refrigerant and the letters "HP" or "LP".

4915.3 New Signs for Changed Refrigerant. When the kind of refrigerant is changed as provided in 4915.7 (Substitution of Refrigerant) there shall be a new sign, of the same type as specified in 4915.2, indicating clearly that a substitution has been made, and stating the same information for the new refrigerant as was stated in the original.

4915.4 Charging and Discharging Refrigerants. When refrigerant is added to a system, except a unit system requiring less than 6 pounds of refrigerant, it shall be charged into the low pressure side of the system. Any point on the downstream side of the main liquid line stop valve shall be considered as part of the low pressure side when operating with said stop valve in the closed position. No service container shall be left connected to a system except while charging or withdrawing refrigerant.

4915.5 Refrigerants Withdrawn from Refrigerating Systems shall be transferred to approved containers only. No refrigerant shall be discharged to a sewer. (See Standards, Section 4601)

4915.6 Containers Used for Refrigerant Withdrawn from a Refrigerating System shall be carefully weighed each time they are used for this purpose, and the containers shall not be filled in excess of the permissible filling weight for such containers and such refrigerants as are prescribed in the pertinent regulations of the Interstate Commerce Commission. (See Standards, Section 4601)
### TABLE 6
MINIMUM REFRIGERANT LEAK FIELD TEST PRESSURES

<table>
<thead>
<tr>
<th>Refrigerant name</th>
<th>Chemical formula</th>
<th>Minimum field refrigerant leak test pressures, psig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High pressure side</td>
</tr>
<tr>
<td>Ammonia</td>
<td>NH₃</td>
<td>300</td>
</tr>
<tr>
<td>Butane</td>
<td>C₄H₁₀</td>
<td>95</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>CO₂</td>
<td>1500</td>
</tr>
<tr>
<td>Dichlorodifluoromethane (Freon-12)</td>
<td>CCl₂F₂</td>
<td>235</td>
</tr>
<tr>
<td>Dichloroethylene</td>
<td>C₂H₂Cl₂</td>
<td>30</td>
</tr>
<tr>
<td>Dichloromethane (Carrene No. 1)</td>
<td>CH₂Cl₃</td>
<td>30</td>
</tr>
<tr>
<td>(Methylene chloride)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichloromonofluoromethane (Freon-21)</td>
<td>CHCl₂F</td>
<td>70</td>
</tr>
<tr>
<td>Dichlorotetrafluoroethane (Freon-114)</td>
<td>C₂Cl₄F₄</td>
<td>50</td>
</tr>
<tr>
<td>Ethane</td>
<td>C₂H₆</td>
<td>1200</td>
</tr>
<tr>
<td>Ethyl chloride</td>
<td>C₂H₅Cl</td>
<td>60</td>
</tr>
<tr>
<td>Ethylene</td>
<td>C₂H₄</td>
<td>1600</td>
</tr>
<tr>
<td>Isobutane</td>
<td>[CH₃]₂CH</td>
<td>130</td>
</tr>
<tr>
<td>Methyl chloride</td>
<td>CH₃Cl</td>
<td>210</td>
</tr>
<tr>
<td>Methyl formate</td>
<td>HCOOCH₃</td>
<td>50</td>
</tr>
<tr>
<td>Monochlordifluoromethane (Freon-22)</td>
<td>CHClF₂</td>
<td>300</td>
</tr>
<tr>
<td>Propane</td>
<td>C₃H₈</td>
<td>300</td>
</tr>
<tr>
<td>Sulphur dioxide</td>
<td>SO₂</td>
<td>170</td>
</tr>
<tr>
<td>Trichloromonofluoromethane (Freon-11)</td>
<td>CCl₃F</td>
<td>30</td>
</tr>
<tr>
<td>Trichlorotrifluoroethane (Freon-113)</td>
<td>C₂Cl₃F₃</td>
<td>30</td>
</tr>
</tbody>
</table>

**NOTES:**

a) For refrigerants not listed in Table 6 the test pressure for the high pressure side shall be not less than the saturated vapor pressure of the refrigerant at 150°F. The test pressure for the low pressure side shall be not less than the saturated vapor pressure of the refrigerant at 110°F. In no case shall the test pressure be less than 30 psig.

b) When a compressor is used as a booster to obtain a low pressure and discharges into the suction line of another system, the booster compressor is considered a part of the low side, and values listed under the low side column in Table 6 shall be used for both high and low side of the booster compressor provided that a low pressure stage compressor of the positive displacement type shall have a pressure relief valve.

c) In field testing systems using nonpositive displacement compressors, the entire system shall be considered for field test purposes as the low side pressure.
4915.7 Substitution of Kind of Refrigerant in a system shall not be made without the permission of the approving authority, the user and the makers of the original equipment, and due observance of safety requirements, including:

a) The effects of the substituted refrigerant on materials in the system;

b) The possibility of overloading the liquid receiver which should not be more than 80 percent full of liquid;

c) The liability of exceeding motor horsepower, design working pressure, or any other element that would violate any of the provisions of this Code;

d) The proper size of refrigerant controls;

e) The effect on the operation and setting of safety devices;

f) The possible hazards created by mixture of the original and the substituted refrigerant;

g) Effect of the classification of the refrigerant as provided in this standard.

4915.8 Refrigerant Stored in a Machinery Room shall be not more than 20 percent of the normal refrigerant charge nor more than 300 pounds of the refrigerant, in addition to the charge in the system and the refrigerant stored in a permanently attached receiver, and then only in approved storage containers.

4915.9 Masks or Helmet. One mask or helmet shall be provided at a location convenient to the machinery room when an amount of a Group 2 refrigerant between 100 and 1000 pounds, inclusive, is employed. If more than 1000 pounds of a Group 2 refrigerant are employed at least two masks or helmets shall be provided.

4915.9.1 Only complete helmets or masks marked as approved by the Bureau of Mines of the United States Department of the Interior shall be used and they shall be kept in a suitable cabinet immediately outside the machinery room or other approved accessible location.

4915.9.2 Canisters or cartridges of helmets or masks shall be renewed immediately after having been used or the seal broken and, if unused, must be renewed at least once every two years. The date of filling shall be marked thereon.

4915.10 Maintenance. All refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and shall be kept readily accessible at all times.

4915.11 Responsibility as to Operation of the System. It shall be the duty of the person in charge of the premises on which a refrigerating system containing more than 50 pounds of refrigerant is installed, to place a card conspicuously as near as practicable to the refrigerant compressor giving directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

a) Instruction of shutting down the system in case of emergency;

b) The name, address, and day and night telephone numbers for obtaining service;

c) The name, address, and telephone number of the municipal inspection department having jurisdiction, and instructions to notify said department immediately in case of emergency.

4915.12 Pressure Gages should be checked for accuracy prior to an air test and immediately after every occasion of unusually high pressure, either by comparison with master gages or by setting the pointer as determined by a dead-weight pressure gage tester.
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<th>Equiv. length of discharge pipe, ft.</th>
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Chapter 50 - Plumbing Code Definitions

Section 5001. General. 5001.1.1 For the purpose of this Code the following terms shall have the meanings indicated in this Chapter.

5001.1.2 No attempt is made to define ordinary words which are used in accordance with their established dictionary meaning, except where the word has been loosely used and it is necessary to define its meaning as used in this Code to avoid misunderstanding.

5001.1.3 Because the primary purpose is to define terms rather than words, the definitions are arranged alphabetically according to the first word of the term rather than the noun.

Section 5001.2 Definitions of Terms.

5001.2.1 Air Gap—An air gap in a water-supply system is the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank or plumbing fixture and the flood-level rim of the receptacle.

5001.2.2 Anchors—See Supports.

5001.2.3 Approved—Shall mean approved in accordance with the provisions of Section 5003.

5001.2.4 Area Drain—An area drain is a drain installed to collect surface or rain water from an open area.

5001.2.5 Backflow—Backflow means the flow of water or other liquids into the distributing pipes of a potable supply of water from any source or sources other than its intended source. Back-siphonage is one type of backflow.

5001.2.6 Backflow Connection—A backflow connection or condition is any arrangement whereby backflow can occur.

5001.2.7 Backflow Preventer—A backflow preventer is a device or means to prevent backflow.

5001.2.8 Back Vent—(See Individual Vent.)

5001.2.9 Branch—A branch is any part of a piping system other than a Main. (See Main.)

5001.2.10 Branch Interval—A branch interval is a length of soil or waste stack, corresponding in general to one-story height but in no case less than 8 feet, within which horizontal branches are connected to the stack.

5001.2.11 Branch Vent—A branch vent is a vent connecting one or more vents with a vent stack or a stack-vent.

5001.2.12 Building—A building is any structure built for support, shelter, and enclosure of persons, animals, chattels, or property of any kind.

5001.2.13 Building Drain—The building drain is that part of the lowest horizontal piping of a building drainage system from the stack or horizontal branch, exclusive of storm sewer, extending to a point not less than 5 feet outside of the building wall.

5001.2.14 Building Sewer—The building sewer is that part of the horizontal piping of a drainage system which extends from the end of the building drain and which receives the discharge of the building drain and conveys it to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

5001.2.15 Building Storm Drain—A building storm drain is a building drain used for conveying surface water, ground water, subsurface water, condensate, cooling water, or other similar discharge to a building storm sewer or a combined building sewer, extending to a point not less than 5 feet outside the building wall.

5001.2.16 Building Storm Sewer—A building storm sewer is the extension from the building storm drain to the public storm sewer, combined sewer, or other disposal system.

5001.2.17 Building Subdrain—A building subdrain is that portion of a drainage system which cannot drain by gravity into the building sewer.

5001.2.18 Circuit Vent—A circuit vent is a branch vent that serves two or more traps and extends from in front of the last fixture connection of a horizontal branch to the vent stack.

5001.2.19 Combination Fixture—A combination fixture is a fixture combining one sink and tray or a two or three compartment sink or tray in one unit.

5001.2.20 Combined Building Sewer—A combined building sewer is a building sewer which also receives storm water.

5001.2.21 Combination Waste and Vent System—A combination waste and vent system is a specially designed system of waste piping embodying the horizontal wet venting of one or more sinks or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain.

5001.2.22 Common Vent—A common vent (dual vent) is a vent connecting at the junction of two fixture drains and serving as a vent for both fixtures.
5001.2.23 **Conductor**—(See Leader.)

5001.2.24 **Continuous Vent**—A continuous vent is a vent that is a continuation of and in a straight line with the drain to which it connects. A continuous vent is further designated by the angle the drain and vent make with the horizontal at the point of connection; for example, vertical continuous-waste-and-vent, 45° continuous-waste-and-vent, and flat (small-angle) continuous-waste-and-vent.

5001.2.25 **Continuous Waste**—A continuous waste is a waste from two or more fixtures connected to a single trap.

5001.2.26 **Cross-Connection**—A cross-connection is any physical connection or arrangement of pipes between two otherwise separate piping systems, one of which contains potable water and the other water of unknown or questionable safety, whereby water may flow from one system to the other, the direction of flow depending on the pressure differential between the two systems.

5001.2.27 **Dead End**—A dead end is a branch leading from a soil, waste, vent, building drain, or building sewer, which is terminated at a developed distance of 2 feet, or more by means of a cap, plug, or other closed fitting.

5001.2.28 **Developed Length**—The developed length of drainage or vent piping is its length measured along the center line of the pipe and fitting.

5001.2.29 **Diameter**—Unless otherwise specifically stated in this Code, diameter means the nominal size for pipe or tubing as designated commercially.

5001.2.30 **Direct Flush Valve**—A device designed to discharge a predetermined quantity of water to fixtures for flushing purposes.

5001.2.31 **Downspout**—(See Leader.) Downspout is the term normally used to denote a water conductor which does not connect with a disposal system.

5001.2.32 **Drain**—A drain or drain pipe is any pipe which carries waste water or waterborne wastes in a building drainage system.

5001.2.33 **Drainage Piping**—(See Drainage System.)

5001.2.34 **Drainage System**—A drainage system (drainage piping) means and includes all the piping within a public or private premise which conveys sewage, storm water, or other liquid wastes, and includes the building sewer.

5001.2.35 **Effective Opening**—The effective opening is the minimum cross-sectional area at the point of water-supply discharge, measured or expressed in terms of (1) the diameter of a circle or (2) if the opening is not circular, the diameter of a circle of equivalent cross-sectional area.

5001.2.36 **Fixture Branch**—A fixture branch is the water-supply pipe from the water-distributing pipe to wall or floor line.

5001.2.37 **Fixture Drain**—A fixture drain is the drain from the trap of a fixture to the junction of that drain with any other drain pipe.

5001.2.38 **Fixture Supply**—A fixture supply is a water-supply pipe connecting the fixture with the fixture branch.

5001.2.39 **Fixture Unit**—A fixture unit is a design factor so chosen that the load-producing values of the different plumbing fixtures can be expressed approximately as multiples of that factor.

5001.2.40 **Flood Level**—Flood level, in reference to a plumbing fixture, means the level at which water begins to overflow the top or rim of the fixture.

5001.2.41 **Flood-Level Rim**—The flood-level rim is the top edge of the receptacle from which water overflows.

5001.2.42 **Flush Valve**—A flush valve is a valve for flushing water closets and similar fixtures.

5001.2.43 **Grade**—(See Slope.) Where the grade of a line of pipe in reference to a horizontal plane is intended, the term Slope applies. Where elevation or ground level is intended, the term Grade applies.

5001.2.44 **Grease Interceptor**—(See Interceptor.)

5001.2.45 **Grease Trap**—(See Interceptor.)

5001.2.45.1 **Ground Water**—Ground water is water obtained from natural storage areas beneath the surface of the ground. (Ord. 98, Series 1955)

5001.2.45.2 **Ground Water Supply**—A ground water supply shall include a well, spring, water suction pipe, water pressure pipe, or similar structure or device used to obtain ground water. (Ord. 98, Series 1955).

5001.2.46 **Hangers**—(See Supports.)

5001.2.47 **Horizontal Branch**—A horizontal branch is a branch drain extending laterally from a soil or waste stack or building drain, with or without vertical sections or branches, which receive the discharge from one or more fixture drains and conducts it to the soil or waste stack or to the building drain.

5001.2.48 **Horizontal Pipe**—Horizontal pipe means any pipe or fitting, which is installed in a horizontal position, or which makes
an angle of less than 30 degrees with the horizontal.

5001.2.49 House Drain — (See Building Drain.)

5001.2.50 House Sewer — (See Building Sewer.)

5001.2.51 Indirect Waste Pipe—An indirect waste pipe is a waste pipe which does not connect directly with the drainage system, but which discharges into it through a properly trapped fixture or receptacle.

5001.2.52 Individual Vent—An individual vent is a pipe installed to vent a fixture trap and connects with the vent system above the fixture it serves.

5001.2.53 Interceptor—An interceptor is a receptacle designed and constructed to intercept or separate and prevent the passage of oil, grease, sand, or other materials into the drainage system to which it is directly or indirectly connected.

5001.2.54 Leader—A leader is the water conductor from the roof to the building storm drain, combined building sewer, or other disposal system.

5001.2.55 Loop Vent—A loop vent is the same as a circuit vent except that it loops back and connects with a stack-vent instead of the vent stack.

5001.2.56 Main—The main of any system of continuous piping is the principal artery of the system to which branches may be connected.

5001.2.57 Main Vent—The main vent is the principal artery of the venting system, to which vent branches may be connected.

5001.2.57.1 Municipal Water System—Municipal water system means the system of plant, pumps, pipes, valves, treatment, storage, and distribution facilities and appurtenances thereto by which water is supplied to the City and County of Denver and its inhabitants by the nonpolitical Board of Water Commissioners created by charter. (Ord. 98, Series 1955.)

5001.2.57.2 Nonpotable Water. Nonpotable water is water which is not potable. (Ord. 98, Series 1955.)

5001.2.58 Offset—An offset in a line of piping is a combination of elbows or bends which brings one section of the pipe out of line with but into a line parallel with another section.

5001.2.59 Person—Person means a natural person, his heirs, executors, administrators, or assigns; and shall also include a firm, partnership, or corporation, its or their successors or assigns. Singular includes plural; male includes female.

5001.2.60 Plumbing—Plumbing is the installing of the pipes, fixtures, and other apparatus necessary for the supplying of water or for removing liquid and waterborne wastes, or both. The term is also used to denote installed fixtures, drainage, vent, water-distribution systems, and underground sprinkler systems. Provided, that this definition shall not be construed to include installation, alteration and/or repair of domestic appliances equipped with back flow preventers, water heating appliances, building heating appliances and systems, fire protection and air conditioning installations, and water conditioning appliances, where such appliances, systems and installations are not connected to the sewer; and provided further that such appliances, systems, and installations are connected to the water supply under permit, subject to inspection, and by persons licensed in accordance with the ordinances of the City and County of Denver.

5001.2.61 Plumbing Fixtures—Plumbing fixtures are receptacles which receive water, liquid, or water-borne wastes and discharge them into a drainage system to which they are connected.

5001.2.62 Plumbing System—The plumbing system includes the drainage and vent system; the water-supply distributing pipes; the fixtures and fixture traps; and the storm-water drainage; with their devices, appurtenances, and connections.

5001.2.63 Pool—A pool is a water receptacle used for swimming or as a plunge or other bath, designed to accommodate more than one bather at a time.

5001.2.64 Potable Water—Potable water is water which is safe for drinking, culinary, and domestic purposes, and is either supplied by the nonpolitical Board of Water Commissioners created by charter or approved as such by the Department of Health and Hospitals. (Ord. 98, Series 1955.)

5001.2.65 Private—In the classification of plumbing fixtures, private applies to fixtures in residences and apartments and to fixtures in private bathrooms of hotels and similar installations where the fixtures are intended for the use of a family or an individual.

5001.2.65.1 Private Water Supply System—A private water supply system means a water supply system which derives its water from a source other than the municipal water system. (Ord. 98, Series 1955.)

5001.2.66 Public—In the classification of plumbing fixtures, public applies to fixtures in general toilet rooms of schools, gymnasiu...
hotels, railroad stations, public buildings, bars, public comfort stations, and other installations (whether pay or free) where a number of fixtures are installed so that their use is similarly unrestricted.

5001.2.67 Relief Vents—A relief vent is a vent the primary function of which is to provide circulation of air between drainage and vent systems.

5001.2.68 Riser—A riser is a water-supply pipe which extends vertically one full story or more to convey water to branches or fixtures.

5001.2.69 Roof Drain—A roof drain is a drain or receptacle installed to receive water collecting on the surface of a roof and to discharge it to a leader.

5001.2.70 Sand Interceptor—(See Interceptor.)

5001.2.71 Sand Trap—(See Interceptor.)

5001.2.72 Sanitary Sewer—A sanitary sewer is a pipe which carries sewage and excludes storm, surface, and ground water.

5001.2.73 Separator—(See Interceptor.)

5001.2.74 Sewage—Sewage is any liquid waste containing animal or vegetable matter in suspension or solution, and may include liquids containing chemicals in solution from laboratories or industrial institutions.

5001.2.75 Shall—The word "shall" is a mandatory term.

5001.2.76 Side Vent—A vent connecting to the drain pipe through a 45° wye.

5001.2.77 Slope—Slope means the grade of a line of pipe in reference to a horizontal plane. In drainage it is usually expressed as the fall in a fraction of an inch per foot length of pipe.

5001.2.78 Soil Pipe—A soil pipe is any pipe which conveys the discharge of water closets or fixtures having similar functions, with or without the discharges from other fixtures.

5001.2.79 Stack—A stack is the vertical main of a system of soil, waste, or vent piping.

5001.2.80 Stack Vent—A stack vent is the extension of a soil or waste stack above the highest horizontal drain connected to the stack.

5001.2.81 Storm Drain—A storm drain is a drain used for conveying rain water, surface water, condensate, cooling water, or similar discharges.

5001.2.82 Storm Sewer—A storm sewer is a sewer used for conveying rain water, surface water, condensate, cooling water, or similar discharges.

5001.2.83 Subsoil Drain—A subsoil drain is a drain which receives only subsurface or seepage water and conveys it to a place of disposal.

5001.2.84 Sump—A sump is a tank or pit which receives the discharge from drains, or other wastes, located below the normal grade of the gravity system, and which must be emptied by mechanical means.

5001.2.85 Supports; Hangers; Anchors—Supports, hangers, and anchors are devices for securing pipe and fixtures to walls, ceilings, or floors.

5001.2.86 Trap—A trap is a fitting or device so designed and constructed as to provide, when properly vented, a liquid seal which will prevent the back passage of air without materially affecting the flow of sewage or waste water through it.

5001.2.87 Trap Seal—The trap seal is the vertical distance between the crown weir and the top of the dip of the trap.

5001.2.88 Underground Piping—Underground piping is piping in contact with earth below grade. Pipe in a tunnel or in a water-tight trench is not included within the meaning of this term.

5001.2.89 Used—Used, when applied to plumbing material, fixtures, or equipment, means removed from previous installations.

5001.2.90 Vacuum Breaker—(See Backflow preventer.)

5001.2.91 Vent Pipe—(See Vent System.)

5001.2.92 Vent Stack—A vent stack is a vertical vent pipe installed primarily for the purpose of providing circulation of air to and from any part of the drainage system.

5001.2.93 Vent System—A vent system is a pipe or pipes installed to provide a flow of air to or from a drainage system or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

5001.2.94 Vertical Pipe—A vertical pipe is any pipe or fitting, which is installed in a vertical position, or which makes an angle of not more than 60 degrees with the vertical.

5001.2.95 Waste Pipe—A waste pipe is any pipe which receives the discharge of any fixture, except water closets or fixtures having similar functions, and conveys it to the building drain or to a soil or waste stack.

5001.2.96 Water-Distributing Pipe—A water-distributing pipe in a building is a pipe which conveys water from the water-service
pipe to the plumbing fixtures branch or other plumbing outlets.

5001.2.97 Water Main—The water (street) main is a water-supply pipe for public or community use.

5001.2.98 Water-Service Pipe—The water-service pipe is the pipe from the water main or other source of water supply to the building served.

5001.2.98 Water Storage Facility—A water storage facility shall mean a reservoir, cistern, storage tank, water supply tank, pressure tank, or similar facility utilized to store water in a private water supply system. (Ord. 98, Series 1955.)

5001.2.99 Water-Supply System—A water-supply system consists of the water service pipe, the water distributing pipes, water storage facilities and necessary connecting pipes, fittings, valves, and appurtenances on a particular premises. (Ord. 98, Series 1955.)

5001.2A Wet Vent—A wet vent is any drain pipe, which also serves as a vent.

5001.2B Yoke Vent—A yoke vent is a pipe connecting upward from the soil or waste stack to a vent stack for the purpose of preventing pressure changes in the stacks.

SECTION 5002. GENERAL REGULATIONS.

5002.1 MATERIALS AND METHODS. 5002.1.1 All plumbing systems, including repairs and additions, hereafter installed shall conform with the provisions of this code.

5002.2 DRAINAGE PIPING. 5002.2.1 Horizontal drainage piping shall be run in practical alignment at a uniform grade. (See Section 5011 for specific slopes.)

5002.2.2 Pipe Trenches. 5002.2.3 Water-service pipe or any underground water pipes shall not be run or laid in the same trench as a building sewer or drainage piping, except as provided in Sections 5010 and 5011.

5002.3 CHANGES IN DIRECTION. 5002.3.1 Fittings—Changes in direction in drainage piping shall be made by the appropriate use of 45° wyes, long-or-short-sweep quarter bends, sixth, eighth, or sixteenth bends, or by a combination of these or equivalent fittings. Single and double sanitary tees and short quarter bends may be used in drainage lines only where the direction of flow is from the horizontal to the vertical except that short quarter bends may be used under floor outlet fixtures.

5002.3.2 Tees and Crosses—Tees and crosses shall not be used in the drainage system.

5002.4 PROHIBITED FITTINGS AND CONNECTIONS. 5002.4.1 Fittings Prohibited—No double-hub fitting, single or double-tee branch or tapped tee branch, shall be used as a drainage fitting. No running threads, bands or saddles shall be used in the drainage system. No drainage or vent piping shall be drilled or tapped. This connection shall be made with lead between stub or lead bend and iron pipe. No branch connection shall be made to a lead bend or lead stub, except for the purpose of a dry vent.

5002.4.2 Heel or Side-Inlet Bend—A heel or side-inlet quarter bend shall not be used as a vent when the inlet is placed in a horizontal position.

5002.4.3 Obstruction to Flow—Any fitting or connection which has an enlargement, chamber or recess with a ledge, shoulder or reduction of the pipe area, that offers an obstruction to flow through the drain, or any fitting or connection that offers abnormal obstruction to flow, is prohibited. The enlargement of a 3-inch closet bend to 4 inches shall not be considered an obstruction.

5002.9 WORKMANSHIP. 5002.9.1 All workmanship shall be of such character as to accomplish the results sought to be obtained in all Sections of this Code.

5002.9.2 Toilet Facilities for Workmen. 5002.9.3 Suitable approved toilet facilities shall be provided and maintained in a sanitary condition for the use of workmen during construction. (See Table 5007.21.2 for minimum facilities.)

5002.10 PROTECTION OF PIPES. 5002.10.1 Breakage and Corrosion—Pipes passing under or through walls shall be protected from breakage. Pipes passing through or under cinder concrete or other corrosive material shall be protected against external corrosion.

5002.10.2 Cutting or Notching—No structural member shall be weakened or impaired by cutting, notching, or otherwise, unless properly reinforced.

(S)Section 2519 of the Building Code, as amended, provides as follows:

"Cutting and Notching. Girders, beams, or joists may be notched or bored in any part of the section within three (3) times the beam depth from either support. Such notches or holes shall not exceed one-fifth (1/5) 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 shear at such point shall not ex-
ceed the value calculated by the following formula:

\[
V = \frac{2}{3} \left( \frac{bdH}{h} \right)
\]

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.

5002.10.3 Pipes Through and Under Footings, and Pipes Through Foundation Walls—A soil or waste pipe or a building drain passing under or through a footing, or through a foundation wall, shall be installed so that the footing or wall shall not be weakened and so that no undue strain will be placed on the pipe due to any movement in the wall. Protection to such walls and pipes shall be afforded in the manner following:

(a) Pipes Under Footings—Where a soil or waste pipe or a building drain is run under a footing, the trench shall be solidly filled with concrete or the footing shall be reinforced over the pipe so as to provide a beam or relieving arch across the trench.

(b) Pipes Through Footings or Foundation Walls—Where an opening greater than 8 inches in diameter is required for the passage of pipes through footings or foundation walls, such walls shall be reinforced as follows. In masonry, such footings or walls shall be provided with relieving arches or steel lintels. In concrete walls or footings, proper reinforcement over the pipe shall be provided.

All openings below grade shall be plugged with mastic or hot-poured bituminized compound and water-proofed by application of an approved water-proofing material.

5002.10.4 Freezing—No water, soil, or waste pipe shall be installed or permitted outside a building or in an exterior wall unless adequate provision is made to protect such pipe from freezing where necessary.

5002.12 INDUSTRIAL WASTES. 5002.12.1 Wastes which are detrimental to the public sewer system or are detrimental to the functioning of the sewage treatment plant, shall be disposed of in a manner approved by the City Engineer.

5002.14 RATPROOFING. 5002.14.1 Exterior Openings—All exterior openings provided for the passage of piping shall be properly sealed with snugly fitting collars of metal or other approved ratproof material securely fastened into place.

5002.14.2 Interior Openings—Interior openings through walls, floors, and ceilings shall be ratproofed in accordance with the ordinance provisions on ratproofing contained in the Revised Municipal Code, Series of 1950.

5002.15 USED MATERIALS AND FIXTURES. 5002.15.1 Approval—Used materials shall not be used except where specifically permitted in this Code, or when approved by the Chief Building Inspector or the Board of Appeals. Used plumbing fixtures shall not be installed unless they have been inspected and been found to meet the requirements of this Code and to be in a satisfactory physical and sanitary condition.

5002.22 INDIVIDUAL SEWAGE DISPOSAL SYSTEMS. 5002.22.1 When Required—When a public sewer is not available for use, sewage drainage piping from buildings shall be connected to an individual sewage disposal system. (See Section 5016.)

5002.23 LOCATION OF FIXTURES. 5002.23.1 Ventilation and Illumination—Water closets and urinals shall be located in a compartment or room provided with ventilation and illumination conforming to the Building Code. (Ordinance No. 140, Series of 1949, as amended.)

5002.26 VENTILATION DUCTS. Ventilation ducts from washrooms and toilet rooms shall exhaust to the outer air or form an independent system.

5002.28 DEAD ENDS. 5002.28.1 In the installation or removal of any part of a drainage system, dead ends shall be avoided except where necessary to extend a cleanout so as to be accessible.

SECTION 5003. METHODS, MATERIALS AND FIXTURES, QUALITY

5003.1 METHODS, MATERIALS AND FIXTURES. 5003.1.1 Use of Materials—All methods, materials, and fixtures shall be used in accordance with limitations imposed throughout this Code and shall meet established technical standards of quality and strength necessary to produce reasonably safe and sanitary plumbing installations.

5003.1.2A Intent—The provisions of this Code are not intended to prevent the use of methods, materials, and fixtures which, as a matter of fact, will meet reasonably safe standards of strength and sanitation.
5003.1.3 **Approved**—Refers to approval by either the Chief Building Inspector or Board of Appeals as the result of investigation and tests conducted or by reason of acceptance of results of tests or principles promulgated of national authorities, technical, or scientific organizations.

Section 4601 (a), (b), (c) and (d) of the Building Code shall also apply.

The following organizations shall be deemed to be authoritative sources:

ASA—American Standards Association (American Standards).

ASTM—American Society for Testing Materials (Standards and Tentative Standards).

FS—Federal Specifications Board (Federal Specifications).

AWWA—American Water Works Association (Standards and Tentative Standards).

CS—National Bureau of Standards (Commercial Standards).

MSS—Manufacturers Standardization Society of the Valve and Fittings Industry (Standards).

NBS—National Bureau of Standards (See “CS” above).

SPR—National Bureau of Standards (Simplified Practice Recommendations).

Note—ASTM standards are issued under fixed designations; the final number indicates the year of original adoption or, in the case of revision, “T” indicates tentative. In the “CS” series of standards also, the final number indicates the year of issue. For Federal Specifications, the year indicates the year of issue or of the last revision or amendment.

5003.1.4 **IDENTIFICATION.** 5003.1.4 **Marking**—Each length of pipe, and each pipe fitting, trap, fixture and device used in a plumbing system shall have cast, stamped, or indelibly marked on it, the maker’s mark or name, the weight, and the quality of the product.

5003.2 **MATERIALS — SPECIAL REQUIREMENTS.** 5003.2.1 **Sheet Lead**—Sheet lead shall weigh not less than 4 pounds per square foot.

5003.2.3 **Calking Ferrules**—Brass calking ferrules shall be of red-brass pipe or of heavy cast red brass. Weights and dimensions for heavy cast red brass shall be in accordance with Table 5003.2.3. Seamless copper ferrules may be used in lieu of cast brass, provided they correspond in size and weight.

<table>
<thead>
<tr>
<th>Pipe size (inches)</th>
<th>Actual inside diam. (in.)</th>
<th>Length, Inches</th>
<th>Weight, Lb. O.z.</th>
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<td>2¼</td>
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<td>4</td>
<td>4¼</td>
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</table>

5003.2.4 **Soldering Nipples and Bushings.** Soldering nipples and bushings shall be red-brass pipe, standard size, or of heavy cast red brass or of weight and dimensions in accordance with Table 5003.2.4:

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<tr>
<th>Size of pipe (Inches)</th>
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<tr>
<td>1¼</td>
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*Correction—Issued June 1, 1954.

5003.2.5 **Floor Flanges**—Closet floor flanges for plumbing fixtures shall be not less than 3/16 inch thick for cast-iron or galvanized malleable iron or not less than 1/8 inch thick for brass or hard lead.
TABLE 5003.5

GUIDE FOR MATERIAL AND FIXTURE SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>ASA</th>
<th>ASTM</th>
<th>CS</th>
<th>FS</th>
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1. Amendment 1 dated Feb. 7, 1946, included
3. Amendment 3 dated Apr. 28, 1940, included.
4. Amendment 2 dated June 9, 1945, included.
5. Amendment 2 dated Feb. 8, 1943, included.
7. Mercurous nitrate test required.
8. Limited to sizes included in SPR 217-49—includes amendment 1, June 27, 1946.
9. Errata 1 dated August 1933, included.
10. Asbestos cement sewer pipe shall meet Federal Specifications SS-P-351 (1940) including Amendment 2, dated Jan. 14, 1942, except for the following substitutions: Sizes only 4-, 5-, and 6-inch. Class: non-pressure. Lengths: 10 feet—out of roundness, inside diameter: -1/4 inch. Hydrostatic strength: not applicable. Flexural strength, 9-foot span: 4-inch, 560 lbs; 5-inch, 900 lbs; and 6-inch, 1,290 lbs. Crushing strength 4-inch, 1,740 lbs; 5-inch, 1,680 lbs; and 6-inch, 1,420 lbs. Tests: 1 specimen from each 300 lengths of pipe.
11. Amendment 1 dated Nov. 18, 1946, included.
12. Amendment 3 dated Nov. 1948, included.
13. Amendment 3 dated May 27, 1944, included.
15. Amendment 1 dated April 19, 1946, included.
SECTION 5004 JOINTS AND CONNECTIONS. 5004.1 Tightness. 5004.1.1 Joints and Connections—All joints and connections shall be made airtight and watertight. (See Section 5014.)

5004.2 TYPES OF JOINTS. 5004.2.1 Calked Joints—Calked joints for cast-iron bell-and-spigot soil pipe shall be firmly packed with oakum or hemp and filled with molten lead not less than 1 inch deep. Lead shall be run in one pouring and calked tight. No paint, varnish, or other coatings shall be permitted on the joining material until after the joint has been tested and approved.

5004.2.2 Threaded Joints—All burrs shall be removed. Pipe ends shall be reamed or filed out to size of bore, and all chips shall be removed. Pipe joint cement and paint shall be used only on male threads.

5004.2.3—Wiped Joints—Joints in lead pipe or fittings, or between lead pipe or fittings and brass or copper pipe, ferrules, solder nipples, or traps, shall be full-wiped joints. Wiped joints shall have an exposed surface on each side of a joint not less than 3/4 inch and at least as thick as the material being joined. All wall or floor flange lead-wiped joints shall be made by using a lead ring or flange placed behind the joint at wall or floor.

5004.2.4 Soldered, or Brazed Joints—Soldered or brazed joints for tubing shall be made with approved fittings. Surfaces to be soldered or brazed shall be cleaned bright. The joints shall be properly fluxed and made with approved solder.

5004.2.5 Flared Joints—All flared joints for soft-copper water tubing shall be made with fittings meeting approved standards. The tubing shall be expanded with a proper flaring tool.

5004.2.6 Hot-Poured Joints—Material for hot-poured joints for clay or concrete pipe shall not soften sufficiently to destroy the effectiveness of the joint when subjected to a temperature of 160° F., nor be soluble in any of the wastest carried by the drainage system. The joint shall be first calked tight with jute, hemp, or other similar approved material.

5004.2.9 Cement Joints—Joints for clay pipe or concrete pipe shall be made by packing a closely twisted jute or oakum gasket, of suitable size to partly fill the annular space between the pipes. The remaining space shall be filled and firmly compacted with mortar composed of one part portland cement and three parts mortar sand. The material shall be mixed dry; only sufficient water shall be added to make the mixture workable. Mortar which has begun to set shall not be used or retempered. Lime putty or hydrated lime may be substituted for not more than 25 per cent of the volume of the portland cement.

5004.2.10 Lead Burned Joints—Lead "burned" (welded) joints shall be lapped and the lead shall be fused together to form a uniform weld at least as thick as the lead being joined.

5004.2.11 Asbestos Cement Sewer Pipe Joints—Joints in asbestos cement pipe shall be made with prepoured couplings. Couplings shall be of the tapered type or with sleeve coupling sealed with rubber rings and of the same composition as the pipe. All joints between asbestos cement pipe and metal pipe shall be made by means of an adapter coupling calked as required in paragraph 5004.2.6.

5004.2.12 Bituminized Fiber Pipe Joints—Joints in bituminized fiber pipe shall be made with tapered type couplings and of the same material as the pipe. All joints between bituminized fiber pipe and metal pipe shall be made by means of an adapter coupling calked as required in paragraph 5004.2.1.

5004.3 USE OF JOINTS. 5004.3.1 Clay Sewer Pipe—All joints in vitrified clay pipe or between such pipe and metals shall be made with approved hot-poured jointing material as specified in paragraph 5004.2.6 or with cement joints as specified in paragraph 5004.2.7.

5004.3.2 Concrete Sewer Pipe—All joints in concrete sewer pipe or between such pipe and metal pipe shall be made with approved hot-poured jointing materials as specified in paragraph 5004.2.9.

5004.3.3 Cast-Iron Pipe—Cast-iron pipe joints shall be either calked or threaded joints made as specified in paragraphs 5004.2.1 or 5004.2.2, respectively.

5004.3.4 Screw Pipe to Cast Iron—Joints between wrought iron, steel, brass or copper pipe, and cast-iron pipe shall be eithercalked or threaded joints made as specified in paragraphs 5004.2.1 or 5004.2.2.

5004.3.5 Lead to Cast Iron, Wrought Iron, or Steel—Joints between lead and cast-iron, wrought-iron, or steel pipe shall be made by means of wiped joints to a calking ferrule, soldering nipple, or bushing, as specified in paragraph 5004.2.3 or by means of ground joint vent coupling.

5004.3.6 Copper Water Tubing—All concealed joints for copper water tubing within buildings shall be soldered or brazed. Joints installed underground may be flared, brazed or soldered.

5004.4 SPECIAL JOINTS. 5004.4.3 Slip Joints—In drainage piping, slip joints, other than expansion joints, shall be used only in the
waste pipe between the trap seal and the fixture. Slip joints used on water piping shall not be concealed.

5004.4.4 Expansion Joints — Expansion joints of approved type may be used where necessary.

5004.4.5 Ground Joints — Ground-joint brass connections which allow adjustment of tubing but provide a rigid joint when made up shall not be considered as slip joints.

5004.5 UNIONS — Unions on the sewer side of the trap shall be ground faced or gasket type. Gasket type unions shall not be concealed or enclosed.

5004.6.1 Water Closet, Pedestal Urinal, and Trap Standard Service Sink — The connection between drainage pipes and water closets, floor-outlet service sinks, pedestal urinals, and earthenware trap standards shall be made by means of brass, hard lead or iron flanges, caulked, soldered, or screwed to the drainage pipe. The connection shall be bolted, with an approved gasket or washer or setting compound between the earthenware and the connection. The floor flange shall be set on an approved firm base.

Exception: On wood floors, connection may be made by use of screws and flanging of the lead.

5004.8 WATERPROOFING OF OPENINGS. 5004.8.1 Pipes Through Roofs or Walls — Where pipes pass through a roof or exterior wall, the opening shall be made watertight.

(Section 2217 (b) of the Building Code, as amended, provides as follows:

"(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.""

SECTION 5005. TRAPS, CLEAN-OUTS, INTERCEPTORS, AND BACKWATER VALVES. 5005.1 TRAPS — WHERE REQUIRED. 5005.1.1 Fixture Traps. — Each plumbing fixture, except those having integral traps, shall be separately trapped by a water-seal trap, placed as close to the fixture outlet as possible; provided, however, that a combination plumbing fixture may be installed on one trap, if one compartment is not more than six (6) inches deeper than the other and the waste outlets are not more than thirty (30) inches apart. (Ord. 364, Series 1957).

5005.2 TYPES AND SIZES OF TRAPS AND FIXTURE DRAINS. 5005.2.1 Trap in Relation to Drain — Every trap shall be of the same nominal size as the fixture drain to which it is connected.

5005.2.2 Integral Traps — The fixture drain for all fixtures with integral traps shall not be smaller than the fixture outlet, and in the case of water closets and pedestal urinals the drain shall be not less than 3 inches.

5005.2.3 Minimum Size — The size (nominal diameter) of trap for a given fixture shall be sufficient to drain the fixture rapidly and shall be not less than given in table 5011.4.2.

5005.2.4 — Drum Traps — Drum Traps for bathtubs and laundry trays shall be not less than 4" in diameter and not less than 2-1/2" for other fixtures. All drum traps shall have not less than a 2-inch water seal. The trap screw shall be one size less than the trap diameter. Drum trap covers shall be of extra heavy brass not less than 1/8" thick and shall be provided with a raised nut or recessed socket for removal.

5005.2.5 "p" Traps. "p" traps may be installed under bathtubs or laundry trays, if of the self-scouring type and if equipped with a clean-out. The location of the clean-out shall be at the top of the trap on the discharge side, and shall be accessible from the floor on which it is located. Such traps, if made of brass, shall be not less in thickness than seventeen (17) U.S. Standard Gauge. (Ord. 364, Series 1957).

5005.3 TRAPS — GENERAL REQUIREMENTS. 5005.3.1 Trap Seal — Each fixture trap shall have a water seal of not less than 2 inches and not more than 4 inches.

5005.3.2 Trap Clean-Outs — Each fixture trap, except those cast integral or in combination with fixtures in which the trap seal is readily accessible or except when a portion of the trap is readily removable for cleaning purposes, shall have an accessible brass trap screw of ample size protected by the water seal.

5005.3.3 Trap Levels and Protection — All traps shall be set true with respect to their water seals and protected from freezing.

5005.3.6 Type Prohibited — No trap which depends for its seal upon the action of movable parts shall be used. No trap with partitions shall be used, unless the trap is integral with a fixture.

5005.3.7 Double Traps — No fixture shall be double trapped.

5005.3.8 Crown Venting — No crown-vented trap shall be installed.

5005.4 PIPE CLEAN-OUTS — GENERAL REQUIREMENTS WHERE REQUIRED. 5005.4.1 Material and Design — The bodies of clean-out ferrules shall conform in thickness to that required for pipe and fittings of the same metal, and extend not less than 1/4 inch above the hub. For new work, the clean-out plug shall be of heavy brass not less than 1/8 inch thick and shall be provided with raised nut or recessed socket for removal. Both ferrule and plug shall
have American national tapered pipe threads. Heavy lead plugs may be used for repairing a clean-out where necessary.

5005.4.1 Location of Clean-Outs—A clean-out shall be provided at or near the foot of each vertical waste or soil stack. Every branch waste line serving a sink or receiving waste from a sink shall be provided with a cleanout. There shall be a cleanout near the junction of the building drain and building sewer, or a cleanout with a wye branch inside the building wall. All cleanouts shall be easily accessible.

5005.4.1A Distance of Clean-Outs—Cleanouts shall be not more than 50 feet apart for each vertical waste or soil stack. Every branch cleanout with a wye branch inside the building drain and building sewer, or a cleanout with a wye branch inside the building wall. All cleanouts shall be easily accessible.

5005.5 SIZE—Clean-outs shall be of the same nominal size as the pipes into which they are installed up to 4 inches and not less than 4 inches for larger pipes.

5005.6 CLEARANCES — Clean-outs on 4-inch or larger pipes shall be so installed that there is a clearance of not less than 18 inches for rodding. Clean-outs smaller than 4 inches shall have not less than 6-inch clearance.

5005.6.4 Accessibility—The opening of all clean-outs shall be made readily accessible. Clean-outs concealed in walls, floors, or ceilings shall be extended to the surface or provided with access doors.

SECTION 5006. 5006.1 INTERCEPTORS.

5006.1.1 When Required—A grease interceptor shall be installed on the discharge line of every dishwashing sink, dishwashing machine, and every fixed receptacle or plumbing fixture designed, intended or used for the purpose of washing dishes or cooking utensils in a restaurant, cafe, cafeteria, lunchroom, hotel kitchen, hospital kitchen, sanitarium kitchen and/or similar establishment that serves, or has capacity to serve, one hundred (100) or more meals per day. The waste lines from these fixtures shall be connected to and shall drain or discharge into an approved grease interceptor. (Provided, however, that this section shall not apply to any such equipment which will not be used to dispose of considerable amounts of grease or grease-containing liquid, when and as approved by the Chief Building Inspector or his authorized deputy.)

Capacity to serve one hundred (100) or more meals per day shall be determined by the serving or seating capacity of fifteen (15) or more patrons at any one time.

5006.1.2 Design and Installation—Grease interceptors shall be located inside the building only when it is impractical to install an outside grease interceptor, and only when such installation is approved by the Chief Building Inspector or his authorized deputy.

All interceptors shall be so designed and installed that they will not become air-bound or permit siphonage. They shall be so located as to be readily and easily accessible for cleaning and inspection.

(a) The flow rate through the interceptor shall not exceed its rated capacity and shall operate at a minimum overall efficiency of 90 percent.

(b) Where more than one fixture discharges into an interceptor, each fixture shall be trapped and vented.

(c) Grease interceptors shall be constructed of impervious materials capable of withstanding shock from hot and cold water and be watertight. Interceptors shall be provided with easily removable covers, which when bolted or attached to interceptor, shall make a watertight fit.

(d) Water-jacketed interceptors or interceptors of similar type, which require connection to the potable water-supply system, shall not be used.

(e) Special conditions shall be submitted for approval of the Chief Building Inspector or his authorized deputy.

5006.3 OIL INTERCEPTORS—(a) All liquid waste containing oil, gasoline, benzine, naphtha, or other flammable liquids or compounds and drainage from areas where such liquids are used shall discharge to an interceptor constructed so as to intercept such materials before they can enter the building sewer.

(b) Oil interceptors shall be constructed so as to be oil-tight and of substantial construction provided with necessary inlet and outlet connections and a separate 2-inch vent from top of the tank to the open air. Cover shall be easily removable and be water and gas-tight.

(c) The minimum capacity for an oil interceptor shall be 6 cubic feet plus 1 cubic foot for each vehicle serviced during a 24-hour period.

(d) Floor drains discharging individually into an oil interceptor need not be trapped.

5006.4 OTHER INTERCEPTORS — Sand interceptors, when required by the Chief Building Inspector or his authorized deputy, shall be constructed and installed so as to separate sand,
silt, grit, rags; or other materials and to prevent
them from entering the drainage system.

5006.14 BACKWATER VALVES—Backwater
valves shall be installed in drainage lines
wherever plumbing fixtures are subjected to
backflow or back pressure. Such backwater
valves shall be so located as to be readily ac-
tessible for inspection and cleaning.

5006.14.4 Backwater valves shall have all
bearing parts of corrosion-resistant material and
be so constructed as to insure a mechanical seal
against backflow.

5006.14.5 Backwater valves when fully
opened shall have a capacity not less than the
pipe in which they are installed.

SECTION 5007 PLUMBING FIXTURES. 5007
GENERAL. 5007.1 QUALITY OF FIXTURES—All
plumbing fixtures shall be made of materials
specified in paragraph 5007.5.1.

5007.3 OVERFLOWS—When any fixture is
provided with an overflow, the waste shall be
so arranged that the standing water in the fix-
ture cannot rise in the overflow when the stop-
per is closed or remain in the overflow when
the fixture is empty.

5007.4 INSTALLATION. 5007.4.1 Cleaning
All plumbing fixtures shall be installed in a
manner to afford easy access for cleaning. Where practical, all pipes from fixtures shall be
run to the wall.

5007.4.3 Securing Fixtures—All floor-outlet
fixtures shall be rigidly secured by screws or
bolts. Wall hung fixtures shall be rigidly sup-
ported by approved metal hangers or bolts.

5007.5.1 Protection of Water Supply —
Where feasible, all plumbing fixtures shall be
supplied with water through an air gap. Other-
wise, fixtures shall be provided with a back-
flow preventer. (See Appendix C.)

5007.5.2 Vacuum Breakers — Vacuum
breakers shall be installed on all urinals
equipped with a direct flush valve.

5007.5.3 Used Plumbing Fixtures — Used
plumbing fixtures shall not be installed unless
they have been inspected and have been found
to meet the requirements of this Code and are
in satisfactory physical and sanitary condition.

5007.7 WATER-CLOSET COMBINATIONS.
5007.7.1 Types of Water Closets—Water-closet
bowls shall be of the siphon-jet, reverse-trap,
washdown, or blow-out type with floor outlet,
or of the siphon-jet or blow-out type with wall
outlet. Water closet bowls and traps shall be
made in one piece and shall be provided with
integral flushing rim constructed so as to flush
the entire interior of the bowl. Water-closet
bowls for public use shall be of the elongated
type with open-front seat.

5007.7.2 Flush Valves—Flush valves for
water-closet tanks shall automatically close
tight and in low water-closet tanks shall have
not less than 2-inch shanks and shall be pro-
vided with overflow except when the tank is
provided with an integral overflow.

5007.7.3 Float Valves—Float valves for
water-closet tanks shall automatically close
tight and in low water-closet tanks shall pro-
vide sufficient refill to seal properly the trap
in the bowl.

5007.7.3.A High Tanks—Flush valves in
high tanks may be of the goose-neck type and
shall have not less than 1-1/2 inch shank. Pro-
tection against backflow shall be provided as
specified in paragraph 5007.5.1.

5007.7.3.B Flush Pipes—Flush connections
shall be not less than 2 inches in diameter for
low tanks and not less than 1-1/4 inches in
diameter for high-tank combinations.

5007.7.3.C Direct Flush Valves—Direct
flush valves shall be so installed that they will
be readily accessible for repairing. When the
valve is operated, it shall complete the cycle
of operation automatically, opening fully and
closing positively under the service pressure. At
each operation the valve shall deliver water in
sufficient volume and at a rate that will thor-
oughly flush the fixture and refill the fixture
trap. Means shall be provided for regulating
flush-valve flow. Not more than one fixture
shall be served by a single flush valve. Pro-
tection against backflow shall be provided as
specified in paragraph 5007.5.1.

5007.8 URINALS. 5007.8.1 Flushing Rim
and Trap—Siphon-jet, blow-out, and pedestal
urinals shall have integral flushing rims and
integral traps except that wash-out and stall
urinals may have separate traps. Stall urinals
shall have flushing rims or spreaders.

5007.8.3 Trough Urinals—Trough urinals
shall be not less than 6 inches deep and shall
be furnished with one-piece backs and have
strainers with outlets at least 1-1/2 inches in
diameter. The wash-down pipe shall be so
perforated as to flush with an even curtain of
water against the back of the urinal. This pipe
shall be securely clamped as high as practical
to the back of the urinal.

5007.8.3.A Flushing—Urinal tanks shall
flush automatically, or shall be provided with
a substantial hand-operated mechanism. The
flushing capacity of all urinal tanks shall be
adequate for the type of urinal used. The flush-
ing capacity of a trough urinal tank shall be
not less than 1-1/2 gallons of water for each
2 feet of urinal trough.
5007.3.B Automatic Tanks—Automatic urinal tanks shall be provided with means for adjusting the flow of predetermined intervals.

5007.3.C Operating Mechanism— Urinal tanks shall be provided with flush valves, operating levers, and overflow. Flush valves may be of goose-neck siphon type. Flow valves shall be operating levers, and overflow. Flush valves may be of goose-neck siphon type. Flow valves shall be as prescribed in paragraph 5007.3.C. Each urinal shall be provided with a valve.

5007.10 LAVATORIES. 5007.10.1 Lavatory Waste—Lavatories shall have waste outlets not less than 1-1/4 inches in diameter and shall be provided with strainers. Wastes may have open strainers or may be provided with stoppers. A lavatory overflow waste plug, if provided, shall be so installed that the bottom edge of the overflow opening in the plug shall be below the bottom of the overflow channel to prevent trapping of water.

5007.11 SHOWER RECEPTACLES — Shower receptacles, except those built directly on the ground or integral with the shower cabinet, shall have watertight pans. The pan shall be turned up on all sides at least 1 inch above the curb and shall be adequately protected against corrosion. Shower receptacles shall have waste outlets not less than 2 inches in diameter and shall be provided with strainers.

5007.12 SINKS. Sinks, other than soda fountains or bar sinks, shall be provided with waste outlets not less than 1-1/2 inches in diameter.

Waste outlets for water fountains or bar sinks shall be not less than 1 inch in diameter. Waste outlets may have open strainers or may be provided with stoppers.

5007.13 FOOD WASTE GRINDER UNITS. 5007.13.1 Separate Connections—Domestic and commercial food waste disposal units shall be connected and trapped separately from any other fixture or compartment, except that a continuous waste with flow directing partition will be acceptable for domestic units. All units may have either automatic or hand operated water supply control; however, domestic units shall be provided with an approved inlet cover having waterway passages, for use during grinding operation.

5007.13.2 Grease Interceptors — No waste from a food waste grinder shall be discharged into or through a grease interceptor.

5007.13.3 Commercial-type Grinders — Commercial type food grinders shall be provided with not less than a 2-inch waste line. Each waste line shall be trapped and vented as provided in other sections of this code. See Sec. 5009.1.

5007.13.4 Design and Installation

5007.13.4.A Design—All food waste grinder equipment shall be designed to meet the following requirements:

Particle Size

One Hundred (100) percent shall pass a No. 2 screen (2-mesh).

Ninety-five (95) percent shall pass a No. 4 screen (4-mesh).

Fibers shall not exceed 2-1/2 inches in length. Vegetable stems shall not exceed 1 inch in length. Leaf sections shall not exceed 1/2 inch in the largest dimension.

Construction

In addition, the Chief Building Inspector shall approve only that equipment which is self-scouring with no fouling surfaces to cause objectionable odors; which is free from electrical or mechanical hazards, and which is of durable construction.

5007.13.4.B Installation—All food waste grinders shall be installed under and in direct connection with a sink or other approved receptacle, supplied with water and discharge through a trap to a sanitary drainage system.

5007.15 FLOOR DRAINS. The floor drains shall have metal traps and be provided with strainers. The ratio of open area of strainer to cross section area of drain line shall be at least 2 to 1. Floor drains shall be considered as plumbing fixtures.

5007.19 LAUNDRY TRAYS. 5007.19.1 Waste Outlets—Each compartment of a laundry tray shall be provided with a waste outlet not less than 1-1/2 inches in diameter and with a stopper.

5007.21 MINIMUM FACILITIES. 5007.21.1 Wherever plumbing fixtures are installed, the minimum number of each type of fixture installed shall be in accordance with Table 7-21.2.
**TABLE 5007.21.2 Minimum facilities**

<table>
<thead>
<tr>
<th>Type of building or occupancy</th>
<th>Water closets</th>
<th>Urinals</th>
<th>Lavatories</th>
<th>Bathtubs or showers</th>
<th>Drinking fountains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dwelling or apartment units</strong></td>
<td>1 per each dwelling or apartment unit.</td>
<td>1 per 30 male</td>
<td>1 per each dwelling or apartment unit.</td>
<td>1 per each dwelling or apartment unit.</td>
<td>1 per 75 persons.</td>
</tr>
<tr>
<td><strong>Schools:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Secondary</td>
<td></td>
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<tr>
<td>Office or public building</td>
<td>1 for each 40 additional persons.</td>
<td></td>
<td></td>
<td></td>
<td>1 for each 75 persons.</td>
</tr>
<tr>
<td><strong>Manufacturing, warehouses, workshops, loft buildings, foundries and similar establishments:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of persons</td>
<td>Number of fixtures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td>1</td>
<td>1-15</td>
<td></td>
<td>1-15</td>
<td></td>
</tr>
<tr>
<td>11-100</td>
<td>2</td>
<td>16-35</td>
<td></td>
<td>16-35</td>
<td></td>
</tr>
<tr>
<td>101-200</td>
<td>3</td>
<td>36-55</td>
<td></td>
<td>36-60</td>
<td></td>
</tr>
<tr>
<td>201-400</td>
<td>4</td>
<td>56-80</td>
<td></td>
<td>61-90</td>
<td></td>
</tr>
<tr>
<td>401-600</td>
<td>5</td>
<td>81-110</td>
<td></td>
<td>91-125</td>
<td></td>
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<tr>
<td>Over 600</td>
<td>6</td>
<td>111-150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dormitories</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Male: 1 for each 10 persons.</td>
<td>1 for each 25 men. Over 150 persons add 1 fixture for each additional 50 men.</td>
<td></td>
<td></td>
<td></td>
<td>1 shower for each 15 persons exposed to excessive heat or to skin contamination with poisonous, infectious, or irritating material.</td>
</tr>
<tr>
<td>Female: 1 for each 8 persons.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Do.</td>
</tr>
<tr>
<td>Over 10 persons, add 1 fixture for each 25 additional males and 1 for each 20 additional females.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Do.</td>
</tr>
<tr>
<td><strong>Theaters, auditoriums:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of persons</td>
<td>Number of fixtures</td>
<td>Number of fixtures</td>
<td>Number of persons</td>
<td>Number of fixtures</td>
<td></td>
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<tr>
<td>1-100</td>
<td>1</td>
<td>1-100</td>
<td></td>
<td>1-100</td>
<td></td>
</tr>
<tr>
<td>101-200</td>
<td>2</td>
<td>201-400</td>
<td></td>
<td>201-400</td>
<td></td>
</tr>
<tr>
<td>201-400</td>
<td>3</td>
<td>401-600</td>
<td></td>
<td>401-750</td>
<td></td>
</tr>
<tr>
<td>Over 600</td>
<td>3</td>
<td>Over 600; 1 for each additional 500 males and 1 for each 300 females.</td>
<td>Over 750; 1 for each additional 500 persons.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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1. The figures shown are based upon one fixture being the minimum required for the number of persons indicated or any fraction thereof.  
2. Building category not shown on this table. Will be considered separately by the administrative authority.  
3. Drinking fountains shall not be installed in toilet rooms.  
4. Laundry trays—1 single compartment tray for each dwelling unit or 2 compartment trays for each 10 apartments. Kitchen sinks—1 for each dwelling or apartment unit.  
5. This schedule has been adopted (1945) by the National Council on Schoolhouse Construction.  
6. Where there is exposure to contamination with poisonous, infectious, or irritating material, provide 1 lavatory for each 5 persons.  
7. Where there is exposure to excessive heat or to skin contamination with poisonous, infectious, or irritating material.  
8. 24 linear inches of wash sink or 18 inches of a circular basin, when provided with water outlets for such space, shall be considered equivalent to 1 lavatory.

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**Notes:**  
- Do. = If more than one fixture is required, the maximum number of fixtures provided shall be considered equivalent to 1 lavatory.  
- General.—In applying this schedule of facilities, consideration must be given to the accessibility of the fixtures. Conformity purely on a numerical basis may not result in an installation suited to the need of the individual establishment. For example, schools should be provided with toilet facilities on each floor having classrooms.  
- Temporary workingmen facilities:  
  - 1 water closet and 1 urinal for each 30 workmen.  
  - 24-inch trough = 1 urinal.  
  - 36-inch trough = 2 urinals.  
  - 48-inch trough = 3 urinals.  
  - 60-inch trough = 4 urinals.
5007.22 WATER CLOSET PROHIBITED FIXTURES. Pan, valve, plunger, offset, washout, latrine, frost-proof, and other water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge, are prohibited. Any water closet which might permit the siphonage of the contents of the bowl back into the tank shall be prohibited.

SECTION 5008 HANGERS AND SUPPORTS.
5008.1 General—Piping in a plumbing system shall be installed without undue strains and stresses and provision shall be made for expansion, contraction, and structural settlement.

5008.2 Vertical Pipes Support—Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alinement and carry the weight of the pipe and contents but in no case less than at every other story height. Lead pipe shall be supported with lead tags, flanges, or other approved means at intervals not exceeding 4 feet.

5008.2.2 Cast-Iron Soil Pipe—Cast-iron soil pipe shall be supported at not less than at every story height and at its base.

5008.3 Horizontal Pipes Support—Horizontal piping shall be supported so as to keep it in alinement and prevent sagging and in no case shall less than the following support be provided:

- Cast-iron hub and spigot—Support within one foot of every hub and at 5-foot intervals.
- Copper tubing—Support at 6-foot intervals.
- Lead pipe—Support by strips, or other approved means, its entire length.
- Other pipe—Support at 12-foot intervals.

Pipes in the ground shall be laid on a firm bed for their entire length.

5008.4 Hangers and Anchors—Hangers and anchors shall be of metal of sufficient strength to support the pipe and its contents. They shall be securely attached to the building construction.

5008.5 Strains and Stresses—All piping in a plumbing system shall be installed without undue strains and stresses and provision made for expansion, contraction and structural settlement.

5008.6.1 Base of Stacks—Bases of stacks shall be supported on concrete, brick laid in cement mortar, metal brackets permanently attached to the building structure, or other approved methods.

5008.6.3 Support—Wall hung fixture supports shall be of the concealed type and of metal and be so designed that no strain is transmitted to the piping.

SECTION 5009 INDIRECT WASTE PIPING AND SPECIAL WASTES. 5009.1 INDIRECT WASTE PIPING.
5009.1.1 General—Wastes from the following shall discharge to the building drainage system through an air gap placed in the drain serving the individual fixtures, devices, appliances, or apparatus.

(a) Refrigerators, ice boxes, steam tables, or other receptacles or devices in which food or drink is stored.

(b) Appliances, devices, or apparatus used for the storage, preparation or processing of food or drink.

5009.1.3 Commercial Dishwashing Machines—Dishwashing machines, except those in private living quarters or dwelling units, shall be indirectly connected, except that when a dishwashing machine is located adjacent to a floor drain the waste from the dishwashing machine may be connected direct on the sewer side of the floor-drain trap.

(a) Drains, overflows or vent from the water supply system.

(b) Appliances, devices or apparatus such as stills, sterilizers, and equipment requiring cooling water.

(c) Domestic dishwashers may be directly connected as a regular fixture provided that the water supply is provided with an air gap or vacuum breaker.

5009.4 PROVISIONS OF AIR GAP—The air gap shall be at least twice the effective diameter of the drain served and shall be provided by:

(a) Extending an indirect waste pipe to an open accessible slop sink, floor drain or other suitable fixture which is properly trapped or vented. The indirect waste shall terminate a sufficient distance above the flood level rim of the receiving fixture to provide the required air gap, and shall be installed in accordance with other applicable sections of this Code, except that underground indirect waste piping of not more than 10 feet in length may be of steel, wrought iron, or brass. For greater lengths see Sec. 5011.1.3.

(b) By providing a break (air gap) in the drain connection on the inlet side of the trap serving the fixture, device, appliance or apparatus.

5009.6 CLEAR WATER WASTES. Water lifts, expansion tanks, cooling jackets, sprinkler systems, drip or overflow pans, or similar devices which waste clear water only, shall discharge
onto a roof, into a sump, or so as to drain into a trapped fixture. For requirements for draining relief outlet wastes, see Section 5010.7.3 and Sec. 5016.4.

5009.7 HOT WASTES—No waste shall discharge into the building sewer at a temperature above 140° F.

5009.9 SPECIAL WASTE PIPES. 5009.9.1 Harmful Wastes—Acid or alkaline wastes harmful to normal drainage-piping materials shall be neutralized or otherwise rendered harmless before discharge to the drainage system. All waste pipes, fittings, traps, and connections from fixtures to the neutralizing device shall be of materials especially suited to resist damage by such wastes.

5009.9.2 Prohibited Wastes—No toxic, corrosive, flammable, or explosive substance, or other liquid, vapor, gas, or substance of any kind harmful to the drainage system shall be discharged into a drain or sewer unless subjected to approved treatment.

5009.10 SWIMMING POOL—Scum gutter drains or floor drains, serving walks around swimming pools, shall be installed as indirect waste pipes.

SECTION 5010 WATER SUPPLY AND DISTRIBUTION — The following requirements have been approved by the Water Board of the City and County of Denver.

5010.1 QUALITY OF WATER SUPPLY

5010.1.1 Potable Water—All premises intended for human habitation or occupancy shall be provided with potable water.

5010.1.3 Nonpotable Water. Nonpotable water may be used for irrigation, cooling or industrial uses where it cannot contaminate or pollute potable water or food products intended for human consumption, or for flushing water closets and urinals and for other purposes not requiring potable water, provided, however, that nonpotable water shall be reasonably safeguarded to prevent its use for drinking, culinary, and domestic purposes or otherwise as potable water. (Ord. 98, Series 1955).

5010.2.1 Identification of Piping—All piping conveying nonpotable water shall be adequately and durably identified by a distinctive green colored paint with 1” white point banding around pipe at 4’ intervals so that it is readily distinguished from piping carrying potable water.

5010.4 PROTECTION OF POTABLE-WATER SUPPLY 5010.4.1 Cross-Connections — Potable and non-potable water supplies shall be distributed through systems entirely independent of each other, and any cross-connections between such supplies is prohibited.

5010.4.3 Backflow—The water-distribution system shall be protected against backflow. Every fixture-supply pipe shall be protected from backflow, preferably by having the outlet end from which the water flows spaced a distance above the flood-level rim of the receptacle into which the water flows sufficient to provide a "minimum required air gap" as set forth in paragraph 5017.C.2.2. Where it is not possible to provide a minimum air gap, the fixture shall be equipped with an accessibly located backflow preventer complying with paragraph 5017.C.2.2.

Where it is not possible to provide either a minimum air gap or backflow preventer, as may be the case in connection with cooling jackets, condensers, or other industrial or special appliances, other approved means of protection shall be provided.

5010.6.1 Separate Trenches—Except as permitted in paragraph 5010.6.2 the underground water-service pipe and the building drain or building sewer shall be not less than 10 feet apart horizontally and shall be separated by undisturbed or compact earth.

5010.6.2 One Trench — The water-service pipe may be placed in the same trench with the building drain and building sewer provided the following conditions are met:

(a) The bottom of the water-service pipe shall be at least 12 inches above the top of the sewer line at all points.

(b) The water-service pipe shall be placed on a solid shelf excavated at one side of the common trench.

(c) The materials and joints of sewer and water-service pipes shall possess the strength and durability necessary to prevent the escape of solids, liquids, and gases, therefrom, under all known adverse conditions such as corrosion, strains due to settlement, temperature changes, and vibration. (See paragraph 5011.2).

5010.6.3. Combination Stop-and-Waste—Combination stop-and-waste valves and cocks shall not be installed in an underground service pipe.

5010.7.1 Pumps and Other Appliances—Water pumps, tanks, filters, softeners, and all other appliances and devices shall be protected against contamination.

5010.7.2 Water-Supply Tanks — Potable-water-supply tanks shall be properly covered to prevent the entrance of foreign material or insects into the water supply. Soil or waste lines shall not pass directly over such tanks.

5010.7.3 Pressure Tanks, Boilers, and Relief Valves — If the discharge or waste from such equipment is connected by piping to the drain-
age system, it shall be connected as an indirect
waste.

5010.7.3.A Protection Against Freezing—
All piping, tanks, appliances, and devices, sub­
ject to freezing temperature, shall be effectively
protected.

5010.7.4 Cleaning, Lining, Painting, or Re­
pairing Water Tanks—A potable-water-supply tank
used for domestic purposes shall not be lined, painted, or repaired with any material
which will affect either the taste or the potabil­
ity of the water supply when the tank is re­
turned to service. Tanks shall be disconnected
from the system during such operation, to pre­
vent any foreign fluid or substance from en­
tering the distribution piping.

5010.8 WATER-SUPPLY TANKS (H O U S E
TANKS) 5010.8.1 When Required—When the
water pressure from the city mains during flow
is insufficient to supply all fixtures freely and
continuously, the rate of supply shall be supple­
mented by a gravity house tank or booster
system.

5010.8.2 Support—All water-supply tanks
shall be supported in accordance with the Build­
ing Code.

5010.8.3 Overflow for Water-Supply Tanks
—Overflow pipes for gravity tanks shall dis­
charge above and within 6 inches of a roof
or catch basin, or they shall discharge over an
open, water-supplied sink. Adequate overflow
pipes properly screened against the entrance of
insects and vermin shall be provided.

5010.8.4 Tank Supply—The water supply
inlet within the tank shall be at an elevation
not less than is required for an air gap in an
open tank with overflow, but in no case shall
the elevation be less than 4 inches above the
overflow.

5010.8.5 Drains—Water-supply tanks shall
be provided with valved drain lines located at
their lowest point and discharged as an indi­
rect waste or as required for overflow pipes in
paragraph 5010.8.3. Each tank shall be pro­
vided with a drain pipe the diameter of which
shall be not less than given below.

<table>
<thead>
<tr>
<th>Drain pipe (inches)</th>
<th>Tank Capacity (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Up to 750</td>
</tr>
<tr>
<td>1½</td>
<td>751 to 1,500</td>
</tr>
<tr>
<td>2</td>
<td>1,501 to 3,000</td>
</tr>
<tr>
<td>2½</td>
<td>3,001 to 5,000</td>
</tr>
<tr>
<td>3</td>
<td>5,001 to 7,500</td>
</tr>
<tr>
<td>4</td>
<td>Over 7,500</td>
</tr>
</tbody>
</table>

Each drain line shall be equipped with a
valve of the same diameter as the pipe.

5010.10 MATERIALS. 5010.10.1 Water-distrib­
uting Pipe, Tubing, and Fittings—Materials
for water-distributing pipes and tubing shall be
brass, copper, lead, cast iron, wrought iron,
open-hearth iron, or steel, with appropriate ap­
proved fittings. All threaded ferrous pipe and
fittings shall be galvanized (zinc-coated) or ce­
ment lined. When used underground in corrosive
soil, all ferrous pipe and fittings shall be coal­
tar enamel coated and the threaded joints shall
be coated and wrapped after installation. (See
Table 5003.5.)

5010.11 ALLOWANCE FOR CHARACTER OF
WATER—When selecting the material and size
for water-supply pipe, tubing, or fittings, due
consideration shall be given to the action of the
water on the interior and of the soil, fill, or
other material on the exterior. No material that
would produce toxic conditions in a potable­
water system shall be used for piping, tubing,
or fittings.

5010.11.2 Potable-Water Piping Material—
No material that has been used for other than
potable-water supply shall be used for pipe,
tubing, or fittings in a potable-water-supply
system.

5010.12.1 Water-supply Control—A main
shut-off valve on the water-service pipe shall
be provided near the curb, and, also, an ac­
cessible shut-off valve with a drip valve shall
be provided inside near the entrance of the
water-service pipe into the building.

5010.12.2 Tank Controls—Supply lines
taken from pressure or gravity tanks shall be
valved at or near their source.

5010.12.3 Separate Secondary Valves—
Separate valves, always accessible shall be
provided for each hot and cold-water riser. A
separate hot and cold-water valve shall be pro­
vided controlling each group of fixtures in each
dwelling unit or group of fixtures in one room.

Exception: Separate secondary valves shall
not be required in single-family houses.

5010.12.3.A Individual Controls—Individ­
ual controls shall be provided for all water clos­
ets and for any fixture isolated from a group.

5010.12.3.B Draining of Water Pipes—Wa­
ter pipes shall be so graded or pitched that the
entire system or parts thereof can be drained.
Sill-cocks shall be provided with stop and waste
valves to facilitate winter draining.

5010.12.4 Line Valves—Valves in the wa­
ter-supply distribution system, except those im­
mediately controlling one fixture supply, when
fully opened shall have the cross-sectional area
of the smallest orifice or opening through which
the water flows at least equal to the cross-sec­
tions area of the nominal size of the pipe in
which the valve is installed.
5010.13 WATER PIPING AND SHUT-OFF VALVES AND DISTRIBUTION. 5010.13.1 Water-Service Pipe—The water-service pipe from the street main to the water-distribution system for the building shall be of sufficient size to furnish an adequate flow of water to meet the requirements of the building at peak demand, and in no case shall be less than 3/4 inch nominal diameter.

If flush valves or other devices requiring a high rate of water flow are used, the water-service pipe shall be designed to supply this flow. Water-service pipe of copper tubing shall be no lighter than type K.

5010.13.2 Demand Load — The demand load in the building water-supply system shall be based on the number and kind of fixtures installed and the probably simultaneous use of these fixtures.

5010.14 PROCEDURE IN SIZING WATER-DISTRIBUTION SYSTEM. 5010.14.1 The sizing of the water-distribution system shall conform to good engineering practice.

5010.14.2 Size of Fixture-Supply Pipe—The minimum size of a fixture-supply pipe shall be as follows:

<table>
<thead>
<tr>
<th>Type of Fixture</th>
<th>Pipe Sizes (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath tubs</td>
<td>1/2</td>
</tr>
<tr>
<td>Combination sink and tray</td>
<td>1/2</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>3/8</td>
</tr>
<tr>
<td>Dish washer (domestic)</td>
<td>1/2</td>
</tr>
<tr>
<td>Kitchen sink, residential</td>
<td>1/2</td>
</tr>
<tr>
<td>Kitchen sink, commercial</td>
<td>3/4</td>
</tr>
<tr>
<td>Lavatory</td>
<td>3/8</td>
</tr>
<tr>
<td>Laundry tray 1, 2 or 3 compartments</td>
<td>1/2</td>
</tr>
<tr>
<td>Shower (single head)</td>
<td>1/2</td>
</tr>
<tr>
<td>Sinks (service, slop)</td>
<td>1/2</td>
</tr>
<tr>
<td>Sinks, flushing rim</td>
<td>3/4</td>
</tr>
<tr>
<td>Urinal (flush tank)</td>
<td>1/2</td>
</tr>
<tr>
<td>Urinal (direct flush valve)</td>
<td>3/4</td>
</tr>
<tr>
<td>Water closet (tank type)</td>
<td>3/8</td>
</tr>
<tr>
<td>Water closet (flush valve type)</td>
<td>1</td>
</tr>
<tr>
<td>Hose bibbs</td>
<td>1/2</td>
</tr>
</tbody>
</table>

For fixtures not listed the minimum supply branch may be made the same as for a comparable fixture.

5010.14.3 Minimum Pressure— Minimum, fairly constant, service pressure at the point of outlet discharge shall be not less than 8 lbs. per square inch for all fixtures except for direct flush-valves, for which it shall be not less than 15 lbs. per square inch, and except where special equipment is used requiring higher pressures. In determining the minimum pressure, allowance shall be made for the pressure drop due to friction loss in the piping system during maximum demand periods.

5010.14.4 Auxiliary Pressure—(a) Supplementary Tank—If the residual pressure in the system is below the minimum allowable at the highest fixture when the flow in the system is at peak demand, an automatically controlled pressure tank or gravity tank shall be installed, of sufficient capacity to supply sections of the building installation which are too high to be supplied directly from the public water main.

(b) Booster Pump—When a booster pump is used on an auxiliary pressure system and the possibility exists that a pressure of 5 lbs. per square inch or less may occur on the suction side of the pump, there shall be installed a low-pressure cut-off on the booster pump to prevent the creation of negative pressures on the suction side of the water system.

5010.14.6 Street Pressures—When the street main has a wide fluctuation in pressure during the day, the water-distribution system shall be designed for the minimum pressure available.

5010.14.7 Hazard and Noise—Where water pressures are excessive, air chambers or other approved mechanical devices shall be provided to reduce water hammer or line noises to such an extent that no pressure hazard to the piping system will exist.

5010.15 HOT-WATER DISTRIBUTION. 5010.15.1 Hot-water Distribution Piping—The sizing of the hot water distribution piping shall conform to good engineering practice.

5010.16 SAFETY DEVICES.

5010.16.2 Temperature and Pressure Relief Valves — Combination pressure-and-temperature relief valves of the thermostatic self-closing type shall be placed only on all water heaters installed on closed water systems. The pressure side shall be set to relieve at a minimum of 165 pounds per square inch. The temperature side shall be set to relieve at 200° F. Each valve shall be rated as to its British thermal unit capacity at 200° F., and shall be capable of discharging sufficient hot water to prevent any further rise in temperature.

5010.16.3 Approvals — Combination temperature-and-pressure relief valves which have been tested and approved by, or meet, the requirements of this Code, and standard specification requirements shall be considered acceptable.

5010.16.4 Relief-Valve Location—Extended Thermostatic self-closing type combination temperature-pressure relief valves shall have the element placed within 6 inches of the top in
the tank. Valves without extended element shall be placed directly above the tank on the hot water side and in no case more than three inches away from such tank. Vacuum-relief valves shall be placed as close to the tanks as possible. There shall be no check valve or shut-off valve between a relief valve and the heater or tank for which it is installed.

5010.16.4 Relief Outlet Wastes—The outlet of a combination pressure and temperature relief valve shall not be connected to the drainage system as a direct waste. The discharge pipe from automatic pressure and temperature relief valves shall be turned down and piped so as to drain into a receptacle, sump or into a fixture.

5010.16.5 Size of Relief Outlet Waste—The cross-sectional area of the relief outlet waste shall be equal to or greater than that of the valve discharge outlet.

5010.17.3 Water used for cooling of equipment or similar purposes shall not be returned to the potable water distributing system. When discharged to the building drainage system, the waste water shall be discharged through an indirect waste pipe or air gap.

Section 5011. DRAINAGE SYSTEM.

5011.1 MATERIALS. 5011.1.1 Pipe, Tubing, and Fittings—Pipe, tubing, and fittings for drainage systems shall comply with the provisions in Section 5003.

5011.1.2 Above-ground Piping Within Buildings—Soil and waste piping for a drainage system within a building shall be of cast iron, galvanized wrought iron, galvanized open hearth iron, galvanized steel, lead, brass, copper pipe or of copper tube. Where floor outlet fixtures bear directly on floors supported by wood joists, lead traps and lead stubs not less than 4 inches in length shall be used for the floor connections on the outlet side.

5011.1.3 Underground Piping Within Buildings—All drains within buildings, when underground, shall be of extra-heavy cast-iron soil pipe, or as approved in writing.

5011.2 BUILDING SEWER—(a) Separate Trenches—The building sewer, when installed in a separate trench from the water main, shall be cast iron, vitrified clay sewer pipe, concrete sewer pipe, bituminized fiber sewer pipe or asbestos cement sewer pipe. Joints shall be tight and rootproof.

(b) One Trench—The building sewer, when installed in the same trench with the water service main, shall be constructed of durable materials which are corrosion-resistant and shall be so installed as to remain watertight and be rootproof. Cast-iron pipe with tested watertight caulked and lead joints or an approved equivalent shall be considered acceptable for this construction.

5011.2.3 Sewer in Filled Ground—A building sewer or building drain installed in filled or unstable ground shall be of cast-iron soil pipe, except that nonmetallic drains may be laid upon an approved concrete pad if installed in accordance with paragraph 5011.2.

5011.3 DRAINAGE PIPING INSTALLATION.

5011.3.1 Horizontal Drainage Piping—Horizontal drainage piping shall be installed at a uniform slope not less than that permitted in Table 5011.3.1.

TABLE 5011.3.1 MINIMUM SLOPES

<table>
<thead>
<tr>
<th>Diameter of pipe (inches)</th>
<th>Slope per foot (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4, 1-1/2, 2, 2-1/2, 3</td>
<td>1/4</td>
</tr>
<tr>
<td>4, 5, 6, 8</td>
<td>1/8</td>
</tr>
<tr>
<td>10, 12, 15</td>
<td>1/16</td>
</tr>
</tbody>
</table>

5011.4 FIXTURE UNITS. 5011.4.1 Values for Fixtures—Fixture-unit values as given in Table 5011.4.2 designate the relative load weight of different kinds of fixtures which shall be employed in estimating the total load carried by a soil or waste pipe and shall be used in connection with the tables of sizes for soil, waste, and drain pipes for which the permissible load is given in terms of fixture units.
### TABLE 5011.4.2 FIXTURE UNITS PER FIXTURE OR GROUP

<table>
<thead>
<tr>
<th>Fixture type</th>
<th>Fixture-unit value as load factors</th>
<th>Minimum size of trap (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tank water</td>
<td>Closet: 6</td>
<td>Nominal 1½</td>
</tr>
<tr>
<td></td>
<td>Valve: 8</td>
<td>1½</td>
</tr>
<tr>
<td>Bidet</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Combination sink-and-tray</td>
<td>3</td>
<td>1½</td>
</tr>
<tr>
<td>Combination sink-and-tray with food-disposal unit</td>
<td>4</td>
<td>Separate traps 1½</td>
</tr>
<tr>
<td>Dental unit or cuspidor</td>
<td>1</td>
<td>1¼</td>
</tr>
<tr>
<td>Dental lavatory</td>
<td>1</td>
<td>1½</td>
</tr>
<tr>
<td>Drinking fountain</td>
<td>½</td>
<td>1</td>
</tr>
<tr>
<td>Dishwasher, domestic</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Floor drains</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Kitchen sink, domestic</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Kitchen sink, domestic, with food-disposal unit</td>
<td>3</td>
<td>1½</td>
</tr>
<tr>
<td>Lavatory</td>
<td>1</td>
<td>Small P. O. 1¼</td>
</tr>
<tr>
<td>Do</td>
<td>2</td>
<td>Large P. O. 1½</td>
</tr>
<tr>
<td>Lavatory, barber, beauty parlor</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Lavatory, surgeon's</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Laundry tray (1 or 2 compartments)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Shower stall, domestic</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Showers (group) per head</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sinks: Surgeon's</td>
<td>3</td>
<td>1½</td>
</tr>
<tr>
<td>Flushing rim (with valve)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Service (Trap standard)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Service (P Trap)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pot, scullery, etc</td>
<td>4</td>
<td>1½</td>
</tr>
<tr>
<td>Urinal, pedestal, syphon jet, blowout</td>
<td>8</td>
<td>Nominal 3</td>
</tr>
<tr>
<td>Urinal, wall lip</td>
<td>4</td>
<td>1½</td>
</tr>
<tr>
<td>Urinal, stall, washout</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Urinal trough (each 2-foot section)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Wash sink (circular or multiple), each set of faucets</td>
<td>2</td>
<td>Nominal 1½</td>
</tr>
<tr>
<td>Water closet: Tank-operated</td>
<td>4</td>
<td>Nominal 3</td>
</tr>
<tr>
<td>Valve-operated</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

1. A shower head over a bathtub does not increase the fixture value.
2. See pars. 5011.4.3 and 5011.4.4 for method of computing unit value of fixtures not listed in table 5011.4.2 or for rating of devices with intermittent flows.
3. Size of floor drain shall be determined by the area of surface water to be drained.
4. Lavatories with 1¼- or 1½-inch traps have the same load value; larger P. O. plugs have greater flow rate.

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TABLE 5011.4.3

5011.4.3 Fixtures not listed in Table 5011.4.2 shall be estimated in accordance with Table 5011.4.3.

<table>
<thead>
<tr>
<th>Fixture drain or trap size</th>
<th>Fixture unit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4 inches and smaller</td>
<td>1</td>
</tr>
<tr>
<td>1 1/2 inches</td>
<td>2</td>
</tr>
<tr>
<td>2 inches</td>
<td>3</td>
</tr>
<tr>
<td>2 1/2 inches</td>
<td>4</td>
</tr>
<tr>
<td>3 inches</td>
<td>5</td>
</tr>
<tr>
<td>4 inches</td>
<td>6</td>
</tr>
</tbody>
</table>

**5011.4.4 Values for Continuous Flow**—For a continuous or semi-continuous flow into a drainage system, such as from a pump, sump ejector, air conditioning equipment, or similar device, two fixture units shall be allowed for each gallon-per-minute of flow.

**5011.5 DETERMINATION OF SIZES OF SOIL AND WASTE PIPING. 5011.5.1 Maximum Fixture-unit Load**—The maximum number of fixture units that may be connected to a given size of building sewer, building drain, horizontal branch or vertical soil or waste stack is given in Table 5011.5.2 and Table 5011.5.3.

**TABLE 5011.5.2 BUILDING DRAINS AND SEwers**

<table>
<thead>
<tr>
<th>Diameter of pipe (inches)</th>
<th>Maximum number of fixture units that may be connected to any portion of the building drain or the building</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/16 in.</td>
<td>21</td>
</tr>
<tr>
<td>1/8 in.</td>
<td>26</td>
</tr>
<tr>
<td>1/4 in.</td>
<td>31</td>
</tr>
<tr>
<td>1/2 in.</td>
<td><strong>20</strong></td>
</tr>
<tr>
<td>3/4 in.</td>
<td><strong>27</strong></td>
</tr>
<tr>
<td>1 in.</td>
<td><strong>36</strong></td>
</tr>
<tr>
<td>1 1/4 in.</td>
<td>180</td>
</tr>
<tr>
<td>1 1/2 in.</td>
<td>216</td>
</tr>
<tr>
<td>1 3/4 in.</td>
<td>250</td>
</tr>
<tr>
<td>2 in.</td>
<td>390</td>
</tr>
<tr>
<td>2 1/2 in.</td>
<td>480</td>
</tr>
<tr>
<td>3 in.</td>
<td>575</td>
</tr>
<tr>
<td>3 1/4 in.</td>
<td>700</td>
</tr>
<tr>
<td>3 1/2 in.</td>
<td>840</td>
</tr>
<tr>
<td>4 in.</td>
<td>1,000</td>
</tr>
<tr>
<td>4 1/4 in.</td>
<td>1,400</td>
</tr>
<tr>
<td>4 1/2 in.</td>
<td>1,600</td>
</tr>
<tr>
<td>4 3/4 in.</td>
<td>1,920</td>
</tr>
<tr>
<td>5 in.</td>
<td>2,300</td>
</tr>
<tr>
<td>5 1/4 in.</td>
<td>2,500</td>
</tr>
<tr>
<td>5 1/2 in.</td>
<td>2,900</td>
</tr>
<tr>
<td>6 in.</td>
<td>3,500</td>
</tr>
<tr>
<td>6 1/4 in.</td>
<td>4,200</td>
</tr>
<tr>
<td>6 1/2 in.</td>
<td>4,600</td>
</tr>
<tr>
<td>7 in.</td>
<td>6,700</td>
</tr>
</tbody>
</table>

**5011.5.4 Minimum Size of Soil and Waste Stacks**—No soil or waste stack shall be smaller than the largest horizontal branch connected thereto.

(b) Any structure on which a building drain is installed shall have at least one stack-vent or vent stack carried full size through the roof not less than 3 inches in diameter or the size of the building drain, whichever is the lesser.

**TABLE 5011.5.3 HORIZONTAL FIXTURES BRANCHES AND STACKS****

<table>
<thead>
<tr>
<th>Diameter of pipe (inches)</th>
<th>Maximum number of fixture units that may be connected to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>More than three stories in height</td>
</tr>
<tr>
<td></td>
<td>Any horizontal fixture branch</td>
</tr>
<tr>
<td>1 1/4 fixture branch</td>
<td>1</td>
</tr>
<tr>
<td>1 1/2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>2 1/2</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td><strong>20</strong></td>
</tr>
<tr>
<td>4</td>
<td>160</td>
</tr>
<tr>
<td>5</td>
<td>360</td>
</tr>
<tr>
<td>6</td>
<td>620</td>
</tr>
<tr>
<td>8</td>
<td>1,400</td>
</tr>
<tr>
<td>10</td>
<td>2,500</td>
</tr>
<tr>
<td>12</td>
<td>3,900</td>
</tr>
</tbody>
</table>

*Does not include branches of the building drain. Also minimum size for food waste grinder is 2 in.
**Not over 2 water closets.
***Not over 6 water closets.
****Ord. 42, Series 1957.

**5011.5.6 Future Fixtures**—When provision is made for the future installation of fixtures, those provided for shall be considered in determining the required sizes of drain pipes. Construction to provide for such future installation shall be terminated with a plugged fitting or fittings at the stack and shall be vented as required in Section 5012.

**5011.5.7 Underground Drainage Piping**—No portion of the drainage system installed un-
that no horizontal branch connects to the stock
provided the total number of fixture units installed
within 2 feet above or below the offset •.

5011.6 OFFSETS ON DRAINAGE PIPING.  
5011.6.1 Offsets—(a) An offset in a vertical
stack, with a change of direction of 45° or less,
may be considered a straight vertical stack pro-
vided the total number of fixture units installed
on the stack is 50 percent or less than the total
allowed by column 2 of Table 5011.5.3 and
that no horizontal branch connects to the stack
within 2 feet above or below the offset.

(b) An offset of 45° or less in the stack,
extcept as permitted in (a), shall be vented as
required in paragraph 5012.18.

(c) An offset above the highest horizontal
branch is an offset in the stack vent and shall
be considered only as it affects the developed
length of the vent.

(d) In case of an offset in a soil or waste
stack below the lowest horizontal branch, no
change in diameter of the stack because of the
offset shall be required if it is made at an angle
of not greater than 45°. If such an offset is
made at an angle greater than 45°, the re-
quired diameter of the offset and the stack be-
low it shall be determined as for a building
drain.

(e) Stack with an offset at 45° or more
shall be sized as follows:

1. The portion of the stack above the
offset shall be sized as for regular
stack.

2. The offset itself including fittings
shall be sized as for a building
drain, Table 5011.5.2.

3. The portion of the stack below the
offset shall be sized as a separate
stack with the fixture unit load at-
tached to the upper portion of the
stack being considered as connect-
ing to the lower portion of the
stack in one branch interval and
shall be sized to meet the require-
ments of columns 2 or 3 and 4,
Table 5011.5.3. A relief vent for
the offset shall be installed as
provided in Section 5012.18.

5011.7 SUMPS AND RECEIVING TANKS.  
5011.7.1 Building Subdrains—Building sub-
drains shall discharge into a tight sump or re-
ceiving tank, so located as to receive the sew-
age by gravity. Sewage shall be lifted and dis-
charged into the building sewer by pumps,
ejectors, or any equally efficient method. Sumps
or tanks shall either be automatically dis-
charged or be of sufficient capacity to hold the
maximum accumulated sewage and waste for
a period of not less than 24 hours. Water-oper-
ated injectors are prohibited.

Section 5012. VENTS AND VENTING.  
5012.1 Materials. 5012.1.1 Vent Pipe and
Fittings—Vent pipes shall be of cast iron, gal-
vanized wrought iron, galvanized open-hearth
iron, galvanized steel, brass, copper, or lead
conforming to provisions of Section 5003.

5012.1.5 Type of Fittings—Fittings shall
conform to the type of pipe used, except that
cast-iron steam pattern or galvanized malle-
able-iron fittings may be used with threaded
pipe.

5012.2 PROTECTION OF TRAP SEALS.  
(a) Individual Vents—The seal of every fixture
in a plumbing system shall be protected by a
properly installed individual vent except as oth-
erwise provided in this Section.

(b) Stack Vents—Every soil or waste stack
shall be extended vertically as a stack vent to
at least 6 inches above the flood level rim of
the highest fixture, then to the open air; or the
stack vent and vent stack shall be joined within
the building at least 6 inches above the flood
level rim of the highest fixture with a single
extension from the point of joining to the open
air.

5012.3 VENT STACKS—A vent stack or
main vent shall be installed with a soil or waste
stack whenever back vents, relief vents or other
branch vents are required in two or more branch
intervals. The vent stack shall terminate inde-
dependently in the open air outside the building
or shall be connected with the stack vent as pre-
scribed in paragraph 5012.2 (b) and shall con-
nect with the soil or waste stack through, at, or
below the lowest horizontal waste branch or
with the building drain.

5012.4.1 Extensions Through Roof—Extens-
ions of vent pipes through a roof shall be ter-
minated at least 6 inches above it and shall be
properly flashed. Where a roof is to be used
for any purpose other than weather protection,
the extensions shall be run at least 6 feet above
the roof.

5012.4.5 Location of Vent Terminal—No
vent terminal from a drainage system shall be
directly beneath any door, window, or other
ventilating opening of the building or an adja-
cent building nor shall any such vent terminal
be within 12 feet horizontally of such an open-
ing unless it is at least 3 feet above the top of
such opening.

5012.4.6 Extensions Through Wall—Vent-
terminals extending through a wall shall be at
least 12 feet horizontally from any building
line. They shall be turned to provide an open-
ing downward. They shall be effective
screened and shall meet the requirements of paragraph 5012.4.5.

5012.5 FROST CLOSURE—Where excessive vapor creates a possibility of frost closure, the vent extension through a roof shall be at least 3 inches in diameter. When increasing the size of the vent terminal, the change in diameter shall be made inside the building.

5012.6 VENT PIPE GRADES AND CONNECTIONS. 5012.6.1 Grades—Vent and branch-vent pipes shall be free from drops or sags and be so graded and connected as to drip back to the soil or waste pipe or vent stack by gravity.

5012.6.2 Connections to Soil or Waste Pipe—Where vent pipes connect to a horizontal soil or waste pipe, the vent shall be taken off above the center line of the soil pipe, and the vent pipe shall rise vertically, or at an angle not more than 45° from the vertical, to a point at least 6 inches above the flood level-rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

5012.6.3 Connection to Vent Stack—A connection between a vent pipe and a vent stack shall be at least 6 inches above the flood level rim of the highest fixture served by the vent. Horizontal vent pipes forming branch vents, relief vents, circuit vents, or loop vents shall be at least 6 inches above the flood-level rim of the highest fixture served.

5012.9 FIXTURE VENTS. 5012.9.1 Distance of Trap from Vent—Each fixture trap shall have a protecting vent so located that the slope and the developed length in the fixture drain from the trap weir to the vent fitting are within the requirements set forth in Table 5012.9.3.

### TABLE 5012.9.3 DISTANCE OF TRAP FROM VENT

<table>
<thead>
<tr>
<th>Size of Fixture Drain (inches)</th>
<th>Sanitary Tee</th>
<th>Longturn TY or Combination Y and 1/8 Bend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td>1/2 inch slope</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>1 1/2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

5012.9.4 Vent Pipe Level—The vent pipe opening from a soil or waste pipe, except for water closets and similar fixtures shall not be below the dip of the trap.

5012.9.5 Crown Vent Prohibited—No back vent shall be installed within two pipe diameters of the trap weir.

5012.9.5A Vents Prohibited—Wet venting or stack venting of fixtures shall be prohibited except as permitted in paragraphs 5012.12 and 5012.13.

5012.10 COMMON VENT. 5012.10.1 An individual vent, installed vertically, may be used as a common vent for two fixture traps when both fixture drains connect with a vertical or horizontal drain limited to 5 foot length, at the same level or at different levels provided the upper fixture drain is less than half the cross sectional area of the vertical drain and is not more than 5 pipe diameters above the lower fixture drain, and the connections, slope, and length are within the limits of paragraph 5012.9.1.

5012.12 WET VENTING. 5012.12.1 Single Bathroom Group—Single bathroom group of fixtures may be installed on the top or next lower floor with a drain from a back-vented lavatory, kitchen sink or combination fixture serving as a wet vent for a bathtub or shower stall and for the water closet provided:

(a) Not more than one fixture unit is drained into a 1 1/2 inch-diameter wet vent or not more than four fixture units drain into a 2-inch diameter wet vent.

(b) The horizontal branch connects to the stack or drain at the same level as the water closet drain when installed next to the top floor or at the same level, or below water closet drain when installed on the top floor.

5012.12.2 Bathroom Groups—Back to back on top floor consisting of two lavatories
and two bathtubs or shower stalls may be installed on the same horizontal branch with a common vent for the lavatories and with no back vent for the bathtubs or shower stalls and for the water closets, provided the wet vent is 2 inches in diameter.

5012.12.3 **Multistory Bathroom Groups**—On the lower floors of a multistory building the waste pipe from one or two lavatories may be used as a wet vent for one or two bathtubs or showers provided that:

(a) The wet vent and its extension to the vent stack is 2 inches in diameter.

(b) Each water closet below the top floor is individually back vented.

(c) The vent stack is sized as follows:

<table>
<thead>
<tr>
<th>Number of Wet Vented Fixtures</th>
<th>Diameter of Vent Stacks (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 or 2 bathtubs or showers</td>
<td>2</td>
</tr>
<tr>
<td>3 to 5 bathtubs or showers</td>
<td>2½</td>
</tr>
<tr>
<td>6 to 9 bathtubs or showers</td>
<td>3</td>
</tr>
<tr>
<td>10 to 16 bathtubs or showers</td>
<td>4</td>
</tr>
</tbody>
</table>

5012.13 **STACK VENTING. 5012.13.1 One Bathroom Group**—A group of fixtures, consisting of one bathroom group and a kitchen sink or combination fixture, may be installed on a one-story building or on the top floor of a building without individual fixture vents, except as indicated in paragraph 5012.13.2 provided, each fixture drain connects independently to the stack; the water closet and bathtub or shower stall drain shall enter the stack at the same level and in accordance with the requirements in paragraph 5012.9.1.

5012.13.2 **Flooded Sewers**—When a sink or combination fixture connects to the stack vented bathroom group, and when the street sewer is sufficiently overloaded to cause frequent submersion of the building sewer, a relief vent or back vented fixture shall be connected to the stack below the stack vented water closet or bathtub.

5012.15 **CIRCUIT AND LOOP VENTS. 5012.15.1 Battery Venting**—A branch soil or waste pipe to which two but not more than eight water closets (except blow-out type), pedestal urinals, trap standard service sinks, shower stalls, or floor drains are connected in battery, shall be vented by a circuit or loop vent which shall take off in front of the last fixture connection. In addition, lower floor branches shall be provided with a relief vent taken off in front of the first fixture connection. When other fixtures discharge above such branch, each vertical branch shall be provided with a vent.

5012.15.2 **Dual Relief Vents**—Two circuit-vent horizontal branches serving a total of not more than eight water closets (as indicated in paragraph 5012.15.1) in the same branch interval shall have a dual relief vent. Where the vents are joined, the point of joining shall be at least 6 inches above the flood-level rim of the highest fixture connected to either branch. When other fixtures discharge above such branch, each branch shall be provided with a vent.

5012.15.3 **Vent Connections**—When the circuit, loop, or relief vent connection is taken off the horizontal branch, the vent connection shall be taken in a vertical line from the top of the horizontal branch.

5012.15.4 **Fixtures back to back in battery**—When connected to one horizontal branch through a double Y or a sanitary T in a vertical position, may be installed on a common vent for each two fixtures back-to-back or double connection. The common vent must be installed in a vertical position.

5012.15.4.A **Size of Vent**—Sumps and receiving tanks (except pneumatic ejectors), into which sewage or other wastes are discharged shall be provided with a vent of a size in accordance with Table 5012.21.5.

5012.16 **PNEUMATIC EJECTORS**—Pneumatic ejectors shall have separate system of venting extending to the open air.

5012.17 **RELIEF VENTS. 5012.17.1 Stacks of More Than 10 Branch Intervals**—Soil and waste stacks in buildings having more than ten branch intervals, shall be provided with a relief vent at each tenth interval installed, counting to begin at the top floor. The size of the relief vent shall be equal to the size of the vent stack to which it connects. The lower end of the relief vent shall connect to the soil or waste stack through a Y below the horizontal branch serving such floor and the upper end shall connect to the vent stack through a Y not less than 3 feet above the floor level.

5012.18 **VENTING OFFSETS. 5012.18.1 Venting Required**—Offsets in soil or waste stacks, except as permitted in paragraph 5011.6.1, shall be vented as provided in paragraph 5012.18.2 or 5012.18.3.

5012.18.2 **Separate Venting**—Such offsets may be vented as two separate soil or waste stacks, namely, the stack section below the offset and the stack section above the offset.

5012.18.3 **Offset Reliefs**—Such offsets may be vented by installing a relief vent as a vertical continuation of the lower section of the stack or as a side vent connected to the lower section between the offset and the next lower fixture or horizontal branch. The diameter of the relief vent shall not be less than the diameter of the main vent.
5012.20 VENT HEADERS. 5012.20.1 Connections of Vents—Stack-vents and vent stacks may be connected into a common vent header at the top of the stacks and then extended to the open air at one point. This header shall be sized in accordance with the requirements of Table 5012.21.5, the number of units being the sum of all units on all stacks connected thereto and the developed length being the longest vent length from the intersection at the base of the most distant stack to the vent terminal in the open air as a direct extension of one stack.

5012.21 SIZE AND LENGTH OF VENTS. 5012.21.1 Length of Vent Stacks—The length of vent stack or main vent shall be its developed length from the lowest connection of the vent system with the soil stack, waste stack, or building drain to the vent stack terminal, if it terminates separately in the open air, or to the connection of the vent stack with the stack vent, plus the developed length of the stack vent from the connection to the terminal in the open air, if the two vents are connected together with a single extension to the open air.

5012.21.1 (a) Length of Branch Vent Stacks—The length of a branch vent shall be the developed length from its connection with the vent stack or stack vent to the fixture drain or horizontal soil or waste branch served by the branch vent.

(b) Length of Stack Vent—The length of a stack vent shall be the developed length from the highest horizontal fixture branch connected to the stack, to the terminal of the stack vent in the open air.

(c) Size of Vent Stack—A vent stack or main vent shall have a diameter of at least one-half the diameter of the soil or waste stack, but in no case less than 1-1/2 inches and, depending on its developed length and the number of fixture units installed on the soil or waste stack, shall be in accordance with Table 5012.21.5.

5012.21.3 Size of Relief Vent—The diameter of a relief vent shall be not less than 1-1/4 inches nor less than one-half the diameter of the drain to which it is connected.

NOTE: The smallest vent permitted is 1-1/4 inch diameter pipe. Note that table 5012.21.5 permits only 2 fixture-units on a 1-1/4 inch diameter vent. However, when a vent is used as a relief on a horizontal waste or vertical soil, the vent may be reduced to half of the drain diameter provided the number of fixture-units connected, or the length of the vent do not exceed the limit provided in table 5012.21.5.

5012.21.3. Size of Relief Vent—The diameter of a relief vent shall be not less than one-half the diameter of the soil or waste branch.

NOTE: The vent must be computed from table 5012.21.5 also.

5012.21.4 Size of Circuit or Loop Vent—The diameter of a circuit or loop vent shall be not less than one-half the size of the diameter of the horizontal soil or waste branch or the diameter of the vent stack, whichever is the smaller.

5012.21.5 Size of Vent Piping*: The size of vent piping shall be determined from its length and the total of fixture-units connected thereto as provided in Table 5012.21.5. Twenty percent of the total length may be installed in a horizontal position.

Table 5012.21.5—where it says "horizontal length not exceeding feet" should read "maximum length of vent (feet)". The twenty percent of the total length that may be installed in a horizontal position as specified in Section 5012.21.5 applies to the maximum of vent as corrected in the preceding sentence.

In connection with Section 5012.22 "How to compute vent stack sizes" there is a diagram with the drawings included in the Plumbing Code, with the same title to illustrate the observation.

Also, in connection with Table 5012.21.5 The National (Illustrated) Plumbing Code, published by Manas Publications, 4513 Potomac Ave., N. W., Washington, D. C. (price $3.00) includes with Section 5012.21.4 the table printed below that you will find very useful:

*Issued as correction—June 1, 1954.
HOW TO COMPUTE VENT STACK SIZES

Observation

The accompanying diagram is used here to show the method of computing vent stack sizes provided in the National Plumbing Code.

Vent stack A has 140 fixture units connected to it. If this vent stack were carried independently through the roof, its total length would be 76 feet. Table 12.21.5 shows that a 76-foot length would require 2 1/2-inch pipe.

The same vent stack connected to the header, as shown here, has a total length of 86 feet. This still requires 2-1/2-inch pipe.

Vent stack B has 170 fixture units connected, and has a total length of 101 feet, if carried through the roof. This would require 3-inch pipe, according to the table. The same vent stack, connected to the header, will have a length of 109 feet, and will still require 3-inch pipe.

Vent stack C, with a total connected load of 220 fixture units and a developed length of 96 feet to the header, should be sized 3 inches.

Vent stack D, with a connected load of 150 fixture units, and a developed length of 60 feet if carried through the roof; would require 2-1/2-inch pipe. The same vent stack connected to the header, with a developed length of 64 feet, will require the same diameter of pipe.

In grouping the various vent stacks, the first portion of the horizontal header, which provides air circulation for vent stack A, may be sized 2-1/2 inches. The next portion of the header, which includes vent stacks A and B, has a total connected fixture load of 310 fixture units and a total developed length of 124 feet. This portion may be sized 3 inches in diameter.

The portion of the header between stacks C and D will have a total developed length of 149 feet with a total connected load of 530 fixture units. This portion of the header will be sized 4 inches.

The balance of the header, including that portion of the vent stack through the room, will be based on a total developed length of 178 feet with a total connected load of 630 fixture units. Required here is 4-inch-diameter pipe.

The 4-inch main vent through the roof will provide sufficient air to balance the drainage and venting system for the total number of fixture units as shown on the various vent stacks. The sizes given provide for the air distribution necessary for all of the soil stacks.

Generally speaking, this same method is used in determining vent stack sizes for any installation, however complex. The governing table (12.21.5) in the National Plumbing Code was developed as a result of extensive tests at the National Bureau of Standards. The tests provided a scientific method of determining sizes, with the fixture unit as the basis of computation.

5012.22 COMBINATION WASTE-AND-VENT SYSTEM. 5012.22.1 Where permitted—A combination waste-and-vent system shall be permitted only where structural conditions preclude
the installation of a conventional system as otherwise provided in this code.

5012.22.2 Limits — A combination waste-and-vent system is limited to floor drains and sinks. It consists of an installation of waste piping in which the trap of the fixture is not individually vented. Every waste pipe and trap in the system shall be at least two pipe sizes larger than the size required in Section 5011.

SECTION 5013. STORM DRAINS. 5013.1 General. 5013.1.1 Drainage Required — Roof and paved areas, yards, courts and courtyards, shall be drained into a storm-sewer system or a combined-sewer system where such systems are available. Permission to use the sanitary sewer for other than sewage shall be obtained from the City Engineer.

5013.1.2 Prohibited Drainage—Storm water shall not be drained into sewers intended for sewage only.
<table>
<thead>
<tr>
<th>Size of Soil or Waste Stack (Inches)</th>
<th>Fixture Units Connected</th>
<th>Diameter of Vent required (Inches)</th>
<th>Horizontal Length, not exceeding (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1(\frac{1}{4})</td>
<td>1(\frac{1}{2})</td>
</tr>
<tr>
<td>1(\frac{1}{4})</td>
<td>2</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>1(\frac{1}{2})</td>
<td>8</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>1(\frac{1}{2})</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>2(\frac{1}{2})</td>
<td>40</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>300</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>1,000</td>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>6</td>
<td>1,000</td>
<td>20</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>600</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>1,400</td>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>2,200</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>3,600</td>
<td>25</td>
<td>60</td>
</tr>
<tr>
<td>10</td>
<td>1,000</td>
<td>75</td>
<td>125</td>
</tr>
<tr>
<td>10</td>
<td>2,500</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>3,800</td>
<td>30</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>5,600</td>
<td>25</td>
<td>60</td>
</tr>
</tbody>
</table>
5013.1.3 Traps—Leaders and storm drains, when connected to a combined sewer, shall be trapped. When the sewage and storm water drainage are combined within the building, one trap on the main storm drain of the building may serve.

5013.1.4 Expansion Joints—Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

5013.1.5 Subsoil Drains—Where subsoil drains are placed under the cellar or basement floor or are used to encircle the outer building walls, they shall be made of open-jointed or horizontally split or perforated clay tile, or perforated bituminized fiber pipe or asbestos cement pipe not less than 3 inches in diameter. When the building is subject to backwater, the subsoil drain shall be protected by an accessibly located backwater valve. Subsoil drains may discharge into a properly trapped area drain or sump. Such sumps do not require vents.

5013.2 MATERIALS. 5013.2.1 Inside Leaders—Leaders when placed within a building, or run in a vent or pipe shaft, shall be of cast iron, galvanized steel, galvanized wrought iron, or galvanized open-hearth iron brass, copper, or lead.

5013.2.2 Outside Leaders—When outside leaders are of sheet metal and connected with a building storm drain or storm sewer, they shall be connected to a cast-iron drain extending above the finish grade.

5013.2.4 Underground Drains—Building storm drains when underground shall be of cast iron soil pipe.

5013.2.5 Building Storm Sewer—The building storm sewer shall be of cast iron, vitrified clay, concrete, bituminized fiber pipe, or asbestos cement pipe.

5013.4.3 Combining Storm with Sanitary Drainage—The sanitary and storm-drainage system of a building shall be entirely separate, except that where a combined sewer is available the building storm drain may be connected in the same horizontal plane through a single Y fitting to the combined drain or sewer at least 10 feet downstream from any branch to the building drain or from any soil stack.

5013.4.4 Double Connections of Storm Drains—Where it is necessary to connect the sanitary and storm drains on both sides of the combined sewer single Y's shall be used and the requirements of paragraph 5013.4.3, relative location of connections, shall also apply to this paragraph.

5013.6 SIZE OF LEADERS AND STORM DRAINS. 5013.6.1 Vertical leaders shall be sized on the maximum projected roof area, according to the following table:

<table>
<thead>
<tr>
<th>Diameter of leader or conductor* (inches)</th>
<th>Maximum projected roof area (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 ........................................</td>
<td>720</td>
</tr>
<tr>
<td>2-1/2 ..................................</td>
<td>1,300</td>
</tr>
<tr>
<td>3 .......................................</td>
<td>2,200</td>
</tr>
<tr>
<td>4 .......................................</td>
<td>4,600</td>
</tr>
<tr>
<td>5 .......................................</td>
<td>8,650</td>
</tr>
<tr>
<td>6 .......................................</td>
<td>13,500</td>
</tr>
<tr>
<td>8 .......................................</td>
<td>29,000</td>
</tr>
</tbody>
</table>

*The equivalent diameter of a square or rectangular leader may be taken as the diameter of that circle which may be inscribed within the cross-sectional area of the leader.

Note: See footnote to table 5013.6.2.

5013.6.2 Building Storm Drains—The size of the building storm drain or any of its horizontal branches having a slope of one-half inch or less per foot, shall be based upon the maximum projected roof area to be handled according to the following table:

<table>
<thead>
<tr>
<th>Diameter of drain (inches)</th>
<th>Maximum projected roof area for drains for various slopes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/8 inch</td>
</tr>
<tr>
<td></td>
<td>Square Feet</td>
</tr>
<tr>
<td>3 ..................................</td>
<td>822</td>
</tr>
<tr>
<td>4 ..................................</td>
<td>1,880</td>
</tr>
<tr>
<td>5 ..................................</td>
<td>3,340</td>
</tr>
<tr>
<td>6 ..................................</td>
<td>5,350</td>
</tr>
<tr>
<td>8 ..................................</td>
<td>11,500</td>
</tr>
<tr>
<td>10 ..................................</td>
<td>20,700</td>
</tr>
<tr>
<td>12 ..................................</td>
<td>33,300</td>
</tr>
<tr>
<td>15 ..................................</td>
<td>59,500</td>
</tr>
</tbody>
</table>

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5013.7 SIZE OF COMBINED DRAINS AND SEWERS. (a) The size of the building drain and building storm drain up to the point of combining into one system shall be as required for separate storm and sanitary systems.

(b) The size of the combined building drain or sewer shall be determined from Table 5013.6.2 for storm drains by obtaining, in the manner described below, the drainage area equivalent of the fixture unit load on the drain, except that in no case shall a combined drain be less than 4 inches in diameter or smaller than the building storm or sanitary drain emptying into it.

(b) 1. When the total fixture unit load on the combined drain is less than 325 fixture units, the equivalent drainage area in horizontal projection shall be taken as 2,000 square feet.

2. When the total fixture unit load exceeds 325 fixture units, each fixture unit shall be considered the equivalent of 6.2 square feet of drainage area.

5013.8.1 Values for Continuous Flow. Where there is a continuous or semicontinuous discharge into the building storm drain or building storm sewer as from a pump, air conditioning plant or similar device, then each gallon per minute of such discharge shall be computed as being equivalent to 48 square feet of roof area.

SECTION 5014 TESTS. 5014.6 MATERIAL AND LABOR FOR TESTS. 5014.6.1 The equipment, material, power, and labor necessary for the inspection and test shall be furnished by the plumber.

5014.7 TESTS OF DRAINAGE AND VENT SYSTEMS. 5014.7.1 All the piping of the plumbing system shall be tested with water or air, provided that the peppermint test may be used where sections or a portion of the system is in use, and the water or air test is impractical.

5014.8 METHODS OF TESTING DRAINAGE AND VENT SYSTEMS. 5014.8.1 Water Test. The water pressure test shall be applied to the drainage system, exclusive of the building sewer, either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to point of overflow. If the system is tested in sections each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections at least the upper 10-feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 feet of the system) shall have been submitted to a test of less than 10-foot head of water. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight at all points.

(b) Water Flow Test. The building sewer shall be tested with a flow test made by dumping, within a 2-minute period, two 5-gallon containers of water into the open pipe at its upper end. The sewer shall pass inspection where the water flows freely from the lower end and no joint shows leakage.

5014.8.2 Air Test. The air test shall be made by attaching an air compressor or testing apparatus to any suitable opening, and, after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure of 5 pounds per square inch or sufficient to balance a column of mercury 10 inches in height. This pressure shall be held without introduction of additional air for a period of at least 15 minutes.

5014.8.3 Peppermint Test. The final test of the completed drainage and vent system shall be a peppermint test. Two ounces of oil of peppermint shall be introduced for each line or stack.

5014.11 TEST OF WATER-SUPPLY SYSTEM. 5014.11.1 Upon completion of a section or of the entire water-supply system it shall be tested and proved tight under a water pressure not less than the working pressure under which it is to be used. The water used for tests shall be obtained from the normal source of supply.

5014.12 TEST OF INTERIOR LEADERS OR DOWN SPOUTS. 5014.12.1 Leaders or downspouts and branches within a building shall be tested by water or air in accordance with paragraph 5014.8.1 or paragraph 5014.8.2.

5014.14 TEST OF DEFECTIVE PLUMBING. 5014.14.1 The drainage system of any building, where there is reason to believe that it has become defective, shall be subjected to test or inspection.

SECTION 5015. APPENDIX A — PRIVATE WATER SUPPLY SYSTEM:

5015.1 A GENERAL. A private water supply system shall be constructed in accordance with the requirements of this code and rules and regulations adopted by the Board of Health and Hospitals consistent with and amplifying and augmenting the provisions hereof.

5015.2 PERMIT FOR INSTALLATION OF PRIVATE WATER SUPPLY SYSTEM.

5015.2.1. Submittal of Plans. It shall be unlawful for any person to install a private wa-
water supply system without first having complied with the requirements set forth in Section 301 of this code and without having first submitted three copies of detailed plans and specifications relating thereto to the Department of Health and Hospitals.

5015.A.2.2. Contents of Plans and Specifications. In addition to the information required to be set forth in Section 301 of this code, the plans and specifications for the proposed private water supply system contain the following information:

a. Proposed source of water;

b. Detailed scaled drawings of the private water distribution system, including the size and type of piping, valves, storage and distribution facilities to be used, and appurtenances thereto;

c. Location, size, type, and specifications for pumping equipment;

d. Location, size, type, specifications of water treatment facilities, if any;

e. Location and details concerning all existing or proposed water supply systems on the premises;

f. A statement of the use to be made of the proposed private water supply system. Such statement shall declare whether or not the proposed private water supply system is intended to furnish potable or nonpotable water. If the plans and specifications are proved, a permit issued, and the system constructed, a notice abstracting this statement shall be recorded with the Clerk and Recorder of the City and County of Denver showing the lawful use of the private water supply system.

g. If the proposed private water supply system is to derive water from a ground water supply, the plans and specifications shall give complete details as to the source, and shall show the size of the well, types of material used in the casing, piping, lining, and other parts thereof, the location of well or spring, and storage facilities, and details as to existing and proposed drainage systems and other actual or potential sources of contamination and pollution, as may be applicable;

h. Detailed scaled drawings of the pump house, well house, or other structure or structures intended to be used in connection with the proposed private water supply system;

i. Estimated depth of well and supporting data and calculations, as applicable.

5015.A.2.3 Notification of Chief Building Inspector. When plans and specifications for a private water supply system have been approved by the Department of Health and Hospitals, the department shall so inform the Chief Building Inspector.

5015.A.2.4. Issuance of Permit. The Chief Building Inspector shall not issue a permit for the installation of a private water supply system unless the plans and specifications therefor have first been approved by the Department of Health and Hospitals and until and unless there has been compliance with all applicable provisions of this code and all pertinent rules and regulations.

5015.A.3. POTABLE PRIVATE WATER SUPPLY SYSTEM.

5015.A.3.1. Distribution. Water from a potable private water supply system shall be distributed and used in accordance with the requirements set forth in Section 5010 of this code.

5015.A.3.2. Spacing Requirements. Every ground water supply intended to be used as a source for a potable private water supply system shall be located not less than 50 feet, measured horizontally, from any drainage system or other possible source of contamination or pollution. Provided, however, that a drainage system may be located not less than 10 feet therefrom, measured horizontally, if such drainage system is constructed of cast iron pipe with leaded joints and is demonstrably watertight in accordance with the applicable tests prescribed in Section 5014.8 of this code.

5015.A.3.3. Special Health Requirements. In order to protect the public health the Department of Health and Hospitals may impose additional requirements on any proposed ground water supply intended to be used as a source for a potable private water system if there is data or other evidence indicating an actual or potential source of contamination or pollution.

5015.A.3.4. Adjacent Pits Prohibited. It shall be unlawful to locate a ground water supply intended to be used as a source for a private potable water supply system within 10 feet, measured horizontally of any pit or unfilled area below the ground surface.

5015.A.3.5. Well Casing, Platform, Seal.

a. Construction. All portions of the suction pipe or drop pipe of drilled wells located below the ground surface and within 10 feet of the ground surface shall be surrounded by a watertight casing pipe; provided, however, that in a pressure system the watertight casing pipe need not extend beyond the point where the system is continuously subjected to internal pressure greater than the external pressure. All portions of dug or bored wells of the buried slab type with a lower casing dis-
connected from the required upper casing, shall have such lower casing cut off at least 10 feet below the ground surface, and the top of the casing shall be closed with a suitable watertight cover, and covered with a compact earth fill so that there is no depression at the ground surface above the casing top. A dug well, in lieu of a casing pipe, shall be provided with a substantial watertight lining of concrete, vitrified tile with outer concrete lining, or similarly impervious material, which lining shall extend at least 10 feet below the surface and up to the well platform with a watertight connection.

b. Platform. The watertight casing pipe, or in the case of a dug well, a metal sleeve, shall emerge from the ground through a concrete platform at least 4 inches in thickness and extending at least 2 feet in all directions from the casing or sleeve. Such casing or sleeve shall project at least 6 inches above the top of the platform, and the platform shall slope away from the casing or sleeve.

c. Sealed Cover or Closure. The opening at the top of the well casing and all openings in the well casing within 10 feet of the ground surface shall be equipped with a watertight seal, cover, or closure. Such seal, cover, or closure shall be constructed of watertight impervious materials approved by the Department of Health and Hospitals for the purpose intended and installed in a manner which will protect the system from contamination or pollution.


a. Location. A water storage facility located wholly or partly beneath the surface of the ground shall meet the same requirements as to horizontal spacing from possible sources of contamination and pollution as set forth in Sections 5015.A.3.2 and 5015.A.3.3 of this code, unless subjected to continuous internal pressure greater than external pressure.

b. Materials. Water storage facilities located wholly or partly underground shall be constructed of reinforced concrete or heavy gauge, corrosion-resistant steel and shall be sufficient to protect the water in the facility from contamination and pollution.

c. Manholes. Manholes installed in water storage facilities shall be constructed to prevent possible contamination or pollution of the facility and fitted with a watertight collar or frame with edges projecting at least 6 inches above the level of the surrounding ground surface and shall be equipped with watertight covers having edges which overlap and project downward at least 2 inches around the external frame of the manhole. Manhole covers shall be equipped with locking devices.


a. Hand-Operated Pumps. Every hand-operated pump shall have the pump head closed by a stuffing-box or similar device to exclude contamination and pollution from the water chamber of the pump. The base of the pump shall be constructed from a single casting and shall be of such diameter and depth to fit over the casing pipe, or in the case of a dug well, the sleeve, which shall project into the base of the pump casting at least 1 inch. The base of the pump shall be bolted to a flange which shall be threaded onto or otherwise securely fastened to the well casing or sleeve. The base of the pump shall not be fastened to the well platform or floor.

b. Power Operated Pumps. Every power operated pump placed directly over the well casing or sleeve shall rest on a solid pedestal of concrete or metal which shall be at least 5 inches above the top of the platform. The base of the pump shall be solid, watertight and with no openings, and the casing pipe or sleeve shall project into the base as required for hand operated pumps, or in lieu thereof a watertight seal shall be installed in the annular space above the platform between the casing pipe or sleeve and the suction or drop pipe.

c. Pump Pits Prohibited. No part of any potable private water supply system which is not under continuous internal pressure greater than external pressure shall be located in any pit, room or space wholly or partly below ground level, or in any room or space above ground level which is walled or otherwise enclosed so as to prevent or obstruct free gravity drainage to the surface of the ground.

d. Lubrication. Pump bearings shall be lubricated by water from the system or with lubricants which cannot contaminate or pollute the water in the system.

e. Airlift Pumping System. Air intake openings on airlift pumping systems shall be located at least 6 feet above the platform if within a structure over the top of the well, or at least 10 feet above the ground if located out-of-doors. Such openings shall be constructed and located to prevent contamination and pollution from entering the system.

5015.A.3.8. Vents and Vent Openings. All vents, overflow gauges, control gauges and similar devices shall be constructed to prevent entrance of contamination and pollution. Vent openings shall be directed downward and shall be not less than 2 feet above the platform of the well, or the roof or cover of the water storage facility, or the ground surface, whichever requires greater elevation, as the case may be.
5015.A.3.9. Disinfection and Treatment. Before any potable private water supply system is used and after repairs or reconstruction of any such system, it shall be treated to remove contamination or pollution in a manner approved by the Department of Health and Hospitals.

5015.A.4. NONPOTABLE PRIVATE WATER SUPPLY SYSTEMS.

5015.A.4.1. Distribution. Water from a nonpotable private water supply system shall be distributed and used in accordance with the requirement set forth in Section 5010 of this Code.

5015.A.4.2. Location of Nonpotable Ground Water Supply. Every ground water supply intended to be used as a nonpotable private water supply system shall be located not less than 5 feet measured horizontally, from any drainage system or other possible source of contamination or pollution.

5015.A.4.3. Special Health Requirements. In order to protect the public health the Department of Health and Hospitals may impose additional requirements on any proposed ground water supply intended to be used as a source for a nonpotable private water supply system if there is data or other evidence indicating an actual or potential source of contamination or pollution which may endanger the public health, and shall prohibit the installation of any such ground water supply which will produce and distribute contaminated or polluted water.

5015.A.5. General Safety Requirements. Every private water supply system and all appurtenances thereto shall be so designed and constructed to eliminate danger to human life or limb, and all wells, closures, manholes and other removable fixtures and appurtenances shall be designed and equipped with locking devices to prevent danger to life or limb.

5015.A.6. WELLS UNDER NATURAL HYDROSTATIC PRESSURE. Every well under natural hydrostatic pressure shall be entirely cased, and provision shall be made to control the flow of water therefrom in order to prevent waste.

5015.A.7. CONTAMINATION OR POLLUTION OF GROUND WATER SUPPLY PROHIBITED. It shall be unlawful for any person, firm or corporation to contaminate or pollute or cause to be contaminated or polluted directly or indirectly ground water, or to increase or attempt to increase water in any natural storage area beneath the surface of the ground. (Ord. 98, Series 1955).

SECTION 5016. APPENDIX B—INDIVIDUAL SEWAGE—DISPOSAL SYSTEM. 5016.B.1 GENERAL. 5016.B.1.1 Design—The design of the individual sewage-disposal system shall take into consideration location with respect to wells or other sources of water supply, topography, water table, soil characteristics, area available, and maximum occupancy of the building. Individual disposal systems shall be subject to inspection by the Chief Building Inspector and approval of, and inspection by, the Bureau of Health and Hospitals.

5016.B.1.2 Type of System — The type of system to be installed shall be determined on the basis of location, soil permeability, and ground-water elevation.

5016.B.1.3 Sanitary Sewage—The system shall be designed to receive all sanitary sewage, including laundry waste from the building. Drainage from basement floor, footings, or roofs shall not enter the system.

5016.B.1.4 Discharge—The system shall consist of a septic tank discharging to either a subsurface disposal field or one or more seepage pits or into a combination of both as approved.

5016.B.1.5 Alternate Design — Where soil conditions are such that neither of the systems mentioned in B.1.4 can operate satisfactorily, approval of alternate design shall be secured from the Board of Appeals with concurrence of the Bureau of Health and Hospitals.

5016.B.2 LOCATION. 5016.B.2.1 Distances —Table 5016.B.2.2 provides for the minimum distances that shall be observed in locating the various components of the disposal system.
### TABLE 5016 B.2.2 LOCATION OF COMPONENTS OF SEWAGE-DISPOSAL SYSTEM

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Distance in feet from Well or Water Supply line (Pressure)</th>
<th>Dwelling Property Seepage Pits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Sewer</td>
<td>50 10</td>
<td>5 5 5 5</td>
</tr>
<tr>
<td>Septic Tank</td>
<td>50 10</td>
<td>10 10 10 10</td>
</tr>
<tr>
<td>Distribution Box</td>
<td>50 10</td>
<td>10 10 10 10</td>
</tr>
<tr>
<td>Disposal Field</td>
<td>100 25 10 10</td>
<td>10 10 10 10</td>
</tr>
<tr>
<td>Seepage Pit</td>
<td>100 50 20 20</td>
<td>10 20 20 20</td>
</tr>
<tr>
<td>Dry Well</td>
<td>50 10</td>
<td>10 10 10 10</td>
</tr>
<tr>
<td>Cesspool</td>
<td>150 50 20 20</td>
<td>10 20 20 20</td>
</tr>
</tbody>
</table>

*This separation may be reduced to 50 feet when the well is provided with an outside watertight casing to a depth of 50 feet or more.

*Not recommended as a substitute for a septic tank. To be used only when approved by the Chief Building Inspector or his authorized deputy.

### 5016.B.2.3 Septic Tanks

Septic tanks or other means of disposal shall only be approved where no public sewer is available. Such means of disposal shall be discontinued when facilities for public sewerage are made available.

### 5016.B.3 BUILDING SEWER

#### 5016.B.3.1 Sewer Size

The sewer shall have a minimum size to serve the connected fixtures as determined from Section 5011 of this Code.

### TABLE 5016.B.4.2 MINIMUM CAPACITIES FOR SEPTIC TANKS SERVING AN INDIVIDUAL DWELLING

<table>
<thead>
<tr>
<th>No. of Bedrooms Served</th>
<th>Maximum Number of Persons Served</th>
<th>Nominal Liquid Capacity of Tank in Gallons</th>
<th>Recommended inside dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Length 6</td>
<td>Width 3</td>
</tr>
<tr>
<td>2 or less</td>
<td>4</td>
<td>500</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>750</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>900</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>1,100</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>14</td>
<td>1,300</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>1,500</td>
<td>0</td>
</tr>
</tbody>
</table>

**NOTE—** Liquid capacity is based on number of bedrooms in dwelling. Total volume in cubic feet includes air space above liquid level.

#### 5016.B.4.3 Multiple Compartments

When tanks have more than one compartment, the inlet compartment shall have a capacity of not less than two-thirds the total tank capacity nor less than 500 gallons.

#### 5016.B.4.4 Garbage Disposal

Where domestic garbage-disposal units are installed or contemplated, the capacity of the septic tank shall be at least 50 percent greater than the requirements given in Table 5016.B.4.2.

#### 5016.B.4.5 Septic Tank Length

Septic tanks shall be at least twice as long as they are wide.

#### 5016.B.4.6 Construction

Septic tanks shall be constructed of corrosion-resistant materials and be of permanent construction. The cover of the tank shall be designed for a dead load of not less than 150 pounds per square foot and, if of concrete, should be reinforced and not less than 4 inches thick.

#### 5016.B.4.7 Manholes

The inlet compartment must be provided with one manhole. Oth-
er compartments may be provided with man-
hole. Manholes shall be at least 20 inches
square or 24 inches in diameter and provided
with covers which can be sealed watertight.
Manholes should be extended to grade. Where
removable covers are provided, manholes are
not required.

5016.B.4.8 Baffles—If inlet and outlet bar-
fies are used, they shall extend the full width
of the tank and be located 12 inches from the
end walls. Such baffles shall extend at least 6
inches above the flow line and inlet baffles 12
inches and outlet baffles 15 to 18 inches below
the flow line.

5016.B.4.9 Pipe Inlet and Outlet—In lieu
of baffles, submerged pipe inlets and outlets
may be installed consisting of cast-iron sanitary
T with a short section of pipe to the required
depth as indicated in paragraph 5016.B.4.8.

5016.B.4.10 Invert—The invert of the inlet
pipe shall be located at least 3 inches above
the invert of the outlet.

5016.B.4.11 Dosing Chambers—Dosing
chambers are not required in the case of indi-
vidual disposal systems.

### TABLE 5016.B.6.2 ABSORPTION AREAS FOR INDIVIDUAL RESIDENCES

<table>
<thead>
<tr>
<th>Time required for water to fall 1 inch (minutes)</th>
<th>Effective Absorption Area Required in Bottom of Disposal Trenches (per Bedroom)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 or less</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
</tr>
<tr>
<td>5</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>130</td>
</tr>
<tr>
<td>30</td>
<td>180</td>
</tr>
<tr>
<td>60</td>
<td>240</td>
</tr>
<tr>
<td>Over 60</td>
<td>(1) Special design</td>
</tr>
<tr>
<td>NOTE: A minimum of 150 square feet should be provided for each dwelling unit.</td>
<td></td>
</tr>
</tbody>
</table>

5016.B.7 PROCEDURE TO BE FOLLOWED FOR PERCOLATION TEST. 5016.B.7.1 Size of Test Holes—Not less than three holes shall be tested
each to be 1 foot square and as deep as the
proposed disposal trenches.

5016.B.7.2 Variations in Soil Conditions—
Fill each hole to a depth of 6 inches and allow
the water to seep away. Allowance shall be
made for variation in soil conditions at the time
of the test from year-round average conditions.

5016.B.7.3 Effective Absorption—Observe
the time in minutes for the water to seep away
completely. Calculate the time in minutes for
the water to fall 1 inch. Average the results
from the holes tested. The effective absorption
area required shall then be determined from
Table 5016.B.6.2.

5016.B.7.4 Special Soils—Tests shall not be
made on filled or frozen ground. Where fissure-
soil formation is encountered, tests shall be
made only as directed by the Board of Appeals
or the Bureau of Health and Hospitals.

5016.B.8 MINIMUM STANDARDS FOR DIS-
POSAL FIELD CONSTRUCTION. 5016.B.8.1 Dis-
posal Field Construction—The minimum stan-
dards for disposal field construction shall be as
given in Table B.8.2.
TABLE 8.8.2 MINIMUM STANDARDS FOR DISPOSAL FIELD CONSTRUCTION

<table>
<thead>
<tr>
<th>Disposal-field Construction:</th>
<th>Minimum Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines per field; minimum number.</td>
<td>2</td>
</tr>
<tr>
<td>Individual lines, maximum length.</td>
<td>100 feet</td>
</tr>
<tr>
<td>Trench bottom, minimum width.</td>
<td>18 inches</td>
</tr>
<tr>
<td>Field-tile, minimum diameter.</td>
<td>4 inches</td>
</tr>
<tr>
<td>Field-tile lines, maximum slope.</td>
<td>6 inches in 100 feet</td>
</tr>
<tr>
<td>Field trenches, minimum separation.</td>
<td>6 feet</td>
</tr>
<tr>
<td>Effective absorption area, minimum per dwelling unit.</td>
<td>(*)</td>
</tr>
</tbody>
</table>

See Table 5016.B.6.2.

5016.B.9 **DISPOSAL TRENCHES.** Disposal trenches shall be designed and constructed on the basis of the required effective percolation area.

5016.B.9.2 **Filter Material**—The filter material shall cover the tile and extend the full width of the trench and shall be not less than 6 inches deep beneath the bottom of the tile. The filter material may be washed gravel, crushed stone, slag, or clean bank-run gravel ranging in size from ½ to 2½ inches. The filter material shall be covered by untreated paper or by a 2-inch layer of straw as the laying of the tile drain proceeds.

5016.B.9.3 **Disposal Field**—The size and minimum spacing requirements for disposal fields shall conform to those given in Table 5016.B.9.4.

<table>
<thead>
<tr>
<th>TABLE 5016.B.9.4. SIZE AND SPACING FOR DISPOSAL FIELDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of Trench at Bottom (inches)</td>
</tr>
<tr>
<td>------------------------------------</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>36</td>
</tr>
</tbody>
</table>

*A greater spacing is desirable where available area permits.

5016.B.9.5 **Absorption Lines**—Absorption lines shall be constructed of tile laid with open joints. In the case of bell-and-spigot tile, it shall be laid with ½ inch open joints, at 2-foot intervals with sufficient cement mortar at the bottom of the joint to insure an even flow line. In the case of agricultural tile, the sections shall be spaced not more than ¼ inch, and the upper half of the joint shall be protected asphalt-treated paper while the tile is being covered, unless the pipe is covered by at least 2 inches of gravel. Horizontally split or perforated clay tile or perforated bituminized fiber pipe or asbestos cement pipe may be used.

5016.B.10 **SEEPAGE PIT.** Seepage pits may be used either to supplement the subsurface disposal field or in lieu of such field where conditions favor the operation of seepage pits, as may be determined and approved by the Chief Building Inspector.

5016.B.10.2 **Water Table**—A seepage pit shall not extend into the ground-water table. Where the pit is used to receive the septic-tank effluent, the same limitations shall be placed on the location of the pit as on the cesspool. (See paragraph 5016.B.12.3.)

5016.B.10.3 **Pit Lining**—The pit shall be lined with stone, brick, or concrete blocks laid up dry with open joints that are backed up with at least 3 inches of coarse gravel. The joints above the inlet shall be sealed with cement mortar. It is customary to draw in the upper section of the lining.

5016.B.10.4 **Pit Covers**—A reinforced-concrete cover shall be provided, preferably to finished grade. If the cover is over 30 inches square, it shall have an access manhole.

5016.B.10.5 **Bottom of Pit**—The bottom of the pit shall be filled with coarse gravel to a depth of 1 foot.

5016.B.10.6 **Trees**—When the seepage pit is located in close proximity to trees, it need not be lined as indicated in Paragraph 5016.B.10.3 but may be filled with loose rock.

5016.B.10.7 **Size of Pit**—The seepage pit shall be sized in accordance with provisions in Table 5016.B.10.8.
### TABLE 5016.B.10.8 · REQUIREMENTS FOR SEEPAGE—PIT DESIGN

<table>
<thead>
<tr>
<th>Soil Structure</th>
<th>Effective Absorption Area Required per Bedroom¹ (Square Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse sand and gravel</td>
<td>20</td>
</tr>
<tr>
<td>Fine sand</td>
<td>30</td>
</tr>
<tr>
<td>Sandy loam or sand clay</td>
<td>50</td>
</tr>
<tr>
<td>Clay with considerable sand and gravel</td>
<td>80</td>
</tr>
<tr>
<td>Clay with small amount of sand and gravel</td>
<td>160</td>
</tr>
<tr>
<td>Heavy tight clay, hardpan, rock, or other impervious soil formations</td>
<td></td>
</tr>
</tbody>
</table>

¹In calculating absorption wall area of pit, gross diameter of pit excavation shall be used.

## 5016.B.11 DRY WELL

### 5016.B.11.1 Dry Well Required
When necessary, a dry well shall be provided to receive the drainage from roofs, basements, or areaways.

### 5016.B.11.2 Size of Dry Well
Large dry wells shall be constructed in general accordance with the requirements given for seepage pits, Paragraph B.10.

### 5016.B.11.3 Small Dry Wells
For small dry wells handling limited quantities of water, the pit may consist of a 3 foot length of 18-inch-diameter vitrified clay or cement pipe, filled with crushed rock or stone.

## 5016.B.12 CESSPOOL

### 5016.B.12.1 Use of Cesspools
The use of cesspools for disposal of sewage and their installation will be accepted only if approval is obtained from the Chief Building Inspector or his authorized deputy or the Bureau of Health and Hospitals.

### 5016.B.12.2 Cesspool Installation
Cesspool installations shall be considered only as a temporary expedient in those instances where connections to a public sewer system will be possible within a reasonable period of time.

### 5016.B.12.3 Health Hazard
Because of the public health hazard involved, extreme care shall be exercised in locating a cesspool, and approval must be secured before work is begun. Under no circumstances shall the cesspool penetrate the ground-water stratum.

### 5016.B.12.4 Approval
After approval is secured, the construction of the cesspool shall comply with the requirements for seepage pits as given in Paragraph 5016.B.10.

## SECTION 5017 APPENDIX C—AIR GAPS, BACKFLOW PREVENTERS, AND DRINKING FAUCET STANDARDS

### 5017.C.2 AIR GAPS
The minimum required air gap shall be measured vertically from the end of the faucet spout, or supply pipe to the flood-level rim of the fixture or vessel. (See fig. 1 and fig. 2 of 5017.C.2.4.)

### 5017.C.2.3 Water inlet to certain fixtures
This water inlet to certain fixtures, such as water-closet flush tanks and tanks or vats, may be difficult to protect with air gaps and therefore require special consideration. (See paragraphs 5017.C.2.5, 5017.C.2.6, 5017.C.2.7, 5017.C.2.8.)

### 5017.C.2.4 The minimum required air gap
The minimum required air gap shall be twice the diameter of the effective opening, but in no case less than given in Table 5017.C.2.4.
TABLE 5017.C.2.4 MINIMUM AIR GAPS FOR GENERALLY USED PLUMBING FIXTURES

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Minimum Air Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>When not affected by near wall†</td>
<td>When affected by near wall†</td>
</tr>
<tr>
<td>Lavatories with effective openings not greater than ( \frac{1}{2} ) inch diameter</td>
<td>1.0</td>
</tr>
<tr>
<td>Sink, laundry trays, and gooseneck bath faucets with effective openings not greater than ( \frac{3}{8} ) inch diameter</td>
<td>1.5</td>
</tr>
<tr>
<td>Overrim bath fillers with effective openings not greater than 1 inch diameter</td>
<td>2.0</td>
</tr>
</tbody>
</table>

*Side walls, ribs, or similar obstructions do not affect the air gaps when spaced from inside edge of spout opening a distance greater than three times the diameter of the effective opening for a single wall, or a distance greater than four times the diameter of the effective opening for two intersecting walls. (See fig. 2.)

*Vertical walls, ribs, or similar obstructions extending from the water surface to or above the horizontal plane of the spout opening require greater air gap when spaced closer to the nearest inside edge of spout opening than specified in note 1 above. The effect of three or more such vertical walls or ribs has not been determined. In such cases, the air gap shall be measured from the top of the wall.

*2x effective opening.

*3x effective opening.

5017.C.2.5 Where it is not practical to provide a minimum required air gap above the flood-level rim of a tank or vat, an arrangement similar to that shown on figure 3 of 5017.C.2.4 may be provided.

5017.C.2.6 Overflow pipe or channel shall be so arranged as to allow overflow water a free discharge to atmosphere under all conditions, overflow piping to be provided with an adequate break in the piping as close to the tank as possible, and the area of the free opening shall be at least equal to that of the overflow pipe. See figure 3. Tank and overflow piping shall be protected against freezing.

5017.C.2.7 When water enters the tank at the maximum rate with all inlets open and all outlets closed, the size and capacity of overflow pipe or channel shall be sufficient to keep the water level from rising to more than half of the minimum required air gap as shown in table 5017.C.2.4, said distance to be measured above the top of the overflow.

5017.C.2.8 The minimum air gap, as measured from the lowest point of any supply outlet to the top of the overflow opening, shall be one-and-one-half times the minimum air gap as required to table 5017.C.2.4. (See Figure 3.)

5017.C.3.1 Drinking Fountain Nozzles—All drinking nozzles, including those which may at times extend through a water surface and with orifice diameter not greater than 7/16 (0.440) inch or 0.150 square inch area shall be placed so that the lower edge of the nozzle orifice is at an elevation not less than \( \frac{3}{4} \) inch above the flood level rim of the receptacle.

The \( \frac{3}{4} \) inch elevations shall also apply to nozzles with more than one orifice providing that the sum of the area of all orifices shall not exceed the area of a circle 7/16 inch in diameter.

5017.C.4.1 Backflow Preventers—Backflow preventers shall be installed with any supply fixture, the outlet end of which may at times be submerged, such as hose and spray, direct flushing valves, aspirators and under-rim water supply connections to a plumbing fixture or receptacle in which the surface of the water in the fixture or receptacle is exposed at all times to atmospheric pressure.

5017.C.4.2 Backflow preventers shall be installed between the control valve and the fixture so it will not be subjected to water pressure, except the back pressure incidental to water flowing to the fixture.

5017.C.4.3 Backflow preventers shall not be installed on inlet side of control valve.

5017.C.5.1 The effective opening is the minimum cross-sectional area at the joint of water-supply discharge, measured or expressed in terms of, (1) the diameter of a circle, or (2) if the opening is not circular, the diameter of a circle of equivalent cross-sectional area. (See fig. 1 5017.C.2.4. In some cases it may be point X.)

5017.C.6.1 Backflow preventers shall be made of corrosion-resistant material of design and proportions which will not deteriorate or deform under reasonable service conditions.
5017.C.8 Drinking Fountains

5017.C.8.1 Materials—Fountains shall be constructed of impervious material, such as vitreous china, porcelain, enameled cast iron, other metals, or stoneware.

5017.C.8.2 Jet—The jet of the fountain shall issue from a nozzle of non-oxidizing, impervious material set at an angle from the vertical such as to prevent the return of water in the jet to the orifice or orifices from whence the jet issues. The nozzle and every other opening in the water pipe or conductor leading to the nozzle shall be above the edge of the bowl, so that such nozzle or opening will not be flooded in case a drain from the bowl of the fountain becomes clogged.

5017.C.8.3 Nozzle and Guard—The end of the nozzle shall be protected by non-oxidizing guards to prevent the mouth and nose of persons using the fountain from coming into contact with the nozzle. Guards shall be so designed that the possibility of transmission of infection by touching the guards is reduced to a minimum.

The inclined jet of water issuing from the nozzle shall not touch the guard, and thereby cause spattering.

5017.C.8.5 Bowl—The bowl of the fountain shall be so designed and proportioned as to be free from corners which would be difficult to clean or which would collect dirt, and so as to prevent unnecessary splashing at a point where the jet falls into the bowl.

5017.C.8.5A Connection—The drain from the fountain shall not have a direct physical connection with a waste pipe, unless the drain is trapped.

5017.C.8.8 Valve—The water-supply pipe shall be provided with an adjustable valve fitted with a loose key or an automatic valve permitting the regulation of the rate of flow of water to the fountain so that the valve manipulated by the users of the fountain will merely turn the water on or off.

5017.C.8.9 Height—The height of the fountain at the drinking level shall be such as to be most convenient to persons utilizing the fountain.

5017.C.8.10 Waste—The waste opening and pipe shall be of sufficient size to carry off the water promptly, and shall be provided with a strainer.

5017.C.8.11 Bathtubs

5017.C.8.11.1 Waste Outlets—Bathtubs shall be provided with waste outlets not less than 1 ½ inches in diameter.

SECTION 5018

5018.1 Dishwashers—If dishwasher tail piece is to be used then discharge air gap must be installed. In the event the dishwasher is connected to a separate trap, the discharge air gap will not be required. INLET air gap required in either case.
Typical installation showing common vent with fixture wastes connecting into double sanitary tee or cross.

If two similar fixtures are connected back-to-back, they may connect into a double sanitary tee or cross or double long TY.

Size must be twice the cross sectional area of the upper branch. In this case 1 1/4 upper branch = 1.495. Twice this (2 x 1.495) = 2.99 which requires 2 inch pipe with cross sectional area of 3.355 sq. in. Distance between fittings must be 5 diameters of the pipe = 5 x 2 inches = 10 inches.

COMMON VENT

This installation assumes a sink with a value of two fixture units and a laboratory with a value of one fixture unit connected at a different level. Three fixture units would require a 1 1/2-inch vertical drain, but the upper branch is 1 1/4-inch, which would be more than half the cross-sectional area of the vertical drain. So the vertical drain must be 2-inch. Reason for the different sizing of the vertical line when the two connections are at different levels is to provide safe operation of the lower fixture trap. Limiting distance between the fixture branches also minimizes chance of self-siphonage.
This sketch shows how the drain from a back-vented lavatory can serve as a wet vent for the bathtub and shower stall, and for the water closet, when no more than one fixture unit drains into a 1½-inch wet vent. It also illustrates the top-floor provision for connection of a horizontal branch at the same level as water closet.

Single bathroom group of fixtures may be installed on top or next lower floor with the drain from a backvented lavatory, kitchen sink (or a combination fixture) serving as a wet vent for a bath tub or shower stall and for the water closet provided.

a. Not more than one fixture unit is drained into a 1½ inch diameter wet vent or not more than four fixture units drain into a 2 inch diameter wet vent.

b. The Horizontal branch connects to the stack or drain at the same level as the water closet drain when installed next to the top floor or at the same level or below water closet drain when installed on the top floor.

Here, the installation has less than four fixture units draining into a 2-inch wet vent. It is a top-floor connection, so that the horizontal branch can connect either below the water closet drain as shown in the sketch, or at the same level. On lower floors the water closet and other fixture branches must connect at the same level.
Two methods of installing bathroom groups back-to-back are shown here. Both conform to the code requirements.

Bathroom groups back-to-back on top floor consisting of two lavatories and two bath tubs (or shower stalls) may be installed on the same horizontal branch with a common vent for the lavatories and with no back vent for the bath tubs (or shower stalls) provided the wet vent is 2 inches in diameter.

One Bathroom group.
One story.
Multistory Bathroom Group. On the lower floors of a multistory building, the waste pipe from one or two lavatories may be used as a vent for one or two bath tubs or showers provided that:

a. The wet vent and its extension to the vent stack is 2 inches in diameter.

b. Each water closet below the top floor is individually back vented.

c. The vent stack is sized as follows:
   - 1 or 2 bath tubs or showers: 2 inch vent.
   - 3 to 5 bath tubs or showers: 2½ inch vent.
   - 6 to 9 bath tubs or showers: 3 inch vent.
   - 10 to 16 bath tubs or showers: 4 inch vent.

By varying types of connections on different floors, this sketch shows alternate methods of wet venting bathroom groups in a multi-story building.
ONE STORY OR TOP FLOOR
SINGLE BATH ROOM GROUP

RELIEF VENT ADDED
Flooded Sewers

VENTING-OFFSETS

OBSERVATION: Offsets of 45 degrees or less do not affect seriously the flow in the stack. The loading of stacks as provided in tables will not permit a stack to run free. If a horizontal branch or a fixture is connected within two feet of the offset, a relief vent is then necessary to prevent positive pressure from developing close to the fixture.
Offsets of 45 degrees or less do not affect seriously the flow in the stack. The loading of stacks as provided in table will not permit a stack to run free. If a horizontal branch or a fixture is connected within two feet of the offset, a relief vent is then necessary to prevent positive pressure from developing close to the fixture.

When it occurs above the highest fixture or horizontal branch the offset need provide only for the flow of air. Usually the stack is large enough so that it will not be affected by bends or offsets. Diameter of the offset may be the same as the diameter of the stack.

A 45-degree offset will not affect the size of an offset, regardless of where such an offset occurs in the soil or waste stack. But if the offset is at 90 degrees, or at an angle greater than 45 degrees, it is necessary in most cases to increase the diameter of the offset pipe in order to avoid developing pressures or a vacuum which would disturb the trap seal of the fixtures. Such a condition becomes more serious as the load in the stack is increased. Thus, the most critical area is at the base of the stack, or at the lowest floor in a building.
Connect to Vent Stack
Relief Vents
Yoke Vent

Size is Based on Total
Number of Fixture Units
Connected to Stack Between
Arrows

No Connection within 2'-0"
of Offset, above nor below.

90° Offset or Any Offset
Less than 45° From Horizontal
is sized same as Building
Drain, Based on Total Number
of Fixtures connected to
Upper Portion of Stack

Size is Based on Total
Number of Fixtures For
Entire Stack.
A TYPICAL ONE-STORY ROW OF HOUSES composed of four dwelling units will have a bathroom and kitchen for each unit. Several methods of installing these multiple groups are permitted by the National Plumbing Code. These four different methods are illustrated, one in each of the four dwelling units. In actual practice, one of the methods might be applied to all dwelling units.

To show how the installation of food waste disposer or an electric dishwasher would affect the requirements, such equipment is included in two of the dwellings.

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**DIAGRAMS—Continued**

ONE STORY MULTIPLE DWELLING UNIT (All Units in One Bldg.) WITH TYPICAL VENTINGS

1. W.C. is stack vented, lavatory and sink individually back vented. Tub wet vented through 2" lavatory waste. 2" waste required for sink and disposer.

2. W.C. is stack vented. Tub is wet vented through 1½" lavatory waste. Sink & disposer at different levels require 2" waste and are trapped separately. Vents must be sized as shown.

3. All fixtures except sink are stack vented and sink when individually vented only requires 1½" vent.

4. All fixtures stack vented and stack (full size) carried through roof provides complete circuit for bldg. drain.
Single Family Unit

NOTE: This vent required when floor drain is in excess of 5'-0" from vented waste line or building drain. For lesser distances it is not required.

NOTE: 2. Where drain is 4" to receive lower floor toilet, stack may be reduced to 3" and lower floor toilet need not be vented if within 5'-0" of building drain or stack.

NOTE: 3. Where Bldg. drain and stack are 3" as shown, lower floor toilets must be vented.

NOTE: 1. If toilet is within 5'-0" of a 4" building drain or stack, no vent is required.
Water Connection Main to House

- Building
- Owner's Service Line
- Service Box
- Ground Key Curb Stop
- Corporation Stop
- City Water Main Maintained by The Denver Municipal Water Works

TO FIXTURES

OWNERS BASEMENT

TO FI VEAST

Pipes

Grades and Graded Cleaned Curbing

Property Line

Sidewalk

Street
HOW TO COMPUTE VENT STACK SIZES

If soil stacks connect with the same header, the vent extension above the connections with the stack must be sized according to the size of the stack vent. In this particular case the header is increased in size only between A and C.
COMBINATION WASTE AND VENT SYSTEM

This system is a specially designed system of waste piping embodying the horizontal wet venting of one or more sinks or floor drains by means of a common waste and vent pipe adequately sized to provide free movement of air above the flow line of the drain, where permitted. This system shall be permitted only where structural conditions preclude the installation of a conventional system as otherwise provided in code. **Limits.** This system is limited to floor drains and sinks. It consists of an installation of waste piping in which the trap of the fixture is not individually vented. Every waste pipe and trap in the system shall be at least two pipe sizes larger than the code sizes given for conventional systems.
"A" in the accompanying sketch shows a sag which would cause a vent line to become useless. Vapor condensing within the line would fill it with water, thus preventing its function. This is equally true of the pocket shown in "B", where the pocket is made with 45-degree or 90-degree fittings. It would form a trap which would be filled with condensed vapor.

"C" illustrates a vent taken on a horizontal plane from a waste or soil line. Dotted line indicates backwash that would tend to cause corrosion, and a pocket where lint, paper and other solids could accumulate. This vent branch would therefore be useless. Actually, it does not really matter whether a 90-degree or a 45-degree fitting is made — if the vent is properly graded to relieve itself of any condensation.

"E" represents a method of grading with horizontal vent. At 45 degrees the flow of air for venting purposes is practically identical as at the horizontal. In the case of cast iron soil pipe in horizontal position, however, there is more chance of scale falling and gradually plugging the horizontal portion.

"F" represents a special condition sometimes encountered in a building where the horizontal branch must be dropped to run under a beam. The pocket should be drained by gravity into another vertical vent connecting with a fixture. Or, it should be carried down until such a connection is possible.

"G" shows what occurs when a plumbing fixture is to be roughed across a corridor, and a branch vent (as illustrated) must also be installed across the ceiling of the corridor, then dropped into a horizontal branch vent which is 36 inches. If the vent across the corridor is sloped or graded to either side, condensation will flow back into a drain and the vent itself will operate satisfactorily.
CHAPTER 51 – GAS FITTING CODE

Section 5100. Hazards. (a) Gas fired appliances, devices or apparatus located in any building or other structure, now in existence or hereafter erected, which have any of the following defects, shall be deemed unsafe:

Those which have broken or cracked heat exchangers, defective or deteriorated vents or venting, defective fuel supply lines or equipment, inadequate air supply for proper combustion of fuel, or defective or improperly installed and adjusted controls and appurtenances; those which are dilapidated or improperly maintained or in a hazardous location with reference to either the structure in which the same is located, the occupants or contents thereof; and those prohibited in Section 5122 hereof.

(b) Nuisances. Such unsafe gas fired appliances, devices or apparatus are hereby declared to be nuisances and shall be abated by their proper adjustment, repair, replacement or removal, and in addition the Chief Building Inspector shall mark the same with warning red tags and order the fuel supply disconnected or discontinued until the nuisance created thereby is abated.

(Ord. 248, Series 1957.)

Section 5101. DEFINITION OF TERMS. (a) Air for Combustion. Air for combustion is the amount of air required for safely and properly burning gas at the altitude of the City and County of Denver.

(b) Appliance, Gas. A gas appliance is a fixture or apparatus manufactured and designed to use natural, manufactured, mixed gas or any gas as a medium for developing light, heat or power and shall be construed herein as including, but not limited to, gas ranges, gas room heaters, gas steam and hot water boilers and gas burners of all kinds, together with any attachments or apparatus designed to be attached to any gas appliance, such as solid tops, pilot lights, governors, regulators, so-called fuel savers, and safety devices.

(c) Appliance, Unvented. A gas appliance designed or installed in such a manner that the products of combustion are not conveyed directly to a chimney or flue.

(d) Appliance, Vented. A gas appliance designed and installed in such a manner that all the products of combustion are conveyed directly to an approved chimney or flue.

(e) Approved. Approved refers to approval by the Chief Building Inspector or the Board of Appeals. Such approval may be given only in conformity with the terms, provisions, and requirements of this code and in conformity with sound engineering procedure, specifications, and recommendations as set forth by the following organizations:

American Gas Association.
American Society of Heating and Ventilating Engineers
American Standards Association
National Board of Fire Underwriters
National Warm Air Heating and Air Conditioning Association
U. S. Bureau of Standards
Underwriters Laboratory

whose procedures, specifications, and recommendations are accepted by the scientific and engineering professions as authoritative.

(f) Chimney. A chimney is a vertical masonry or reinforced concrete shaft enclosing one or more flues designed for the purpose of removing the products of combustion of solid, liquid or gas fuel to the outside atmosphere.

(g) Combustible Material. A combustible material is one which will ignite at or below a temperature of 1200° F. and will continue to burn or glow at that temperature.

(h) Combustible Material, Protected. (See Chapter 43.)

(i) Draft Hood or Draft Diverter and Automatic Draft Regulators.

1. Draft Hood or Draft Diverter. Is a device attached to or made a part of the vent outlet from an appliance and is designed to (a) insure the ready escape of the products of combustion in the event of no draft, back draft, or stoppage in the vent beyond the draft hood; (b) prevent a back draft from entering the appliance; (c) neutralize the effect of stack action of the flue upon the operation of the appliance.

2. "Automatic Draft Regulator" is a device attached to or made a part of the vent outlet from an appliance, and is designed to govern the effect of stack action of the flue upon the operation of the appliance.

(j) Flue. Flue is a conduit or pipe, vertical or nearly so in direction, designed to convey all the products of combustion to the outside atmosphere.

1. Flue—Type A. Lined chimneys or metal smoke stacks as provided for in Chapter 37.

*Source—Ord. 206, Series 1954, except where otherwise indicated.
2. Flue—Type B. Approved flue piping of non-combustible, corrosion-resistant material of adequate strength and heat insulating value and having acceptable joints and capable of withstanding continuous temperatures not in excess of 550° F.

3. Flue—Type BW. Type B. W. gas flues are special flues with special installation requirements for venting only approved vented recessed wall heaters.

4. Flue—Type D-1. Approved flue and vent piping of non-combustible, corrosion-resistant materials capable of withstanding a continuous temperature of 1000° F. or an intermittent temperature of 1400° F.

(k) Gas. The word gas, as used in this code is intended to include natural, manufactured, mixed gas or liquefied petroleum products with B.T.U. content based on the altitude of the City and County of Denver.

(l) Gas Fitting. Gas fitting is the installation of all gas and oil house piping, and all fuel piping, fittings, controls, burners, and venting for all gas and oil fired appliances and equipment.

(m) Gas Service Line. Gas service line is a pipe and fittings used to convey unmeasured gas from the main to the premises to be supplied, and in general extends underground to the inside face of the first main foundation wall through which the pipe passes.

(n) Gas Service Line Extension. Consists of all pipe and fittings including any service pressure regulators, meter headers, etc., which are installed inside the premises to connect the end of the service with the fitting to which the inlet piping for the meter installation is to be attached, and which contains unmeasured gas.

(o) Main, Gas. Street main (or main) means a portion of the system used for distributing gas, generally located entirely outside of the premises, and which is designed to supply gas to the service pipes of one or more units. The main is generally parallel to the line of the roadway in which it lies.

(p) Outlet, Gas. A gas outlet is a threaded or bolted flange connection in a house gas piping system to which a gas burning appliance is or may be attached.

(q) Piping, House Gas. House gas piping means the system of piping within a structure or a building, either exposed or concealed, which conveys gas from the outlet of the service meter or line to appliances at various places throughout the building. Any piping underground which contains measured gas is also house piping.

(r) Purge. Means to clear of air, water or other foreign substance.

(s) Rating, Input. The amount of gas fuel in B. T. U. per hour that can be safely burned in an appliance at the altitude of the City and County of Denver. (The rating is subject to approval by the Chief Building Inspector or the Board of Appeals.)

(t) Rating, Output. The amount of heat in B. T. U. per hour that an appliance will deliver for useful service when operating at rated input.

(u) Regulator, Gas Pressure. A device which maintains a substantially uniform gas pressure at its outlet.

(v) Riser. A riser is a fuel gas supply pipe which extends vertically, one full story or more.

(w) Vent. A pipe designed to convey the products of combustion from an appliance to a flue or chimney.

Section 5102. HOUSE GAS PIPING. (a) House gas piping shall be not less than standard weight wrought iron or steel pipe, or brass or copper pipe of iron pipe size.

(b) Gas pipe shall either be new or shall previously have been used for no purpose other than for the conveying of gas.

(c) Gas pipe shall be free from internal obstructions, splits, or other imperfections which would render it unfit for the purpose intended, and the ends thereof shall be properly reamed.

(d) Fittings shall be of not less than standard weight.

(e) The use of soldered joints is prohibited.

(f) Running threads or long screw joints are prohibited.

(g) Bushings, unions and compression-type couplings shall not be used in concealed work.

(h) The use of thread or joint compound, or lubricant (pipe dope), is permitted when properly and sparingly applied to the male threads only. Such compounds must be approved for the type of gas used.

Section 5103. CONSTRUCTION. (a) All gas pipes, other than liquefied petroleum gas pipes, shall be graded toward the meter wherever possible. Piping trapped by a change of grade shall be provided with a suitable drip leg, which shall be of the same size as the pipe it serves. The outlets of such drip leg shall be carried to an exposed accessible location. A tee shall be placed at the bottom of all risers in any gas piping. The bottom openings of the
tee shall be provided with a long nipple and cap the same size as the vertical pipe.

(b) All gas piping shall be rigidly supported at intervals of not more than ten (10) feet by approved metal straps or hangers in such a manner so as to prevent shifting or dislocation. Straps or hangers of aluminum or of combustible material shall not be used.

(c) All branches from horizontal runs shall be taken from sides or top of such runs.

(d) Where two or more house gas piping lines are to be supplied by individual meters, they shall be spaced horizontally not less than fifteen (15) inches apart at the gas meter location. When it is necessary to set one meter above the other, the lines shall be spaced vertically not less than twenty-four (24) inches apart at the gas meter location.

(e) In buildings or dwellings occupied by one or more families, every gas outlet hereafter connected to a gas appliance shall be equipped with an approved stop-cock adjacent to the appliance.

(f) House gas piping at multiple meter locations shall be plainly marked to designate the section of the building supplied.

(g) When gas piping is used on the exterior of a building or exposed to unusually damp conditions, it shall be coated or wrapped with approved protective covering.

(h) Piping shall be installed so as to permit proper location of gas meter.

(i) Piping systems which are supplied by separate meters shall not be interconnected.

(j) Where piping is concealed, all plugged or capped openings shall be exposed and accessible.

(k) Gas piping shall not be installed in or through chimneys, flues or in ventilating ducts or shafts.

Section 5104. UNDERGROUND PIPING. (a) Underground house gas piping shall be installed not less than eighteen (18) inches below the surface of the ground, free from traps and sags and properly graded to an accessible location. A drip shall be provided, consisting of a piece of pipe the same size as the pipe it serves, not less than eighteen (18) inches in length and such drip shall be accessible for service or cleaning. No pipe smaller than three-fourths (3/4) inch shall be used and shall be of steel or wrought iron protected with an approved coating.

(b) Pipe laid on earth surface and subsequently covered by concrete shall not be construed to be imbedded in the concrete unless it is raised above earth level and properly supported in such raised position to permit complete encasement in the concrete.

(c) Pipe laid on earth surface, or underneath the earth surface over which is to be poured concrete or other material of similar nature shall be enclosed in tile or steel pipe ducts.

Section 5105. SIZING OF PIPE. (a) All pipe used for the installation, extension, alteration and repair of any house gas piping shall be of ample size to supply the full number of outlets for the purpose intended and pipe sizes shall be determined by use of the following tables: (Not to be used for Liquefied Petroleum Gas.)

TABLE I

Capacity of Pipes of Various Sizes in Cubic Feet Per Hour Based on Natural Gas having a Specific Gravity of 0.69.

To use the table, determine the maximum gas consumption of the appliance in cubic feet per hour. Determine the length of the pipe to supply the appliance, adding three (3) feet for each bend. Opposite the length (first column) find the figure nearest to the actual maximum gas consumption of the appliance. At the top of the column is the pipe size required. The C.F.H. shown are at metered pressures and the table is based on 0.3 inch water column total pressure drop.
Length of Pipe in Feet | Nominal Pipe Diameters in Inches |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>15</td>
<td>172</td>
</tr>
<tr>
<td>30</td>
<td>120</td>
</tr>
<tr>
<td>45</td>
<td>99</td>
</tr>
<tr>
<td>60</td>
<td>86</td>
</tr>
<tr>
<td>75</td>
<td>155</td>
</tr>
<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

Greatest Length Allowed:

Size in Inches: 3/4" 1" 1 1/4" 1 1/2" 2"
Length in Feet: 60 75 90 150 180

Pipe sizes or capacities not covered in this table shall be subject to the approval of the Chief Building Inspector.

In the absence of specific information relating to actual consumption, the following table may be used as a guide to the average consumption of the appliances listed.

### TABLE II

(Based on Natural Gas having a B.T.U. Content of 830 B.T.U. at 60° F. and 24.7 inches of Mercury.)

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Small</th>
<th>Average</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Range</td>
<td>50</td>
<td>70</td>
<td>90</td>
</tr>
<tr>
<td>Domestic Water Heater (Storage Type)</td>
<td>30</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>Domestic Space Heaters (Circulating)</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Domestic Floor Type Furnace</td>
<td>25</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>Domestic Central Type Furnace</td>
<td>75</td>
<td>125</td>
<td>200</td>
</tr>
<tr>
<td>Domestic Central Type Boilers (Steam or Hot Water)</td>
<td>75</td>
<td>125</td>
<td>200</td>
</tr>
<tr>
<td>Commercial Range (Restaurant)</td>
<td>150</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>Commercial Griddle or Hot Plate</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Commercial Steam Table, per burner</td>
<td>10</td>
<td>25</td>
<td>35</td>
</tr>
<tr>
<td>Commercial Coffee Urn</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>Commercial Toaster</td>
<td></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

Industrial Appliance

Require individual determination.

Section 5106. MINIMUM SIZE OF PIPE. (a)

All fuel piping and openings shall be three-quarter (3/4) inch or larger except for gas refrigerators, bunsen burners, or small movable appliances requiring less than twenty-five (25) cubic feet per hour gas input. In no case shall the pipe size be less than one-half (1/2) inch, then the maximum length shall not exceed thirty (30) feet.

(b) In no case shall the diameter of the supply pipe to any gas appliance be of smaller size than the inlet connection of such gas appliance.

(c) In remodeling or extending existing house gas piping, connections shall be made only where sizes can be maintained in accordance with Table I.

Section 5107. TESTING FOR LEAKAGE. (a)

A leakage test shall be made after all authorized piping has been installed and before any portions thereof which are to be concealed by plastering or otherwise have been so concealed and before any fixture or gas appliance has been attached thereto. The test pressure shall not be less than double that to which the pipe will be subjected and in no case less than 10 psi, and such piping shall withstand this air pressure for a period of not less than one hour without any perceptible drop. When the test is made at 10 psi, a mercury column or an accurate pressure gauge having a maximum range
not to exceed 15 psi, shall be used. Where test is made in excess of 10 psi, a gauge having a range of not more than 10 psi in excess of the required test pressure shall be used.

(b) Leaks in gas piping shall be located by applying soapy water to the exterior of the piping. Fire or acid shall not be used to locate leaks nor shall water be introduced into the gas piping.

Section 5108. REPAIRING LEAKS. (a) Cement, acid, calking or any similar material or method shall not be used for the purpose of stopping leaks. Defective fittings or pipe shall be replaced and not repaired. The gas supply to any piping found to be leaking shall be shut off until permanent repairs are made.

Section 5109. PURGING. (a) When turning gas into new or repaired piping, air shall be thoroughly purged from the piping through an opening nearest the extremity of the piping to the outside of the structure, and all joints and connections shall be tested for leakage. When purging is completed, all outlets shall be closed and the test hand on the meter watched for at least thirty (30) minutes to make certain no leaks exist. This gas leakage test shall not be used in lieu of the pressure test.

Section 5110. CONNECTIONS TO APPLIANCES. (a) No gas fixture or gas appliance shall be removed or disconnected without capping or plugging with a screwed joint fitting, the outlet from which said fixtures or gas appliances were removed. All outlets to which fixtures are not connected shall be left capped or plugged gas tight on any piping system being installed, altered, extended or repaired. Any such plugged or capped openings shall be left accessible.

Section 5111. CHIMNEYS, FLUES AND VENTS. (For further information regarding other Chimneys, Flues and Vents, See Chapter 37.)

(a) All chimneys and flues to which gas appliances are vented shall be constructed and installed in accordance with the requirements of this Code.

(b) Type A flues shall be required for all incinerators and any appliance producing flue gas temperatures in excess of 550° F. when burning fuel at the approved input rating of the City and County of Denver. (See Sections 5126, 5136 and Chapter 37.)

(c) Type B and Type B. W. flues or vent pipes shall be used only with approved gas appliances which are not required by Paragraph (b) above, to be vented to Type A flues.

1. Type B flues shall be used only in the interior of structures except that six (6) feet may be exterior to carry the flue gases to the proper elevation. Whenever more than six (6) feet of Type B flue is exterior, it shall be insulated with one (1) inch of rock wool or its equivalent and encased in a water tight enclosure. Type B flues must be plainly and permanently marked, tagged, or labeled as follows:

<table>
<thead>
<tr>
<th>TYPE B—FLUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOR VENTING ONLY APPROVED GAS-FIRED APPLIANCES. THIS FLUE SHALL NOT BE USED FOR VENTING INCINERATORS OR APPARATUS BURNING LIQUID OR SOLID FUELS.</td>
</tr>
<tr>
<td>This tag or label shall be permanently attached to each flue inlet connection or the adjacent structure, be plainly visible, and shall not be removed as long as such flue is in place.</td>
</tr>
</tbody>
</table>

2. Type B. W. Gas flues are special approved flues with special installation requirements for venting only approved vented recessed wall heaters. Minimum clearance shall be no less than 3/8 inch from any material, combustible or non-combustible.

(d) Type D-1 flues may be used for the venting of gas-fired appliances or gas-fired incinerators, none of which produce a continuous flue gas temperature of 1000° F. or intermittent flue gas temperature of 1400° F.

(e) Every gas appliance flue, other than a masonry chimney, shall extend in a vertical direction without bends, and shall be continuous from the inlet to the flue to its outlet above the roof. The outlet of every flue shall be equipped with an approved cowl cap, open on all sides, and having a ventilating area of not less than the cross-sectional area of the flue and so constructed as to prevent entry of, or blocking by birds or rodents. Any opening in any flue cowl cap shall not be less than twenty-four (24) inches from any portion of a building and not less than ten (10) feet in a horizontal direction from any of that portion of a building or structure which extends at an angle of more than forty-five (45) degrees upward from the horizontal.

Exception: Not more than one portion of any such flue may extend at an angle of not less than thirty (30) degrees from the horizontal.

(f) Flues other than Type A may start at any desired level. Flues shall be securely anchored to the building so that they cannot be moved in any direction. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of no more than five (5) feet, and at every change in direction.
(g) Where two or more inlets are provided in any flue, such inlets shall be offset in such a manner that no section of any inlet shall be opposite to other inlets.

(h) Vent inlets not in use shall be tightly closed by means of approved caps or plugs.

(i) An accessible and approved clean-out opening with a tight-fitting cover shall be provided at least twelve (12) inches below the lowest vent inlet into chimney or flue and shall be provided with a tag marked "Clean-out," provided however, that no clean-out shall be required on Type B or B.W. Flues, with cowl caps conforming to Section 5111 (e):

(j) Rectangular or elliptical flues may be used for appliances where input will not exceed 50,000 B.T.U., Denver rated, and provided further, the flue gas carrying capacity of such flue is equal to the capacity of round pipe for which it is substituted and the ratio of its internal dimensions is not greater than 3 to 1. Transition to round Type B and B.W. pipe shall be made at the ceiling plate or ceiling joist of the room in which the heater is located, unless such pipe is specifically approved for other methods of installation.

(k) Approved safety thimbles shall be used on all inside flue pipes, except Type B or B.W. Type B metal flues shall have not less than one (1) inch clearance to combustible materials. Approved roof jacks shall be used on all flues except Type A.

(l) The total area of any chimney or flue shall either be not less than the area of the largest vent connection inlet plus 50% of the areas of all additional inlets or the total area shall be not less than 75% of the combined areas of all connected appliance vents, whichever is the greater area. No chimney or flue shall have an area of less than the equivalent of a three (3) inch round pipe. Whenever chimney or flue is other than round, its area shall be such as to provide the same flue gas carrying capacity as round pipe as specified above. (See Section 5111 (j).)

(m) The size of chimneys or flues for commercial, industrial and large heating boiler equipment shall be adequate to handle the volume of flue products produced by such equipment. (See Section 5156 and Chapter 37.)

(n) Vents and vent fittings shall be constructed of any of the following materials: Galvanized or lead coated iron or steel, stainless steel, monel, aluminum 2-S ½ H, none of which shall be less than No. 26 U.S. Standard Gauge; copper not less than sixteen (16) ounces per square foot, or any other material, metallic or non-metallic, of standard construction and weight and approved by the Chief Building Inspector. Such pipe shall be formed by means of a locked seam, and a rivet or other approved locking device of like material shall be placed at the female end of the seam in each length of pipe or fitting used. Each joint shall be lapped not less than one and one-half (1½) inches. Vents from gas ranges or water heaters in domestic kitchens may be constructed of sheet iron or steel not lighter than No. 28 U.S. Standard gauge. Vents located in non-habitable areas shall be of Type B construction.

(o) A vent pipe shall be so installed as to avoid sharp turns or other constructional features which would create excessive resistance to the flow of the gaseous products. Vents shall be securely anchored to the building so that they cannot be moved in any direction. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of no more than five (5) feet, and at every change in direction. Gas vents in excess of six (6) feet in length shall be of one-piece construction or the connecting joints shall be held together by means of rivets or other approved locking devices.

(p) All vent pipe connections to a masonry chimney or flue shall be made with a slip joint, the thimble to be cemented into the chimney and not to extend into the chimney beyond the chimney lining. Before making the vent connection, the chimney shall be examined to ascertain that it is properly constructed, clear and will normally conduct the products of combustion to the outer air.

(q) Chimneys which terminate a few feet below the ceiling of the first floor of a building, commonly called shelf or bracket chimney, shall not be used to vent any gas appliance.

(r) In buildings where the existing chimney is in such a location that it is necessary to crawl to the chimney to inspect and clean it, a new chimney or flue shall be constructed.

(s) The area of any vent shall be not less than the area of the appliance vent connection. When additional vents from other appliances are connected, the vent area shall be equal to the vent area of the appliance having the largest vent and shall be increased at least 50% of the areas of all additional smaller appliance vents or when all vent areas of such multiple connected appliances are substantially equal, the total vent area shall be not less than 75% of the combined areas of all connected appliance vents, whichever is the greater area.

(t) Horizontal runs of gas vents depending on natural draft shall not exceed seventy-five (75) percent of the vertical height of the flue and in no case exceed fifteen (15) feet in length, except by special authorization of the Chief Building Inspector.
Metal vents from approved domestic and house-heating appliances shall be not less than six (6) inches from combustible material and shall not pass through combustible walls, floors, ceilings or partitions unless they are guarded at point of passage by approved metal vented thimbles.

Type B vent or flue piping of approved double wall construction shall be installed with a clearance to combustible material or construction whether plastered or unplastered, of not less than one (1) inch, provided that for vents of floor furnaces such clearance shall be not less than three (3) inches for a distance of not less than three (3) feet from the outlet of the draft hood measured along the center line of the vent piping.

Vents from commercial, industrial and large heating boiler equipment shall be of approved material and shall have approved clearances from combustible material in accordance with the type of appliance being vented. (See Section 5136 and Chapter 37.)

A gas appliance vent pipe may be connected to the vent pipe of another gas appliance through a suitable "Y" junction fitting, provided proper increase in vent size is made to accommodate the increased volume of gases. The junction fitting shall be made so that the angle at which the two vents intersect shall not exceed forty-five (45) degrees between the inlets.

A gas appliance vent shall not be connected to the vent or smoke-pipe from an appliance burning other fuels but may be connected into the same chimney or flue through separate openings, provided the vent from the gas-burning appliance shall enter the flue above the point of entrance of such solid or liquid fuel appliance vent pipe.

No dampers or other obstructions to free flow shall be installed or left in the vent pipe from any approved domestic or house-heating appliance, or any other appliance where a draft hood or automatic draft regulator is used, unless otherwise approved by the Chief Building Inspector.

The horizontal portion of all gas appliance vents shall have a uniform rise of not less than one-fourth (1/4) inch per each lineal foot of run, and shall be free of dips or sags.

Draft hoods and automatic draft regulators. (See Section 5101 (l)).

Section 5112. GAS APPLIANCES — GENERAL. (a) Except as otherwise provided in this code, appliances so constructed that the burners are not shielded by metal or other approved insulating material shall not be located within eighteen (18) inches of any combustible material. All appliances, except floor and wall furnaces so constructed that metal shields or other approved insulating materials are an integral part of their construction, shall not be located so as to permit such metal shields or other approved insulating material to be within six (6) inches of combustible material, unless such appliances have been approved for lesser clearance. Gas appliances having open flames, such as gas plates and ranges, shall not be installed within three (3) feet of any ceiling of combustible material.

(b) All appliances shall be installed so that burners, orifices, controls, filters, motors, and blowers are readily accessible for observation, inspection and service.

(c) Means of access to room or space in which gas-fired equipment is located shall conform to other portions of this code.

(d) Gas appliances shall not be installed in a garage or any other place where inflammable vapors are likely to be present, unless the design, operation and installation of said appliance is such as to eliminate the possible ignition of inflammable vapors, and unless such appliance and installation is in accordance with the provisions of this code. (For details refer to sections on specific appliances.)

No gas or oil fired equipment shall be installed so as to constitute or create an indirect or direct fire hazard to other equipment or to the building.

Clearances to and accessibility of all gas-fired appliances, except gas-fired incinerators, shall comply with the requirements of Chapter 52 in addition to the requirements of this Chapter. Gas Fired incinerators shall comply with the requirements of Section 5126.

Section 5113. REQUIRED VENTILATION AND AIR FOR COMBUSTION. (a) All domestic, commercial and industrial gas appliances shall be installed with provision for air supply for ventilation and proper combustion. This supply of air may be taken from other parts of the house or directly from the outside.

(b) House-heating appliances including conversion burners shall have sufficient air supplied to the furnace or heater room.

1. When this air is supplied from ventilated or adjacent areas or from other parts of the house, two openings, each equal to one (1) square inch of free area per 1000 B.T.U. input rating of all gas appliances, shall be provided in the furnace room door or walls in such manner and at such locations that the sufficient supply will always be available. The minimum free area of each such opening shall be one hundred (100) square inches, and fus-
ible link dampers shall be provided where required by the Chief Building Inspector.

2. When adjacent areas do not have sufficient air infiltration to supply the air required to safely and properly burn the gas being supplied to the appliances, air shall be supplied directly from the outdoors.

3. When exhaust fans are used for exhausting air to the outdoors, air shall be supplied directly from the outdoors in sufficient quantity to replace the air removed by the fan and to supply air for combustion.

4. When air is supplied directly to the furnace room from outdoors, an opening or openings equal to one (1) square inch of free area per 1000 B.T.U. input rating of all gas appliances shall be provided and such air shall be discharged at or near the burner level of the appliance.

5. Such opening or openings to the outside shall be screened with (4) four mesh galvanized hardware cloth, having a minimum free area of one hundred (100) square inches and shall be so located that they cannot be obstructed. Whenever possible at least two openings shall be provided in diametrically opposite outside walls.

6. Whenever a heating appliance is so located that air for combustion is taken from an unexcavated or partially excavated space, permanently open ventilators from the outside shall be provided.

(c) Whenever a vented gas appliance is located in the same room or structure in which a ventilating or exhaust fan or wood-burning or coal-burning fireplace is used, protection shall be provided against fan or chimney pulling a down-draft on the appliance or appliance vent.

(d) For requirements pertaining to ranges, water heaters, refrigerators, space heaters and other miscellaneous domestic appliances, refer to sections covering installation.

Section 5114. ERECTION AND INSTALLATION — General. (a) All appliances shall be erected in accordance with manufacturers’ instructions and this code.

(b) All water, steam, air piping ductwork shall be installed in accordance with this code. Refer to Sections 5115 through 5125, and Chapter 52.

(c) Except as provided herein, every gas appliance shall be rigidly connected to the house gas piping outlet with standard weight wrought-iron pipe or steel pipe and malleable iron fittings, or copper pipe and copper fittings, or brass fittings. A ground joint or gasket union shall be placed between the outlet and the appliance.

(d) Connections from a gas outlet to a gas appliance may be made with seamless metal tubing connectors meeting the following requirements:

1. End fittings shall be screw-type or union-type, permanently attached by the manufacturer. The method of attaching such tubing connectors to the gas piping outlet and the gas appliance shall not depend upon separate ferrules, washers, gaskets or other detachable parts for gas tightness, nor shall such separate parts be used to establish and maintain the method of seal provided within the connector and fittings.

2. The overall length of such tubing connectors shall not exceed six (6) feet unless otherwise approved by the Chief Building Inspector.

3. No part of such tubing connector shall extend through any partition, floor or ceiling of a building.

(e) Each appliance connection shall include an accessible gas cock in addition to any cock on the appliance and shall always be installed ahead of any metal tubing or flexible connector. Heating equipment which is provided with main and pilot shut-off valves shall not require an additional shut-off when approved and accessible unions are provided between the burner assemblies and such valves.

(f) Flexible metal or fabric and rubber tubing permanently equipped with union or screw-type end connectors by the manufacturer may be used for connecting gas appliances designed for portable use, such as irons, clothes dryers, flat iron, dentist’s torches, etc., the location of which must be changed prior to or during operation, provided, however that such flexible tubing shall not exceed six (6) feet in length. Where such tubing is used, a shut-off valve or gas cock shall be installed at the point where the tubing is connected to the gas supply line. No valve or stopcock shall be on the outlet side of such tubing. No cooking, water heating, or space heating appliance shall be connected with any type of flexible metal or fabric and rubber tubing, except that flexible metal tubing specifically approved and not exceeding five (5) feet in length may be used to connect domestic gas ranges. Flexible tubing shall bear a seal or insignia showing that it complies with the approval requirements of an approved laboratory or other nationally recognized standards. No part of such tubing connector shall extend through any partition, floor or ceiling of a building or structure.
(g) No gas appliance, pump or similar apparatus, capable of producing a vacuum in the gas service pipe, shall be installed unless a low-pressure cutout valve or other suitable device is provided to prevent the gas pressure at the service outlet from being reduced below three (3) inches water column pressure.

(h) Where air or oxygen under pressure is used in conjunction with the gas supply, a high pressure cutout such as a check valve, shall be provided to prevent air or oxygen from entering the gas supply line.

(i) Approved draft hoods or draft diverters shall be provided in all vent pipes from domestic gas appliances unless hoods or diverters are built into the appliances, except incinerators, trash burners and other appliances specifically mentioned in this code.

(j) In special cases when draft hoods or draft diverters cannot be used, an automatic draft regulator may be used, if approval is obtained from the Chief Building Inspector. Such regulator must be equipped with:

1. An adjustable weight to balance the weight of the governing air louver.

2. A separate arm with adjustable weight to regulate the amount of draft on the appliance.

(k) The input rating to all appliances or any part thereof shall be limited to that approved by a recognized approved laboratory for high altitude operation.

(l) Appropriate instructions shall be supplied by the manufacturer or installer of gas appliances and posted permanently in a prominent position on the appliance.

(m) The occupant shall be thoroughly instructed by the installer as to the proper and safe operation of the appliance and shall have actual practice in its operation before it is placed in continuous service.

Section 5115. GAS RANGES AND PLATES.

(a) Gas ranges and plates shall not be installed in rooms used for sleeping purposes or any other room not properly ventilated.

(b) All ranges and plates shall be rigidly connected to the house gas piping outlet with not less than ½ inch pipe except that a maximum of six (6) feet of approved semi-rigid tubing not less than one-half (½) inch outside diameter may be used for such domestic appliances. (See Section 5102 and 5114 (f).)

(c) The vent from the oven of a manually controlled domestic gas range may be omitted. This exemption also applies to: (1) any domestic range equipped with automatic means for turning off the gas supply to one or more burners; and (2) any domestic range equipped with automatic means for turning on the gas supply to one or more burners, provided such burners are furnished with automatic ignition means and equipped with an automatic device which in the event that the means of ignition become inoperative, will automatically shut off the gas supply to such burner.

(d) Space heaters integral with ranges shall be vented.

(e) Hotel and restaurant ranges, deep fat fryers and unit broilers, when set on their own bases or legs, may be installed on unprotected combustible floors unless marked "For use only in fireproof location."

Hotel and restaurant ranges, deep fat fryers and unit broilers, which are not listed for mounting on a combustible floor, shall be mounted on fireproof floors or be mounted in accordance with the following paragraph, or in some manner substantially equivalent thereto that is acceptable to the Chief Building Inspector and Manager of Health and Hospitals.

1. Where the appliance is set on legs which provide not less than eighteen (18) inches open space under the base of the appliance, or where it has no burners and no portion of any oven or broiler within eighteen (18) inches of the floor, it may be mounted on a combustible floor without special protection, provided there is at least one sheet metal shield between the burner and the floor and the distance between the shield and the floor shall be not less than six (6) inches. (For Hoods, see Chapter 52.)

Section 5116. GAS REFRIGERATORS.

(a) When gas refrigerators are enclosed by adjacent equipment or wall surfaces, clearance shall be provided for ventilation around sides, top and bottom of cabinet. Whether enclosed or not, the back of the unit shall be at least two (2) inches from any wall.

(b) Gas supply line shall be constructed of at least one-half (1½) inch standard weight steel or wrought-iron pipe. Such pipe shall extend to a point adjacent to the unit. Semi-rigid connectors not more than three (3) feet in length and with a minimum outside diameter of three-eighths (3/8) inch may be used to connect from the refrigerator to the rigid piping. In no case shall this tubing extend through a floor, ceiling or partition.

Section 5117. GAS WATER HEATERS.

(a) Gas water heaters shall not be installed in any closet, bathroom, toilet room, room used for sleeping purposes, garages, in any room or space not properly ventilated, or in any recess. Water heaters shall be at least six (6) inches from any unprotected combustible material and three (3) inches from fire resistant material or
protected combustible material unless otherwise approved for lesser clearances. Uninsulated tank water heaters shall not be installed in any room where the heat liberated will constitute a fire hazard.

(b) Proper ventilation for the space in which the heater is located shall consist of permanent openings equal in effective area to two (2) square inches per 1000 B.T.U. input rating of the heater.

(c) Every gas water heater installed shall be properly vented to the outside. See Section 5111.

Section 5118. GAS-DESIGNED STEAM AND HOT WATER HEATING BOILERS. (a) A m p l e clearance shall be provided around boilers to allow ready access for cleaning and servicing of all heating surfaces and for ready removal of burner parts and controls. Suitable fireproofing shall be used where boilers are installed on or adjacent to combustible materials.

(b) Boilers shall be installed with provisions for sufficient air supply for ventilation and proper combustion. (See Section 5113, 5133 and 5134.)

(c) Boilers shall be erected in accordance with the manufacturer's instructions on a firm, level, fireproof foundation. Boilers which have been approved by a recognized approved laboratory for installation on combustible material shall not require a fireproof foundation.

Section 5119. FORCED AIR FURNACES. (a) Furnaces shall be erected in accordance with the manufacturer's instructions on a firm, level, fireproof foundation. Furnaces which have been approved by a recognized approved laboratory for installation on combustible material shall not require a fireproof foundation.

(b) Furnace sections shall be properly sealed to prevent flue gas leakage. All access openings on the blower inlet side of forced air gas furnaces and in the same room or space with the furnace shall be so constructed and labeled that they will not be accidentally opened or left open during such time as the unit is operated for heating purposes. The furnace base shall be air tight or grouted to prevent air leakage.

(c) Gas piping shall not obstruct access openings to blower, motors, filters or controls.

Section 5120. GRAVITY WARM AIR FURNACES. (a) Furnaces shall be erected in accordance with manufacturer's instructions on a firm, level, fireproof foundation. The furnace base shall be grouted to prevent air leakage. All furnace sections shall be properly sealed to prevent flue gas leakage.

Section 5121. FLOOR AND WALL-TYPE FURNACES AND WALL HEATERS. (a) Floor or wall-type furnaces shall be so located that all parts are easily accessible for service, repair, and cleaning of all heating surfaces. Adequate provisions shall be made for easy access to the furnace under the house. (See Chapter 52.)

(b) Floor and wall-type furnaces shall not be installed in any location where any portion of such furnace below the floor level would extend into any garage or space used as such, into any furnished room, into any basement space or other space used for storage purposes for inflammable materials or waste. Floor and wall-type furnaces shall not be installed in locations where surface water or excessive ground moisture is present. Floor furnaces shall not be installed in hallways or aislesways of public buildings. Temperatures on furnace grills, faces or registers set in floor shall not exceed 200° F.

(c) All furnaces shall be so installed as to prevent any possible overheating of combustible material adjacent to such furnaces, or any portion thereof, to a point where ignition of such combustible material might occur. All furnaces shall be erected in accordance with manufacturer's instructions.

Section 5122. HEATING APPLIANCES, DEVICES OR APPURTENANCES. (a) It shall be unlawful to sell or offer for sale, advertise or cause to be advertised, install, or cause to be installed, or use any and all unvented gas, oil and solid fuel fired heating appliances for use within the corporate limits of the City and County of Denver.

(b) Vented gas, oil, and solid fuel fired appliances, shall not be permitted in bedrooms, bathrooms, toilet rooms, or rooms used for sleeping purposes in new or existing structures, unless such equipment to be used in the above areas is specifically approved by the Chief Building Inspector based on the following:

Appliances, devices or apparatus to be used in bathrooms, toilet rooms, bedrooms or rooms used for sleeping purposes, shall be of the sealed combustion chamber type so that the air for combustion and the combustion and flue gases are completely sealed off from any of the aforementioned areas. Further, such equipment shall bear the seal of and shall be approved by a nationally recognized testing laboratory.

(Ord. 55, Series 1957.)

Section 5123. UNIT HEATERS. (a) Unit heaters to be installed in garages, airplane hangars and similar locations must be approved by the Chief Building Inspector for use in such locations. The location of any unit heater or the ductwork attached thereto shall be such that the fan will not create a negative pressure in the room in which the heater is located.
(b) Unit heaters designed for use with duct systems shall be installed in rooms ventilated according to the regulations for forced air furnaces.

(c) Ductwork shall not be added to unit heaters of the fan type except as recommended by the manufacturer and as approved by the Chief Building Inspector.

Section 5124. CONVERSION BURNERS. (a) The equipment in which any conversion burner may be installed shall be such that it will not endanger life, health, or property.

(b) A conversion burner shall not be installed in an appliance located in a room where the normal facilities for ventilation do not permit proper combustion of the gas, unless special provision is made for supplying sufficient air for complete combustion as prescribed in Section 5113.

(c) All appliance flues through which flue gases are conducted shall be thoroughly cleaned and made gas-tight before burners are installed. The burner or burners shall be located according to the manufacturer's instructions and shall be securely fastened in place to prevent twisting, sliding or dropping out of position. The burners shall be installed so as to be readily accessible for cleaning and inspection. The burner or burners shall be so installed that no part of the flames impinge so as to cause incomplete combustion and no baffles shall be applied that will interfere with proper combustion of gas. Where an automatic secondary air control is provided, the construction shall be such that, in case the control fails in any way, either the gas will be shut off or the secondary air door will remain open. Pilot burners shall be supported in such a manner that their position relative to the main burner or burners will be fixed. Pilot burner or burners shall be placed so that they can be safely lighted and they shall be readily accessible or removable for cleaning.

(d) Approved draft hood or its equivalent shall be installed on the vent outlet of the appliance. Where this is impossible due to construction limitations or inability to burn adequate gas in the appliance, the method of venting shall be approved by the Chief Building Inspector. The draft hood shall be located at a point not lower than the top of the highest flue passage in the appliance. Appliances of the reversible flue type shall have the draft hood located at least one (1) foot higher than the top of the highest flue passage.

(e) The internal cross-sectional area of the section of the vent pipe between the outlet of the appliance and the draft hood shall be such as to provide not less than one (1) square inch of flue area per 6000 B.T.U. hourly input to the appliance.

(f) Where dampers are an internal part of the boiler or furnace they shall be removed or permanently secured in the wide-open position, except such dampers the function of which is to alter the passage of flue gases through the appliance, which shall be locked in a position so as to not interfere with the normal operation of the burners.

(g) Boilers or furnaces shall be equipped with approved safety devices arranged to limit high steam pressures, or water temperatures, or air temperatures in warm air furnaces. (Each gas-fired steam boiler shall be equipped with a low water cut-off.)

Section 5125. LAUNDRY EQUIPMENT. (a) Adequate means shall be provided to properly ventilate the room or space in which laundry equipment is installed and to permit proper combustion of the gas.

(b) All equipment shall be erected in accordance with the manufacturer's instructions, subject to approval of the Chief Building Inspector.

Section 5126. FREE STANDING INCINERATORS — GAS-FIRED. (a) Accessibility. Sufficient clearance to permit ready access and servicing of unit shall be provided.

(b) Air for Combustion and Ventilation.

1. Sufficient air for combustion and ventilation shall be supplied to the area in which incinerator is installed.

2. When incinerator, not to exceed 4-bushel capacity, is installed in a confined area and when air is supplied from ventilated adjacent areas to the room housing the incinerator, two openings one near the floor and one near the ceiling, each with a minimum free area of 100 square inches shall be provided in the room door or walls.

3. When adjacent areas do not have sufficient air infiltration, air shall be supplied from outdoors directly to room housing incinerator through openings with a total net free area of 100 square inches for incinerators not to exceed 4-bushel capacity.

(c) Chimneys and Vents. Incinerators shall be directly vented, and only to a Type A, Type D-1 or other approved chimney or flue, and through a type D-1 vent or a vent pipe not less than 24 U. S. Standard Gauge iron with joints and supports complying with other provisions of this code. Shelf or bracket type chimneys are prohibited.

(d) Chimney Connection. Vent pipe from an incinerator shall enter the chimney or flue
below the lowest connection from any other gas
fired appliance to that chimney or flue.

[e] **Clean-Out.** A clean-out of not less than
six (6) inches in its smallest dimension, tightly
sealed but readily removable and accessible,
shall be provided in the chimney or flue-vent-
ing an incinerator and the top edge of such
clean-out shall be not less than twelve (12)
inches below the bottom edge of the lowest
vent pipe connection to such chimney or flue.

(f) **Clearance.** Incinerators free standing and
having a capacity rating not in excess of four
(4) bushels, shall have a clearance to woodwork
or other combustible material of not less than
twelve (12) inches at sides and rear, not less
than thirty (30) inches at front, thirty-six (36)
inches above, and not less than eighteen (18)
inches from the vent pipe thereof.

**Exception:** 1. Incinerators approved for
installation with lesser clearance than here-
in specified may be installed in accordance
with the conditions of such approval.

2. Incinerators may be installed with side
and rear clearances to woodwork or other
combustible material as shown in the fol-
lowing table if such woodwork or material
is protected in conformity with this table.

**TABLE III**

<table>
<thead>
<tr>
<th>Type of Protection Applied to Combustible material and covering all surfaces within the distance specified as the required clearance.</th>
<th>Required clearance without Protection is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4&quot; asbestos millboard spaced out 1 inch*</td>
<td>12&quot; Sides and Rear 6&quot;</td>
</tr>
<tr>
<td>28 gauge galvanized sheet metal on 1/4&quot; asbestos millboard</td>
<td>12&quot; 6&quot;</td>
</tr>
<tr>
<td>28 gauge sheet metal on 1/8&quot; asbestos millboard spaced out 1 inch*</td>
<td>9&quot; 4&quot;</td>
</tr>
</tbody>
</table>

\*Spacers shall be of noncombustible material and the air space shall be ventilated.

3. No clearance required to masonry con-
struction of four (4) inches or more thick-
ness, except on service side. (See Section
5126 (f).)

(g) **Draft Hoods, Prohibited.** The use of
draft hood as defined in Section 5101 (i) 1., of
this code is prohibited.

(h) **Automatic Draft Regulators.** The use of
automatic draft regulator is permitted provided
it is of a single swing type that is designed to
swing inward with the updraft but will not
swing outward in the event of a back draft.
Such draft regulator shall be the same size as
the incinerator vent.

(i) **Floors.** Incinerators shall be mounted or
set on masonry floors.

**Exception:** 1. Incinerators approved for
installation on combustible floors may be
installed in accordance with the condi-
tions of such approval, provided however,
that such floors be covered with sheet
metal of not less than 24 U. S. Standard
Gauge, and extending at the sides and
back not less than the required clearance
to combustible material and extending not
less than thirty (30) inches beyond the
front.

(j) **Locations, Prohibited.** See Prohibited Lo-
cations.

(k) **Other Incinerators.** Incinerators in excess
of 4-bushel capacity and not of the free stand-
ing type are covered by other sections of this
Building Code and shall be subject to approval
by the Chief Building Inspector.

(l) **Piping.** All gas supply piping shall be
not less than standard weight wrought iron or
steel pipe, and sized and installed in compli-
ance with other provisions of this code.

(m) **Prohibited Locations.** Installation of in-
cinerators in garages or in areas containing ex-
plodive or flammable liquids, is expressly pro-
hibited unless separated therefrom by not less
than an "absolute separation". (See Section
503 (c) 1.)

(n) **Use of Safety Thimbles.** For incinerator
vent or flue connectors, the exterior diameter of
the thimble shall be twelve (12) inches larger
than the flue or vent connection diameter. (See
Chapter 37.)

(o) **Vents.** See Chimneys and Vents.

(p) **Additional Regulation.** Gas-fired incin-
erators shall also conform to regulations issued
pursuant to Section 4601. (Ord. 44, Series 1957).

**Section 5127. SPECIAL EQUIPMENT.**
(a) Whenever it is necessary to install equipment
specifically approved for installation in fire-
proof locations on or near combustible material
such combustible material shall be ade-
quately protected and shall meet the require-
ments of the Fire Prevention Bureau and this
code.

(b) Adequate means shall be provided to
properly ventilate the room or space in which