BUILDING CODE

Volume I

Ordinance No. 1 - Series of 1965

CITY AND COUNTY OF DENVER
ACKNOWLEDGMENT

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Hon. Tom Curriigan
Mayor

John E. O'Fallon
Director, Building Dept.
ERRATA

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CHAPTER 1

TITLE, SCOPE AND ORGANIZATION

Section 100. Title.
The title of this ordinance shall be and this ordinance shall be cited as and referred to as “The Building Code” or the “Building Code of the City and County of Denver.”

Where the term “Department” is used in this Building Code, this shall mean the “Building Department.” Where the term “Director,” “Building Official” or “Chief Building Inspector,” is used in this Building Code, this shall mean the Director of the Building Department or his authorized representative. Where the term “City” is used in this Building Code, this shall mean the City and County of Denver.

Section 101. Purpose of the Building Code.
This Building Code is enacted to preserve and promote the public health, safety, and welfare of the inhabitants of the City and County of Denver, and of the public generally, by regulating and controlling the use, construction and quality of materials; location and maintenance of buildings, structures and utilities within the City and certain equipment specifically regulated herein including Air Pollution Control.

Section 102. Severability and Transition of Building Code.
If for any reason any one or more sections, sentences, clauses or parts of the Building Code are held invalid, such judgment shall not affect, impair or invalidate the remaining provisions of this Building Code but shall be confined in its operation to the specific sections, sentences, clauses or parts of this ordinance held invalid and the invalidity of any section, sentence, clause or part of this ordinance or in any one or more instances shall not affect or prejudice in any way the validity of this Building Code in any other instance.

All offenses committed and all liabilities incurred prior to the effective date of this ordinance shall be treated as though all prior applicable ordinances and amendments thereto were in full force and effect for the purpose of sustaining any proper suit, action or prosecution with respect to such offenses and liabilities.

Section 103. Scope of Building Code.
The Building Code shall extend to and govern the following:

(a) Construction, addition, alteration, repair, demolition, removal, moving, occupancy and maintenance of any building, structure or utility hereafter erected.

(b) Alteration, addition, repair, demolition, removal, moving, change of occupancy and maintenance of any existing building, structure or utility heretofore erected.

(c) Air pollution control.

Section 104. Organization.
(a) Creation of Building Department; Director.
There shall be and is hereby established, as an agency under the Mayor, a Building Department. This Department shall be administered by a Director appointed by the Mayor and whose powers and duties are hereinafter defined. The Director shall be an engineering graduate of a recognized engineering college or university and a professional engineer registered by the State of Colorado or a graduate architect from a recognized school of architecture and an architect licensed by the State of Colorado.

(b) Authorization and Identification. The Director shall authorize or appoint various individuals to carry out such duties and exercise such powers as may be delegated to him by this Building Code.

Each employee of this Department shall be provided by the City with an identification card bearing information required by the Director. Such identification card shall bear the authority of this Section. Such card shall be carried upon the person identified, and shall be used when necessary to identify such person properly while performing his official duties.

Section 105. General Powers and Duties of the Building Department; Director.
This Department, administered by the Director shall administer and enforce this Building Code and all other ordinances and codes which may hereafter be assigned to the Department for enforcement and administration. There are hereby vested in the Department the duties of enforcing and administering this Building Code and the power necessary for such enforcement.
(a) Authority to inspect. The Director shall have the authority to inspect, or cause to be inspected for compliance to this Building Code, all buildings, structures or utilities.

(b) Investigations and Surveys. Incidental to any of these duties and powers, but without limitation of same, the Department shall conduct investigations and surveys to determine compliance or non-compliance with the provisions of this Building Code and shall investigate or cause to be investigated all incidents pertaining to buildings, structures or utilities for the purpose of ascertaining whether the requirements of this Building Code have been violated.

(c) Right of Entry. Incidental to such inspections, investigations and surveys, an authorized representative of the Director may enter into and upon and cause any land, building, structure or utility to be inspected and examined. A failure or refusal to permit such entry and inspection, after the issuance by the Department of an order therefor, shall constitute a violation of this Building Code. Additionally, the right to entry and inspection may be enforced by application to and proper orders from a court of proper jurisdiction.

(d) Stop Orders. Wherever any work is being performed contrary to the provisions of this Building Code, the Department may order the work stopped by notice in writing served on any person engaged in such work and/or causing such work to be performed. The order shall be given to the owner or licensee or their agents.

It shall be unlawful for any person to proceed with such work until the corrective action required to be performed by such notice is accomplished.

Section 106. Valuation.
The determination of value or valuation under any of the provisions of this Building Code or any of the several codes or ordinances enforced and administered by this Department shall be made or caused to be made by the Director and shall be the reproduction cost new without depreciation and without regard to any loss occasioned from fire or other causes. The valuation of the structure and each of the utilities, as defined in Chapter 4, shall be made independently.

Section 107. Unsafe Buildings or Structures.
An unsafe building or structure is one which constitutes a fire hazard or hazard to life, health, property or public welfare by reason of use, construction, quality of materials and inadequate maintenance or dilapidation. However, without limitation of the foregoing, any building or structure in which any one or more of the following conditions exists shall be deemed conclusively to be an unsafe building or structure.

(a) Those in which a wall or other vertical structural members lists, leans or buckles to such an extent that a plumb line passing through the center of gravity falls outside of the middle third of the base.

(b) Those which, show damage or deterioration to any structural or load bearing member or members to the extent that such members do not have sufficient strength to resist all applicable loads specified in Chapter 23. Also, those which show damage or deterioration of non-bearing exterior walls or enclosures to such an extent that they will not resist the wind pressure or lateral forces in accordance with the requirements of Chapter 23, or show damage or deterioration of any exposed exterior member or members to the extent that such member or members provide inadequate protection from the elements to the occupants or contents of such building or structure.

(c) Those in which the loads upon the floors or roofs exceed the maximum design limits.

(d) Those whose facilities for egress fail to conform to the requirements of Chapters 30 and 33 of this Building Code.

(e) Those which have parts thereof which are so attached that they may fall and cause injury to the public or property.

(f) Incompleted buildings or structures when the permit has been cancelled.

(g) Open pits, open wells and open excavations of all types when such are determined to be hazardous by the Director.

(h) Trenches or ditches not properly shored or cribbed.

Section 108. Unsafe Utility.
An unsafe utility is one which constitutes a fire hazard or a hazard to life, health, property, or the public welfare by reason of use, construction, quality of materials and inadequate maintenance or dilapidation. However, without limitation of the foregoing, any utility in which any one or more of the following conditions exists shall be deemed conclusively to be an unsafe utility.

(a) Gas fired, oil fired or solid fuel fired appliances, devices, or apparatus which have any of the following defects:

1. Broken or cracked heat exchangers.
2. Defective or deteriorated vents, venting or flues which permits leakage of flue gases through the walls.
3. Defective fuel supply lines.
4. Insufficient air supply for combustion of fuel.
5. Defective or improperly installed and adjusted controls and appurtenances.
6. Equipment locations which will constitute a fire or explosion hazard.
7. Defective or improperly installed equipment.
8. Excessive exhaust in boiler, furnace rooms or areas where gas, liquid or solid fuel fire equipment is located.
9. Trenches or ditches not properly shored or cribbed.

(b) Elevators, escalators, dumb waiters and similar conveyances or apparatus which have any of the following defects:

1. Hoisting, counter-weight or governor ropes with frayed or broken strands.
2. Operation in hoistway, including the pit and the penthouse, that is being used to store material other than elevator equipment.
3. Operation in a hoistway, including the pit and penthouse, that is in danger as a result of accumulations of dust or other highly combustible material on the mechanism or in the hoistway.
4. Brake mechanism not functioning or not functioning properly.
5. Not safety tested in accordance with the requirements of this Building Code or where required safety devices have been disconnected.
6. Where hoistway entrance protection does not meet the requirements of this Building Code.
(c) Electrical systems, appliances, devices or apparatus which have any of the following defects:
1. Bare wiring.
2. Poor connections.
3. Overloaded circuits, feeders or services.
4. Equipment not properly grounded.
5. Disconnecting means not provided at the appliance.
6. Over-fused circuits.
7. Misuse of cord wiring.
8. Wiring not properly supported.
9. Non-approved wiring exposed to extreme heat, moisture, gases or other harmful vapors or liquids.
10. Trenches or ditches not properly shored or cribbed.
(d) Boilers and their appurtenances which have any of the following defects:
1. Excessive scaling, corrosion; cracks in seam, tubes or shell.
2. Defective valves, gauges or cocks.
3. Defective burners, piping, shutoffs or controls.
4. Grooving or pitting.
5. Defective vents, venting or flues which permits leakage of flue gases through the walls.
6. Inadequate air supply for combustion of fuel.
7. Defective or improperly installed and adjusted controls and appurtenances.
8. Hazardous location of equipment which will constitute a fire or explosion hazard.
(e) Refrigeration equipment which has any of the following defects:
1. Inadequate ventilation.
2. Inadequate venting of pressure relief valves.
3. Unauthorized fuel fired equipment located in the same room as the refrigeration equipment.
4. Improperly installed cooling towers by reason of location, type, fan, water condition, controls or roof or floor overload.
5. Faulty controls.
(f) Plumbing systems which have any of the following defects:
1. Where the water does not meet the standards for potability as required by the Colorado State Department of Public Health and the City Department of Health and Hospitals.
2. Those water systems subjected to the hazards of back-flow or back syphonage, which might create pollution.
3. Where inadequate piping does not supply sufficient water. (See Chapter 50).
4. Where drainage systems are fouled and depositing solids.
5. Clogged sewers and drains.
6. Where no seal trap is provided or is inadequate.
7. Inadequate venting.
8. Leaking water, sewage or sewer gas within a building.
9. Trenches or ditches not properly shored or cribbed.

Section 109. Abatement and Notice of Unsafe Buildings, Structures or Utilities.
After inspection, if the building, structure or utility is determined to be unsafe it shall be declared a nuisance to be abated by repair, replacement or removal, upon notice by the Director to the person or persons having a record interest therein.
(a) Unsafe Building or Structure. In the case of an unsafe building or structure, the Director may order such building or structure or any buildings or structures placed in jeopardy by the unsafe building or structure, vacated immediately and the buildings or structures shall be posted in accordance with other provisions of this Building Code. Such buildings or structures shall not be reoccupied until determined safe by the Director.
(b) Unsafe Utility. In the case of an unsafe utility, the Director shall attach or affix a warning red tag to the unit declared to be unsafe. Where a utility is declared to be unsafe, the Director shall order such utility disconnected or its use discontinued until the nuisance created thereby is abated. In addition he may order any building, structure or utility which is placed in jeopardy by the unsafe utility to be vacated or disconnected and these shall not be reoccupied or reconnected until deemed safe by the Director.

It shall be unlawful for any person, firm or corporation to mark any unsafe utility as herein defined, with any type markings or tags declaring such to be unsafe except as authorized by the Director.
(c) Emergency Demolition. In the event an emergency should occur wherein the continued existence of a building, structure or utility would constitute a hazard to life, health or other property, the Director may cause such building, structure or utility to be demolished, removed or disconnected, at once by any such means as are available to him. Recovery of the cost and expense of demolition and removal shall be made as provided for in this Building Code.
(d) Emergency Sidewalk Barricades. If any building or structure is a hazard to life or limb of persons using a public walk, the public way shall
be barricaded to prevent public use. The necessary barricades shall be erected on order from the Director.

e) Posting of Signs. When necessary to protect life, health and public welfare, the Director may post signs which shall prohibit entry into an unsafe building or structure; provided, however, that with permission of the Director, it shall be lawful to enter the building for the purposes of effecting any required repairs, rehabilitation, or demolition. It shall be unlawful to remove any such sign without permission from the Director. It shall be unlawful to enter, occupy or inhabit such unsafe building or structure contrary to the terms of this Building Code.

(f) Service and Notice. Service of any notice may be by personal service, as defined by the Colorado Rules of Civil Procedure, or may be made by registered or certified mail, return receipt requested and service shall be deemed complete upon delivery. In the event the address of a person to be notified is unknown or the receipt of a notice which has been mailed is returned unsigned, such notice may be served by posting the same on a conspicuous place on the premises upon which the unsafe building is located, in which event service shall be deemed complete as of the moment of posting.

(g) Demolition by City. If the owner of any unsafe building, structure or utility fails to carry out the repairs, rehabilitation, or removal required to be carried out on notice within the time specified in such notice, the Director shall, upon receiving competitive and responsible bids, cause the demolition and/or removal of such building, or structure or utility. Recovery of the cost and expense of demolition and removal shall be made as provided for in this Building Code.

(h) City’s Lien for Costs. In the event the owner or owners fail to pay the costs and expenses of demolition or removal, the Director shall serve notice upon the person or persons having a recorded interest therein, and in the manner provided for in this Section, as to the amount of such costs and expenses, and he will at a time and place specified in the notice, hold a hearing when and where such persons shall be required to show cause why said amount should not be paid and a lien placed against the property.

In the event said persons fail to show cause as provided, said amount shall constitute a lien against the real property upon which the building or structure was or is situate. The Director shall thereafter pay the cost and expense of demolition and removal from any appropriation made available for that purpose and shall certify a statement thereof to the Manager of Revenue who shall assess and charge the same against the property involved and collect the same due, together with interest at the rate of interest established by law for delinquent real property taxes.

The lien created hereby shall be superior and prior to other liens, regardless of date, except liens for general and special taxes.

For purposes of this Building Code, cost and expense shall include the demolition or removal and all administrative costs incurred therewith.

Section 110. Additions, Alterations, Repairs and Maintenance of Existing Buildings, Structures or Utilities.

(a) General. Existing buildings, structures or utilities to which additions, alterations or repairs are made or required to be made pursuant to Sections 107, 108 and 109 of this Building Code, shall be made to comply with all the requirements for new buildings, structures or utilities unless otherwise specifically provided in this Building Code.

(b) Additions, Alterations and Repairs; Exceeding 75 Per Cent. Any existing building or structure which is for any reason, added to, altered or repaired within any 12 month period, in excess of 75 per cent of the value thereof, shall be made to conform with all of the requirements of this Building Code. Repair work performed to maintain the structural integrity of the foundations shall not be included in the allowable 75 per cent valuation. The determination of the Director shall be conclusive as to the per cent of improvement.

(c) Additions, Alterations and Repairs; Not Exceeding 75 Per Cent. Such additions, alterations and repairs not exceeding 75 per cent of the value of an existing building or structure shall be made to comply with the requirements of this Code for the type of building or structure of the intended occupancy.

(d) Utilities. All utilities used within or on all buildings or structures now existing shall be made to conform to the requirements of this Building Code when such alterations or additions exceed 75 per cent of the valuation of the existing utilities, except that this provision shall not apply to Group 1 Occupancies, (See Chapter 53 for electrical requirements).

(e) Use and Occupancy. The use or occupancy of any existing building or structure shall comply with the provisions of Chapters 3 and 5 of this Building Code.

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

Section 111. Alternate Methods, Materials and Equipment.

(a) General. The provisions of this Building Code shall not prevent the use of alternate methods, materials or equipment which meet the reasonable safe standards of strength, safety, sanitation, and fire resistance required to be met in any
 Alternate Methods, Materials and Equipment. It shall be unlawful for any person, firm or corporation to use any method, material or equipment as an alternate to the methods, materials or equipment permitted by this Building Code without first having obtained approval in the manner provided.

2. Licensing. It shall be unlawful to erect, construct, enlarge, remodel, alter, repair, move, improve, remove, convert or demolish any building, structure or utility in the City without first obtaining a license or certificate in accordance with the provisions of this Building Code.

3. Licensee and Certificate Holder Responsibility. It shall be unlawful for any licensee or certificate holder to commit any violation of the responsibilities as enumerated elsewhere in this Building Code.

4. Drawings and Specifications. It shall be unlawful to make application for a permit without first having submitted drawings and specifications as required by provisions of this Building Code.

5. Permits. It shall be unlawful to erect, construct, enlarge, remodel, alter, repair, move, improve, remove, convert or demolish any building or structure or utility without first having obtained a permit as required by provisions of this Building Code.

6. Certificate of Occupancy. It shall be unlawful for any person, firm, or corporation to occupy any building or structure without first having obtained a Certificate of Occupancy as required by the provisions of this Building Code.

7. Unsafe Buildings. It shall be unlawful for any person, firm, or corporation to maintain or permit to be maintained, any building, structure or utility when such building, structure or utility is unsafe in accordance with the provisions of this Building Code. These requirements shall apply to buildings, structures or utilities, new, existing, under construction or being demolished.

8. Wrecking. It shall be unlawful to sell or to advertise for sale used building material at the site of wrecking operations.

9. Burning of Waste Material. It shall be unlawful for any contractor to burn paper, refuse, waste, or other materials at the site of any wrecking or building operation.

(b) Violations. Wherever, by the provisions of this Building Code, the performance of any act is prohibited or wherever any regulation, dimension or limitation is imposed on the erection, alteration, maintenance or occupancy of any building, structure or utility, a failure to comply with the provisions of this Building Code shall constitute a violation. Every day on which a violation exists shall constitute a separate violation and a separate offense.
2. **Penalties.** Whenever in any section of this Building Code, or any section of a rule or regulation promulgated hereunder, 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 shall, for each offense, be fined in a sum not more than three hundred dollars ($300.00) or imprisoned not to exceed ninety (90) days, or both so fined and imprisoned. The suspension or revocation of any license, certificate, permit or other privileges conferred by the City shall not be regarded as a penalty for the purposes of this Building Code.

3. **Remedies.** In the event any building, structure or utility is erected, constructed, reconstructed, altered, repaired, converted, demolished, moved, or maintained; or any building, structure or utility is used in violation of this Building Code, the City or any proper person may institute any appropriate action or proceedings to prevent such unlawful erection, construction, reconstruction, alteration, repair, conversion, maintenance or occupancy, to restrain, correct or abate such violation or to prevent the occupancy of said building, structure or land. The imposition of any penalty hereunder shall not preclude the City or any proper person from instituting any appropriate action or proceeding to require compliance with the provisions of this Building Code and with administrative orders and determination made hereunder.

{Ord. 480 – Dec. 19, 1969}
CHAPTER 2-A
BOARD OF APPEALS

Section 201. Board of Appeals
(a) Membership. There shall be in the City a Board known as "The Board of Appeals" hereinafter referred to as the "Board" which shall consist of five (5) members, three (3) of which shall constitute a quorum. The members of the Board shall be appointed by the Mayor within thirty (30) days after this ordinance becomes effective and shall be constituted of persons with the following qualifications:

One Professional Engineer: Registered by the State of Colorado.
One Architect, Licensed by the State of Colorado.
Three Citizen Members (not associated with building industry).

The Board of Appeals, when and only when hearing appeals from Chapter 44 "Air Pollution Control" of this Building Code, shall consist of the above five (5) members and an additional four (4) members for a total of nine (9) members, five (5) of which shall constitute a quorum. The said four (4) additional members of the Board shall be appointed by the Mayor and shall be constituted of persons with the following qualifications:

One Professional Engineer, Registered by the State of Colorado, with at least five years experience in the actual practice of his profession and who is not from industry, and is qualified in the Mechanical or Chemical Engineering fields.
One Physician licensed to practice in the State of Colorado and who is not from industry.
Two Citizen Members from industry in this City and County. (ORD. 297-1966.)

There shall be a Secretary of the Board, appointed by the Mayor and such Secretary shall be without voting power. The Secretary shall be the custodian of the records, conduct correspondence and be responsible for clerical work of the Board. The Secretary shall be present at all meetings and shall present all relevant information regarding appeals to the Board. The Secretary shall notify all interested parties regarding such matters as may come before the Board prior to the meeting of such Board.

(b) Board of Appeals Advisory Committee.

There shall be in the City an Advisory Committee to the Board of Appeals whose members may be requested to appear individually before the Board of Appeals. Such appearance may be at the request of the Board members, the Director or by their own request in behalf of any case before the Board of Appeals in which they have a concern.

The members of the Advisory Committee who appear at the regular meetings of the Board of Appeals shall be paid at the same rate as the members of the Board.

In the case where a member's appearance is at his own request, the Director shall have authority to approve or disapprove his appearance in any specific case before the Board. In the event a member should be aggrieved by the Director's disapproval of his appearance before the Board, he may write directly to the Chairman of the Board indicating his reasons for wishing to appear on any specific case. He will then be permitted to appear at that scheduled meeting with no further action required by any party. However, after hearing the member's interest in the specific case, the Board shall determine if such appearance shall be construed an official appearance and whether or not it shall be reimbursable. The Board shall then instruct the Director either to reimburse or not reimburse the member for such appearance. The portions of this Chapter regarding appeals shall not apply in this procedure.

This Advisory Committee shall consist of the following:

A representative of the Building Trades Council.
A representative of the Building Contractors.
A representative of the Plumbing Contractors.
A representative of the Electrical Contractors.
A representative of the Air Treatment Contractors.
A representative of the Steam and Hot Water Contractors.
A representative of the Refrigeration Contractors.
A representative of the Wrecking Contractors.
A representative of the Gas Service Contractors.
A representative of the Sign Contractors.
A representative of the Fire Protection Contractors.
A representative of the Elevator Contractors.
A representative of the Domestic Appliance Contractors.
A representative of the Stationary Engineers.
A representative of the Refrigeration Operators.
A representative of the Denver Fire Department Fire Prevention Bureau designated by the Chief of the Denver Fire Department.
A representative of the Denver Department of Health and Hospitals designated by the Manager of Health and Hospitals.

The Advisory Committee shall have no voting power on matters before the Board of Appeals but shall act only in an advisory capacity to the Board.

(c) Terms. The members of the Board shall be appointed by the Mayor to serve a term of two (2) calendar years and may be removed only for cause upon written charges and after public hearing. The members of the Board serving on the effective date of this ordinance, under a Building Code effective prior hereto, shall be and constitute the first Board hereunder and each member thereof shall serve the balance of the term to which he was appointed. Any vacancy which occurs in the Board shall be filled by the Mayor for the unexpired term of any member whose term became vacant. No member of the Board shall serve more than two (2) consecutive full terms or a total of more than four (4) consecutive calendar years.

Except for the representative of the Denver Fire Department Fire Prevention Bureau designated by the Chief of the Denver Fire Department and except for the representative of the Denver Department of Health and Hospitals designated by the Manager of Health and Hospitals, no member of the Advisory Committee shall serve more than two (2) consecutive full terms or a total of more than four (4) consecutive calendar years.

(d) Meetings. Regular meetings shall not be held more often than twice in each month. At the first regular meeting of each calendar year, one of the members of the Board shall be elected as Chairman and one as Vice-Chairman. No appeal shall be considered unless filed with the Director at least ten (10) days prior to the meeting. The chairman of the Board shall require that all members be polled during voting at the meeting and shall instruct the Secretary to record each vote of aye or nay.

Special meetings shall be held at the call of the Chairman and at such other times as the Board shall determine. Any special meeting held at the request of an appellant shall be paid for by said appellant which payment shall be one hundred and twenty-five dollars ($125.00).

(e) Compensation. Each member of the Board, not employed by the City, shall receive twenty-five ($25.00) dollars per regular meeting attended. The Secretary shall be compensated not to exceed $200.00 per month.

(f) Duties. It shall be the duty of the Board:

1. To hear and decide appeals where it is alleged there is error in any order, requirements, decision or determination made by the Director in the enforcement of this Building Code.

2. To pass upon appeals where there are practical difficulties or unnecessary hardships caused by conformance to the strict letter of this Building Code, to vary or modify the application of any of the regulations or provisions of this Building Code relating to the construction or alteration of buildings, structures or utilities so that the intent of this Building Code shall be observed to the end that public safety and welfare is secured and substantial justice done.

(g) Procedures and By-Laws. The Board shall be authorized to make rules of procedure and adopt bylaws necessary for the transaction of business consistent with this Building Code.

(h) Powers of the Board.

1. Any person, firm or corporation aggrieved by a decision of the Director in the enforcement of this Building Code, or any person, firm or corporation who has been ordered by the Director in the enforcement of this Building Code to incur any expense, or any person who feels that there are practical difficulties or unnecessary hardships involved in carrying out the strict letter of this Building Code, or where it is alleged there is error in any order, requirements, decision or determination made by the
Director in the enforcement of this Building Code, may within thirty (30) days after being notified of such refusal or order, appeal the decision of the Director in the enforcement of this Building Code by filing an application with the Board.

2. Whenever the owner of an alleged unsafe building, structure, utility or other condition does not agree with the order from the Director in the enforcement of this Building Code as to the corrections to be made, he shall have the right to appeal to the Board within thirty (30) days from the date of said order stating how he proposes to make the building, structure, utility or other condition safe, and if required by the Board shall submit detailed engineering analyses or recommendations accompanied by plans and specifications prepared by a Colorado Licensed Architect, a Colorado Registered Professional Engineer or a licensed contractor who also holds a Certificate of Qualification as issued in accordance with the requirements of this Building Code, or other substantiating data concerning the removal or other remedial steps to be taken to render the building, structure, utility or condition safe.

3. The Board may, in exercising its powers, reverse or affirm wholly or in part, or modify the order, requirements, decision or determination made by the Director in the enforcement of this Building Code appealed from and shall render its order, requirements, decision or determination. The concurring vote of three (3) members of the Board shall be necessary to render a decision in all cases except cases involving appeals from Chapter 44 “Air Pollution Control” of this Building Code. The concurring vote of five (5) members of the Board shall be necessary to render a decision in all cases involving appeals from Chapter 44 “Air Pollution Control” of this Building Code. Such decision shall be in writing and a copy shall be furnished to the appellant.

Section 202. Method of Application; Fee.
Prior to any action by the Board, an application shall be filed in the office of the Department on a form providing necessary information required by the Board. Upon filing the application, a fee of ten dollars ($10.00) shall be paid the City for appeal from decisions, orders, requirements or determinations issued by the Director in the enforcement of this Building Code. All checks shall be made payable to the Manager of Revenue and shall be paid in the office of the Department.

Section 203. Appeals from Decisions of the Board.

(a) Procedure. Any person aggrieved, any taxpayer, the municipality or any officer or department of the municipality may have a decision of the Board reviewed in the manner provided by rules relating to civil proceedings. No such review shall be granted unless a petition therefore, duly verified, setting forth that such decision is illegal, in whole or in part, and specifying the grounds of the illegality, is presented to a court of record within thirty (30) days after the filing of the decision in the office of the Board. The Board shall not be required to return the original papers acted upon by it, but it shall be sufficient to return copies thereof or such portions thereof as may be called for. The return shall concisely set forth such other facts as may be pertinent and material to the decision appealed from and shall be verified.

(b) Effect of Appeal. The issuance of a writ on a petition hereunder shall not stay proceedings upon the decision appealed from but the court, on application after notice to the Board and on due cause shown may grant a restraining order.

(c) Costs. Any person applying to the courts for a review of a decision of the Board shall be required to pay the costs of preparing a transcript of proceedings before the Board in the amount of One Hundred Dollars ($100.00) whenever such a transcript is demanded by the person taking the appeal or when such a transcript is furnished by the Board pursuant to court order.

(Ord. No. 481 Dec. 19, 1969)
CHAPTER 2-B  
LICENSING, CERTIFICATION,  
BOARD OF EXAMINERS

LICENSING

Section 210. AUTHORITY.

(a) Licenses and Certificates of Qualifications. There is hereby vested in the Building Department thereof, pursuant to law, the duty of determining the qualification of applicants for those certain licenses and certificates established by the Building Code, including the issuance, reissuance, renewal, suspension or revocation of such licenses and certificates.

(b) Examining Procedures.

1. The Director shall establish examining procedures and shall be the examining body for issuance of licenses.

2. The Board of Examiners shall establish examining procedures and shall be the examining body for Certificates of Qualification for the Director.

Section 211. LICENSES DEFINED AND REQUIRED

(a) Definition. A license is authority granted to the person, firm, partnership, company, corporation, association, agency or political entity to whom it is issued to perform certain work and is not transferable.

(b) Licenses Required. Licenses shall be required for all types of work hereinafter specified and classified.

EXCEPTION: Public Utility Companies will not be required to obtain licenses for the firm or corporation nor for their employees when engaged in the installation, operation and maintenance of equipment which will be used for the production, generation or distribution of the utility, product or service through the facilities owned or operated by such utility company to the point of the customer service.

(c) Application and Fee. Every applicant for a license shall fill out a form provided by the Department and shall pay an application fee of fifteen dollars ($15.00) at the time of filing. Such fee shall not be refundable and shall not apply on the license fee. The name of the certified supervisor shall appear on the license application. A final review and appropriate action shall be taken on such license application and the applicant shall be notified accordingly. The applicant shall procure such license within 90 days after notification of approval of such license. Thereafter, a new application with fee shall be filed; but no re-examination shall be required.

If the application for license is disapproved, the applicant may appeal from such adverse decision to the Board of Appeals in the manner provided in this Building Code.

(d) Supervisor Required. Every licensed person, firm or corporation shall be required to have in their employ a supervisor who holds a Certificate of Qualification. The license shall be valid only as long as the named supervisor shall remain in the employ of the licensee in an active full time capacity. If the supervisor should leave the employ of the licensee, the licensee shall notify the Department immediately. The licensee shall be required to obtain a supervisor certified according to the requirements of this Building Code within 15 days after the date the supervisor leaves the employ of the licensee. If such supervisor is not obtained with the 15 day period, the license may be deemed suspended until such supervisor is obtained. Failure of the licensee to notify the Department immediately that the supervisor has left the employ of said licensee shall be cause for suspension or revocation of the license. If the licensee be an individual, he may qualify as the supervisor for that license. (See Section 225 for requirements for Certificate of Qualification.)

The following licenses shall not require a supervisor:

- Building Contractor Class E
- Sign Contractor Class B
- Lawn Sprinkler Contractor
- Electrical Signaling Contractor

Section 212. CLASSIFICATION OF LICENSES.

(a) General. There shall be various classes of licenses and the holder of each license shall be authorized to do the following:

1. Building Contractor Class A. Building altering, or adding to the struc-
tural portions of all types of any building, structure or portion thereof, including all structural steel and iron, and new construction, remodel, alter, the demolition of all or any part of a building or structure on a site on which he will build or repair an existing building or structure. All work shall be performed by or under the supervision of the holder of a Class A Construction Certificate of Qualification.

2. Building Contractor Class B. Building altering or adding to the structural portions of any building, structure or portion thereof of all types of any building, or portion thereof, except that buildings of Type 1 or 2 construction shall not exceed the height and area which would be permitted for Type 3 construction and shall include the demolition of only that portion of the building or structure on which he will make alterations or repairs, except that any J Occupancy building may be demolished. In addition, this licensee shall be permitted to do any or all of the work permitted under the provisions of a Building Contractor Class C license. All work shall be performed by or under the supervision of the holder of a Class A or B Construction Certificate of Qualification.

3. Building Contractor Class C. Building altering, or adding to the structural portion of any building or structure or portion thereof of Group I or J Occupancy. In addition, work may be performed on any type of building or structure provided the character of the work is non-structural. Such demolition as will be necessary to prepare the building for alterations or repair may be performed under this license, except that any J Occupancy building may be demolished. All work shall be performed by or under the supervision of the holder of a Class A, B or C Construction Certificate of Qualification.

4. Building Contractor Class D. Work listed under the appropriate number involving any one of the following skills: All the work enumerated in this Section shall be performed by or under the supervision of the holder of the particular Class A, B, C or D Certificate of Qualification.

D-1 Lathing, Plastering and Dry Wall. Installation of all lathing, plastering and dry wall.

D-2 Roof Covering and Waterproofing. Installation of new roof and re-roof coverings, including the installation of valleys, flashings, waterproofing, downspouts and gutters.

D-3 Masonry. Laying and forming masonry.

D-4 Sand Blasting and Cleaning. Sand blasting, cleaning or texturing of the exterior of buildings or structures.

D-5 Well Drilling, Excavating, Concrete, Foundations and Caissons. Well drilling, all types of excavating work, installation of concrete except that portion on City property, installation of foundations and caissons.

D-6 Moving. Moving of any and all types of buildings or structures.

D-7 Swimming Pools. Installation of swimming pools, but shall not include the installation of utilities.

D-8 Structural Metals. The erection or fabrication of metals only for all types of buildings, structures or utilities excluding the complete construction of Type IV buildings.

5. Building Contractor Class E. Perform the work involving any or all of the following skills:

- Acoustical Insulation
- Exterior Sheet Metal
- Fences
- Glass and Glazing
- Miscellaneous Metal
- Patio, Carport, Marquee and Awning
- Pipe and Duct Insulation
- Retaining Walls
- Scaffold Erectors
- Siding
- Temperature Insulation
- Tile and Marble

A certified supervisor shall not be required for this license.
6. Wrecking Contractor Class A. Demolishing or wrecking any building or structure or portion thereof. All work shall be performed by or under the supervision of the holder of a Class A Wrecking Certificate of Qualification.

7. Wrecking Contractor Class B. Demolishing or wrecking any building of not over two stories in height, excluding the basement. All work shall be performed by or under the supervision of the holder of a Class A or B Wrecking Certificate of Qualification.

8. Electrical Contractor Class A. Installation of electrical wiring, electrical apparatus and appliances, including fire detection, fire alarm and burglar alarm systems and pneumatic controls systems. All work shall be performed under the supervision of the holder of a Master Electrical Certificate of Qualification.

9. Electrical Contractor Class B. Installation of electrical wiring, electrical apparatus and appliances in I and J Occupancies only. All work shall be performed by or under the supervision of the holder of a Master Electrical Certificate of Qualification.

10. Plumbing Contractor Class A. Installation of all sanitary plumbing and portable water supply piping and appliances connected thereto, and including gas piping and the complete installation of water heaters, the installation of piping for transmission of chemicals and gases; the installation of gas ranges, domestic gas incinerators, gas dryers and gas refrigerators. All work shall be performed by or under the supervision of the holder of a Master Plumbing Certificate of Qualification.

11. Plumbing Contractor Class B. Installation of all sanitary plumbing and portable water supply piping and appliances connected thereto and including all gas piping and the complete installation of water heaters (100 gallons or less storage capacity), gas ranges, domestic gas incinerators, gas dryers and gas refrigerators, in I and J Occupancies. All work shall be performed by or under the supervision of the holder of a Master Plumbing Certificate of Qualification.

12. Steam and Hot Water Contractor Class A. Installation of steam and hot water heating systems, process and industrial piping, and related appurtenances which shall include the piping used for the transmission of chemicals and gases, the installation of burners, piping and controls utilizing gas liquid and solid fuel; water heaters, pipe insulation and low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in a conduit or raceway. All work shall be performed by or under the supervision of the holder of a Class A Steam and Hot Water Certificate of Qualification.

13. Hot Water Contractor Class B. Installation of hot water heating systems and shall be limited to Group I and J Occupancies and the installation of burners, piping and controls utilizing gas, liquid and solid fuel; water heaters, pipe insulation and low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in a conduit or raceway. All work shall be performed by or under the supervision of the holder of a Class A Steam and Hot Water Certificate of Qualification.

14. Heating and Ventilating Contractor Class A. Installation of warm air heating, all ductwork, ventilation and evaporative cooling; the installation of gas piping, burners, venting and controls; and exterior sheet metal; duct insulation and low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in a conduit or raceway. Install up to and including ten (10) tons of refrigeration when such is utilized for comfort cooling. Such systems shall be completely self-contained. This shall not include systems with precharged lines or separate air-cooled condenser or chilled water systems. All work shall be performed by or under the supervision of the holder of a Master Heating and Ventilating Certificate of Qualification.

15. Heating and Ventilating Contractor Class B. Installation of warm air heating, all ductwork, ventilation and evaporative cooling; exterior sheet metal; duct insulation, the installation of gas piping, burners, venting
and controls, in Group I and J Occupancies. Low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in a conduit or raceway. All work shall be performed by or under the supervision of the holder of a Class A or B Heating and Ventilating Certificate of Qualification.

16. Gas Service Contractor. Installation of gas and liquid fuel systems as follows:

- Gas and liquid fuel piping
- Gas and liquid fuel controls
- Gas ranges
- Gas dryers
- Gas refrigerators
- Gas incinerators
- Conversion burners
- Venting
- Water Heaters (100 gallons or less storage capacity)
- Low voltage wiring which does not exceed 48 volts and such wiring is not enclosed in a conduit or raceway.

All work shall be performed by or under the supervision of the holder of a Gas Service Certificate of Qualification.

17. Refrigeration Contractor Class A. Installation of refrigeration systems and appurtenant cooling towers; pipe insulation (excludes window type air conditioners) and low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed by or under the supervision of the holder of a Class A Refrigeration Certificate of Qualification.

18. Refrigeration Contractor Class B. Installation of refrigeration systems in Group I Occupancies only and shall be limited to the installation of self-contained refrigeration systems, five (5) tons or less, in said Group I Occupancies. Installation of pre-charged systems utilizing Group I refrigerants and gas fired absorption chillers in Group I Occupancies. All work shall be performed by or under the supervision of the holder of a Class A or B Refrigeration Certificate of Qualification.

19. Sign Contractor Class A. Fabricating, installing and erecting or maintaining all types of signs. All work shall be performed by or under the supervision of the holder of a Sign Certificate of Qualification.

20. Sign Contractor Class B. Installation and erecting or maintaining the following types of non-illuminated signs:
- Signs painted directly on the wall.
- Wall signs not to exceed two hundred (200) square feet in area.
- Ground signs not to exceed one hundred fifty (150) square feet in area.
- Cloth signs. Arcade signs not to exceed twenty-five (25) square feet in area per side.

A certified supervisor shall not be required for this license. (ORD. 536 - Dec. 1971)

21. Elevator Contractor. Installation and maintenance of elevators, escalators, moving sidewalks and moving ramps, dumbwaiters, stage lifts, man-lifts and amusement devices which employ ropes, cables, pulleys or platforms. In addition to the elevator work on the equipment itself, this license shall include electrical work from the controller to the equipment. All work shall be performed by or under the supervision of the holder of an Elevator Certificate of Qualification.

22. Fire Protection Contractor. Installation of the following:
- Automatic fire sprinkler systems of all types
- Carbon dioxide systems
- Standpipe systems and appurtenances

All work shall be performed under the supervision of the holder of a Fire Protection Certificate of Qualification.

23. Lawn Sprinkler Contractor. Installation of underground lawn sprinkler systems. A certified supervisor shall not be required for this license.

24. Electrical Signal Contractor. Installation of fire detection, fire alarm, burglar alarm, pneumatic control and all signaling systems where the electrical voltage does not exceed 48
volts. A certified supervisor shall not be required for this license.

EXCEPTION: Authorized and Franchised Public Utility Companies.

25. Domestic Appliance Contractor. The installation of domestic appliances as defined in Chapter 41. This license shall also apply to repairs and replacement as defined in Chapter 41 of this Building Code. All work shall be performed by or under the supervision of the holder of a Domestic Appliance Certificate of Qualification.

26. Boilermaker Contractor. Installation, assembly, repair and erection of steam and hot water boilers, pressure and non-pressure vessels, precipitators, breaching, stacks, plate and casing. All work shall be performed by or under the supervision of the holder of a Boilermaker Certificate of Qualification. (ORD. 227 - 1971)

Section 213. LICENSE FEES.
(a) Annual Fees Required. The annual license fees applicable to those herein enumerated shall be paid in accordance with the following table. When a licensee holds more than one license, the most expensive shall be paid at full fee and each additional license shall be paid at half fee.

EXCEPTION: The license fee for the City or its employees shall be waived when performing work for the City or when employed as an inspector in the Department when such license is renewed only to keep the license from lapsing.

(b) Prorating of Fees. In case the license is issued after March 31st and prior to July 1st of any year, the license fees shall be three-fourths (¾) of the annual license fee; in case the license is issued after June 30th and prior to October 1st of any year, the license fee shall be one-half (½) of the annual license fee; in case the license fee is issued after September 30th of any year, the license fee shall be one-fourth (¼) of the annual license fee.

(c) Fees for Contractor License.

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<tbody>
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<td>Building Class D</td>
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<td>Building Class E</td>
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<td>Wrecking Class A</td>
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<tr>
<td>Sign Class A</td>
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<td>Sign Class B</td>
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<th>Class</th>
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<tbody>
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<tr>
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<td>Refrigeration Class A</td>
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<td>Class A</td>
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<td>Heating and Ventilating</td>
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<td>Class B</td>
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<td>Elevator</td>
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<td>75.00</td>
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<tr>
<td>Boilermaker</td>
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</table>

Section 214. LICENSE RENEWAL.
Licenses shall be renewed by December 31 each year. Any work performed after expiration and prior to obtaining such license shall be a violation of this Building Code.

Section 215. REISSUANCE OF LICENSE. The Department shall have the authority to reissue a license without a new application provided such reissuance shall be accomplished within 1 year after the license has expired. If such license is not reissued within said 1 year period, a new application shall be required.

Section 216. LICENSEE RESPONSIBILITY.
(a) General. All licensees shall be responsible for work requiring a permit under the provisions of this Building Code, without limitation, to the items as herein listed.

1. To report in writing to the Department any accident occurring in any construction or undertaking which has resulted in lost time, injury or death to any person or damage to any building or structure within 72 hours after such accident.
2. To provide minimum safety measures and equipment to protect workmen and the public as prescribed by this Building Code.
3. To observe any other City ordinance prescribing measures for the safety of workmen and of the public.
4. To present his license card when requested by the Director or his authorized representative.
5. To employ a qualified supervisor certified in accordance with the requirements of the Building Code. To provide the name of such supervisor on the employer's license card.
6. To employ qualified journeymen certified in accordance with the requirements of this Code.
7. To obtain a permit when the same is required.
8. To faithfully construct, without substantial departure from or disregard of drawings and specifications, when such drawings and specifications have been filed and approved by the Department and permit issued for same, unless such changes are approved by the Department.
9. To complete all work authorized on the permit issued under the authority of this Building Code unless good cause is proved.
10. To obtain inspection services when the same are required by this Building Code.
11. To pay any fee assessed under authority of this Building Code.
12. To obey any order issued under authority of this Building Code.
13. To provide all vehicles, used in the operation of a business where a license is required by this Building Code, with identification of such business, in a manner as prescribed by the Department.

(See Chapter 1 for unlawful acts.)

Section 217. VALIDITY OF LICENSE.
(a) Change of Name, Organization and Ownership. The following changes of a licensee shall require the obtaining of a new license and shall be reported by the licensee to the Department within 15 days after the making of such change.
1. Incorporation or change in incorporation creating a new legal entity which requires a license even though one or more stockholders or directors have a license.
2. The organization of a partnership or the change in a partnership creating a new legal entity which requires a new license, even though one or more of the partners are licensed.
3. The dissolution of a corporation or partnership which has been licensed, terminates the license and no individual or firm may operate under such license.

(b) Procedure. When any of the acts or omissions as herein enumerated are committed by a licensee holder and the Director deems that such license shall be suspended or revoked, the procedure shall be as follows:
1. The licensee shall be notified, in writing, by certified mail, at least seven (7) days prior to suspension or revocation.
2. Upon receipt of the notice, the licensee may request a hearing. Such request shall be in writing to the Director within seven (7) days of receipt of notice.
3. If a hearing is requested by the licensee, the Director shall set a time, date and place and so notify the licensee.
4. When a hearing is conducted, the licensee and other interested parties may be in attendance. Upon completion of the hearing, the Director may appoint a qualified employee of the Department to sit in his stead as hearing commissioner to conduct said hearing. Final decision shall be rendered by the Director.

(c) Emergency Suspension. If the Director finds that cause does exist for suspension or revocation of a license, he may enter an order for immediate suspension of such license, pending further investigation. The licensee may, upon notice of such suspension, request an immediate hearing before the Director and the hearing shall be conducted in the manner prescribed by other Sections of this Building Code.

(d) Delegation of Authority. In the event of hearing, the Director may appoint a qualified employee of the Department to sit in his stead as hearing commissioner to conduct said hearing. Final decision shall be rendered by the Director.

Section 218. SUSPENSION OR REVOCATION OF LICENSES.
(a) Authority. The Director may suspend or revoke a license when the licensee commits one or more of the following acts or omissions:
1. Failure to comply with any of the licensee responsibilities as outlined in Section 216.
2. Knowingly combining or conspiring with a person, firm or corporation by permitting one's license to be used by such person, firm or corporation.
3. By acting as agent, partner, associate or in any other capacity with persons, firms or corporations to evade the provisions of this Building Code.
4. Violation of any provisions of this Building Code.

Section 225. CERTIFICATES DEFINED AND REQUIRED.
(a) Definition. A Certificate of Qualification is authority to perform certain skills and is issued by the Department upon successful completion of an examination given by the Board of Examiners. A Certificate of Qualification is not transferable.
(b) Certificates Required. Certificates of Qualification shall be required for all types of work hereinafter specified and classified.
(c) Temporary Certificate. 1. The Department may issue a temporary Certificate of Qualification as a supervisor when the applicant has previously exhibited his skills working in the City and the
applicant's qualifications are acceptable. The period of the temporary Certificate shall not exceed the time between the date of first application for a Certificate and the date of the next regularly scheduled examination.

2. The Department shall issue a temporary Certificate of Qualification as a Journeyman or other Certificate, except supervisor, to an applicant who holds an equivalent qualification in any jurisdiction outside the City. The period of time shall not exceed that of the date of the filing of the application and the date the results are given from all phases of the regularly scheduled examination. If the applicant qualified for any phase of the examination, such temporary Certificate shall be extended to the time of the results of the next regularly scheduled examination, provided that such applicant continues to work under the general supervision of a Certified Journeyman until all phases of the examination have been passed.

(d) Application and Fee. Every applicant for a Certificate of Qualification shall fill out the form provided by the Department and shall pay an application fee of $15.00 at the time of filing. Such fee shall not be refundable except where the applicant does not take the examination, in which case, $10.00 of the fee will be refunded. The application fee shall not apply on the Certificate fee. Such fee shall entitle the applicant to one examination only, and if the applicant is re-examined for any reason whatsoever, a new application shall be filed and additional fee of $15.00 shall be required.

(e) Successful Applicants. The examining committee shall submit their recommendations to the Department after appropriate examination has been made of the applicant for a Certificate. The Director shall make final review of the examination papers and the qualification of the applicant.

After an applicant has successfully passed the examination given by the Board of Examiners and is so notified by the Department and fails to procure such Certificate within ninety (90) days after notification, such Certificate shall be declared null and void. Thereafter, a new application with fee shall be filed but no re-examination shall be required.

(f) Failure to Pass Examination. When an applicant has failed to pass the examination, he shall be so notified in writing by the Department. Every applicant who fails to pass the required examination shall not be eligible for another examination until the next regularly scheduled examination thereafter, and any applicant who shall fail to pass the second examination shall not be eligible for re-examination for six months thereafter. Where an examining committee administers an examination of more than one part, each part of the examination may be considered separate under this re-examination clause upon concurrence by the Director and the examining committee.

(g) Right of Appeal. In every instance that the Board of Examiners or the Director disapproves the issuance of a Certificate to a particular applicant, the said applicant may appeal from such adverse decision to the Board of Appeals in the manner provided in this Building Code.

(h) Supervisors. Every supervisor required for a particular license shall be examined by the appropriate examining committee and if qualified, shall be issued a Certificate of Qualification and shall be entitled to perform and supervise the work in the particular skill for which he is qualified and certified. This Certificate is an individual Certificate and shall not be construed to be a license. The Certificate Holder shall maintain an active part in the supervision of the workmen under his direction.

When the Certificate Holder leaves the employment of the licensee, such Certificate shall be declared null and void until such time as the Certificate Holder notifies the Department in writing that he is no longer in the employ of the particular licensee.

After notifying the Department, the Certificate shall be deemed to be suspended until such time as the Certificate Holder establishes employment with a new licensee and informs the Department of this fact and he is issued a new Certificate indicating the new employer and such change is indicated on the license.

Section 226. CLASSIFICATION OF CERTIFICATES OF QUALIFICATION.

(a) Supervisors. For the purposes of this Building Code, Master Plumbing and Master Electrical Certificates of Qualification shall be the same as Supervisors. A Certificate of Qualification shall be required and permit the holder thereof to be supervisor for each of the following licenses:

<table>
<thead>
<tr>
<th>LICENSE</th>
<th>SUPERVISOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Contractor Class A</td>
<td>Construction Certificate Class A</td>
</tr>
<tr>
<td>Building Contractor Class B</td>
<td>Construction Certificate Class A, B</td>
</tr>
<tr>
<td>Building Contractor Class C</td>
<td>Construction Certificate Class A, B, C</td>
</tr>
<tr>
<td>Building Contractor Class D</td>
<td>Construction Certificate Class A, B, C, D</td>
</tr>
<tr>
<td>Wrecking Contractor Class A</td>
<td>Wrecking Certificate Class A</td>
</tr>
<tr>
<td>Wrecking Contractor Class B</td>
<td>Wrecking Certificate Class A, B</td>
</tr>
<tr>
<td>Sign Contractor Class A</td>
<td>Sign Certificate</td>
</tr>
</tbody>
</table>

2B-7
(b) Journeyman Certificates of Qualification. Certificate of Qualification shall be required in the following trades and shall entitle the individual to work only in the trade for which he is certified and classified. Such Certificate shall permit the individual to work only under a certified supervisor.

1. Journeyman Electrical Certificate of Qualification. Installation of electrical wiring, electrical apparatus, and appliances, including fire detection, fire alarm and burglar and pneumatic control systems. The holder of this Certificate may perform this work only in the employ of an Electrical Contractor Licensee Class A or B and such work shall be confined to that particular license.

2. Journeyman Plumbing Certificate of Qualification. Installation of all sanitary plumbing and potable water supply piping and appliances connected thereto, the installation of piping for the transmission of chemical and gases, gas piping and the complete installation of water heaters. The holder of this Certificate may perform this work only in the employ of a Plumbing Contractor Licensee Class A or B and such work shall be confined to that permitted under the particular license.

3. Journeyman Steamfitter Certificate of Qualification. Installation of steam and hot water heating systems and appliances connected thereto; process and industrial piping, piping used for the transmission of chemical and gases and the installation of burners, piping and controls utilizing gas, liquid and solid fuel; the complete installation of water heaters, pipe insulation and low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in a conduit or raceway. The holder of this Certificate may perform this work only in the employ of a Steam and Hot Water Contractor Licensee Class A or B and such work shall be confined to that permitted under the particular license.

4. Journeyman Roofer Certificate of Qualification. Installation of roof coverings, valleys, gutters, downspouts, water proofing and flashings. The holder of this Certificate may perform this work only in the employ of a D-2 Roof Covering and Water-proofing Contractor and such work shall be confined to that permitted under the particular license.

5. Journeyman Drainlayer Certificate of Qualification. Installation of sanitary sewer and sewer connections. Such work shall commence at the cast iron pipe located five (5) feet from the building and thence to the main sewer and shall include the digging and backfilling of ditches. The holder of this Certificate may perform this work when in the employ of a Plumbing Contractor Licensee Class A or B and such work shall be confined to that permitted by this particular license.

6. Journeyman Gas Service Certificate of Qualification. Installation of gas and liquid fuel piping, of gas or liquid fuel appliances as permitted under the provisions of the Gas Service License; all venting, controls and low voltage wiring when such voltage does not exceed 48 volts and is not enclosed in conduit or raceways. Such low voltage permitted by this Certificate shall apply only to gas or liquid fuel fired appliances. The holder of this Certificate may perform this work when in the employ of a Gas Service Contractor or a Heating and Ventilating Contractor Class A or B licensee.

7. Journeyman Heating and Ventilating Certificate of Qualification. Installation of warm air heating, all ductwork, ventilation, and evaporative cooling; exterior sheet metal; the installation of gas piping, burners, venting and controls; duct insulation; low voltage wiring which does not exceed 48 volts and when such wiring is
not enclosed in a conduit or raceway. The holder of this Certificate may perform this work only in the employ of a Heating and Ventilating Contractor Class A or B and such work shall be confined to that permit under the particular license.

8. Journeyman Refrigeration Certificate of Qualification. Installation of refrigeration systems and appurtenant cooling towers; pipe insulation, low voltage wiring which does not exceed 48 volts and when such wiring is not enclosed in conduit or raceway. The holder of this Certificate may perform this work only in the employ of a Refrigeration Contractor Licensee Class A or B and such work shall be confined to that permitted under the particular license. (ORD. 227 – 1971)

9. Journeyman Domestic Appliance Certificate of Qualification. Installation, repair and replacement of Domestic Appliances, as defined in Chapter 41 of this Building Code. This Certificate shall also include repair and replacement as defined in Chapter 41 of this Building Code. The holder of this Certificate may perform this work only in the employ of a Domestic Appliance Contractor and such work shall be confined to that particular license.

10. Journeyman Boilermaker Certificate of Qualification. Installation, Assembly, repair and erection of steam and hot water boilers, pressure and non-pressure vessels, precipitators, incinerators, breaching, stacks, plate and casing. The holder of this Certificate may perform this work only in the employ of a Boilermaker Contractor licensee Class A or B and such work shall be confined to that permitted under that particular license. (ORD. 227 – 1971)

11. Residential Journeyman Electrical Certificate of Qualification. Installation of electrical wiring, electrical apparatus and appliances in Group I and J Occupancies only. The holder of this Certificate may perform this work only in the employ of an Electrical Contractor Licensee Class A or B. (ORD. 7 – Jan. 1972)

(c) Stationary Engineer and Operator’s Certificate of Qualification. It shall be unlawful to operate any equipment for which a Certified Stationary Engineer, Boiler Operator, Refrigeration Operator, Hoist Operator or Motion Picture Operator is required, unless a properly Certified Engineer or Operator is in personal attendance during the hours such equipment is in operation and in accordance with the requirements of this Section.

1. Stationary Engineer Certificate Class A. A Stationary Engineer’s Certificate Class A shall entitle the 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 for systems where the steam pressure is in excess of fifteen (15) p.s.i.g. working pressure and where such equipment produces a total of ten (10) boiler hp. or more; and hot water heating systems when the water temperature exceeds two hundred fifty (250) degrees Fahrenheit in the entire system. This Certificate shall also entitle the holder thereof to operate mechanical refrigeration systems as set forth in other portions of this Section.

2. Boiler Operator Certificate Class A. A Boiler Operator’s Certificate Class A shall entitle the 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 for systems where the steam pressure is in excess of fifteen (15) p.s.i.g. working pressure and where such equipment produces a total of ten (10) boiler hp. or more. This Certificate shall also be required for hot water heating systems when the design water temperature operates at two hundred and fifty (250) degrees Fahrenheit or more in the entire system.

3. Boiler Operator Certificate Class B. A Boiler Operator’s Certificate Class B shall entitle the 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 systems where the steam pressure is between fifteen (15) and one hundred (100) p.s.i.g. and where such equipment produces a total of between ten (10) and one hundred (100) hp.

4. Refrigeration Operator Certificate. A Refrigeration Operator’s Certificate shall entitle the holder thereof to take charge of, operate, and make needful adjustments and maintenance repairs, for refrigeration systems of all sizes and types. Refrigeration systems for which a Refrigeration Operator’s Certificate shall be required are as follows:

Multiple Machine Grouping
A. Composite groupings of refrigeration machines, where machines are twenty-five (25) tons or larger in capacity and connected in parallel or series to a common refrigerant piping system. The co-ordinate charge in the entire system shall determine the requirement for certified operators.

B. Refrigeration systems utilizing Group II or Group III refrigerants as defined in Chapter 49 of this Building Code.
having charges of two hundred (200) pounds or more;
C. Refrigeration systems having manual or semi-automatic controls with charges of four hundred (400) pounds or more of Group I refrigerants; or
D. Refrigeration systems with fully automatic controls with charges of fifteen hundred (1500) pounds, or more of Group I refrigerants.
E. Semi-automatic shall mean plants or systems with automatic safety controls by manual load proportioning controls requiring other than seasonal adjustments.

(d) Additional Operator’s Certificate of Qualification. It shall be unlawful to operate any equipment for which a Hoist Operator or Motion Picture Operator is required unless a properly Certified Operator is in personal attendance during the hours such equipment is in operation and in accordance with the requirements of this Section.

1. Hoist Operator’s Certificate. This Certificate shall be required to operate construction hoists of all types. For purposes of this Section, construction hoists shall include those hoists that are powered by steam, electricity or fuel when such hoists serve buildings or structures under construction or demolition and are over twenty-five (25) feet in height. This Section shall not be construed to include elevators which are defined in Chapter 55 of this Building Code.

2. Motion Picture Machine Operator Certificate. This Certificate shall be required 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.

Section 227. APPRENTICES.

(a) General. This Section shall govern the requirements for apprentices and shall be limited to the crafts listed herein.

Apprentices shall not be required by other portions of this Building Code but shall be registered in a recognized apprenticeship program of the Federal Government or State of Colorado.

(b) Definition of Apprentice. For the purpose of this Building Code, an Apprentice shall mean any person sixteen (16) years of age or older who has entered into a written apprentice agreement which provides for participation in an approved program of training through employment and education in related and supplementary subjects, and which conforms to the provisions of the Colorado State Statutes governing apprentices and rules and regulations as approved by the Colorado State Agency governing same.

An apprentice may do any work which is distinctive to a specific craft but only under direct supervision of a Certified Supervisor of that craft. Persons working on tasks not distinctive to any specific craft need not be classed as apprentices.

c) Employment of Apprentices. Contractors may employ apprentices for their particular craft or trade only as specified herein. The ratio of apprentices to Journeymen employed shall not exceed one apprentice to one Journeyman.

d) Employer. This Section shall govern apprentices for the following crafts:

1. Plumbing Contractor Class A or B
2. Electrical Contractor Class A or B

Section 228. CERTIFICATE FEES.

(a) Annual Fees. The annual Certificate of Qualification fees shall be paid to the Department in accordance with the provisions of this Section as follows:

<table>
<thead>
<tr>
<th>Certificate Type</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor or Master Certificate</td>
<td>$15.00</td>
</tr>
<tr>
<td>Journeyman Certificate</td>
<td>$5.00</td>
</tr>
<tr>
<td>Engineer Certificate</td>
<td>$5.00</td>
</tr>
<tr>
<td>Operator Certificate</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

Exceptions: 1. When the licensee is an individual and is also certified as the supervisor for the license, the appropriate Certificate shall be issued to the licensee but no Certificate fee shall be charged.
2. The Certificate fee for employees of the City shall be waived when performing work for the City or when employed as an Inspector for the Department.

(b) Certificate Fee Refund. Certificate fees shall not be refundable.

Section 229. CERTIFICATE RENEWAL.

Certificates shall be renewed by June 30 of each calendar year. Any work performed after expiration of the Certificate and prior to obtaining a renewal of such Certificate shall be a violation of this Building Code.

Section 230. REISSUANCE.

The Department shall have the authority to reissue a Certificate without a new application provided such reissuance shall be accomplished within one year after the Certificate has expired. If such Certificate is not reissued within said one year period, a new application shall be required.

Section 231. CERTIFICATE HOLDER’S RESPONSIBILITY.

(a) General. All Certificate Holders shall be responsible for the work they assume in accordance with the requirements of this Building Code, without limitation, and to the items as herein listed.

1. To have a Certificate on his person at all times.
2. To present his Certificate when requested by any member of the Department.
3. To faithfully construct without departure from or disregard of approved drawings and specifications.
4. To obey any order issued under authority of this Building Code.
5. To pay any fee assessed under authority of this Building Code.
6. To observe any City ordinances prescribing measures for the safety of workmen and of the public.
7. In addition to the foregoing, the Supervisor for the licensee shall always maintain an active part in the supervision of the workmen under his direction.

Section 232. SUSPENSION AND REVOCATION.

(a) Authority. The Director may suspend or revoke a Certificate issued under the provisions of this Building Code for any one or more of the following acts or omissions:

1. Incompetence.
3. Violation of any provisions of this Building Code.
4. Failure to comply with any of the Certificate Holder responsibilities as outlined in Section 231.

(b) Procedures. When any of the acts or omissions herein enumerated are committed by a Certificate Holder and the Director deems that such Certificate shall be suspended or revoked, the action shall be as follows:

1. The Director shall notify the Certificate Holder in writing by certified mail, at least seven (7) days prior to suspension or revocation.
2. Upon receipt of the notice, the Certificate Holder may request a hearing. Such request shall be in writing to the Director within seven (7) days of receipt of notice.
3. If a hearing is requested by the Certificate Holder, the Director shall set a time, date and place and so notify the Certificate Holder and the Certificate shall be deemed to be suspended or revoked.
4. When a hearing is conducted, the Certificate Holder and other interested parties may be in attendance. Upon completion of the hearing, the Director shall take all evidence admitted under advisement and shall notify the Certificate Holder of his findings and ruling in writing by certified mail.
5. If the decision rendered by the Director is adverse to the Certificate Holder, the Certificate Holder may appeal to the Board of Appeals as an "aggrieved" person and shall file an application in the manner prescribed in Chapter 2-A within thirty (30) days after notice of ruling.

(c) Emergency Suspension. If the Director finds that cause does exist for suspension or revocation of a Certificate, he may enter an order for immediate suspension of such certificate, pending further investigation. The Certificate Holder may, upon notice of such suspension, request an immediate hearing before the Director and the hearing shall be conducted in the manner prescribed by other Sections of this Building Code.

(d) Delegation of Authority. In the event of a hearing, the Director may appoint a qualified employee of the Department to sit in his stead as the hearing commissioner to conduct said hearing. Final decision shall be rendered by the Director.

BOARD OF EXAMINERS

Section 235. Board of Examiners.

(a) Creation of Board of Examiners. There is hereby created and established a Board of Examiners, consisting of various examining committees, which will act as a certificate examining agency for the Department. The Board of Examiners shall have the duties, powers and functions prescribed by this Building Code.

(b) Meetings, Chairman and Salary. The Board of Examiners shall meet at least once each calendar year, unless in the opinion of the Chairman such meeting is not necessary. Meetings shall be assembled by the Chairman of the En Banc Committee and compensation shall be for a maximum of two meetings in any one calendar year.

The Chairman shall be appointed by the Mayor and shall be a voting member of the Board of Examiners and shall be responsible for its organization, management and operation. His term of office shall be two years plus an additional two years if re-appointed and in no case shall his term of office exceed four years.

In addition to the En Banc meetings, the Chairman may meet with any of the examining committees at that committee's regularly scheduled meeting for the purpose of discussion of standards and procedures applying to that committee. His attendance at such meeting shall be at his discretion upon approval by the Director.

The Chairman shall receive $100.00 per meeting for attendance at each En Banc meeting.

The Chairman shall receive $100.00 for attendance at a meeting with the individual examining committees.

The members of the examining committees shall be paid $25.00 for attending En Banc meetings.

(c) Procedure and By-Laws. A quorum at all En Banc meetings shall consist of a simple majority of the members of the Board of Examiners. The Board of Examiners and each examining committee is authorized to make rules of procedure and adopt by-laws necessary for the transaction of business consistent with this Building Code. To be effective, such rules of procedure and by-laws shall be subject to approval by the Board of Examiners at the next En Banc meeting.

(d) Examination Standards. The Board of Examiners shall set the examination standards to be
followed by the examining committees. The Director shall approve such standards prior to approval of Board of Examiners. The standards shall be consistent with the purpose of this Building Code which is the protection of the public health and public safety of the people of the City so that those who are recommended to be certified under this Building Code are qualified in terms of their skills, knowledge, practical experience and knowledge of pertinent law to perform the work for which they may be certified.

1. The Board of Examiners shall set standards and examine applicants in the following areas:
   A. Applicable technical portions of the Building Code.
   B. Technical knowledge
   C. Skills

2. The Department shall establish minimum standards and examine applicants in the following areas:
   A. Education and experience

All standards, except those established by the Department, shall be approved by the Board of Examiners within 180 days after the enactment of this ordinance by City Council. Annual review of standards shall be made to maintain the standards current with improvements in the Building Code and building practices. If other licenses, certificates or lawful requirements are required from the applicant by other ordinances of the City, such license requirements shall be deemed prerequisites to the recommendation of the issuance of a Certificate.

Section 236. EXAMINING COMMITTEES OF THE BOARD OF EXAMINERS.

The examining committees as herein established shall act as an examining body for the Department for Certificates as specified. Each committee shall have such duties, powers and functions as prescribed by this Building Code and shall function as directed in the By-Laws of the Board of Examiners.

The members of the examining committees shall be appointed by the Mayor to serve a period of two (2) calendar years and may be reappointed for an additional two years; but no member shall serve more than four (4) consecutive years on a committee. Each committee shall elect its own chairman at the first meeting of each calendar year and that person shall be chairman for the entire year.

The examining committee of the Board of Examiners shall conduct examination of applicants for examination. If no applicants are available for examination, the meeting shall not be held. Special examinations by the committee may be called for by the Director and when such event occurs, the committee shall be compensated as if this were a regular examination. Each member of the examining committee shall receive twenty-five dollars ($25.00) for attendance and participation in examinations given. Each applicant given a special examination shall pay a fee of $150.00 for such examination.

The qualifications for members of the respective committees shall be as follows and a simple majority shall constitute a quorum:

(a) **Building Committee**
   Building Contractor Licensee Class A (shall possess a Class A Certificate)
   Building Contractor Licensee Class C (shall possess a Class C Certificate)
   Professional Engineer (registered by the State of Colorado)
   Public Member (not associated with the building industry)

When this Committee examines applicants for Sign Certificate Class A, Wrecking Certificate Class A or B, a member as follows shall participate in the examination for their respective certificates and replace Building Contractor Licensee Class C.
   Sign Contractor Licensee Class A (shall possess a Sign Certificate)
   Wrecking Contractor Licensee Class A (shall possess a Class A Certificate)

This committee shall be responsible for the examination of the applicants for the following certificates:
   Construction Class A
   Construction Class B
   Construction Class C
   Construction Class D
   Wrecking Class A
   Wrecking Class B
   Sign Certificate
   Journeyman Roofer

(b) **Heating, Ventilating and Gas Service Committee**
   Heating and Ventilating Licensee Class A (shall possess a Class A Certificate)
   Gas Service Contractor or Licensee (shall possess a Gas Service Certificate)
   Professional Engineer (registered in the State of Colorado)
   Public Member (not associated with the building industry)
   Journeyman Heating and Ventilating Certificate Holder

This Committee shall be responsible for the examination of the applicants for the following certificates:
   Heating and Ventilating Class A
   Heating and Ventilating Class B
   Gas Service Certificate
   Journeyman Gas Service
   Journeyman Heating and Ventilating

(c) **Mechanical Committee**
   Steam and Hot Water Contractor Licensee Class A (Shall possess a Class A Certificate)
   Journeyman Steamfitter Certificate Holder
   Stationary Engineer Class A
   Professional Engineer (registered in State of Colorado)
   Public Member (not Associated with building industry)
   Refrigeration Contractor Licensee Class A (shall possess a Class A Certificate)
This Committee shall be responsible for the examination of the applicants for the following Certificates:

- Master Electrical Certificate
- Journeyman Electrical
- Residential Journeymen Electrical
- Elevator

(e) Plumbing Committee

- Plumbing Contractor Licensee Class A (shall possess Master Certificate)
- Journeyman Plumbing Certificate Holder
- Professional Engineer (registered in State of Colorado)
- Public Member (not associated with the building industry)
- Domestic Appliance Contractor (shall possess a Domestic Appliance Certificate)
- Journeyman Domestic Appliance Certificate Holder.

This Committee shall be responsible for the examination of the applicants for the following Certificates:

- Master Plumbing
- Journeyman Plumbing
- Journeyman Drainlayer
- Domestic Appliance
- Domestic Appliance Journeyman

Section 240. TRANSITIONAL PROVISIONS.

Except as otherwise expressly provided herein, this Building Code shall not be construed to require the duplication of reissuance of any license or certificate within the same calendar year, the duplication of any examination, nor the duplication of any payment of any license or certificate fee for a particular grade of license or certificate 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. [Ord. No. 205 – May 1, 1970]
CHAPTER 3
PERMITS AND INSPECTIONS

Section 301. PERMITS REQUIRED.

(a) General. No person, firm, or corporation, nor the Federal, State, County or City government or any agency, sub-division or department thereof shall erect, construct, enlarge, remodel, alter, repair, move, improve, remove, convert, demolish or change type of occupancy of any building, structure or utility or perform any other work regulated by this Building Code, or cause the same to be performed, without first having obtained a permit for the specific work to be performed from the Department. Permits shall not be transferable.

EXCEPTIONS: 1. Blasting permits shall be required and issued by the Manager of Safety and Excise.

2. Public Utility. A permit shall not be required of a Public Utility duly franchised or authorized as such in the City, for the repair and maintenance of the equipment and facilities used in the distribution of such utility which has been exempted elsewhere in this Building Code.

3. Signs. For exemptions, see Chapter 56.

(b) Authorized Applicants. Only persons, firms, or corporations duly licensed under the terms and provisions of this Building Code may apply for a permit, and such licensees may apply for and be issued permits to perform only such work as they are entitled to perform under their respective licenses. Any application for a permit filed in derogation of this Chapter or Building Code shall be deemed to have been filed with fraudulent intent and shall be a nullity. Notwithstanding the foregoing and in addition thereto, the following persons shall be deemed to be authorized applicants.

1. Any person who owns a Group I or J building may make application for a permit to enlarge, remodel, alter, repair, improve, convert or demolish such build-

ing. Upon the issuance of a permit berender all such work authorized shall be performed personally only by such person and shall be performed in accordance with all the requirements of this Building Code.

2. Any person who owns a property and wishes to construct or erect a Group I or J Occupancy building or structure on said property for his own occupancy, may make application for a permit for such building or structure. Only one such owner's permit may be issued to the owner in any twelve month period. Any owner who does not occupy said building within 90 days after its construction shall be deemed a contractor and shall be required to qualify as such including payment of all applicable fees.

(c) Application. To obtain a permit, the applicant shall first file an application in writing on a form furnished by the Department and such application shall include all information and reflect such qualifications as may be required.

(d) Valuation of Work. Valuation to be shown on the permit shall be determined by the Department and it shall reflect the reproduction cost new without depreciation. Permits for installing utilities shall include value of fixtures.

(e) Signature. A licensee or his authorized representative shall be required to sign all applications for permits issued to him. The licensee shall submit a list annually to the Department indicating the licensee signature and those of his authorized representatives. An applicant for an owner's permit shall be required to sign all applications for permits issued in his name.

(f) Validity. The issuance of a permit or the approval of drawings and specifications shall not be construed to be a permit for, nor an approval of, any violation of or deviation from the provisions of this Building Code or any other ordinance, law, rule or regulation. A permit issued
FEES REQUIRED FOR PERMITS

<table>
<thead>
<tr>
<th>Valuation of Work</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 0.00 - $ 50.00</td>
<td>$1.00</td>
</tr>
<tr>
<td>51.00 - 300.00</td>
<td>$3.00</td>
</tr>
<tr>
<td>301.00 - 2,000.00</td>
<td>$8.00</td>
</tr>
<tr>
<td>2,001.00 - 50,000.00</td>
<td>$4.00 per each $1000 valuation or fraction thereof plus $3.00 per each $1000 valuation or fraction thereof of total valuation plus $2.00 per each $1000 valuation or fraction thereof of total valuation</td>
</tr>
<tr>
<td>Over $500,000.00</td>
<td>$550.00</td>
</tr>
</tbody>
</table>

Moving: ......................................................................... 25.00
Wrecking: (Includes all stories and basement or cellars)
- 500 sq. ft. or less ................................................. 1.00
- 500 sq. ft. to 2000 sq. ft. ................................. 6.00
- 2001 sq. ft. or over ................................................. 6.00 plus $2.00 per 1000 sq. ft. or fraction thereof

Signs: Valuation fees as shown above plus one cent ($0.01) per sq. ft. measuring all faces of the sign. For open signs the square footage determined by the Zoning Code will establish the square footage for the sign permit fees.

Elevators: Major repairs as determined by the Department shall carry a fee in accordance with the above valuation schedule. Ordinary or minor maintenance as determined by the Department shall not require a permit.

shall be invalid if, in the work completed, a violation of this Building Code or deviation therefrom, ensued. When such violation occurs the permit shall be deemed to be cancelled and the building, structure or utility shall be made to conform with the provisions of this Building Code or shall be removed or demolished.

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

(g) Expiration—Cancellation. Every permit shall expire if the work authorized by such permit is not commenced within 60 days from the issue date of such permit, or if the work authorized is suspended or abandoned for a period of 60 days at any time after the work is started. Expired permits shall be cancelled and no refund of the permit fee shall be made. Before such work can be commenced or resumed, a new permit shall be obtained and the fee therefore shall be one-half the amount required for the original permit, provided, that no changes have been made in the original drawings and specifications for such work; and provided further, that such suspension or abandonment has not exceeded one year. If the permit holder can demonstrate that the suspension or abandonment was occasioned by circumstances beyond his control and that it would be an injustice to require a fee for a new permit, the same may be issued without charge.

EXCEPTION: The work authorized by a wrecking, or moving permit shall be commenced within 30 days from the date of issuance of such permit and shall be continuous until the work authorized by such permit is completed. If such work is suspended or abandoned for a period of 10 days after the work is commenced, the permit shall expire. For the purpose of this Building Code, the definition of "continuous" shall be the normal rate of progress in completion of a project in keeping with good building or demolition practices.

(h) Revocation—Suspension. The Department may revoke or suspend any permit or may stop the work for any of the following reasons:

1. Whenever there is a violation or suspicion of a violation of any provision of this Building Code or any City ordinance which the Department is empowered to enforce.

2. Whenever the continuance of any work becomes dangerous to life or property.

(i) Notice. The revocation or suspension notice of the permit in every instance shall be in writing and shall be served upon the holder of the permit, the owner, or the person having charge of the work. After the notice is served, it shall be unlawful to proceed with any work for which such permit was issued. Revoked permits shall be cancelled and the permit fee shall not be refunded. Reinstatement of a permit shall be by written notice from the Department.
Section 315. PERMIT FEES.

(a) Fees Required. The above schedule prescribes fees required for permits issued.

(b) Reinspection Permit Fee. Permit fees provide for customary inspections only. Where additional inspections are made necessary by incomplete or faulty work or because of incorrect address given or building locked, no fee shall be charged for the first reinspection, however, a fee of $5.00 shall be charged for each additional reinspection. This fee shall be paid by the holder of the permit to the Department before another inspection can be called for.

(c) Late Permit Fees. Items of work for which a permit is required under this Building Code which are commenced before a permit is secured, shall be assessed fees for permits in twice the amounts prescribed in the schedule herein.

EXCEPTION: for items of work performed on any emergency basis as determined by the Department, to maintain an existing service or to maintain an existing installation, building, or structure, where such maintenance is necessary to protect life, health and safety, the above penalties shall not apply if application for such permit is made within 72 hours after commencement of the emergency work.

(d) Permits Not Requiring Fees.

1. The Government of the United States of America, the State of Colorado and its political subdivisions, the City and County of Denver and all agencies and departments thereof, shall be exempt from the payment of fees for work performed on buildings, structures or utilities owned wholly by such agencies or departments and devoted exclusively to governmental use.

2. No permit fee shall be required for permits for any implement, device or utility used exclusively for the prevention of Air Pollution and which implement, device or utility would not otherwise be required under the provisions of this Building Code.

(Ord. No. 90 Feb. 27, 1970)

(e) Additional Permit Fees. The fee for a supplementary permit to cover any additional valuation not included in the original permit shall be the difference between the fee paid for the original permit and the fee which would have been required had the original permit included the entire valuation.

(f) Additional Permit Fees for Rejected Plans. Where plans are rejected by the Department and returned to the architect, engineer, designer or contractor for resubmission to the Department, the following schedule of additional fees will be charged:

1. Ten per cent of the cost of the permit fee for the first resubmission.

2. Ten per cent of the permit fee for each additional resubmission after the first.

3. Where an approved set of drawings is modified or substantially changed so as to require rechecking by the plan checkers or plan checking engineers, an additional fee equal to 25% of original permit fee will be charged. If such changes or modifications require additional rechecking of construction covered by other permit fees to determine code compliance an additional permit fee equal to 10% of the original permit fee for construction covered by this permit will be charged.

(Ord. No. 90 Feb. 27, 1970)

Section 330. DRAWINGS, SPECIFICATIONS AND FIELD SURVEYS

(a) General. Drawings, specifications and field surveys shall be required prior to the issuance of a permit. Such drawings, specifications and field surveys shall be checked and approved by the Department prior to the issuance of a permit for the work to be performed. All drawings shall have the Department stamp of approval on each page thereof.

(b) New Construction and Additions. All applications for a permit for new construction and additions shall be accompanied by:

1. Three complete sets of drawings which shall include architectural, structural, plumbing, mechanical and electrical details and general elevator arrangements.

2. Four plot plans.

3. One complete set of specifications.

(c) Alteration or Repair. All applications for a permit to alter or repair a building or structure shall be accompanied by:

1. Three complete sets of drawings which shall include architectural, structural, plumbing, mechanical and electrical details and general elevator arrangements.

2. One complete set of specifications.

(d) Approval. Drawings complying with the provisions of this Building Code, and approved by the Department, shall bear the Department stamp of approval on the first page thereof. When corrections are required to be made, the Department may require that the drawings be revised and resubmitted for approval prior to the issuance of a permit. Approval of drawings shall not be construed to mean approval of any violation of this Building Code if such violation is included in the approved drawing and shall
not relieve or exonerate any person, firm or corporation from the responsibility of complying with the provisions of this Building Code.

(a) Distribution of Drawings. One set of approved drawings shall be returned to the applicant to be placed on the job site, one approved set shall be returned to the applicant for his own use and one approved set of drawings and specifications shall remain in the office of the Department. If required by the Department, additional drawings shall be submitted for approval by other City agencies.

(f) Responsibility for Design. Any person, firm or corporation may submit drawings and specifications in connection with an application for a permit in accordance with the following limitations. For the purpose of this Chapter, where the term "architect" is used this shall mean an architect licensed by the State of Colorado; where the term "engineer" is used this shall mean a professional engineer registered by the State of Colorado.

1. Drawings and specifications for the following buildings or structures shall bear the seal of an architect and the seal of an engineer who is responsible for the engineering design phases of the building, structure or utility.

A. Any building or structure three (3) or more stories in height.

B. Any building or structure housing a Group A, B-1, B-2, B-3, C, D-1, D-2, and F-2 Occupancy except as listed under paragraph 2.

2. Drawings and specifications for the following buildings, structures or utilities shall bear the seal of either an architect, or an engineer.

A. Any building or structure housing a Group B-4, E-1, E-2, E-3, E-4, E-5, F-1, F-3, G and H Occupancy and the following F-2 Occupancies:

1. Printing Plants
2. Factories and work shops using material not highly flammable or combustible.
3. Storage and salesrooms for combustible goods.
4. Paint stores without bulk storage.
5. Dry cleaning plants using non-flammable solvents.

3. Except at the discretion of the Department, drawings and specifications for buildings, structures or utilities which require neither an architect’s or engineer’s seal are as follows:

A. Dwellings intended solely for Group I Occupancy.

B. Apartment houses, lodging houses, hotels, motels, or structures when the area does not exceed five thousand (5000) square feet single floor and not more than one story in height, exclusive of one-story basement.

C. Public or private garages, industrial buildings, warehouses, stores and mercantile buildings, office and other buildings or structures accessory to the operation of an industrial plant located on or adjoining the plant site. Such buildings or structures shall not exceed one story in height and shall not exceed five thousand (5000) square feet in area and, further, shall be without basement or excavated sub-floor area.

D. Farm buildings or structures. Such buildings or structures shall not exceed five thousand (5000) square feet in area.

E. Additions, alterations or repairs to buildings or structures which do not exceed five thousand (5000) square feet in area and do not exceed the applicable limitations herein set forth.

F. Non-structural alterations to any building or structure, provided that such alterations do not affect the safety of the building or structure or the health and safety of the occupants.

EXCEPTIONS: 1. Minor Buildings, Structure or Utilities. At the discretion of the Department, drawings, specifications and surveys need not be submitted for minor buildings, structures or utilities; minor alterations and minor repairs to existing buildings, structures and utilities only when the strength safety, sanitation and fire resistance can be described on the application form to justify issuance of a permit. Where identical drawings would apply to several buildings of I or J Occupancies to be under construction simultaneously, one drawing shall suffice.

2. Utility Companies. Design of buildings for the franchised or authorized public utility companies may be varied from these Building Code requirements when the plans have been certified by an engineer that such design is necessary for operation of the equipment to be housed and that such equipment is necessary for the production or distribution of the utility for which authorized or franchised.

(g) Information and Preparation. Drawings shall be made to scale upon substantial paper, plastic or cloth and the drawings and specifications shall be complete and of sufficient clarity to indicate the entire nature and extent of the work proposed and to indicate in detail that the building, structure and utilities will conform to the provisions of this Building Code and all relevant laws, ordinances, rules and regulations. Each set of drawings shall contain at least the following information:
1. Architectural Drawings, Specifications and Analyses.
   A. The exact address, legal description and location of the work to be performed.
   B. Name and address of owner.
   C. Name; signature and address of the person responsible for the preparation of such drawings and specifications. The seal of the architect or engineer responsible for the preparation of such drawings and specifications, as required by this Building Code, shall be stamped on each drawing and the signature affixed thereto.
   D. Plot plan showing the location of the proposed construction and the location of every adjacent existing building on the property, including roads, walks, utilities and other site improvements. All adjacent property lines, streets, alleys and other public areas, with notations if vacated, shall also be indicated.
   E. The occupancy Group (or Groups) which applies to the building, the type of construction of the building, and the fire zone in which the building is located.
   F. Building plans, elevations and sufficient sections indicating all architectural requirements including the number of stories in the building.
   G. Detailed drawings at suitable scale necessary to illustrate adequately all elements of the architectural phase of the building, including door and window schedules and interior finish schedules, and details substantiating fire-resistive characteristics required.
   H. Specifications which clearly describe the condition under which the work is to be executed. The types, qualities, and finish of materials and architectural equipment to be furnished, and the method of assembly erection and installation.
   I. An analysis of floor areas permitted for a new building or addition to an existing building where the total floor area exceeds the basic area permitted in Chapter 5.

2. Structural Drawings, Specifications and Analyses.
   A. The name, signature and address of the person or firm responsible for preparation of such drawings and specifications. The seal of the engineer(s) or architect responsible for the preparation of such drawings and specifications shall be stamped on each drawing and signature affixed thereto.
   B. Foundation plans, floor plans, elevations and sections showing all structural requirements.
   C. Detailed drawings at suitable scale necessary to illustrate adequately all elements of the structure and special structural engineering features.
   D. Basic foundations design criteria in accordance with acceptable reports of soils investigation. This report shall be signed and sealed by an engineer responsible for the preparation of the report.
   E. Design criteria indicating all lateral and vertical loads applied, form of analysis and design, and stresses in all structural materials.
   F. Specifications which clearly describe the type and qualities of material employed with proper reference to accepted standards.
   G. Calculations indicating the determination of sizes of elements of the structure, when of unusual design or construction.

3. Mechanical Drawings, Specifications and Analyses.
   A. The name, signature and address of the person or firm responsible for preparation of such drawings and specifications. The seal of the engineer(s) or architect responsible for the preparation of such drawings and specifications shall be stamped on each drawing and signature affixed thereto.
   B. Submit at least single line drawings (including typical isometric) of plumbing, heating and air treatment systems.
   C. Include Btu rating of gas units, including method of combustion air supply, type of refrigeration and horsepower; and gas meter locations.
   D. Heating, ventilation, cooling and fire protection details and calculations shall be provided.

4. Electrical Drawings, Specifications and Analyses.
   A. The name, signature and address of the person or firm responsible for preparation of such drawings and specifications. The seal of the engineer(s) or architect responsible for the preparation of such drawings and specifications shall be stamped on each drawing and signature affixed thereto.
specifications shall be stamped on each drawing and signature affixed thereto.

B. Submit a complete electrical layout with a service diagram showing load breakdown and sizes of service and feeder conductors and location of feeder panels.

C. Calculations indicating the determination of sizes of all electrical wiring and equipment.

D. Complete elevator layout.

5. Additional Information That May Be Required by the Department.

A. Reports of an independent testing agency which substantiate requirements of this Building Code regarding structural or fire-resistive characteristics of the building or portion thereof.

B. Calculations indicating the determination of sizes of elements of the structure.

C. Any other information that may be deemed necessary in the determination of compliance with requirements of this Building Code.

(h) Supervision of Construction by Architect, Engineer, Other. Supervision of construction of buildings, structures or utilities to which required drawings and specifications pertain shall be performed by the architect or engineer responsible for his phase of the design of such building, structure or utility or by a representative of such architect or engineer. Where an architect or engineer seal is not required, the responsibility of such supervision shall be that of the designer.

(i) Disposal of Drawings. After final inspection has been made upon completion of the work approved in a set of drawings and specifications, the Department copy of such drawings and specifications shall be disposed of in the following manner:

1. All drawings and specifications pertaining to City owned buildings, structures or utilities shall be retained in a permanent file.

2. Other drawings and specifications may be disposed of at any time after two years have elapsed from the date of issuance of the permit.

3. Drawings and specifications submitted for checking only may be disposed of after 60 days.

(j) Field Surveys. Prior to the issuance of a permit, a field survey shall be conducted by a land surveyor, registered by the State of Colorado, establishing the following:

1. Corners and placement of corner stakes or markers.

2. All lines and locations of all surrounding buildings, on the same property, any part of which is within twenty (20) feet of the proposed construction.

3. Building site boundaries.

4. All items 1 through 3 shall be indicated on a surveyor's certificate and shall be drawn to scale.

The corner stakes or markers shall be constructed of steel with a dimension of at least one-half \((\frac{1}{2})\) inch in diameter and at least two (2) feet in length. Upon completion of the driving of the stake or marker into the ground, the top of such stake or marker shall terminate not more than one (1) inch below the finished surface of the ground, or as approved by the Department.

The contractor and/or property owner shall provide clearance to permit the Department access to the location of the required corner stakes, markers and setbacks.

Section 331. FOUNDATION PERMITS.

(a) General. A foundation permit may be issued by the Department for a portion of the work to be covered under the Construction Permit provided the following conditions are met:

1. Total valuation of the construction covered by all permits for the project as issued by the Department shall exceed eight hundred thousand dollars ($800,000.00).

2. Height of the building or structure is four or more stories or forty (40) or more feet in height or the foundation and substructure conditions are such that at least one-third of the total construction time must be spent on underground or substructure work. Structures requiring driven piling (caissons excepted) will be given special consideration.

3. Plans of the proposed superstructure must contain sufficient detail to design the foundation or substructure and complete calculations to validate the design of footings, caissons and all other substructure elements must be submitted to the Department.

4. Where the approval of other City Agencies is required prior to the issuance of a No. 1 (construction) permit the approval of these same agencies must be obtained before a foundation permit will be issued.

5. The award of a separate foundation or substructure permit shall not endanger the public health, safety or general welfare and the limitation of the construction to be performed under the permit must be specified on both the permit and the applicable drawings.

6. The fee charged at the time of the issuance of the permit shall be based on the total valuation of the construction permit for both the substructure and the superstructure construction.

7. Any deviation from the approved foundation permit drawings will be cause for
cancellation of the permit unless such changes are substantiated by engineering calculations and revised drawings approved by all city agencies concerned.

8. The contractor assumes all responsibility for the installation of plumbing, electrical and mechanical utilities in the substructure. Any changes in design or construction necessary to meet code requirements for the combined substructure and superstructure are the sole responsibility of the contractor and any and all such changes must be approved by the Department before a permit to proceed with the construction of the superstructure will be issued.

9. No foundation permit shall be issued unless the construction covered by said foundation permit and the proposed superstructure is in full compliance with the provisions of the Building Code and all other applicable statutes, ordinances and regulations in effect at the time of the issuance of said foundation permit.

10. The Director will make the final determination as to whether a permit will be issued.

(Ord. No. 90 Feb. 27, 1970)

Section 340. INSPECTIONS.

(a) General. All work performed under the provisions of this Building Code shall be subject to inspection by the Department and certain types of work shall have continuous special inspection by privately employed qualified inspectors as specified hereafter. All inspections except those requiring a special inspection as stated above, shall be requested at least 24 hours in advance of the actual physical inspection.

(b) Required General Inspection. The Department shall make the following inspection, without limitation, of buildings, structures, or utilities, and shall either approve that portion of the work as completed or shall notify the permit holder or his agent wherein the same fails to comply with the requirements of this Building Code.

1. Construction Inspections.

A. Excavation, Trenches and Caissons. To be made after excavations are completed, forms erected and reinforcing steel, if any, placed and before any concrete is poured.

EXCEPTION: The permit holder may employ an engineer to make caisson inspection. Said engineer shall submit to the Department in writing a full report of the inspections made and shall include a log of the holes drilled.

B. Foundation and Waterproofing. To be made after the foundation is poured, forms removed, waterproofing is completed and before backfill is placed and sub-floor is installed.

C. Frame. To be made after all utilities are rough-inspected, floors, bearing masonry, framing, fire-blocking, and bracing are in place and before lathing is commenced.

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

E. Final. To be made when all construction is completed.

2. Plumbing Inspection.

A. Rough-In. This is the first inspection which shall consist of the water test on all waste and vent piping and prior to the covering of all piping.

B. Sewer. Inspection of building sewer is to be made before it is covered.

C. Water Distribution. To be made prior to covering.

D. Final. To be made when all fixtures are set and work is completed and operating.

3. Electrical Inspection.

A. Rough-In. First inspection which shall consist of all conduit, semi-rigid piping or wiring being in place prior to covering.

B. Final. Final inspection to be made when the work is completed and operating.

4. Mechanical Inspections.

A. Rough-In. First inspection to be made when all duct and pipe-work is in place before it is covered.

B. Final. Final inspection to be made when the system is completed and operating.

(c) Special Inspections. In addition to the inspections herein specified, the Department may require and make any other inspections of any work required by this Building Code to ascertain compliance with the provisions of this Building Code and other codes, ordinances, rules and regulations which are enforced and administered by the Department.

1. Owner’s Inspector. In addition to the inspection to be made as specified in this Chapter, the owner or his agent shall privately employ a qualified inspector during construction on the following types of work when required by the Department.

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

B. Masonry: On plain masonry when the design is based on a strength of masonry (f’m) in excess of 1000 pounds per square inch.
C. Structural Steel: At all times during the erection of structural steel or when field bolting, riveting, or structural welding is being carried on.

D. Light Weight Construction: At all times when cast-in place structural reinforced gypsum or other light-weight aggregate concretes are being mixed or deposited.

2. Qualifications. Every privately employed inspector shall be qualified for the work he is employed to do. Such inspector shall be one of the following:
   A. An engineer.
   B. An architect.
   C. A person in the employ of or subject to direct supervision and control of a person in category (A) or (B). The names and qualifications of inspectors proposed to be employed shall be submitted to the Department for approval prior to their assignment of the work.

3. Duties of Private Inspector. Every privately employed inspector shall furnish regular inspection on the construction and work requiring his employment. Such privately employed inspectors shall furnish a copy of a report to the Department weekly when required so to do by the Department.

(d) Inspection Record Card. All construction work including new work, additions, alterations and repairs for all occupancies 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 Department conveniently to make the required entries thereon regarding inspection of the work. This card shall include the information requested by the Department and shall be maintained in such location until the work has been completed and final inspections made. Upon completion of the work and after all necessary inspections have been made and properly signed by personnel of the Department, such record card shall be returned to the Department by the construction permit holder. Return of the completed card shall be mandatory prior to the issuance of a Certificate of Occupancy, where such Certificate is required.

(e) Approvals Required. Work shall not be performed on any portion of a building, structure or utility beyond the point indicated in each successive inspection without first obtaining the approval of the Department. Such 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 in this Chapter.

Foundation work, reinforcing steel or structural framework of any part of any building, structure or utility shall not be covered or concealed in any manner whatever without first obtaining the approval of the Department.

There shall be a final inspection and approval on every building, structure or utility when the same is complete and ready for occupancy.

(f) Exposure of Work. Whenever any work is covered or concealed by additional work without first having been inspected as required, the Department may order, by written notice, that such work be exposed for examination. The work of exposing and recovering shall not entail expense to the City.

Section 350. CERTIFICATE OF OCCUPANCY.

(a) When Required. No new building or structure in Groups A through H Occupancy inclusive 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 permit holder has applied for and the Department has issued a Certificate of Occupancy as provided herein. (See Section 350(d) for Temporary Certificate.)

(b) Requirements Prior to Issuance. A Certificate of Occupancy shall be issued when the following information has been furnished.

1. The inspection record card previously issued to the permit holder indicating all required final inspections have been made.

2. The signature on the inspection record card by the architect, engineer or designer as appropriate, certifying that he has observed the construction and that to the best of his knowledge such construction is in general accordance with the drawings and specifications approved.

3. A survey by a land surveyor, registered by the State of Colorado. Such survey to indicate all lot lines and the location of the building, including all required set-backs.

4. All conditions on which approvals of the drawings and specifications were made by other City agencies have been complied with.

5. A statement from the owner or his agent verifying the valuation shown on the permits issued.

6. All fees paid.

(c) Issuance of Certificate of Occupancy. When all of the conditions of this Section have been fulfilled, the Department, in conjunction with the Department of Zoning Administration, shall issue a Certificate of Occupancy indicating:
1. The use and occupancy for which the Certificate is issued, including occupant load.
2. Approval by the Department.
3. Approval by the Department of Zoning Administration.

(d) Duplicate Certificate of Occupancy. Upon payment of $1.00 each to the Department, a duplicate Certificate of Occupancy may be secured by the owner, architect, engineer, contractor, permit holder or tenant.

(e) Temporary Certificate of Occupancy. If the Department and the Department of Zoning Administration finds that no substantial hazard will result from occupancy of any building or portion thereof, before the same is completed and satisfactory evidence is submitted that the work could not have been completed prior to the time such occupancy is desired because of unusual construction difficulties, such Departments may issue a temporary Certificate of Occupancy for such building or portion thereof upon payment of fee to the Zoning Administrator. Such temporary Certificate shall be valid for a period not to exceed six months. After the expiration of a temporary Certificate of Occupancy, the building or structure shall require a Certificate of Occupancy in accordance with other provisions of this Chapter.

(f) Change of Occupancy. Changes in the character or occupancy of Groups A through I Occupancies shall not be made except as specified in Chapter 5 of this Building Code.

(g) Posting. The Certificate of Occupancy shall be posted in a conspicuous place on the premises in all Occupancies A through H and shall not be removed except by order of the Department.

(h) Violation. It shall be a violation of this Building Code to occupy a building or structure prior to obtaining a Certificate of Occupancy as required.

Section 360. TRANSITIONAL PROVISIONS.

(a) Permits and Inspections. All fees paid under codes and ordinances repealed by this Building 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 Building Code. Insofar as is possible, such permits and authorizations for inspection services shall be deemed to have been issued under authority of this Building Code. Except as otherwise expressly provided herein, this Building Code shall not be construed to require the duplication or reissuance of any permit or of any inspection.

Section 365. ADDRESS.

(a) Address on Job Site. The construction permit holder for new or remodeling construction shall post at the front of the premises in a conspicuous place, an approved sign indicating the following:

1. The address number and street or avenue of the building or structure as designated by the City Engineer.
2. His name or the firm name, address, business phone number and emergency phone number.
3. The building permit number.

Such sign shall be posted prior to and during construction until such construction has been completed, and shall be kept durable and legible at all times.

(b) Permanent Address. It shall be the duty of the owner or occupant of every building or structure to display the permanent address of each building in a permanent visible location in the manner provided by Article 341 of the Revised Municipal Code.
CHAPTER 4
DEFINITIONS AND ABBREVIATIONS

Section 400. DEFINITIONS AND ABBREVIATIONS

Introductory. For the purpose of this Building Code, words, phrases and terms defined herein shall be given the defined meaning. Words, phrases and terms not defined herein but defined in this Building Code shall be construed as defined. Words, phrases and terms neither defined herein nor in this Building Code, shall be given their usual and customary meanings except where the context clearly indicates a different meaning. The text of the ordinance shall control captions, titles and maps.

Abandon (abandoned). For purposes of this Building Code, the term abandon shall mean the desertion of a building, structure or utility. Abandon shall also mean, when all utilities are disconnected and/or the building structure or utility is left to the mercy of vandalism, dilapidation, deterioration and creates a fire hazard, an unsafe condition or a nuisance.

Alter or Alteration is any change, rearrangement, addition, or modification in construction occupancy.

Amusement Park Structure. A structure used to house or support rides, games and amusement devices common to carnivals, amusement parks, and side shows. Examples: Roller coaster, shooting gallery, bath houses, drive-in movies, etc.

Apartment. A habitable room, or a suite of two or more of such rooms, used as a dwelling unit in any building occupied, or intended, or designated to be occupied by a family consisting of two or more persons, or occupied as a household by an individual person, and doing their own cooking, or having facilities for cooking within such apartment or dwelling unit. The same shall apply to dwelling unit, light housekeeping, or kitchenette apartments or units.

Apartment House is any building, or portion thereof, which is designed, built, rented, leased, let, or hired out to be occupied, or which is occupied as the home or residence of three or more families living independently of each other and doing their own cooking in the said building, and shall include flats and apartments.
Approved as to methods, materials and types of construction, refers to approval by the Department as the result of investigation and tests conducted, or by reason of accepted principles or tests by national authorities, technical or scientific organizations or by the Standards established within this Building Code.

Approved (Approval) shall also mean to be officially acceptable or satisfactorily meeting the basic requirements of this Building Code.

Approved Agency is an established and recognized agency regularly engaged in conducting tests or furnishing inspection services when such agency has been approved by the Department.

Area. (See “Floor Area”).

Area Way. An excavated space outside and joining the outer wall of a building for the purpose of lighting, venting, or gaining access to a basement or sub-basement. When the distance from the building wall to the area-way wall is over eight (8) feet, the lower level shall be considered a full story.

Assembly Building is a building used, in whole or in part, for the gathering together of persons for such purposes as deliberation, worship, entertainment, recreation, amusement, dancing, drinking or dining, awaiting transportation, or any other similar uses.

Assembly, Fire. (See Chapter 43).

Attic is a portion of the building situated wholly or partly in the roof space which does not have a floor area exceeding fifty (50) per cent of the floor below.

Attic Story is any space situated wholly or partly within the roof area, so designated, arranged, or built as to be used for business, storage, or habitation.

Awning. (See Chapter 45).

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

Balcony Exterior Exit. (See Chapter 33).

Balcony, Interior. (See Mezzanine).

Balcony, Private. Private balcony shall mean a balcony provided for the exclusive use of a home owner or a tenant. This balcony is generally attached to one dwelling unit.

Balcony, Public. A public balcony shall mean any balcony used by more than one tenant or used as an exit balcony.

Basement is that portion of a building between floor and ceiling which is partly below and partly above grade but so located that the vertical distance from grade to the floor below is less than the vertical distance from grade to ceiling. (See “Story”).

Board shall mean the Board of Appeals. Board of Examiners shall mean the Board of Examiners, a media used for testing applicants for licenses and certificates of qualifications.

Boarding House is similar to a hotel or apartment house except that food is served family style.

Boiler or Furnace Room may be used interchangeably in this Building Code. A boiler or furnace room is any room where heating equipment is located. This equipment may be producing hot water, steam or warm air, where such equipment utilizes solid, liquid, liquefied petroleum gas, natural or manufactured gas as the fuel. For purposes of this Building Code, this definition shall not include floor or dual-wall furnaces, unit heaters, space heaters, wall type heaters, water heaters of less than one hundred (100) gallons storage capacity, or any heating equipment in Group I Occupancies.

Breezeway. A covered passageway between buildings which are not contiguous.

Building shall be a structure, including utilities, enclosed with a roof and within exterior walls built, erected and framed of component structural part, designed for the housing, shelter, enclosure and support of individuals, animals, or property of any kind.

Building, Accessory. A building smaller than, and used in conjunction with, the principal building on the same lot.

Building, Existing. Any building actually constructed or started under properly issued building permit previous to the adoption of this Building Code, or located on land annexed to the City or built prior to the requirement of a building permit.

Building, Temporary. A temporary building that is not intended for permanent use, at one location. Temporary shall mean use of said building for a period of time not to exceed six (6) continuous months, unless otherwise approved by the Department.

Building Row Dwellings. (See Chapter 13).
Canopy. (See Chapter 45).

Carport. A roof shelter for an automobile or similar motor vehicle which is open on at least two sides.

Cast Stone is a building stone manufactured from cement concrete precast and used as a trim, veneer, or facing on or in buildings or structures.

Cellar is that portion of a building between floor and ceiling which is wholly or partly below grade and so located that the vertical distance from grade to the floor below is equal to or greater than the vertical distance from grade to ceiling. (See “Story”.)

Chimney or Flue. (See Chapter 37).

City. City and County of Denver.

Clinic is a building or portion thereof containing offices for provision of medical, dental or psychiatric services to outpatients. This shall not include the use of x-ray equipment or radio-active sources, unless as otherwise approved by the Department (See Group D Occupancies).

Column. (See Chapter 26).

Combustible Material is one which does not meet the requirements of the definition of incombustible material:

Construction. Includes all labor and materials used in the framing or assembling of component parts in the erection, construction, raising, demolition, and removal of any appliance, device, building, structure, or utility.

Corridor, Private is any corridor other than a public corridor.

Corridor, Public is a corridor open to general or common use by more than one tenant or occupancy.

Court is a space, open and unobstructed to the sky, located at or above grade level on a lot bounded on three or more sides by walls of a building. An inner court is a court entirely within the exterior walls of a building.

Crawl Space shall be that portion located underneath a dwelling, building or structure with headroom of less than five (5) feet.

Department shall mean the Building Department.

Deterioration as applied to buildings, structures, equipment, and materials shall include corrosion, decay, wear and tear through abuse, obsolescence, effects of the elements, fire damage, lack of maintenance, or by any other cause. Includes fatigue due to over-stressing, disintegration of component parts of a building, structure, and equipment and the separation of materials and structural parts.

Dispersal Area. (See Chapter 33).

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 Dwellings” shall include the term “Apartment House,” “Apartment Hotel,” “Apartment Court,” “Bungalow Court,” “Terrace,” and “Tenement House.”

Dwelling Unit is one or more habitable rooms which are occupied or which are intended or designed to be occupied by one family with facilities for living, sleeping, cooking and eating.

Dilapidation. (See Deterioration).

Door, (Fire) Assembly. (See Chapter 43).

Door, (Fire) Assembly, Automatic. (See Chapter 43).

Door (Fire) Assembly, Self-Closing. (See Chapter 43).

Door Leaf. A single door section. When a doorway is to be closed by two or more doors then each individual door which may be used independent of another is considered as a leaf.

Door, Self-Closing is a door which closes automatically after use.

Dormitory is a room occupied by more than two guests.

Equipment. As specifically regulated by this Building Code includes dry cleaning, dyeing, and washing machines, furnaces, boilers, high
or low pressure steam systems, all air pressure or other tanks; and all self-contained systems used in conjunction with buildings or structures. (See utilities).

Exit. (See Chapter 33).
Exit, Court. (See Chapter 33).
Exit, Horizontal. (See Chapter 33).
Exit, Passageway. (See Chapter 33).
Exit, Vertical. (See Chapter 33).

Family is an individual of two or more persons related by blood or marriage or a group of not more than five persons (excluding servants) who need not be related by blood or marriage living together in a dwelling unit.

Fire Assembly. (See Chapter 43).
Fire District (Zones). (See Chapter 16).

Fire-Resistance or Fire-Resistive Construction is construction to resist the spread of fire, details of which are specified in Chapters 42 and 43 of this Building Code.

Fire-Retardant Wood is lumber or plywood impregnated with chemicals and when tested in accordance with ASTM E-84-61, Method of Test for Surface Burning Characteristics of Building Materials, for a period of 30 minutes, shall have a flame-spread of not over 25, and show no evidence of progressive combustion. The fire-retardant properties shall not be considered permanent where exposed to the weather.

Flamespread. The propagation of flame over a surface. (ASTM E 84).

Flamespread Rating. The measurement of flame spread on the surface of materials or their assemblies as determined by tests conducted in compliance with recognized standards. ASTM E-84).

Floor Area is the area included within the surrounding exterior walls of a building or portion thereof, exclusive of vent shafts and courts. The floor area of a building, or portion thereof, not provided with surrounding exterior walls shall be the usable area under the horizontal projection of the roof or floor above.

Footing is that portion of the foundation of a structure which spreads and transmits loads directly to the soil or the piles.

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.

Fuels, (Gas, Liquid and Solid). See Chapter 51 for requirements. Fuel shall include manufactured or natural gas, mixed gas, liquefied petroleum products, coal, coke, wood, oil, distillate, kerosene or similar low grade products, or any other burning products used as medium for developing light, power or heat.

Furnace Room. See Boiler (Furnace) Room.

Gage (Gauge). A United States standard for measuring the thickness of metals. An instrument for or means of measuring or testing.

Garage is a building or portion thereof in which a motor vehicle containing gasoline, distillate or other volatile flammable liquid in its tank, is stored, repaired, or kept.

Garage, Open Parking. (See Chapter 11).

Garage, Private is a building, or a portion of a building, not more than one thousand (1000) square feet in area, in which only motor vehicles used by the tenants of the building or buildings on the premises are stored or kept.

Garage, Repair is any building or portion thereof used for repair of internal combustion motors, repair of motor vehicle transmission, differentials, frames or bodies, or where any part is removed for repair which would render the vehicle inoperative, repairs requiring welding or brazing, removal or replacing of upholstery other than seat covers, wrecking or stripping of inoperative motor vehicle painting or any other work not permitted in a storage garage.

Garage, Storage is a building other than a private, repair or open parking garage used exclusively for housing 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 (5) feet of a sidewalk, alley or other public way, the above ground level shall be measured at the elevation of the sidewalk, alley or public way.

Grade (Lumber). (See Chapter 25).

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

Guest Room is any room or rooms used, or intended to be used by a guest for sleeping
purposes. Every one hundred square feet (100 sq. ft.) of superficial floor area in a dormitory is a guest room.

Habitable Room is any room meeting the requirements of this Building Code for sleeping, living, cooking or dining purposes excluding such enclosed spaces as closets, pantries, bath or toilet rooms, service rooms, connecting corridors, laundries, unfinished attics, foyers, storage spaces, cellars, utility rooms and similar spaces.

Homes, Nursing. (See Nursing Homes).

Homes for the Aged (Senior Homes) is a building for housing persons over sixty-five years of age, usually with group dining facilities, which provides no hospital, medical or detention services.

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

Incinerator. (See Chapter 48).

Incinerator, Domestic. (Outside Type). (See Chapter 48).

Incinerator, Domestic, Gas Fired. (See Chapter 48).

Incombustible as applied to building construction material means a material which, in the form in which it is used, is either one of the following:

1. Material of which no part will ignite and burn when subjected to fire. Any material conforming to ASTM standard E-136 shall be considered incombustible within the meaning of this Section.

2. "Incombustible" does not apply to surface finish materials. Material required to be incombustible for reduced clearances to flues, heating appliances, or other materials shall refer to material conforming to Item No. 1. No material shall be classed as incombustible which is subject to increase in combustibility or flame-spread rating beyond combustibility or flame-spread rating beyond the limits herein established, through the effects of age, moisture or other atmospheric condition.

3. Flame-spread rating as used herein refers to rating obtained according to tests conducted as specified in ASTM Standard No. E-84.

Hospital means a health institution planned, organized, operated and maintained to offer facilities, beds, and services over a continuous period exceeding twenty-four (24) hours to individuals requiring diagnosis and treatment for illness, injury, deformity, abnormality, or pregnancy. This shall include within the hospital such facilities as a clinical laboratory, diagnostic X-ray, treatment facilities for emergency, surgery, and definitive medical treatment under an organized medical staff. Definitive medical treatment may include obstetrics, pediatrics, psychiatry, physical medicine and rehabilitation, X-ray therapy, and similar specialized treatment.

Hospital, Mental is a building or portion thereof used for housing mentally ill persons where generally restraint of some manner may be exercised.

Landing. A continuation of the floor of a building that gives access to the top or bottom of a flight of stairs, ramps or escalators, or any level space larger than a tread between two flights of stairs.

Lintel is a supporting member placed over an opening in a wall to carry the superimposed weight above.

Liquid, Flammable. Any liquid having a flash point below two hundred (200) degrees Fahrenheit and having a vapor pressure not exceeding forty pounds per square inch (40 psi) (absolute) at one hundred (100) degrees Fahrenheit. See Article 234, Revised Municipal Code.

Load, Dead. (See Chapter 23).

Load, Live. (See Chapter 23).

Loads, Occupant. (See Chapter 33 for requirements).

Lodging House. (See Chapter 45).

Machine Room. A machine room is a room used for the housing of elevator or refrigeration equipment.

Masonry. (See Chapter 24).

Masonry, Solid. (See Chapter 24).

May as used in this Building 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 33 1/7 per cent of the total floor area in that room, it shall be considered
as constituting an additional "story." The clear height above or below a "Mezzanine Floor" construction shall be not less than seven (7) feet.

**Nursing Home** is a facility which is operated in connection with a hospital, or in which nursing care and medical services are prescribed by or performed under the general direction of persons licensed to practice medicine or surgery in the State, for the accommodation of convalescents or other persons who are not actually ill and not in need of hospital care, but who do require skilled nursing care and related medical services. The term "nursing home" shall be restricted to those facilities, the purpose of which is to provide skilled nursing care and related medical services for a period of not less than 24 hours a day to individuals admitted because of illness, disease, or physical or mental infirmity and which provide a community service.

**Occupancy** is the purpose for which a building is used or intended to be used. The term shall also include the building or room housing such use. Change of occupancy is not intended to include change of tenants or proprietors.

**Occupancy, Mixed.** A building used for more than one purpose.

**Occupant, Load.** (See Chapter 33).

**Panic Hardware.** (See Chapter 33).

**Partition.** Any vertical construction used to divide a building or part thereof into rooms or spaces and which extends over six (6) feet above the floor on which it rests or which extends more than one-half the distance from floor to ceiling, whichever is less.

**Partition, Permanent.** A partition meeting the requirements of this Building Code for fire resistive value for non-combustibility as determined by the type of construction. In addition, a permanent partition is one that is either made a part of the floor and ceiling or is fastened to the floor or ceiling in such a manner that it cannot be moved.

**Partition, Temporary.** A partition which does not meet the requirements of this Building Code for fire resistance or non-combustibility as determined by the type of construction. In addition, a temporary partition is one that is fastened to the floor or ceiling in such a manner that it can be readily and easily moved.

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

**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.

**Penthouse.** (See Chapter 36).

**Pit.** (See Chapter 52).

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

**Plumbing.** (See Chapter 50).

**Porch (patio).** An unenclosed, partially, or wholly self-supporting exterior structure having a paved, graveled, floors, or planted platform area adjacent to an entrance or to exterior walls of a building or structure having a roof.

**Porch, Enclosed** shall have at least fifty (50) per cent of the horizontal section of the exterior walls in glass.

**Proscenium.** The vertical plane of separation between an assembly area and a stage.

**Public Way.** (See Chapter 33).

**Repair** is the reconstruction or renewal of any part of an existing building, structure or utilities for the purpose of its maintenance. The word "repair" or "repairs" shall not apply to any change of construction.

**Roof, Open Skeleton Frame.** A roof, all supporting members of which are exposed on the underside, without ceiling or other obstruction under the roof.

**Roof Structure.** (See Chapter 36).

**School.**

1. A public place of instruction operated by public authorities, including elementary, secondary, and higher learning institutions.

2. A place of instruction operated by private persons or religious organizations in which the course of study is similar to that in a public school, or a pre-
school for children, age 2 to 6 years for 6 or more children and which has been authorized by the State as an educational institution.

3. A building or part thereof used as a trade, art, voice, music, modeling school or studio, when having an occupant load of 50 or less (based on Table 33-A) is classed as Group "B" Occupancy, and having an occupant load of 50 or more shall be classed as Group "C" Occupancy.

Shaft is a vertical opening through a building for elevators, dumbwaiter, light, heat or air conditioning, ventilation, utilities or similar purposes.

Shall as used in this Building 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 used, and where the distance between the top of the proscenium opening and the ceiling above the stage is more than five (5) feet.

Skylight. (See Chapter 34).

Smoke-proof Enclosure. (See Chapter 33).

Stairway. Two or more risers shall constitute a stairway.

Stairway, Monumental. (See Chapter 33).

Stairway, Private. (See Chapter 33).

Stairway, Public. (See Chapter 33).

Service Station. A building or lot, whose primary purpose is the sale of motor vehicle fuels. The term includes replacement of minor parts and minor repairs but does not include parking of motor vehicles within a building or any other garage use.

Street shall mean a public thoroughfare, not less than twenty (20) feet 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."

Story means that portion of a building included between the upper surface of the topmost floor and the ceiling or roof above. If the finished floor level directly over a basement is more than five (5) feet above grade, such basement shall be considered a story.

Structure. An assembly of materials forming a construction for occupancy and including among others, buildings, stadiums, tents, viewing stands, platforms, stagings, observation towers, radio and television towers, water tanks, swimming and wading pools, retaining walls, open sheds, coal bins, shelters, fences, display signs. This definition shall not include utilities.

Treads. The horizontal part of a step, including nosing.


Useable Space. Useable space shall mean any space that may be used for the storage of materials or equipment. This definition shall also include any area where such space may be used for any other purposes, This definition shall not apply, where a potential useable space is sealed off in such a manner so that access to the area will not be afforded.

Use. A component or constituent of an occupancy.

Utilities: For the purposes of this Building Code, utilities shall be defined without limitation, to include the following:

Refrigeration systems and their appurtenances

Electrical systems and all appurtenances such as motors, etc.

Heating and Ventilating systems and appurtenances

Elevators, dumb waiters, escalators and similar conveyances

Fire protection systems and apparatus

Air conditioning or air treatment systems, including ductwork

Exhaust or ventilating systems including ductwork

Plumbing and sanitary systems and all appurtenances

Signal and annunciator systems

Gas, oil and solid fuel fired appliances, piping, controls, burners and their appurtenances
Evaporative cooling, antennas, wells and equipment, water heaters, gas lights, fences

Swimming pool piping, gasoline pumps, L.P.G., liquid fuel and gasoline tanks and piping

(For the purpose of this Building Code this definition shall not include a Public Utility.)

Utility, Public. A public utility is one which is authorized franchised by an affirmative vote of the people of the City to perform such services as are necessary to fulfill the obligations as indicated by such authorization or franchise, or any City, State or Federal owned utility.

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

Value or Valuation. (See Chapter 1).

Vent. (See Chapter 37).

Vertical Openings.

1. Vertical openings shall include a shaft, chute, elevator, dumbwaiter or similar story penetration (other than a stairway) above or below the floor forming the story separation. (See Chapter 33 for stairway enclosures.

2. Openings through floors which carry flues, vents, or ducts, chimneys.

Walls. Vertical structures serving to enclose space, form a division, or support superimposed loads extending from floor to ceiling.

Wall, Bearing. A wall which supports any load other than its own weight.

Wall, Cavity. 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.

Wall, Curtain. A non-bearing wall between columns or piers.

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

Wall, Exterior is any wall or element of a wall, or any member or group of members, which defines the exterior boundaries or courts of a building.

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

Wall, Fire means a wall which subdivides a building or separates buildings to restrict the spread of fire, and which starts at the foundations and extends continuously through all stories to and above the roof, except where the roof is incombustible and the wall is carried up tightly against the underside of the roof slab.

Wall, Fire Partition. A partition for the purpose of restricting the spread of fire or to provide an area of refuge, but not necessarily continuous through all stories nor extended through the roof, and to be so classed shall have a fire-resistive rating of not less than one hour.

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

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

Wall, Hollow. (See Chapter 24).

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

Walls, Nonbearing. A wall which supports no load other than its own weight.

Wall, Panel. (See Chapter 24).

Wall, Parapet. That part of any wall entirely above the roof line.

Wall, Party. A wall used or adopted for joint service between two buildings.

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

Wall, Veneer. (See Chapter 29).

Windows. (See Chapter 38).

Window, Bay. A rectangular, curved, or polygonal window.

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

Yard. An open, unoccupied space, other than a court, unobstructed from the ground to the sky, except where specifically provided by this Building Code, on the lot on which a building is situated.
Section 402. STANDARDS

Unless as otherwise specified in other Sections of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
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<tbody>
<tr>
<td>ASTM</td>
<td>Method of Test for Surface Burning Characteristics of Building Materials, E-84-67</td>
</tr>
<tr>
<td></td>
<td>Method of Test for Determining Non-combustibility of Elementary Materials, E-136-59 T</td>
</tr>
</tbody>
</table>

Legend:

ASTM—American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103
### 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 Building Official according to its use or the character of its occupancy, as a building of Group A, B, C, D, E, F, G, H, I or J, as defined in Chapters 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15 respectively. (See Table No. 5-A).

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

#### Section 502. Change in Occupancy.

No change shall be made in the character of occupancy of any building which would place the building in a division of the same Group of Occupancy or in a different Group of Occupancy, unless such building is made to comply with the requirements of this Building Code for such division or Group of Occupancy.

**Exception:** The character of the occupancy of existing buildings may be changed subject to the approval of the Building Official and included in the Group which its existing use most nearly resembles based on the existing or proposed life and fire hazard.

#### Section 503. Mixed Occupancy.

**a) General.**

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

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

**Exceptions:**

1. When a one-story building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. The area of the building shall be such that the sum of the actual areas divided by the allowable area for each separate occupancy shall not exceed one.

2. Where minor accessory uses do not occupy more than ten (10) per cent of the area of a building, nor more than ten (10) per cent of the basic area permitted in the occupancy by Table No. 5-C, the major use of the building shall determine the occupancy classification provided the uses are separated as set forth in Section 503 (d).

**b) Forms of Occupancy Separations.**

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

**c) Types of Occupancy Separation.**


1. A "Four-Hour Fire Resistant Occupancy Separation" shall have no openings therein and shall be of at least four-hour fire-resistive construction.
2. A "Three-Hour Fire-Resistive Occupancy Separation" shall be of at least three-hour fire-resistive construction. All openings in walls forming such separation shall be protected by a fire assembly having a three-hour fire-resistive rating. A total width of all openings in any three-hour fire-resistive occupancy separation wall in any one story shall not exceed twenty-five (25) per cent of the length of the wall in that story and no single opening shall have an area greater than one hundred and twenty (120) square feet.

All openings in floors forming a "Three-Hour Fire-Resistive Occupancy Separation" shall be protected by a vertical enclosure extending above and below such openings. The walls of such vertical enclosure shall be of at least two-hour fire-resistive construction and all openings therein shall be protected with a fire assembly having a one and one-half (1 1/2) hour fire-resistive rating.

3. A "Two-Hour Fire-Resistive Occupancy Separation" shall be of at least two-hour fire-resistive construction. All openings in such separation shall be protected by a fire assembly having a one and one-half (1 1/2) hour fire-resistive rating.

4. A "One-Hour Fire-Resistive Occupancy Separation" shall be of at least one-hour fire-resistive construction. All openings in such separation shall be protected by a fire assembly having a one-hour fire-resistive rating.

(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. Where any occupancy separation is required the minimum shall be a "One-Hour Fire-Resistive Occupancy Separation." Where the occupancy separation is horizontal, structural members supporting the separation shall be protected by equivalent fire-resistive construction.

Section 504. Location Within City and Location on Property.

(a) General.

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, District Zoning Regulations and Fire Zone Regulations shall be followed. Included in both regulations are restrictions which, within a particular zone, may modify general provision herein contained with respect to building heights, area, and property setbacks.

Buildings shall adjoin or have access to a public space, yard, or street on at least one side. Required yards shall be permanently maintained.

For the purposes of this Section, the center line of an adjoining street or alley shall be considered an adjacent property line.

For requirements for eaves, see Chapter 17.

(b) Fire Resistance of Walls.

Exterior walls shall have fire-resistance and opening protection as set forth in Chapter 5 through 15, (Requirements Based on Occupancy), and in accordance with such additional provisions as are specified in Chapter 16, (Requirements Based on Location in Fire Zones), and Chapters 17 through 22, (Requirements Based on Types of Construction) in this Building Code. Distance shall be measured at right angles from the property line. The above provisions shall not apply to walls at right angles to the property line.

(c) Buildings on Same Property.

For the purpose of determining the required exterior wall protection, buildings on the same property shall be assumed to have a property line between them.

When a new building is to be erected on the same property with an existing building, the assumed property line from the existing building shall be the distance to the property line for each occupancy as set forth in Table No. 5-A and Chapters 17 through 22, (Requirements Based on Types of Construction).

Exception: Two or more buildings on the same property may be considered as portions of one building if the area within a line circumscribing the buildings is within the limits set forth in Section 505. In this case, the space between buildings shall be considered an inner court for the purpose of determining the exterior wall construction.

When the buildings so considered house different occupancies or are of different types of construction, the area shall be that permitted for most restricted occupancy or construction.

(d) Fire Zones.

Fire Zone regulations are in Chapter 16 of this Building 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, and No. 3.

(e) District Zones.

District Zoning regulations shall be based on a classification of use by districts as residential, business, industrial, etc. These regulations shall be administered and enforced by the Zoning Administrator, under authority granted in Article 610 of the Revised Municipal Code.
Section 505. Allowable Floor Areas.

(a) One-Story Areas.

The area of a one-story building in Fire Zone No. 1 and No. 2 shall not exceed the limits set forth in Table No. 5-C except as provided in Section 506, nor the limits set forth in Chapter 16.

For buildings located in Fire Zone No. 3 the basic area may be increased thirty-three and one-third (33½%) per cent.

(b) Areas of Buildings Over One Story

The total area of all floors of buildings over one story in height shall not exceed two hundred (200) per cent of the area permitted for one story buildings. No single floor area shall exceed that permitted for one-story buildings. Basements and cellars need not be included in the total allowable area.

(c) Separation of Areas.

For the purpose of this Section each portion of the building separated by one or more continuous fire-resistive walls extending from the foundation to the roof at all points may be considered a separate building. Such area separation wall shall be at least four-hour fire-resistive construction in buildings of Types I, II, III construction with all openings protected by a fire assembly having a three-hour fire-resistive rating and shall be at least two-hour fire-resistive construction in buildings of Types IV and V with all openings protected by a fire assembly having a two-hour fire-resistive rating except as set forth in Table No. 33-B.

The total width of all openings in such fire-resistive wall in each story shall not exceed twenty-five (25) per cent of the length of the wall in that story.

Section 506. Allowable Area Increase.

(a) General.

The floor areas set forth in Section 505 may be increased by one of the following:

1. Separation on two sides.

Where public space, streets, or yards more than twenty (20) feet in width extend along and adjoins two sides of the building, floor areas may be increased at a rate of one and one-fourth (1¼) per cent for each foot by which the minimum width exceeds twenty (20) feet, but the increase shall not exceed fifty (50) per cent.

2. Separation on three sides.

Where public space, streets, or yards more than twenty (20) feet in width extend along and adjoins three sides of the building, floor areas may be increased at a rate of two and one-half (2½) per cent for each foot by which the minimum width exceeds twenty (20) feet, but the increase shall not exceed one hundred (100) per cent.

3. Separation on all sides.

Where public space, streets or yards, more than twenty (20) feet in width extend on all sides of one- and two-story buildings and adjoin the entire perimeter, floor areas may be increased at a rate of five per cent for each foot by which the minimum width exceeds twenty (20) feet. Such increases shall not exceed one hundred (100) per cent.

Exceptions: A. Aircraft repair hangars may have the floor area increased three hundred (300) per cent.

B. One-story aircraft storage hangars may have the floor area increased five hundred (500) per cent.

(b) Unlimited Area.

The area of any one or two-story building of Group E, Division 5, Group F and Group G Occupancies shall not be limited, if the building is provided with an approved automatic fire-extinguishing system throughout, as set forth in Chapter 38, and entirely surrounded by public space, streets or yards at least twenty (20) feet in width.

The area of a one-story Type II, Type III Heavy Timber, Type III one-hour or Type IV building of Group G Occupancy shall not be limited if the building is entirely surrounded by public space, street, or yards at least forty (40) feet in width.

(c) Automatic Fire-Extinguishing Systems.

The area set forth 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 an approved automatic fire-extinguishing system throughout installed in accordance with Chapter 38. The area increases permitted in this paragraph may be combined with that permitted in paragraph numbered 1, 2 or 3, of Subsection (a) of this Section except where other provisions of this Building Code require approved automatic fire-extinguishing systems the increases permitted in this Section shall not apply.

Section 507. Maximum Height of Buildings and Increases.

The maximum height and number of stories of every building shall be dependent upon the character of the occupancy, the type of construction and the Fire Zone, and shall not exceed the limits set forth in Table No. 5-D, except as provided in this Section. The height shall be measured from the highest adjoining sidewalk or ground surface, provided that the height measured from the lowest adjoining surface shall not exceed such maximum height by more than ten (10) feet.

The limits set forth in Table No. 5-D may be increased by one story if the building is provided with an automatic fire-extinguishing system throughout installed in accordance with the provisions of
Chapter 38 except that the increase in height, for sprinklers, shall not apply when other provisions of this Building Code require automatic fire-extinguishing systems throughout or when the increases under Section 506 (c) are used.

Exceptions:

1. Towers, spires, and steeples, erected as a part of a building and not used for habitation or storage, are limited as to height only by structural design if completely of incombustible material, or may extend not to exceed twenty (20) feet above the height limit in Table No. 5-D if of combustible materials.

2. The height of one-story aircraft hangars shall not be limited if the building is provided with automatic fire-extinguishing systems throughout installed in accordance with Chapter 38 and is entirely surrounded by public space, streets, or yards not less in width than one hundred and fifty (150) per cent of the height of the building.

Section 508. Fire Resistive Substitution.

Where one-hour fire-resistive construction throughout is required by this Building Code, an approved automatic fire-extinguishing system installed in accordance with Chapter 38 may be substituted, provided such system is not otherwise required. Fire-resistive doors shall be installed in any case where otherwise required in this Building Code.

Section 509. Arcades.

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

Exception: In Group F or G occupancy, factory, industrial or warehouse buildings, automatic fire doors may be installed in lieu of the self-closing doors as required above.

The length of the arcade shall conform with the distance required between the buildings based on the fire resistance of the walls of the buildings and the openings therein.

Section 510. Food Waste Disposal Mandatory.

New structures erected, 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 of this Section unless such structure is provided with a new kitchen. Such kitchen, only, shall be provided with a food disposal unit. (For detailed requirements, see Chapter 50.)

Section 511. Sanitary Toilets Required During Construction or Demolition.

Building Licensees Class A, B, C and home owners, Wrecking Licensees Class A and B engaged in the construction or demolition of any building classified according to its use or the character of its occupancy as a building of Group A through I occupancies as defined in Chapters 6 through 14, respectively, shall maintain on such construction or demolition projects, toilet facilities for the use of workmen employed engaged or engaged in such projects. Such toilet facilities shall be completely enclosed in a fly-proof, weather-tight, vented unit. The doors and screens shall be tight-fitting and self-closing, and the toilets shall be provided with seats and covers and shall be of smooth and easily cleanable construction. All such toilets shall be maintained odorless, clean, free from flies and other insects and vermin, and shall be supplied with toilet paper, and the toilet fixtures shall be conventional water closets or urinals installed in accordance with Chapter 50 or of chemical storage type meeting the standards herein set forth.

Section 512. Exceptions and Deviations.

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

Section 513. Requirements for Anesthetizing Locations.

(See Section 910). Where any of the above are located in any occupancy, such rooms or areas shall comply with the requirements of Chapter 9 of this Building Code.

Section 514. Draperies, Blinds, Curtains and Decorations.

Draperies, blinds, curtains and decorations of all types, in buildings of Group A, B, C, D, E and H Occupancies, and in Group F Occupancies when the area of rooms or areas exceed thirty-five hundred
(3500) square feet, shall be required to be of approved flame-proof materials or shall be incombustible.

Section 515. Standards.

Unless otherwise provided in this Building Code, the standards as set forth in this Chapter shall prevail.

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
</table>

Legend:

60 Batterymarch St.
Boston, Mass. 02110

ASTM—American Society for Testing and Materials
1916 Race St.
Philadelphia, Penn. 19103
## TABLE NO. 5-A
### GROUPS OF OCCUPANCY

<table>
<thead>
<tr>
<th>GROUP</th>
<th>DIVISION</th>
<th>DESCRIPTION</th>
<th>CHAPTER REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>Any assembly building with a stage and an occupant load of 1000 or more in the building</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1.</td>
<td>Any assembly building with a stage and an occupant load of less than 1000 in the building</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Any assembly building without a stage and having an occupant load of 300 or more in the building</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than eight hour per week</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>Stadiums, reviewing stands, and amusement park structures not included within Group A nor Group B, Divisions 1, 2 and 3 occupancies</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td>Any building used for pre-school, school, college, university, library or day-care purposes more than eight hours per week, involving assemblage for instruction, education or recreation, and not classified in Group A or Group B, Divisions 1 and 2 occupancies</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>Mental hospitals, mental sanitariums, jails, prisons, reformatories, houses of correction, and buildings where personal liberties of inmates are similarly restrained.</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>1.</td>
<td>Nurseries for full-time care of children under kindergarten age, hospitals, sanitariums, homes for the aged, nursing homes, orphanages, and homes for children of kindergarten age or older, and similar buildings (each accommodating 5 persons).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Storage and handling of hazardous and highly inflammable or explosive materials other than flammable liquids</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>Storage and handling of Class I, II and III flammable liquids, dry cleaning plants using flammable liquids, paint stores with bulk handling, paint shops and inside service stations.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:** (1) For definitions of assembly buildings, garages, dwellings, etc. see Chapter 4 of this Building Code.
### TABLE NO. 5-A — Continued

<table>
<thead>
<tr>
<th>GROUP</th>
<th>DIVISION</th>
<th>DESCRIPTION</th>
<th>CHAPTER REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>3.</td>
<td>Woodworking establishments, flourmills, grain elevators, planing mills and box factories; shops, factories where loose, combustible fibers or dust are manufactured, processed or generated; warehouses where highly combustible material is stored; rubber, plastic or paper processing; rag processing or storage.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td>Repair garages.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.</td>
<td>Aircraft repair hangars.</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1.</td>
<td>Outdoor gasoline and service stations, storage garages where no repair work is done except exchange of parts and maintenance requiring no open flame, welding or the use of highly flammable liquids; paper storage and rubber storage.</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Drinking and eating establishments having an occupant load of less than 100, wholesale and retail stores, office buildings, printing plants, municipal police and fire stations, factories and workshops using material not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling and dry cleaning plants using non-flammable solvents. (For other drinking and eating establishments, see Group B).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td>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. Open parking garages. (For requirements, see Chapter 11).</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>1.</td>
<td>Greenhouses, 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.</td>
<td>12</td>
</tr>
<tr>
<td>H</td>
<td>1.</td>
<td>Hotels, apartment houses, dormitories, lodging houses, convents, monasteries and similar buildings not included in Group D, Division 2 (each accommodating more than 10 persons), row dwelling buildings.</td>
<td>13</td>
</tr>
<tr>
<td>I</td>
<td>1.</td>
<td>Dwellings (one or two-family units).</td>
<td>14</td>
</tr>
<tr>
<td>J</td>
<td>1.</td>
<td>Private garages; minor buildings used as accessories to any other occupancy only when not over one thousand (1,000) square feet in area; swimming pools; covered patios and carports.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Fences over four (4) feet high, retaining walls over three (3) feet high; tanks and towers.</td>
<td></td>
</tr>
</tbody>
</table>
**TABLE NO. 5-B**

**REQUIRED SEPARATIONS IN BUILDINGS OF MIXED OCCUPANCY (In Hours)**

<table>
<thead>
<tr>
<th>Group</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E-1</th>
<th>E-2</th>
<th>E-3</th>
<th>E-4-5</th>
<th>F-1</th>
<th>F-2</th>
<th>F-3</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>E-2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>E-3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-4-5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
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<tr>
<td>F-1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
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<tr>
<td>F-2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<td>F-3</td>
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</tr>
<tr>
<td>G</td>
<td>1</td>
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<td>H</td>
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<td></td>
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<tr>
<td>I</td>
<td>1</td>
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<td></td>
<td></td>
<td>1*</td>
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<tr>
<td>J</td>
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</tr>
</tbody>
</table>

*Provided that materials as approved for one-hour fire-resistive construction on the garage side and a self-closing tight-fitting solid wood door at least one and three-eighths (1\(\frac{3}{8}\)) inches in thickness, shall be permitted.
TABLE NO. 5-C

BASIC ALLOWABLE FLOOR AREA FOR BUILDINGS ONE STORY IN HEIGHT*

(In Square Feet)

For Buildings Located in Fire Zone No. 3, the basic area may be increased 33 1/3 per cent.

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unlimited</td>
<td>13,500</td>
<td>10,200</td>
<td>Not Permitted</td>
<td>10,200</td>
</tr>
<tr>
<td>B) 1-2</td>
<td>Unlimited</td>
<td>13,500</td>
<td>10,200</td>
<td>6,900</td>
<td>10,200</td>
</tr>
<tr>
<td>B) 3-4</td>
<td>Unlimited</td>
<td>13,500</td>
<td>10,200</td>
<td>6,900</td>
<td>10,200</td>
</tr>
<tr>
<td>C</td>
<td>Unlimited</td>
<td>20,400</td>
<td>15,300</td>
<td>10,200</td>
<td>15,300</td>
</tr>
<tr>
<td>D) 1</td>
<td>Unlimited</td>
<td>6,900</td>
<td>Not Permitted</td>
<td>5,100</td>
<td>5,100</td>
</tr>
<tr>
<td>D) 2-3</td>
<td>Unlimited</td>
<td>6,900</td>
<td>5,100</td>
<td>Not Permitted</td>
<td>5,100</td>
</tr>
<tr>
<td>E) 1-2</td>
<td>Unlimited</td>
<td>11,250</td>
<td>5,700</td>
<td>4,200</td>
<td>2,700</td>
</tr>
<tr>
<td>E) 3-4-5</td>
<td>Unlimited</td>
<td>11,400</td>
<td>8,400</td>
<td>5,700</td>
<td>8,400</td>
</tr>
<tr>
<td>F) 1-2-3</td>
<td>Unlimited</td>
<td>18,000</td>
<td>13,500</td>
<td>9,000</td>
<td>13,500</td>
</tr>
<tr>
<td>G</td>
<td>Unlimited</td>
<td>27,000</td>
<td>20,400</td>
<td>13,500</td>
<td>20,400</td>
</tr>
<tr>
<td>H</td>
<td>Unlimited</td>
<td>13,500</td>
<td>10,200</td>
<td>6,900</td>
<td>10,200</td>
</tr>
<tr>
<td>I</td>
<td>Unlimited</td>
<td>6,900</td>
<td>Not Permitted</td>
<td>5,100</td>
<td>5,100</td>
</tr>
<tr>
<td>J</td>
<td>See Chapter 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N.—No general requirements for fire resistance.
H.T.—Heavy Timber
*
—For storage sheds open on at least one side, the area may be increased 100 per cent.
### TABLE NO. 5-D
#### MAXIMUM HEIGHT OF BUILDINGS

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hour or H.T.</td>
<td>N</td>
<td>1-Hour</td>
<td>N</td>
<td>1-Hour</td>
<td>N</td>
</tr>
</tbody>
</table>

#### MAXIMUM HEIGHT IN FEET

<table>
<thead>
<tr>
<th></th>
<th>Unlimited</th>
<th>95'</th>
<th>65'</th>
<th>55'</th>
<th>65'</th>
<th>55'</th>
<th>50'</th>
<th>40'</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Unlimited</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
<td>2</td>
<td>Not Permitted</td>
<td>2</td>
<td>Not Permitted</td>
<td>2</td>
</tr>
<tr>
<td>B) 1-2</td>
<td>Unlimited</td>
<td>4</td>
<td>2</td>
<td>Not Permitted</td>
<td>2</td>
<td>Not Permitted</td>
<td>2</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>B) 3-4</td>
<td>Unlimited</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>Unlimited</td>
<td>4*</td>
<td>2*</td>
<td>1</td>
<td>2*</td>
<td>1</td>
<td>2*</td>
<td>1</td>
</tr>
<tr>
<td>D) 1</td>
<td>Unlimited</td>
<td>2</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>D) 2</td>
<td>Unlimited</td>
<td>3</td>
<td>1**</td>
<td>Not Permitted</td>
<td>1**</td>
<td>Not Permitted</td>
<td>1**</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>D) 3</td>
<td>Unlimited</td>
<td>3</td>
<td>2**</td>
<td>Not Permitted</td>
<td>2**</td>
<td>Not Permitted</td>
<td>2**</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>E) 1</td>
<td>Unlimited</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>E) 2-3-4-5</td>
<td>Unlimited</td>
<td>2</td>
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N.—No general requirements for fire resistance.

H.T.—Heavy Timber

* See Chapter 8
** See Chapter 9
*** H.T. only
CHAPTER 6
REQUIREMENTS FOR GROUP A OCCUPANCIES

Section 601. Group A Occupancies Defined.

Group A Occupancies shall be: Any assembly building with a stage and an occupant load of 1000 or more in the building.
For occupant load see Chapter 33.
For occupancy separations see Table No. 5-B.

Section 602. Construction, Height, and Area Allowable.

(a) General.

Buildings or parts of buildings classed in Group A because of the use or character of the occupancy shall be of Type I construction and shall not be limited as to height or area.

(b) Special Provisions.

1. Stages and enclosed platforms as defined in Chapter 4 shall be constructed in accordance with Chapter 39.

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

Section 603. Location.

(a) In City.

Buildings of Group A Occupancy shall not be limited as to location in Fire Zones.

(b) On Property.

Buildings housing Group A occupancies shall front directly upon or have access to a public street at least twenty feet (20') in width. The access to the public street shall be a minimum twenty-foot (20') wide right-of-way unobstructed and maintained only as access to the public street. The main entrance to the building shall be located on the public street or on the access way. The main assembly floor shall be located at or near the adjacent ground level. (For property setbacks, see Zoning Regulations.)

(c) Exterior Wall and Opening Protection.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 18. For regulating adjacent buildings on the same property, see Chapter 5.

Section 604. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Section 605. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group A Occupancies customarily used by human beings and all dressing rooms shall be provided with light by means of windows or skylights with an area at least one-eighth of the total floor area or shall be provided with artificial light.

(b) Ventilation.

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.

For ventilation requirements in Group A Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)

Section 606. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed as set forth in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

Section 607. Fire Protection Systems.

Automatic fire-extinguishing systems, standpipes, fire detection systems, and fire alarm systems, shall be installed as set forth in Chapter 38.
(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Motion Picture Machine Booths.

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

(c) Flammable Liquids.

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

(d) Boiler Rooms.

All exterior openings in a boiler room or room containing central heating equipment shall be protected by a fire assembly having a three-fourths (¾) hour fire-resistive rating. Such fire assemblies shall be fixed, automatic, or self-closing.

Every room containing a boiler or a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by at least a "Three-Hour Fire-Resistive Occupancy Separation" with all openings protected as set forth in Table No. 33-B. Every room containing a boiler or a central heating plant which burns gas as fuel shall be separated from the rest of the building by at least a "One-Hour Fire-Resistive Occupancy Separation" with all openings protected as set forth in Table No. 33-B.

Exception: Where boilers or central heating plants burning liquid or solid fuel are located at grade level they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation" with all openings protected by a fire assembly having a one-hour fire-resistive rating, mounted within the boiler room, and having closing devices as set forth in Table No. 33-B.

Section 609. Exceptions and Deviations.

Gymnasiums and similar occupancies may have running tracks constructed of wood or unprotected steel or iron.
CHAPTER 7
REQUIREMENTS FOR GROUP B OCCUPANCIES

Section 701. Group B Occupancies Defined.

Division 1.
Group B Occupancies shall be:
Any assembly building with a stage and an occupant load of less than 1000 in the building.

Division 2.
Any assembly building without a stage and having an occupant load of 300 or more in the building.

Division 3.
Any assembly building without a stage and having an occupant load of less than 300 in the building, including such buildings used for school purposes less than eight hours per week.

Division 4.
Stadiums, reviewing stands, and amusement park structures not included within Group A nor Group B Divisions 1, 2 and 3 occupancies.

For occupancy separations see Table No. S-B. For occupant load see Chapter 33.

Section 702. Construction, Height and Area Allowable.

(a) General.
Buildings or parts of buildings classed in Group B because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height or area, the limits set forth in Chapter 5.

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

(b) Special Provisions.
1. Stages and enclosed platforms as defined in Chapter 4 shall be constructed in accordance with Chapter 39.

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

3. Divisions 1 and 2 occupancies shall be of at least one-hour fire-resistive construction throughout, except that a fire-resistive ceiling shall not be required in one-story buildings of Type III, IV or V construction having an open frame roof. Division 2 occupancies with an occupant load of 1000 or more shall be of Type I, II or III construction.

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

4. Division 3 occupancies located in a basement or above the first story shall be of at least one-hour fire-resistive construction.

5. Group B assembly rooms having an occupant load of 1000 or more shall not be located in the basement.

6. Division 3 occupancies with an occupant load of 50 or more, which are located over usable space, shall be separated from such space by at least one-hour fire-resistive construction.

7. For attic space partitions and draft stops see Chapter 31.

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

2. Structures housing Division 4 occupancies, other than those of open skeleton frame type, when more than one story in height or four hundred (400) square feet in area, shall be of at least one-hour fire-resistive construction.

3. When the space under a Division 4 occupancy is used for any purpose, it shall be separated from all parts of such Division 4 occupancy, including exits, by walls, floors and ceilings of at least one-hour fire-resistive construction.

Section 703. Location.

(a) In City
For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property.
All buildings housing Group B Occupancies shall front directly upon or have access to a public street at least twenty feet (20') in width. The access to the public street shall be a minimum twenty-foot (20') wide right-of-way unobstructed and maintained only as access to the public street. The main entrance to the building shall be located on the public street or on the access way. (For property setbacks, see Zoning Regulations).
(c) Exterior Wall and Opening Protection.

For fire-resistant protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 inclusive. For regulating adjacent buildings on the same property, see Chapter 5.

Section 704. Exit Facilities.

(a) General.

Stairs and exits shall be provided as set forth in Chapter 33.

(b) Amusement Structures.

Stairs and exits for Division 4 amusement structures shall be provided as set forth in Chapter 33, subject to the approval of the Building Official. Exit signs shall be installed as set forth in Chapter 33 and where required by the Building Official.

Section 705. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group B Occupancies customarily used by human beings and all dressing rooms shall be provided with natural or artificial light as set forth in Chapter 6.

(b) Ventilation.

For requirements in Group B Occupancies, see Chapter 32.

(c) Sanitation. (See Chapter 50.)

Section 706. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed as set forth in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

Section 707. Fire Protection Systems.

Automatic fire-extinguishing systems, standpipes, fire detection systems, and fire alarm systems, shall be installed as set forth in Chapter 38.

Section 708. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Motion Picture Machine Booths.

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

(c) Flammable Liquids.

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

(d) Boiler Rooms.

All exterior openings in a boiler room or rooms containing central heating equipment shall be protected by a fire assembly having a three-fourths-hour fire-resistant rating. Such fire assemblies shall be fixed, automatic, or self-closing.

Every room containing a boiler or a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a “Three-Hour Fire-Resistive Occupancy Separation” with all openings protected as set forth in Table No. 33-B. Every room containing a boiler or a central heating plant which burns gas as fuel shall be separated from the rest of the building by at least a “One-Hour Fire-Resistive Occupancy Separation” with all openings protected as set forth in Table No. 33-B.

Exception: Where boilers or central heating plants burning liquid or solid fuel are located at grade level they may be separated from the remainder of the building by a “One-Hour Fire-Resistive Occupancy Separation” with all openings protected by a fire assembly having a one-hour fire-resistant rating, mounted within the boiler room and having closing devices as set forth in Table No. 33-B.

Section 709. Exceptions and Deviations.

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

In gymnasiums and in multi-purpose schoolrooms having an area not greater than thirty-two hundred (3200) square feet, one (1) inch nominal tight tongue-and-grooved or three-fourths (¾) inch plywood wall covering may be used on the inner side in lieu of fire-resistant plaster. (See Chapter 42 for Interior Finishes.)
CHAPTER 8
REQUIREMENTS FOR GROUP C OCCUPANCIES

Section 801. Group C Occupancies Defined.

Group C Occupancies shall be: Any building used for pre-school, school, college, university, library or day-care purposes more than eight (8) hours per week, involving assemblage for instruction, education, or recreation, and not classed in Group A Occupancies or in Group B Division 1 and 2 Occupancies.

For occupancy separations see Table No. 5-B. For occupant load see Chapter 33.

Section 802. Construction, Height and Area Allowable.

(a) General.

Buildings or parts of buildings classed in Group C because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height or area, the limits set forth in Chapter 5.

(b) Special Provisions.

1. Rooms having an occupant load of more than 100, and rooms used for pre-school or kindergarten, first or second-grade pupils, shall not be located above the first story above grade except in buildings of Type I construction.

2. Except in one-story buildings in which all rooms used for instruction have at least one exit door directly to the outside, all buildings housing Group C Occupancies shall be at least one-hour fire-resistant construction throughout. A fire-resistant ceiling will not be required in one-story buildings having an open frame roof.

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

4. Balconies and bleachers over usable space and all janitor closets shall be protected with materials approved for one-hour fire-resistant construction.

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

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

7. For attic space partitions and draft stops, see Chapter 31.

Section 803. Location.

(a) In City.

For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property

All buildings housing Group C Occupancies shall front directly upon or have access to a public street at least twenty feet (20') in width. The access to the public street shall be a minimum twenty-foot (20') wide right-of-way unobstructed and maintained only as access to the public street. At least one required exit shall be located on the public street or on the access way. (For property setbacks, see Zoning Regulations.)

(c) Exterior Wall and Opening Protection.

For fire-resistant protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 inclusive. For regulating adjacent buildings on the same property, see Chapter 5.

(d) Special Provision.

Exterior walls or parts of walls of Group C Occupancies having an occupant load of less than 100 persons, when within ten (10) feet of adjacent property lines, may be of one-hour fire-resistant construction.

Section 804. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Section 805. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group C Occupancies shall be provided with light, either natural or artificial, as set forth in Chapter 6.

(b) Ventilation.

For ventilation requirements in Group C Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)
Section 806. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed as set forth in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately, and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

Section 807. Fire Protection Systems.

Automatic fire-extinguishing systems, standpipes, fire detection systems, and fire alarm systems, shall be installed as set forth in Chapter 38.

Section 808. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapter 37, 51 and 52.

(b) Motion Picture Machine Booths.

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

(c) Boiler Rooms.

All exterior openings in a boiler room or rooms containing central heating equipment shall be protected by a fire assembly having a three-fourths-hour fire-resistive rating. Such fire assemblies shall be fixed, automatic, or self-closing.

Every room containing a boiler or a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation" with all openings protected as set forth in Table No. 33-B.

(d) Flammable Liquids.

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

Section 809. Exceptions and Deviations.

(a) Gymnasiums.

For requirements for gymnasiums and similar buildings, see Chapter 7.

(b) Roof Covering.

Roof covering shall be a "fire-retardant" roofing as set forth in Chapter 32.

(c) Exceptions.

A building which will have only the first floor accessible to not more than 20 pupils at any time, may be used for school purposes with the following exceptions to Code requirements:

1. Exterior walls or parts of walls which are less than three (3) feet from adjacent property lines shall have no openings therein and shall be of at least one-hour fire-resistive construction as set forth in Chapter 43.

2. Classrooms may have only one exit not less than two (2) feet six inches (6) wide.

(d) Heating or Equipment Room Doors.

When the opening for a heating or equipment room is protected by a pair of fire doors, the inactive leaf shall be normally secured in the closed position and shall be opened only by the use of a tool. An astragal shall be provided and the active leaf shall be self-closing.

Section 810. Special Separations.

Laboratories, wood-working and metal-working shops, machine shops, paint shops, storage rooms, and similar areas shall be separated from each other and from classrooms by not less than a One-Hour Fire-Resistive Occupancy Separation as defined in Chapter 5.
CHAPTER 9
REQUIREMENTS FOR GROUP D OCCUPANCIES

Section 901. Group D Occupancies Defined.

Group D Occupancies shall be:

Division 1.
Mental hospitals, mental sanitariums, jails, prisons, reformatories, and buildings where personal liberties of inmates are similarly restrained.

Division 2.
Nurseries for the full-time care of children, hospitals, homes for the aged, nursing homes, orphanages, sanitariums, and similar buildings (each accommodating more than five persons).

Exception: Group D Occupancies shall not include buildings used only for private residential purposes or for a family group.

For occupancy separations see Table No. 5-B. For occupant load see Chapter 33.

Section 902. Construction, Height and Area Allowable.

(a) General.
Buildings or parts of buildings classed in Group D because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height or area, the limits set forth in Chapter 5.

(b) Special Provisions.

1. Division 1 Occupancies shall be of Type I or II construction throughout. Occupancies in which the personal liberties of inmates or patients are restrained within the building shall have floors of incombustible construction.

2. Division 2 Occupancies more than one story in height shall be of Type I or II construction and further shall be of one-hour fire-resistive construction throughout.

3. For attic space partitions and draft stops, see Chapter 31.

Section 903. Location.

(a) In City.
For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property.
Buildings of Group D Occupancy shall adjoin a yard, public space or street on at least one side. For property setbacks see Zoning Regulations.

(c) Exterior Wall and Opening Protection.
For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 inclusive.
For regulating adjacent buildings on the same property, see Chapter 5.

Section 904. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Section 905. Light, Ventilation and Sanitation.

(a) Light.
All portions of Group D Occupancies customarily used by human beings shall be provided with light by means of windows or skylights with an area equal to one-eighth of the total floor area or shall be provided with artificial light.

(b) Ventilation.
For ventilation requirements in Group D Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)

Section 906. Enclosure of Vertical Openings.

Exits shall be enclosed as set forth in Chapter 33. Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately, and the enclosure shall be as set forth in Table 17-A and Chapter 30.

Section 907. Fire Protection Systems.
Automatic fire-extinguishing systems, standpipes, fire detection systems, and fire alarm systems, shall be installed as set forth in Chapter 38.

Section 908. Special Hazards.

(a) Chimneys and Heating Apparatus.
Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Motion Picture Machine Booths.
Motion picture machine booths shall conform to the requirements of Chapter 40.
(c) Flammable Liquids.

Storage of volatile flammable liquids shall not be allowed in Group D occupancies and the handling of such liquid shall not be permitted in any Group D occupancies in quantities of more than one gallon.

(d) Boiler Rooms.

Every room containing a boiler or a central heating plant which burns liquid or solid fuel shall be separated from the rest of the building by a "Three-Hour Fire-Resistive Occupancy Separation" with all openings protected as set forth in Table No. 33-B. Every room containing a boiler or a central heating plant which burns gas as fuel shall be separated from the rest of the building by at least a "One-Hour Fire-Resistive Occupancy Separation" with all openings protected as set forth in Table No. 33-B.

Exception: Where boilers or central heating plants burning liquid or solid fuel are located at grade level they may be separated from the remainder of the building by a "One-Hour Fire-Resistive Occupancy Separation" with all openings protected by a fire assembly having a one-hour fire-resistant rating, mounted within the boiler room, and having closing devices as set forth in Table No. 33-B.

(f) Auxiliary Power Plants.

Auxiliary power plants 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 at least eight (8) inch masonry walls. The use of liquified petroleum gas for fuel is prohibited.

Section 909. Heating or Equipment Room Doors.

When the opening for a heating or equipment room is protected by a pair of fire doors, the inactive leaf shall be normally secured in the closed position and shall be openable only by the use of a tool. An astragal shall be provided and the active leaf shall be self-closing.

Section 910. Requirements for Anesthesia Storage Rooms, All Anesthetizing Locations, Obstetrical Rooms and Wards, Operating Rooms, and Radio-Active Materials Storage Rooms.

(a) Definitions.

1. Anesthesia Storage Room.

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.

2. Anesthetizing Locations.

An anesthetizing location is 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 electro-static 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.

4. Fracture Room.

A fracture room is a room where surgery or manipulation is performed for the setting of bones.

5. Obstetrical Rooms.

An obstetrical room is a room for the delivery of babies.

6. Operating Room.

An operating room is a room where surgery is performed.


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 the use of patients immediately following surgery.

9. X-Ray Room.

An x-ray room is any room in which x-ray equipment is permanently installed.

(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 Building...
Official. A Certificate of Occupancy shall not be issued by the Building Official unless such report indicates that a health hazard does not exist. The Board of Health and Hospitals is hereby authorized to adopt rules and regulations to protect health with relation to such installations.

2. Radio-Active Materials Storage Rooms, Vaults or Containers.

Radio-active materials shall 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 at least 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 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 910 (a)-2.

2. Anesthetizing Locations.

Conductive flooring shall be provided to prevent accumulation of electrostatic charges. A resistance not exceeding five to ten 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.

(d) Heating and Cooling.

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

(e) Standards.

Unless otherwise provided in this Code, the Standards as set forth in this Chapter relating to Section 910 shall prevail.

Organization Title of Publication
NFPA Pamphlet No. 56, June 1965, For The Use of Flammable Anesthetics.

Legend:

NFPA—National Fire Protection Association
60 Battery March St.
Boston, Mass. 02110
CHAPTER 10
REQUIREMENTS FOR GROUP E OCCUPANCIES

Section 1001. Group E Occupancies Defined.

Group E Occupancies shall be:

Division 1.

Storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.

Division 2.

Storage and handling of Class I, II, and III flammable liquids (See Article 234, Revised Municipal Code); dry-cleaning plants using flammable liquids; paint stores with bulk handling; paint shops; and service stations inside buildings.

Division 3.

Woodworking establishments, planing mills and box factories; shops and factories where loose, combustible materials, fibers or dust is manufactured, processed or generated; warehouses where highly combustible material is stored; grain elevators; flour mills; rubber, plastic or paper processing; rag processing or storage.

Division 4.

Repair garages.

Division 5.

Aircraft repair hangars.

For occupancy separations see Table No. 5-B.

For occupant load see Chapter 33.

Flammable liquids shall be deemed to be those with a flash point below 200° Fahrenheit as determined by the closed cup tester, provided that liquids with a flash point above 138.5 degree Fahrenheit may be permitted when used in a closed safety cleaning system for a Class III rating. (See Standard).

Section 1002. Construction, Height and Area Allowable

(a) General.

Buildings or parts of buildings classed in Group E because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height, or area, the limits, set forth in Chapter 5. (See Section 1010 for Additional Requirements for Dry Cleaning Plants.

(b) Special Provisions.

1. Division 5 Occupancies shall have exterior walls of at least one-hour fire-resistive construction or shall be surrounded by public space, streets, or yards at least sixty (60) feet in width.

2. Area increases for aircraft repair hangars, see Chapter 5.

3. In public garages where flammable or explosive liquids are stored or used, floors shall be entirely protected with combustible materials against saturation.

4. In buildings over ninety-five (95) feet in height, the structural frame shall be protected with at least four-hour fire-resistive protection and the floors shall be of at least three-hour fire-resistive construction.

5. A Division 4 Occupancy having a floor area not exceeding twenty-five hundred (2500) square feet shall have exterior walls of at least two-hour fire-resistive construction when less than five (5) feet from a property line and of at least one-hour fire-resistive construction when more than five (5) feet but less than ten (10) feet from a property line, when located in Fire Zone No. 3.

Section 1003. Location.

(a) In City.

Buildings of Group E Occupancy shall be restricted as to location in Fire Zones as set forth in Chapter 16.

(b) On Property.

Buildings of Group E Occupancy shall adjoin a yard, public space or street on at least one side. For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22, inclusive. For regulating adjacent buildings on the same property, see Chapter 5.

Section 1004. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Where ramps are used for the transfer of automobiles from one floor to another, such ramps shall meet at the ground floor level at a point at least twenty (20) feet from the exit of such building.

Section 1005. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group E Occupancies customarily used by human beings shall be provided with light 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.
(b) Ventilation.

For ventilation requirements in Group E Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)

Section 1006. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed in separate enclosures as set forth in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

(c) Ramps.

Doors which are part of an automobile ramp enclosure may be kept normally open but shall be provided with an automatic fire assembly so arranged as to be self-closing when released.

Section 1007. Fire Protection Systems.

Automatic fire-protection systems, standpipes, fire detection systems, fire extinguishers, and fire alarm systems, shall be required and installed as set forth in Chapter 38.

Section 1008. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Boiler Rooms.

Every boiler room or room containing a central heating plant in Divisions 1, 2 and 3 shall be separated from other portions of the building by a Four-Hour Fire-Resistive Occupancy Separation. See Chapters 51 and 52 for unit heaters in hangars.

(c) Flammable Liquids.

In any room in which volatile flammable liquids are used or stored, devices generating a glow or flame capable of igniting vapors shall not be installed or used unless complying with Chapters 51 and 52.

The use, handling, storage, and sale of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group E Occupancy unless such use, handling, storage, and sale comply with Article 234, Revised Municipal Code.

(d) Dust Collecting Systems.

Equipment or machinery which generates or emits dust or fibers shall be provided with an adequate dust or fiber collecting and exhaust system installed in conformance with Chapter 52, unless the building or portion thereof housing such machinery is provided with an automatic fire-extinguishing system conforming to the provisions of Chapter 38.

Section 1009. Service Stations Inside Buildings.

(a) General.

For the purpose of this Chapter, a service station inside a building shall mean one dispensing flammable liquids used as motor fuel when the dispensing devices are located anywhere inside a building. For requirements for outside service stations, see Chapter 11 of this Building Code and see Article 234, Revised Municipal Code, for other requirements.

(b) Construction.

Such service stations shall be provided with an enclosure of at least two-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 and such door shall be power operated and equivalent to a Class "B" fire door. A two (2) inch 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. (See Chapter 38.) An automatic fire sprinkler system shall be provided in accordance with the requirements of Chapter 38.

(f) Supervision.

All gasoline dispensing stations shall be supervised during the hours when gasoline is dispensed.

(g) Fuel Pumps.

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

Section 1010. Additional Regulations for Dry Cleaning Plants.

(a) General.

Dry cleaning plants shall be of Type I construction and shall not exceed one story in height, with no basement, cellar or any floor below grade. All
CHAPTER 10
REQUIREMENTS FOR GROUP E OCCUPANCIES

Section 1001. Group E Occupancies Defined.

Group E Occupancies shall be:

Division 1.
Storage and handling of hazardous and highly flammable or explosive materials other than flammable liquids.

Division 2.
Storage and handling of Class I, II, and III flammable liquids (See Article 234, Revised Municipal Code); dry-cleaning plants using flammable liquids; paint stores with bulk handling; paint shops; and service stations inside buildings.

Division 3.
Woodworking establishments, planing mills and box factories; shops and factories where loose, combustible materials, fibers or dust is manufactured, processed or generated; warehouses where highly combustible material is stored; grain elevators; flour mills; rubber, plastic or paper processing; rag processing or storage.

Division 4.
Repair garages.

Division 5.
Aircraft repair hangars.

For occupancy separations see Table No. 5-B.

For occupant load see Chapter 33.

Flammable liquids shall be deemed to be those with a flash point below 200° Fahrenheit as determined by the closed cup tester, provided that liquids with a flash point above 138.5 degree Fahrenheit may be permitted when used in a closed safety cleaning system for a Class III rating. (See Standard).

Section 1002. Construction, Height and Area Allowable

(a) General.

Buildings or parts of buildings classed in Group E because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height, or area, the limits, set forth in Chapter 5. (See Section 1010 for Additional Requirements for Dry Cleaning Plants.

(b) Special Provisions.

1. Division 5 Occupancies shall have exterior walls of at least one-hour fire-resistive construction or shall be surrounded by public space, streets, or yards at least sixty (60) feet in width.

2. Area increases for aircraft repair hangars, see Chapter 5.

3. In public garages where flammable or explosive liquids are stored or used, floors shall be entirely protected with incombustible materials against saturation.

4. In buildings over ninety-five (95) feet in height, the structural frame shall be protected with at least four-hour fire-resistive protection and the floors shall be of at least three-hour fire-resistive construction.

5. A Division 4 Occupancy having a floor area not exceeding twenty-five hundred (2500) square feet shall have exterior walls of at least two-hour fire-resistive construction when less than five (5) feet from a property line and of at least one-hour fire-resistive construction when more than five (5) feet but less than ten (10) feet from a property line, when located in Fire Zone No. 3.

Section 1003. Location

(a) In City.

Buildings of Group E Occupancy shall be restricted as to location in Fire Zones as set forth in Chapter 16.

(b) On Property.

Buildings of Group E Occupancy shall adjoin a yard, public space or street on at least one side. For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22, inclusive. For regulating adjacent buildings on the same property, see Chapter 5.

Section 1004. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Where ramps are used for the transfer of automobiles from one floor to another such ramps shall meet at the ground floor level at a point at least twenty (20) feet from the exit of such building.

Section 1005. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group E Occupancies customarily used by human beings shall be provided with light 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.
(b) Ventilation.

For ventilation requirements in Group E Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)

Section 1006. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed in separate enclosures as set forth in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed, and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

(c) Ramps.

Doors which are part of an automobile ramp enclosure may be kept normally open but shall be provided with an automatic fire assembly so arranged as to be self-closing when released.

Section 1007. Fire Protection Systems.

Automatic fire-protection systems, standpipes, fire detection systems, fire extinguishers, and fire alarm systems, shall be required and installed as set forth in Chapter 38.

Section 1008. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Boiler Rooms.

Every boiler room or room containing a central heating plant in Divisions 1, 2 and 3 shall be separated from other portions of the building by a Four-Hour Fire-Resistive Occupancy Separation. See Chapters 51 and 52 for unit heaters in hangsars.

(c) Flammable Liquids.

In any room in which volatile flammable liquids are used or stored, devices generating a glow or flame capable of igniting vapors shall not be installed or used unless complying with Chapters 51 and 52. The use, handling, storage, and sale of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group E Occupancy unless such use, handling, storage, and sale comply with Article 234, Revised Municipal Code.

(d) Dust Collecting Systems.

Equipment or machinery which generates or emits dust or fibers shall be provided with an adequate dust or fiber collecting and exhaust system installed in conformance with Chapter 52, unless the building or portion thereof housing such machinery is provided with an automatic fire-extinguishing system conforming to the provisions of Chapter 38.

Section 1009. Service Stations Inside Buildings.

(a) General.

For the purpose of this Chapter, a service station inside a building shall mean one dispensing flammable liquids used as motor fuel when the dispensing devices are located anywhere inside a building. For requirements for outside service stations, see Chapter 11 of this Building Code and see Article 234, Revised Municipal Code, for other requirements.

(b) Construction.

Such service stations shall be provided with an enclosure of at least two-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 and such door shall be power operated and equivalent to a Class “B” fire door. A two (2) inch 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. (See Chapter 38.) An automatic fire sprinkler system shall be provided in accordance with the requirements of Chapter 38.

(f) Supervision.

All gasoline dispensing stations shall be supervised during the hours when gasoline is dispensed.

(g) Fuel Pumps.

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

Section 1010. Additional Regulations for Dry Cleaning Plants.

(a) General.

Dry cleaning plants shall be of Type I construction and shall not exceed one story in height, with no basement, cellar or any floor below grade. All
partitions shall be of one-hour fire-resistive construction and of incombustible material, except for the necessary openings for the vents, ducts, piping, and shafting. All openings in exterior walls shall be protected by a fire assembly having a three-fourths-hour fire-resistive rating. Such fire assemblies shall be fixed, automatic, or self-closing. Dwelling occupancy shall not be permitted in conjunction with this occupancy.

(b) Floor Construction.

The entire floor area in both the public area and utility area, shall be provided with a masonry slab or approved equivalent and such slab shall be designed to accommodate the loads imposed by the equipment.

(c) Solvent Containment.

A satisfactory means of preventing liquid leaks shall be provided. This shall include a method of digging or recessing the floor or in a method of containment approved by the Building Official. An approved means shall be provided for the collection of solvent in the event of a leak.

(d) Odors and Contamination.

Odors, vapors, mist or similar contaminants shall not be emitted to the atmosphere so as to create a nuisance generally or a health hazard. (Article 762, Revised Municipal Code.)

Section 1011. Additional Requirements for Spray Painting, Dipping Rooms and Booths.

(a) Location.

Paint spray or dipping rooms or booths shall not be permitted in Fire Zone No. 1.

(b) General.

In establishments where varnishes, lacquers, enamels, stains, and other flammable finishes, primer coats or other flammable liquids or solvents are used or applied by means of spraying or dipping, a special room or booth shall be provided and cleaning, spraying, or dipping operation shall not be permitted except in such room or booth. Storage of combustible or flammable materials within such rooms or booths is prohibited. Such rooms or booths shall not be permitted below grade level.

(c) Spray Painting and Dipping Rooms.

1. Construction.

Spray painting and dipping rooms shall be constructed in accordance with the requirements of this Chapter and Building Code and shall be constructed of materials of not less fire-resistive than the building or structure housing same and in no case shall such construction be less than one-hour fire-resistive.

2. Floors.

Floors shall be of incombustible material (if of metal, the metal shall be of non-spark-producing type), and such incombustible material shall extend for a distance of at least three (3) feet outward from any opening into the room.

3. Electrical.

Electrical equipment shall comply with Chapter 53 (Electrical Code) pertaining to explosion-proof installations.

4. Ventilation.

See Chapter 52.

5. Heating.

Heat generating devices shall not be located within the room. Heating shall be provided by an indirect method (See Chapter 52).


Each spray paint or dipping room shall be provided with fire protection devices complying with Chapter 38 of this Building Code.

7. Exits.

Two means of egress shall be provided and shall be spaced remote from each other. Minimum size shall be at least two feet six inches by six feet (2'6" x 6") and shall be constructed of at least one and three-fourths (1¾) inch solid wood slab. One door may be of the sliding type. The door of the swinging type shall swing with the means of egress and such door shall be equipped with an automatic self-closer. Doors shall be in a closed position at all times and shall be readily openable from the inside when the room is in use.

(d) Spray Painting and Dipping Booths.

1. Construction.

Spray booths shall be constructed of metal in accordance with Chapter 27, and shall not exceed one hundred square feet (100 sq. ft.) in area and shall not be more than eight (8) feet in height. Booths shall be enclosed on three sides and the top, and the open side shall have a metal or incombustible curtain extending downward to within at least six feet six inches (6'6") above the floor from the top of the front opening of the booth across the entire open portion of such booth.

2. Floors.

Floors shall be of incombustible materials (if of metal, the metal shall be of non-spark-producing type), and such incombustible material shall extend for a distance of at least three (3) feet outward from any opening into the booth.

3. Electrical.

The electrical equipment shall comply with the provisions of Chapter 53 (Electrical Code) pertaining to explosion-proof installations, and the same requirements shall apply for a distance at least six (6) feet from any opening into the booth.
4. **Ventilation.**
   See Chapter 52.

5. **Heating.**
   Heat generating devices shall not be located within the booth. Heating shall be provided by an indirect method. (See Chapter 52).

6. **Fire Protection Systems.**
   Each booth shall be provided with fire protection devices complying with the requirements of Chapter 38.

7. **Other Booths.**
   Other booths bearing the label of a nationally recognized testing laboratory may be permitted when approved by the Building Official.

**Section 1012. Standards.**

Unless otherwise provided in this Building Code, the Standards as set forth in this Chapter shall prevail.

**Organization** | **Title of Publication**
--- | ---
NFPA | Pamphlet No. 30, 1966—Storage and Handling of Flammable Liquids
    | Pamphlet No. 32, 1964—Dry Cleaning Plants
    | Pamphlet No. 33, 1966—Spray Finishing
    | Pamphlet No. 61C, 1962—Flour and Feed Mills
    | Pamphlet No. 63, 1964—Dust Explosions in Industrial Plants
    | Pamphlet No. 58, 1967—Liquified Petroleum Gases
ASTM | Pamphlet D-92, 1966—Test for Flash and Fire Points by Cleveland Open Cup

**Legend:**

ASTM — American Society for Testing and Materials
1916 Race St.
Philadelphia, Pa. 19103

60 Batterymarch St.
Boston, Mass. 02110
CHAPTER 11
REQUIREMENTS FOR GROUP F OCCUPANCIES

Section 1101. Group F Occupancies Defined.

Group F Occupancies shall be:

Division 1.

Gasoline service stations, storage garages where no repair work is done except exchange parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids; paper storage and rubber storage.

Division 2.

Wholesale and retail stores, office buildings, drinking and eating establishments having an occupant load of less than one hundred (100), printing plants, municipal police and fire stations, factories and workshops using materials not highly flammable or combustible, storage and sales rooms for combustible goods, paint stores without bulk handling, dry cleaning plants, including coin operated types using non-flammable solvents. (See Chapter 4 for definition of Assembly Buildings.)

Division 3.

Open parking garages; laundries; aircraft hangars where no repair work is performed except exchange of parts and maintenance requiring no open flame, welding, or the use of highly flammable liquids.

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

Section 1102. Construction, Height and Area Allowable.

(a) General.

Buildings or parts of buildings classed in Group F because of the use or character of the occupancy shall be of Type I, II, III, IV or V construction and shall not exceed, in height or area, the limits set forth in Chapter 5. (See Section 1110 for Additional Requirements for Dry Cleaning Plants.)

(b) Special Provisions.

1. Motor vehicle service stations shall be of incombustible or one-hour fire-resistive construction, including canopies and supports over pumps.

2. In storage garages, the floor finish shall be constructed of impervious material.

3. Storage areas in excess of one thousand (1000) square feet in connection with wholesale or retail sales, shall be separated from the public areas by a one-hour fire-resistive occupancy separation as defined in Chapter 5.

4. For attic space partitions and draft stops, see Chapter 31.

Section 1103. Locations.

(a) In City.

For restrictions on other buildings based on location in Fire Zones, see Chapter 16.

(b) On Property.

Buildings of Group F Occupancies shall adjoin a yard, public space or street on at least one side. For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.

For fire-resistive protection of exterior walls and openings, as determined by location on the property, see Chapter 5 and Chapters 17 through 22 inclusive of this Building Code. For regulating adjacent buildings on the same property, see Chapter 5.

Section 1104. Exit Facilities.

Stairs and exits shall be provided as set forth 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 at least twenty (20) feet from the exit from such building.

Section 1105. Light, Ventilation and Sanitation.

(a) Light.

All portions of Group F Occupancies customarily used by human beings shall be provided with light by means of windows or skylights with an area at least one-eighth of the total floor area or shall be provided with artificial light.

(b) Ventilation.

For ventilation requirements for Group F Occupancies, see Chapter 52.

(c) Sanitation. (See Chapter 50)
Section 1106. Enclosure of Vertical Openings.

(a) Exits.
Exits shall be enclosed as set forth in Chapter 33.

(b) Shafts.
Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately, and the enclosure shall be set forth in Table No. 17-A and Chapter 30.

(c) Ramps.
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 1107. Fire Protection Systems.

Automatic fire-protection systems, standpipes, fire detection systems, fire extinguishers, and fire alarm systems shall be installed as set forth in Chapter 38.

Section 1108. Special Hazards.

(a) Chimneys and Heating Apparatus.
Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Flammable Liquids.
Storage of flammable liquids shall not be permitted in Group F Occupancies and the handling and use of gasoline, fuel oil and other flammable liquids shall not be permitted in any Group F occupancy unless such use and handling comply with Article 234, Revised Municipal Code.

Devices generating a glow or flame capable of igniting vapors shall comply with the requirements of Chapters 51 and 52.

(c) Boiler Rooms.
Every boiler room or room containing a central heating plant using solid or liquid fuel shall be separated from other portions of the building by a “Two-Hour Fire-Resistive Occupancy Separation” as defined in Chapter 5. Every boiler room or room containing a central heating plant which burns gas as a fuel shall be separated from other portions of the building by at least a “One-Hour Fire-Resistive Occupancy Separation” as defined in Chapter 5.

Exception: In buildings not more than two stories in height a “One-Hour Fire-Resistive Occupancy Separation” as defined in Chapter 5 may be permitted.

Section 1109. Open Parking Garages.

(a) Scope.
Except where specific provisions are made in the following subsections, other requirements of this Building Code and other ordinances of the City shall apply.

(b) Definition.
For the purpose of this section, an open parking garage is a structure of Type I, II, or IV Construction more than one tier in height which is at least 50 per cent open on two or more sides and is used exclusively for the parking or storage of passenger motor vehicles.

(c) Construction.
Construction shall be of incombustible materials. Open parking garages shall meet the design requirements of Chapter 23. Adequate curbs and railings shall be provided at every opening.

(d) Area and Height.
Area and height of open parking garages in Fire Zones No. 1, No. 2 and No. 3 shall be limited as set forth in Table No. 11-A except for increases permitted by Subsection (e).

Table No. 11-A—Open Parking Garages

<table>
<thead>
<tr>
<th>Type</th>
<th>Area</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Unlimited</td>
<td>Unlimited</td>
</tr>
<tr>
<td>Type II</td>
<td>75,000 per tier</td>
<td>7 stories, 8 tiers</td>
</tr>
<tr>
<td>Type IV-one hour</td>
<td>50,000 per tier</td>
<td>5 stories, 6 tiers</td>
</tr>
<tr>
<td>Type IV-unprotected</td>
<td>30,000 per tier</td>
<td>3 stories, 4 tiers</td>
</tr>
</tbody>
</table>

Table No. 11-B—Open Parking Garages

<table>
<thead>
<tr>
<th>Dist. from Property Line to Building</th>
<th>Fire Zone No. 1</th>
<th>Fire Zone No. 2</th>
<th>Fire Zone No. 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-hour</td>
<td>2-hour</td>
<td>1-hour</td>
</tr>
<tr>
<td>0'-10'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10'-20'</td>
<td>1-hour</td>
<td>1-hour</td>
<td>None</td>
</tr>
</tbody>
</table>

11-2
(a) Area and Height Increases.

Area of structures open on three sides may be increased 25 per cent and one tier in height. Areas of structures open on four sides may be increased 50 per cent and one tier in height.

(f) Location on Property.

When located adjacent to interior property lines, exterior walls shall be of the degree of fire resistance set forth in Table No. 11-B and such walls shall be without openings.

(g) Stairs and Exits.

Where persons other than parking attendants are permitted, stairs and exits shall meet the requirements of Chapter 33, based on an occupant load of two hundred (200) square feet per occupant. Where no persons other than parking attendants are permitted there shall be at least two stairs, three (3) feet wide. Lifts may be installed for use of employees only, provided they are completely enclosed by incombustible materials.

(h) Fire Protection Equipment.

Standpipes shall be of the wet or dry type and in accordance with Chapter 38. At each stair and lift opening on each tier there shall be installed at least one hand fire extinguisher of a size and content approved by the Chief of the Fire Department. Automatic fire-extinguishing systems shall be installed as set forth in Chapter 38.

(i) Occupancy Separations.

Occupancy separations shall be installed as required in Chapter 5 between open parking garages and other occupancies. See Chapter 10 for Service Stations Inside Buildings.

(j) Enclosure of Vertical Openings.

Enclosure shall not be required for vertical openings except as specified in Subsection (g) for stairs, exits, and lifts.

(k) Ventilation.

See Chapter 52.

(1) Prohibitions.

The following uses and alterations are prohibited.

1. Automobile repair work.
2. Sale of gasoline or oil.
3. Parking of busses, trucks, and similar vehicles.
4. Partial or complete closing of required openings in exterior walls by tarpaulins or any other means.

Section 1110. Additional Requirements for Dry-Cleaning Plants Using Non-Flammable Solvents.

(a) General.

Dry cleaning plants shall be constructed with no basement, cellar or any floor below grade. Dwelling occupancy shall not be permitted.

(b) Floor Construction.

The entire floor area in both the public and utility area shall be provided with a masonry slab or approved equivalent. Such slab shall be designed to accommodate the loads imposed.

(c) Solvent Containment.

A satisfactory means of preventing liquid leaks shall be provided. This shall include a method of diking or recessing the floor or a method of containment as approved by the Building Official. An approved means shall be provided for the collection of solvent in the event of a leak.

(d) Odors and Contamination.

Odors, vapors, mist or similar contaminants shall not be emitted to the atmosphere so as to create a nuisance generally or a health hazard. (Article 762, Revised Municipal Code).

(e) Coin Operated Machine Location.

The front or public use side of the dry cleaning equipment shall be exposed to the public use area and such equipment shall be enclosed in such a manner so that the working or maintenance portion of the equipment is located on another side of such enclosure. This shall not apply when the equipment is designed and approved by the Building Official, for servicing from the front, provided, however, that when such equipment is serviced from the front, a curtain wall for ventilation purposes shall be provided. Where servicing is required from the rear of the equipment, a service area shall be provided and such area shall be of sufficient size to permit ready access and servicing of the equipment.

(f) Ventilation.

A supply of outside air shall be provided to the interior of the building so that a negative pressure differential will not result within the building. Other methods of vapor removal may be permitted when approved by the Building Official.

For further ventilation requirements, see Chapter 52.

(g) Use of Flammable Liquids.

Flammable liquids shall not be permitted for use or on the premises of dry cleaning plants.
(h) Heating Equipment.

Heating equipment and water heaters shall be separated in accordance with the requirements of this Chapter. Entry to such furnace or boiler room shall be provided from the exterior of the building. Combustion air shall be provided from the outside and in accordance with the provisions of Chapter 51. Venting of such equipment shall comply with Chapter 37. The use of duct or unit type heaters may be permitted when approved by the Building Official. The use of wall heaters is expressly prohibited.

Where heating or cooling is provided through ducts, such ducts shall be provided with gravity or motorized type back-draft dampers at each outlet.

Section 1111. Standards.

Unless otherwise provided in this Code, the standards as set forth in this Chapter shall prevail.

Legend:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFPA</td>
<td>Pamphlet No. 30, 1966—Storage and Handling of Flammable Liquids.</td>
</tr>
<tr>
<td>MCA</td>
<td>Chemical Data Sheet—Perchlorethylene 1948.</td>
</tr>
</tbody>
</table>

MCA—Manufacturing Chemists Association, Inc.

60 Batterymarch St.
Boston, Mass. 02110
CHAPTER 12

REQUIREMENTS FOR GROUP G OCCUPANCIES

Section 1201. Group G Occupancies Defined.

Group G Occupancies shall be:
Greenhouses, ice plants, power plants, pumping plants, cold storage plants, creameries.
Factories and workshops using incombustible and non-explosive materials. Storage and sales rooms of incombustible materials.
For occupancy separations see Table No. 5-B.
For occupant load see Chapter 33.

Section 1202. Construction, Height and Area Allowable.

(a) General.
Buildings or parts of buildings classed in Group G because of the use or character of the occupancy shall be of Type I, II, III, IV or V Construction and shall not exceed, in height or area, the limits set forth in Chapter 5.

(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 Chapter 31.

Section 1203. Location.

(a) In City.
For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property.
Buildings of Group G Occupancy shall adjoin a yard, public space or street on at least one side.
For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.
For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 inclusive (Requirements Based on Types of Construction). For regulating adjacent buildings on the same property, see Chapter 5.

Section 1204. Exit Facilities.

Stairs and exits shall be provided as set forth in Chapter 33.

Section 1205. Light, Ventilation and Sanitation.

(a) Light.
All portions of Group G occupancies customarily used by human beings shall be provided with light by means of windows or skylights with an area at least one-eighth of the total floor area or shall be provided with artificial light.

(b) Ventilation.
For ventilation requirements in Group G Occupancies, see Chapter 32.

(c) Sanitation. (See Chapter 50.)

Section 1206. Enclosure of Vertical Openings.

(a) Exits.
Exits shall be enclosed as set forth in Chapter 33.

(b) Shafts.
Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

Section 1207. Fire-Protection Systems.

Automatic fire-extinguishing systems, standpipes, fire detection systems, and fire alarm systems shall be installed as set forth in Chapter 38.

Section 1208. Special Hazards.

(a) Chimneys and Heating Apparatus.
Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Flammable Liquids.
The storage, use, and handling of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group G occupancy unless such storage, use, and handling comply with Article 234, Revised Municipal Code.

(c) Boiler Room.
Every boiler room or room containing a heating plant shall be separated from the rest of the building by a “One-Hour Fire-Resistive Occupancy Separation.”
2. **Fire Separation.** Such separation shall continue from the lowest level of the building to the highest point within the building. In no case shall any openings be permitted through such fire separation.

3. **Electrical.** Electrical installations shall conform to all the requirements of Group H Occupancies.

4. **Heating and Plumbing.** Heating and plumbing installations shall conform to all the requirements of Group I Occupancies.

5. **Below Grade.** For purposes of this Section, if living quarters are located in a basement, such basement shall be considered a story.

6. **Prohibitions.** The second story or basement of any row dwelling building shall not be utilized to house another family. Penthouses shall not be permitted.
CHAPTER 13
REQUIREMENTS FOR GROUP H OCCUPANCIES

Section 1301. Group H Occupancies Defined.

Group H Occupancies shall be:
Motels, hotels, apartment houses, dormitories, lodging houses, convents, and monasteries and similar buildings not included in Group D, Division 2 (each accommodating more than 10 persons); and row dwelling buildings.
For occupancy separation see Table No. 5-B.
For occupant load see Chapter 33.

Section 1302. Construction, Height and Area Allowable.

(a) General.
Buildings or parts of buildings classed in Group H because of the use or character of the occupancy shall be of Type I, II, III, IV or V Construction and shall not exceed in height or area, the limits set forth in Chapter 5.

Section 1303. Location.

(a) In City.
For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property.
Buildings of Group H Occupancy shall adjoin a yard, public space or street on at least one side. For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.
For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 (Requirements Based on Types of Construction). For regulating adjacent buildings on the same property, see Chapter 5.

Section 1304. Exit Facilities.

Stairs and exits shall be as set forth 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 at least four (4) feet in width directly connected to a street or alley by means of a passageway of at least as wide as the stairway opening into such passageway and at least seven (7) feet in height.
Buildings more than one story in height shall have no transoms or unprotected ventilating openings from guest rooms to public corridors.
Door openings from guest rooms to public corridors shall be protected with a fire-resistive assembly as set forth in Table No. 33-B.

Section 1305. Light, Room Sizes, Ceiling Heights, Ventilation and Sanitation.

(a) Light.
All living rooms, kitchens, and other rooms used for living, eating, or sleeping purposes shall be provided with windows with a minimum area of at least twelve (12) square feet or one-eighth of the floor area, whichever is greater, of such rooms or shall be provided with artificial light.
Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of at least seven (7) feet and a depth or not more than seven (7) feet. Such porch shall be at least fifty (50) per cent open on at least two sides.
The width of such courts or yards shall be at least three (3) feet when such courts or yards are not more than two (2) stories high and shall be increased at the rate of six (6) inches for each additional story in height. If such court is entirely surrounded by the building, it shall have a width at least fifty (50) per cent greater than that otherwise required.

(b) Room Sizes and Ceiling Heights.
Every room required to have windows by Subsection (a) shall have a ceiling height of at least seven (7) feet in at least fifty (50) per cent of its required area with no portion of the required area less than five (5) feet in height. Rooms used for living, eating, or sleeping purposes shall have an area of at least ninety (90) square feet. Kitchens shall have a superficial floor area of at least fifty (50) square feet.

(c) Ventilation.
For ventilation requirements in Group H Occupancies, see Chapter 52.

(d) Sanitation. (See Chapter 50)
Section 1306. Enclosure of Vertical Openings.

(a) Exits.

Exits shall be enclosed as required in Chapter 33.

(b) Shafts.

Elevator shafts, vent shafts, and other vertical openings shall be enclosed separately and the enclosure shall be as set forth in Table No. 17-A and Chapter 30.

Section 1307. Fire-Protection Systems.

Automatic fire-extinguishing systems, standpipes, fire detection systems and fire alarm systems, shall be installed as set forth in Chapter 38.

Section 1308. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Flammable Liquids.

The storage and handling of gasoline, fuel oil, and other flammable liquids shall not be permitted in any Group H Occupancy unless such storage and handling comply with Article 234, Revised Municipal Code.

Doors leading into rooms in which volatile flammable liquids are stored or used shall be protected by a fire assembly having a one-hour fire-resistant rating. Such fire assembly shall be self-closing and shall be posted with a sign on each side of the door in one 1 inch block letters stating: "FIRE DOOR—KEEP CLOSED".

(c) Boiler Rooms.

Every room containing a boiler or a central heating plant using a solid or liquid fuel shall be separated from the rest of the building by a "Three-Hour Fire Resistant Occupancy Separation" with all openings protected as set forth in Table No. 33-B.

Exceptions:

1. Boilers or furnaces may be used with a "One-Hour Fire-Resistant Occupancy Separation" in buildings not more than two (2) stories in height. All openings in such separation shall be protected by a fire assembly having a one-hour fire-resistant rating, mounted within the boiler room and having closing devices as set forth in Table No. 33-B.

2. Where boilers or central heating plants burning liquid or solid fuel are located at grade level they may be separated from the remainder of the building by a "One-Hour Fire-Resistant Occupancy Separation" with all openings protected by a fire assembly having a one-hour fire-resistant rating, mounted within the boiler room and having closing devices as set forth in Table No. 33-B.

Section 1309. Exceptions and Deviations.

Group H Occupancies constructed on the roof of buildings in excess of one story, shall be considered as an additional story in so far as the construction, location, exposure, stairs, exits, and fire protection apparatus are concerned.

Section 1310. Row Dwelling Buildings

(a) General.

In addition to the other requirements of this Chapter and Building Code, pertaining to Group H Occupancies, the requirements of this Section shall apply. Where conflict exists between this Section and other Sections of this Building Code, this section shall supersede.

(b) Definition.

A building or structure containing a row of three (3) or more dwelling units all in direct alignment, not more than two (2) stories in height, with each unit being separated from the adjoining units in each story by one (1) hour fire-resistant walls, without openings, and each unit having independent access to the exterior of the building in the ground story.

(c) Qualification.

In addition to the requirements of this Section and Building Code, the following requirements shall be met to qualify for a row Dwelling Building:

1. Utilities. Such buildings and structures shall be provided with separate sewerage, water supply, heating, electric and plumbing systems together with all other housing utilities and equipment.
CHAPTER 14
REQUIREMENTS FOR GROUP I OCCUPANCIES

Section 1401. Group I Occupancies Defined.

Group I Occupancies shall be:
Dwellings (One or two-family units).
For occupancy separations see Table No. 5-B.
For occupancy load see Chapter 33.

Section 1402. Construction, Height and Area Allowable.

Buildings or parts of buildings classed in Group I because of the use or character of the occupancy shall be of Type I, II, III, IV or V Construction and shall not exceed, in height or area, the limits set forth in Chapter 5.

Section 1403. Location.

(a) In City.
For restrictions based on location in Fire Zones, see Chapter 16.

(b) On Property.
Buildings of Group I Occupancy shall adjoin a yard, public space or street on at least one side. For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.
For fire-resistive protection of exterior walls and openings, as determined by location on property, see Chapter 5 and Chapters 17 through 22 (Requirements Based on Types of Construction).

Section 1404. Exit Facilities.
Stairs and exits shall be provided as set forth in Chapter 33.

Section 1405. Light, Room Sizes, Ceiling Heights, Ventilation, and Sanitation.

(a) Light.
All living rooms, kitchens, and other rooms used for living, eating or sleeping purposes shall be provided with windows with a minimum area of twelve (12) square feet or one-eighth of the floor area, whichever is greater, of such rooms or shall be provided with artificial light.

Required windows shall open on a court, yard, or street either directly or through a porch with a minimum clear height of at least seven (7) feet. Such porch shall be at least fifty (50) per cent open on at least one side.

(b) Room Sizes and Ceiling Heights.
Every room regulated by Subsection (a) shall have a ceiling height of at least seven (7) feet in at least fifty (50) per cent of its required area with no portion less than five (5) feet in height. Rooms used for living, eating, or sleeping purposes shall have an area of at least eighty (80) square feet. Kitchens shall have a superficial floor area of at least fifty (50) square feet, superficial floor area being herein defined as clear floor space, exclusive of fixed or built in cabinets or appliances.

(c) Ventilation.
For ventilation requirements in Group I Occupancies, see Chapter 52.

(d) Sanitation. (See Chapter 50)

Section 1406. Enclosure of Vertical Openings.
No requirements.

Section 1407. Fire Protection Systems.
Fire-extinguishing systems, fire detection systems, and fire alarm systems, when installed, shall conform to the requirements of Chapter 38.

Section 1408. Special Hazards.
Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

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

Section 1409. Exceptions and Deviations.
Group I Occupancies constructed on the roof of buildings in excess of one story, shall be considered as an extra story in so far as the construction, location, exposure, stairs, exits, and fire protection apparatus are concerned.

A carport open on two or more sides need not have a fire separation between the carport and the dwelling. Windows between the carport and the dwelling shall not be openable. Doors may be of any type, provided that any sash used in a door be fixed; doors between a building and a carport shall be self-closing.
CHAPTER 15
REQUIREMENTS FOR GROUP J OCCUPANCIES

Section 1501. Group J. Occupancies Defined.

Group J Occupancies shall be:

Division 1.

Private garages, covered patios and carports and minor buildings used as accessories to any other occupancy only when not over one thousand (1000) square feet in area.

Division 2.

Fences over four (4) feet high, retaining walls over three (3) feet high, tanks, and towers. For occupancy separations see Table No. 5-B. For occupant load see Chapter 33.

Section 1502. Construction, Height and Area Allowable.

Buildings or parts of buildings classed in Group J occupancy because of the use or character of the occupancy shall be Type I, II, III, IV or V Construction as set forth in Chapter 5 and Chapters 17 through 22 (Requirements Based on Types of Construction) of this Building Code. The floor area shall not exceed one thousand (1000) square feet. The height shall not exceed one story.

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

Section 1503. Location.

(a) In City.

For restrictions on other buildings, based on location in Fire Zones, see Chapter 16.

(b) On Property.

For property setbacks, see Zoning Regulations.

(c) Exterior Wall and Opening Protection.

For fire-resistive protection of exterior walls and openings, as required by location on property, see Chapter 5 and Chapters 17 through 22 (Requirements Based on Types of Construction).

Section 1504. Ventilation.

Private garages which are constructed in conjunction with any Group H or I occupancies and which have openings into such buildings shall be equipped with fixed louvered or screened openings or exhaust ventilation with exhaust openings located within six (6) inches of the floor. The clear area of the louvered opening or of the openings into the exhaust ducts shall be at least sixty (60) square inches per car stored in such private garage. Under no circumstances shall a private garage have any opening directly into a room used for sleeping purposes.

Section 1505. Special Hazards.

(a) Chimneys and Heating Apparatus.

Chimneys and heating apparatus shall conform to the requirements of Chapters 37, 51 and 52.

(b) Flammable Liquids.

Flammable liquids shall not be stored, handled, or used in Group J occupancies unless such storage or handling shall comply with Article 234, Revised Municipal Code.

Section 1506. FENCES AND RETAINING WALLS.

(a) General.

1. This Section shall apply to all fences or walls in excess of four (4) feet in height; all retaining walls in excess of three (3) feet in height; combination fences and retaining walls in excess of four (4) feet in height and all fences, walls and retaining walls to be installed on corners or other locations, regardless of height as provided for in this Section.

2. When the Department shall determine that the installation, removal or repair of a fence shall be for the general welfare and safety of the public, notwithstanding the provisions of this Section, the Department may order such action to be taken as is deemed to be necessary.

(b) Design. All fences, walls and retaining walls shall be designed in accordance with the following:

1. Retaining walls shall be so designed, and drainage provided, so as to resist all lateral pressure to which they may be subjected.

2. Fences shall be designed to resist any wind load to which they may be subjected.
(c) Prohibitions. The prohibitions, as indicated herein, shall apply to all fences, walls or retaining walls, regardless of height.

1. The use of barbed wire or any other sharp pointed material as a fencing material or on top of fences or retaining walls is hereby prohibited except when and where specifically approved by the Department.

2. The use of electrically charged fences, as such, or on top of fences or retaining walls, is hereby prohibited except when and where specifically approved by the Department.

(d) Review and Approval. Fences, walls or retaining walls to be installed on corner or other locations which may create traffic hazards or be in violation of other applicable Ordinances, shall be subject to review by the appropriate City Agency and no such fence, wall or retaining wall shall be installed or maintained in derogation of the disapproval of any City Agency.

(e) Repair or Removal. When a fence, wall or retaining wall is declared by the Department to be dilapidated or hazardous, the Department may order such fence, wall or retaining wall to be removed or repaired.
CHAPTER 16
RESTRICTIONS IN FIRE ZONES

Section 1601. General.

(a) Fire Zones Defined.

For the purposes of this Building Code, the City and County of Denver in its entirety shall be and hereby is declared to be a Fire District which Fire District shall be known and composed of Fire Zones 1, 2 and 3, each of which zones shall include and be composed of the following areas:

Fire Zone No. 1.

Fire Zone No. 1 shall include all the area lying within the following described boundaries:
Starting at the intersection of East Colfax Avenue and Sherman Street, thence north on Sherman Street to 20th Street, thence northwest on 20th Street to Lawrence Street, thence southwest on Lawrence Street to 14th Street, thence southeast on 14th Street to Colfax Avenue, thence east on Colfax Avenue to Sherman Street.

Fire Zone No. 2.

Fire Zone No. 2 shall include all the area lying within the following described boundaries, except that which is included in Fire Zone No. 1:
Starting at the intersection of E. Colfax Avenue and Grant Street, thence north on Grant Street to 21st Street, thence northwest on 21st Street to Lawrence Street, thence northeast on Lawrence Street to 31st Street, thence northwest on 31st Street to Larimer Street, thence southwest on Larimer Street to 21st Street, thence northwest on 21st Street to Market Street, thence southwest on Market Street to Speer Boulevard, thence south on Speer Boulevard to 13th Street, thence southeast on 13th Street to West Colfax Avenue, thence east on Colfax Avenue to Grant Street.
In addition, those areas within the city within 150 feet of the center lines of the following streets, Colfax Avenue from Sheridan Boulevard to Yosemite, West Alameda from Sheridan Boulevard to South Broadway, Federal Boulevard from Eastman Avenue to 52nd Avenue, South Broadway from Yale Avenue to Colfax Avenue, Colorado Boulevard from Hampden Avenue to 54th Avenue, and 31st Street from Lawrence Street to the Platte River.

Fire Zone No. 3.

Fire Zone No. 3 shall include all the areas of the City and County of Denver except that which is included in Fire Zones No. 1 and No. 2.

(b) Fire Zone Boundaries Defined.

Where streets, alleys or right-of-ways are referred to in this Section, it shall be taken to mean the center lines of said streets, alleys or rights-of-way.

(c) Buildings Located in More than One Fire Zone.

A building or structure which is located partly in one fire zone and partly in another shall be considered in the more highly restricted fire zone when more than one-third of its total floor area is located in such zone.

(d) Moved Buildings.

Any building or structure moved within or into any fire zone shall be made to comply with all the requirements for new buildings in that fire zone.

(e) Temporary Buildings.

Temporary buildings such as reviewing stands and other miscellaneous structures conforming to the requirements of this Building Code, and sheds, canopies, or fences used for the protection of the public around and in conjunction with the construction work may be erected in Fire Zones No. 1 and No. 2 by special permit from the Building Official for a limited period of time, and such building or structure shall be completely removed upon the expiration of the time limit stated in such permit.

(f) Center Lines of Streets.

For the purpose of this Chapter, the center line of an adjoining street or alley may be considered an adjacent property line. Distance shall be measured at right angles to the street or alley.

For permissible use of plastics, see Chapter 60. Roof covering shall be “Fire-Retardant” as set forth in Chapter 32.

Section 1602. Restrictions in Fire Zone No. 1.

(a) General.

Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 1 shall be only of Type I, II, III-H.T., III One-Hour, or IV One-Hour construction and shall meet the requirements of this Building Code. Wood or other combustible veneers shall not be permitted on the outside of exterior walls. For requirements relating to open parking garages, see Chapter 11.
Exceptions:

1. Unprotected Type III buildings one story in height and not more than one thousand (1000) square feet in area shall be permitted if the exterior walls are twenty (20) feet or more from adjacent property lines.

2. Unprotected Type IV buildings one story in height and not more than one thousand (1000) square feet in area shall be permitted if the exterior walls are twenty (20) feet or more from adjacent property lines.

3. Type V one-hour buildings, one story in height and not more than four hundred (400) square feet in area shall be permitted if the exterior walls are twenty (20) feet or more from adjacent property lines.

(b) Alterations.

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

Exceptions:

1. Such Type III building may be made to conform to all the provisions of Sections 1602 (a) and 2003.

2. Such Type IV building may be made to conform to all the provisions of Section 1602 (a) and 2103.

3. Such Type V building may be made to conform to all the provisions of Sections 1602 (a) and 2203.

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

5. Roofs of such buildings may be covered only with a "fire-retardant" roofing as set forth in Chapter 32.

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

7. Such building may be demolished.

(c) Occupancies Prohibited.

No Group E, Division 2 Occupancy having a floor area exceeding fifteen hundred (1500) square feet shall be permitted in Fire Zone No. 1.

No Group E, Division 1 or 5 Occupancies shall be permitted in Fire Zone No. 1.

Exceptions:

1. This shall not apply to dry cleaning plants not using highly flammable liquids.

2. Where permitted by Article 234 of the Revised Municipal Code, those service stations described in Chapter 10 of this Building Code.

Section 1603. Restrictions in Fire Zone No. 2.

(a) General.

Buildings or structures hereafter erected, constructed, moved within or into Fire Zone No. 2 shall be only of Type I, II, III-H.T., III one-hour, or IV one-hour construction and shall meet the requirements of this Section.

Roof covering shall be “Fire-Retardant” as set forth in Chapter 32.

For fire-resistive protection of exterior walls and openings, as determined by location on property, see Section 504 and Chapters 17 through 22, inclusive (Requirements Based on Types of Construction). For requirements covering open parking garages see Chapter 11. For permissible use of plastics, see Chapter 60.

Exceptions:

1. Unprotected Type III buildings not more than one story in height and not more than twenty-five hundred (2500) square feet in area shall be permitted if the exterior walls are ten (10) feet or more from adjacent property lines.

2. Unprotected Type IV buildings not more than one story in height and not more than twenty-five hundred (2500) square feet in area shall be permitted if the exterior walls are ten (10) feet or more from adjacent property lines.

3. Type V one-hour buildings not more than one story in height and not more than twenty-five hundred (2500) square feet in area shall be permitted if the exterior walls are ten (10) feet or more from adjacent property lines.

4. Wood or other combustible veneers on noncombustible backing may be permitted provided it does not extend more than twenty (20) feet above finished grade on the outside of exterior walls.

5. Sheds, chicken houses, and similar accessory buildings to a residential use and not exceeding one hundred (100) square feet 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.

(b) Alterations.

No building of Type III or IV construction in excess of one thousand (1000) square feet in floor area nor any building of Type V construction already erected in Fire Zone No. 2 shall hereafter be altered, raised, enlarged, added to or moved.

Exceptions:

1. Such Type III building may be made to conform to the provisions of Section 2003 if such addition or alteration exceeds twenty (20) per cent of the value of such building.
2. Such Type IV building may be made to conform to the provisions of Section 2103 if such addition or alteration exceeds twenty (20) percent of the value of such building.

3. Such Type V building may be made to conform to the provisions of Section 2203 if such addition or alteration exceeds twenty (20) percent of the value of such building.

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

5. Roofs of such buildings may be covered only with a "Fire Retardant" roofing as set forth in Chapter 32.

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

7. Such building may be demolished.

8. Combustible finish on the outside of walls may be replaced by or covered with exterior plaster as set forth in Chapter 47.

(c) Occupancies Prohibited.

No Group E, Division 2 Occupancy having a floor area exceeding fifteen hundred (1500) square feet shall be permitted in Fire Zone No. 2.

No Group E, Division 1 or 5 Occupancies shall be permitted in Fire Zone No. 2.

Exception: This shall not apply to dry cleaning plants not using highly flammable liquids.

Section 1604. Restrictions in Fire Zone No. 3.

(a) General.

Any building or structure complying with the requirements of this Building Code may be erected, constructed, moved within or into Fire Zone No. 3. For permissible use of plastics, see Chapter 60.

(b) Type IV Buildings.

Exterior walls of a building not greater in area than fifteen hundred (1500) square feet are not required to be of fire-resistive construction if three (3) feet or more from an adjacent property line.

(c) Type V Buildings.

Exterior walls of a building not greater in area than fifteen hundred (1500) square feet are not required to be of one-hour fire-resistive construction if three (3) feet or more from an adjacent property line.
FIRE ZONE MAP
CITY & COUNTY OF DENVER

Note: For restrictions in Fire Zones, see Chapter 16 of the Building Code, City & County of Denver, as amended.
CHAPTER 17
CLASSIFICATION OF ALL BUILDINGS BY TYPES
OF CONSTRUCTION AND GENERAL REQUIREMENTS

Section 1701. General.

The requirements of Chapters 17 through 22 inclusive, are for the various Types of Construction and represent varying degrees of public safety and resistance to fire. Every building shall be classified by the Building Official into one of the Types of Construction set forth in Table No. 17-A. Any building which does not entirely conform to a Type of Construction set forth in Table No. 17-A shall be classified by the Building Official into a type having an equal or lesser degree of fire resistance.

Buildings or portions thereof shall not be required to conform to the details of a Type of Construction higher than that type which meets the minimum requirements based on Occupancy (Chapters 5 through 15 inclusive) or Location in Fire Zone (Chapter 16) even though certain features of such building actually conform to a higher Type of Construction.

Where specific materials, types of construction, or fire-resistive protection are required, such requirements shall be the minimum requirements and any materials, type of construction, or fire-resistive protection which will afford equal or greater public safety or resistance to fire, as set forth in this Building Code, may be used.

Portions of buildings separated as set forth in Chapter 5 may be considered a separate building for classification of type of construction. When there is no such separation, the area of the entire building shall not exceed the least area permitted for the types of construction involved.

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

Section 1702. Structural Frame.

(a) General.

The structural frame shall be considered to be the columns and the girders, beams, trusses, and spandrels having direct connections to the columns and all other 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 column shall be considered secondary members and not a part of the structural frame.

(b) Fire-Protection of Structural Frame.

Members of the structural frame shall be fire-protected as set forth in Table No. 17-A.

Section 1703. Usable Space Under Floors.

Usable space under the first floor shall be enclosed, except in Group I and J occupancies, and such enclosure shall be as required for one-hour fire resistive construction. Doors shall be self-closing. Class "C" fire doors or solid wood core at least one and three-fourths (1 ¾) inches in thickness. Glazing conforming with Class "C" openings may be permitted in such doors.

Section 1704. Roof Construction.

For roof covering requirements, see Chapter 32. Skylights shall be constructed as set forth in Chapters 34 and 60. Penthouses shall be constructed as set forth in Chapter 36. For attics, Access and Area, see Chapter 31. For Roof Drainage, see Chapter 31. For permissible use of plastics, see Chapter 60.

Section 1705. Unprotected Materials Permitted.

(a) Partitions.

Regardless of the fire-resistive requirements for permanent partitions, temporary partitions dividing portions of stores, offices or similar places occupied by one tenant only, and which do not establish any public corridor or a private corridor serving an occupant load of thirty (30) or more, may be constructed of:

1. Incombustible materials;
2. Fire-retardant treated wood;
3. One-hour fire-resistive construction;
4. 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 at least the upper one-fourth of the partition constructed of glass.

For use of plastics in partitions, see Chapter 60.

(b) Show Windows and Cases.

Show window frames, aprons, show cases, and other appurtenances on the first floor of stores or other similar occupancies may be of wood or unprotected steel or iron.

(c) Trim.

Trim, picture molds, chair rails, baseboards, handrails, and show-window backing, may be made of wood. Unprotected wood doors and windows may be used except where openings are required to be fire-protected.
Materials used for interior finish of walls and ceilings, including wainscoting, shall be as set forth in Chapter 42.

(d) Loading Platforms.

Exterior loading platforms shall be of incombustible construction or heavy timber construction with wood floors at least two inches (2") nominal thickness. Such wood construction shall not be carried through the exterior walls.

(e) Insulating Boards.

Combustible insulating boards may be used under finished flooring in buildings of Type III and V construction when the flame spread of such insulating boards does not exceed 225 as tested in accordance with the standards of this Chapter.

(f) Walls Fronting on Public Ways.

Regardless of the fire resistive requirements for exterior walls certain elements of wall fronting on public ways may be constructed as follows:

1. In Fire Zones 2 and 3, wood of at least one (1) inch nominal thickness may be applied to walls provided the veneer does not exceed twenty (20) feet above finished grade, and further providing such wood shall be placed either directly against incombustible surfaces or furred out from such surfaces not to exceed one and five-eights (1½) inches with all concealed spaces fire stopped as provided in Chapter 25.

Section 1706. Enclosure of Vertical Openings.

(a) General.

Enclosure for elevator shafts, vent shafts and other vertical openings shall be set forth in Table No. 17-A and all exterior openings therein shall be protected by a fire assembly having a three-fourths (¾) hour fire-resistive rating and all interior openings shall be protected by a fire assembly having a one-hour fire-resistive rating except as set forth in Table No. 33-B. (See Chapter 30).

Exception: In Type V buildings, chutes and dumbwaiter shafts with a cross-sectional area of not more than nine (9) square feet may be lined with approved incombustible materials. All openings into any such vertical enclosures shall be protected by metal or metal-clad doors with either metal or metal-clad jambs, casings, or frames.

(b) Construction.

Exit enclosures shall be constructed as set forth in Chapter 33.

(c) Guardrails.

All enclosed floor and roof openings, open and glazed sides of landings and stairs, balconies and porches which are more than 2 risers above ground level, and roof areas used for other than service of the building shall be provided with guardrail(s). Such guardrail shall be at least forty-two (42) inches in height. Open guardrails shall provide intermediate rails or an ornamental pattern such that no object seven (7) inches in its smallest dimension can pass through the guardrail.

(Ord. 524 — 1966)
<table>
<thead>
<tr>
<th>MATERIALS OF CONSTRUCTION</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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<td>(Sec. 2003 (a))</td>
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<td>(Sec. 2203 (a))</td>
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<td>(Sec. 2003 (b))</td>
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<td>(Sec. 2006)</td>
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</table>

H.T.—Heavy Timber
N—No general requirements for fire resistance.

*—For Details see Chapters under Occupancy and Types of Construction.
**—For Protection of Openings, see Table 17-C
***—Fire Retardant treated wood may be permitted.

1. For permissible use of Plastics, see Chapter 60.
**TABLE. NO. 17-B**  
**TYPES IV AND V CONSTRUCTION**  
**FIRE RESISTANCE OF EXTERIOR WALLS**

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>FIRE ZONE</th>
<th>FIRE RESISTANCE OF EXTERIOR WALLS</th>
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<tr>
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Notes: 1. All distances given are in feet from the property line to the wall. (See Section 504 and Chapters under Types of Construction.)
2. For additional restrictions see Chapters under Occupancy, Fire Zones, and Types of Construction.
3. For walls facing streets and public ways see Chapters under Types of Construction.
4. This Table shall not apply for Types I, II, or III Construction. For exterior walls and protection of openings for these types of buildings, see Sections 1803, 1903 and 2003 and Table 17-C.
5. For exceptions to the limitations for Types IV & V Construction, see Sections 1109, 1602, 1603, 1604, 2103 and 2203.
6. For permissable use of Plastics, see Chapter 60.
<table>
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<th>OCCUPANCY GROUP</th>
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</table>

See Section 1707 for Additional Opening Requirements.
Section 1707. Openings in Walls.

(a) Abbreviations.

Where the abbreviation NP is used in Table 17-C this shall mean “construction not permitted.”

(b) Openings Not Permitted.

Openings shall not be permitted in exterior walls in Type I through V construction of Group A through H Occupancies less than five (5) feet from the adjacent property line, and no openings shall be permitted in exterior walls in Type I through V Construction of Group I and J Occupancies less than three (3) feet from the adjacent property line.

d) Inner Court Walls.

All openings in inner court walls of buildings over one story in height in Types I, II and III construction, shall be protected by a fire assembly having a three-fourths (¾) hour fire-resistive rating when the least dimension of the court is less than forty (40) feet. All openings in inner court walls of buildings over one story in height in Types IV and V Construction, shall be protected by a fire assembly having a three-fourths (¾) hour fire-resistive rating when the least dimension of the court is less than that required for protection from adjacent property lines. Center line of the court shall be considered an adjacent property line. Distance shall be measured at right angles to the center line.

(e) Plastics.

For permissible use of Plastic, see Chapter 60.

Section 1708. Weather Protection.

(a) Building Paper.

Asphalt-saturated felt, free from holes and breaks and weighing at least fourteen (14) pounds per hundred (100) square feet or approved waterproof paper, shall be applied over studs or sheathing of all exterior walls. Such felt or paper shall be applied weatherboard fashion, lapped at least two (2) inches at horizontal joints and at least six (6) inches at vertical joints.

Building paper may be omitted in the following cases.

1. When exterior covering is of approved weatherproof panels.
2. In back-plastered construction.
3. When there is no human occupancy.
4. Over water-repellent panel sheathing.

(b) Flashing and Counter Flashing.

Exterior openings exposed to the weather shall be flashed in such a manner as to make them weather-proof.

All parapets shall be provided with coping of approved material. All flashing, counter flashing and coping when of metal shall be of at least No. 26 U. S. Gauge corrosion-resistant metal.

Section 1709. Members Carrying Masonry or Concrete.

All members carrying masonry or concrete walls or floors in buildings over one story in height shall be fire-protected with at least one-hour fire protection.

Exception: Fire protection may be omitted from the bottom flange of lintels, shelf angles, or plates that are not a part of the structural frame.
Section 1710. Parapets.

Parapet walls at least thirty (30) inches in height shall be provided on exterior walls of buildings located in Fire Zones No. 1 and No. 2 when the walls are required to be fire-resistive due to their location on the property.

Parapet walls at least twelve (12) inches in height shall be provided on exterior walls of buildings located in Fire Zone No. 3 when the walls are required to be fire-resistive due to their location on the property.

A parapet wall shall have the same fire resistance as required for the wall itself.

Exceptions: Parapets shall not be required on the following wall:
1. When roof construction is entirely incombustible.
2. When the roof has an angle of more than 20 degrees from the horizontal.
3. On buildings twenty (20) feet or less in height.

Section 1711. Projections from Buildings.

In Type I, II and IV construction, cornices, eave overhangs, architectural projections, and similar appendages shall be constructed of substantial incombustible materials and when over public property, as set forth in Chapter 45. In Type III and V construction such projections shall be provided with an incombustible or approved fire retardant material. Porches and exterior balconies shall be constructed as set forth in Chapter 35. Eaves over required windows shall be at least thirty (30) inches from the side and rear property lines. Other eaves extending beyond walls required to be fire-resistive, shall be of incombustible material or one-hour fire-resistive construction or heavy timber.

Section 1712. Toilet Compartments and Showers.

(a) Floors and Walls.

The floors and walls of public toilet compartments in Group A through H Occupancies, and those within two (2) feet of the front and sides of urinals, shall be finished with a smooth hard non-absorbent surface of cement, tile, or approved equal. Walls shall be so finished to a height of four (4) feet above the floor. Materials other than structural elements used in such walls shall be of a type which is not adversely affected by moisture. Shower areas in all occupancies shall be so finished to a height of at least six (6) feet. Each water closet compartment shall be at least thirty (30) inches in width.

(b) Shower Areas.

Shower areas in Groups A through I Occupancies shall be finished as specified in Subsection (a) to a height of at least six (6) feet.

(c) Doors and Panels.

Doors and panels of shower and bathtub enclosures shall be substantially constructed of approved shatter-resistant materials. Hinged shower doors shall open outward.

(d) Glass.

Glass used in doors and panels of shower and bathtub enclosures shall be at least seven thirty-seconds (7/32) inch in thickness and shall be an approved type of wire reinforced, tempered or laminated safety glass.

(e) Plastics.

Plastics used in doors and panels of shower and bathtub enclosures shall be of a shatter-resistant type.

Section 1713. Clearances for Electric Ranges and Hot Plates.

Electric ranges or hot plates shall not be installed where the vertical clearance between burners and combustible construction or metal cabinets is less than thirty (30) inches or as approved on the marking plate.

Section 1714. Tents and Cloth Covered Structures.

(a) General.

Outdoor tents or cloth-covered structures may be erected for a period of not more than 120 days if constructed in accordance with this Section.

(b) Construction.

Outdoor tents and cloth structures shall be erected in conformance with the applicable portions of this Building Code.

(c) Aisles and Exits.

Every portion of the area under any tent or cloth-covered structure shall be within 100 feet of an exit. Arrangement and width of aisles and exits shall conform to the requirements of Chapter 33 of this Building Code as required for a building.

(d) Fire Department Approval.

Fire Department approval shall be required prior to the issuance of any permit for a tent or cloth-covered structure.

Section 1715. Trailers.

In addition to the requirements of Article 633 of the Revised Municipal Code, the following shall apply:
1. For the purposes of this Building Code, a trailer shall be considered as a vehicle when the unit is mobile, equipped with wheels and is not connected to a sewer or power supply.

2. Trailers shall be permitted for I Occupancies only when located in Trailer Parks as described in Article 633 of the Revised Municipal Code and as approved by the Zoning Administrator.

3. Trailers shall not be permitted for any other occupancy unless meeting the requirements of this Code for buildings and specifically approved by the Building Official.

Section 1725. Standards.

Unless as otherwise provided in this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
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<tbody>
<tr>
<td>NFPA</td>
<td>Standards for Flameproofed Textiles, Pamphlet 701, 1966</td>
</tr>
<tr>
<td>ASTM</td>
<td>E-84-67</td>
</tr>
<tr>
<td></td>
<td>Surface Burning Characteristics of Bldg. Materials</td>
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<td></td>
<td>Philadelphia, Pa. 19103</td>
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Legend:

NFPA—National Fire Protection Association
60 Batterymarch St.
Boston, Mass. 02110

ASTM—American Society for Testing and Materials
1916 Race St.
CHAPTER 18
TYPE I BUILDINGS

Section 1801. General.

The structural elements in Type I buildings shall be of steel, iron, concrete, or masonry. Walls and permanent partitions shall be of incombustible fire resistive construction except that interior permanent partitions may be constructed of fire retardant treated wood as set forth in Table No. 17-A. Materials of construction and fire-resistive requirements shall be as set forth in Chapter 17. See Table 17-C for Protection of Openings. For requirements due to occupancy, see Chapters 5 to 15, inclusive. For requirements in Fire Zones, see Chapter 16.

Section 1802. Structural Framework.

Structural framework shall be of structural steel or iron as set forth in Chapter 27, reinforced concrete as in Chapter 26, or reinforced masonry as in Chapter 24.

Section 1803. Exterior Walls and Openings.

(a) Exterior Walls and Inner Court Walls.

Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty (50) feet in Fire Zone No. 1 or thirty (30) feet in Fire Zones No. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

Exception:

1. In Group F, G and H Occupancies exterior bearing walls and inner court bearing walls may be two-hour fire-resistive where openings are permitted.

2. In other than Group E Occupancies, exterior non-bearing walls and inner court non-bearing walls may be of two-hour fire-resistive construction where fire protection of openings is required and one-hour fire-resistive construction where unprotected openings are permitted.

3. For Group E Occupancies, see Special Provisions in Chapter 10.

(b) Openings in Walls.

All openings in exterior walls, including outer courts, shall be protected by a fire assembly having a three-fourths hour fire-resistive rating in conformance with Section 1707 and Table 17-C.

Section 1804. Floors.

(a) Wood Sleepers.

Where wood sleepers are used for laying wood flooring more than two (2) inches above masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material or fire stopped in such a manner that there will be no open spaces under the flooring which will exceed one hundred (100) square feet in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

(b) Mezzanine Floors.

Mezzanine floors may be of wood or unprotected steel except that in Fire Zone No. 1 they shall be of incombustible materials and as approved for one-hour fire-resistive construction or of heavy timber construction as set forth for floors in Chapter 25. Not more than two mezzanine floors shall be in any room of a building. Mezzanine floor or floors shall not exceed 33 1/3 per cent of the area of any room.

Section 1805. 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 set forth in Chapter 33.

Section 1806. Roofs.

Roofs more than twenty-five (25) feet above any floor, balcony, or gallery may be of unprotected incombustible materials. Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is at least twenty-five (25) feet above any floor, balcony, or gallery, fire protection of all members of the roof construction may be omitted. Where every part of the structural steel framework of the roof of a Group A, B, or C Occupancy is more than eighteen (18) feet and less than twenty-five (25) feet above any floor, balcony or gallery, the roof construction shall be protected by a ceiling of at least one-hour fire-resistive construction.

Roofs may be sheathed by wood planks of two (2) inch nominal thickness when such sheathing is more than thirty (30) feet distant from any floor, balcony, or gallery and when such plank sheathing is protected on the underside by a ceiling of at least one-hour fire-resistive construction.
Roof covering shall be a "fire-retardant" as set forth in Chapter 32.

Section 1807. Penthouses and Roof Structures.

Penthouses and other roof structures shall conform to the requirements set forth in Chapter 36.

Section 1808. Skylights.

Skylights shall conform to the requirements set forth in Chapters 34 and 60.

Section 1809. Insulation.

All insulation and insulating boards installed in Type I buildings shall be of incombustible materials.

Section 1810. Horizontal Separations.

When the distance between stairways exceeds 190 feet but not more than 300 feet, and standpipes have been provided for each stairway, a horizontal separation may be provided between such stairways for the installation of additional standpipes as indicated in Chapter 38. The separation shall be constructed of incombustible one-hour fire-resistive material. Any openings in such separations shall be protected with appropriate self-closing or automatic type fire assemblies.

Section 1811. Plastics.

For permissible use of plastics, see Chapter 60.
CHAPTER 19

TYPE II BUILDINGS

Section 1901. General.

The structural elements in Type II buildings shall be of steel, iron, concrete, or masonry.

Walls and permanent partitions shall be of incombustible fire-resistive construction except that interior permanent partitions may be constructed of fire-retardant treated wood as set forth in Table No. 17-A.

Materials of construction and fire-resistive requirements shall be as set forth in Chapter 17. See Table 17-C for Protection of Openings.

For requirements due to occupancy, see Chapters 5 to 15, inclusive.

For requirements in Fire Zones, see Chapter 16.

Section 1902. Structural Framework.

Structural framework shall be of structural steel or iron as set forth in Chapter 27, reinforced concrete as in Chapter 26, or reinforced masonry as in Chapter 24.

Section 1903. Exterior Walls and Openings.

(a) Exterior Walls and Inner Court Walls. Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty (50) feet in Fire Zone No. 1 or thirty (30) feet in Fire Zones No. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

Exception:

1. Group F, G and H occupancies exterior bearing walls may be of two-hour fire-resistive construction where openings are permitted.

2. In other than Group E occupancies, exterior non-bearing walls may be of two-hour fire-resistive construction where fire protection of openings is required and one-hour fire-resistive construction where unprotected openings are permitted.

3. In other than Group E occupancies, inner court non-bearing walls may be of one-hour fire-resistive construction where unprotected openings are permitted.

4. For Group E occupancies, see Special Provisions in Chapter 10.

(b) Openings in Walls. All openings in exterior walls including outer courts shall be protected by a fire assembly having a three-fourths hour fire-resistive rating in conformance with Section 1707 and Table 17-C.

Section 1904. Floors.

(a) Wood Sleepers.

Where wood sleepers are used for laying wood flooring more than two (2) inches above masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material or fire-stopped in such a manner that there will be no open spaces under the flooring which will exceed one hundred (100) square feet in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

(b) Mezzanine Floors.

Mezzanine floors may be of wood or unprotected incombustible material except that in Fire Zone No. 1 they shall be of incombustible materials as approved for one-hour fire-resistive construction or of heavy timber construction as set forth for floors in Chapter 25.

Not more than two mezzanine floors shall be in any room of a building.

No mezzanine floor or floors shall cover more than 33 1/3 per cent of the area of any room.

Section 1905. 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 set forth in Chapter 33.

Section 1906. Roofs.

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

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is at least twenty-five (25) feet above any floor, balcony or gallery, fire protection of all members of the roof construction may be omitted.

Where every part of the structural steel framework of the roof of a Group A, B, or C occupancy is more than eighteen (18) feet and less than twenty-five (25) feet above any floor, balcony, or gallery, the roof construction shall be protected by a ceiling of at least one-hour fire-resistive construction.

Roofs may be sheathed of wood planks of two (2) inch nominal thickness when such sheathing is more than thirty (30) feet distant from any floor, balcony, or gallery and when such plank sheathing is protected on the underside by a ceiling of at least one-hour fire-resistive construction.
Roof covering shall be a "fire-retardant" roofing as set forth in Chapter 32.

Section 1907. Penthouses and Roof Structures.

Penthouses and other roof structures shall conform to the requirements set forth in Chapter 36.

Section 1908. Skylights.

Skylights shall conform to the requirements set forth in Chapters 34 and 60.

Section 1909. Insulation.

All insulation and insulating boards installed in Type II buildings shall be of incombustible materials.

Section 1910. Horizontal Separations.

When the distance between stairways exceeds 190 feet but not more than 300 feet, and standpipes have been provided for each stairway, a horizontal separation may be provided between such stairways for the installation of additional standpipes as indicated in Chapter 38. The separation shall be constructed of incombustible one-hour fire-resistive materials. Any openings in such separations shall be protected with appropriate self-closing or automatic type fire assemblies.

Section 1911. Plastics.

For permissible use of plastics, see Chapter 60.
CHAPTER 20
TYPE III BUILDINGS


Structural elements of Type III Buildings may be of any materials permitted by this Building Code. Type III, One-Hour buildings shall be one-hour fire-resistive construction throughout.

Type III, Heavy Timber buildings shall be Heavy Timber construction as set forth in Chapter 25.

Exterior walls shall be of incombustible fire-resistive construction.

Materials of construction and fire-resistive requirements shall be as set forth in Chapter 17. See Table 17-C for Protection of Openings.

For requirements due to occupancy, see Chapters 5 to 15, inclusive.

For requirements in Fire Zones, see Chapter 16.


Structural framework shall be of steel or iron as set forth in Chapter 27, concrete as in Chapter 26, masonry as in Chapter 24, or wood as in Chapter 25 and this Chapter.

Section 2003. Exterior Walls, Openings and Partitions.

(a) Exterior Walls and Inner Court Walls.

Exterior walls and inner court walls shall be as set forth in Table No. 17-A, except that walls fronting on streets having a width of at least fifty (50) feet in Fire Zone No. 1 or thirty (30) feet in Fire Zones No. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A, with a minimum of one-hour fire protection.

Exceptions:

1. In Group F, G, and H occupancies exterior bearing walls may be of two-hour incombustible construction where openings are permitted.

2. In other than Group E occupancies, exterior non-bearing walls may be of two-hour incombustible construction where fire protection of openings is required and one-hour incombustible construction where unprotected openings are permitted.

3. Bulkheads, not more than thirty (30) inches high above or below show windows, need not be of incombustible material but may be of one-hour fire-resistive construction.

4. Group E, Division 5 Occupancies shall have exterior walls of at least one-hour fire-resistive construction or shall be surrounded by public space, streets, or yards at least sixty (60) feet in width.

5. In Fire Zone No. 2, exterior walls of a building not greater in area than twenty-five hundred (2500) square feet and not more than one story in height, are not required to be of one-hour fire-resistive construction if ten (10) feet or more from an adjacent property line.

6. Wood columns and arches conforming to heavy timber sizes may be used externally when they are at least twenty (20) feet from property lines of adjacent property, or from the center lines of adjacent public streets or alleys.

(b) Openings in Walls.

All openings in exterior walls including outer courts shall be protected by a fire assembly having a three-fourths hour fire-resistive rating in conformance with Section 1707 and Table 17-C.

(c) Partitions.

Permanent partitions in Type III, one-hour buildings shall be of one-hour fire-resistive construction. In Type III Heavy Timber buildings they shall be of solid wood construction formed by at least two layers of one (1) inch nominal matched boards or laminated construction four (4) inches thick, or of one-hour fire-resistive construction. Bearing partitions when constructed of wood shall not support more than two stories and a roof. Partitions shall be constructed as set forth in Chapter 25.

Section 2004. Floors.

(a) General.

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

Wood joists, beams, and girders supported by masonry walls shall be anchored thereto as set forth in Chapter 24. Ventilation shall be provided between the ground and a wood floor as set forth in Chapter 25.

(b) Heavy Timber Floors.

Heavy timber floors shall be constructed as set forth in Chapter 25.

(c) Wood Sleepers.

Where wood sleepers are used for laying wood flooring more than two (2) inches above masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall
be filled with incombustible material or fire-stopped in such a manner that there will be no open spaces under the flooring which will exceed one hundred (100) square feet in area and such space shall be filled solidly under all partitions so that there is no communication under the flooring between adjoining rooms.

(d) Mezzanine Floors.

Mezzanine floors in Fire Zone No. 1 shall be constructed of at least one-hour fire-resistive construction or of heavy timber construction as set forth for floors in Chapter 25.

Not more than two mezzanine floors shall be in any room of a building.

Mezzanine floor or floors shall not exceed 33 1/3 per cent of the area of any room.

Section 2005. Stair Construction.

(a) General. Stairs may be constructed of any material permitted in this Building Code. In heavy timber buildings, stairs may be constructed of wood, with treads and risers of at least two (2) inch nominal thickness. Also, in heavy timber buildings, where the stairs are built on laminated or plank inclines as required for floors, the treads and risers may be of one inch nominal thickness or the stairs may be constructed as required for Type I buildings.

(b) Buildings 4 or More Stories in Height. In buildings four (4) or more stories in height, stairs shall be constructed as required for Type I construction.

EXCEPTION: In Group H Occupancies, four (4) stories or less in height, wood stairs shall be permitted. The underside of the stairs shall be protected by at least five-eighths (5/8) inch approved fire resistive gypsum board or equivalent.

(c) Design. Stairs and exits shall be designed and constructed meeting the requirements as set forth in Chapters 23 and 33.

(Ord. 93 — 1968)

Section 2006. Roofs.

(a) General.

Roofs shall be constructed as specified in Chapter 25 for Wood, Chapter 26 for Concrete or Chapter 27 for Steel or Iron.

Wood joists, beams, and girders supported by masonry walls shall be anchored thereto as specified in Chapter 23.

(b) Heavy Timber Roofs.

Heavy Timber roofs shall be constructed as specified in Chapter 25.

(c) Roof Covering.

Roof covering shall be a “fire-retardant” roofing as set forth in Chapter 32, except for Group I Occupancies.


Penthouses and other roof structures shall conform to the requirements set forth in Chapter 36.

Section 2008. Skylights.

Skylights shall conform to the requirements set forth in Chapters 34 and 60.

Section 2009. Insulation.

(a) General.

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 Chapters 6 through 15, inclusive or location in Chapter 16. 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 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 225, as determined under the standards of Chapter 22, 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 Building Code, and not more than three-fourths (¾) 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 Chapter 1 hereof. No application of insulating materials shall interfere with required fire blocking or fire separation.

Each application of insulating materials shall be identified by an appropriate tag or cord permanently affixed in a conspicuous place near the insulated areas. Such tag or cord shall be in form approved by the Building Official 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.

This Section shall not include rigid insulating boards.

Where insulation is provided in buildings or structures to reduce heat flow to or from rooms or areas, such insulation shall be installed in a thickness that will provide thermal resistance to heat flow per square foot of at least 13.0 in ceilings or floors and 9.0 in exterior walls due to the insulation only. The thermal resistance figure shall be shown on the tag as herein provided.

Section 2010. Plastics.

For permissible use of plastics, see Chapter 60.
CHAPTER 21
TYPE IV BUILDINGS

Section 2101. General.

The structural elements of Type IV buildings shall be of incombustible materials.
Type IV, One-Hour buildings shall be of incombustible construction and one-hour fire-resistive throughout except that roof construction may be of fire retardant treated wood.
Walls and permanent partitions shall be of incombustible construction except that interior permanent partitions may be constructed of fire retardant treated wood as set forth in Table No. 17-A.
Materials of construction and fire-resistive requirements shall be as set forth in Chapter 17. See Table 17-C for Protection of Openings.
For requirements due to occupancy, see Chapters 5 to 15 inclusive.
For requirements in Fire Zones, see Chapter 16.

Section 2102. Structural Framework.

Structural framework shall be as set forth in Chapter 24 for masonry, Chapter 26 for Concrete, and Chapter 27 for Iron and Steel.

Section 2103. Exterior Walls, Openings and Partitions.

(a) Exterior Walls and Inner Court Walls.
Exterior walls shall be as set forth in Table No. 17-B and inner court walls shall be as set forth in Table No. 17-A.

Exceptions:

1. Walls fronting on streets having a width of at least fifty (50) feet in Fire Zone No. 1 or thirty (30) feet in Fire Zones No. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

2. In Fire Zone No. 1 unprotected Type IV buildings one story in height and not more than one thousand (1000) square feet in area shall be permitted if the exterior walls are twenty (20) feet or more from adjacent property lines.

3. In Fire Zone No. 2, exterior walls of a building not greater in area than twenty-five hundred (2500) square feet and one story in height are not required to be fire-resistive construction if ten (10) feet or more from any adjacent property line.

4. In Fire Zone No. 3, exterior walls of a building not greater in area than fifteen hundred (1500) square feet are not required to be of fire-resistive construction if three (3) feet or more from an adjacent property line.

(b) Opening in Walls.
All openings in exterior walls, including outer courts, shall be protected by a fire assembly having a three-fourths hour fire-resistive rating in conformance with Section 1707 and Table 17-C.

(c) Partitions.
All partitions shall be of incombustible construction or fire retardant treated wood.

Exception: Combustible partitions of at least one-hour fire-resistive construction may be used to separate offices and accessory areas from the remainder of a Type IV building provided the area separated does not exceed 25 per cent of the overall area of the building. Ceiling installed over areas separated by such partitions shall be of incombustible, fire retardant treated wood, or one-hour fire-resistive construction.

Section 2104. 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 2105. Stair Construction.

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

Section 2106. Roof Construction.

Roofs shall be of incombustible construction or fire retardant treated wood. In Type IV, One-Hour buildings, roofs may be as set forth in Chapter 18.
Roof covering shall be a "fire-retardant" roofing as set forth in Chapter 32.

Section 2107. Penthouses and Roof Structures.

Penthouses and other roof structures shall conform to the requirements as set forth in Chapter 36.

Section 2108. Skylights.

Skylights shall conform to the requirements as set forth in Chapters 34 and 60.

Section 2109. Insulation.

All insulation and insulating boards installed in Type IV buildings shall be of incombustible materials.

Section 2110. Plastics.

For permissible use of plastics, see Chapter 60.
CHAPTER 22
TYPE V BUILDINGS

Section 2201. General.

Type V Buildings may be of any materials allowed by this Building Code.

Type V, One-Hour buildings shall be of one-hour fire-resistive construction throughout.

Materials of construction and fire-resistive requirements shall be as set forth in Chapter 17.

For requirements due to occupancy, see Chapters 5 to 15 inclusive.

For requirements in Fire Zones, see Chapter 16.

Section 2202. Wall Covering.

(a) Sheathing.

Type V buildings shall have all exterior walls covered with solid sheathing as set forth in this Section. Such sheathing, when of wood, shall be applied diagonally.

Sheathing shall be one or more of the following materials:

- Wood at least five-eighths (5/8) inch thick.
- Fiberboard at least seven-sixteens (7/16) inch thick.
- Gypsum sheathing at least one-half (1/2) inch thick.
- Plywood at least five-sixteens (5/16) inch thick.

(b) Weatherboarding.

Studs or sheathing shall be covered on the outside face with one layer of building paper as set forth in Chapter 17. Weatherboarding, when in place, shall have an average thickness of at least five-eighths (5/8) inch and a minimum thickness of at least three-eighths (3/8) inch. Such weatherboarding shall be placed over the paper and shall be securely nailed to the studding with at least one nail to each stud in each piece of such weatherboarding. Horizontal joints in the weatherboarding shall be tongued and grooved or shiplapped joints, or such weatherboarding shall be laid shingle fashion and lapped at least one-half (1/2) inch. Siding patterns known as rustic, drop siding, or shiplap shall have an average thickness in place of at least nineteen thirty-seconds (19/32) inch and a minimum thickness of at least three-sixteens (3/16) inch. Bevel siding shall have a minimum thickness measured at the butt section of at least seven-sixteens (7/16) inch and a tip thickness of at least three-sixteens (3/16) inch. Siding of lesser dimensions may be used, provided the outside face of the stud is first covered with sheathing as provided in this Section.

Nails shall be so located as to hold the bottom of the weatherboarding or siding secure and thereby to hold tight the top of the piece below. Where such nailing is not possible, two nails to each stud shall be used to hold each piece.

(c) Plywood.

Where plywood is used for covering the exterior of outside walls it shall be of the exterior type at least three-eighths (3/8) inch thick. Joints shall be backed solid with nailing pieces at least two (2) inches wide.

(d) 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 set forth in Chapter 17. The thickness of shingles or shakes between wood nailing boards shall be at least three-eighths (3/8) inch.

(e) Exterior Plastering.

See Chapter 47.

(f) Masonry Veneer.

See Chapter 29.

(g) Galvanized Iron.

Galvanized iron at least 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 (4) feet.

Section 2203. Exterior Walls, Openings and Partitions.

(a) Exterior Walls and Inner Court Walls.

Exterior walls shall be as set forth in Table No. 17-B and inner court walls shall be as set forth in Table No. 17-A.

Exceptions:

1. Walls fronting on streets having a width of at least fifty (50) feet in Fire Zone No. 1 or thirty (30) feet in Fire Zones No. 2 and No. 3 may be of unprotected incombustible construction with all structural members fire protected as set forth in Table No. 17-A.

2. In Fire Zone No. 1, Type V one-hour buildings one story in height and not more than four hundred (400) square feet in area shall be permitted if the exterior walls are twenty (20) feet or more from adjacent property lines.

3. In Fire Zone No. 2 Type V one-hour buildings not more than one story in height and not more than twenty-five hundred (2500) square feet in area shall be permitted if the exterior walls are ten (10) feet or more from adjacent property lines.
4. In Fire Zone No. 3, exterior walls of Type V building not greater in area than fifteen hundred (1500) square feet are not required to be of one-hour fire-resistive construction if three (3) feet or more from an adjacent property line.

5. Group I Occupancy.

6. Group E Division 5 Occupancies shall have exterior walls of at least one-hour fire-resistant construction or shall be surrounded by public space, streets, or yards at least sixty (60) feet in width.

(b) Opening in Walls.

All openings in exterior walls, including outer courts, shall be protected by a fire assembly having a three-fourths hour fire-resistive rating in conformance with Section 1707 and Table 17-C.

(c) Partitions.

Partitions may be of any material permitted in this Building Code and shall conform to the requirements of Table No. 17-A.

When of wood, such partitions shall be constructed in accordance with Chapter 25.

Section 2204. Stair Construction.

Stair construction may be of any type permitted in this Building Code and shall conform to the requirements of Chapter 33.

Section 2205. Penthouses and Roof Structures.

Penthouses and other roof structures shall conform to the requirements of Chapter 36.

Section 2206. Skylights.

Skylights shall conform to the requirements set forth in Chapters 34 and 60.

Section 2207. Insulation.

(a) General

Blanket, batt, loose or reflective type insulating materials, including vapor seals, wrappings, with flame-spread characteristics or combustibility greater than that of 225, as determined under the Standards of this Chapter, 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 Building Code, and not more than three-fourths (¾) 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 Chapter 1 hereof. No application of insulating materials shall interfere with required fire blocking or fire separations.

(b) Identification and Approval.

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 a form approved by the Building Official 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.

Where insulation is provided in buildings or structures to reduce heat flow to or from rooms or areas, such insulation shall be installed of a thickness that will provide thermal resistance to heat flow per square foot of at least 13.0 in ceilings or floors and 9.0 in exterior walls due to the insulation only. The thermal resistance figure shall be shown on the tag as herein provided.

This Section shall not include rigid insulating boards.

Section 2208. Plastics.

For permissible use of plastics, see Chapter 60.

Section 2209. Standards.

Unless as otherwise provided in this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Government</td>
<td>Prefabricated Accoustical Units, Standard Fire Tests, SS-A-118 (b)</td>
</tr>
</tbody>
</table>

Legend:

Superintendent of Documents
Washington, D.C. 20402

ASTM — American Society for Testing and Materials
1916 Race St.
Philadelphia, Pa. 19103
CHAPTER 23
STRUCTURAL DESIGN AND LOADING

Section 2300. GENERAL.

(a) Scope. Except as otherwise provided in other portions of this Building Code, this Chapter shall govern all loads and forces acting upon a building or structure in such a manner as to cause stresses and deformation within such building or structure or any part thereof. All loads indicated in this Chapter shall supersede loads indicated in other portions of this Building Code.

(b) Earthquake Provisions. For purposes of this Building Code, the City and County of Denver shall be deemed to be in an Earthquake No. 1 Zone (Minor Damage).

Section 2301. DEFINITIONS.

(a) 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, structure or utility.

(b) Live Load. The live load shall include the total of all loads and forces on the building, structure or utility except dead loads.

Section 2302. LOADS.

(a) General. Buildings and structures and all parts thereof shall be of sufficient strength to support, in addition to the dead loads, live loads not less than those specified in the following Sections, without exceeding the stresses noted elsewhere in this Building Code. Impact, vibration and rolling loads shall be considered in the design of any structure where such loads occur and they shall not be reduced with unit live loads. Provision shall be made in designing floors for occupancies other than Group H, I and J Occupancies, for a minimum load of two thousand (2000) pounds or other known concentrated loading, upon any area two and one-half feet by two and one-half feet (2' 6" x 2' 6") square wherever this load upon an otherwise unloaded floor would produce stresses greater than those induced by a uniformly distributed load as specified in Table 23-A.

(b) Temporary Loads. Temporary loads imposed during construction shall be investigated and provided for by the responsible person imposing such loads.

Section 2303. METHOD OF DESIGN.

Any system or method of construction used shall admit of a rational analysis in accordance with well established principles of mechanics and with design criteria and methods as covered in Chapters 24, 25, 26, 27, 28 and 29. Design calculations shall be submitted to the Department when requested. Design uniform live loads and concentrated loads shall be indicated on all drawings submitted to the Department.

All allowable stresses and soil bearing values specified in this Building Code may be increased one-third due to wind or earthquake either acting alone or when combined with vertical loads. No increase shall be allowed for vertical loads acting alone. Wind and earthquake loads need not be assumed to act simultaneously.

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.

Section 2305. ROOF LIVE LOADS.

(a) Snow Load.

1. Roofs shall sustain, within the stress limitations of this Building Code, all "dead loads" plus unit "snow loads" set forth in Table 23-B. The snow loads shall be assumed to act vertically upon the area projected upon a horizontal plane.

2. Greenhouses, lath houses, and farm accessory buildings shall be designed for a vertical live load of not less than ten (10) pounds per square foot.

3. Trusses and arches shall be designed to resist the stresses caused by unit snow loads on one-half of the span if such loading results in a reversal of stresses, or stresses greater in any portion than the stresses produced by the required unit snow 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 snow load design may be reduced fifty per cent (50%).

Section 2306. REDUCTION OF LIVE LOADS.

The following reductions in unit live loads as set forth in Table 23-A for floors shall be permitted in the designing of columns, piers, walls, foundations, trusses, beams and flat slabs.

Except for places of public assembly, and except for live loads greater than 100 pounds
per square foot, the design live load on any member supporting one hundred and fifty square feet (150 sq. ft.) or more may be reduced at the rate of 0.08 per cent per square foot of area supported by the member. The reduction shall not exceed 60 per cent nor "R" as determined by the following formula:

\[ R = 23.1 \left( 1 + \frac{D}{L} \right) \]

WHERE:
- \( R \) = Reduction in per cent;
- \( D \) = Dead load per square foot of area supported by the member;
- \( L \) = Unit live load per square foot of area supported by the member.

For storage loads exceeding one-hundred (100) pounds per square foot, no reduction shall be made except that design live loads on columns may be reduced 20 per cent.

Section 2307. LATERAL LOADS AND FORCES.
(a) Scope.

1. General. Every building or structure and every portion thereof shall be designed and constructed to resist stresses produced by lateral forces as provided in this Section. Stresses shall be calculated as the effect of a force applied horizontally at each floor or roof level above the foundation. The force shall be assumed to come from any horizontal direction.

2. Definitions. The following definitions apply to the provisions of this Section.

A. Space Frame is a three-dimensional structural system composed of interconnected members, other than shear or bearing walls, laterally supported so as to function as a complete self-contained unit with or without the aid of horizontal diaphragms or floor bracing systems.

B. Space Frame — Vertical Load-Carrying is a space frame designed to carry all vertical loads.

C. Space Frame — Moment Resisting is a vertical load-carrying space frame in which the members and joints are capable of resisting design lateral forces by bending moments. This system may or may not be enclosed by or adjoined by more rigid elements which would tend to prevent the space frame from resisting lateral forces.

D. Box System is a structural system without a complete vertical load-carrying space frame. In this system the required lateral forces are resisted by shear walls as herein-after defined.

E. Shear Wall is a wall designed to resist lateral forces parallel to the wall. Braced frames subjected primarily to axial stresses shall be considered as shear walls for the purpose of this definition.

3. Assumptions.

A. In the absence of more specific data justifying other assumptions the values prescribed for lateral forces shall be considered as the minimum for purposes of design, except as otherwise noted.

B. Special structures designed for lateral loads shall be investigated for the special loadings and for the specific use intended. The normal factor of safety shall be increased at least 50 % in all cases of uncertainty regarding the load or the action of the prescribed loads.


A. Structures or parts of structures shall be designed for the larger stress due to the combination of all loads which may occur on the structure at any one time.

B. The stresses in the various materials of construction may be increased under certain combinations of loading as prescribed under the various chapters.

5. Symbols and Notations. The following symbols and notations apply only to the provisions of this Section.

\[ C = \text{Numerical coefficient for base shear as specified in Section 2307 (c).} \]

\[ C_p = \text{Numerical coefficient as specified in Section 2307 (c) and as set forth in Table No. 23-G.} \]

\[ D = \text{The dimension of the building in feet in a direction parallel to the applied forces.} \]

\[ F_a = \text{Allowable axial stress.} \]

\[ f_a = \text{Computed axial stress.} \]

\[ F_b = \text{Allowable bending stress.} \]

\[ f_b = \text{Computed bending stress.} \]
\[ F_p = \text{Lateral forces on the part of the structure and in the direction under consideration.} \]

\[ F_x = \text{Lateral forces applied to a level designated as "x."} \]

\[ H = \text{The height of the main portion of the building in feet above the base.} \]

\[ h_x = \text{Height in feet above the base to the level designated as "x."} \]

\[ J = \text{Numerical coefficient for base moment as specified in Section 2307 (a).} \]

\[ K = \text{Numerical coefficient as set forth in Table No. 23-F.} \]

\[ \Sigma w_h = \text{Summation of the products of all "w_x" "h_x" for the building.} \]

\[ M = \text{Overturning moment at the base of the building or structure.} \]

\[ N = \text{Total number of stories above exterior grade.} \]

\[ T = \text{Fundamental period of vibration of the building or structure in seconds in the direction under consideration.} \]

\[ V = \text{Total lateral load or shear at the base.} \]

\[ W = \text{Total dead load.} \]

\[ \text{EXCEPTION: "W" shall be equal to the total dead load plus 25 per cent of the floor live load in storage and warehouse occupancies.} \]

\[ W_p = \text{The weight of a part or portion of a structure.} \]

\[ w_x = \text{That portion of "W" which is located at or is assigned to the level designated as "x."} \]

\[ Z = \text{Numerical coefficient} = 0.25. \]

6. Distribution of Horizontal Shear. Total shear in any horizontal plane shall be distributed to the various resisting elements in proportion to their rigidities considering the rigidity of the horizontal bracing system or diaphragm as well as the rigidities of the vertical resisting elements.

7. Drift. Lateral deflections or drift of a story relative to its adjacent stories shall be considered in accordance with accepted engineering practice.

8. Horizontal Torsional Moments. Provisions shall be made for the increase in shear resulting from the horizontal torsion due to an eccentricity between the center of force and the center of rigidity. Negative torsional shears shall be neglected. Where the vertical resisting elements depend on diaphragm action for shear distribution at any level, the shear resisting elements shall be capable of resisting a torsional moment assumed to be equivalent to the story shear acting with an eccentricity of not less than five per cent of the maximum building dimension at that level.

9. Overturning. Every building or structure shall be designed to resist the overturning effects caused by the wind forces and related requirements specified in this Section, or the earthquake forces specified in this Section, whichever governs.

\[ M = J \Sigma F_x h_x \]

WHERE:

\[ J = \frac{0.5}{\sqrt{T}} \]

The required value of "J" shall be not less than 0.33 nor more than 1.00.

B. The overturning moment "M_x" at any level designated as "x" shall be determined in accordance with the following formula:

\[ M_x = \frac{H - h_x}{H} M \]

At any level the overturning moments shall be distributed to the various resisting elements in the same proportion as the distribution of the shears in the resisting system. Where other vertical members are provided which are capable of partially resisting the overturning moments, a redistribution may be made to these members if framing members of sufficient strength and stiffness to transmit the required loads are provided. Where a vertical resisting element is discontinuous, the overturning moment carried by the lowest story of that element
shall be carried down as loads to the foundation. The dead load resisting moment shall be \(1\frac{1}{2}\) times the calculated overturning moment due to wind forces or adequate foundation anchorage shall be provided.

10. Set-Backs. Buildings having set-backs wherein the plan dimension of the tower in each direction is at least 75 per cent of the corresponding plan dimension of the lower part may be considered as a uniform building without set-backs for the purpose of determining seismic forces.

For other conditions of set-backs the tower shall be designed as a separate building using the larger of the seismic coefficients at the base of the tower determined by considering the tower as either a separate building for its own height or as part of the over-all structure. The resulting total shear from the tower shall be applied at the top of the lower part of the building which shall be otherwise separately considered for its own height.

11. Structural Frame. Buildings more than 13 stories or one hundred and sixty feet (160') in height shall have a complete moment resisting space frame capable of not less than 25 per cent of the required seismic load for the structure as a whole.

12. Design Requirements.

A. Combined axial and bending stresses in columns forming a part of a space frame. Maximum allowable extreme fiber stress in columns at intersection of columns with floor beams, girders or slabs for combined axial and bending stresses shall be the allowable bending stress for the material used. Within the center one-half of the unsupported length of column, the combined axial and bending stresses shall be as defined in Chapters 24, 25, 26 and 27 of this Building Code.

When stresses are due to a combination of vertical and lateral loads, the allowable unit stresses may be increased as specified in Section 2303.

B. Building Separations. All portions of structures shall be designed and constructed to act as an integral unit in resisting horizontal forces unless separated structurally by a distance sufficient to avoid contact under deflection from seismic action or wind forces.

C. Minor Alterations. Minor structural alterations may be made in existing buildings and other structures, but the resistance to lateral forces shall be not less than that before such alterations were made, unless the building as altered meets the requirements of this Section and this Building Code.

(b) Wind Forces on Structures.

1. General. Buildings or other structures shall be designed to withstand the minimum horizontal pressures set forth in Table No. 23-C, allowing for wind from any direction. The height is to be measured above the average level of the ground adjacent to the building or structure. The wind pressures set forth in Table 23-C are minimum values. When the form factor, as determined by wind tunnel tests of other recognized methods, indicates vertical or horizontal loads of lesser or greater severity than those produced by the loads herein specified, the roof structure shall be designed accordingly if effects are greater.

2. Walls. All exterior walls shall be capable of withstanding the design wind loads, acting either inwardly or outwardly and all construction shall be adequately anchored to resist these suction and pressure loads.

3. Wind Loads on Roofs.

A. Pitched Roofs. The external wind forces on pitched roofs with a slope greater than thirty (30) degrees shall be assumed to be not less than ten (10) pounds per square foot pressure, normal to the windward side and suction of not less than ten (10) pounds per square foot normal to the leeward side.

B. Curved Roofs. The external wind forces on curved roofs with a radius of curvature not less than one-half (\(\frac{1}{2}\)) nor more than three-quarters (\(\frac{3}{4}\)) of the span of the roof shall be assumed as a pressure of not less than ten (10) pounds per square foot normal to the surface on the windward side and not less than ten (10) pounds per square foot suction on the leeward side.

C. Integral Curved Walls and Roof. When the curve of the roof starts
from ground level, a pressure in pounds per square foot of not less than twenty (20) times the ratio of rise to span shall be assumed on the windward side and a suction of not less than ten (10) pounds per square foot on the leeward side.

D. Test Determination. The effect of shape of irregular or unusual roofs may be determined by wind tunnel or equivalent tests. In determining the effect of shape, the assumed wind velocity shall be the maximum average for a five (5) minute period shown in the records of the U.S. Weather Bureau during the past fifteen (15) years, and the prescribed wind forces shall be modified accordingly.

E. Anchorage. Roof framing shall be anchored to wall framing and walls to foundations so as to resist wind uplift and sliding in excess of seventy-five (75) per cent of the dead load resistance.

F. Uplift of Eaves. Overhanging eaves, cornices and other roof projections shall be designed and constructed to withstand an upward pressure of forty (40) pounds per square foot.

G. Flat Roofs. All flat roofs are to be designed for uplift of twenty (20) pounds per square foot.

4. Solid Towers. Chimneys, tanks, and solid towers shall be designed and constructed to withstand the pressures as specified by this Section, multiplied by the factors set forth in Table No. 23-D.

5. Open Frame Towers. Radio towers and other towers of trussed construction shall be designed and constructed to withstand wind pressures specified in this Section, multiplied by the shape factors in Table No. 23-E. Wind pressures shall be applied to the total normal projected area of all the elements of one face (excluding ladders, conduits, lights, elevators, etc., which shall be accounted for separately by using the indicated factor for these individual members).


A. Signs in which the open area is less than one-third of the gross area shall be considered as solid signs and the gross area shall be used in computing wind loads.

B. Solid signs shall be designed to withstand the wind loads given in Tables 23-C.

C. Open signs shall be designed to withstand one and one-half times the wind loads, applied to the net exposed surface.

D. The requirements for structural drawings, specifications and analysis as indicated in Chapter 3 shall apply when required by the Department.

E. For signs not covered in A thru D see (b) 4 and (b) 5 of this Section.

(c) Earthquake Forces on Structures. Every building or structure shall be designed and constructed to withstand minimum total lateral seismic forces assumed to act non-concurrently in the direction of each of the main axes of the building in accordance with the following formula:

\[ V = Z K C W \]

The value of "K" shall be not less than that set forth in Table 23-F. The value of "C" shall be determined in accordance with the following formula:

\[ C = \frac{0.05}{\sqrt{T}} \]

1. EXCEPTION: "C" = 0.10 for all one-story and two-story buildings. "T" is the fundamental period of vibration of the structure in seconds in the direction considered. Properly substantiated technical data for establishing the period "T" for the contemplated structure may be submitted. In the absence of such data, the value of "T" shall be determined by the following formula:

\[ T = \frac{0.05 H}{\sqrt{D}} \]

2. EXCEPTION: "T" = 0.10N in all buildings in which the lateral resisting system consists of a moment resisting space frame which resists 100 per cent of the required lateral forces and which frame is not enclosed by or adjoined by more rigid elements which would tend to prevent the frame from resisting lateral forces. For the purpose of computing "C," the value of "T" need not be less than 0.10 seconds. The total lateral force "V" shall be distributed over the
height of the building in accordance with the following formula:

\[ F_x = \frac{V w_x h_x}{w h} \]

3. EXCEPTIONS:
A. One-story and two-story buildings shall have uniform distribution.
B. Where the height to depth ratio of a lateral force resisting system is equal to or greater than five to one, 10 per cent of the total force "V" shall be considered as concentrated at the top story. The remaining 90 per cent shall be distributed as provided for in the above formula.

At each level designated as "x," the force "F_x" shall be applied over the area of the building in accordance with the mass distribution on that level.
C. Lateral force on parts or portions of buildings or structures. Parts or portions of buildings or structures and their anchorage shall be designed for lateral forces in accordance with the following formula:

\[ F_p = Z C_p W_p \]

The values of "C_p" are set forth in Table No. 23-G. The distribution of these forces shall be according to the gravity loads pertaining thereto.
D. Pile Foundations. Individual pile or caisson footings of every building or structure shall be so interconnected by ties each of which can carry by tension and compression a horizontal force equal to 10 per cent of the larger pile cap loading unless it can be demonstrated that equivalent restraint can be provided by other approved methods.

(d) Structural Masonry. All elements within a structure which are of masonry or concrete and which are intended to resist lateral forces either seismic or wind, shall be calculated by accepted structural analysis. When this analysis indicates stresses greater than allowed for unreinforced masonry or concrete, the elements shall be reinforced so as to qualify as reinforced masonry or reinforced concrete as specified in Chapters 24 and 26.

Section 2308. MISCELLANEOUS STRUCTURES.

Greenhouses, lath houses and agricultural buildings shall be designed for a wind pressure of not less than ten (10) pounds per square foot.

Section 2309. ANCHORAGE.

Concrete or masonry walls shall be anchored to all floors and roofs which provide lateral support for the wall or are required to provide stability for the wall. Such anchorage shall be capable of resisting the horizontal forces specified in this Chapter or a minimum force of 100 pounds per linear foot of wall, whichever is the larger.

Section 2310. LIVE LOADS POSTED.

Live loads used for the design of warehouses or manufacturing buildings shall be conspicuously posted by the owner in that part of each story to 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 maintaining actual loading equal to or below these posted loads.

Section 2311. RETAINING WALLS.

(See Chapter 28.)

Section 2312. HELIPORTS.

All structures to provide a landing surface for helicopters shall be designed to support a concentrated load equivalent to 75 per cent of the gross weight of the helicopter on any one square foot of the landing area. This load shall act anywhere on the contact surface simultaneously with all existing dead loads and applicable live loads as prescribed in this Chapter.

Section 2313. TABLES.

<table>
<thead>
<tr>
<th>TABLE 23-A UNIT LIVE LOADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live Loads</td>
</tr>
<tr>
<td>Armories</td>
</tr>
<tr>
<td>Awnings — Fixed</td>
</tr>
<tr>
<td>Balconies — Private for apartments and hotels</td>
</tr>
<tr>
<td>Public</td>
</tr>
<tr>
<td>Bleachers: The minimum unit live load for reviewing stands, grandstands and bleachers shall be 100 pounds per square foot of horizontal projection for the structure as a whole. Seat and footboards shall be designed for 120 pounds per linear foot parallel to the seats, and 10 pounds per linear foot perpendicular to the seats. Sway forces need not be applied simultaneously with other lateral forces.</td>
</tr>
<tr>
<td>Canopies</td>
</tr>
<tr>
<td>Ceilings</td>
</tr>
<tr>
<td>Church Auditoriums: with movable seats, including aisles, sanctuary or chancel, sacristies, choirs and chapels</td>
</tr>
<tr>
<td>with fixed seats</td>
</tr>
</tbody>
</table>
Classrooms, not exceeding 1200 sq. ft. in area, or larger size rooms where fixed seats are used ........................................... 50
Class and Lecture rooms in excess of 1200 sq. ft. in area without fixed seats ................................................... 75
Corridors: In theatres and serving assembly halls, and in churches and school buildings ........................................ 100
Other corridors: Same loading as heaviest occupancy from which they provide egress.
Domestic Occupancy: Lounge and Recreational Areas ................................................................. 60
All parts of private dwellings, rooms and suites in apartment houses, lodging houses and clubs; educational and religious institutions, including corridors giving access thereto; and bedrooms of hotels .................................................. 40
Drill Rooms ................................................................................................................................. 150
Driveways or Sidewalks over area ways or basements ............................................................................ 250
(Or in accordance with A.A.S.H.O. Specifications).
Equipment and Machinery rooms — Design for use but not less than .................................................. 125
Fire Escapes ........................................................................................................................................... 100
Garages: For vehicles larger than passenger automobiles the structure shall be designed for the loading to which building is to be subjected with maximum vehicle load posted, at least .... 60
For vehicles no heavier than passenger automobiles, all floors and auto ramps ........................................ 50
Roof decks used for parking, including snow load ........................................................................... 65
Hospitals .................................................................................................................................................. 40
Laundries: Weight of specific equipment, but not less than .................................................................. 150
Libraries: Stack Rooms ...................................................................................................................... 125
Reading Rooms ....................................................................................................................................... 60
Manufacturing: Load to be determined from proposed use or occupancy, but never less than .......... 100
Marquees .................................................................................................................................................. 50
Office Buildings: First and Basement floors ....................................................................................... 100
Office Occupancy: Above first floor in office buildings, offices in other buildings, including corridors ................................................................. 50
Structure to be designed for special equipment used.
Partitions: A uniform load equivalent to 1/12 of weight of one linear foot of partitions. .................. 150
Printing Plants: Load to be determined from proposed use or occupancy, but never less than ........ 100
Public Occupancy: Lobbies, foyers, vestibules and similar public spaces of hotels, theatres, clubs and public buildings, assembly halls, dance halls, public dining rooms and restaurants including kitchens, gymnasiums ........................................... 100
Railings: A uniform horizontal force applied at top of rail equal to 20 pounds per linear foot, for balconies and stairs.
Skating Rinks ........................................................................................................................................ 120
Stairs (except in I occupancy) ............................................................................................................. 100
Storage: Heavy—Load to be determined from proposed use or occupancy, but never less than .......... 250
Light storage ........................................................................................................................................... 125
Stores: Wholesale (Light Merchandise) .............................................................. 100
Retail (Light Merchandise) .................................................................................................................. 75
Theatre Auditoriums and Assembly Halls: with fixed seats, including aisles, passageways and balconies ................................................................. 75
Theatre Stages, Gridirons and Fly Galleries ......................................................................................... 125

**TABLE NO. 23-B**

**ROOF SNOW LOADS IN P.S.F.**

**Roof Member** (See also 2305)

| Flat or rise less than four (4) inches per foot: Arch or Dome with rise less than one-eighth (1/8) of the span | 30 |
| Rise four (4) inches per foot to less than twelve (12) inches per foot: 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 | 25 |
| Rise twelve (12) inches per foot and greater; Arch or Dome with rise three-eighths (3/8) span or greater or radius less than three-fourths (3/4) of the span | 15 |

**TABLE NO. 23-C**

**WIND PRESSURES IN PSF FOR VARIOUS HEIGHT ZONES ABOVE GROUND**

<table>
<thead>
<tr>
<th>Height Zones (in feet)</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100</td>
<td>20</td>
</tr>
<tr>
<td>100 to 400</td>
<td>30</td>
</tr>
<tr>
<td>400 and over, special study req’d. Min.</td>
<td>30</td>
</tr>
</tbody>
</table>

**TABLE NO. 23-D**

**MULTIPLYING FACTORS FOR WIND PRESSURES FOR CHIMNEYS, TANKS AND SOLID TOWERS**

<table>
<thead>
<tr>
<th>Horizontal Cross Section</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square or rectangular</td>
<td>1.00</td>
</tr>
<tr>
<td>Hexagonal or octagonal</td>
<td>0.80</td>
</tr>
<tr>
<td>Round or elliptical</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**TABLE NO. 23-E**

**SHAPE FACTORS FOR RADIO TOWERS AND TRUSSED TOWERS**

<table>
<thead>
<tr>
<th>Type of Exposure</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind normal to one face of tower four-cornered, flat or angular sections, steel or wood</td>
<td>2.20</td>
</tr>
</tbody>
</table>
TABLE NO. 23-F
HORIZONTAL FORCE FACTOR "K" FOR
BUILDINGS OR OTHER STRUCTURES

<table>
<thead>
<tr>
<th>Type or Arrangement of Resisting Elements</th>
<th>Factor K</th>
</tr>
</thead>
<tbody>
<tr>
<td>All building framing systems except as hereinafter classified</td>
<td>1.00</td>
</tr>
<tr>
<td>Buildings with a box system as specified in Sec. 2307 (a) 2D</td>
<td>1.33</td>
</tr>
<tr>
<td>Buildings with a complete horizontal bracing system capable of resisting all lateral forces, which system includes a moment resisting space frame, which when assumed to act independently is capable of resisting a minimum of 25 per cent of the total required lateral force</td>
<td>0.80</td>
</tr>
<tr>
<td>Buildings with a moment resisting space frame which when assumed to act independently of any other more rigid elements is capable of resisting 100 per cent of the total required lateral forces in the frame alone</td>
<td>0.67</td>
</tr>
<tr>
<td>Structures other than buildings and other than those set forth in Table No. 23-G</td>
<td>1.50</td>
</tr>
</tbody>
</table>

TABLE NO. 23-G
HORIZONTAL FORCE FACTOR "Cp" FOR PARTS OR PORTIONS OF BUILDINGS OR OTHER STRUCTURES

<table>
<thead>
<tr>
<th>Part or Portion of Buildings</th>
<th>Direction of Force</th>
<th>Cp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior bearing and nonbearing walls, interior bearing walls and partitions, interior nonbearing walls and partitions over ten feet (10') in height, masonry and concrete fences over six feet (6') in height</td>
<td>Normal to flat surface</td>
<td>0.20</td>
</tr>
<tr>
<td>Cantilever parapet and other cantilever walls, except retaining walls</td>
<td>Normal to flat surface</td>
<td>1.00</td>
</tr>
<tr>
<td>Exterior and interior ornamentations and appendages</td>
<td>Any direction</td>
<td>1.00</td>
</tr>
<tr>
<td>When connected to or a part of a building; towers, tanks, towers and tanks plus contents, chimneys, smokestacks, and penthouses</td>
<td>Any direction</td>
<td>0.20*</td>
</tr>
<tr>
<td>Elevated tanks plus contents not supported by a building</td>
<td>Any direction</td>
<td>0.20</td>
</tr>
<tr>
<td>When resting on the ground, tank plus effective mass of its contents</td>
<td>Any direction</td>
<td>0.10</td>
</tr>
<tr>
<td>Floors and roofs acting as diaphragms**</td>
<td>Any direction</td>
<td>0.10</td>
</tr>
</tbody>
</table>

* When "H/D" of any building is equal to or greater than five to one, increase value by 50 per cent.

** Floors and roofs acting as diaphragms shall be designed for a minimum value of "Cp" of 10 per cent applied to loads tributary from that story unless a greater value of "Cp" is required by the basic seismic formula: 

\[ V = Z K C W \]
CHAPTER 24
MASONRY

Section 2400. SCOPE

In addition to the other requirements of this Building Code, this Chapter shall govern the installation, maintenance and materials of masonry construction. Provisions are provided for waiving certain requirements when written evidence is submitted by an architect or engineer. This written evidence shall include design calculations based on generally accepted engineering principles and substantiated allowable stresses and data. The use of alternate methods, new materials and new equipment not specifically authorized by these requirements may be permitted in accordance with the provisions of Chapter 1 of this Building Code.

Section 2401. GENERAL

(a) Quality and Design. All masonry materials shall conform to the minimum requirements specified in this Chapter. See Section 2425 (Standards).

1. Masonry units may be re-used if they conform to all the requirements of new units as described in this Chapter, except that the allowable working stresses shall be 50% of that permitted for new masonry units. Representative samples of re-used masonry units from each construction project shall be tested according to Section 2406 unless waived by the Department. (See also Section 2407 (a).)

Section 2402. DEFINITIONS

For the purposes of this Chapter, the following shall be defined as set forth in this Chapter. (See also Chapter 4 and Chapter 26).

Approved. See Chapter 4.

Architectural Terra Cotta. Plain or ornamental (molded or extruded) hard-burned building units, consisting of mixtures of plastic clays, fusible materials, and grog, and having a glazed or unglazed ceramic finish. (See Ceramic Veneer).

Ashlar Masonry. Masonry composed of rectangular units, properly bonded, having sawed, dressed, or squared beds, and mortar joints.

Block.

1. Block, Concrete. A hollow or solid masonry unit composed of a mixture of portland cement, water, sand and gravel aggregates.

2. Block, lightweight. Hollow or solid masonry unit composed of a mixture of cement, water, sand and lightweight aggregates such as pumice, scoria, expanded shale, clay and similar material.

3. All of the units listed in Items 1 and 2 are formed by machine pressing ingredients to shape and then cured by hydration of the cements by natural or artificial means.

   Grade A. Exterior wall use below and above grade subject to frost action

   Grade B. For general use not subject to frost action

Bonder (Header). A masonry unit which ties two or more adjacent wythes of the wall together by overlapping.

Brick. A solid masonry unit, not less than 75 per cent solid. The word "Brick" used without qualification indicates its composition is primarily of clay, shale or a mixture thereof,
and that these ingredients have been fused together as a result of exposure to heat. Brick may be composed of other materials when so designated, such as, "concrete brick," and "sand-lime brick."

Building. See Chapter 4.

Buttress. A bond column of masonry built as an integral part of the wall and projecting from either or both surfaces decreasing in cross-sectional area from base to top.

Ceramic Veneer. A type of architectural terra cotta two and one half (2 ½) inches or less in thickness.

Chase. A continuous recess in a wall to receive pipes, ducts, conduits, etc.

Column. See Chapter 26.

Concrete. See Chapter 26.

Coping. The materials or units used to form a cap or finish on top of a wall, pier or pilaster to protect the masonry below from penetration of water from above.

Corbel. A shelf or ledge formed by projecting successive courses of masonry out from the face of the wall.

Course. One of the continuous horizontal layers of masonry bonded together with mortar.

Cross-Sectional Area. Net cross-sectional area of a masonry unit is the gross cross-sectional area minus the area of the cores or cellular spaces. Gross cross-sectional area of scored units shall be determined to the outside of the scoring but the cross-sectional area of the grooves shall not be deducted from the gross cross-sectional area to obtain the net cross-sectional area.

Deformed Bar. A reinforcing bar conforming to the ASTM Standard A305. Bars not conforming to these specifications are classed as plain bars.

Effective Area of Reinforcement. The area obtained by multiplying the cross-sectional area of the metal reinforcement taken perpendicular to the longitudinal axis by the cosine of the angle between its direction and the direction for which the effectiveness of the reinforcement is to be determined.

Grog. Ground particles of fired clay products that are sometimes mixed with the raw clay in the manufacturing process of new burned clay units.

Grout. A mixture of cementitious materials and aggregates to which sufficient water has been added to make a consistency that will flow without segregation of the ingredients. See Section 2419 (a) 4-B.

Concrete Grout. Grout with the large aggregate exceeding the size of pea gravel.

Mortar Grout. A mortar mixture to which sufficient water has been added to bring it to grout consistency.

Pea Gravel Grout. Mortar grout to which pea gravel is added.

Grouted Masonry. Masonry construction made with solid or hollow masonry units in which the interior voids are filled with grout.

Header (See Bonder).

Height of Wall. The vertical distance from the foundation wall or other intermediate support of such wall, to the top of the wall.

Hollow Masonry Unit. A masonry unit whose net cross-sectional area in any plane parallel to the bearing surface is less than 75 per cent of its gross cross-sectional area measured in the same plane.

Joints, Bed, Head, Collar and Core.

Bed. The horizontal layer of mortar on which a masonry unit is laid.

Head. The vertical mortar joint between ends of masonry units often called cross joint.

Collar. The vertical, longitudinal joint between adjacent wythes of masonry.

Core. An enlarged collar joint or void within a wall.

Lateral Support. The means whereby walls are braced or supported either vertically or horizontally at right angles to the face of the walls. The distance between these supports shall not exceed values as set forth in this Chapter. Lateral support shall be obtained by cross walls, columns, pilasters, or buttresses, when the limiting distance is measured horizontally, or by floors, roofs and properly designed beams when the limiting distance is measured vertically. Sufficient bonding or anchorage shall be provided between the walls and supports to resist normal wind or other horizontal forces acting either inward or outward. Columns, pilasters, buttresses and cross walls relied upon for lateral support shall have
sufficient strength and stability to transfer these horizontal forces, acting in either direction, to adjacent structural members or to the ground. When walls are dependent upon floors or roofs or beams for their lateral support, provision shall be made in the building to transfer the lateral forces to the ground.

Lintel. A supporting member over an opening in a wall to carry the superimposed load.

Masonry. Construction composed of masonry units, laid up unit by unit and set in mortar.

Masonry Unit. Any brick, tile, stone or block conforming to the requirements of this Chapter.

Mortar. A plastic mixture of cementitious materials, fine aggregates and water used to bond masonry together.

Integrally Reinforced Masonry Walls. Walls designed as plain masonry except that reinforcement is provided in some portions to resist flexural tensile stresses.

Partition. See Chapter 4.

Pier. An isolated column of masonry.

Plaster. A bonded column of masonry built as an integral part of a wall projecting from either or both surfaces and having uniform cross section throughout its height.

Reinforced Brick Masonry. Brick masonry in which steel reinforcement is imbedded in such a manner that the two materials act together in resisting forces.

Reinforced Grouted Brick Masonry. Reinforced brick masonry in which the collar joint or core is filled with grout and in which all or part of the reinforcement is embedded.

Reinforced Masonry. Unit masonry in which reinforcement is embedded in such a manner that the two materials act together in resisting forces.

Reinforced Hollow Unit Masonry. Masonry construction made with hollow masonry units in which certain cells are continuously filled with concrete or grout and in which reinforcement is embedded.

Reinforcement. Structural steel shapes, steel bars, rods, wire fabric, or expanded metal embedded or incased in masonry in such a manner that it works with the masonry in resisting forces.

Rubble.

Rubble, Coursed—Masonry composed of roughly shaped stones fitting approximately on level beds, well bonded, and brought at vertical intervals to continuous level beds or courses.

Rubble, Random—Masonry composed of roughly shaped stones, well bonded and brought at irregular vertical intervals to discontinuous but approximately level beds or courses.

Rubble, Rough or Ordinary. Masonry composed of non-shaped or field stones laid without regularity of coursing, but well bonded.

Solid Masonry Unit. (See Brick)

Solid Masonry Wall. (See Wall: Solid Masonry).

Stretcher. A unit laid with its length horizontal, and parallel with the face of the wall or other masonry member.

Story. See Chapter 4.

Through-Wall Unit. A single unit or wythe the same thickness as the wall.

Unit Masonry. A built-up construction or combination of masonry units set in mortar or grout.

Used Masonry Unit. Masonry units salvaged for reuse after having been adhered together with cementitious materials of any type.

Walls. (For other than Masonry Wall, see Chapter 4).

Bearing Wall—See Chapter 4.

Cavity Wall—See Chapter 4 and Section 2413.

Composite Wall—A masonry wall composed of more than one Type or Grade of masonry unit or mortar.

Curtain Wall—See Chapter 4.

Faced Wall—See Chapter 4.

Foundation Wall—See Chapter 4.

Hollow Wall—A wall built of masonry units with an air space between the wythes which are securely bonded together.

Hollow Unit Wall—A wall composed entirely of hollow masonry units.

Masonry Bonded Hollow Walls—A hollow wall in which solid masonry units are used to bond the inner and outer wythes together.

Non-Bearing Wall—See Chapter 4.

Panel Wall—A masonry wall wholly supported at each story on a skeleton frame, floor, or other structural member.
Parapet Wall—See Chapter 4.

Party Wall—See Chapter 4.

Spandrel Wall—That portion of a wall above the head of a window or door in one story and below the window sill of the story above.

Solid Masonry Wall—A wall built of solid masonry units, laid continuously with the joints between units completely filled with mortar.

Veneered Wall—See Chapter 4.

Wythe. Each continuous vertical section of a wall one masonry unit in thickness.

Section 2403. 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 the units having the lowest allowable stress.

Section 2404. COLD WEATHER PROTECTION

All masonry shall be protected from freezing by heating and maintaining the temperature of the masonry materials to at least 40° Fahrenheit but not more than 160° Fahrenheit and maintaining an air temperature above 40° Fahrenheit on both sides of the masonry for a period of at least 48 hours if Type M or S mortar is used, and 72 hours if Type N or O mortar is used. These periods may be reduced to 24 and 48 hours respectively if high early-strength cement is used. No masonry shall be built with or upon frozen materials. No antifreeze liquid, salts or other substances shall be used in the mortar to lower the freezing point.
Section 2405. DIMENSIONS

Dimensions used herein are nominal dimensions. Nominal dimensions of unit masonry are the actual dimensions of the units or walls plus the thickness of a mortar joint. This joint thickness is limited to a maximum of one-half (½) inch.

Section 2406. TESTS

(a) When Required. Whenever there is reasonable doubt as to the ability of a masonry material or construction to conform to these requirements, or there is insufficient evidence to substantiate claims for alternate materials or construction, the Department shall require tests to be made at the expense of the applicant, by an approved laboratory.

(b) Methods. Tests of masonry materials and masonry construction shall be made in accordance with recognized standards. (Refer to 2419 (b)-3 and 4 and Section 2425 (a) 25, 26, 35, 46 and 20). Duly authenticated tests by a competent person or laboratory may be accepted by the Department in lieu of tests under Department supervision.

(c) Load Tests of Existing Structures

1. Load tests of an existing masonry structure to determine its structural adequacy for the design loads shall be made as in accordance with Chapter 26 of this building Code.

2. The maximum deflection, D, of a flexural member at the end of the 24 hour period shall not exceed the limit in Table 24A. All terms are expressed in the same units; L being the span of the member and t the thickness or depth. The maximum deflection shall not exceed L/200 for a floor construction intended to support or to be attached to partitions or other construction likely to be damaged by large deflections of the floor.

Section 2407. MATERIALS

(a) Solid Masonry Units. Building brick of clay or shale, shall conform to the requirements of Section 2425 (a) (2). Where in contact with the ground and where used on exterior walls, the brick shall be of at least Grade SW for clay, shale or sandlime brick; or Grade A for concrete units. Other solid masonry units of sand-lime or concrete shall meet the requirements for the physical properties as specified in the Standards in Section 2425 (a) (3, 4 and 6).

(b) Concrete Masonry Units. Concrete masonry units for use in exterior walls below grade and for exterior walls above grade that may be exposed to frost action shall be at least Grade A. All concrete masonry units shall conform to the requirements of Section 2425 (a) (4, 5, 6, 7).

(c) Structural Clay Tile. Structural clay tile shall conform to the requirements of Section 2425 (a) (8 and 9); 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 the Standards in Section 2425 when used for interior non-load-bearing purposes or for floor construction.

(d) Cast Stone. Cast stone shall conform to the requirements of Section 2425 (a) (10).

(e) Stone. Natural stone shall be sound and free from loose or friable inclusions, with sufficient strength and durability to sustain the required design loads.

(f) Gypsum Units. Gypsum partition tile or block shall conform to the requirements of Section 2425 (a) (29).

(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 the requirements of Section 2425 (a) (12), except that the requirements for finish shall not apply to salt-glazed building units.

(i) Architectural Terra Cotta and Ceramic Veneer. Architectural terra cotta and ceramic veneer shall have a strong homogeneous body and shall conform to the applicable requirements of ASTM Specifications for structural clay tile and ceramic glazed masonry units. All units of the anchor type shall have the necessary anchor holes and shall be so formed as to engage properly with the supporting structure. All units of the adhesion type shall have keyed or scored back surfaces.

(j) Cementitious Materials. Materials used as ingredients in mortar shall conform to the requirements of Section 2425 (a) (12) and the following requirements:

1. Portland cement—see Section 2425 (a) 24, 14, 23.

2. Masonry cement—See Section 2425 (a) 15.

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3. Quicklime—See Section 2425 (a) 16.
4. Hydrated Lime—See Section 2425 (a) 17.
5. Aggregates — See Section 2425 (a) 18.
6. Water — Water shall be clean and free from deleterious amounts of acids, alkalies, or organic materials.
7. Admixtures — Integral waterproofing compounds, accelerators, or other admixtures that reduce the structural properties of the mortar or grout shall not be used unless approved by the Department. See also Section 2404.
8. Mortar Colors — Mortar coloring materials shall consist of inorganic compounds and their use shall comply to the requirements of Section 2425 (a) 13.

(k) Solar Screen and other special units. See Section 2409 (o).

Section 2408. MORTAR AND GROUT

General. Mortar, other than gypsum mortar, used in masonry construction shall be classified by the requirements as set forth in Table 24-B or 24-C and shall comply with the requirements of Section 2425 (a) 13. Mortar with the materials and proportions to be used in the construction, thoroughly mixed to an initial flow of 100 to 115, shall have a flow, after suction, of not less than 70% when determined by the method of water retention test described in the Standards of Section 2425 (a) 19.

1. Tests made to classify mortar by compressive strength shall be made as described in the Standards in Section 2425 (a) (13).

2. 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 24-C shall be assumed to meet the strength classification shown when mixed with aggregate in the proportions required by this Section.

(b) 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.

(c) Special Mortars. Any use of special mortars shall be substantiated by test or engineering data pursuant to Section 111.

(d) Grout. See definition Section 2402.

(e) Mortar for Footings and Foundations. Masonry units used in foundation walls and footings shall be laid up in Type M or S mortar.

Section 2409. REQUIREMENTS FOR MASONRY WALLS

(a) General. The following shall apply to all masonry walls. See Chapter 28 for foundation wall requirements. Masonry walls shall be designed so as to be sufficient at all points to withstand all vertical and horizontal loads as specified in Chapter 23. Table 24-D shall be used for minimum thickness and ratio of unsupported height or length to thickness.

EXCEPTION: Limits on height or length to thickness ratios and minimum thickness may be waived when written evidence is submitted by the engineer or architect showing that the walls were designed using accepted engineering principles and the allowable stresses in Table 24-F, and Section 2409 (n).

(b) Thickness of Bearing Walls. The thickness of a masonry bearing wall shall be at least the nominal dimension as indicated in Table 24-D (See also Section 2409 (a) exception)

EXCEPTION: Special type walls designed by an architect or engineer and approved by the Department and including the following:

1. Walls of Group H, I and J Occupancies. In buildings of Group H, I, or J Occupancy, not more than 3 stories in height, the exterior masonry walls shall be at least eight (8) inches nominal thickness when not over thirty-five (35) feet in height and when the roof and floors are designed so as to impart no lateral thrust.

2. Penthouse and Roof Structures. Masonry walls above roof level, twelve (12) feet or less in height, enclosing stairways, machinery rooms, shafts or penthouses, may be considered as neither increasing the height nor requiring any increase in the thickness of the wall below.

(c) Non-Bearing Walls and Partitions. Shall be designed to carry their own weight and superimposed finish. When resisting any lateral forces, they shall be designed as panels.
(d) Change in Thickness. Except for properly supported panels, permissible chases and recesses or when designed for engineering reasons, walls shall not vary in thickness between their lateral supports. 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) Decrease in Thickness. Where masonry walls of hollow units are decreased in thickness, a course or courses of solid masonry shall be interposed between the wall below and the thinner wall above, or special units or construction shall be used that will adequately transmit the loads from the shells above to those below.

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

(g) Supported Members. Beams, joists, girders, or other concentrated loads supported by a wall or pier shall have adequate bearing upon a minimum of eight (8) inches of solid masonry or upon a bearing plate of adequate design and dimensions to distribute the loads safely on the wall or pier.

(h) Support. Masonry shall not be supported on combustible construction.

(i) Anchorage. (See also other construction materials in Chapters 23, 25, 26, 27, 29, 31 and etc.

1. Masonry walls that meet or intersect shall be securely bonded or anchored to each other.

2. Structural members, joist and lintels framing into or supported by walls or columns shall be properly anchored to these walls or columns.

3. Masonry walls supported by structural members or masonry used for enclosing structural members shall be anchored to these members with properly designed, non-corrosive type anchors.

4. Roof and floor structures shall be properly anchored to load-bearing masonry walls and conform to the requirements of Chapter 23 of this Building Code.

(j) Piers of Unit Masonry.

1. The unsupported height of isolated piers shall not exceed ten (10) times their least dimension unless reinforced as required in Section 2419. Piers shall be laid up in Type M, S or N mortar.

2. Walls two (2) feet or less in width shall be computed and constructed as isolated piers.

3. Piers, columns, or pilasters shall be provided under concentrated loads that exceed the allowable design loads of the walls.

(k) 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 (4) inches.

(l) 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-E.

(m) Masonry Panels. The thickness of panels shall be adequate to resist the forces of wind and other horizontal forces from adjacent members and transmit these forces to their supporting elements.

(n) Allowable Stresses. The maximum permitted working stresses for all types of unreinforced masonry shall not exceed the value set forth in Table No. 24-F unless the ultimate compressive strength (f' m) is determined by tests according to Section 2419 (b) 2 and 3 and is approved by the Department. See also Section 2419 (e) 6-8 and Chapter 23 for increased allowable stresses due to wind and earthquake forces.

(o) Special Uses. Where standard manufactured or special-designed masonry units are used as either solid or perforated walls for solar screening or decorative purposes, they shall conform to all of the requirements of this Chapter and shall be designed to resist all of the forces and loads imposed upon them by the particular design use.

Section 2410. PLAIN SOLID MASONRY

(a) General. Plain solid masonry is that form of construction made with brick, solid concrete masonry units, or stone in which the units are all laid and set in mortar. Load bearing or exterior plain solid masonry shall be laid up in Type M, S or N mortar.

(b) Construction.

1. Solid masonry shall be laid with all joints solidly filled with mortar. At the time of laying, burned clay units and sand lime units shall have an initial rate of absorption not exceeding 0.025
ounces per square inch per minute as determined by the requirements of Section 2425 (a) 25.

2. Where a wall is more than one wythe in thickness, the wythes shall be anchored together using one of the following methods:

A. Bonding with Headers. Where the separate wythes are bonded by means of masonry headers, no less than 4 per cent of the wall surface of each face shall be composed of headers extending at least four (4) inches into the backing. The distance between adjacent full-length headers shall not exceed twenty-four (24) inches either vertically or horizontally. In walls in which a single header course does not extend through the wall, bonders from the opposite sides shall lap at least four (4) inches, or bonders from opposite sides shall be covered with another bonder course overlapping the bonder below at least four (4) inches.

B. Bonding With Metal Ties. In lieu of masonry headers the separate wythes of solid masonry walls shall be bonded together with corrosion-resistant metal ties conforming to the requirements in Section 2413 (b) 1, or with other metal ties of equivalent strength and stiffness embedded in the horizontal joints.

Longitudinal joint (ladder type) reinforcement shall be prefabricated from No. 9 or larger gage cold-drawn steel wire and shall consist of two or more parallel, deformed, longitudinal wires with weld connected cross wires. Where the longitudinal collar joint between the metal-tied wythes is not completely filled with mortar, metal-tied walls shall conform to the allowable stress, lateral support and other requirements for cavity walls.

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

EXCEPTION: In one-story dwellings where eight (8) inch masonry walls are used, one-half (1/2) inch corbeling shall be permitted, and the maximum projection shall not exceed two (2) inches.

(d) Allowable Stresses. The allowable working stresses in plain solid masonry shall conform to Section 2409 (n) except that when fm is determined by tests as required in Section 2419 (b) 2, fm shall equal .20 f'm.

Section 2411. GROUTED BRICK MASONRY

(a) General. Grouted brick masonry is that form of construction made with brick or solid concrete units in which interior joints of the masonry are completely filled with grout.

(b) Low-lift Grouted Construction. Requirements for construction shall be as follows:

1. All units in the two outer tiers shall be laid with full shoved head and bed mortar joints. Masonry headers shall not project into the grout space.

2. All longitudinal vertical joints shall be grouted and shall be not less than three-fourths (¾) inch in thickness. In members of three or more tiers in thickness, interior bricks shall be embedded into the grout so that at least three-fourths (¾) inch of grout surrounds the sides and ends of each unit. All grout shall be puddled with a grout stick immediately after pouring.

3. One exterior tier may be carried up sixteen (16) inches before grouting, but the exterior tier shall be laid up and grouted in lifts not to exceed six times the width of the grout space with a maximum of eight (8) inches whichever is greater.

4. If the work is stopped for one hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation and with the grout one and one-half (1½) inch below the top.

(c) High-Lift Grouted Construction.

1. All units in the two tiers shall be laid with full head and bed joints.

2. The two tiers shall be bonded together with wall ties. Ties shall be at least No. 9 wire in the form of rectangles four (4) inches wide by two (2) inches less in length than the over-all wall thickness. Kinks, water drips or deformations shall
not be permitted in the ties. One tier of the wall shall be built up not more than sixteen (16) inches ahead of the other tier. Ties shall be laid not to exceed twenty-four (24) inches on center horizontally and sixteen (16) inches on center vertically for running bond and not more than twenty-four (24) inches on center horizontally and twelve (12) inches on center vertically for stack bond.

3. Cleanouts shall be provided for each pour by leaving out every other unit in the bottom tier of the section being poured. During the work a high pressure jet stream of water shall be used to remove mortar fins and any other foreign matter from the grout space. The cleanout shall be sealed after inspection and before grouting.

4. The grout space (longitudinal vertical joint) shall be at least two (2) inches in width and shall be filled solidly with grout.

5. Vertical grout barriers or dams shall be built of solid masonry across the grout space the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall not be more than twenty-five (25) feet apart.

6. Grout shall be a plastic mortar or concrete mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by an approved alternate method and shall be placed before any initial set occurs and in no case more than one and one-half hours after water has been added.

7. Grouting shall be done in a continuous pour, in lifts not exceeding four (4) feet with a maximum total pour of twelve (12) feet. It shall be consolidated between lifts by puddling, rodding or mechanical vibrating during placing and reconsolidated after excess moisture has been absorbed but before plasticity is lost. The grouting of any section of a wall between control barriers shall be completed in one day with no interruptions greater than one hour.

(d) Sizes of Grout Aggregate for Varying Core Dimensions. Where the minimum clear opening of an unobstructed vertical grout core is two (2) inches or less in both horizontal and vertical dimensions, mortar grout shall be used. When this grout core is two (2) inches to six inches wide, pea gravel grout shall be used and when greater than six (6) inches, concrete grout shall be used.

(e) Facing of Grouted Masonry Construction. Facing of grouted masonry construction need be neither mechanically bonded nor anchored, provided the bond of grout to the facing unit and backing develop a strength in shear of at least fifty (50) pounds per square inch.

(f) Allowable Stresses. The allowable working stresses in grouted brick masonry shall conform to Section 2409 (n), except that when $f_m$ is determined by tests $f_m$ shall be equal to $0.20 f_m$.

Section 2412. 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 M, S, or N 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 with a continuous bond course at vertical intervals not exceeding twenty-four (24) inches by lapping at least four (4) inches over the unit below or by lapping with a continuous course of units at least fifty per cent (50%) greater in thickness than the units below at vertical intervals not exceeding seventeen (17) inches or by bonding with corrosion-resistant metal ties conforming to the requirements for cavity walls. There shall be one metal tie for not more than each four and one-half (4 ½) square feet of wall area. Ties in alternate courses shall be staggered, and the maximum vertical distance between ties shall not exceed eighteen (18) inches, and the maximum horizontal distance shall not exceed thirty-six inches (36"). Walls bonded with metal ties shall conform to the requirements for allowable stress, lateral support, thickness (excluding cavity), height, and mortar for cavity walls. See also Section 2409 (e).

(c) Stresses. The allowable working stresses in hollow unit masonry shall conform to Section 2409 (n), except that when $f'_m$ is determined by tests $f'_m$ shall be equal to $0.10 f'_m$.
(d) Grouted Hollow Unit Masonry. (Filled cell construction). In walls of hollow unit masonry, structural members may be built by filling continuous unobstructed vertical cores or spaces with concrete or grout. The minimum continuous clear dimensions of vertical cores shall be two (2) inches by three (3) inches in plan. Such members shall be designed as specified for unreinforced masonry including Section 2403 and for unreinforced concrete (Chapter 26). 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. The value of $f_m$ may be assumed as provided in Table 24-K or the value of $f_m$ may be determined by tests as provided in Section 2419 (b) 2 and 3. The cells shall be solidly filled with the concrete or grout on which the design is based. In filling vertical cores, the grout pour shall not exceed four (4) feet in height unless cleanouts are left open at the bottom masonry course of each core to be grouted and such cleanouts closed only after inspection of the core space. The maximum height of a grout pour shall be eight (8) feet.

Section 2413. 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 M, S or N mortar shall be used in cavity wall masonry.

(b) Construction.

1. Neither the facing nor the backing of cavity walls shall be less than four (4) inches in nominal thickness and the cavity shall be at least two (2) inches and not more than three (3) inches in width. The facing and backing of cavity walls shall be tied together with non-corrosive bonding ties consisting of at least one three-sixteenths (3/16) inch diameter steel rod or metal ties of equivalent strength and stiffness for each four and one-half (4½) square feet 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 at least two (2) inches long. Ties in alternate courses shall be staggered and the maximum distance between ties shall not exceed eighteen (18) inches vertically or thirty-six (36) inches horizontally. Additional bonding ties shall be placed around the perimeter of all openings and shall be spaced not more than three (3) feet apart and within one (1) foot of the opening.

EXCEPTION: When the facing and backing of a cavity wall is composed of masonry units having a compressive strength of at least 2500 psi, gross area, the cavity may be increased to a nominal four (4) inches in width, but the net cross-sectional area of wall ties shall be increased 25%.

2. In exterior cavity walls, weepholes or open vertical head joints approximately three (3) feet on center, shall be provided at the base of the cavity.

3. The maximum height of a cavity wall shall be determined by Table 24-D.

(c) Stresses. The allowable working stresses in cavity wall construction shall conform to Section 2409 (n), except that when $f_m$ is determined by tests, $f_m$ shall be equal to .10$f_m$. The allowable compressive stresses for cavity walls in Table 24-F are based on the assumption that the floor loads bear upon but one of the two wythes. When cavity walls are loaded concentrically, the allowable stresses may be increased 25 per cent.

(d) Masonry Bonded Hollow Walls. In masonry bonded hollow walls, the masonry bonding units connecting the facing and backing shall be spaced as required in Section 2410 (b) 4A and 2413 (b-3.), except that bonding units having compressive strength of at least 4500 psi gross area may be placed not more than twenty-four (24) inches apart in either direction, but not less than 2 per cent of the wall area shall be composed of bonders.

Section 2414. 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 Type M or S mortar, with all joints thoroughly filled. Walls of rubble stone masonry shall be at least four (4) inches greater in thickness than specified for ashlar stone masonry in Table 24-D.

(b) Construction. In ashlar masonry, bond stones uniformly distributed shall be provided to the extent of not less than 10 per cent of the area of exposed facets. Rubble stone masonry twenty-four (24) inches or less in thickness shall have bond stones with a maximum
spacing of three (3) feet vertically and three (3) feet horizontally, and if the masonry is of greater thickness than twenty-four (24) inches, shall have one bond stone for each six (6) square feet of wall surface on both sides.

(c) Minimum Thickness. Load bearing stone wall shall in no case have a minimum thickness of less than sixteen (16) inches.

(d) Stresses. The allowable working stresses in stone masonry construction shall conform to Section 2409 (n), except that when \( f_m \) is determined by tests, \( f_m \) shall be equal to \( 0.10f_m \).

Section 2415. 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 or continuous wetting.

(b) Construction. All units in gypsum masonry shall be placed with cells horizontal and the bonding of units in such masonry shall comply with the requirements for bonding of hollow unit masonry as specified in Section 2412 (b). The entire bearing surface of every unit shall be covered with mortar and all joints shall be filled with mortar.

(c) Stresses. The allowable compressive unit working stresses for designing gypsum masonry to carry its own weight shall not exceed 20 psi.

Section 2416. REINFORCED GYPSUM

(a) General.

1. Reinforced gypsum shall consist of a mixture of gypsum with or without wood chips, shavings, or fiber, or other approved aggregates, premixed at the mill, with only water added at the job. Reinforced gypsum shall not be used in any bearing wall, or where exposed directly to the weather, or where subject to frequent or continuous wetting.

Section 2417. GLASS MASONRY

(a) General. Masonry of glass blocks may be used in nonload-bearing wall construction, provided the mortared surfaces of the blocks are treated for mortar bonding. Glass block may be used in load-bearing walls if their weakening effect is accounted for in the structural design.

(b) Horizontal Forces. The block shall be restrained laterally by an approved mechanical device capable of resisting the horizontal forces specified in Chapter 23.

(c) Maximum Size of Panels. Panels of glass block masonry shall not exceed fifteen (15) feet in any dimension or one hundred forty-four (144) square feet in area of unsupported wall surface, unless reinforced in an approved manner.

(d) Mortar. Glass block shall be laid in Type S mortar. Both vertical and horizontal mortar joints shall be at least one-fourth (1/4) inch and not more than three-eighths (3/8) inch thick and shall be completely filled.

(e) Expansion Joints. Every glass block panel shall be provided with one-half (1/2) inch expansion joints between the edges of the panel, the jambs and head. Expansion joints shall be entirely free of mortar, and shall be filled with resilient material.

Section 2418. FACED WALLS

(a) Materials. Materials used in the backing and facing of faced walls shall conform in all aspects to Section 2407. The facing shall be at least two (2) inches thick, and in no case less in thickness than one-eighth (1/8) the height of the unit.

Permitted Stresses. The stresses in faced walls shall not exceed the permitted 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 2410 (b) 2, 2411, 2412, and 2414 for the applicable facing and backing material, the full cross section of both the facing and the backing may be considered the wall thickness 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.

Section 2419. REINFORCED MASONRY (Except Reinforced Gypsum)

(a) Materials.

1. Masonry units shall be clean, whole, and free of cracks that would impair the structural strength of the unit at time of laying and shall conform to Section 2407.

2. Second-hand or used materials shall not be used in reinforced masonry.
3. Reinforcement shall conform to Section 2425 and applicable sections of Chapter 26.

4. Cementitious materials for reinforced masonry shall conform to the requirements of Section 2407 (j) and Section 2408 except that:

A. Mortar shall consist of a thorough mixture of cementitious materials and fine aggregates brought to a plastic state by adding the maximum amount of water consistent with good workability. Mortar proportions are by volume and are based on damp, loose measure of sand. Mortar shall be composed of one part portland cement, ¼ to ½ parts hydrated lime or lime putty, and fine aggregate consisting of 2½ to 3 times the sum of the separate volumes of the cementitious materials used.

B. Grout Proportions—See also Section 2402 — Definitions. Grout proportions are by volume and are based on damp, loose measure of sand and gravel. Grout shall be of Type MG or PG, or high-lift grout proportioned as follows: MG grout shall be composed of 1 part portland cement, not more than ¼ part hydrated lime or lime putty, and fine aggregate consisting of 2½ to 3 times the sum of the separate volumes of the cement and the lime used.

PG grout shall be composed of 1 part portland cement, not more than ¼ part hydrated lime or lime putty and 2 to 3 parts fine aggregate and 1 to 2 parts coarse aggregate.

High-Lift Grout shall be composed of 1 part portland cement, 2 to 3 parts fine aggregate and not more than 2 parts well graded coarse aggregate, the size of which to be determined by the grout core. The minimum cement content shall be 8 sacks per cubic yard.

Method of Measuring Materials—The method of measuring materials for the mortar used in construction shall be such that the specified proportions of the mortar materials can be controlled and accurately maintained.

(b) Allowable Working Stresses.

1. Masonry Strength. For the design of reinforced masonry structures, the value of f’m used for determining the allowable stresses as stipulated in Table 24-L shall be based on a specified minimum 28-day compressive strength of the masonry or on the specified minimum compressive strength at the earlier age at which the masonry may be expected to receive its full load. All plans and drawings shall clearly indicate the assumed strength of masonry at the specified age for which all parts of the structure were designed.

2. Determination of Masonry Strength.

A. Solid Masonry. The determination of the compressive strength of solid masonry (f’m) shall be made by one of the following methods:

When the compressive strength of the solid masonry is to be established by preliminary tests, the tests shall be made in advance of the operations using prisms built of similar materials under the same conditions and, insofar as possible, with the same bonding arrangement and joint thickness as for the structure. In building the prisms, the moisture content of the unit at time of laying, the consistency of the mortar and the workmanship shall be the same as will be used in the structure. The test prisms for beams and slabs shall be built of representative units, with their long dimension horizontal, or with the same bonding arrangement as the intended use.

All specimens shall have a height-to-thickness ratio (h/d) of not less than 2 and shall be not less than 8 inches in height. If h/d dif-
fers from 2, the value of f'm shall be taken as the compressive strength of the specimens multiplied by a correction factor as indicated in Table 24-J.

Masonry strength (f'm) shall be computed by dividing the maximum load by the gross area of the masonry units used in construction of the prisms.

When the compressive strength of the solid masonry is not determined by preliminary tests and the units, mortar, and workmanship conform to all applicable requirements of these regulations, the allowable stresses may be based upon an assumed value of f'm given in Table 24-K.

3. Tests of Masonry Prisms.

A. Test prisms shall be constructed as prescribed in 2419 (b) and shall be stored for seven days in air, at a temperature not less than 70° Fahrenheit, plus or minus 5° Fahrenheit, in a relative humidity exceeding 90 per cent and then in air at 70 degrees, plus or minus 5 degrees at a relative humidity of 30 per cent to 50 per cent until tested. The prism shall be capped and tested in accordance with the relevant provisions of the Standard Method of Test for Compressive Strength of Molded Concrete Cylinders, Section 2425 (a) 38.

B. Not less than three specimens shall be made for each preliminary test to establish f'm and not less than three shall be made for each field test to confirm that the materials are as assumed in the design, when required.

C. The standard age of test specimens shall be 28 days but 7-day tests may be used, provided the relation between the 7 and 28 day strengths of the masonry is established by test for the materials used as required in Section 2425 (a) 49—paragraph 504.

4. Allowable Stresses in Reinforced Masonry.

A. The allowable stresses in reinforced masonry shall not exceed the values shown in Table 24-L.

B. In composite walls or other structural members composed of different kinds or grades of units the maximum stress shall
not exceed the allowable stress for the weakest unit of the combination of which the member is composed.

5. Allowable Stress in Reinforcement. Unless otherwise provided in this Chapter, the stresses in reinforcement shall not exceed the requirements for the “Allowable Stresses in Reinforcement” of Section 2425 (a) 49 of this Chapter.

(c) Masonry Construction.

1. General. Unless otherwise required in this Chapter, construction practices shall be as required in Section 2425 (a) 48 and 2425 (a) 25 of this Chapter.

2. Mortar and Grout. Mortar and grout consistency, retempering, brick pieces embedded in grout spaces, and grout core versus aggregate size shall be as required in Section 2425 (a) 48, Section 2419 (a) 4, and Section 2411 (d) of this Chapter.


A. General. Reinforced grouted masonry shall conform to all of the requirements for grouted masonry specified in Section 2411 and also the requirements of this Section.

B. Joint Thickness. Joint thickness shall be as required in Section 2419 (d) 3 of this Chapter.

C. Stresses. See Section 2419 (b) 4 and 5.

4. Reinforced Grouted Hollow Unit Masonry.

A. General. Reinforced grouted hollow unit masonry shall conform to all requirements for grouted hollow unit masonry specified in Section 2412 (d) and also requirements of this Section.

B. All vertical cores and horizontal beams containing reinforcement shall be solidly filled with grout.

C. In filling vertical cores, the cleanouts shall be closed only after setting and properly attaching the vertical reinforcement in its fixed positions and after inspection of the core space and the reinforcement therein. The maximum total height of grout pour shall be eight (8) feet.

D. Horizontal beams shall be constructed and grouted as required in paragraph 6.5 in Section 2425 (a) 48 of this Chapter.

E. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

F. The grout shall be consolidated at the time of pouring by puddling and rodding or vibrating to insure complete filling of the core; and reconsolidated later before plasticity is lost. When grouting is stopped for 1 hour or longer, the grout pour shall be stopped 1 ½ inches below the top of a masonry unit.

G. Shrinkage and Temperature Reinforcement. Such reinforcement normal to the principal reinforcement shall conform to the requirements of Chapter 26 (Concrete) of this Building Code for concrete masonry units and Section 2419 (g) 8-E of this Chapter for clay masonry units.

(d) Details of Construction.

1. General. Unless otherwise required in this Chapter, construction details, design of forms, removal of forms and embedment of pipes and conduit shall conform to the requirements of Section 2425 (a) 48 and Section 2425 (a) 49 of this Chapter.

2. Details of Reinforcement. Unless otherwise required in this Chapter, placement of reinforcement, cleaning of reinforcement, spacing of bars, splices in reinforcement, hooks and bends of reinforcement, lateral reinforcement, and thickness of masonry coverage for the
The requirements and formulas set forth in this section are based on the accepted straight-line theory of elastic design acting within the range of the working stresses. The design of reinforced masonry is analogous to that of reinforced concrete; therefore, formulas used in the calculation of stresses, deflections and sizes of reinforced concrete flexural members in Chapter 26 (Concrete) of this Building Code including designs based on ultimate strength may be used for similar reinforced masonry members when not already covered by the requirements and design criteria of this Chapter.

A. The requirements and formulas set forth in this section are based on the accepted straight-line theory of elastic design acting within the range of the working stresses. The design of reinforced masonry is analogous to that of reinforced concrete; therefore, formulas used in the calculation of stresses, deflections and sizes of reinforced concrete flexural members in Chapter 26 (Concrete) of this Building Code including designs based on ultimate strength may be used for similar reinforced masonry members when not already covered by the requirements and design criteria of this Chapter.

B. For the design of reinforced masonry members any one of the following methods may be used:

1. The design is based on a transformed section in which the masonry as well as the steel is transformed into an equivalent area of concrete having the same strength and elastic properties as the concrete grout used to fill the core and conforming to the requirements of Chapter 26 (Concrete) of this Building Code.

2. The design is based on taking the composite masonry and concrete portion of the section as equivalent to a homogeneous section of concrete with an ultimate strength equal to the compressive strength of the masonry and conforming to the requirements of this Section.

3. The design neglects the masonry portion of the section, in which case the strength of the member is based on the area and strength of the reinforced core alone and conforms to the requirements of Chapter 26 (Concrete) of this Building Code.
2. Notations. (See also Section 2419 (g) 1 this Chapter.

a Angle between inclined web bars and axis of beam, degrees.

$A_s$ Area of steel reinforcement, square inches.

$A'_{s}$ Area of compressive steel reinforcement in flexural members, square inches.

$A_y$ Total area of web reinforcement in tension within a distance of $s$ (measured in a direction parallel to that of the main reinforcement), or the total area of all bars bent up in any one plane, square inches.

b Width of rectangular flexural member or width of flange for T and I sections, inches.

$b'$ Width of web in T and I flexural members. For hollow masonry, width is equal to width of filled core area plus the thickness of adjacent webs, inches.

d Depth from compression face of beam or slab to center of longitudinal tensile reinforcement; the least lateral dimension of a prism, inches.

d' Distance from extreme compressive fiber to compressive reinforcement— inches.

$E_m$ Modulus of elasticity of masonry in compression, p.s.i.

$E_s$ Modulus of elasticity of reinforcement, p.s.i.

$f_m$ Allowable compressive stress in extreme fiber of masonry in flexure, p.s.i.

$f'_m$ Ultimate compressive strength of masonry at age of 28 days unless otherwise specified, p.s.i. (gross area for solid units and net area for hollow units.)

$f_s$ Tensile stress in main reinforcement; nominal allowable stress in reinforcement, p.s.i.

$f'_{s}$ Stress in compressive reinforcement in flexural members p.s.i.

$f_v$ Tensile stress in web reinforcement, p.s.i.

j Ratio of distance between centroid of compression and centroid of tension to the depth $d$.

k Ratio of distance between extreme compressive fiber and neutral axis to effective depth.

l Clear span for positive moment and the average of the two adjacent clear spans for negative moment, feet.

$M$ External moment, inch pounds.

$M_m$ Moment as governed by masonry, inch pounds.

$M_s$ Moment as governed by reinforcing steel, inch pounds.

$M'_s$ Moment as governed by compression in reinforcing steel, inch pounds.

n Ratio of modulus of elasticity of reinforcement to that of masonry ($E_s/E_m$), assumed as equal to 29,000/$f'_m$

p Ratio of steel reinforcement.

s Spacing of stirrups, parallel to direction of main reinforcement, inches.

u Bond stress, p.s.i.

v Unit shearing stress, p.s.i.

$v_m$ Shearing stress permitted in masonry, p.s.i.

$V$ Total shear, pounds.

$V'$ Excess of the total shear over that permitted in the masonry, pounds.

w Uniformly distributed load per unit of length of beam, lb/ft, or uniformly distributed load per unit length of slab strip 12 inches wide, psf.

$W$ Total uniformly distributed loads, pounds.

$\Sigma$ Sum of perimeters of bars in one set, inches.
3. **Assumptions.** The design of reinforced masonry shall be in accordance with the following principal assumptions:

A. Except in deep beams plane sections before bending remain plane after bending. Fiber strains are directly proportional to their distance from the neutral axis.

B. Compressive stresses in the masonry, mortar and grout, and tensile and/or compressive stresses in the steel (or in unreinforced masonry) are directly proportional to the strains.

C. The bond between the various elements is such that they will work together as a homogeneous material within the range of working stresses.

D. The modulus of elasticity of the masonry, mortar and grout is constant throughout the member within the working stresses.

E. Stress in a reinforcing bar is assumed uniform over its area.

F. The member is straight and of uniform cross-section, or proper consideration shall be made for curving or haunching.

G. External forces are in equilibrium.

H. In reinforced portions of a member, the masonry carries no tensile stress.

4. **Design Loads.** The provisions for design herein specified are based on the assumption that all structures shall be designed for all dead and live loads to which they may reasonably be expected to be subjected with such reductions for structural members as are permitted.

5. **Allowable Reduction of Bending Stresses by Vertical Load.** In calculating maximum tensile fiber stress due to lateral forces other than earthquake forces, the maximum tensile fiber stress may be reduced by not more than 50 per cent of the direct stress due to vertical dead loads.

6. **Resistance to Wind, Blast, and Earthquake Forces.** (See Chapter 23).

A. The moments, shears and direct stresses resulting from wind, blast, or earthquake forces determined in accordance with recognized methods shall be added to the maximum stresses which exist at any section for dead and live loads. Real live loads here refers to loads which are called live loads in the design but which actually have a degree of permanence, such as storage loads, where it may be assumed that one-half of the load is always present on the structure, and thus probably present when the earthquake occurs. Normal roof live load other than snow need not be considered as occurring with wind, earthquake, or blast.

B. For stresses due to wind, blast, or earthquake combined with dead and live loads, the allowable stresses may be increased 33 1/3 per cent, provided the strength of the section thus formed is not less than that required for dead and live loads alone.

C. Wind, blast, and earthquake stresses may be assumed never to occur simultaneously.

7. **Concentrated Load.** For calculating wall stresses, vertical concentrated loads may be assumed to be distributed over a length of wall not exceeding the center to center distance between loads of the wall measured from the floor to the bearing plate. Concentrated loads shall not be assumed distributed across a continuous vertical joint, such as in stack bond, unless reinforced elements are designed to distribute the loads. In walls laid in running bond, where there is no distributing member under the load, the length of wall considered as supporting a concentrated load should not exceed the width of bearing plus four times the wall thickness. See also Section 2409 (g).
(f) Flexural Computations

1. Design-Frame Analysis

A. All members shall be designed to resist at all sections the maximum bending moment and shears produced by dead load, live load, and other forces, as determined by the principle of continuity, elasticity, and relative rigidity, subject to the requirements of Paragraph 905 of Section 2425 (a) 49 of this Building Code.

**EXCEPTION:** Where the larger of the two adjacent spans does not exceed the shorter by more than 20 per cent and loads are uniformly distributed and the live load does not exceed three times the dead load, the moments and shears coefficients for beams and girders as stated in Section 2425 (a) 49 Paragraph 904 may be used.

B. Span Length. The span length of freely supported beams shall be the clear span. In the application of the principle of continuity, center-to-center distances may be used in the basic moment determination of all members. Moments actually prevailing at the faces of support shall be used for the design of beams and girders at such points.

C. Effective Depth. The depth (d) of the beam or slab shall be taken as the distance from the centroid of the tensile reinforcement to the compression face.

D. Distance Between Lateral Supports. The clear distance between lateral supports of a beam shall not exceed 50 times the least width of compression flange.

E. Anchorage of Compression Steel. Compression steel in beams or girders shall be anchored by ties or stirrups at least one-fourth (¼) inch in diameter, spaced not farther apart than 16-bar diameters or 48-tie diameters. Such ties or stirrups shall be used throughout the distance where compression steel is required.

F. Effective Width. In computing flexural stresses where reinforcement occurs, the effective width shall not be greater than four times the wall thickness in solid masonry, nor more than the width of the solidly filled section plus the length of the masonry unit but not to exceed four times the wall thickness in hollow masonry.

G. Deflection. When spans are long relative to the depth they shall be checked for deflection by using standard deflection formulas. See also paragraph 909 in Section 2425 (a) 49 of this Building Code.

H. Deep Beams. Beams with depth to span ratios greater than 1 to 3 shall be designed as deep beams taking account of nonlinear distribution of stress, lateral buckling, and other pertinent effects.

I. Flexural Formula.

\[
M_m = \frac{1}{2} f_m j k b d^2 \quad j = \frac{1 - k}{3} \\
M_s = A_s f_s j d \\
n = \frac{E_b}{E_m} \\
p = A_s / b d \\
A's = M_s / (d - d') f_s (n - 1) / n
\]

2. Combined Axial and Flexural Stresses. Members subject to combined axial and flexural stresses shall be so proportioned that the quantity

\[
\frac{f_a}{F_a} + \frac{f_m}{F_m}
\]

shall not exceed 1

where \( f_a \) = computed axial stress = total axial load/area.

\( F_a \) = Allowable axial stress permitted by this standard at point under consideration if member were carrying axial load only, including any increase in stress allowed by Section 2419 (e) 6.

\( F_m \) = Computed flexural stress.
Allowable flexural stress permitted if member were carrying bending load only, including any increase in stress allowed by Section 2419 (e) 5 and 6. The bending moments due to eccentric loads and end conditions shall be determined as for rigid frames or other forms of continuous structures. Where e/t is less than 1/3, the design may be based on the uncracked section.

3. Shear and Diagonal Tension.

A. Shearing Stress. The shearing stress, \( v \), as a measure of diagonal tension in reinforced masonry flexural members, shall be computed by the following formula:

\[
v = \frac{V}{bd}
\]

except for members of I or T section, where \( b' \) shall be substituted for \( b \).

When the value of the computed shearing stress including effects of torsion exceeds the shearing stress, \( v_m \), permitted on the masonry of an unreinforced web, web reinforcement shall be provided to carry the excess. When the total shear (\( v \)) exceeds 100 p.s.i., web reinforcement shall be designed to carry the entire shear. Such reinforcement shall be provided for a distance equal to the depth, \( d \), of the member, beyond the point theoretically required.

Where continuous or restrained members are so constructed as not to provide T-beam or equivalent action, the following provisions shall apply: Web reinforcement shall be provided sufficient to carry the shearing stress in excess of 20 psi at any section from the support to a point beyond the point of inflection for a distance equal to 1/16 the clear span or the depth of the member, whichever is greater. Web reinforcement shall be provided sufficient to carry the shearing stress in excess of 20 psi at any section in which there is negative reinforcement.

B. Types of Web Reinforcement. Web reinforcement may consist of:

1. Bars (stirrups) perpendicular to the longitudinal reinforcement.
2. Bars (stirrups) welded or otherwise rigidly attached to the longitudinal reinforcement and making an angle of 45° or more thereto.
3. Longitudinal bars bent so that the axis of the inclined portion of the bar makes an angle of 30° or more with the axis of the longitudinal portion of the bar.
4. Special arrangements of bars shall be made with adequate provisions to prevent slip of bars or splitting of the masonry by the reinforcement.

C. Stirrups. The area and spacing of steel required in stirrups placed perpendicular to the longitudinal reinforcement shall be computed by the following formula:

\[
A_v = \frac{V'}{s} \frac{f_v}{f_mbd}
\]

Inclined stirrups shall be proportioned by the formula in Section 2419 (f) 3-D.

D. Bent Bars. Only the center three-fourths (\( \frac{3}{4} \)) of the inclined portion of bent bars shall be considered effective as web reinforcement. When the web reinforcement consists of a single bent bar or of a single group of bent bars, the required area of such bar or bars shall be computed by the following formula, provided \( V' \) shall not exceed 0.035 \( f_m \)bd:

\[
A_v = \frac{V'}{f_v \sin a}
\]
Where there is a series of parallel bent bars, the required area shall be determined by the following formula:

$$A_v = \frac{V_v}{f_y d (\sin a + \cos a)}$$

E. Spacing of Web Reinforcement. Where web reinforcement is required, it shall be so spaced that every 45° line (representing a potential crack) extending from the middepth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement.

F. Anchorage of Web Reinforcement for Hooks. Adequate anchorage of stirrups and other types of web reinforcement shall be as provided for in Section 8.8.3 and Section 8.8.4 of Section 2425 (a) of this Building Code or in Chapters 8 and 9 of Section 2425 (a) 49 of this Building Code except that any mechanical device capable of developing the strength of the bar without damage to the masonry may be used in lieu of a hook. Tests must be presented to show the adequacy of such devices.

4. Bond and Anchorage.

A. Computation of Bond Stress in Beams. In flexural members in which tensile reinforcement is parallel to the compressive face, the bond stress, \( u \), shall be computed by the following formula:

$$u = \frac{V}{\leq \text{ojd}}$$

in which \( V \) = total external shear at the section.

B. Anchorage Requirements. Adequate anchorage shall be provided for the tension reinforcement in all flexural members as required in Section 8.8.2 (Anchorage Requirements) of Section 2425 (a) 48 of this Chapter or in Chapters 9 and 13 of Section 2425 (a) 49 of this Chapter.

(g) Reinforced Masonry Columns and Walls.

1. Notations. (See also Section 2419 (e) 2 of this Chapter.)

A. The overall or gross area of a reinforced masonry column or wall of solid masonry units or solidly filled hollow masonry units. In walls of reinforced hollow masonry construction, \( A_g \) equals the net cross-sectional area in bearing (area bedded in mortar plus area of cavities filled with grout or mortar), square inches.

E. Eccentricity of the resultant load on a column measured from the gravity axis, inches.

h. Unsupported height of column or wall, inches.

h' Effective clear height of column or wall, inches.

\( p_g \) Ratio of the effective cross-sectional area of vertical reinforcement (\( A_S \)) to the gross area, \( (A_g) \).

P. Total allowable axial load on a column, \( h/t \leq 10 \) or less, in pounds.

P'. Total allowable axial load on a column, \( h/t > 10 \), in pounds.

t. Least lateral dimension of a column section or thickness of wall, inches.

2. Minimum Dimensions of Columns. Reinforced masonry columns shall have a minimum nominal dimension of twelve (12) inches and a maximum unsupported height of 25 times their least dimension.

EXCEPTIONS:

A) When minor columns do not support concentrated floor or roof loads or when stressed to less than \( \frac{1}{2} \) of their allowable stress, these columns may have a minimum thickness of eight (8) inches.
b) The limits on height or length to thickness ratios and minimum thickness may be waived when compliance is made with the provisions of Section 2400 and 2409 (a).

3. Permissible Load on Columns.

The maximum allowable axial load, P and P' on properly tied (See 2419 (g) 5) reinforced masonry columns shall be that calculated by:

\[ P = A_g (0.18 \, f_m + 0.65 \, f_s \, P_g) \]
\[ P' = A_g (0.18 \, f_m + 0.65 \, f_s \, P_g) \left[1 - \left(\frac{h'}{30t}\right)^3\right] \]

The \( h' \) for the above equation is the effective clear height which is related to the actual clear unsupported height as follows:

\( h' = 1.0 \, h \) for pin ended columns
\( h' = 0.5 \, h \) for fixed ended columns
\( h' = 0.75 \, h \) for column fixed one end, pinned at other (normal column condition)
\( h' = 2.00 \, h \) for cantilever column
\( h' = 1.8 \) for cantilever column guided at top.

The actual clear unsupported height \( h \), of reinforced masonry shall be taken as not less than the clear distance between the floor surface and the under side of the deeper beam framing into the column in each direction at the next higher floor level.


A. Vertical reinforcement should be a minimum of \( \frac{1}{2} \) of 1 percent and a maximum of 4 percent of the gross cross-sectional area of the column. Columns which are stressed to less than \( \frac{1}{2} \) of their allowable stress may have their reinforcement reduced to not less than 1/5 of 1 percent. In all cases the reinforcement of columns shall be not less than 4 bars of \( \frac{3}{8} \) inch minimum diameter. The column reinforcement shall be held firmly in its designed position.

B. Splices in Reinforcement.

Where lapped splices are used the amount of lap shall be sufficient to transfer the allowable stress by bond but in no case shall the length of lapped splice be less than 24-bar diameter or 12 inches. Welded splices shall develop the full strength of the bar.

5. Lateral Reinforcement of Columns.

Lateral reinforcement shall be ties at least one-fourth (1/4) inches in diameters, shaped as a circle or rectangle. The spacing shall not exceed any one of the following: 16 vertical bar diameters, 48 tie diameter, the least column dimension or sixteen (16) inches. Ties may be placed in the mortar joint or in contact with the vertical steel.


A. Bending moments resulting from eccentric loads and conditions of restraint, as in rigid frames or other forms of continuous construction, shall be considered in the design.

B. Columns shall be designed to resist the axial forces from loads on all floors, plus the maximum bending due to loads on a single adjacent span of the floor under consideration.

C. The resistance to bending at any floor level shall be provided by distributing the moment between the columns immediately above and below the given floor in proportion to their relative stiffness and conditions of restraint.

7. Combined Stresses. Stresses due to combined axial load and bending shall be determined in accordance with Section 2419 (f) 2 "Combined Axial and Flex," except that where \( e/t \) is less than one third (1/3), design may be based on the uncracked section.

8. Reinforced Masonry Walls

A. The maximum allowable load (p) on reinforced masonry bearing walls with minimum reinforce-
ment as required by Section 2419 (g) 8-E shall be 0.20 fm Ag for walls having a ratio height to thickness of 10 or less. Walls having ratios of height to thickness greater than 10 shall be calculated by the formula:

\[ P' = 0.20 \times f_m \left[ 1 - \left( h' / 30t \right)^3 \right] Ag \]

with the same h' values for the typical end condition as for columns in Section 2419 (g) 3.

When the reinforcement in bearing walls is designed, placed, and anchored in position as for columns, the allowable stresses shall be on the basis of Section 2419 (g) 3, as for columns. The length of the wall to be considered as effective for concentrated loads shall not exceed the center-to-center distance between loads, nor shall it exceed the width of the bearing plus four times the wall thickness. Concentrated loads shall not be considered as distributed by metal ties, nor distributed across continuous vertical joints.

B. Walls shall be designed for eccentric loads and for any lateral forces, pressures or shears to which they are subjected. The design shall conform to the requirements of Section 2419 (g) 7.

C. Reinforced masonry bearing walls shall have a nominal thickness of at least six (6) inches and the ratio of unsupported height or length to thickness, whichever is the shorter, shall not exceed 25, (see Table 24-D for other walls), except that: Limits on height-to-thickness ratios of this Section may be waived when written evidence is submitted according to the requirements of Section 2400 and 2409 (a) of this Chapter.

D. Reinforced masonry walls shall be securely anchored to adjacent structural members, such as roofs, floors, columns, pilasters, buttresses, and intersecting walls.

E. Reinforced masonry walls shall be reinforced with an area of steel not less than 0.002 times the cross-sectional area of the wall, not more than two-thirds of which may be used in either direction. The maximum spacing of principal reinforcement shall be not more than six times the wall thickness nor more than forty-eight (48) inches.

F. Horizontal reinforcement shall be provided at the bottom and top of wall openings, at roof and floor levels, and at the top of parapet walls. Only reinforcement which is continuous in the wall shall be considered in computing the minimum area of reinforcement, there shall be not less than one 1/2-inch diameter bar around all window and door openings, which shall extend at least twenty-four (24) inches beyond the corner of the openings.

9. Walls as Grade Beams. Walls designed as grade beams shall have top and bottom reinforcement as required by stresses. Portions exposed above grade shall, in addition, be reinforced with not less than the amount specified in Section 2419 (g) 8.

10. Masonry Walls with Reinforced Integral Columns & Beams. (Hereafter referred to as "Integrally" reinforced masonry.)

A. "Integrally" reinforced masonry is that type of construction that combines reinforced masonry columns and/or beams with reinforced wall areas of masonry. The unreinforced sections shall be designed as for plain masonry. (Sections 2409 through 2418). The reinforced integral members shall be designed as set forth in Section 2419 (g). Reinforced Masonry Columns and Walls and as for beams as in Section 2419 (e) and (f). All flexural tensile stresses shall be resisted by the reinforcement.

B. The minimum area of reinforcement required in Section 2419 (g) 8-E shall not apply to "integ-
grally" reinforced masonry walls shall be determined by the limits of the unreinforced wall areas as set forth in Table 24-D or Section 2409 (a). Reinforcement shall be provided at each side of each opening and at each corner of all walls. Horizontal reinforcement shall be provided at the bottom and top of wall openings, at roof and floor levels, and at the top of parapet walls. When masonry units are laid in stacked bond, horizontal reinforcement consisting of one-fourth (1/4) inch diameter bars placed sixteen (16) inches on center or their equivalent shall be provided.

C. The effective width used in computing flexural stresses of the reinforced "integral" members shall be not greater than four times the wall thickness for solid masonry nor more than the width of the solidly filled section plus the unit length but not to exceed four times the wall thickness in hollow masonry.

Section 2420. TABLES

TABLE 24-A

MAXIMUM ALLOWABLE DEFLECTION

<table>
<thead>
<tr>
<th>Construction</th>
<th>Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cantilever beams and slabs</td>
<td>$L^2/1,800t$</td>
</tr>
<tr>
<td>Simple beams and slabs</td>
<td>$L^4/000t$</td>
</tr>
<tr>
<td>Beams continuous at one support and slabs continuous at one support for the</td>
<td>$L^4/9,000t$</td>
</tr>
<tr>
<td>direction of the principal reinforcement.</td>
<td></td>
</tr>
<tr>
<td>Flat slabs ($L =$ the shorter span)</td>
<td>$L^2/10,000t$</td>
</tr>
<tr>
<td>Beams and slabs continuous at the supports for the direction of the</td>
<td>$L^2/10,000t$</td>
</tr>
<tr>
<td>principal reinforcement.</td>
<td></td>
</tr>
</tbody>
</table>

TABLE 24-B

TYPES OF MORTAR CLASSIFIED BY COMPRESSIVE STRENGTH

<table>
<thead>
<tr>
<th>Mortar Type</th>
<th>Minimum Compressive Strength of 2-inch Cubes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressive Strength at 28 Days, psi</td>
</tr>
<tr>
<td>M</td>
<td>2500</td>
</tr>
<tr>
<td>S</td>
<td>1800</td>
</tr>
<tr>
<td>N</td>
<td>750</td>
</tr>
<tr>
<td>O</td>
<td>350</td>
</tr>
<tr>
<td>K</td>
<td>75</td>
</tr>
</tbody>
</table>
### TABLE NO. 24-C

**TYPES OF MORTAR CLASSIFIED BY PROPORTIONS OF CEMENTITIOUS MATERIALS**
(by volume)

<table>
<thead>
<tr>
<th>Mortar Type</th>
<th>Parts by Volume of Portland Cement or Portland Blast Furnace Slag Cement</th>
<th>Parts by Volume of Masonry Cement</th>
<th>Parts by Volume of Hydrated Lime or Lime Putty</th>
<th>Aggregate, Measured in a Damp, Loose Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>1 (type II)</td>
<td>.</td>
<td>.</td>
<td>Not less than 2½ and not more than 3 times the sum of the volumes of the cements and lime used.</td>
</tr>
<tr>
<td>S</td>
<td>1/2</td>
<td>1 (type II)</td>
<td>.</td>
<td>over 1/4 to 1/2</td>
</tr>
<tr>
<td>N</td>
<td>1</td>
<td>1 (type II)</td>
<td>.</td>
<td>over 1/2 to 1 1/4</td>
</tr>
<tr>
<td>O</td>
<td>1</td>
<td>1 (type I or II)</td>
<td>.</td>
<td>over 1 1/4 to 2 1/2</td>
</tr>
<tr>
<td>K</td>
<td>1</td>
<td></td>
<td>.</td>
<td>over 2 1/2 to 4</td>
</tr>
</tbody>
</table>

### TABLE NO. 24-D

**MINIMUM THICKNESS OF MASONRY WALLS**

<table>
<thead>
<tr>
<th>Type of Masonry</th>
<th>*Maximum Ratio Unsupported Height or Length to Thickness Type M, S or N Mortar</th>
<th>Nominal Minimum Overall Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing Walls:****</td>
<td></td>
<td></td>
</tr>
<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>6</td>
</tr>
<tr>
<td>Hollow Unit Masonry (1)</td>
<td>18</td>
<td>8**</td>
</tr>
<tr>
<td>Masonry Bonded Hollow Walls</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Cavity Wall***</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>Stone Masonry (Ashlar)</td>
<td>14</td>
<td>12</td>
</tr>
<tr>
<td>Non Bearing:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Unreinforced</td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>Exterior Reinforced</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>Interior Partitions</td>
<td>48</td>
<td>2</td>
</tr>
</tbody>
</table>

* See definition—Lateral Support.
** The walls of a one story building may be 6 inches nominal thickness provided the masonry units meet the minimum compressive strength requirement of 2500 psi for the gross area.
*** In computing the ratio for cavity wall, the value for thickness shall be the sum of the nominal thickness of the inner and outer wythe.
**** In computing the ratio where raked joints are used, the value for thickness shall be reduced by the depth of the rake. Joints in hollow unit load bearing walls shall not be raked unless the strength is substantiated by written engineering data. See also Section 2403 for combination of units with dissimilar allowable stresses.
(1) The figures for Hollow Unit Masonry shall be the same for Solid Light Weight Concrete Units.
### TABLE NO. 24-E

**ALLOWABLE SHEAR ON BOLTS**

<table>
<thead>
<tr>
<th>Diameter of Bolt (Inches)</th>
<th>Embedment (Inches)</th>
<th>Shear in Pounds</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Plain Masonry</td>
<td>Grouted Masonry</td>
<td></td>
</tr>
<tr>
<td>½</td>
<td>4</td>
<td>350</td>
<td>550</td>
<td></td>
</tr>
<tr>
<td>⁵⁄₈</td>
<td>4</td>
<td>500</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>¾</td>
<td>5</td>
<td>750</td>
<td>1100</td>
<td></td>
</tr>
<tr>
<td>⁷⁄₈</td>
<td>6</td>
<td>1000</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>1250</td>
<td>1850*</td>
<td></td>
</tr>
<tr>
<td>1 ⁷⁄₈</td>
<td>8</td>
<td>1500</td>
<td>2250*</td>
<td></td>
</tr>
</tbody>
</table>

*Permitted only with not less than 2500 p.s.i. units.*
<table>
<thead>
<tr>
<th>MATERIAL Grade of Unit</th>
<th>TYPE M &amp; S MORTAR</th>
<th>TYPE N MORTAR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compression psi</td>
<td>Tension in Flexure or Shear psi</td>
</tr>
<tr>
<td>Solid Brick Masonry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12,000 psi plus</td>
<td>500</td>
<td>30</td>
</tr>
<tr>
<td>10,000 to 12,000 psi</td>
<td>450</td>
<td>30</td>
</tr>
<tr>
<td>8,000 to 10,000 psi</td>
<td>400</td>
<td>30</td>
</tr>
<tr>
<td>4,500 to 8,000 psi</td>
<td>250</td>
<td>30</td>
</tr>
<tr>
<td>2,500 to 4,500 psi</td>
<td>175</td>
<td>30</td>
</tr>
<tr>
<td>1,500 to 2,500 psi</td>
<td>125</td>
<td>30</td>
</tr>
<tr>
<td>Solid Concrete Unit Masonry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,500 to 4,500 psi</td>
<td>175</td>
<td>12</td>
</tr>
<tr>
<td>Grade B</td>
<td>125</td>
<td>12</td>
</tr>
<tr>
<td>Grouted Masonry and Thru-the-Wall Solid Clay Masonry Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12,000 psi plus</td>
<td>600</td>
<td>36</td>
</tr>
<tr>
<td>10,000 to 12,000 psi</td>
<td>560</td>
<td>36</td>
</tr>
<tr>
<td>8,000 to 10,000 psi</td>
<td>500</td>
<td>36</td>
</tr>
<tr>
<td>4,500 to 8,000 psi</td>
<td>350</td>
<td>36</td>
</tr>
<tr>
<td>2,500 to 4,500 psi</td>
<td>275</td>
<td>36</td>
</tr>
<tr>
<td>1,500 to 2,500 psi</td>
<td>225</td>
<td>36</td>
</tr>
<tr>
<td>Hollow Unit Masonry (a)</td>
<td>85</td>
<td>12a</td>
</tr>
<tr>
<td>Cavity Walls &amp; Masonry Bonded Hollow Walls (a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid Units:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12,000 psi plus</td>
<td>380</td>
<td>15a</td>
</tr>
<tr>
<td>10,000 to 12,000 psi</td>
<td>360</td>
<td>15a</td>
</tr>
<tr>
<td>8,000 to 10,000 psi</td>
<td>320</td>
<td>15a</td>
</tr>
<tr>
<td>4,500 to 8,000 psi</td>
<td>200</td>
<td>15a</td>
</tr>
<tr>
<td>2,500 to 4,500 psi</td>
<td>140</td>
<td>15a</td>
</tr>
<tr>
<td>and Grade A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,500 to 2,500 psi</td>
<td>100</td>
<td>15a</td>
</tr>
<tr>
<td>and Grade B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow Units:</td>
<td>70</td>
<td>12a</td>
</tr>
<tr>
<td>Stone Masonry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast Stone</td>
<td>400</td>
<td>8</td>
</tr>
<tr>
<td>Natural Stone</td>
<td>140</td>
<td>8</td>
</tr>
</tbody>
</table>

(a) Allowable working stress net area in contact with mortar.

(1) Allowable working stresses p.s.i. gross cross-sectional area (except as noted).
TABLE NO. 24-G
MINIMUM ULTIMATE COMPRESSIVE STRENGTH
Reinforced Gypsum

<table>
<thead>
<tr>
<th>CLASS</th>
<th>MIXTURE</th>
<th>COMPRESSION 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>

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>

TABLE NO. 24-I
WEIGHTS OF MATERIALS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland cement</td>
<td>94 lb./ft.$^3$</td>
</tr>
<tr>
<td>Hydrated lime</td>
<td>40 lb./ft.$^3$</td>
</tr>
<tr>
<td>Lime putty a</td>
<td>80 lb./ft.$^3$</td>
</tr>
<tr>
<td>Sand</td>
<td>1 ft.$^3$ of damp, loose sand contains 80 lb. of dry sand</td>
</tr>
</tbody>
</table>

$^a$ All quicklime shall be slaked according to the manufacturer's directions. All quicklime putty, except pulverized quicklime putty, shall be sieved through a No. 20(840-U) sieve and allowed to cool until it has reached a temperature of 80° F.
### TABLE NO. 24-J

<table>
<thead>
<tr>
<th>Ratio of height to thickness (h/d)</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correction factor</td>
<td>0.86</td>
<td>1.00</td>
<td>1.11</td>
<td>1.20</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Factors between those listed shall be determined by direct interpolation.

### TABLE NO. 24-K

**COMPRESSIVE STRENGTH OF MASONRY**

Gross area for masonry of solid units; net area for masonry of hollow units.

<table>
<thead>
<tr>
<th>Compressive strength of the units</th>
<th>Assumed compressive strength of masonry, f'm</th>
</tr>
</thead>
<tbody>
<tr>
<td>psi</td>
<td>psi</td>
</tr>
<tr>
<td>1,000 to 1,500</td>
<td>900 to 1,150</td>
</tr>
<tr>
<td>over 1,500 to 2,500</td>
<td>1,151 to 1,550</td>
</tr>
<tr>
<td>over 2,500 to 4,000</td>
<td>1,551 to 2,000</td>
</tr>
<tr>
<td>over 4,000 to 6,000</td>
<td>2,001 to 2,400</td>
</tr>
<tr>
<td>over 6,000 to 8,000</td>
<td>2,401 to 2,700</td>
</tr>
<tr>
<td>over 8,000 to 10,000</td>
<td>2,701 to 2,900</td>
</tr>
<tr>
<td>over 10,000 to 12,000</td>
<td>2,901 to 3,000</td>
</tr>
<tr>
<td>over 12,000</td>
<td>3,000</td>
</tr>
</tbody>
</table>

### TABLE NO. 24-L

**ALLOWABLE STRESSES IN MASONRY**

<table>
<thead>
<tr>
<th>Description</th>
<th>Allowable Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive:</td>
<td></td>
</tr>
<tr>
<td>Axial</td>
<td>f'm</td>
</tr>
<tr>
<td>Flexural</td>
<td>f'm</td>
</tr>
<tr>
<td>Shear:</td>
<td></td>
</tr>
<tr>
<td>Beams with no web reinforcement ..........</td>
<td>Vm</td>
</tr>
<tr>
<td>Beams with web reinforcement ............</td>
<td>V</td>
</tr>
<tr>
<td>Bond:</td>
<td></td>
</tr>
<tr>
<td>Plain bars</td>
<td>u</td>
</tr>
<tr>
<td>Deformed bars (ASTM A305) ..............</td>
<td>u</td>
</tr>
<tr>
<td>Bearing</td>
<td>f'm</td>
</tr>
<tr>
<td>Modulus of elasticity</td>
<td>Em</td>
</tr>
<tr>
<td>Modulus of rigidity</td>
<td>E_v</td>
</tr>
</tbody>
</table>

- .20 f'm or see Section 2419 (g) 3 and 8
- 0.33 f'm
- 50 psi. a
- 150 psi.
- 80 psi.
- 160 psi.
- 0.25 f'm
- 1,000 f'm
- 400 f'm

a. (See Section 2419 (f) 3.)
Section 2425. STANDARDS

Unless otherwise specified in other Sections of the Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>Facing Brick (solid masonry units made from clay or shale), C-216-66.</td>
</tr>
<tr>
<td></td>
<td>Building Brick (solid masonry units made from clay or shale), C-62-66.</td>
</tr>
<tr>
<td></td>
<td>Concrete Building Brick, C-55-66-T.</td>
</tr>
<tr>
<td></td>
<td>Hollow Load-Bearing Concrete Masonry Units, C-90-66-T.</td>
</tr>
<tr>
<td></td>
<td>Solid Load-Bearing Concrete Masonry Units, C-145-66-T.</td>
</tr>
<tr>
<td></td>
<td>Hollow Non-Load-Bearing concrete Masonry Units, C-129-64-T.</td>
</tr>
<tr>
<td></td>
<td>Structural Clay Load-Bearing Wall Tile, C-34-62.</td>
</tr>
<tr>
<td></td>
<td>Structural Clay Non-Load-Bearing Tile, C-56-62.</td>
</tr>
<tr>
<td></td>
<td>Gypsum Partition Tile or Block, C-52-54.</td>
</tr>
<tr>
<td></td>
<td>Glazed Building Units, C-126-67.</td>
</tr>
<tr>
<td></td>
<td>Mortar for Masonry other than Gypsum, C-270-64-T.</td>
</tr>
<tr>
<td></td>
<td>Masonry Cement, C-91-67.</td>
</tr>
<tr>
<td></td>
<td>Quicklime for Structural Purposes, C-5-59.</td>
</tr>
<tr>
<td></td>
<td>Hydrated Lime for Masonry Purposes, C-207-49.</td>
</tr>
<tr>
<td></td>
<td>Aggregate for Masonry Mortar, C-144-66-T.</td>
</tr>
<tr>
<td></td>
<td>Mortar Testing (water retention), C-91-67.</td>
</tr>
<tr>
<td></td>
<td>Mortar Testing (compressive strength), Sections 16-22 of C-91-67.</td>
</tr>
<tr>
<td></td>
<td>Cold Drawn Steel Wire for Concrete Reinforcement, A-82-66.</td>
</tr>
<tr>
<td></td>
<td>Axle Steel Bars for Concrete Reinforcement, A-160-66.</td>
</tr>
<tr>
<td></td>
<td>Welded Steel Wire Fabric for Concrete Reinforcement, A-185-64.</td>
</tr>
<tr>
<td></td>
<td>Mortar &amp; Grout for Reinforced Masonry ASTM—C-476-63.</td>
</tr>
</tbody>
</table>

Legend

ASTM American Society for Testing and Materials
1916 Race St.
Philadelphia, Pa. 19103

ACI American Concrete Institute
P.O. Box 4754, Redford Station
Detroit, Mich.

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U.S. Government Printing Office
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CHAPTER 25

WOOD

Section 2501. GENERAL.

(a) Quality and Design. The quality and design of wood members and their fastenings used for load supporting purposes shall conform to the requirements of this Chapter and Standards hereinafter specified.

(b) Workmanship. All members shall be framed, anchored, tied and braced so 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 the glues, connectors and mechanical devices for the fastening thereof, shall conform to good engineering practices and in accordance with the appropriate standards as listed in the Standards Section.

(d) Standards. Except as otherwise specifically provided in this Building Code, the "National Design Specification for Stress-Grade Lumber and Its Fastenings," shall be accepted as good engineering practice, covering design with and use of stress-grade lumber, of glued laminated lumber and of their fastenings.

(e) Abbreviations. Where NFPA is used in this Chapter this shall mean National Forest Products Association. Where APA is used this shall mean American Plywood Association and where UBC is used this shall mean Uniform Building Code.

Section 2502. DEFINITIONS AND NOTATIONS.

Except as otherwise provided the following terms and symbols used in this Chapter shall be defined as follows:

Built-Up Members. Structural members, the sections of which are composed of combinations of sawn lumber or plywood, in which all parts are bonded or joined together with glue, bolts, nails, metal clips or other similar fastenings.

Glued-Laminates. Lumber composed of an assembly of wood laminations bonded with adhesives in which the laminations are too thick to be classed as veneers.

Grade (Lumber). The classification of lumber in regard to strength and utility. A mechanical means of grading may be accepted when approved by the Department.

Grade-Stress. A lumber grade defined in such terms that a definite working stress may be assigned to it.

Nominal Size. The commercial size designation of width, and depth, in standard sawn lumber and glued laminated lumber grades; somewhat larger than standard net size of dressed lumber.

Plywood-Construction and Industrial Softwood. A built up board of laminated veneers conforming to PS 1 of the U. S. Department of Commerce, Bureau of Standards.

Treated Woods. Pressure treatment or the term "pressure impregnated with an approved preservative" is that treatment of wood which is in accordance with standards C1, C2, C3, C4, C9 and C12 of the American Wood Preservers Association as listed in the Standards in this Chapter.

Section 2503. SIZE OF STRUCTURAL MEMBERS.

(a) Required Sizes. Wood structural members shall be of sufficient size to carry the design loads without exceeding the allowable working stresses hereinafter specified.

(b) Net Size. Computations to determine the required sizes of lumber members shall be based on the net dimensions (actual size) and not on the nominal sizes.

(c) Nominal Size. Where sizes of lumber members are mentioned in this Building Code, they shall be construed as meaning nominal sizes.

For glued laminated lumber the net sizes established in the "National Design Specification" shall be accepted as the minimum sizes conforming to such nominal sizes.

(d) Size on Plans. The Department shall require the sizes and allowable unit stress or the species and the grade of lumber used for structural purposes to be indicated on the drawings. If rough sizes or finished sizes
greater or smaller than the American Lumber Standard dressed sizes are used in calculations, the actual sizes shall be specified on the plans.

Section 2504. ALLOWABLE STRESSES.

(a) General. Except as hereinafter provided, induced stresses shall not exceed the allowable unit stresses in pounds per square inch for the respective species and grades and grade combination as set forth in the ‘National Design Specification’ for solid sawn stress-grade lumber and structural glued laminates, and for plywood stresses as set forth in Section 2 — Technical Data Handbook — American Plywood Association.

The allowable stresses as set forth in the ‘National Design Specification’ and the ‘Technical Handbook’ of the American Plywood Association, and stresses herein apply also to lumber, to structural glued laminated lumber and to plywood that has been pressure impregnated by an approved process and preservative with the adjustments thereof.

Studs, joists, rafters, foundation plates or sills, planking two (2) inches or more in depth, beams, stringers, posts and similar load-bearing members shall be of at least the minimum grades set forth in Table 1, ‘National Design Specification’ or comparable grades for other species.

(b) Poles and Piles. Induced stresses in pounds per square inch for normal loading of round poles or piles when used as structural members, except modulus of elasticity which shall be the same as for sawn lumber, shall not exceed 75% of the basic unit working stresses for clear lumber for the species as set forth in USASI 05.1 United States of America Standards Institute for Wood Poles and D25 of the American Society for Testing Materials for Round Timber Piles as listed in Standards Section.

(c) Lumber Identification. Stresses given in Table 1 of ‘National Design Specification’ shall be used only when the lumber is of an assured grade. Assurance of grade may be established by the grade-mark of, or certificate of inspection issued by, a lumber grading or inspection bureau or agency recognized as being competent. Stresses for lumber, the grade of which is not so identified, shall be established by the Department in accordance with the principles set forth in the ‘National Design Specification’.

(d) Plywood Identification. All plywood used structurally, including sidings, roof and wall sheathing, subflooring, diaphragms, and built-up beams, shall conform to performance standards for its type in PS 1 as listed in the Standards Section.

Plywood shall be identified as to grade and glue type by an approved agency. In addition to the above requirements all plywood when permanently exposed in outdoor applications shall be of exterior type.

(e) Glued Laminates Identification. All structural glued laminated lumber shall be identified in a manner meeting the approval of the Department.

Section 2505. TIMBER CONNECTORS AND FASTENINGS.

Except as otherwise provided, the design with, allowable loads for, and installation of timber connectors and other mechanical fastenings of wood members shall be in accordance with the ‘National Design Specification’.

The number and size of nails connecting wood members shall be not less than the amount set forth in Table 25-A. Other connections shall be nailed to provide equivalent strength.

Connections depending upon joist hangers or framing anchors, ties and other mechanical fastenings not otherwise covered may be used where approved.

Section 2506. VERTICAL MEMBERS OR ASSEMBLIES.

(a) Columns and Posts.

All wood columns and posts shall be framed to true end bearings; shall extend down to supports of such design as to hold the column or post securely in position and to protect its base from deterioration; and shall be supported in basements by piers projecting at least two (2) inches above the finished floor and separated therefrom by an approved metal barrier, or when pressure-impregnated timber is used, it may be placed directly on concrete or masonry.

Untreated wood columns in basements, when built into masonry partitions or walls shall be exposed on at least two sides.

(b) Stud Walls and Bearing Partitions.

1. Placing. Studs in walls and partitions may be placed with their wide faces parallel to the wall or partition, provided the studs are considered as columns and are designed accordingly. Stud walls shall have top and bottom plates except that joists may be supported by a let-in ribbon as provided in Section (a).

2. Size. Except as otherwise provided, exterior stud walls and bearing partitions for buildings of two stories or less shall consist of at
least two inch by 4 inch (2" x 4") studs; for buildings of four stories, the studding shall be at least three inches by four inches (3" x 4") or two inches by six inches (2" x 6") to the bottom of the third floor joists, and two inches by four inches (2" x 4") for the two upper stories.

**Height.** Unless supported laterally by adequate framing, the maximum allowable height shall be ten (10) feet for two inch by three inch (2" x 3") stud framing; fourteen (14) feet for two inch by four inch (2" x 4") stud framing; sixteen (16) feet for three inch by four inch (3" x 4") stud framing, and twenty (20) feet for two inch by six inch (2" x 6") stud framing.

When studs of the minimum grade are used, the maximum allowable height shall be eight (8) feet for two inch by three inch (2" x 3") framing and ten feet (10) for all other sizes.

4. **Spacing.** Except for one-story buildings of Group 1 and J Occupancy, where twenty-four-inch (24") spacing may be used, unless otherwise limited by the wall covering, no studding shall be spaced more than sixteen (16) inches on center unless vertical supporting members in the walls are designed as columns, or may be of post and beam framing with plank sheathing at least one and one-half (1½) inches thick.

5. **Corners and Bracing.** Angles or corners where stud walls or partitions meet shall be framed solid. All exterior walls and main cross stud partitions shall be effectively and thoroughly braced or sheathed with approved panels adequately nailed along all edges and as set forth in Section 2506 (e) 2.

6. **Pipes in Walls.** Stud partitions containing plumbing, heating, or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged. 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 (1/8) inch thick and one and one-half (1½) inches wide shall be fastened to the plate across and to each side of the opening with at least four 16d nails.

7. **Separation From Chimneys.** For clearance space between chimneys and combustible materials see Chapter 37.

8. **Top 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 plates shall be staggered at least four (4) feet.

9. **Foundation Plates.** Stud walls resting on masonry or concrete shall have foundation plates or sills and be anchored thereto.

10. **Foundation Studs.** Foundation studs shall be at least the size of the studding above, and when exceeding four (4) feet in height shall be of the size required for an additional story.

Foundation studs under bearing walls and partitions shall be thoroughly and effectively braced.

11. **Bridging.** All load bearing stud partitions or walls over eight feet six inches (8'6") in height, and non-load bearing over ten feet (10') in height, shall have bridging, at least two (2) inches in thickness and of the same width as the stud, fitted snugly and spiked into the studs at their mid-height, or other means for giving adequate lateral support to the studs. Bridging meeting the requirements of Section 2507 may serve as required firestopping.

12. **Headers.** All openings four (4) feet wide or less in bearing walls shall be provided with headers equivalent to double headers at least two inches (2") thick, placed on edge, securely fastened together, and all openings more than four (4) feet wide shall be trussed or provided with headers or lintels. Such headers or trusses shall have at least two (2) inch solid bearing at each end to the floor or bottom plate, unless other approved framing methods or joint devices are used.
(c) Laminated Walls and Partitions. Walls and partitions may be of laminated construction of at least four (4) inches nominal thickness, with the structural assembly designed to support all loads.

(d) Interior Walls and Partitions. Interior partitions shall be constructed, framed, and firestopped as specified for exterior walls, except that interior non-bearing partitions may have a single top plate. In Group I Occupancies, nonbearing partitions constructed of two inch by three inch (2” x 3”) studs spaced sixteen (16) inches on center may be used. Where wood-frame walls and partitions are covered on the interior with plaster, tile, or similar materials and are subject to water splash, the framing shall be protected with 15-pound asphalt-saturated felt.

For provisions covering maximum allowable spacing of gypsum, wood and fiber insulation lath, see Chapter 47. For provisions covering maximum allowable spacing of gypsum wallboard on wood studs and rafters and method of attachment, see Chapter 47.

(e) Exterior Wall Covering.

1. General. Exterior wood stud walls shall be covered on the outside with the materials and in the manner specified in this section. Studs or sheathing shall be covered on the outside face with one layer of building paper when required in Chapter 17.

2. Sheathing. Sheathing shall have a minimum thickness of:

A. Approved plywood not less than 5/16 inch.
B. Wood one (1) inch nominal but not less than 5/8 inch.
C. Approved fiberboard not less than 7/16 inch.
D. Approved gypsum sheathing not less than 5/16 inch.

All wood-framed exterior walls, unless sheathed with one (1) inch boards applied diagonally or with plywood not less than 5/16 inch thick, shall be structurally braced at all corners with not less than 1 x 4’s let-in to the outer face of studs and extending continuously from top to bottom plates, or by other approved bracing.

Sheathing shall be laid horizontally, diagonally, or in panels and in conformity with Section 2506 (e) 5.

Siding patterns known as rustic, drop siding, or shiplap shall have an average thickness in place of at least nineteen thirty-seconds (19/32) inch and shall have a minimum thickness of at least three-eighths (3/8) inch. Bevel siding shall have a minimum thickness measured at the butt section of at least seven-sixteenths (7/16) inch, a tip thickness of at least three-sixteenths (3/16) inch. Siding of lesser dimensions may be used, provided such wall covering is placed over sheathing which conforms to the provisions specified in this Chapter.

All siding shall be securely nailed to each stud with at least one nail, or to solid nominal wood sheathing with at least one line of nails spaced not more than twenty-four (24) inches on center in each piece of the siding. Nails shall be so located as to hold the bottom of the siding secure and thereby to hold tight the top of the piece below. Where such nailing is not possible, two nails to each stud shall be used to hold each piece.

3. Plywood. Where plywood is used for covering the exterior of outside walls, it shall be of the exterior type at least three-eighths (3/8) inch thick. Joints shall occur over framing members at least two (2) inches thick, unless sheathing is used, or joints are lapped horizontally or otherwise made waterproof to the satisfaction of the Department.

4. Shingles or Shakes. Wood shingles or shakes and asbestos cement shingles may be used for exterior wall covering provided the frame of the structure is covered with building paper as specified in Chapter 17. All shingles or shakes attached to sheathing other than wood shall be secured with approved mechanical-binding nails or by approved corrosion-resistant nails on furring strips attached to the studs. Wood shingles or shakes may be applied over fiberboard shingle backer and sheathing with annular grooved nails. The thickness of wood shingles or shakes between wood nailing boards shall be at least three-eighths (3/8) inch.

5. Weather-Resistant Metal. Painted, treated or non-corrosive metal may be used on stud walls. When sheathing is omitted the installation must be approved by the Department. Contact between dissimilar metals shall be broken.
by approved methods. Galvanized steel sheets formed or flat may be used.


Section 2507. FIRESTOPPING.

Firestoppling shall be provided to cut off all concealed shaft openings (both vertical and horizontal) and form an effective barrier between stories, and between a top story and 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 (8) feet, and in furred masonry walls not to exceed ten (10) feet in any direction.

3. Between stair stringers at least once in the middle portion of each run, at top and bottom, and between studs, along and in line with run of stair adjoining stud walls and partitions.

4. Around top, bottom, sides and ends of sliding door pockets.

5. 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.

6. Any other locations not specifically mentioned above, such as holes for pipes, shafting, behind furring strips and similar places which could afford 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 (1) inch material with joints broken.

Section 2508. HORIZONTAL MEMBERS OR ASSEMBLIES.

   (a) Bearing. Every beam, girder, and joist shall have sufficient bearing area so that the compression perpendicular to grain values do not exceed those set forth in the "National Design Specification".

   EXCEPTIONS:
   1. Two (2) inch joists when nailed to adjacent studs may be supported on a one (1) inch let-in ribbon.

   2. Approved supporting devices, may be used for bearing purposes, if allowable stresses are not exceeded. Wood members bearing on or in contact with masonry or concrete at or below ground level shall be as specified in this Chapter.

   (b) Built-Up Members.

   1. Beams. Built-up beams with through members at least two (2) inches in nominal thickness may be used in place of solid timbers. Beams ten (10) inches or less in depth may be spiked together with at least 16d spikes at twelve (12) inch centers, staggered. Unless so spiked, or if the depth of beam is more than ten (10) inches, the members shall be connected together with bolts not smaller than one-half inch (½") diameter spaced not over two (2) feet apart, staggered or equal. Fastenings shall be placed at a maximum of one-fourth the depth of the member from the top and bottom edges.

   2. Trusses. The design, fabrication, and erection of timber trusses shall conform to the provision of this Building Code.

   (c) Joist and Rafter Blocking and Bridging. Rafters of more than eight (8) inch depth and joists of more than four (4) inch depth shall be stabilized against overturning or buckling from superimposed load as follows:

   1. At ends and at each support, by solid blocking of at least two (2) inch thickness and the full depth of joists, by nailing to studs when supported by ribbon boards, or by approved hangers or fastenings.

   2. Between supports as required so that joists will be stabilized every eight (8) feet and rafters every ten (10) feet by solid blocking two (2) inches thick and the full depth of the joist or rafter, or by wood cross bridging of at least one inch by three inches (1” x 3") or metal cross bridging of equal strength. Where cross bridging is used, the lower ends of such cross bridging shall be driven up and nailed after the floor or subfloor has been nailed. Blocking and bridging of joists between supports may be
eliminated for Group I Occupancies where joist depth does not exceed twelve (12) inches.

(d) Joists Under Bearing Partitions. Joists under and parallel to partitions shall be doubled and well spiked, or may be separated by solid blocking spaced at no more than four (4) foot intervals.

(e) Headers. Header joists over six (6) feet long and tail joists over twelve (12) feet long shall be hung in joist or beam hangers or framing anchors or secured by other devices or methods affording equivalent support. Trimmers and headers shall be provided with clearance from flues, chimneys, and fireplaces as specified in Chapter 37.

(f) Wood Members Entering Masonry or Concrete. Wood members entering masonry or concrete walls shall be at least four (4) inches from other wood members entering from the opposite side of the wall nor from the exterior face of a wall, except on street fronts.

EXCEPTION: Where unprotected openings are permitted in the wall, wood members may extend through such wall.

Ends of wood members entering masonry or concrete walls, unless treated with an approved preservative, shall be provided with a one-half (½) inch air space on sides, top and end.

Wood members other than beams and girders shall be beveled so that the top edge does not enter more than one (1) inch.

(g) Anchors and Ties. For anchorage of wood joists or beams to masonry walls or concrete walls, see Sections 2509 and 2513.

(h) Floors. See Section 2510 and 2513.

(i) Roofs. See Section 2510 and 2513.

Section 2509. WOOD WITH MASONRY OR CONCRETE.

The vertical dead load of masonry or concrete shall not be supported by wood members, other than wood piling.

Wood may be combined structurally with masonry or concrete if provision is made for the different rigidities and other properties of the materials, and in accordance with Section 2516.

Section 2510. LIGHT FRAME CONSTRUCTION.

(a) General. In one and two story buildings housing Group H, I and J Occupancies, where engineering design is not provided, Tables Nos. 25-B, 25-C, 25-D and the follow-

ing publications may be used to determine framing requirements:

Manual For House Framing — National Forest Products Association
Maximum Spans for Joists and Rafters in Residential Construction — National Forest Products Association
Random Length Wood Decking — National Forest Products Association

(b) Roof Construction. There shall be a ridge board at least one (1) inch thick at all ridges, not less in depth than the cut end of the rafter. Where the slope of the roof is less than three in twelve, the ridge member shall be designed as a vertical load-bearing member. At all valleys and hips there shall be a valley or hip rafter at least two (2) inches thick and not less in depth than the cut end of the rafter.

Where the ridge member is not designed as a vertical load-bearing member, rafters shall be framed directly opposite each other at the ridge and shall be nailed to adjacent ceiling joists to form a continuous tie between exterior walls. Where the ceiling joists run other than parallel to the rafters, rafters shall be tied back to the roof framework by means of cross ties spaced at least forty-eight (48) inches on center. Such cross ties shall be at least in size one inch by four inches (1" x 4").

Purlins to support roof loads may be installed to reduce span of rafters within allowable limitations and shall be supported by struts from bearing walls or partitions. Struts shall be not smaller than two inches by four inches (2" x 4"). The unbraced length of struts shall not exceed eight (8) feet and the slope of said struts shall be at least 45 degrees from the horizontal.

(c) Girders. Girders supporting first floor joists shall be at least four inches by four inches (4" x 4") for spans five (5) feet or less, or at least four inches by six inches (4" x 6") (placed on edge) for spans not more than seven (7) feet.

(d) Plank and Beam Construction. Floor and roof systems may be designed as provided in this Building Code or may be as set forth in “Plank and Beam Framing for Residential Buildings” — NFPA

Span lengths for grades given in the “National Design Specification” may be based on the stresses therein.

End joints in planking may be randomly spaced provided planks are end matched or splined and each plank bears at least one support, and joists are separated by at least twelve (12) inches in adjacent pieces except at supports.
(e) Plywood Subflooring. Where used as structural subflooring, plywood shall be of the minimum thicknesses set forth in Table No. 25-C.

(f) Plywood Roof Sheathing. Where used as structural roof sheathing, plywood shall be of the minimum thicknesses set forth in Table No. 25-D.

Section 2511. GLUED CONSTRUCTION.

(a) Design and Allowable Unit Stresses. Glued laminates and glued-built-up structural members shall be designed by the applicable engineering formulas used for sawn members, plywood, and as otherwise provided without exceeding the allowable unit stresses specified in Section 2504.

(b) Fabrication of Members.


2. Fastenings. The methods of design of bolts and connectors and their allowable loads when used with glued-laminates shall be the same as provided for their use with sawn lumber.

Section 2512. PLYWOOD COMPONENTS.

(a) General. Plywood components shall be acceptable when designed according to accepted engineering procedure and fabricated with adequate control according to accepted procedure as outlined below. Detailed drawings showing design shall be submitted. All Plywood Components shall be designed in accordance with APA General Design Specification No. 1, “Design of Plywood Lumber Structural Assemblies,” published by the American Plywood Association.

(b) Design and Fabrication.

1. Flat Plywood Stresses Skin Panels shall be designed in accordance with “The Design of Flat Panels with Stressed Covers”, Section 8 of Technical Data Handbook, published by the American Plywood Association and shall be fabricated in strict compliance with APA Specification SS-8 “Fabrication of Flat Plywood Stressed Skin Panels”.

2. Curved Plywood Panels shall be designed in accordance with APA Design Method No. CP-8D, “Design of Curved Plywood Panels”, published by the American Plywood Association and shall be fabricated in strict compliance with APA Fabrication Specification CP-8, “Fabrication of Curved Plywood Panels”.

3. Plywood Beams shall be designed in accordance with APA Design Method No. BB-8D, “Design of Plywood Beams”, published by the American Plywood Association, and shall be fabricated in strict compliance with APA Fabrication Specification No. BB-8, “Fabrication of Plywood Beams”.

(c) Inspection and Testing. To ensure conformance with the applicable fabrication specification as outlined above, production of Plywood Components shall be under the continuing inspection and testing of an approved, independent testing agency, and each component unit shall bear the trademark of this testing agency indicating conformance to the applicable fabrication specifications.

Section 2513. HEAVY TIMBER CONSTRUCTION.

(a) Columns. Wood columns may be sawn or glued laminated and shall be at least eight (8) inches, nominal, in any dimension when supporting floor loads and at least six (6) inches, nominal, in width and at least eight (8) inches, nominal, in depth when supporting roof and ceiling loads only.

Columns shall be continuous or superimposed by means of reinforced concrete or metal caps with brackets, or shall be connected by properly designed steel or iron caps, with pintles and base plates, or by timber splice plates affixed to the columns by means of metal connectors housed within the contact faces, or by other approved methods.

(b) Floor Framing. Beams and girders of wood may be sawn or glued laminated and shall be at least six (6) inches, nominal, in width and at least ten (10) inches, nominal, in depth.

Framed or glued laminated arches which spring from grade or the floor line and support floor loads shall be at least eight (8) inches nominal, in any dimension.

Frame timber trusses supporting floor loads shall have members of at least eight (8) inches, nominal, in any dimension.

(c) Roof Framing. Framed or glued laminated arches for roof construction which spring from grade or the floor line and do not support floor loads shall have members at least six (6) inches, nominal, in width and at least eight (8)
inches, nominal, in depth for the lower half of the height and at least six (6) inches, nominal, in depth for the upper half.

Framed or glued laminated arches for roof construction which spring from the top of walls or wall abutments, framed timber trusses, and other roof framing which do not support floor loads, shall have members not less than four (4) inches nominal in width and not less than six (6) inches, nominal, in depth. Spaced members may be composed of two or more pieces at least three (3) inches nominal, in thickness when blocked solidly throughout their intervening spaces or when such spaces are tightly closed by a continuous wood cover plate of at least two (2) inches, nominal, in thickness, secured to the underside of the members. Wood splice plates shall be no less than three (3) inches, nominal, in thickness. When protected by approved automatic fire sprinklers directly under the roof deck, framing members shall be at least three (3) inches, nominal, in width.

(d) Heavy Timber Floors. Floors shall be of sawn or glued laminated: (1) planks, splined or tongue-and-groove, of at least three (3) inches, nominal, in thickness covered with one inch, nominal, dimension tongue-and-groove flooring, laid crosswise or diagonally to the plank or with other approved wearing surfaces or (2) planks, not less than four (4) inches, nominal, in width set on edge close together and well spiked, and covered as for three (3) inch thick plank. The planks shall be laid so that there is no continuous line of end joints except at points of support. Floors shall not extend closer than one-half (½) inch to walls to provide an expansion joint, but the joint shall be covered at top or bottom to avoid flue action.

(e) Heavy Timber Roof Decks. Roof decks shall be sawn or glued laminated, splined or tongue-and-groove plank, at least two (2) inches, nominal, in thickness, or of planks at least three (3) inches, nominal, in width, set on edge close together and laid as required for floors. Other types of decking may be used when approved by the Department.

(f) Construction Details. Wood beams and girders supported by walls required to have a fire resistance rating of two hours or more shall have at least four (4) inches of solid masonry between their ends and the outside face of the wall and between adjacent beams.

Wood beams may pass through masonry walls where unprotected openings are permitted. When the beam passes through such masonry, the beam at the opening shall be protected against moisture penetration, with incombustible materials, but shall afford free movement of air in the cavity as noted in the paragraph below. Mechanical anchorage shall be provided in accordance with good engineering practice.

Wall plate boxes of self-releasing type or approved hangers shall be provided where beams and girders bear on masonry. An air space of one inch shall be provided at the top, end, and sides of the member unless approved durable or treated wood is used.

Girders and beams shall be closely fitted around column and adjoining ends shall be cross tied to each other, or inter-tied by caps or ties, to transfer horizontal loads across the joint. Wood bolsters may be placed on top of columns which support roof loads only.

Where intermediate beams are used to support a floor, they shall rest on top of the girders, or shall be supported by ledgers or blocks securely fastened to the sides of the girders, or they may be supported by approved metal hangers into which the ends of the beams shall be closely fitted.

Columns, beams, girders, arches, trusses, and floor slabs of material other than wood shall have a fire resistance of at least one hour.

Floors and roof decks shall be without concealed spaces, except that building service equipment may be enclosed provided the spaces between the equipment and enclosures are fire stopped or protected by other acceptable means.

Adequate roof anchorage shall be provided.

Section 2514. WOOD DIAPHRAGMS.

(a) General. Wood and plywood diaphragms may be used to resist horizontal forces in horizontal and vertical distributing or resisting elements, provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom does not exceed the permissible deflection of attached distributing or resisting elements.

Permissible deflection shall be that deflection up to which the diaphragm and any attached distributing or resisting element will maintain its structural integrity under assumed load conditions, i.e., continue to support assumed loads without danger to occupants of the structures.

Connections and anchorages capable of resisting the design forces shall be provided between the diaphragms and the resisting elements. Openings in diaphragms which materially affect their strength shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

Size and shape of diaphragms shall be limited as set forth in Table No. 25-E.

In buildings of wood construction where rotation is provided for, transverse shear resisting elements normal to the longitudinal element shall be provided at spacings not exceeding one and one-half times the width for conventional diagonally sheathed diaphragms.
or two times the width for special diagonally sheathed or plywood diaphragms.

(b) Diagonally Sheathed Diaphragms.

1. Conventional Construction. Such wood diaphragms shall be made up of one (1) inch nominal sheathing boards laid at an angle of approximately 45 degrees to supports. Sheathing boards shall be directly nailed to each intermediate bearing member with at least two 8d nails for one inch by six inch (1” x 6”) boards and three 8d nails for boards eight (8) inches or wider, and in addition three 8d nails and four 8d nails shall be used for six (6) inch and eight (8) inch boards, respectively, at the diaphragm boundaries. End joints in adjacent boards shall be separated by at least one joist or stud space, and there shall be at least two boards between joints on the same support. Boundary members at edges of diaphragms shall be designed to resist direct tensile or compressive chord stresses and shall be adequately tied together at corners.

Conventional wood diaphragms may be used to resist shears, due to wind or seismic forces, not exceeding 300 pounds per lineal foot of width.

2. Special Construction. Special diagonally sheathed diaphragms shall conform to conventional construction and, in addition, shall have all elements designed in conformance with the provisions of this Building Code.

Each chord or portion thereof may be considered as a beam, loaded with a uniform load per foot equal to 50 percent of the unit shear due to diaphragm action. The load shall be assumed as acting normal to the chord, in the plane of the diaphragm and either toward or away from the diaphragm. The span of the chord, or portion thereof, shall be the distance between structural members of the diaphragm such as the joists, studs, and blocking, which serve to transfer the assumed load to the sheathing.

Specially diagonally sheathed diaphragms may be used to resist shears, due to wind or seismic loads, provided such shears do not stress the nails beyond their allowable safe lateral strength and do not exceed 600 pounds per lineal foot of width.

(c) Plywood Diaphragms. Horizontal and vertical diaphragms sheathed with plywood may be used to resist horizontal forces not exceeding those set forth in Table No. 25-B, or may be calculated by principles of mechanics without limitation by using values of nail strength and plywood shear values as given elsewhere in this Building Code. Plywood thickness for horizontal diaphragms shall be not less than set forth in Tables No. 25-C and 25-D for corresponding joist spacing and loads, except that one-fourth (¼) inch plywood may be used where perpendicular loads permit. Plywood used for horizontal and vertical diaphragms shall conform to PS 1 as listed in Standard Section of this Chapter.

All boundary members shall be proportioned and spliced where necessary to transmit direct stresses. Framing members shall be at least one and five-eighths (1½) inch wide. In general, panel edges shall bear on the framing members and butt along their center lines. Nails shall be placed at least three-eighths (¾) inch from the panel edge, not more than twelve (12) inches apart along intermediate supports and six (6) inches along panel edge bearings, and shall be firmly driven into the framing members. No unblocked panels less than twelve (12) inches wide shall be used.

Section 2515. PROTECTION FROM MOISTURE AND TERMITES.

(a) General. Structures shall be protected from moisture and termites as provided in this Section or as set forth in “Design of Wood Structures for Permanence”.

(b) Foundation Ventilation. The space between the bottom of floor joists and the ground of any building (except such space as is occupied by a basement or cellar) shall be provided with a sufficient number of ventilating openings through foundation walls or exterior walls to insure ample ventilation, and such openings shall be covered with a corrosion-resistant wire mesh not greater than one-half (½) inch nor less than one-fourth (¼) inch in any dimension. The minimum total area of ventilating openings shall be proportioned on the basis of two (2) square feet for each twenty-five (25) linear feet or major fraction thereof of exterior wall. One such ventilating opening shall be within three (3) feet of each corner of said building. Such openings need not be placed in the front of the building.
Minimum clearance between bottom of floor joist or bottom of floors without joists and the ground beneath shall be eighteen (18) inches. Minimum clearance under girders shall be twelve (12) inches.

(c) Durability. Where not otherwise prohibited by other provisions of this Building Code, no wood, other than Foundation Grade redwood, Foundation Grade cedar, all heartwood cypress, or any species of wood, pressure-treated with an approved preservative, all marked or branded by an approved agency, shall be nearer than six (6) inches to any earth unless separated by concrete at least three (3) inches thick, except that untreated wood may be used where entirely below ground-water level or continuously submerged in fresh water, and untreated wood may be used in fences and similar well-ventilated and accessible non-load-bearing structures where not actually in direct contact with earth.

(d) Termite Protection. Where termite precautions are necessary, the degree of hazard shall be determined by the Department and requirements for protection shall be as contained in “Design of Wood Structures for Permanence”.

Section 2516. COMPOSITE CONSTRUCTION.

Wood or timber members may be employed in structural compositions with other structural materials to create a structural integrated system. When such structural systems are employed, they shall be accompanied by a full structural engineering analysis.

Section 2517. TABLES.

These tables shall be used wherever referred to by other portions of this Building Code.
## TABLE NO. 25-A
### NAILING SCHEDULE

Using Common or Box Nails

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Nail Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joist to sill or girder, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Bridging to joist, toe nail each end</td>
<td>2-8d</td>
</tr>
<tr>
<td>Ledger strip</td>
<td>3-16d</td>
</tr>
<tr>
<td>1” x 6” subfloor or less to each joist, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>Over 1” x 6” subfloor to each joist, face nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>2” subfloor to joist or girder, blind and face nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Sole plate to joist or blocking, face nail</td>
<td>16d @ 16” oc</td>
</tr>
<tr>
<td>Top plate to stud, end nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Stud to sole plate, toe nail</td>
<td>4-8d</td>
</tr>
<tr>
<td>Doubled studs, face nail</td>
<td>16d @ 24” oc</td>
</tr>
<tr>
<td>Doubled top plates, face nail</td>
<td>16d @ 16” oc</td>
</tr>
<tr>
<td>Top plates, laps and intersections, face nail</td>
<td>2-16d</td>
</tr>
<tr>
<td>Continuous header, two pieces</td>
<td>16d @ 16” oc</td>
</tr>
<tr>
<td>Ceiling joists to plate, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Continuous header to stud, toe nail</td>
<td>4-8d</td>
</tr>
<tr>
<td>Ceiling joists, laps over partitions, face nail</td>
<td>3-16d</td>
</tr>
<tr>
<td>Ceiling joists to parallel rafter, face nail</td>
<td>3-16d</td>
</tr>
<tr>
<td>Rafter to plate, toe nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>1 inch brace to each stud and plate, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>1” x 8” sheathing or less to each bearing, face nail</td>
<td>2-8d</td>
</tr>
<tr>
<td>Over 1” x 8” sheathing to each bearing, face nail</td>
<td>3-8d</td>
</tr>
<tr>
<td>Built-up corner studs</td>
<td>16d @ 24” oc</td>
</tr>
<tr>
<td>Built-up girders and beams</td>
<td>20d @ 32” oc</td>
</tr>
</tbody>
</table>

25-11
TABLE NO. 25-B
ALLOWABLE SHEAR IN POUNDS PER FOOT FOR PLYWOOD DIAPHRAGM

<table>
<thead>
<tr>
<th>THICKNESS OF PLYWOOD (in inches)</th>
<th>COMMON NAIL SIZE</th>
<th>NOMINAL WIDTH OF FRAMING MEMBERS (in inches)</th>
<th>PLYWOOD SPECIES¹</th>
<th>BLOCKED DIAPHRAGMS² UNIFORM NAIL SPACING ON ALL PANEL EDGES</th>
<th>UNBLOCKED DIAPHRAGM WITH NAILS SPACED 6” O.C. AT SUPPORTING EDGES</th>
<th>( \text{Load Perpendicular to Unblocked Edges and Continuous Panel Joints} )</th>
<th>All other Panel Arrangements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>6d</td>
<td>Not less than 2</td>
<td>Douglas Fir</td>
<td>188 281 315 167 125</td>
<td></td>
<td></td>
<td>125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>125 183 210 111 84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 or more</td>
<td>Douglas Fir</td>
<td>210 315 356 187 140</td>
<td></td>
<td></td>
<td>140</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>140 210 238 125 93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>8d</td>
<td>Not less than 2</td>
<td>Douglas Fir</td>
<td>270 398 450 240 180</td>
<td></td>
<td></td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>180 265 300 160 120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 or more</td>
<td>Douglas Fir</td>
<td>300 450 506 267 120</td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>200 300 338 178 133</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>10d</td>
<td>Not less than 2</td>
<td>Douglas Fir</td>
<td>319 480 548 283 212</td>
<td></td>
<td></td>
<td>212</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>213 320 365 189 141</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 or more</td>
<td>Douglas Fir</td>
<td>360 540 615 320 240</td>
<td></td>
<td></td>
<td>240</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western Softwood</td>
<td>240 360 410 213 160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Plywood grades shall be interior structural grade or exterior grade or better. For Douglas fir interior types Grade A-A, A-B, A-D and B-D reduce values 25 per cent.

² These values may be increased one-third provided the nail spacing is reduced one-third at the diaphragm boundary and at continuous panel joints.
TABLE NO. 25-C
MINIMUM THICKNESS AND MAXIMUM SPAN OF PLYWOOD FOR FLOORS SUPPORTING LIVE LOADS OF 40 p.s.f., 50 p.s.f., or 100 p.s.f.\(^2\)

<table>
<thead>
<tr>
<th>MINIMUM THICKNESS OF PLYWOOD (in Inches)</th>
<th>MAXIMUM SPACING OF JOISTS (in Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Douglas Fir</td>
</tr>
<tr>
<td>½</td>
<td>16</td>
</tr>
<tr>
<td>¾</td>
<td>20</td>
</tr>
<tr>
<td>¾</td>
<td>24</td>
</tr>
</tbody>
</table>

\(^1\)Plywood continuous over two or more spans and face grain perpendicular to supports.

\(^2\)Blocking shall be installed at unsupported edges except where twenty-five thirty-seconds-inch (25/32") finish floor is used. The thickness of Douglas fir may be reduced to not less than one-half (½") for the sixteen-inch (16") and twenty-four-inch (24") spans where a twenty-five thirty-seconds-inch (25/32") finish floor is applied perpendicular to the supports.

\(^3\)When identified as Group I, interior type Grade C-D and exterior type Grade C-C may be used with Douglas fir spans.

TABLE NO. 25-D
MINIMUM THICKNESS AND MAXIMUM SPANS OF PLYWOOD ROOF SHEATHING

<table>
<thead>
<tr>
<th>THICKNESS OF PLYWOOD (in Inches)</th>
<th>LIVE LOAD (in pounds Per Square Foot)</th>
<th>MAXIMUM SPACING OF RAFTERS (in Inches)(^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DOUGLAS FIR</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blocked or other Approved Type of Edge Support</td>
</tr>
<tr>
<td>5/16(^2)</td>
<td>20, 30, or 40</td>
<td>16</td>
</tr>
<tr>
<td>¾(^2)</td>
<td>20, 30, or 40</td>
<td>24</td>
</tr>
<tr>
<td>½(^2)</td>
<td>20 or 30</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>¾(^2)</td>
<td>20 or 30</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>36</td>
</tr>
<tr>
<td>¾(^2)</td>
<td>20 or 30</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>42</td>
</tr>
</tbody>
</table>

\(^1\)Plywood continuous over two or more spans; and face grain perpendicular to supports.

\(^2\)When identified as Group I, Interior type Grade C-D and exterior type Grade C-C may be used with Douglas fir spans.

\(^3\)These values are for interior type Grade C-D and exterior Type Grade C-C only.

TABLE NO. 25-E
MAXIMUM DIAPHRAGM DIMENSION RATIOS

<table>
<thead>
<tr>
<th></th>
<th>HORIZONTAL DIAPHRAGMS</th>
<th>VERTICAL DIAPHRAGMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Span-Width Ratio</td>
<td>Maximum Height-Width Ratio</td>
</tr>
<tr>
<td>1. Diagonal sheathing, conventional</td>
<td>3:1</td>
<td>2:1</td>
</tr>
<tr>
<td>2. Diagonal sheathing, special</td>
<td>4:1</td>
<td>3½:1</td>
</tr>
<tr>
<td>3. Plywood, nailed all edges</td>
<td>4:1</td>
<td>3½:1</td>
</tr>
<tr>
<td>4. Plywood, blocking omitted at intermediate joints</td>
<td>4:1</td>
<td>2:1</td>
</tr>
</tbody>
</table>
**Section 2525. STANDARDS.** Unless as otherwise specified in other Sections of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOD</strong></td>
<td>Softwood Plywood, Construction and Industrial, Product Standard PS1-66</td>
</tr>
<tr>
<td></td>
<td>&quot;Hardwood Plywood,&quot; U.S. Commercial Standard CS 35-61</td>
</tr>
<tr>
<td></td>
<td>Structural Glued Laminated Timber, U.S. Commercial Standard CS 253-63</td>
</tr>
<tr>
<td><strong>AWPA</strong></td>
<td>C1-67, Standard for Preservative Treatment by Pressure Process — All Timber Products</td>
</tr>
<tr>
<td></td>
<td>C2-67, Standard for The Preservative Treatment of Lumber, Timbers, Bridge Ties and Mine Ties by Pressure Processes</td>
</tr>
<tr>
<td></td>
<td>C3-67, Standard for the Preservative Treatment of Piles by Pressure Processes</td>
</tr>
<tr>
<td></td>
<td>C4-67, Standard for the Preservative Treatment of Poles by Pressure Processes</td>
</tr>
<tr>
<td></td>
<td>C9-67, Standard for the Preservative Treatment of Plywood by Pressure Processes</td>
</tr>
<tr>
<td></td>
<td>C12-67, Standard for Creosoted-Wood Foundation Piles</td>
</tr>
<tr>
<td><strong>APA</strong></td>
<td>Technical Data on Plywood, 1964</td>
</tr>
<tr>
<td></td>
<td>Design of Plywood Lumber Structural Assemblies, 1964</td>
</tr>
<tr>
<td></td>
<td>The Design of Flat Plywood Panels with Stressed Skin Panels, SS-62D-1964</td>
</tr>
<tr>
<td></td>
<td>Fabrication of Flat Plywood Stressed Skin Panels SS-62D-1964</td>
</tr>
<tr>
<td></td>
<td>Design of Curved Plywood Panels CP-8D-1964</td>
</tr>
<tr>
<td></td>
<td>Fabrication of Curved Plywood Panels CP-8-1964</td>
</tr>
<tr>
<td></td>
<td>Design of Plywood Beams BB-80-1964</td>
</tr>
<tr>
<td></td>
<td>Fabrication of Plywood Beams BB-8-1964</td>
</tr>
<tr>
<td><strong>NFPA</strong></td>
<td>National Design Specification for Stress Grade Lumber and Its Fastenings—1968</td>
</tr>
<tr>
<td></td>
<td>Manual for House Framing, 1961</td>
</tr>
<tr>
<td></td>
<td>Random Length Wood Decking, 1961</td>
</tr>
<tr>
<td></td>
<td>Plank and Beam Framing for Residential Buildings, 1961</td>
</tr>
<tr>
<td></td>
<td>Design of Wood Structures for Permanence</td>
</tr>
<tr>
<td><strong>USASI</strong></td>
<td>American Standard Specifications and Dimensions for Wood Poles, ASA 05.1-1963</td>
</tr>
<tr>
<td><strong>ASTM</strong></td>
<td>Specifications for Round Timber Piles, D25-58-1964</td>
</tr>
<tr>
<td><strong>AITC</strong></td>
<td>Structural Glued Laminated Timber, AITC 200-63</td>
</tr>
</tbody>
</table>

**Legend**

- **USASI** United States of America Standards Institute 10 East 40th Street New York, New York 10016
- **AITC** American Institute of Timber Construction 1700 K Street, N.W. Washington, D.C. 20006
- **AWPA** American Wood Preservers Association 2600 Virginia Ave. Washington, D.C. 20037
- **APA** American Plywood Assn. 1119 A Street Tacoma, Washington 98402
- **NFPA** National Forest Products Assn. 1619 Massachusetts Avenue, N.W. Washington, D.C. 20036
CHAPTER 26
CONCRETE

Section 2600. GENERAL
(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the requirements for the design and construction of reinforced concrete or composite structural elements of any building or structure erected under the requirements of this Building Code and Chapter.

(b) Supplemental. This Chapter supplements this Building Code and shall govern in all matters pertaining to design and construction whenever it is in conflict with the requirements of this Building Code.

c) Special Structures. For special structures such as arches, chimneys, tanks, reservoirs, grain elevators, shells, domes, and blast-resistant structures, the provisions of this Chapter shall govern so far as they are applicable.

Section 2601. PERMITS, DRAWINGS AND INSPECTIONS (See Chapter 3).

Section 2602. DEFINITIONS. The following terms are defined for general use in this Chapter.

Admixture. A material other than portland cement, aggregate, or water added to concrete to modify its properties.

Aggregate. Inert material which is mixed with portland cement and water to produce concrete.

Aggregate, lightweight. Aggregate having a dry, loose weight of 70 pounds per cubic foot or less.

Column. An upright compression member the length of which exceeds three times its least lateral dimension.

Combination column. A column in which a structural steel member, designed to carry the principal part of the load, is encased in concrete of such quality and in such manner that the remaining load may be allowed thereon.

Composite column. A column in which a steel or cast-iron structural member is completely encased in concrete containing spiral and longitudinal reinforcement.

Composite concrete flexural construction. A precast concrete member and cast-in-place reinforced concrete so interconnected that the component elements act together as a flexural unit.

Compressive strength of concrete (f’c). Specified compressive strength of concrete in pounds per square inch (psi). Compressive strength shall be determined by tests of standard 6x12-inch cylinders made and tested in accordance with ASTM specifications at 28 days or such earlier age as concrete is to receive its full service load or maximum stress.

Concrete. A mixture of portland cement, fine aggregate, coarse aggregate, and water.

Concrete, structural lightweight. A concrete containing lightweight aggregate conforming to Section 2606 (c).

Deformed bar. A reinforcing bar conforming to “Specifications for Minimum Requirements for the Deformations of Deformed Steel Bars for Concrete Reinforcement” (ASTM A305) or “Specifications for Special Large Size Deformed Billet-Steel Bars for Concrete Reinforcement” (ASTM A408). Welded wire fabric with welded intersections not farther apart than 12 inches in the direction of the principal reinforcement and with cross wires not more than six gauge numbers smaller in size than the principal reinforcement may be considered equivalent to a deformed bar when used in slabs.

Effective area of concrete. The area of a section which lies between the centroid of the tension reinforcement and the compression face of the flexural member.

Effective area of reinforcement. The area obtained by multiplying the right cross-sectional area of the reinforcement by the cosine of the angle between its direction and the direction for which the effectiveness is to be determined.

Pedestal. An upright compression member whose height does not exceed three times its average least lateral dimension.

Plain bar. Reinforcement that does not conform to the definition of deformed bar.

Plain concrete. Concrete that does not conform to the definition for reinforced concrete.

Precast concrete. A plain or reinforced concrete element cast in other than its final position in the structure.

Prestressed concrete. Reinforced concrete in which there have been introduced internal stresses of such magnitude and distribution that the stresses resulting from such magnitude and distribution that the stresses resulting from service loads are counteracted to a desired degree.

Reinforced concrete. Concrete containing reinforcement and designed on the assumption that the two materials act together in resisting forces.

Reinforcement. Material that conforms to Section 2606 (e), excluding prestressing steel unless specifically included.

Service dead load. The calculated dead weight supported by a member.

Service live load. See Chapter 23.

Splitting tensile strength. (See Section 505, A.C.I.)

Stress. Intensity of force per unit area.

Surface water. Water carried by an aggregate except that held by absorption within the aggregate particles themselves.
Yield strength or yield point \( f_y \). Specified minimum yield strength or yield point of reinforcement in pounds per square inch. Yield strength or yield point shall be determined in tension according to applicable ASTM specifications. (See Standards, Section 2610.)

Section 2603. TEMPERATURE REQUIREMENTS. When the temperature falls below forty (40) degrees Fahrenheit, or rises above one hundred (100) degrees Fahrenheit, an approved means shall be provided to protect the concrete from freezing or from drying out too rapidly, respectively.

Section 2604. APPROVAL OF SPECIAL SYSTEMS OF DESIGN OR CONSTRUCTION. The sponsors of any system of design or construction within the scope of this Chapter, which has been in successful use, or the adequacy of which has been indicated by analysis or test, and the design of which is either not consistent with, or not provided for by this Building Code, shall have the right to present data on which their design is based to the Department for subsequent approval or disapproval.

Section 2605. LOAD TESTS OF STRUCTURES.*

* For approval of special systems of design or construction, see Section 2604.

(a) Notation.

\[ D = \text{service dead load.} \]
\[ L = \text{service live load.} \]
\[ \Delta = \text{maximum deflection, produced by a test load, of a member relative to the ends of the span, or of the free end of a cantilever relative to its support.} \]
\[ I = \text{span of member under load test (the shorter span of flat slabs and of slabs supported on four sides).} \]
\[ t = \text{total thickness or depth of member under load test (in inches).} \]

(b) Static Load Tests of Structures.

1. The Department shall have the right to order a test under the load of any portion of a structure, when conditions are such as to cause doubt about the safety of the structure.
2. When such load tests of a structure are required, a qualified engineer acceptable to the Department shall conduct the tests.
3. A load test of a structure shall not be made until the portion subjected to load is at least 56 days old, unless the owners of the structure agrees to the test being made at an earlier age.
4. When the entire structure is not to be tested, the portion of the structure thought to provide the least margin of safety shall be selected for loading. Prior to the application of the test load, a load which simulates the effect of that portion of the service dead load which is not already present shall be applied and shall remain in place until after a decision has been made regarding the acceptability by the Department of the structure. The test load shall not be applied until the structural members to be tested have borne the full service dead load for at least 48 hours.
5. Immediately prior to the application of the test load to flexural members (including beams, slabs, and floor and roof constructions), the necessary initial readings shall be made for the measurements of deflections (and strains, if these are considered necessary) caused by the application of the test load.
6. The members selected for loading shall be subjected to a super-imposed test load equivalent to 0.3 times the service dead load plus 1.7 times the service live load (test load = 0.3D + 1.7L). The test load shall be applied without shock to the structure and in a manner to avoid arching of the loading materials.
7. The test load shall be left in position for 24 hours whereupon readings of the deflections shall be taken. The test load shall be removed and additional readings of deflections shall be taken 24 hours after the removal of the test load.

(c) Criteria for Evaluation of Load Tests.

1. If the structure indicates evident failure or fails to meet the following criteria, the changes required to make the structure adequate for the rated capacity shall be made or a lower rating may be established.

A. If the maximum deflection, \( \Delta \), of a reinforced concrete beam, floor or roof exceeds \( 12/20,000t \), the recovery of deflection within 24 hours after the removal of the test load shall be at least 75 percent of the maximum deflection.
B. If the maximum deflection, \( \Delta \), is less than \( 12/20,000t \), the requirement on recovery of deflection in A may be waived.
C. In determining the limiting deflection for a cantilever, \( I \) shall be taken as twice the distance from the support to the end, and the deflection shall be adjusted for movement of the support.
D. Construction failing to indicate 75 per cent recovery of the deflection may be retested. The second test loading shall not be made until at least 72 hours after removal of the test load for the first test. The structure shall indicate no evidence of failure in the retest, and the recovery of deflection caused by the second test load shall be at least 75 per cent.

Section 2606. SPECIFICATIONS AND TESTS FOR MATERIALS.

(a) Tests of Materials.
1. The Department shall have the right to order from time to time the test of any material entering into the concrete or reinforced concrete to determine whether the materials and methods in use are such as to produce the specified quality.
2. Tests of materials and of concrete shall be made in accordance with the standards of the American Society for Testing and Materials, as noted elsewhere in this Chapter. (See Section 2610.) The complete records of such tests shall be available for inspection during the progress of the work and for two years thereafter, and shall be preserved by the engineer or architect for that purpose. (See Section 2610.)

(b) Portland Cement.
1. Portland cement shall conform to "Specifications for Portland Cement" (ASTM C 150) or "Specifications for Air-Entraining Portland Cement" (ASTM C 175). (See Section 2610.)
2. If provisions are made for sufficient damp curing of the concrete in the structure to develop a compressive strength at least equal to that of concrete containing cement conforming to (a), Portland type cements which conform to the following standards may be used: "Specifications for Portland Blast-Furnace Slag Cement" (ASTM C 205) and "Specifications for Portland-Pozzolan Cement" (ASTM C 340). (See Section 2610.)

(c) Concrete Aggregates.
1. Concrete aggregates shall conform to "Specifications for Concrete Aggregates" (ASTM C 330), except that aggregates failing to meet these specifications but which have been indicated by special test or actual service to produce concrete of adequate strength and durability may be used under Section 502 (a), Method 2 (ACI), where authorized by the Department.
2. Except as permitted elsewhere in this Chapter, the maximum size of the aggregate shall be not larger than one-fifth of the narrowest dimension between sides of the forms of the member for which the concrete is to be used nor larger than three-fourths of the minimum clear spacing between individual reinforcing bars or bundles of bars.

(d) Water. Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or steel. Mortar cubes made with nonpotable mixing water shall have 7-day and 28-day strengths equal to at least 90 per cent of the strengths of similar specimens made with potable water.

(e) Metal Reinforcement. (See Section 2610.)
1. Reinforcing bars shall conform to "Specifications for Billet-Steel Bars for Concrete Reinforcement" (ASTM A 15). "Specifications for Rail-Steel Bars for Concrete Reinforcement" (ASTM A 16). "Specifications for Deformed Rail-Steel Bars for Concrete Reinforcement with 60,000 psi Minimum Yield Strength" (ASTM A 61). "Specifications for Axle-Steel Bars for Concrete Reinforcement" (ASTM A 160), "Specifications for Special Large Size Deformed Billet-Steel Bars for Concrete Reinforcement" (ASTM A 408), "Specifications for High Strength Deformed Billet-Steel Bars for Concrete Reinforcement with 75,000 psi Minimum Yield Strength" (ASTM A 431), or "Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement with 60,000 psi Minimum Yield Strength" (ASTM A 432). Deformations on deformed bars shall conform to "Specifications for Deformations of Deformed Steel Bars for Concrete Reinforcement" (ASTM A 305) or "Specifications for Special Large Size Deformed Billet-Steel Bars for Concrete Reinforcement" (ASTM A 408). If reinforcing bars are to be welded, these ASTM specifications shall be supplemented by requirements assuring satisfactory weldability in conformity with AWS D12.1, "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
2. Bar and rod mats for concrete reinforcement shall conform to "Specifications for Fabricated Steel Bar or Rod Mats for Concrete Reinforcement" (ASTM A 184).
3. Wire for concrete reinforcement shall conform to "Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement" (ASTM A 82).

4. Welded wire fabric for concrete reinforcement shall conform to "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A 185) except that the weld shear strength requirement of Section 5b of those specifications shall be extended to include a wire size differential up to and including six gages.

5. Wire and strands for prestressed concrete shall conform to "Specifications for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete" (ASTM A 416) or "Specifications for Wire, Uncoated Stress-Relieved for Prestressed Concrete" (ASTM A 421). Wires used in making strands for post-tensioning shall be cold-drawn and either stress-relieved in the case of uncoated strands, or hot-dip galvanized in the case of galvanized strands.

6. High strength alloy steel bars for post-tensioning shall be proof-stressed to 90 per cent of the guaranteed tensile strength. After proof-stressing, the bars shall conform to the following minimum properties:
   - Tensile strength $f_p$ \( \geq 45,000 \text{ psi} \)
   - Yield strength \(0.2\% \text{ offset}) \leq 0.90 f_p\)
   - Elongation at rupture in 20 diameters \( \geq 4 \text{ per cent} \)
   - Reduction of area at rupture \( \geq 25 \text{ per cent} \)

7. Structural steel shall conform to "Specifications for Structural Steel" (ASTM A 36), or "Specifications for Structural Steel for Welding" (ASTM A 373). (See Section 2610).

8. Steel pipe for concrete-filled pipe columns shall conform to Grade B of "Specifications for Welded and Seamless Steel Pipe" (ASTM A 53).

9. Cast-iron pipe for composite columns shall conform to "Specifications for Cast Iron Pressure Pipe" (ASTM A 377). (See Section 2610.)

(h) Pozzolanic Admixtures.

1. Fly ash, when used as an admixture, shall conform to "Specifications for Fly Ash for Use as an Admixture in Portland Cement Concrete" (ASTM C 350). (See Section 2610.)

2. Other pozzolans used as admixtures shall conform to "Specifications for Raw or Calcined Natural Pozzolans for Use as Admixtures in Portland Cement Concrete" (ASTM C 402). (See Section 2610.)

(i) Storage of Materials. Cement and aggregates shall be stored in such a manner as to prevent their deterioration or the intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

Section 2607. BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE (ACI-318).

For purposes of this Chapter, Parts I and II of the ACI Code shall be invalid and Sections 2600 through 2610 of this Chapter shall apply. Parts III, IV, IV A, IV B, V and the Appendix of the ACI Code shall apply. (See Section 2610). Design analysis shall conform to ACI-318. (See Section 2610).

Section 2610. STANDARDS. Unless otherwise provided in this Building Code, the Standards as set forth in this Chapter shall prevail.

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| Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Laboratory, C192-66
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| Specifications for Air-Entraining Admixtures for Concrete, C260-66T
| Specifications for Lightweight Aggregates for Structural Concrete, C330-64T
| Specifications for Portland-Pozzolan Cement, C595-67T
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| Method of Test for Splitting Tensile Strength of Molded Concrete Cylinders, C496-66
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ACI Recommended Practice for Evaluation of Compression Test Results of Field Concrete, 214-57
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<td>ACI</td>
<td>American Concrete Institute P.O. Box 4754, Reford Station Detroit 19, Mich.</td>
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CHAPTER 27
STRUCTURAL STEEL

Section 2701. SCOPE

In addition to other provisions of this Building Code, this Chapter shall govern the design, fabrication and erection of structural steel, open web steel joists, and light gauge cold formed steel for buildings, structures and utilities.

Section 2702. MATERIAL

(a) Structural Steel. Structural steel shall conform to one of the following specifications:

- Structural Steel for Welding, ASTM A 36
- Structural Steel, ASTM A 36
- High-Strength Structural Steel, ASTM A 440
- High-Strength Low-Alloy Structural Manganese Vanadium Steel, ASTM A 441
- High-Strength Low-Alloy Structural Steel, ASTM A 242
- Welded and Seamless Steel Pipe, ASTM A 53, Grade B

Certified mill test reports shall constitute sufficient evidence of conformity with the specifications.

Unidentified steel, if free from surface imperfections, may be used for parts of minor importance, or for unimportant details, where the precise physical properties of the steel and its weldability would not affect the strength of the structure.

(b) Other Metals. Cast steel shall conform to one of the following specifications:

- Mild-to-Medium-Strength Carbon-Steel Castings for General Application, ASTM A 27, Grade 65-35
- High-Strength Steel Castings for Structural Purposes, ASTM A 148, Grade 80-50

Certified test reports shall constitute sufficient evidence of conformity with the specifications.

Steel forgings shall conform to one of the following specifications:

- Carbon Steel Forgings for General Industrial Use, ASTM A 235, Class C 1, F and G (Class C 1 Forgings that are to be welded shall be ordered in accordance with Supplemental Requirements S 5 of A 235)
- Alloy Steel Forgings for General Industrial Use, A 237, Class A

Certified test reports shall constitute sufficient evidence of conformity with the specifications.

(c) Rivet Steel. Rivet steel shall conform to one of the following specifications:

- Structural Rivet Steel, ASTM A 141
- High-Strength Structural Rivet Steel, ASTM A 195
- High-Strength Structural Alloy Rivet Steel, ASTM A 406

Certified mill test reports shall constitute sufficient evidence of conformity with the specifications.

(d) Bolts. High strength steel bolts shall conform to one of the following specifications:

- High Strength Steel Bolts for Structural Joints, ASTM A 325
- Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts, ASTM A 354, Grade BC

Other bolts shall conform to the Specifications for Low-Carbon Steel Externally and Internally Threaded Standard Fasteners, ASTM A 307 hereinafter designated as A 307 bolts.

Manufacturer's certification shall constitute sufficient evidence of conformity with the specifications.

(e) Filler Metal for Welding. Welding electrodes for manual shielded metal-arc welding shall conform to the E 60 or E 70 series of the Specification for Mild Steel Arc-Welding Electrodes, ASTM A 233.

Bare electrodes and granular flux used in the submerged-arc process shall conform to the provisions of Section 2714 (c).

Manufacturer's certification shall constitute sufficient evidence of conformity with the specifications.

(f) Used Steel. Used steel is permitted provided proper allowance is made for holes, reduction in section by rust or other defects, and provided that not more than eighty per cent (80%) of the stresses permitted in Section 2704 for ASTM A 7 steel is used. Used steel shall not be employed in structures designed by Plastic Design, specified in Section 2723.

Section 2703. NOMENCLATURE

The following is the nomenclature used in this Chapter:

- \( A_b \) Nominal body area of a bolt.
- \( A_c \) Actual area of effective concrete flange in composite design.
- \( A_{bc} \) Planar area of web at beam-to-column connection.
- \( A_t \) Area of compression flange.
- \( A_w \) Area of steel beam in composite design.
- \( A_{st} \) Cross-sectional area of stiffener or pair of stiffeners.
- \( A_w \) Area of girder web.
- \( B \) Coefficient used in column formula for plastic design.
- \( C_b \) Bending coefficient dependent upon moment gradient; equal to

\[
1.75 - 1.05 \left( \frac{M_1}{M_2} \right) + 0.3 \left( \frac{M_3}{M_2} \right)
\]

- \( C_e \) Column slenderness ratio dividing elastic and inelastic buckling; equal to

\[
\sqrt{\frac{2 \pi^2 \nu^2}{E} \frac{2L}{D}}
\]
\[ C_m \text{ Coefficient applied to bending term in interaction formula and dependent upon column curvature caused by applied moments.} \]

\[ C_r \text{ Ratio of "critical" web stress, according to the linear buckling theory, to the shear yield point of web material; equal to} \]

\[ \frac{TT^* E_k \sqrt{3}}{12 (1 - \nu^2) (h/t)^2 F_y} \]

\[ D \text{ Factor depending upon type of transverse stiffeners.} \]

\[ E \text{ Modulus of elasticity of steel (29,000,000 pounds per square inch).} \]

\[ E_e \text{ Modulus of elasticity of concrete} \]

\[ F_a \text{ Axial stress, permitted in the absence of bending moment.} \]

\[ F_b \text{ Bending stress permitted in the absence of axial force.} \]

\[ F'_b \text{ Allowable bending stress in compression flange of plate girders as reduced because of large web depth-to-depth thickness ratio.} \]

\[ F_e \text{ Euler stress divided by factor of safety; equal to} \]

\[ \frac{149,000,000}{\left( \frac{Kl_b}{r_b} \right)^2} \]

\[ F_p \text{ Allowable bearing stress.} \]

\[ F_t \text{ Allowable tensile stress.} \]

\[ F_y \text{ Specified minimum yield point of the type of steel being used (pounds per square inch unless otherwise noted).} \]

\[ G \text{ Coefficient used in column formula in plastic design.} \]

\[ H \text{ Coefficient used in column formula in plastic design.} \]

\[ I_{tr} \text{ Moment of inertia of transformed composite section.} \]

\[ J \text{ Coefficient used in column formula in plastic design.} \]

\[ K \text{ Effective length factor.} \]

\[ L \text{ Span length, in feet.} \]

\[ L_u \text{ Maximum unbraced length of compression flange, in feet, for which full bending stress is permitted by Formula (5).} \]

\[ M \text{ Moment.} \]

\[ M_1 \text{ Smaller end moment on unbraced length of beam-column.} \]

\[ M_2 \text{ Larger end moment on unbraced length of beam-column.} \]

\[ M_D \text{ Moment produced by dead load.} \]

\[ M_L \text{ Moment produced by live load.} \]

\[ M_{rd} \text{ Reduced plastic moment.} \]

\[ M_{pl} \text{ Plastic moment.} \]

\[ N \text{ Length of bearing of applied load.} \]

\[ P \text{ Applied load.} \]

\[ P_f \text{ Plastic axial load; equal to profile area times specified minimum yield point.} \]

\[ R \text{ Reaction or concentrated transverse load applied to beam or girder.} \]

\[ S_s \text{ Section modulus of steel beam used in composite design, referred to the tension flange.} \]

\[ S_{st} \text{ Section modulus of transformed composite cross-section referred to the tension flange.} \]

\[ T_b \text{ Proof load of a high strength bolt.} \]

\[ V \text{ Statical shear on beam.} \]

\[ V_h \text{ Total horizontal shear to be resisted by connectors.} \]

\[ V_u \text{ Statical shear produced by "ultimate" load in plastic design.} \]

\[ Y \text{ Ratio of yield point of web steel to yield point of stiffener steel.} \]

\[ \alpha \text{ Clear distance between transverse stiffeners.} \]

\[ \alpha' \text{ Distance required at ends of welded partial length cover plate to develop stress.} \]

\[ b \text{ Effective width of concrete slab.} \]

\[ b_t \text{ Flange width of rolled beam or plate girder.} \]

\[ c \text{ Distance from neutral axis to top of concrete slab.} \]

\[ d \text{ Depth of beam or girder. Also diameter of roller or rocker bearing.} \]

\[ e \text{ Horizontal displacement, in the direction of the span, between top and bottom of simply supported beam at its ends.} \]

\[ f \text{ Computed axial stress.} \]

\[ f_b \text{ Computed bending stress.} \]

\[ f_c \text{ Specified compression strength of concrete at 28 days.} \]

\[ f_t \text{ Computed tensile stress.} \]

\[ f_v \text{ Computed shear stress, in pounds per square inch.} \]

\[ f_{vs} \text{ Shear between girder web and transverse stiffeners, in pounds per linear inch of single stiffener or pair of stiffeners.} \]

\[ g \text{ Transverse spacing between fastener gage lines.} \]

\[ h \text{ Clear distance between flanges of a beam or girder.} \]

\[ k \text{ Coefficient relating linear buckling strength of a plate to its dimensions and condition of edge support. Also distance from outer face of flange to web toe of fillet.} \]

\[ l \text{ Actual unbraced length, in inches.} \]

\[ l_b \text{ Actual unbraced length in plane of bending, in inches.} \]

\[ l_{cr} \text{ Critical unbraced length adjacent to plastic hinge, in inches.} \]

\[ n \text{ Modular ratio; equal to } E/E_s. \]

\[ q \text{ Allowable horizontal shear to be resisted by a connector.} \]

\[ r \text{ Governing radius of gyration.} \]

\[ r_b \text{ Radius of gyration about axis of concurrent bending.} \]

\[ r_f \text{ Lesser radius of gyration.} \]

\[ s \text{ Spacing (pitch) between successive holes in line of stress.} \]

\[ t \text{ Girder or beam web thickness.} \]

\[ t_f \text{ Flange thickness.} \]

\[ t_{pl} \text{ Thickness of thinner part joined by partial penetration groove weld.} \]

\[ w \text{ Web thickness of plastically designed rolled beams. Also length of channel shear connectors.} \]
Poisson's ratio.

Section 2704. ALLOWABLE UNIT STRESSES.

Except as provided in Sections 2705, 2708, 2709, 2723, 2724 and 2725, all components of the structure shall be so proportioned that the unit stress, in pounds per square inch, shall not exceed the following values, except as they are rounded off in the Appendix to the A.I.S.C. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

(a) Structural Steel

1. Tension
   - On the net section, except at pin holes
     \[ F_t = 0.60 F_y \]
   - On the net section at pin holes in eyebars, pin-connected plates or built-up members
     \[ F_t = 0.45 F_y \]

2. Shear
   - On the gross section of beam and plate girder webs
     \[ F_s = 0.40 F_y \]
     (See Section 2708 for reduction required for thin webs)

3. Compression
   - On the gross section of axially loaded compression members when \( K_l/r \), the largest effective slenderness ratio of any unbraced segment as defined in Section 2706, is less than \( C_c \)
     \[ F_c = \left( 1 - \frac{(K_l/r)^2}{2C_c^2} \right) F_y \]
     \( F.S. \quad \text{Formula (1)} \)
     \[ \text{where:} \]
     \[ \text{factor} \quad 5 \quad \frac{3(K_l/r)^2}{8C_c} \]
     \[ \text{safety} \quad 3 \quad \frac{8C_c}{8C_c} \]
     \[ C_c = \sqrt{\frac{2F_y^2}{E}} \]
   - On the gross section of axially loaded columns when \( 1/r \) exceeds \( C_c \)
     \[ F_c = \frac{149,000,000}{(K_l/r)^2} \]
     \( \text{Formula (2)} \)

NOTE: Compression members made from pipe shall be designed on the basis of ASTM - A7 steel, except that the allowable axial stress \( F_a \) and allowable bending stress \( F_b \) shall be further reduced by ten per cent (10%). If ASTM A 53 Grade B pipe is specified, such members may be designed on the basis of ASTM - A36 steel.

On the gross area of plate girder stiffeners
\[ F_a = 0.60 F_y \]

On the web of rolled shapes at the toe of the fillet (crippling, see Section 2708 (j)).
\[ F_a = 0.75 F_y \]

4. Bending
   - Tension and compression on extreme fibers of rolled shapes and built-up members having an axis of symmetry in the plane of loading and proportions meeting the requirements of Section 2723 (f) when the compression flange is supported laterally at intervals no greater than 13 times its width
     \[ F_b = 0.66 F_y \]
   - Beams and girders which meet the requirements of the preceding paragraph and are continuous over supports or are rigidly framed to columns by means of rivets, high strength bolts or welds, may be proportioned for 9/10 of the negative moment's produced by gravity loading which are maximum at points of support, provided that, for such members, the maximum positive moment shall be increased by 1/10 of the average negative moments. This reduction shall not apply to moments produced by loading on cantilevers. If the negative moment is resisted by a column rigidly framed to the beam or girder, the 1/10 reduction may be used in proportioning the column for the combined axial and bending loading, provided that the unit stress, due to any concurrent axial load on the member, does not exceed 0.15 \( F_y \).
   - Tension and compression on extreme fibers of unsymmetrical members when the compression flange is supported laterally at intervals no greater than 13 times the width
     \[ F_b = 0.60 F_y \]
   - Tension and compression on extreme fibers of box-type members whose proportions do not meet the provisions of a compact section, but do conform to the provisions of Section 2707.
     \[ F_b = 0.60 F_y \]
   - Tension on extreme fibers of other rolled shapes, built-up members and plate girders
     \[ F_b = 0.60 F_y \]
   - Compression on extreme fibers of rolled shapes, plate girders and built-up members having an axis of symmetry in the plane of their web (other than box-type beams and girders), the larger value computed by Formulas (4) and (5), but not more than 0.60 \( F_y \).
     \[ F_b = \left( 1.0 - \frac{(1/r)^2}{2C_c^2 C_b} \right) 0.60 F_y \]
     \( \text{Formula (4)} \)

27-3
Where \( 1/r \) is less than 40, stress reduction according to Formula (4) may be neglected.

\[
F_b = \frac{12,000,000}{\frac{1}{r}} \quad \text{Formula (5)}
\]

Where \( l \) is the unbraced length of the compression flange; \( r \) is the radius of gyration of a tee section comprising the compression flange plus one-sixth of the web area, about an axis in the plane of the web; \( A_r \) is the area of the compression flange; \( C_0 \) is defined in Section 2704 (a) (3) and \( C_b \), which can conservatively be taken as unity, is equal to

\[
C_b = 1.75 - 1.05 \left( \frac{M_1}{M_2} \right) + 0.3 \left( \frac{M_1}{M_2} \right)^2
\]

but not more than 2.3 where \( M_1 \) is the smaller and \( M_2 \) the larger bending moment at the ends of the unbraced length, taken about the strong axis of the member, and where \( M_1/M_2 \), the ratio of end moments, is positive when \( M_1 \) and \( M_2 \) have the same sign (single curvature bending). When the bending moment at any point within an unbraced length is larger than that at both ends of this length the ratio \( M_1/M_2 \) shall be taken as unity. See Section 2708 for further limitation in plate girder flange stress.

Compression on extreme fibers of channels, the value computed by Formula (5), but not more than

\[
F_c = 0.60F_y
\]

Tension and compression on extreme fibers of pins:

\[
F_t = 0.90F_y
\]

Tension and compression on extreme fibers of rectangular bearing plates:

\[
F_b = 0.75F_y
\]

5. Bearing (on contact area).

Milled surfaces, including bearing stiffeners, and pins in reamed, drilled or bored holes, pounds per square inch:

\[
F_{p} = 0.90F_y \quad *\quad \text{Expansion rollers and rockers, pounds per linear inch}
\]

\[
F_{p} = \left( \frac{F_y - 13,000}{20,000} \right) 660d
\]

where \( d \) is the diameter of roller or rocker in inches.

* When parts in contact have different yield points, \( F_y \) shall be the smaller value.

(b) Rivets and Bolts.

1. Allowable unit tension and shear stresses on rivets, bolts and threaded parts (pounds per square inch of area of rivets before driving or unthreaded body area of bolts and threaded parts) shall be as given in Table No. 27-A.

2. Allowable bearing stress on projected area of bolts in bearing type connections and on rivets:

\[
F_b = 1.35F_y
\]

(Bearing stress not restricted in friction-type connections assembled with A325 and A354, Grade BC, bolts.)

(c) Welds (stress in pounds per square inch of throat area).

1. Fillet, Plug, Slot and Partial Penetration Groove Welds.

Fillet, plug, slot and partial penetration groove welds made with A233 Class E60 series electrodes and fillet welds made by submerged arc welding Grade SAW-1, 13,600 Fillet, plug, slot and partial penetration groove welds made with A233 Class E70 series electrodes and fillet welds made by submerged arc welding SAW-2............15,800

2. Groove Welds.

On complete penetration groove welds the allowable tension, compression, bending, shear and bearing stresses shall be the same as those allowed by Section 2704 in the connected material, and these stresses are also applicable to partial penetration groove welds in compression or bearing. See Section 2714 (b) for electrodes to be employed on various grades of steel.

(d) Cast Steel and Steel Forgings.

1. Tension (on net section)

\[
F_t = 0.60F_y
\]

2. Shear (on gross section)

\[
F_v = 0.40F_y
\]

3. Compression

Same as provided under Section 2704 (a) 3

4. Bending (on extreme fibers)

\[
F_b = 0.60F_y
\]

5. Bearing

Same as provided under Section 2704 (a) 5

(e) Wind and Seismic Stresses.

Allowable stresses may be increased one-third above the values provided in Sections 2704 (a), (b), (c), and (d) when produced by wind or seismic loading, acting alone or in combination with dead and live loads, provided the section so obtained is at least that required by dead and live load alone.

Section 2705. COMBINED STRESSES.

(a) Axial Compression and Bending. Members subject to both axial compression and bending stresses shall be proportioned to meet the requirements of both Formula (6) and Formula (7).
when \( F_a/F_b \leq 0.15 \)  
\[
\frac{f_a}{F_a} + \frac{f_b}{F_b} \leq 1.0
\]
Formula (6)

when \( F_a/F_b > 0.15 \)  
\[
\frac{f_a + C_m f_b}{F_a (1 - f_a/F_b)} \leq 1.0
\]
Formula (7a)

and, in addition, at points braced in the plane of bending,  
\[
\frac{f_a}{0.6 F_y} + \frac{f_b}{F_b} \leq 1.0
\]
Formula (7b)

where
- \( F_a \) = axial stress that would be permitted if axial stress alone existed
- \( F_b \) = bending stress that would be permitted if bending stress alone existed
- \( f_a \) = computed axial stress
- \( f_b \) = computed bending stress at the point under consideration
- \( C_m = 0.85 \), except as follows:
  1. When \( f_a/F_b \leq 0.15 \). (For this case the member selected shall meet the limitation that \( f_a/F_a + f_b/F_b \leq 1.0 \).
  2. For restrained compression members in frames braced against joint translation but not subject to transverse loading between their supports in the plane of loading, \( C_m \) may be taken as 0.6 + 0.4 \( (M_r/M_s) \), where \( M_r/M_s \) is the ratio of smaller to larger moments at the ends of the critical unbraced length of the member. \( M_r \) is positive when the unbraced length is bent in single curvature and negative when it is bent in reverse curvature.
  3. For restrained compression members in frames braced against joint translation in the plane of loading and subject to transverse loading between their supports (joints) in the plane of loading, a value of \( C_m \) may be determined by rational analysis.
  4. See note for compression members made of pipe under Section 2704 (a) 3.

(b) Shear and Tension. Rivets and bolts subject to combined shear and tension due to force applied to the connected parts, shall be so proportioned that the tension stress produced by the force shall not exceed the following:

For A141 rivets ....... \( F_t = 28,000 - 1.6 f_t \leq 20,000 \)
For A195 and A406 rivets —
\( F_t = 38,000 - 1.6 f_t \leq 27,000 \)
For A307 bolts ....... \( F_t = 20,000 - 1.6 f_t \leq 14,000 \)
For A325 bolts in bearing-type joints —
\( F_t = 50,000 - 1.6 f_t \leq 40,000 \)
For A354, Grade BC, bolts in bearing-type joints ......... \( F_t = 60,000 - 1.6 f_t \leq 50,000 \)

where \( f_t \), the shear stress produced by the same force, shall not exceed the value for shear given in Section 2704 (b).

For bolts used in friction-type joints, the shear stress allowed in Section 2704 (b) shall be reduced so that:

For A325 bolts ......... \( F_t \leq 15,000 (1 - f_t A_b/T_b) \)
For A354, Grade BC, bolts .... \( F_t \leq 20,000 (1 - f_t A_b/T_b) \)

where \( f_t \) is the tensile stress due to applied load and \( T_b \) is the proof load of the bolt.

Section 2706. SLENDERNESS RATIOS.

(a) Definition. In determining the slenderness ratio of an axially loaded compression member, \( K_l \) shall be taken as its effective length and \( r \) the corresponding radius of gyration.

(b) Sidesway Prevented. The effective length of compression members in trusses, and in frames where lateral stability is provided by diagonal bracing, shear walls, attachment to an adjacent structure having adequate lateral stability, or by floor slabs or roof decks secured horizontally by walls or bracing systems parallel to the place of the frame, shall be taken as the actual unbraced length, unless analysis shows that a shorter length may be used.

(c) Sidesway Not Prevented. The effective length of compression members in a frame which depends upon its own bending stiffness for lateral stability, shall be determined by a rational method and shall not be less than the actual unbraced length.

(d) Maximum Ratios. The slenderness ratio of compression members shall not exceed 200.

The slenderness ratio of tension members, other than rods, preferably should not exceed:

For main members .......................................... 240
For bracing and other secondary members.............. 300

Section 2707. WIDTH-THICKNESS AND MINIMUM THICKNESS.

(a) 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; double-angle struts with separators .......... 2,400/\( \sqrt{F_y} \)
Struts comprising double angles in contact; angles or plates projecting from girders, columns or other compression members; compression flanges of beams; stiffeners on plate girders .... 3,000/\( \sqrt{F_y} \)
Stems of tees ........................................ 4,000/\( \sqrt{F_y} \)

The widths of plates shall be taken from...
the free edge to the first row of rivets, bolts or
welds; the width of legs of angles, channels and
zees, 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 preced­
ing paragraph, but would conform to same and
would satisfy the stress requirements with a por­
tion of its width considered as removed, the
member will be acceptable.

(b) Compression Elements Supported Along
Two Edges. In compression members the unsup­
ported width of web, cover or diaphragm plates,
between the nearest lines of fasteners or welds,
or between the roots of the flanges in case of
rolled sections, shall not exceed 8,000/\sqrt{F_y} times
its thickness.

When the unsupported width exceeds this
limit, but a portion of its width no greater than
8,000/\sqrt{F_y} times the thickness would satisfy the
stress requirements, the member will be consid­
ered acceptable.

The unsupported width of cover plates per­
forated with a succession of access holes, may
exceed 8,000/\sqrt{F_y}, but shall not exceed 10,000/
\sqrt{F_y}, times the thickness. The gross width of the
plate less the width of the widest access hole
shall be assumed available to resist compression.

(c) Exterior Steelwork. Exterior steelwork ex­
posed 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.

The controlling thickness of rolled shapes
shall be taken as a mean thickness of their
flanges, regardless of web thickness.

Exterior purlins, girts, trusses and bracing
members sheltered from direct exposure to rain
and snow shall have a minimum thickness of
three-sixteenths (3/16) inch.

Signs, exterior stairs, joists, skylight bars,
non-bearing partitions and walls, suspended
ceilings, studs, and similar steel shapes, and
light gage cold-formed steel, shall not be lim­
ited by the above thickness requirements.

(d) Interior Steelwork. Interior steelwork ex­
posed to conditions no more corrosive than indoor
atmosphere controlled for human comfort shall
not be limited in thickness except as otherwise
specified in this Chapter.

(e) Exceptions to the Above Requirements.

Steelwork exposed to industrial fumes or vapor
of a corrosive nature shall be suitably increased
in thickness or be given special protection, which
shall meet the approval of the Department.

Section 2708. PLATE GIRDERS AND
ROLLED BEAMS.

(a) Proportions. Riveted and welded plate
girders, cover-plated beams and rolled beams
shall in general be proportioned by the moment
of inertia of the gross section. No deduction shall
be made for shop or field rivet or bolt holes in
either flange, except that in cases where the
reduction of the area of either flange by such
holes, calculated in accordance with the provi­
sions of Section 2711 (c) exceeds 15 percent of
the gross flange area, the excess shall be de­
ducted.

(b) Web. The clear distance between flanges
in inches, shall not exceed

\[
\frac{14,000,000}{\sqrt{F_y} \left( F_y + 16,500 \right)}
\]

times the web thickness.

(c) Flanges. The thickness of outstanding
parts of flanges shall conform to the require­
ments of Section 2707.

Each flange of welded plate girders shall
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 joined by complete penetra­
tion butt welds.

Unstiffened cover plates on riveted girders
shall not extend more than 3,000/\sqrt{F_y} times the
thickness of the thinnest outside plate beyond
the outer row of rivets or bolts connecting them
to the angles. The total cross-sectional area of
cover plates of riveted girders shall not exceed
70 percent of the total flange area.

(d) Flange Development. Rivets, high
strength bolts or welds connecting flange to web,
or cover plate to flange, shall be proportioned to
resist the total horizontal shear resulting from
the bending forces on the girder. The longitudinal
distribution of these rivets or intermittent welds
shall be in proportion to the intensity of the
shear. But the longitudinal spacing shall not ex­
ceed the maximum permitted, respectively, for
compression or tension members in Section
2715 (b) or 2715 (c). Additionally, rivets or welds
connecting flange to web shall be proportioned
to transmit to the web any loads applied directly
to the flange unless provision is made to trans­
mit to the web any loads applied directly to the
flange unless provision is made to transmit such
loads by direct bearing.

Partial length cover plates shall be extended
beyond the theoretical cut-off point and the ex­
tended portion shall be attached to the beam or
girder by rivets, high strength bolts (friction-type
joint), or fillet welds adequate, at stresses al­
lowed in Section 2704 (b) or (c), to develop the
cover plate’s portion of the flexural stresses in
the beam or girder in the length a’, defined
below, shall be adequate, at the allowed stress-
es, to develop the cover plate's portion of the flexural stresses in the beam or girder at the distance \( a' \) from the end of the cover plate. The length \( a' \), measured from the end of the cover plate, shall be:

1. A distance equal to the width of the cover plate when there is a continuous weld equal to or larger than \( \frac{3}{4} \) of the plate thickness across the end of the plate and continued welds along both edges of the cover plate in the length \( a' \).

2. A distance equal to \( 1\frac{1}{2} \) times the width of the cover plate when there is a continuous weld smaller than \( \frac{3}{4} \) of the plate thickness across the end of the plate and continued welds along both edges of the cover plate in the length \( a' \).

3. A distance equal to 2 times the width of the cover plate when there is no weld across the end of the plate but continuous welds along both edges of the cover plate in the length \( a' \).

(e) Stiffeners.

1. Bearing stiffeners shall be placed in pairs at unframed ends on the webs of plate girders and, where required by the provisions of Section 2708 (f), at points of concentrated loads. Such stiffeners shall have a close bearing against the flange, or flanges, through which they receive their loads or reactions, and shall extend approximately to the edge of the flange plates or flange angles. They shall be designed as columns subject to the provisions of Section 2704 (a), assuming the column section to comprise the pair of stiffeners and a centrally located strip of the web whose width is equal to not more than 25 times its thickness at interior stiffeners or a width equal to not more than 12 times its thickness when the stiffeners are located at the end of the web. The effective length shall be taken as not less than \( \frac{3}{4} \) 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.

2. The largest average web shear \( f_v \) in any panel between stiffeners (total shear force divided by web cross-sectional area), in pounds per square inch, computed for any condition of complete or partial loading, shall not exceed the value given by Formula (8) or (9), as applicable. (For values of \( F_v \) corresponding to various stiffener spacing, see Tables 3 in the Appendix of the A.I.S.C. Specification for the Design, Fabrication and Erection of Structural for Buildings.)

\[
F_v = \frac{F_y}{2.89} \left( C_v + \frac{1 - C_v}{1.15 \sqrt{1 + (a/h)^2}} \right) \quad \text{Formula (8)}
\]

where \( C_v \) is less than 1.0;

\[
F_v = \frac{F_y}{2.89} C_v \quad \text{Formula (9)}
\]

but not more than \( 0.4 \) \( F_y \), when \( C_v \) is more than 1.0 when intermediate stiffeners are omitted; where

\( a = \) clear distance between transverse stiffeners, in inches

\( h = \) clear distance between flanges, in inches

\( t = \) thickness of web, in inches

\[
45,000,000k
\]

\[
C_v = \frac{F_y}{F_v (h/t)^2} \quad \text{when } C_v \text{ is less than 0.8}
\]

\[
6,000 \sqrt{\frac{k}{h/t}} F_v \quad \text{when } C_v \text{ is more than 0.8}
\]

\[
k = 4.00 + \frac{(a/h)^2}{5.34} \quad \text{when } a/h \text{ is less than 1.0}
\]

\[
k = 4.00 + \frac{(a/h)^2}{5.34} \quad \text{when } a/h \text{ is more than 1.0}
\]

When \( a/h \) is more than 3 its value shall be taken as infinity. In this case Formula (8) reduces to Formula (9) and \( k = 5.34 \).

3. Intermediate stiffeners are not required when the ratio \( h/t \) is less than 260 and the maximum web shear stress \( f_v \) is less than that permitted by Formula (9).

The spacing of intermediate stiffeners, when stiffeners are required, shall be such that the web shear stress will not exceed the value for \( F_v \) given by Formula (8) or (9), as applicable and the ratio \( a/h \) shall not exceed

\[
\left( \frac{260}{h/t} \right)^2 \text{ nor 3.0.}
\]

The spacing between stiffeners at end panels and panels containing large holes shall be such that the smaller panel dimension, \( a \) or \( h \), shall not exceed
4. The gross area, in square inches, of intermediate stiffeners spaced in accordance with Formula (8) (total area, when stiffeners are furnished in pairs) shall be at least that computed by

Formula (10)

\[
A_{st} = \frac{1 - C_v}{2} \left( \frac{a}{h} - \frac{(a/h)^2}{\sqrt{1 + (a/h)^2}} \right) YDht
\]

where \( C_v \), \( a \), \( h \) and \( t \) are as defined in Section 2708 (e)

\( Y = \frac{F_y}{F_v} \) yield point of web steel

\( D = 1.0 \) for stiffeners furnished in pairs

\( = 1.8 \) for single angle stiffeners

\( = 2.4 \) for single plate stiffeners

When the greatest shear stress \( f_v \) in a panel is less than that permitted by Formula (8) this gross area requirement may be reduced in like proportion.

The moment of inertia of a pair of stiffeners, or a single stiffener, with reference to an axis in the plane of the web, shall not be less than \((h/50)^4\).

Intermediate stiffeners may be stopped short of the tension flange a distance not to exceed 4 times the web thickness, provided bearing is not needed to transmit a concentrated load or reaction. When intermittent fillet welds are used, the clear distance between welds shall not be more than sixteen \((16)\) times the web thickness nor more than ten \((10)\) inches.

(f) Reduction in Flange Stress.

When the web depth-to-thickness ratio exceeds \(24,000/F_v\), the maximum stress in the compression flange shall not exceed:

\[
F'_{b} \leq F_b \left( 1.0 - 0.0005 \frac{A_w}{A_t} \left( \frac{h}{t} - \frac{24,000}{F_b} \right) \right)
\]

where

\( F_b = \) applicable bending stress given in Section 2704 (a)

\( A_w = \) area of the web

\( A_t = \) area of compression flange

(g) Combined Shear and Tension Stress.

Plate girder webs subject to a computed average shear stress in excess of that permitted by Formula (9) shall be so proportioned that the bending tensile stress, due to moment in the plane of the girder web, shall not exceed 0.6\(F_v\), nor

\[
0.825 - 0.375 \frac{F_v}{F_y} \frac{f_v}{F_t}
\]

where

\( f_v = \) computed web shear stress (total shear divided by web area)

\( F_y = \) allowable web shear stress according to Formula (8) or (9)

(h) Splices.

Spliced cross-sections in plate girders and in beams, except butt welded splices, shall develop the strength required by the stresses, at the point of splice, but in no case less than 50 percent of the effective strength of the material spliced. Butt welded splices shall develop the full strength of the smaller spliced section.

(i) Horizontal Forces.

The flanges of plate girders supporting cranes or other moving loads shall be proportioned to resist the horizontal force produced by such loads. (See Chapter 23).

(j) Web Crippling.

1. Webs of beams and welded plate girders 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 \(0.75F_y\) pounds per square inch allowed in Section 2704 (a); otherwise, bearing stiffeners shall be provided. The governing formulas shall be:

For interior loads:

\[
\frac{R}{t(N+2k)} \leq 0.75F_y \text{ pounds per square inch} \\
\text{Formula (13)}
\]

For end reactions:

\[
\frac{R}{t(N+k)} \leq 0.75F_y \text{ pounds per square inch} \\
\text{Formula (14)}
\]

where

- \(R\) = concentrated load or reaction, in pounds
- \(t\) = thickness of web, in inches
- \(N\) = length of bearing in inches (not less than \(k\) for end reactions)
- \(k\) = distance from outer face of flange to web toe of fillet, in inches

2. Webs of plate girders shall be proportioned or stiffened that the sum of the compression stresses resulting from concentrated and distributed loads, bearing directly on or through a flange plate, and not supported directly by bearing stiffeners, shall not exceed

\[
5.5 + \frac{4}{(a/h)^2} \times \frac{10,000,000}{(h/t)^2} \text{ pounds per square inch} \\
\text{Formula (15)}
\]

when the flange is restrained against rotation, or

\[
2 + \frac{4}{(a/h)^2} \times \frac{10,000,000}{(h/t)^2} \text{ pounds per square inch} \\
\text{Formula (16)}
\]

when the flange is not so restrained.

These stresses shall be computed as follows:

- Concentrated loads and loads distributed over partial length of a panel shall be divided by the product of the web thickness and the girder depth or the length of panel in which the load is placed, whichever is the lesser panel dimension.
- Any other distributed loading, in pounds per linear inch of length, shall be divided by the web thickness.

Section 2709. COMPOSITE CONSTRUCTION.

(a) Definition. Composite construction shall consist of steel beams or girders supporting a reinforced concrete slab, so inter-connected that the beam and slab act together to resist bending. When the slab extends on both sides of the beam, the effective width of the concrete flange shall be taken as not more than one-fourth \(1/4\) of the span of the beam, and its effective projection beyond the edge of the beam shall not be taken as more than one-half \(1/2\) the clear distance to the adjacent beam, nor more than eight times the slab thickness. When the slab is present on only one side of the beam, the effective width of the concrete flange (projection beyond the beam) shall be taken as not more than one-twelfth \(1/12\) of the beam span, nor six times its thickness nor one-half \(1/2\) the clear distance to the adjacent beam.

Beams totally encased two (2) inches or more on their sides and soffit in concrete poured integrally with the slab may be assumed to be inter-connected to the concrete by natural bond, without additional anchorage, provided the top of the beam is at least one and one-half \(1\frac{1}{2}\) inches below the top and two (2) inches above the bottom of the slab, and provided that the encasement has adequate mesh or other reinforcing steel throughout the whole depth and across the soffit of the beam. When shear connectors are provided in accordance with Section 2709 (d), encasement of the beam to achieve composite action is not required.

(b) Design Assumptions.

1. Encased beams shall be proportioned to support unassisted all dead loads applied prior to the hardening of the concrete, unless these loads are supported temporarily on shoring) and, acting in conjunction with the slab, to support all dead and live loads applied after hardening of the concrete, without exceeding a computed bending stress of \(0.66F_y\), where \(F_y\) is the yield point of the steel beam.

The bending stress produced by loads after the concrete has hardened shall be computed on the basis of the moment of inertia of the composite section. Concrete tension stresses below the neutral axis of the composite section shall be neglected. Alternatively, the steel beam alone may be proportioned to resist unassisted the moment produced by all loads, live and dead, using a bending stress equal to \(0.76F_y\), in which case temporary shoring is not required.

2. When shear connectors are used in accordance with Section 2709 (d) the composite section shall be proportioned to support all of the loads without exceeding the allowable stress prescribed in Section 2704 (a) (4) as applicable. The moment of inertia \(I_y\) of the composite section shall be computed in accordance with
the elastic theory. Concrete tension stresses below the neutral axis of the composite section shall be neglected. The compression area of the concrete above the neutral axis shall be treated as an equivalent area of steel by dividing it by the modular ratio \( n \).

For construction without temporary shoring the value of the section modulus of the transformed composite section used in stress calculations (referred to the tension flange) shall not exceed:

\[
S_{tr} = \left( \frac{M_L}{1.35 + 0.35 \frac{M_D}{M_p}} \right) S_s
\]

Formula (17)

where \( M_L \) and \( M_D \) are, respectively, the live load and dead load moments and \( S_s \) is the section modulus of the steel beam (referred to its tension flange) and provided that the steel beam alone, supporting the loads before the concrete has hardened, is not stressed to more than the applicable bending stress given in Section 2704 (a).

(c) End Shear. The web and the end connections of the steel beam shall be designed to carry the total dead and live load.

(d) Shear Connectors. Except in the cases of encased beams as defined in Section 2709 (c), the entire horizontal shear at the junction of the steel beam and the concrete slab shall be assumed to be transferred by shear connectors welded to the top flange of the beam and embedded in the concrete. The total horizontal shear to be thus resisted between the point of maximum positive moment and each end of the steel beam (or between the point of maximum positive moment and a point of contraflexure in continuous beams) shall be taken as the smaller value using the formulas

\[
V_{sh} = \frac{0.85f'_c A_e}{2} \quad \text{Formula (18)}
\]

and

\[
V_{sh} = \frac{A_e F_y}{2} \quad \text{Formula (19)}
\]

where

- \( f'_c \) = specified compression strength of concrete at 28 days
- \( A_e \) = actual area of effective concrete flange defined in Section 2709 (a)
- \( A_e \) = area of steel beam

The number of connectors resisting this shear, each side of the point of maximum moment, shall not be less than that determined by the relationship \( V_{sh}/q \), where \( q \), the allowable shear load for one connector, or one pitch of a spiral bar, is as given in Table 27-B.

The required number of shear connectors may be spaced uniformly between the sections of maximum and zero moment.

Shear connectors shall have at least one (1) inch of concrete cover in all directions.

Section 2710. DEFLECTIONS.

Beams and girders supporting floors and roofs shall be proportioned with due regard to the deflection produced by the design loads.

Beams and girders supporting plastered ceilings shall be so proportioned that the maximum live load deflection will not exceed \( 1/360 \) of the span.

The depth of beams and girders supporting flat roofs shall be not less than \( F_y/1,000,000 \) times their span length whether designed as simple or continuous spans.

Section 2711. 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 Section 2711 (c) to 2711 (f) inclusive.

(b) Application. Unless otherwise specified, tension members shall be designed on the basis of net section. Compression members shall be designed on the basis of gross section. Beams and girders shall be designed in accordance with Section 2708 (a).

(c) Net Section. 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

- \( s \) = longitudinal spacing (pitch, in inches) of any two consecutive holes
- \( g \) = transverse spacing (gage, 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; however, the net section taken through a hole shall in no case be considered as more than 85 percent of the corresponding gross section.

In determining the net section across plug or slot welds, the weld metal shall not be considered as adding to the net area.

(d) Angles. For angles, the gross width shall be the sum of the widths of the legs less the thickness. The gage for holes in opposite legs shall be the sum of the gages from back of angles less the thickness.

(e) Size of Holes. In computing net area the
diameter of a rivet or bolt hole shall be taken as 
\( \frac{1}{8} \)-inch greater than the nominal diameter of 
the rivet or bolt.

(f) Pin-Connected Members. Eyebars shall 
be of uniform thickness without reinforcement at 
the pin holes. They shall have "circular" heads 
in which the periphery of the head beyond the 
pin hole is concentric with the pin hole. The 
radius of transition between the circular 
head and the body of the eyebar shall be equal to or 
greater than the diameter of the head.

The width of the body of the eyebar shall 
not exceed 8 times its thickness, and the thick­ 
ness shall not be less than one-half (\( \frac{1}{2} \)) inch. 
The net section of the head through the pin hole 
transverse to the axis of the eyebar, shall not be 
less than 1.33 nor more than 1.50 times the 
cross-sectional area of the body of the eyebar. 
The diameter of the pin shall not be less than 
seven-eighths (\( \frac{7}{8} \)) the width of the body of the 
eyebar. The diameter of the pin hole shall not be 
more than one-thirty-second (\( \frac{1}{32} \)) inch greater 
than the diameter of the pin.

The minimum net section across the pin 
hole, transverse to the axis of the member, in 
pin-connected plates and built-up members shall 
be determined at the stress allowed for such 
sections in Section 2704 (a) 1. The net section 
beyond the pin hole, parallel to the axis of the 
member, shall not be less than \( \frac{1}{2} \) of the net sec­ 
tion across the pin hole. The corners beyond the 
pin hole may be cut at 45° to the axis of the 
member provided the net section beyond the pin 
hole on a plane perpendicular to the cut is not 
less than that required beyond the pin hole 
parallel to the axis of the member. The parts of 
members built up at the pin hole shall be at­
tached to each other by sufficient fasteners to 
support the stress delivered to them by the pin.

The distance transverse to the axis of a pin­ 
connected plate or any separated element of a 
built-up member from the edge of the pin hole 
to the edge of the member or element, shall not 
exceed 4 times the thickness at the pin hole. The 
diameter of the pin shall preferably not be less 
than 5 times the thickness of the member or 
separated element at the pin hole. If a smaller 
size is used, the bearing stress shall not exceed 
that allowed by Section 2704 (a) 5. The diamet­ er of the pin hole shall not be more than one­
thirty-second (\( \frac{1}{32} \)) inch greater than the diamet­ter of the pin.

(g) Effective Areas of Weld Metal. The effective 
area of butt and fillet welds shall be con­
idered as the effective length of the 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 effective length, the 
length of centerline of the weld through the cen­
ter 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.

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 a complete 
penetration butt weld (i.e., a butt weld conform­
ing to the requirements of Section 2720 (f)) shall 
be the thickness of the thinner part joined.

The effective throat thickness of single-V or 
single-bevel groove welds having no root open­
ing and having partial penetration into their 
joints shall be one-fourth (\( \frac{1}{4} \)) inch less than 
the depth of the V or bevel groove. The effective 
throat thickness of single-J or single-U groove 
welds having no root opening and having partial 
penetration into their joints shall be the depth 
of the J or U groove. The effective throat thick­
ness of any of these partial penetration groove 
welds shall be not less than \( \sqrt{t_1/6} \), where \( t_1 \) is 
the thickness of the thinner part connected by 
the weld.

Section 2712. CONNECTIONS.

(a) Minimum Connections. Connections car­
ying calculated stresses, except for lacing, sag 
bars, and girts, shall be designed to support at 
least 6,000 pounds.

(b) Eccentric Connections. Axially stressed 
members meeting at a point shall have their 
gravity axes intersect at a point if practicable; 
if not, provision shall be made for bending 
stresses due to the eccentricity.

(c) Placement of Rivets, Bolts and Welds. 
Except as hereinafter provided, the rivets, bolts 
or welds at the ends of any member transmitting 
axial stress into that member shall have their 
centers of gravity on the gravity axis of the mem­
ber unless provision is made for the effect of the 
resulting eccentricity. Except in members subject 
to repeated variation in stress, as defined in the 
A.I.S.C. Specifications for the Design, Fabrication 
and Erection of Structural Steel for Buildings, dis­
position of fillet welds to balance the forces 
about the neutral axis or axes for end connec­
tions of single angle, double angle, and similar 
type members is not required. Eccentricity be­
tween the gravity axes of such members and 
the gage lines for their riveted or bolted end 
connections may be neglected.
(d) Unrestrained Members. Except as otherwise indicated by the designer, connections of beams, girders or trusses shall be designed as flexible, and may ordinarily be proportioned for the reaction shears only.

Flexible beam connections shall permit the ends of the beam to rotate sufficiently to accommodate its deflection by providing for a horizontal displacement of the top flange determined as follows:

\[ e = 0.007d \text{, when the beam is designed for full uniform load and for live load deflection not exceeding } 1/360 \text{ of the span} \]

\[ f_bL = \frac{3,600,000}{d} \text{, when the beam is designed for full uniform load producing the unit stress } f_b \text{ at mid-span} \]

where

- \( e \) = the horizontal displacement of the end of the top flange, in the direction of the span, in inches
- \( f_b \) = the flexural unit stress in the beam at mid-span, in pounds per square inch
- \( d \) = the depth of the beam, in inches
- \( L \) = the span of the beam, in feet

(e) Restrained Members. Fasteners or welds for end connections of beams, girders and trusses not conforming to the requirements of Section 2712 (d) shall be designed for the combined effect of end reaction shear and tensile or compressive stresses resulting from moment induced by the rigidity of the connection when the member is fully loaded.

(f) Fillers. When rivets or bolts carrying computed stress pass through fillers thicker than one-fourth (\( \frac{1}{4} \)) inch, except in friction-type connections assembled with high strength bolts, the fillers shall be extended beyond the splice material and the filler extension shall be secured by enough rivets or bolts to distribute the total stress in the member uniformly over the combined section of the member and the filler, or an equivalent number of fasteners shall be included in the connection.

In welded construction, any filler one-fourth (\( \frac{1}{4} \)) inch or more in thickness shall extend beyond the edges of the splice plate and shall be welded to the part on which it is fitted with sufficient weld to transmit the splice plate stress, applied at the surface of the filler as an eccentric load. The welds joining the splice plate to the filler shall be sufficient to transmit the splice plate stress and shall be long enough to avoid overstressing the filler along the toe of the weld. Any filler less than one-fourth (\( \frac{1}{4} \)) inch thick shall have its edges made flush with the edges of the splice plate and the weld size shall be the sum of the size necessary to carry the splice plate stress plus the thickness of the filler plate.

(g) Connections of Tension and Compression Members in Trusses. The connections at ends of tension or compression members in trusses shall develop the strength required by the stress, but not less than fifty (50) percent of the effective strength of the member. Groove welds in connections at the ends of all members in trusses shall be complete penetration groove welds.

(h) Compression Members with Bearing Joints. Where compression members bear on bearing plates, and where tier-building columns are finished to bear, there shall be sufficient rivets, bolts or welds to hold all parts securely in place.

Where other compression members are finished to bear, the splice material and its riveting, bolting or welding shall be arranged to hold all parts in line and shall be proportioned for 50 percent of the computed stress.

All of the foregoing shall be proportioned to resist any tension that would be developed by specified lateral forces acting in conjunction with 75 percent of the calculated dead load stress and no live load.

(i) Combination 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.

(j) Rivets and Bolts in Combination with Welds. In new work, rivets, A307 bolts, or high strength bolts used in bearing-type connections shall not be considered as sharing the stress in combination with welds. Welds, if used, shall be provided to carry the entire stress in the connection. High strength bolts installed in accordance with the provisions of Section 2713 (a) as a friction-type connection prior to welding may be considered as sharing the stress with the welds.

In making welded alterations to structures, existing rivets and properly tightened high strength bolts may be utilized for carrying stresses resulting from existing dead loads, and the welding need be adequate only to carry all additional stress.

(k) High Strength Bolts (in Friction-Type Joints) in Combination with Rivets. In new work and in making alterations, rivets and high strength bolts, installed in accordance with the provisions of Section 2713 (a) as friction-type connections, may be considered as sharing the stresses resulting from dead and live loads.

(l) Field Connections. Rivets, high strength bolts or welds shall be used for the following connections:

- Column splices in all tier structures two hundred (200) feet or more in height.
- Column splices in tier structures one hundred (100) to two hundred (200) feet in height,
if the least horizontal dimension is less than 40 percent of the height.

Column splices in tier structures less than one hundred (100) feet in height, if the least horizontal dimension is less than 25 percent of the height.

Connections of all beams and girders to columns and of any other beams and girders on which the bracing of column is dependent, in structures over one hundred and twenty-five (125) feet in height.

Roof-truss splices and connections of trusses to columns, column splices, column bracing, knee braces and crane supports, in all structures carrying cranes of over 5-ton capacity.

Connections for supports of running machinery, or of other live loads which produce impact or reversal of stress.

Any other connections stipulated on the design plans. In all other cases field connections may be made with A307 bolts.

For the purpose of this Section, the height of a tier structure shall be taken as the vertical distance from the curb level to the highest point of the roof beams, in the case of flat roofs, or to the mean height of the gable, in the case of roofs having a rise of more than 2/12 in 12. Where the curb level has not been established, or where the structure does not adjoin a street, the mean level of the adjoining land shall be used instead of curb level. Penthouses may be excluded in computing the height of structure.

Section 2713. RIVETS AND BOLTS.

(a) High Strength Bolts. Use of high strength bolts shall conform to the provisions of the Specifications for Structural Joints Using ASTM A325 Bolts as approved by the Research Council on Riveted and Bolted Structural Joints, except that A354, Grade BC, bolts tightened to their A325 Bolts as approved by the Research Council on Riveted and Bolted Structural Joints, except that A354, Grade BC, bolts tightened to their working stresses permitted in Section 2704 and 2705.

(b) Effective Bearing Area. The effective bearing area of rivets and bolts shall be the diameter multiplied by the length in bearing, except that for countersunk rivets and bolts half the depth of the countersink shall be deducted.

(c) Long Grips. Rivets and A307 bolts which carry calculated stress and the grip of which exceeds five diameters, shall have their number increased 1 percent for each additional one-sixteenth (1/16) inch in the grip.

(d) Minimum Pitch. The minimum distance between centers of rivet and bolt holes shall be at least 2 1/2 times the nominal diameter of the rivet or bolt but preferably at least 3 diameters.

(e) Minimum Edge Distance. The minimum distance from the center of a rivet or bolt hole to any edge, used in design or in preparation of shop drawings, shall be that given in Table 27-13 above.

(f) Minimum Edge Distance in Line of Stress. The distance from the center of the end rivet or high strength bolt in a bearing-type connection of a tension member having not more than two fasteners in a line parallel to the direction of stress and that end of the connected member towards which the stress is directed, shall be at least the shearing area of the fastener (single or double shear) divided by the plate thickness for riveted connections, or by 3/4 of the plate thickness for high strength bolted connections. This end distance may, however, be decreased in such proportion as the stress per fastener is less than that permitted under Section 2704 but it shall not be less than the distance specified in Section 2713 (e) above.

(g) Maximum Edge Distance. The maximum distance from the center of any rivet or bolt to the nearest edge of parts in contact with one another shall be 12 times the thickness of the plate, but shall not exceed six (6) inches.

Section 2714. WELDS.

(a) Welder and Welding Operator Qualifications. Welds shall be made only by welders and welding operators who have been previously qualified by tests as prescribed in the Standard Code for Arc and Gas Welding in Building Construction of the American Welding Society, to perform the type of work required, except that this provision need not apply to tack welds not later incorporated into finished welds carrying calculated stress.

(b) Qualification of Weld and Joint 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 welding procedure qualification shall comply with all the requirements for joints which are accepted without procedure qualification under the Standard Code for Arc and Gas Welding in Building Construction or the Standard Specifications for Welded Highway and Railway Bridges of the American Welding Society. Additionally, single-V, single-beveled, single-J and single-U partial penetration groove welds, having no root opening and an effective throat thickness as defined in Section 2711, are accepted without procedure qualification. Joint forms or procedures other than those included in the foregoing may be employed provided they shall have been qualified in accordance with the requirements of these AWS Standards.

E60 and E70 series electrodes for manual arc welding and Grade SAW-1 or SAW-2 submerged arc process may be used for welding A7, A373 and A36 steel. Only E70 low-hydrogen electrodes for manual arc welding or Grade SAW-2 for submerged arc welding shall be used with A441 or weldable A242 steel, except that fillet welds or partial penetration groove welds
f) Length of Fillet Welds. The minimum effective length of a strength fillet weld shall be not less than 4 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.

If longitudinal fillet welds are used alone in end connections of flat bar tension members, the length of each fillet weld shall be at least the perpendicular distance between them. The transverse spacing of longitudinal fillet welds used in end connections shall not exceed eight (8) inches, unless the design otherwise prevents excessive transverse bending in the connection.

(g) Intermittent Fillet Welds. 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 permitted size, and to join components of built-up members. The effective length of any segment of intermittent fillet welding shall be at least 4 times the weld size with a minimum of 1 1/2 inches.

(h) Lap Joints. The minimum width of laps on lap joints shall be 5 times the thickness of the thinner part joined and not less than one (1) inch. Lap joints joining plates or bars subjected to axial stress shall be fillet welded along the edges of both lapped parts except where the deflection of the lapped parts is sufficiently restrained to prevent opening of the joint under maximum loading.

(i) End Returns of Fillet Welds. Side or end fillet welds terminating at ends or sides, respectively, of 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, on the plane about which bending moments are computed. End returns shall be indicated on the design and detail drawings.

(j) Fillet Welds in Holes and Slots. Fillet welds in holes or slots may be used to transmit shear in lap joints or to prevent the buckling or separation of lapped parts, and to join components of built-up members. Such fillet welds may overlap, subject to the provisions of Section 2711. Fillet welds in holes or slots are not to be considered plug or slot welds.

(k) Plug and Slot Welds. Plug or slot welds may be used to transmit shear in a lap joint or to prevent buckling of lapped parts and to join component parts of built-up members.

The diameter of the holes for a plug weld shall be at least the thickness of the part containing it plus five sixteenths (5/16) inch, rounded to the next greater odd one-sixteenth (1/16) inch, or greater than two and one-fourth (2 1/4) times the thickness of the weld metal.

The minimum center-to-center spacing of plug welds shall be 4 times the diameter of the hole.

The length of slot for a slot weld shall not exceed 10 times the thickness of the weld. The width of the slot shall be at least the thickness of the part containing it, plus five-sixteenths (5/16) inch, rounded to the next greater odd one-sixteenth (1/16) inch, or shall be greater than 2 1/4 times the thickness of the weld. The ends of the slot shall be semicircular or shall have the corners rounded to a radius at least the thickness of the part containing it, except those ends which extend to the edge of the part.

The minimum spacing of lines of slot welds in a direction transverse to their length shall be
4 times the width of the slot. The minimum center-to-center spacing in a longitudinal direction on any line shall be two (2) times the length of the slot.

The thickness of plug or slot welds in material five-eighths (5/8) inch or less in thickness shall be equal to the thickness of the material. In material over five-eighths (5/8) inch in thickness, it shall be at least one-half (1/2) the thickness of the material but not less than five-eighths (5/8) inch.

Section 2715. BUILT-UP MEMBERS.

(a) Open Box-Type Beams and Grillages. Where two or more rolled beams or channels are used side-by-side to form a flexural member, they shall be connected together at intervals of not more than five (5) feet. Through-bolts and separators may be used, provided that in beams having a depth of twelve (12) inches or more, no fewer than two (2)bolts shall be used at each separator location. When concentrated loads are carried from one beam to the other, or distributed between the beams, diaphragms having sufficient stiffness to distribute the load shall be riveted, bolted or welded between the beams. Where beams are exposed, they shall be sealed against corrosion of interior surfaces, or spaced sufficiently far apart to permit cleaning and painting.

(b) Compression Members.

1. All parts of built-up compression members and the transverse spacing of their lines of fasteners shall meet the requirements of Section 2706 and 2707.

2. At the ends of built-up compression members bearing on base plates or milled surfaces, all components in contact with one another shall be connected by rivets or bolts spaced longitudinally not more than 4 diameters apart for a distance equal to 1 1/2 times the maximum width of the member, or by continuous welds having a length at least the maximum width of the member.

3. The longitudinal spacing for intermediate rivets, bolts or intermittent welds in built-up members shall be adequate to provide for the transfer of calculated stress. However, where a component of a built-up compression member consists of an outside plate, the maximum spacing shall not exceed the thickness of the thinner outside plate times 4,000 / \sqrt{F_y} when rivets are provided on all gage lines at each section, or when intermittent welds are provided along the edges of the components, but this spacing shall not exceed twelve (12) inches. When rivets or bolts are staggered, the maximum spacing on each gage line shall not exceed the thickness of the thinner outside plate times 6,000 / \sqrt{F_y} nor eighteen (18) inches. The maximum longitudinal spacing of rivets, bolts or intermittent welds connecting two rolled shapes in contact with one another shall not exceed twenty-four (24) inches.

4. Compression members composed of two or more rolled shapes separated from one another by intermittent fillers shall be connected to one another at these fillers at intervals such that the slenderness ratio \( I/r \) of either shape, between the fasteners, does not exceed the governing slenderness ratio of the built-up member. The least radius of gyration \( r \) shall be used in computing the slenderness ratio of each component part.

5. 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 at least the distance between the lines of rivets, bolts or welds connecting them to the components of the member. Intermediate tie plates shall have a length at least on-half of this distance. The thickness of tie plates shall be at least 1/50 of the distance between the lines of rivets, bolts or welds connecting them to the segments of the member. In riveted and bolted construction, the pitch in tie plates shall be not more than 6 diameters and the tie plates shall be connected to each segment by at least three fasteners. In welded construction, the welding on each line connecting a tie plate shall aggregate at least one-third the length of the plate.

6. Lacing, including flat bars, angles, channels or other shapes employed as lacing, shall be so spaced that the ratio \( I/r \) of the flange included between their connections shall not
exceed the governing ratio for the member as a whole. Lacing shall be proportioned to resist a shearing stress normal to the axis of the member equal to 2 percent of the total compressive stress in the member. The ratio 1/r for lacing bars arranged in single systems shall not exceed 140. For double lacing this ratio shall not exceed 200. Double lacing bars shall be joined at their intersections. In determining the required section for lacing bars, Formula (1) or (3) shall be used, I being taken as the unsupported length of the lacing bar between rivets or welds connecting it to the components of the built-up member for single lacing and 70 percent of that distance for double lacing. The inclination of lacing bars to the axis of the member shall preferably be at least 60 degrees for single lacing and 45 degrees for double lacing. When the distance between the lines of rivets or welds in the flanges is more than fifteen (15) inches, the lacing shall preferably be double or be made of angles.

7. The function of tie plates and lacing may be performed by continuous cover plates perforated with a succession of access holes. The net width of such plates at access holes, as defined in Section 2707, is assumed available to resist axial stress, provided that: the width-to-thickness ratio conforms to the limitations of Section 2707; the ratio of length (in direction of stress) to width of hole shall not exceed 2; the clear distance between holes in the direction of stress shall be at least the transverse distance between nearest lines of connecting rivets, bolts or welds; and the periphery of the holes at all points shall have a minimum radius of one and one-half (1½) inches.

(c) Tension Members.

1. The longitudinal spacing of rivets, bolts and intermittent fillet welds connecting a plate and a rolled shape in a built-up tension member, or two plate components in contact with one another, shall not exceed 24 times the thickness of the thinner plates nor twelve (12) inches. The longitudinal spacing of rivets, bolts and intermittent welds connecting two or more shapes in contact with one another in a tension member shall not exceed twenty-four (24) inches. Tension members composed of two or more shapes or plates separated from one another by intermittent fillers shall be connected to one another at these fillers at intervals such that the slenderness ratio of either component between the fasteners does not exceed 240.

2. Either perforated cover plates or tie plates without lacing may be used on the open sides of built-up tension members. Tie plates shall have a length at least two-thirds (2/3) the distance between the lines of rivets, bolts or welds connecting them to the components of the member. The thickness of such tie plates shall be at least 1/50 of the distance between these lines. The longitudinal spacing of rivets, bolts or intermittent welds at tie plates shall not exceed six (6) inches. The spacing of tie plates shall be such that the slenderness ratio of any component in the length between tie plates will not exceed 240.

Section 2716. CAMBER.

Cambering, if any, of trusses, beams or girders shall be called for on the design plans.

Section 2717. EXPANSION.

Adequate provision shall be made for expansion and contraction appropriate to the service conditions of the structure.

Section 2718. COLUMN BASES.

(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 in accordance with the following requirements: 1. Rolled steel bearing plates, two (2) inches or less in thickness, may be used without planing, provided a satisfactory contact bearing is obtained; rolled steel bearing plates over two (2) inches but not over four (4) inches in thickness may be straightened by pressing; or, if presses are not available, by planing for all bearing surfaces except as noted under requirement 3 of this Section. 2. Rolled steel bearing plates over four (4) inches in thickness shall be planed for all bearing surfaces except as noted under requirement 3 of this Section.

2. Column bases other than rolled steel bearing plates shall be planed for all bearing surfaces except as noted
under requirement 3 of this Section).

3. The bottom surfaces of bearing plates and column bases which are grouted to insure full bearing contact on foundations need not be planed.

Section 2719. 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 or partial fixation of columns.

Section 2720. FABRICATION.

(a) Straightening Material. Rolled material, before being laid off or worked, must be straight within the tolerances allowed by ASTM Specification A6. If straightening is necessary, it shall be done by methods that will not injure the metal.

(b) Gas Cutting. Gas cutting shall preferably be done by machine. Gas cut edges which will be subjected to substantial stress or which are to have weld metal deposited on them shall be free from gouges; any gouges that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least one-half (1/2) inch.

(c) Planing of Edges. Planing or finishing of sheared or gas cut edges of plates or shapes will not be required unless specifically called for on the drawings or included in a stipulated edge preparation for welding.

(d) Riveted and Bolted Construction—Holes. Holes for rivets or bolts shall be one-sixteenth (1/16) inch 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 (1/8) inch, 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 (1/8) inch, 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 (1/16) inch smaller than the nominal diameter of the rivet or bolt.

(e) Riveted and High Strength Bolted 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. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection.

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 in the Tentative Specifications for Cold-Driven Rivets of the Industrial Fasteners Institute.

Surfaces of high strength bolted parts in contact with the bolt head and nut shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the surface of a high strength bolted part has a slope of more than 1:20, a beveled washer shall be used to compensate for the lack of parallelism. High strength bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers, shall be free of scale except tight mill scale. They shall be free of dirt, loose scale, burrs, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer or galvanizing.

All A325 and A354, Grade BC, bolts shall be tightened to a bolt tension not less than the proof load given in the applicable ASTM specification for the type of bolt used. Tightening shall be done with properly calibrated wrenches or by the turn-of-nut method.

Bolts tightened by means of a calibrated wrench shall be installed with a hardened washer under the nut or bolt head, whichever is the element turned in tightening. Hardened washers are not required when bolts are tightened by the turn-of-nut method.

(f) Welded Construction. Surface 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. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than three-sixteenths (3/16) inch. If the separation is one-sixteenth (1/16) inch 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 and butt joints on a backing structure shall not exceed one-sixteenth (1/16) inch. 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 (1/8) inch shall be corrected and, in making the correction, the parts shall not be drawn into a sharper slope than 2 degrees (seven-sixteenths [7/16] inch in twelve [12] inches).

The work shall be positioned for flat welding whenever practicable.

In assembling and joining parts of a structure 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. Long girders or girder sections may be made by shop splicing not more than three (3) subsections, each made in accordance with this paragraph.

All complete penetration butt welds made by manual welding, 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 (5/16) inch thick with root opening at least one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged 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 cross-section. Butt welds made with 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 gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Butt welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates, if used, shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts.

No welding shall be done when the ambient temperature is lower than 0° F.

Base metal shall be preheated as required to the temperature called for in the Table 27-E prior to tack welding or welding. When base metal not otherwise required to be preheated is at a temperature below 32° F, it shall be preheated to at least 70° F prior to tack welding or welding. Preheating shall bring the surface of the base metal within three (3) inches of the point of welding to the specified preheat temperature, and this temperature shall be maintained as a minimum interpass temperature while welding is in progress. Minimum preheat and interpass temperature shall be as specified in Table 27-E.

Where required, multiple-layer welds may be peened with light blows from a power hammer, using a 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, or flaking of weld and base metal from over-peening.

The technique of welding employed, the appearance and quality of welds made, and the methods used in correcting defective work shall conform to Section 4—Workmanship, of the Standard Code for Arc and Gas Welding in Building Construction of the American Welding Society.

(g) Finishing. Compression joints depending upon contact bearing shall have the bearing surfaces prepared to a common plane by milling, sawing or other suitable means.

(h) Tolerances.

1. Straightness. Structural members consisting primarily of a single rolled shape shall, unless otherwise specified, be straight within the appropriate tolerances allowed by ASTM Specification A6 or as prescribed in the following paragraph. Built-up structural members fabricated by riveting or welding, unless otherwise specified, shall be straight within the tolerances allowed for wide flange shapes by ASTM Specification A6 or by the requirements of the following paragraph.

Compression members shall not deviate from straightness by more than 1/1000 of the axial length between points which are to be laterally supported.

Completed members shall be free from twists, bends and open joints. Sharp kinks or bends shall be cause for rejection of material.

2. Length. A variation of one-thirty-second (1/32) inch is permissible in the overall length of members with both ends finished for contact bearing as in Section 2720 (g).

Members without ends finished for contact bearing, 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 (1/16) inch for members thirty (30) feet or less in length,
and not greater than one-eighth ($\frac{1}{8}$) inch for members over thirty (30) feet in length.

Section 2721. SHOP PAINTING.

(a) General Requirements. Steelwork which will be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned in accordance with the following paragraph, by brush, spray, roller coating, flow coating, or dipping, at the election of the fabricator.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing, or by other methods elected by the fabricator, of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by thorough sweeping with a fiber brush.

The shop coat of paint is intended to protect the steel for only a short period of exposure, even if it is a primer for subsequent painting to be performed in the field by others.

(b) Inaccessible Surfaces. Surfaces inaccessible after assembly shall be treated in accordance with Section (a) before assembly.

(c) Contact Surfaces. Contact surfaces shall be cleaned in accordance with Section (a) before assembly but shall not be painted.

(d) Finished Surfaces. Machine finished surfaces shall be protected against corrosion by a rust-inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

(e) Surfaces Adjacent to Field Welds. Surfaces within two (2) inches of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

Section 2722. ERECTION.

(a) Bracing. The frame of steel skeleton buildings shall be carried up true and plumb (that is, in accordance with the erection tolerances prescribed by Section 7 of the A.I.S.C. Code of Standard Practice for Steel Buildings and Bridges), 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.

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 such loads.

(b) Adequacy of Temporary Connections. As erection progresses, the work shall be securely bolted, or welded, to take care of all dead load, wind and erection stresses.

(c) Alignment. No riveting, permanent bolting or welding shall be done until as much of the structure as will be stiffened thereby has been properly aligned.

(d) Field Welding. Any shop paint on surfaces adjacent to joints to be field welded shall be wire brushed to reduce the paint film to a minimum.

Section 2723. PLASTIC DESIGN.

(a) Scope. Subject to the limitations contained herein, simple or continuous beams, one and two-story rigid frames and similar portions of structures rigidly constructed so as to be continuous over at least one interior support, may be proportioned on the basis of plastic design, i.e., of their maximum strength. As used here, "interior support" may be taken to include a rigid frame knee formed by the junction of a column and a sloping or horizontal beam or girder. This strength, as determined by rational analysis, shall not be less than that required to support 1.70 times the given live load and dead load for simple and continuous beams. For continuous frames it shall not be less than 1.85 times the given live load and dead load, nor 1.40 times these loads acting in conjunction with 1.40 times any specified wind or earthquake forces.

Connections joining a portion of a structure designed on the basis of plastic behavior with a portion not so designed need be no more rigid than ordinary seat-and-cap angle or standard web connections.

Where plastic design is used as the basis for proportioning continuous beams and structural frames, the provisions relating to allowable working stress, contained in other sections of this Chapter are waived. Except as modified by these rules, however, all other pertinent provisions of this Chapter shall govern.

It is not recommended that crane runways be designed continuous over interior vertical supports on the basis of maximum strength. However, rigid frame bents supporting crane runways may be considered as coming within the scope of the rules.

(b) Structural Steel. Structural steel shall conform to one of the following specifications: Steel for Bridges and Buildings, ASTM A7 Structural Steel for Welding, ASTM A373 Structural Steel, ASTM A36

(c) Columns. In the plane of bending of columns which would develop a plastic hinge at ultimate loading, the slenderness ratio $I/r$ shall not exceed 120, I being taken as the distance center-to-center of adjacent members connecting
to the column or the distance from such a member to the base of the column. The slenderness ratio of columns covered by Formula (21) shall not exceed 100. The maximum axial load P at ultimate loading shall not exceed six-tenths P_y, where P_y is the product of yield-point stress times column area.

Columns in continuous frames, where side-sway is not prevented (a) by diagonal bracing, (b) by attachment to an adjacent structure having ample lateral stability or (c) by floor slabs or roof decks secured horizontally by walls or bracing systems parallel to the plane of the continuous frames, shall be so proportioned that

\[ \frac{2P}{P_y} \leq 1.0 \quad \text{Formula (20)} \]

Except as otherwise provided in this Section, M_o/M_p, the ratio of allowable end moment to the full plastic bending strength of columns and other axially loaded members shall not exceed the value given by the following formulas, where they are applicable:

**CASE I.** For columns bent in double curvature by moments producing plastic hinges at both ends of the columns

\[ \frac{M_o}{M_p} \leq 1.18 \left( \frac{P}{P_y} \right) \leq 1.0 \quad \text{when } P/P_y > 0.15 \quad \text{Formula (21)} \]

**CASE II.** For pin-based columns required to develop a hinge at one end only, and double curvature columns required to develop a hinge at one end when the moment at the other end would be less than the hinge value

\[ \frac{M_o}{M_p} \leq B - G \left( \frac{P}{P_y} \right) \leq 1.0 \quad \text{Formula (22)} \]

the numerical values for B and G, for any given slenderness ratio in the plane of bending 1/r, being those listed in Tables 4-33 and 4-36 of the Appendix to the A.I.S.C. Specification for Design, Fabrication, and Erection of Structural Steel for Buildings. Where 1/r in the plane of bending is less than 60, and P/P_y does not exceed 0.15, the full plastic strength of the member may be used \( M_o = M_p \).

**Case III.** For columns bent in single curvature

\[ \frac{M_o}{M_p} \leq 1.0 - H \left( \frac{P}{P_y} \right) - J \left( \frac{P}{P_y} \right)^2 \quad \text{Formula (23)} \]

the numerical values for H and J being those given in Tables 5-33 and 5-36 of the Appendix to the A.I.S.C. Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

In no case shall the ratio of axial load to plastic load exceed that given by the following expression:

\[ \frac{P}{8,700} \leq \frac{1}{(1/r)^{1/2}} \quad \text{when } P > 120 \quad \text{Formula (24)} \]

where 1 and r are the unbraced length and radius of gyration of the column in the plane normal to that of the continuous frame under consideration

**(d) Shear.** Unless reinforced by diagonal stiffeners or a doubler plate, the webs of columns, beams, and girders shall be so proportioned that

\[ V_w \leq 0.00055 \frac{F_y w d}{V} \quad \text{where } V_w \text{ is the shear, in kips, that would be produced by the required ultimate loading, } d \text{ is the depth of the member, and } w \text{ is the web thickness.} \]

(Shear stresses are generally high within the boundaries of the connection of two or more members whose webs lie in a common plane. The foregoing provisions will be satisfied, without reinforcing the web within the connection, when its thickness w, in inches, is greater than 23,000 \( M/A_{wF_y} \), \( M \) being the algebraic sum of clockwise and counterclockwise moment (in kip-foot) applied on opposite sides of the connection web boundary, and \( A_w \) the planar area of the connection web, expressed in square inches, and \( F_y \) is given in pounds per square inch. When the thickness of this web is less than that given by the above formula the deficiency may be compensated by a pair of diagonal stiffeners or by a reinforcing plate in contact with the web over the connection area).

**(e) Web Crippling.** Web stiffeners are required on a member at a point of load application where a plastic hinge would form.

At points on a member where the concentrated load delivered by the flanges of a member framing into it would produce web crippling opposite the compression flange or high tensile stress in the connection of the tension flange, web stiffeners are required, opposite these flanges, when

\[ w < \frac{A_t}{t_b + 5k} \]

or when

\[ t_f < 0.4 \sqrt{A_t} \]

where

- \( w \) = thickness of web to be stiffened
- \( k \) = distance from outer face of flange to web toe of fillet of member to be stiffened
- \( t_b \) = thickness of flange delivering concentrated load
- \( t_f \) = thickness of flange of member to be stiffened
- \( A_t \) = area of flange delivering concentrated load

The area of such stiffeners, \( A_{wF} \), shall be such that

\[ A_{wF} \geq A_t - w (t_b + 5k) \]

The end of such stiffeners shall be fully welded to the inside face of the flange opposite the con-
centrated tensile load. It may be fitted against the inside face of the flange opposite the concentrated compression load. When the concentrated load delivered by a beam occurs on one side only, the web stiffener need not exceed one-half the depth of the member, but the welding connecting it to the web shall be sufficient to develop \( P \).

\( \text{(f) Minimum Thickness (Width-Thickness Ratios).} \) Projecting elements that would be subjected to compression involving plastic hinge rotation under ultimate loading, shall have width-thickness ratios no greater than the following:

Flanges of rolled shapes and flange plates of similar built-up shapes: 8 \( \sqrt{\gamma} \), except that for rolled shapes an upward variation of 3 percent may be tolerated. The thickness of sloping flanges may be taken as their average thickness. Stiffeners and that portion of flange plates in box sections and cover plates included between the free edge and the first longitudinal row of fasteners or connecting welds: 8 \( \sqrt{\gamma} \).

The width-thickness ratio of flange plates in box sections and flange cover plates included between longitudinal lines of connecting rivets, high strength bolts or welds, shall not exceed 32.

The depth-thickness ratio of beam and girder webs subjected to plastic bending without axial loading shall not exceed 70 and, when subjected to combined axial force and plastic bending moment at ultimate loading, the value given by the formula

\[
\frac{d}{w} \leq \frac{100}{P_f} \quad \text{Formula (25)}
\]

with a minimum value of 43.

\( \text{(g) Connections.} \) All connections, the rigidity of which is essential to the continuity assumed as the basis of the design analysis, shall be capable of resisting the moments, shears and axial loads to which they would be subjected by the ultimate loading.

Corner connections (haunches), tapered or curved for architectural reasons, shall be so proportioned that the full plastic bending strength of the section adjacent to the connection can be developed, if required.

Stiffeners shall be used, as required, to preserve the flange continuity of interrupted members at their juncture with other members in a continuous frame. Such stiffeners shall be placed in pairs on opposite sides of the web of the member which extends continuously through the joint.

Rivets, welds and A307 bolts shall be proportioned to resist the forces produced at ultimate load using unit stresses equal to 1.67 times those given in Section 2704.

In general, groove welds are preferable to fillet welds, but their use is not mandatory when the strength of the latter at 1.67 times the stress given in Section 2704 is sufficient to resist the ultimate load imposed upon a joint.

High strength bolts may be proportioned, on the basis of their minimum guaranteed proof load, to resist the tension produced by the ultimate loading. When used to transmit shear produced by the ultimate loading, one bolt may be substituted for a rivet of the same nominal diameter. High strength bolts may be used in joints having painted contact surfaces when these joints are of such size that the slip required to produce bearing would not interfere with the formation, at ultimate loading, of the plastic hinges assumed in the design.

\( \text{(h) Lateral Bracing.} \) The maximum laterally unsupported length of members designed on the basis of ultimate loading need not be less than that which would be permitted for the same members designed under the provisions of other Sections of this Chapter, except at plastic hinge locations associated with the failure mechanism. Furthermore, the following provisions need not apply in the region of the last hinge to form in the failure mechanism assumed on the basis for proportioning a given member, nor in members oriented with their weak axis normal to the plane of bending. Other plastic hinge locations shall be adequately braced to resist lateral and torsional displacement.

The laterally unsupported distance \( l_{cr} \) from such braced hinge locations to the nearest adjacent point on the frame similarly braced, need not be less than that given by the formula

\[
l_{cr} = \left( \frac{60 - 40}{M} \right) \frac{M}{M_p} \frac{r_y}{r_p} \quad \text{Formula (26)}
\]

nor less than 35 \( r_y \), where

\( r_y = \) the radius of gyration of the member about its weak axis

\( M = \) the lesser of the moments at the ends of the unbraced segment and

\( M/M_p \), the end moment ratio, is positive when the segment is bent in single curvature and negative when bent in double curvature

Any greater laterally unbraced length for these segments must be justified by an analysis based upon the predictable amount of restraint present at the ends of the segment in the plane of the computed bending moments.

Members built into a masonry wall and having their webs perpendicular to this wall can be assumed to be laterally supported with respect to their weak axis of bending.

\( \text{(i) Fabrication.} \) The provisions of other Sections of this Chapter with respect to workmanship shall govern the fabrication of structures, or portions of structures, designed on the basis of maximum strength, subject to the following
limitations:

The use of sheared edges shall be avoided in locations subject to plastic hinge rotation at ultimate loading. If used they shall be finished smooth by grinding, chipping or planing.

In locations subject to plastic hinge rotation at ultimate loading, holes for rivets or bolts in the tension area shall be sub-punched and reamed or drilled full size.

Section 2724. OPEN WEB STEEL JOISTS.

The materials, design, fabrication, application, handling, and erection of open web steel joists suitable for direct support of floor slabs or roof decks, shall conform to the Steel Joist Institute Specifications and Load Tables for Open Web Steel Joists.

Section 2725. LIGHT GAGE COLD-FORMED STEEL.

The materials, design, fabrication, application, handling, and erection of light gage cold-formed steel shall conform to American Iron and Steel Institute Specifications for the Design of Light Gage Cold-Formed Steel Structural Members.

Section 2730. STANDARDS.

Unless as otherwise specified in other Sections of this Building Code, the following Standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI</td>
<td>Specification for the Design of Light Gage Cold-Formed Steel Structural Members, 1962</td>
</tr>
<tr>
<td>ASTM</td>
<td>General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use. A6-67</td>
</tr>
<tr>
<td></td>
<td>Mild-to-Medium Strength Carbon Steel Castings for General Application, A27-65</td>
</tr>
<tr>
<td></td>
<td>Structural Steel, A36-67</td>
</tr>
<tr>
<td></td>
<td>Specification for Welded and Seamless Steel Pipe, A53 67</td>
</tr>
<tr>
<td></td>
<td>Structural Rivet Steel, A502-6b</td>
</tr>
<tr>
<td></td>
<td>High-Strength Steel Castings for Structural Purposes, A148-65</td>
</tr>
<tr>
<td></td>
<td>High-Strength Structural Rivet Steel, A502-65</td>
</tr>
<tr>
<td></td>
<td>Specification for Mild-Steel Arc-Welding Electrodes, A233-64T</td>
</tr>
<tr>
<td></td>
<td>Carbon Steel Forgings for General Industrial Use, A235-67</td>
</tr>
<tr>
<td></td>
<td>Alloy Steel Forgings for General Industrial Use, A237-67</td>
</tr>
<tr>
<td></td>
<td>High-Strength Low-Alloy Structural Steel, A242-66a</td>
</tr>
<tr>
<td></td>
<td>High-Strength Steel Bolts for Structural Joints, A325-66b</td>
</tr>
<tr>
<td></td>
<td>Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts, A354 66</td>
</tr>
<tr>
<td></td>
<td>Structural Steel for Welding, A36-67</td>
</tr>
<tr>
<td></td>
<td>High-Strength Structural Steel, A440-66a</td>
</tr>
<tr>
<td></td>
<td>Low-Alloy Structural Manganese Vanadium Steel, A441 66a</td>
</tr>
<tr>
<td>AWS</td>
<td>Standard Code for Arc and Gas Welding in Building Construction, D1.0-1963</td>
</tr>
<tr>
<td></td>
<td>Standard Specification for Welded Highway and Railway Bridges, D2.0-1963</td>
</tr>
<tr>
<td>SJI</td>
<td>Standard Specifications and Load Tables for Open Web Steel Joists, J Series, 1965</td>
</tr>
<tr>
<td></td>
<td>Standard Specifications and Load Tables for Open Web Steel Joists, H Series, 1965</td>
</tr>
<tr>
<td></td>
<td>Standard Specifications and Load Tables for Open Web Steel Joists, Longspan or LJ &amp; LH Series, 1967</td>
</tr>
<tr>
<td></td>
<td>Standard Specifications and Load Tables for Open Web Steel Joists, High Strength Longspan or LH Series, 1962</td>
</tr>
</tbody>
</table>

Legend

AISC — American Institute of Steel Construction, 101 Park Avenue, New York 17, N.Y.

AISI — American Iron and Steel Institute, 150 East Forty-second St., New York 17, N.Y.


AWS — American Welding Society, Inc., 345 East 47th Street, New York 17, N.Y.

SJI — Steel Joist Institute, 1346 Connecticut Avenue, N.W., Washington 6, D.C.
TABLE NO. 27-A

<table>
<thead>
<tr>
<th>Description of Fastener</th>
<th>Tension ( (F_t) )</th>
<th>Shear ( (F_v) )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Friction-Type</td>
<td>Bearing-Type</td>
</tr>
<tr>
<td></td>
<td>Connections</td>
<td>Connections</td>
</tr>
<tr>
<td>A141 hot-driven rivets</td>
<td>20,000</td>
<td>15,000</td>
</tr>
<tr>
<td>A195 and A406 hot-driven rivets</td>
<td>27,000</td>
<td>20,000</td>
</tr>
<tr>
<td>A307 bolts and threaded parts of A7 and A373 steel</td>
<td>14,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Threaded parts of other steels</td>
<td>0.40(F_y)</td>
<td>0.30(F_y)</td>
</tr>
<tr>
<td>A325 bolts when threading is not excluded from shear planes</td>
<td>40,000</td>
<td>15,000</td>
</tr>
<tr>
<td>A325 bolts when threading is excluded from shear planes</td>
<td>40,000</td>
<td>15,000</td>
</tr>
<tr>
<td>A354, Grade BC, bolts when threading is not excluded from shear planes</td>
<td>50,000</td>
<td>20,000</td>
</tr>
<tr>
<td>A354, Grade BC, when threading is excluded from shear planes</td>
<td>50,000</td>
<td>20,000</td>
</tr>
</tbody>
</table>

TABLE 27-B

<table>
<thead>
<tr>
<th>Connector</th>
<th>Allowable Horizontal Shear Load ( (q) ) (kips)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( f'_c=3,000 )</td>
</tr>
<tr>
<td>( \frac{1}{2} )&quot; diam. x 2&quot; hooked or headed stud</td>
<td>5.1</td>
</tr>
<tr>
<td>( \frac{1}{4} )&quot; diam. x 2( \frac{1}{2} )&quot; hooked or headed stud</td>
<td>8.0</td>
</tr>
<tr>
<td>( \frac{3}{4} )&quot; diam. x 3&quot; hooked or headed stud</td>
<td>11.5</td>
</tr>
<tr>
<td>( \frac{1}{2} )&quot; diam. x 3( \frac{1}{2} )&quot; hooked or headed stud</td>
<td>15.6</td>
</tr>
<tr>
<td>3&quot; channel, 4.1 lb</td>
<td>4.3w</td>
</tr>
<tr>
<td>4&quot; channel, 5.4 lb</td>
<td>4.6w</td>
</tr>
<tr>
<td>5&quot; channel, 6.7 lb</td>
<td>4.9w</td>
</tr>
<tr>
<td>( \frac{1}{2} )&quot; diam. spiral bar</td>
<td>11.9</td>
</tr>
<tr>
<td>( \frac{3}{8} )&quot; diam. spiral bar</td>
<td>14.8</td>
</tr>
<tr>
<td>( \frac{3}{4} )&quot; diam. spiral bar</td>
<td>17.8</td>
</tr>
</tbody>
</table>

\( w= \)length of channel in inches
### TABLE 27-C

<table>
<thead>
<tr>
<th>Rivet or Bolt Diameter (Inches)</th>
<th>Minimum Edge Distance for Punched, Reamed or Drilled Holes (Inches)</th>
<th>At Sheared Edges</th>
<th>At Rolled Edges of Plates, Shapes or Bars or Gas Cut Edges**</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>⅛</td>
<td>⅛</td>
<td>¼</td>
</tr>
<tr>
<td>⅛</td>
<td>1⅛</td>
<td>⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>⅝</td>
<td>1⅜</td>
<td>⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>⅞</td>
<td>1½*</td>
<td>1⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>1</td>
<td>1⅛*</td>
<td>1⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>1⅛</td>
<td>2</td>
<td>⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>1¼</td>
<td>2¼</td>
<td>⅛</td>
<td>⅛</td>
</tr>
<tr>
<td>Over 1¼</td>
<td>1⅛ x Diameter</td>
<td>1⅛ x Diameter</td>
<td></td>
</tr>
</tbody>
</table>

*These may be 1¼ in. at the ends of beam angles.

**All edge distances in this column may be reduced ⅛ inch when the hole is at a point where stress does not exceed 25% of the maximum allowed stress in the element.

### TABLE 27-D

<table>
<thead>
<tr>
<th>Material Thickness of Thicker Part Joined (Inches)</th>
<th>Minimum Size of Fillet Weld (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ½ inclusive</td>
<td>⅛</td>
</tr>
<tr>
<td>Over ½ to ¾</td>
<td>¼</td>
</tr>
<tr>
<td>Over ¾ to 1½</td>
<td>⅛</td>
</tr>
<tr>
<td>Over 1⅛ to 2¼</td>
<td>⅛</td>
</tr>
<tr>
<td>Over 2¼ to 6</td>
<td>⅛</td>
</tr>
<tr>
<td>Over 6</td>
<td>⅛</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>A373 Steel</td>
</tr>
<tr>
<td>Over 1&quot; to 2&quot;, Incl.</td>
<td>100°F</td>
</tr>
<tr>
<td>Over 2&quot;</td>
<td>200°F</td>
</tr>
</tbody>
</table>

1. Welding with ASTM A233 E60XX or E70XX electrodes other than a low-hydrogen class.
2. Welding with properly dried ASTM A233 EXX15, 16, or 18 or 28 electrodes or submerged arc welding with properly dried flux.
3. Preheating for weldable A242 steel may need to be either higher or lower than these requirements, depending on composition of steel.
4. Except when base metal temperature is below 32°F.
CHAPTER 28
EXCAVATIONS, FOUNDATIONS
AND RETAINING WALLS

Section 2800. SCOPE

In addition to the requirements of other portions of this Building Code, this Chapter shall govern the construction of excavations, foundations and retaining walls.

For purposes of this Chapter, where the term "Engineer" is used, this shall mean a professional engineer registered by the State of Colorado.

Section 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 Department, and of sufficient strength to retain the embankment together with any surcharge loads.

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 such excavation to be made, where such a condition is a possibility, shall give notice in writing, at least 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 Department.

(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 or structural fill as defined in Section 2804 or the footing shall be extended to solid bearing.

(c) Trench Excavations. All vertical walled trenches more than five (5) feet deep shall be furnished with minimum protection of two inch by ten inch (2"x10") uprights held tightly against the banks with trench jacks or cross braces.

1. The horizontal spacing of pairs of uprights shall not exceed ten (10) feet and the vertical spacing of pairs of uprights shall not exceed ten (10) feet and the vertical spacing of the trench jacks or cross braces shall not exceed five (5) feet.

2. The Department may determine that a shoring or support system is inadequate and may require additional shoring and/or sheeting.

3. A trench shoring system designed by an Engineer to meet the loading and soil requirements for a particular job, when approved by the Department shall constitute an adequate support system.

4. Trench shoring as above specified may be omitted after investigation and written justification by a registered professional engineer and approval by the Department in the following circumstances: (1) Trenches in sound rock formations, (2) trenches in which approved mobile shoring is provided such that workmen in the trench are at all times protected from caving.

5. Failure to comply with the minimum requirements of this Section shall be an unlawful act subject to penalty in accordance with Section 112 of this Building Code.

(d) Inspection. Provision shall be made to allow for proper inspection of footings, foundations and waterproofing thereof.

Section 2802. FOUNDATIONS

(a) General. Every permanent structure shall be supported by a satisfactory type of foundation and proper bearing materials as defined in Table 28-C. Foundations and foundation walls shall be designed to withstand all vertical and horizontal loads.

1. Except for the special provisions of Section 2809, covering the design of piles, all portions of footings shall be designed in accordance with the structural provision of this Code and shall be designed to minimize differential settlement.

2. No foundations shall be placed on frozen soil unless adequately protected against freezing. Foundations shall not be laid in freezing weather.

(b) Different Levels. Where foundations are supported at different levels, or at different levels from foundations of adjacent structures, the effect of such differences in foundation levels shall be considered in the design.
(c) Materials and Construction. Footings shall be of concrete as specified in 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.

(d) Access to Crawl-Space Areas.

1. An outside means of access conforming to the following shall be provided to the crawl space under structures. The opening shall be at least twenty-four (24) inches in width and eighteen (18) inches in height, and shall be protected by an area well securely dowelled to the foundation wall. Such area well shall have a minimum wall thickness of six (6) inches and shall be at least 3 feet in depth. The distance from the foundation wall to the area well wall, measured horizontally, shall be at least 4 feet. The distance between the other two exterior area well walls shall be at least 3 feet. The opening shall be protected by an attached, tight fitting cover placed at the top of the area well.

2. Where a furnace is to be installed in the crawl space, access shall be provided in accordance with the following:

A. A vertical access opening shall be provided and the furnace shall be located not more than twenty (20) feet therefrom.

B. The vertical and horizontal dimensions shall be at least thirty (30) inches in depth and thirty-six (36) inches in width and shall be provided with a well to the exterior. The inside of such well shall extend at least fifty-four (54) inches out from the outside face of the access opening. The walls shall be at least six (6) inches in thickness of concrete and the floor of the well may be of washed gravel at least four (4) inches in thickness or four (4) inches of concrete. The top of the well shall be curbed to at least four (4) inches above the exterior grade, and covered in such a manner as to be weather-tight.

C. In addition to the other requirements of this Building Code, the crawl space where heating equipment is to be installed shall be accessible by an opening and passageway at least that required to install or remove the heating equipment without disassembling such equipment.

D. The opening shall be protected by an attached, tight fitting cover placed on the top of the area well.

(e) Depth. Foundations, footings and grade beams of permanent structures, except when founded on rock, and except as otherwise provided in this Section and Section 2806, shall be carried below the frost line. Foundations of buildings of Type IV and V Construction may be carried to the depth designated in Table No. 28-B, except where soil conditions require special design.

(f) Minimum Dimension. Tables No. 28-A and No. 28-B give the minimum requirements for buildings not over three (3) stories in height of Type III, IV or V Construction where soil conditions do not require special design.

(g) Height Above the Ground. Foundation walls supporting wood members shall extend at least six inches (6") above the finished grade.

(h) Damp Proofing. All foundation walls below finished grade shall be damp proofed by the application of an approved damp proofing material.

Suitable insulation shall be installed adjacent to boilers, furnaces and other heat-producing apparatus to protect the damp proofing against damage by heat.

When masonry units are used in foundation walls below grade, the exterior surfaces shall be plastered with at least one-quarter (1/4) inch cement plaster before the application of damp proofing. Where loads are concentrated, solid units shall be used.

(i) Ventilation. Where heating equipment is located in crawl spaces, see Chapter 52 for ventilation requirements.

1. 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 at least four (4) ventilating openings, the minimum total area of which shall be proportioned on the basis of one-half square foot (1/2 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 (18) inches.
BY AUTHORITY

Ordinance No. 180

COUNCILMAN'S BILL NO. 168, SERIES OF 1970, INTRODUCED BY COUNCILMEN HENTZELL, HOOK AND DE TEMPLE.

A BILL

FOR AN ORDINANCE AMENDING THE BUILDING CODE OF THE CITY AND COUNTY OF DENVER AND IN PARTICULAR BY AMENDING CHAPTER 28 THEREOF.

Section 2806 (c) Basement Flooding: In areas where there is a known history of subsurface water problems, and in all new or proposed residences, residential and commercial developments sufficient test holes or test borings must be taken to determine subsurface water conditions and water levels at the construction site. If test data indicates a water problem or the probability of a future problem a soil geotechnical engineer shall submit to the Department a report indicating what design measure should be incorporated in the building substructure to alleviate the problem. In cases where the recommendations require the structure to be designed to resist hydrostatic pressures to assure a stable water tight structure, the structural design shall be done by a registered structural engineer.

April 6, 1970.
Section 2803. BORINGS AND TEST PITS.

(a) General. Prior to the issuance of a permit for erection or alteration of a permanent structure, the Department, in the absence of satisfactory data, shall require the owner to dig pits or make borings at such locations, carried to such depths, and with appropriate sampling as will disclose the character of the materials underlying the site of the proposed structure.

(b) Boring Logs and Samples. Duplicate copies of the results of all borings and pits made shall be filed with the Department. Samples, properly protected from evaporation or disturbance, representing the various classes of materials, may be requested by the Department for examination.

Section 2804. CLASSIFICATION OF MATERIALS.

(a) Materials. The classification of rock shall be in accordance with generally accepted geological or engineering nomenclature. The classification of soils shall be in accordance with the Unified Soil Classification System.

(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 determined in accordance with the provisions of Sections 2806 and 2807. Foundations shall be placed on satisfactory undisturbed soil at least one foot below the surface of virgin ground except as otherwise specified for structural fill.

(c) Pressure Distribution. 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; however, the area considered as supporting the load shall not extend beyond the intersection of sixty (60) degree planes of adjacent foundations.

(d) Erratic Foundation Soils. Where portions of the foundation of an entire building or structure rest directly upon or are underlain by materials having substantially different supporting capacities, or layers of such different materials vary greatly in thickness, the magnitude and distribution of the probable settlement shall be investigated, and if necessary, the allowable load shall be reduced or special provisions be made in the design of the structure to prevent detrimental differential settlements.

(e) Structural Fill. Footings for buildings or structures may rest upon compacted, structural fill if recommended by an Engineer specializing in soil and foundation engineering, after a satisfactory soil investigation. The fill shall be of satisfactory approved materials compacted to the density specified by the Engineer, but in no case to less than 95% density, ASTM D698. The structural fill shall be placed under the continuous supervision of the Engineer or his qualified representative. Footings placed on the fill shall be designed in accordance with the criteria established by the soil Engineer.

(f) 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 Department 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 stability of the bearing material, the material shall be removed to adequate bearing.

Section 2805. CONCRETE SLABS.

(a) Accessory Buildings. Accessory buildings (Group J) and other buildings of comparable size 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 at least four (4) inches thick with thickened edges. Footings for isolated columns and piers shall be as specified in Chapters 23 and 26, and this Chapter.

(b) I Occupancy. A building housing Group I Occupancy of Type IV or V Construction, not over seven hundred twenty (720) square feet in area, may be supported on a concrete slab with thickened edges. Such edges shall extend at least six (6) inches above finished grade and twelve (12) inches below grade.

Section 2806. SPECIAL SOIL INVESTIGATIONS.

(a) Requirements. Whenever, in the opinion of the Department, the classification or allowable bearing capacity of a soil or rock cannot be determined by the test boring or excavation require a special soil investigation by an engineer specializing in soil and foundation engineering, before approving the foundation design.

(b) Deviations. Deviations from the allowable soil and rock pressure set forth in Section 2804 and other foundation requirements may be permitted after performance of a special soil investigation under the direction of an engineer specializing in soil and foundation engineering. The Department may approve such deviations only after receiving a written opinion from such engineer together with substantiating evidence of acceptable laboratory and field investigation of the soils involved.

Section 2807. LOAD TESTS.

Where the bearing capacity of the soil is not definitely known or is in question, the Department may require suitable load tests or other adequate proof so to the permissible safe
bearing capacity at that particular location. To determine the safe bearing capacity of soil it may be tested by loading an area at least two square feet (2 sq. ft.) to at least twice the maximum bearing capacity desired for use. Such load shall be sustained by the soil until no additional settlement takes place for a period of at least 48 hours in order that such desired bearing capacity may be used. Examination of subsoil conditions may be required when deemed necessary.

Section 2808. STRUCTURAL DESIGN.

All foundations shall be designed in accordance with the structural provisions of this Building Code.

Section 2809. PILES AND PIERS.

(a) General. The allowable axial and 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 Department.

(b) Group Action. Consideration shall be given to the reduction of allowable pile load when piles are placed in groups.

(c) Static Load Tests. When the allowable axial load of a single pile is determined by load test it shall not exceed 50 per cent of the yield point under test load. The yield point shall be defined as that point at which an increase in load produces a disproportionate increase in settlement. In addition, the allowable load shall not exceed one-half of that load under which, during a 40-hour period of continuous load application, no additional settlement takes place.

(d) Column Action. All piles standing unbraced in air, water, or material not capable of lateral support, shall conform with the applicable column formula as specified in this Building Code. Such piles driven into firm ground may be considered fixed and laterally supported at five (5) feet below the ground surface and in soft material at ten (10) feet below the ground surface unless otherwise prescribed by the Department after a foundation investigation by an approved agency.

(e) Piles in Subsiding Areas. Where piles are driven through subsiding fills or other subsiding strata and derive support from underlying firmer materials, consideration shall be given to the downward frictional forces which may be imposed on the piles by the subsiding upper strata.

(f) 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 Department. 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.

(g) Structural Strength of Piles and Limiting Values of Stresses. The allowable compressive stresses on all piling materials shall not exceed the values as specified below, except that stresses may be increased on submission of satisfactory data for specially protected, selected, or high-strength material.

1. Concrete — .225f'c
2. Structural steel — 9000 pounds per square inch
3. Wood — the allowable stress in compression parallel to the grain of round wood piles shall not exceed 75 per cent of the basic stress for clear material as set forth in ASTM D-2555 — and in no event shall the stress exceed 1000 pounds per square inch.

4. Reinforcing steel — as in Chapter 26. The full load shall be assumed as carried on the pile cross section located at the upper surface of the soil supporting the pile.

(h) Round Wood Piles.

1. Quality. Except where untreated piles are permitted, wood piles shall be pressure-treated in accordance with the requirements of Chapter 25 of this Building Code. The basic material shall conform to that of untreated piles.

2. Untreated Piles. Untreated piles may be used only when it has been established that the cutoff will be below lowest groundwater level assumed to exist during the life of the structure. Every wood pile shall conform to the specification for Class A or Class B piles as required in Chapter 25 of this Building Code.

(i) Precast-Concrete Piles.

1. Quality. Precast-concrete piles shall be cast in one piece prior to driving, and at 28 days casting shall develop an ultimate compressive strength (f'c) of at least 3000 pounds per square inch.

2. Stresses. Precast-concrete piling shall be designed to resist stresses induced by handling and driving as well as by foundation loads.
(i) Uncased Cast-in-Place Piles or Piers.

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 30 times the average diameter. Concrete shall have an ultimate compressive strength \( f'_{cu} \) of at least 2500 pounds per square inch.

A concrete pile or pier cast in a metal casing which is withdrawn during concrete placement, shall be considered an uncased, cast-in-place pile or pier.

2. Friction. Any uncased cast-in-place pile may be assumed to develop a frictional resistance equal to one-tenth of the bearing value of the soil material at minimum depth as set forth in Table No. 28-C, but not to exceed 500 pounds per square foot unless a greater value is approved by the Department after a soil investigation as specified in Section 2806. Such pile may also be assumed to develop end bearing equal to the bearing value of the soil as set forth in Table 28-C.

(k) Metal-Cased Concrete Piles.

1. General. 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. Every metal casing for a concrete pile shall have a sealed tip with a diameter of at least eight (8) inches.

2. Concrete. All concrete used in metal-cased concrete piles shall have an ultimate compressive strength \( f'_{cu} \) of at least 2500 pounds per square inch.

3. Order of Driving. Piles shall be driven in such order and with such spacing as to insure against distortion of or injury to piles already in place. No pile shall be driven within four and one-half average pile diameters of a pile of concrete less than 24 hours old.

(l) Concrete-Filled Steel Pipe Piles.

1. Steel Pipe. Steel pipe piles shall conform to ASTM A-233 and AWS A 5.1. If it is desired to use pipe of other material, satisfactory substantiating data shall be submitted.

2. Concrete. The concrete used in concrete-filled steel pipe piles shall have an ultimate compressive strength \( f'_{cu} \) of at least 2500 pounds per square inch.

3. Allowable Loads. The allowable load on concrete-filled steel pipe piles shall not exceed 9000 pounds per square inch on the steel plus .225 of the ultimate compressive strength \( f'_{cu} \) of the concrete.

(m) Rolled Structural-Steel Piles.

Structural steel piles shall conform to Chapter 27 and ASTM A7. No section shall have a nominal thickness less than three-eighths (\( \frac{3}{8} \) ) inch.

(n) Special Piles and Special Conditions.

The use of types of piles not specifically mentioned herein, and the use of piles under conditions not specifically covered herein shall be permitted, subject to the approval of the Department, upon submission of acceptable test data, calculations, or other information relating to the properties and load-carrying capacity of such piles.

(o) Jetting. Jetting shall not be used except where and as specifically permitted by the Department. When used, jetting shall be carried out in such a manner that the carrying capacity of existing piles and structures shall not be impaired. After withdrawal of the jet, piles shall be driven down until the required resistance is obtained.

Section 2810. QUALITY AND DESIGN.

The quality and design of materials used structurally in excavations and foundations shall conform to the requirements set forth in Chapters 23, 24, 25, 26 and 27 of this Building Code.

Section 2811. RETAINING WALLS.

Retaining walls shall be designed to resist the lateral pressure of the retained material in accordance with accepted engineering practice and the effect of surcharge shall be considered in addition to the equivalent fluid pressure. Walls retaining drained earth where sufficient movement of the wall is allowable to enable mobilization of the soil strength, may be designed for pressure equivalent to that exerted by a fluid weighing at least thirty (30) pounds per cubic foot and having a depth equal to that of the retained earth.

Section 2820. STANDARDS.

Unless otherwise specified in other Sections of this Building Code, these Standards shall apply:
<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>A-36-67 T, Spec. for Steel for Bridges and Buildings</td>
</tr>
<tr>
<td></td>
<td>A-233-64 T, Spec. for Mild Steel Arc-Welding Electrodes</td>
</tr>
<tr>
<td></td>
<td>D 245-68 T, Methods for Establishing Structural Grades for Visually Graded Lumber</td>
</tr>
<tr>
<td></td>
<td>D 402-67 Method of Test for Distillation of Cut-Back Asphaltic Products</td>
</tr>
<tr>
<td></td>
<td>D 449-49 Spec. for Damp-proofing and Waterproofing</td>
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<tr>
<td></td>
<td>D-450-41, Spec. for Coal-Tar Pitch for Roofing, Damp-proofing and Waterproofing</td>
</tr>
<tr>
<td></td>
<td>D 696-66 T., Methods of Test for Moisture-Density Relations of Soils, Using 5.5-lb. Rammer and 12-in. Drop.</td>
</tr>
<tr>
<td>AWS</td>
<td></td>
</tr>
<tr>
<td>NFPA</td>
<td>U.S. Government</td>
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</tr>
<tr>
<td></td>
<td>SS-R-451-1933, Roof-Coating; Asphalt, Brushing-Consistency</td>
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</tbody>
</table>
Section 2830. TABLES.

**TABLE NO. 28-A**

**MINIMUM FOUNDATION REQUIREMENTS FOR TYPE III BUILDINGS**

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Depth of Foundation Below Finish Grade in Inches</th>
<th>Width of Footing in Inches*</th>
<th>Thickness of Footing in Inches</th>
<th>Thickness of Foundation Wall in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>20</td>
<td>8</td>
<td>8</td>
</tr>
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<td>2</td>
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<td>8</td>
<td>12</td>
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<tr>
<td>3</td>
<td>36</td>
<td>24</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

**NOTES:** For reinforced concrete see Chapter 26 and Table No. 26-C. *Does not apply in the case of expansive soils — special investigation required. (See Table 28-C)*

**TABLE NO. 28-B**

**MINIMUM FOUNDATION REQUIREMENTS FOR TYPES IV AND V BUILDINGS**

<table>
<thead>
<tr>
<th>Number of Stories</th>
<th>Depth of Foundation Below Finish Grade in Inches</th>
<th>Width of Footing in Inches*</th>
<th>Thickness of Footing in Inches</th>
<th>Thickness of Foundation Wall in Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>14</td>
<td>6</td>
<td>6</td>
</tr>
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<tr>
<td>3</td>
<td>36</td>
<td>18</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

**NOTES:** For reinforced concrete see Chapter 26 and Table No. 26-C. *Does not apply in the case of expansive soils — special investigation required. (See Table 28-C)*

**TABLE 28-C**

**ALLOWABLE SOIL PRESSURE**

<table>
<thead>
<tr>
<th>CLASS OF MATERIAL</th>
<th>MAXIMUM ALLOWABLE SOIL PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound unweathered claystone, sandstone or siltstone</td>
<td>20,000 psf.</td>
</tr>
<tr>
<td>Compact, coarse sand and/or gravel</td>
<td>4,000 psf.</td>
</tr>
<tr>
<td>Compact, fine sand</td>
<td>3,000 psf.</td>
</tr>
<tr>
<td>High-density silt</td>
<td>2,000 psf.</td>
</tr>
<tr>
<td>Clays, silty or sandy clays, and weathered claystone</td>
<td>Usually expansive*</td>
</tr>
<tr>
<td>Loose sand</td>
<td>1,000 psf.</td>
</tr>
<tr>
<td>Organic soils, very soft soils, muck, filled ground</td>
<td>*</td>
</tr>
</tbody>
</table>

*Special investigations required (Section 2806). Provision shall be made for the possible effect of moisture changes on the bearing capacity of the soil.
CHAPTER 29

VENEERED WALLS

Section 2900. GENERAL

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation and maintenance of veneered walls.

(b) Definitions. For purposes of this Chapter, the following definitions shall apply:

Veneer is a nonstructural facing of an approved material attached to a backing for ornamentation, protection, insulation, or like purposes. Veneer does not include floor covering or acoustical tile.

Interior Veneer is veneer applied to weather protected interior surfaces of a building. (See Chapter 42.)

Exterior Veneer is veneer exposed to the weathering action of the elements.

Adhered Veneer is veneer secured to and fully supported by the backup wall by adhesion of an approved bonding material.

Anchored Veneer is veneer supported by and secured to a structural backing with approved mechanical fasteners. The veneer shall be completely supported by a structural element.

Bonding Agent is an adhesive material used to stick or adhere two similar or dissimilar materials together such that the agent develops the required bond stresses.

(c) Limitations. Veneer shall not be assumed to add to the strength of any wall. The surface to which the veneer is attached shall be designed to support the additional loads imposed by the veneer. The limitations in this Chapter shall not apply to interior veneer of units five-eights inch (\( \frac{5}{8}'' \)) or less in thickness.

Section 2901. VENEER OF MASONRY 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. Veneer shall not support any vertical load other than the dead load of the veneer. Veneer above openings shall be supported upon lintels of incombustible material.

(c) Anchored Veneer. Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties, or other approved method, designed to resist all horizontal forces as specified in Chapter 23.

1. Veneer ties, if strand wire, shall be corrosion resistant, galvanize or copper of not less than No. 9 U. S. Standard Gauge wire and shall be provided with a hook of not less than 2" embedded at least 2" in the mortar joint. Each tie shall support not more than two square feet (2 sq. ft.) of wall area and shall be spaced not more than twenty-four inches (24") on center horizontally. If sheet metal ties are used, they shall be corrosion-resistant galvanize or copper of No. 22 U. S. Standard Gauge corrugated.

2. In lieu of such wire ties, an approved method of grouting the veneer to a paperbacked reinforcement attached directly to the studs may be used.

(d) Support. The weight of masonry veneers shall be supported upon incombustible structural supports spaced not more than twelve feet (12') vertically.

EXCEPTION. The weight of masonry veneer attached to wood frame walls shall be supported upon footings or foundations.
(e) Adhered Veneer

1. Permitted Backing. Backing shall be continuous and may be of any material permitted by this Building Code. The backing shall have surfaces prepared to secure and support the imposed loads of veneer.

2. Application
   a. Surface preparation. Surfaces shall be clean, dry and free of dust or other similar material.
   b. Bonding Agent. The bonding agent shall be applied to provide bond between the veneer and the backing sufficient to withstand a shearing stress of 50 pounds per square inch.

   Bonding agents, other than cement mortar, shall be not less than one-eighth inch (\(\frac{1}{8}\)") or more than one-half inch (\(\frac{1}{2}\)") in thickness.

   Cement mortar bonding agents shall be not less than one-half inch (\(\frac{1}{2}\)"") nor more than one and one-fourth inches (1 ¼") in thickness.

Section 2902. NON-MASONRY VENEER

(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 shall not support any superimposed loads except wind and seismic loads as provided in Chapter 23.

(c) Anchored Veneers. The veneer shall be anchored to the backing by corrosion-resistant metal ties not less in thickness than No. 9 U. S. Gauge wire, and spaced not more than twenty-four inches (24") apart horizontally and vertically. Each tie shall not support more than two square feet (2 sq. ft.) of wall area.

(d) Adhered Veneer. Approved veneer may be cemented to a masonry or concrete surface or to exterior plaster with a portland cement-lime mortar, provided the mortar bond is sufficient to withstand a shearing stress of 50 pounds per square inch after curing for 28 days.

Section 2903. 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.

(b) Height. Glass veneer shall not be attached to any exterior wall at a point more than thirty-five feet (35') above the adjoining ground elevation.

(c) Dimensions. Glass-Veneer units shall be not less than one-eighth inch (\(\frac{1}{8}\)") 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-fourth (\(\frac{1}{4}\)"") inch not 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.

(d) Anchored Glass Veneer. Every glass-veneer unit shall be attached to the backing by approved corrosion-resistant ties and shall be supported upon shelf angles. Shelf angles shall be of corrosion-resistant material capable of supporting four times the weight of the supported veneer.

The shelf angles shall be spaced vertically in alternate horizontal joints but not more than three feet (3') apart.

The shelf angles shall be spaced not farther apart horizontally than the width of the supported units.

(e) Adhered Glass Veneer. (See also 2902 (d).) Approved bonding agents shall cover not less than one-half of the area of the unit after the unit has been set in place.

1. The mastic shall be insoluble in water and shall not lose its adhesive qualities when dry.

2. Absorbent surfaces shall be sealed by a bonding coat before mastic is applied. The bonding coat shall be adhesive with the mastic.

(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. WHEN REQUIRED.

Vertical openings shall be 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 in Chapters 6 through 15 (Occupancy). Stairways and ramps are specifically included in Chapter 33.

Any unusual vertical opening which is not specifically covered in any of these Chapters shall be subject to approval by the Department and shall require enclosure or protection of such vertical opening as shall substantially meet the intent of this Building Code which is to provide a stop against fire or smoke spread through these openings.

Section 3002. ELEVATOR ENCLOSURES.

Walls and partitions enclosing elevators within buildings or structures shall be of at least the fire-resistant construction required under Types of Construction in Chapters 17 through 22 of this Building Code. One of the enclosing walls of an elevator shaft may contain wire glass, one-fourth (¼) inch in thickness, set in metal frames, on the entrance side only. Such wire glass shall not exceed a total of one hundred (100) square inches. Elevator shafts extending through more than two stories shall be equipped with an approved means of ventilation. (See Chapter 52 for requirements).

Section 3003. OTHER VERTICAL OPENINGS

All shafts, ducts, chutes and other vertical openings not covered in Sections 3002 and 3004 shall be enclosed in conformance with the requirements specified under Type of Construction (Chapters 17 through 22) of the building in which they are located.

Section 3004. AIR DUCTS

Air ducts passing through a floor shall be enclosed in a shaft as required for vertical openings in Chapters 17 through 22 or shall be provided with fire dampers at each floor level. (See Chapter 52.)
CHAPTER 31
FLOOR, CEILING AND ROOF CONSTRUCTION

Section 3100. General

(a) Materials and Construction. Materials and construction shall be as required under Occupancy and under Type of Construction in this Building Code. Fire resistive standards of construction are described in Chapter 43.

(b) Design. The design of floor, ceiling and roof construction shall be in accordance with engineering regulations for the materials used. Design loads shall conform with the requirements of Chapter 23.

All floors and roofs shall be so framed and tied into the framework and supporting walls so as to form an integral part of the whole building.

The construction used shall provide means to keep the joists, beams and girders from spreading by installing either ties or bridging with no laterally unsupported length of joists being permitted to exceed eight (8) feet except as otherwise specified in this Chapter.

Section 3101. Floor Construction.

(a) General. Floor construction shall be as described below:

1. Type I Buildings. Floor construction in Type I buildings shall consist of any incombustible floor system of at least two-hour fire-resistant construction.

2. Type II Buildings. Floor construction in Type II buildings shall consist of at least one-hour fire-resistant construction or of heavy timber floors or of laminated floors.

3. Type III Buildings. Floor construction in Type III buildings shall consist of concrete, masonry, steel, iron or wood as required in this Building Code. Any floor having a usable space below shall be at least one-hour fire-resistant construction except in Group I and J Occupancies.

4. Type IV Buildings. Floor construction in Type IV buildings shall consist of incombustible materials, provided however, that a wood or asphalt wearing surface or finish may be applied over such incombustible material. Any floor having a usable space below shall be at least one-hour fire-resistant construction except in Group I and J Occupancies.

5. Type V Buildings. Floor construction in Type V buildings shall consist of any floor system permitted in this Building Code.

(b) Wood Sleepers. Where wood sleepers are used for laying wood flooring more than two (2) inches above masonry or concrete fire-resistive floors the space between the floor slab and the underside of the wood flooring shall be filled with incombustible material or firestopped in such a manner that there will be no open spaces under the flooring which will exceed one hundred (100) square feet in area and such space shall be filled solidly under all permanent partitions so that there is no communication under the flooring between adjoining rooms.

(c) Mezzanine Floors. Mezzanine floors shall be constructed as herein described:

1. Not more than 2 mezzanine floors shall be in any room of a building.

2. Mezzanine floor or floors shall not cover more than thirty-three and one-third (33 1/3%) percent of the area of a room.

3. Type I, II, or III Buildings. Mezzanine floors in Type I, II, or III buildings may be of unprotected steel or wood except that in Fire Zones No. 1 or 2 they shall be of incombustible materials approved for one-hour fire-resistant construction or of heavy timber as described in Chapter 25.


Section 3102. Suspended Ceiling Construction

(a) General. Suspended ceiling construction shall be as described below:

1. Type I, II, III, or IV Buildings. Ceiling construction in Types I, II, III, and IV buildings shall be of incombustible or fire retardant treated wood materials, including all supports and coverings materials. Where such ceilings are required to be fire-resistive within a corridor, room or other area, they shall have all openings fire-protected in an approved manner. (See Chapter 42 for other requirements).
Section 3103. Roof Construction.

(a) General. Roof construction shall be as described below:

1. Type I Buildings. Roof construction in Type I building shall consist of an incombustible roof system of at least two-hour fire-resistive construction:

EXCEPTIONS:

A. Roofs at least twenty-five (25) feet above any floor, balcony, or gallery may be sheathed by wood planks of two (2) inches nominal thickness when such wood planks are protected on the underside by at least one-hour fire-resistant incombustible construction.

B. Roofs at least twenty-five (25) feet above any floor, balcony, or gallery may be of unprotected incombustible construction.

C. Roof not more than twenty-five (25) feet and at least eighteen (18) feet above any floor, balcony or gallery shall be protected by at least a one-hour fire-resistant incombustible construction.

2. Type II Buildings. Roof construction in Type II building shall consist of an incombustible roof system of at least one-hour fire-resistive construction:

EXCEPTION: Roofs at least twenty-five (25) feet above any floor, balcony, or gallery may be of unprotected incombustible materials.

3. Type III Buildings. Roof construction in Type III buildings shall consist of concrete, masonry, steel, iron or wood as required in this Building Code. Any building required in this Building Code to be one-hour fire-resistive construction throughout, shall have such roof construction unless otherwise permitted.

4. Type IV Buildings. Roof construction in Type IV buildings shall consist of an incombustible roof system, a one-hour fire-resistive roof system or a fire retardant treated wood system. Any building, required in this Building Code to be one-hour fire-resistive construction throughout, shall have such roof construction unless otherwise permitted.

5. Type V Buildings. Roof construction in Type V buildings shall consist of any roof system permitted in this Building Code.

Section 3104. Concrete Construction.

Combustible material shall not be permitted for supporting concrete. Concrete slab floors laid directly on earth shall conform to the requirements of Chapter 28. Other concrete slabs shall be at least two (2) inches thick. Topping, when poured monolithic with the slab, may be included as a structural portion of the slab. Sleepers used 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 further, shall not be placed more than one-half (1/2) inch into the slab.

Section 3105. Steel Joist Construction.

(a) Joists. Steel joist construction shall consist of steel joist as described in Chapter 27. When used in Type I, II, III, or IV buildings such joist shall have a reinforced concrete or gypsum slab at least two (2) inches thick placed on and secured to the top thereof. 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 (8) feet along the joist length.

(b) Bridging. 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 direction of the joists. Such bridging shall consist of solid concrete sections, structural steel shapes or plates, portal bridging, diagonal rods, or other bridging which will provide equal stiffness. Any row of bridging shall be capable of transferring five hundred (500) pounds from each joist to the adjoining joists.

Section 3106. Cellular Steel Construction.

(a) General. Cellular steel construction shall consist of sheet or strip steel formed into an integrated system of parallel steel beams which combines 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 (2) inches of concrete fill on top and shall be protected with a fire-resistive ceiling on, or suspended from, the under side.

(b) Physical Properties. The steel used in the manufacture of steel units shall conform to the requirements of this Building Code and the standards.
(c) Minimum Thickness. The thickness of the steel used in manufacture of steel floors shall be at least the U. S. Standard Gauge No. 18 in thickness.

EXCEPTION: Steel used to form load-carrying panels, including ribbed roof deck construction, shall be not less than No. 22 U. S. Standard Gauge in thickness.

(d) Design. Cellular steel sections shall have been structurally analyzed, and such 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).

Section 3107. WOOD CONSTRUCTION.

(a) General. Wood joist, rafter, and truss systems shall be designed, framed and constructed, and anchored to supporting stud or masonry walls as described in Chapter 25 and all such wood systems shall be stressed not to exceed the maximum allowable fiber stress permitted in this Building Code.

Floor and roof systems shall have all joints well fitted and shall have all tension members well tightened before any load is placed on the system. Diagonal and sway bracing shall be used to brace all systems. The minimum net section of the members after framing shall be used in determining the strength at any point.

Plywood sheathing, unless of exterior type, shall have no surface or edge exposed to weather.

The allowable span of roof rafters shall be measured from plate to ridge, except where braced with a member sloping not more than forty-five (45°) degrees from the vertical and supported by a partition.

(b) Heavy Timber Floors. Heavy timber floors shall be constructed of tongued and grooved or splined lumber at least three (3) inches nominal thickness. Structural floors shall be covered with one (1) inch nominal tongued and grooved flooring laid crosswise or diagonally. Flooring shall not extend closer than one-half (½) inch to walls. Such one-half (½) inch space shall be covered by a molding fastened to the wall and so arranged that it will not obstruct the swelling or shrinking movements of the floor. Corbeling of masonry walls under floor planks may be used in place of such molding.

(c) Laminated Floors. Laminated floors shall be constructed of square-edged lumber at least four (4) inches nominal width set on edge and securely spiked together. Laminations 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 (18) inches for two (2) inch by eight (8) inch nominal width and be proportional for other plank widths. Nail length shall be at least two and one-half (2½) times the net thickness of each lamination. Laminated floors shall be covered with flooring as required for heavy timber floors.

(d) Suspended Ceilings. In wood frame construction where suspended ceilings occur, the spaces between ceilings and under side of floors or roof shall be divided into horizontal areas of not more than twenty-five hundred (2500) square feet with tight one (1) inch partitions of matched wood, one-half (½) inch 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 space immediately above the ceiling is sprinklered the divided horizontal area may be tripled.

(e) Heavy Timber Roofs. Heavy timber roof decks shall be constructed of tongued and grooved or splined lumber at least two (2) inches nominal thickness, or of square-edged lumber at least three (3) inch nominal width set on edge and securely spiked together.

(f) Laminated Roofs. Laminated roof decks shall be constructed of square-edged lumber at least three (3) inches nominal width set on edge and securely spiked together. Laminations 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 (18) inches for two (2) inch by eight (8) inch nominal width and be proportional for other plank widths. Nail length shall be at least two and one-half (2½) times the net thickness of each lamination.

Section 3108. DRAFT STOPS.

(a) Required. Draft stops shall be required and installed in all buildings, regardless of the occupancy, as follows:

1. In all buildings where the attic area exceeds twenty-five hundred (2500) square feet. The draft stops shall divide the areas into sections not to exceed twenty-five hundred (2500) square feet.

2. In buildings having floor areas exceeding twenty thousand (20,000) square feet. Such areas shall be divided by draft stops into sections not to exceed twenty thousand (20,000) square feet.

3. Where suspended or other type ceiling occurs, the area between such ceiling and the floor or roof above shall have draft
stopped when the area exceeds twenty-five hundred (2500) square feet.

(b) Construction. Draft stops shall be constructed as follows:

1. Draft stops shall be constructed of incombustible materials or wood. If constructed of wood, this shall consist of two by four (2 x 4) inch framing, sixteen (16) inch on center, with one-half (½) inch gypsum board or one-fourth (¼) inch asbestos millboard, applied to both sides of the studs. Such stops shall be made tight to both the lower and upper limits of the framing.

2. Openings through the draft stops, as indicated in Item (b) 1., shall be doors or access panels may be constructed of wood or other approved materials. If wood is used, the doors or panels shall be at least one and three-fourths (1 ¾”) inches in thickness and shall be solid, with no voids. A latch and self-closing device shall be provided. The door or access panel shall be not less than thirty (30) inches in its least dimension.

3. Where draft stops are required for buildings or rooms without ceilings, such draft stops shall extend from the deck down to include the bottom flange of the beam or truss. In no case shall this dimension be less than twenty-four (24) inches in depth. Both sides of the beam or truss shall be covered or filled with at least one-half inch (½”) gypsum board or one-fourth (¼”) inch asbestos millboard.

4. Where a partition wall is provided and such extends from the floor to ceiling, this shall be acceptable as substantially meeting the requirements of this Section.

(c) Unlimited Areas. The installation of fire sprinkler systems to gain unlimited areas shall not eliminate the requirement for draft stops.

(d) Fire Sprinklers. Where fire sprinklers are installed in attics or above suspended ceilings, the draft stop may be omitted.

Section 3109. ATTICS.

(a) Access. Access to any attic space shall be provided by means of a stairway or permanent ladder or a scuttle. The opening provided through the ceiling for such access into the attic space shall be at least twenty-two (22) inches by thirty (30) inches and shall be located in the hallway or corridor of all Type II, III or V buildings.

EXCEPTION: The space in which any attic furnace is installed shall be accessible by an opening and passageway at least the size required to install or remove the unit without disassembling, and such opening shall in no case be less than thirty-six by thirty-six (36 x 36) inches. Access openings to attics shall be so located that a clearance of four (4) feet exists between the top of the ceiling joist and the bottom of the rafters at the point of entrance.

(b) Attic Ventilation. Adequate cross ventilation shall be provided by vents the net area of each being at least one hundred forty-four (144) square inches. The openings are to be covered with corrosion resistant screening, the mesh of which shall be at least sixteen (16) per inch.

Section 3110. ROOF DRAINAGE.

(a) General. All buildings or other enclosed structures shall be provided with proper gutters and downspouts, which shall discharge upon concrete blocks placed under the downspouts, which block shall have a minimum dimension of twelve (12) inches wide by thirty-six (36) inches long.

EXCEPTIONS:

1. When the roof extends at least three (3) feet beyond the building wall and such wall is at least ten (10) feet from adjacent property lines, gutters and downspouts shall not be required when other requirements of this Section are complied with. For purposes of this exception, the distances are horizontal dimensions.

2. Gutters and downspouts shall not be required for greenhouses.

(b) Maintenance. The roof of all buildings shall be kept in good repair.

(c) Discharge Water. Water shall not be discharged from any conductor pipes upon any public sidewalk, but shall be conducted underneath the walk to the gutter.

Section 3115. STANDARDS. Unless otherwise specified in other Sections of this Building Code, the following standards shall apply:

Organization | Title of Publication
--- | ---
ASTM | Tentative Specifications for Heavy (Light) Gauge Structural Quality Flat Hot-Rolled Carbon-Steel Sheets A245-64.


American Lumber Standards for Soft-Wood Lumber (Simplified Practice Recommendations R16-53)

LEGEND

ASTM—American Society for Testing and Materials

1916 Race Street, Philadelphia Pa. 19103
CHAPTER 32
ROOF COVERINGS

Section 3201. GENERAL

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the construction, materials, flashings and application of roof coverings for new and existing buildings.

(b) Materials. All materials shall be delivered in original packages bearing the manufacturer's label. All materials shall bear the seal or label of the Underwriters' Laboratories for Class A, B or C roofing, or as set forth in Table 32-A of this Building Code.

(c) New Roof Coverings. New roof coverings for all structures located in Fire Zones No. 1 and 2 and for new structures of Type I, II, III and IV construction located in other Fire Zones shall be fire retardant as specified in Section 3204 of this Chapter.

EXCEPTIONS:

1. Ordinary roof coverings may be used for Group I Occupancy buildings located outside Fire Zones No. 1 and No. 2.

2. Any composition roofing having a fire-retardant value of at least six (6) points, as set forth in Table No. 32-A may be used for Group J, Division 1 Occupancy buildings located outside Fire Zones No. 1 and 2.

3. Roof covering repairs may be covered with the same materials as the existing roofing when not more than 25% of the roof area is to be replaced on a building or structure in any twelve month period. Where roof covering repairs exceed twenty-five (25) percent of a roof area in any twelve (12) month period, such roof covering shall conform to the requirements for new buildings or structures.

(d) Re-Roof Coverings. Subject to exceptions (c) 1, 2 and 3 of this Section, re-roof coverings for all structures located in Fire Zones No. 1 and 2 and for structures of Type I and II construction located in other Fire Zones shall be fire retardant as specified in Section 3204 of this Chapter. Other structures may have ordinary re-roof coverings.

1. Existing roof covering, when properly cleaned and prepared may be used as a base for re-roofing, and may be given a value of three (3) points in assembling points for a fire-resistant re-roof. (See Section 3204).

(e) Mechanical Units on Roofs. Mechanical units, ducts, piping or structures shall not be placed, replaced or reset over roofing without being properly supported by curbs, pads, bases or piers which shall be flashed to the roofing in a watertight manner. All such installations shall be a minimum of twelve (12) inches above the plane of the roof so that they will not be an obstruction to re-roofing, and so located that proper drainage from the roof will not be blocked or impeded.

1. Rectangular space, surrounded by curbs, shall be sheathed over solid and covered with metal, a minimum 26 gauge or equal. All seams and miter corners shall be riveted and soldered in a watertight manner. Such curbs shall be nine (9) inches in height.

2. Mechanical units shall mean heating, cooling, refrigeration, ventilating equipment, fans and blowers, or any similar type of equipment.

(f) Roof Insulation. The use of cork, fibreboard or other approved combustible roof in-
sulation shall be permitted in all types of roof construction provided such is covered with approved roof coverings, applied thereto.

Section 3202. DEFINITIONS

For purposes of this Chapter, the following shall be defined as set forth in this Section.

**Asphalt.** A brown and black bitumen used in the manufacture of roofing materials.

**Asphalt (composition) shingles.** Shingles surfaced with incombustible granules.

**Asphalt Primers.** A liquid bitumen with no additives. Primers are used wherever a firm bond is required between asphalt, concrete, gypsum roof decks, untreated metal roof decks, masonry, fire and parapet walls, between old felts and new material being applied in repair of built-up roofs.

**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.

**Bitumen.** An asphalt or a coal tar pitch or a compound having an asphalt or a coal tar pitch as a base.

**Cant Strip.** A filler used where roof intersects projection from the roof or parapet walls. Cant strips may be made from lumber, concrete, gypsum or similar materials.

**Cap Sheets.** Roofing made of organic or inorganic fibers saturated and coated on both sides with a bituminous compound and surfaced with material granules, mica, talc, ilmenite, inorganic fibers, or similar materials, except on the unexposed portions of split cap sheets.

**Coal Tar Pitch.** A bitumen by-product of coke used in pitch felts and the application of water-proofing and flat built-up roofs.

**Coatings.** Coatings may be either liquid bitumen with no additives or they may have asbestos fibers added. Some are pure asphalts which have been thinned or "cutback" with a petroleum solvent. Asphalt coatings are made in several consistencies. The heavy material is used to resurface old smooth surfaced built-up roofs and smooth roll roofings that have become weathered.

**Felt.** Roofing felt made from organic or inorganic fibers saturated with bituminous compound.

**Flashings.** Flashings are primarily used in waterproofing roof valleys, hips, intersection of roof with walls, chimneys, vents and similar.

**Gravel.** Inorganic material of rock, slag, ceramic, and other similar approved materials, that are dry and free of dirt and are used as top surfacing for various types of built-up roofs.

**Gravel, Metal Stops.** Stops used in conjunction with built-up roofs, to prevent gravel from washing off roofs at the edges.

**Grease Pans.** Pans used to catch and contain droppings of grease or oil from mechanical units.

**Nails.** For purposes of this Chapter, nails are sharp pointed hot galvanized (or equivalent) steel, copper, or aluminum metals. Length, gauge and head varies in size. Nails are to secure various types of materials firmly in place.

**Pitch Pans or Pitch Cups.** Pans or cups of metal or asphalt roofing materials used to contain asphalt, bitumen or plastic roof cement.

**Quick Setting Lap Cement.** An asphalt material with high grade quick setting action, in brush and trowel consistency.

**Roof Cement.** This material is generally referred to as "plastic cement" and is made either from an asphalt or coal tar base. Because of its thick, putty like consistency, its elasticity, it is particularly adapted for use in flashing around chimneys and other roof openings. Generally, it is mill-mixed with asbestos fiber.

**Roofing Tape.** Cotton fabric asphalt saturated, burlap asphalt saturated, glass fiber treated. Used primarily with coatings, plastics, patching breaks, holes and covering seams on roll roofing where nails are exposed to the elements.

**Shake (wood).** A shake is a fissured wood shingle of various types and dimensions.

**Tile.** A piece of fired clay, stone or concrete or similar used for roofing.

**Valleys.** Where two sloping roofs join at an angle.

Section 3203. FLASHINGS

(a) For Built-Up Roofs. Flashings may be of any type complying with roof flashings bondable for 10, 15, or 20 years.

Otherwise, flashings shall consist of at least one (1) layer of a minimum width of nine (9)
inches, ninety (90) pound roll roofing or other approved material set separately, and shall be nailed at least eight (8) inches on center, unless otherwise approved by the Department. Flashings shall also be securely cemented and fastened in place with plastic cement of at least four (4) inches on the upper inside sheet of flashing material and sealed on top outside edge.

(b) Flashings Around Chimneys, Dormers, Skylights, and Similar Projections. Where wood shingles, shakes and clay or concrete tile are used on new and re-roofs, the base and counter flashing shall be of metal. Asphalt shingles may be flashed with ninety (90) pound roll roofing and plastic cement.

1. On new construction the application of ridged asbestos, slate, wood shingles, wood shakes, composition shingles, metal base and metal counter flashing of a minimum 30 gauge galvanized metal or equal, shall be used against all vertical roof projections, walls, chimneys, etc.

2. Base flash shall be step type between each course of material.

3. Under clay or concrete tile there shall be a metal base and counter flash on new or old existing roofs.

4. For reroofs, where composition shingles are used, all pipes and vertical projections shall be flashed with plastic cement.

5. Saddles or crickets in the rear of all projections shall be of galvanized metal or asphalt roll roofing equivalent to the type roofing being applied, nailed and sealed with plastic cement.

Section 3204. ROOF COVERINGS

(a) Fire-Retardant Roof Coverings. A fire retardant roof covering shall be any roof covering which meets the requirements specified in this Section, or any other material or combination of materials when applied according to manufacturer's specifications, Items 1 through 7 of this Section; or shall be any roof assembly bearing the seal or label of an approved testing laboratory for Class A or B roofing.

(b) Classification. For purposes of this Building Code a fire retardant roof is any one of the following:

1. An approved built-up composition roofing.

2. Hydraulic compressed rigid shingles.

3. Asphalt saturated mineral surfaced prepared composition shingles.

4. Concrete slab roofs.

5. Metal roof covering.

6. Slate shingles.

7. Clay and concrete roof tile.

(c) Classification Qualifications. The following assemblies, as classified in Items 1 through 7 of this Section, shall qualify as a fire retardant roof:

1. Built-up composition roofing is one consisting of materials whose fire-retardant values are as set forth in Table No. 32-A, equal to at least fifteen (15) points including a top covering selected from parts (b), (c) or (d) of such table.

2. Hydraulic compressed rigid shingles which are at least one-eighth (1/8) inch thick, composed of Portland cement and asbestos fibers, laid over a layer of saturated felt weighing a nominal fifteen (15) pounds to one hundred (100) square feet or hydraulic compressed rigid sheets at least seven thirty-seconds (7/32) inch thick, composed of Portland cement and asbestos fibers. The felt may be omitted when the compressed shingles are placed over an existing roof covering.

3. Asphalt saturated mineral surfaced prepared composition shingles are laid so that at least ninety-seven (97) per cent double coverage is obtained. Such material shall carry a Class A, B or C rating.

4. Concrete slab roofs when constructed as specified in Chapter 26.

5. Metal roof covering which is constructed of corrugated, standing seam, or flat seam of at least No. 30 U.S. Standard Gauge metal. All flat metal roof coverings shall be laid on solid sheathing. Corrugated or standing seam metal roof coverings shall be designed to support the required live load between supporting members.

6. Slate shingles which are the type that shall be fastened with copper nails or No. 14 B & S Gauge non-corrosive nails.
of such length as to provide at least three-fourths (¾) inch 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 a nominal thirty (30) pounds to one hundred (100) square feet.

7. Clay and concrete roof tiles which are the type that shall be fastened with copper or galvanized nails or copper wire, provided, however, that for roofs not exceeding eight (8) inch rise in twelve (12) inch run, galvanized nails may be used. Where the roof pitch is not over four (4) inch rise in twelve (12) inch run, and tile with suitable lugs are used, nailing shall not be required when 1” x 2” horizontal wood strips shall be laid over vertical batten or lath placed at not more than twenty-four (24) inch centers.

A. There shall be placed under clay or concrete tile, one (1) layer of asphalt felt weighing a normal forty-three (43) pounds per one hundred (100) square feet. When the roof pitch is less than four (4) inch rise in twelve (12) inch run, two layers of forty-three (43) pound asphalt felt shall be laid shingle fashion. When the roof pitch is two (2) inch or less in twelve (12) inch run, two layers of forty-three (43) pound asphalt felt shall be mopped solidly together as described in Section 3205 (a)-3. Forty-three (43) pound base felt under tile on existing roofs of wood shingles and composition roofing.

B. Roofing tile, other than flat pan tile with or without flanges, or flat shingle tile or flat decorative tile, shall meet the following strength requirements: When supported on the turned-down edges at points six (6) inches each side of the center of the tile, giving four (4) inches of support and a span of twelve (12) inches loaded with a concentration at the center, the average breaking load per tile for five (5) representative tile tested shall be at least four hundred (400) pounds and the breaking load for any individual tile tested shall be at least three hundred and fifty (350) pounds.

C. Roof tile shall not absorb more than fifteen (15) percent of the dry weight of the tile during a forty-eight (48) hour immersion test.

(d) Ordinary Roof Coverings. Ordinary roofing shall be any roof covering which meets the requirements specified for any one of the following roofs, or shall be any roofing meeting the Class "C" specifications of an approved testing laboratory.

1. 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-A equals at least ten (10).

2. Asphalt shingles laid in one or more layers.

3. All wood shingles for roofs bearing the label of an approved inspection bureau or agency. All wood shingles shall be laid with a side lap of at least one and one-half (1½) inches in adjacent courses, and three-fourths (¾) inch in alternate courses with at least two (2) courses of solid wood protecting each side joint.

A. Every wood shingle shall be laid not less than one-eighth (1/8) inch or more than three-eighths (3/8) inch from any adjacent shingle and shall be nailed to the sheathing with two No. 14 gauge hot-dipped galvanized, zinc, cadmium plated, aluminum, or copper nails penetrating into the sheathing at least three-fourths (¾) inch. The exposure to the weather of wood shingle roofs shall not exceed the amount set forth in Table No. 32-B.

(e) Shakes. All shakes shall be of western red cedar or redwood, bearing the label of an approved inspection bureau or agency.

1. Shakes shall be laid with one and one-half (1½) inch minimum side lap between joints in adjacent courses.

2. Shakes shall be laid in straight or staggered courses. Double courses at the eaves and the underlay course may be eighteen (18) inch shakes or shingles, or twenty-four (24) inch shingles.

3. Each shake shall be fastened with two rust-resistant nails of adequate length to penetrate into sheathing at least three-fourths (¾) inch.

4. Valleys shall be lined with galvanized metal of at least thirty (30) U. S. Standard Gauge or corrosion resistant equivalent materials, of at least twenty (20) inches in width.
5. Roofs shall be sheathed solid and prior to applying shakes, shall be covered with at least one layer of thirty (30) pounds per one hundred (100) square foot asphalt felt applied shingle fashion.

6. Exposure to weather shall not exceed eight and one-half (8½) inches, ten (10) inches, and thirteen (13) inches for eighteen (18) inch, twenty-four (24) inch, and thirty-two (32) inch shakes, respectively except that weather exposure of eighteen (18) inch and twenty-four (24) inch straight-split or barn shakes shall not exceed five and one-half (5½) inches and seven and one-half (7½) inches respectively. Edges shall be parallel within one (1) inch.

7. Shakes shall not be installed on roofs having a pitch less than four (4) inches to twelve (12) inches except that roofs or porches or attached garages, or roof over clipped ceilings having an area not exceeding 20 per cent of the total roof area, may have a pitch of at least three (3) inches to twelve (12) inches. On roof pitch of less than four (4) inches in twelve (12) inches run, cement together shingle fashion two (2) thirty (30) pound asphalt felts.

Section 3205. APPLICATION

(a) General. In application of new roof and re-roof coverings the following shall apply:

1. When thirty (30) pound asphalt felt is used in any built-up composition roofing, it shall be considered as one ply or one layer.

2. Application of base sheets of one and two ply laid dry shall be nailed as follows:
   - Laps, 12" O.C. for 2 ply application
   - Laps, 12" O.C. for 2 rows 12" O.C. staggered through center of sheets for 1 ply application

3. Built-up composition roof shall be thoroughly mopped solid between layers with bituminous compound using at least twenty-(20) pounds of hot asphalt or at least one and one-half (1½) 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 (100) square feet, of roof area.

4. For securing base sheet to non-nailable decks, intermittent application of asphalt sealing agent in an amount of at least ten (10) pounds per one hundred (100) square feet of roof area at points not more than twelve (12) inches apart.

5. Parapet walls, firewalls or any protrusion through a roof shall be covered with approved type of primers, prior to intermittent application. This applies to new roofs only.

6. Hot asphalt shall be applied at a temperature of at least 375° Fahrenheit and shall in no case be heated to a temperature higher than 425° Fahrenheit at the kettle.

7. Coal tar pitch shall not be heated above 375° Fahrenheit.

8. When a top covering from part (d) of Table No. 32-A is used, pour over the entire surface a uniform coating of a minimum of fifty (50) pounds of asphalt, or sixty (60) pounds of pitch, and imbed gravel, slag, ceramic or other similar surfacing materials.

9. Ninety (90) pound smooth roofing shall not be used on roofs having a slope of less than one-fourth (¼) inch in twelve (12) inch run. Twelve points of fire-retardant value as set forth in Table No. 32-A may be allowed when ninety (90) pound smooth roofing material is used as recover roofing over existing smooth or slate covered roofing provided that existing roof covering is in good condition. Existing gravel roofs shall not be recovered with ninety (90) pound smooth roofing. Ninety (90) pound roofing shall not be applied when atmospheric temperature is less than 45° Fahrenheit.

10. Existing smooth surfaced roofs shall be cleaned thoroughly. All buckles shall be cut. Re-cement and nail all felts. Renail any open laps. Remove all loose or raised nails. Check entire roof deck for any weak or decayed sheathing and replace with new sheathing where necessary. Clean existing clay or gravel-covered roofs by removing all slag and gravel and layers of existing felt as may be required to provide a smooth even surface, free from slag or gravel particles.

11. Where existing roofs of coal tar pitch are to be recovered, a layer of red rosin or building paper shall be applied to the roof prior to the asphalt base sheet application.
12. Nails for composition roofs shall not be smaller than twelve (12) gauge with heads at least nine-sixteenths (9/16) inch for built-up roofs and shall be of sufficient length to penetrate one-half (½) inch plywood sheathing a minimum of three-eighths (3/8) inch. Nails shall penetrate a minimum of three-fourths (3/4) inch into wood sheathing when such sheathing is thicker than three-fourths (3/4) inch. The above shall apply to new and re-roof coverings.

13. Cant strip shall be installed where roof meets vertical projections.

14. Curbs or flange metal vents shall be installed on top of finished felts with two (2) layers of fifteen (15) pound felt applied over the top of metal flanges. All flanges shall be set in plastic cement. All roof jack flashing around pipes and projections protruding through roof decking shall extend a minimum of six (6) inches above plane of roof deck. Flanges shall extend a minimum of six (6) inches on deck. All metal shall be primed prior to the application of roof covering over such metal. This application applies to flat roofings.

15. Projections such as ladder struts, flag poles, sign braces and similar projections shall have pitch pans, pitch cups around the projections. Such pans or cups shall be filled with self-sealing bitumen or plastics.

16. Gravel stop or guards shall be installed on top of all felts on built-up roofs. Gravel stops shall be set in a bed of plastic cement and nailed to roof decking on at least six (6) inch centers. Minimum height of such stops shall be three-fourths (3/4) inches and the apron that extends onto roof decking shall be at least four (4) inches.

17. Gravel stops shall be stripped or covered with two (2) plys of fifteen (15) pound felt nine (9) and twelve (12) inches in width.

18. Metal gravel stops that extend from roof decking over outside facia; and metal covering on low parapet walls shall have one (1) layer of fifteen (15) pound felt under metal and extending over outside edges.

19. Asphalt shingles shall be nailed and applied according to manufacturer's specifications. However, strip shingles of the square tab type, and measuring twelve by thirty-six (12 x 36) inches, at least six (6) nails shall be provided for each strip.

20. Nails for composition shingle roof shall not be smaller than twelve (12) gauge with heads at least three-eighths (3/8) inch in diameter for shingle application and shall be of sufficient length to penetrate one-half (½) inch plywood sheathing a minimum three-fourths (3/4) inch in wood sheathing.

21. Application of asphalt shingles on new construction when the roof pitch is less than two (2) inch rise in twelve (12) inch run is prohibited. Prior to applying asphalt shingles on other roofs, the deck shall be covered with asphalt felt weighing nominal fifteen (15) pounds per one hundred (100) square feet and shall be applied as follows:

   A. When the roof pitch is from two (2) inch rise in twelve (12) inch run, two (2) layers of felt shall be applied shingle fashion. The two layers of felt shall be cemented together two (2) feet in from the exterior walls of the building. Cementing shall begin at the extreme edge of the roof.

   B. When the roof pitch is four (4) inch rise or more in twelve in. run, one layer of fifteen (15) pound felt shall be applied.

22. Re-roof coverings of asphalt shingles on areas of roofs when the roof pitch is less than two (2) inch in twelve (12) inch run, shall be underlaid with asphalt roofing material weighing nominal ninety (90) pounds per one hundred (100) square feet.

23. Open valleys shall be lined with metal with a minimum width of twenty (20) inches or with roofing material weighing nominal ninety (90) pounds per one hundred (100) square feet, one (1) strip nine (9) inches in width and with an additional strip eighteen (18) inches applied over the nine (9) inch strip. Closed valleys shall be lined with ninety (90) pound per one hundred (100) square feet of roofing material, eighteen (18) inches minimum width where shingles are applied, thatched, woven or California type.

   A. Open valleys shall be lined with metal, minimum thirty (30) gauge, with a minimum width of twenty (20) inches or with roofing material
weighing nominal ninety (90) pounds per one hundred (100) square feet, one strip nine (9) inches in width and an additional strip eighteen (18) inches applied over the nine (9) inch strip.

B. All valleys in new construction shall be lined with a minimum of thirty-six (36) inch width of fifteen (15) pound felt, laid vertically, in addition to any other valley material used.

C. Closed valleys shall be lined with ninety (90) pound per one hundred (100) square feet of roofing material, eighteen (18) inches in width; or with fifty-five (55) pound roofing thirty-six (36) inches in width, where shingles are applied, thatched, woven or California type.

D. Closed valleys shall not be permitted in the application of lock type shingles.

Section 3206. TABLES

| TABLE 32-A  
FIRE RETARDANT VALUES OF ROOFING MATERIALS |
<table>
<thead>
<tr>
<th></th>
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<tr>
<td><strong>SHIPPING WEIGHT (IN LBS.)</strong></td>
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<tr>
<td>(b) BASE OR CAP SHEETS</td>
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Continued
### TABLE NO. 32-A — Continued

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<td>Smooth Roofing</td>
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<td>Asphalt Saturated Asbestos Roofing (White Top)</td>
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<td>1/4&quot; to 1/2&quot; in size</td>
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* To be used for re-roof only.
** For new construction when pitch is not less than 1/2" to 1 foot.

### TABLE NO. 32-B

**WOOD SHINGLE ROOF COVERING**

**MAXIMUM EXPOSURE TO WEATHER**

<table>
<thead>
<tr>
<th>Pitch of Roof</th>
<th>Single Length</th>
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<tr>
<td>Rise</td>
<td>Run</td>
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<tr>
<td>3&quot; to less than 4&quot;</td>
<td>12&quot;</td>
</tr>
<tr>
<td>4&quot; to less than 5&quot;</td>
<td>12&quot;</td>
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<tr>
<td>5&quot; or more</td>
<td>12&quot;</td>
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</table>
Section 3210. STANDARDS

Unless as otherwise specified in other Sections of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
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<tbody>
<tr>
<td>Roofing Asphalt</td>
<td>Std. Spec. D-312-64.</td>
</tr>
<tr>
<td>UL</td>
<td>Composition Roofing. Std. Spec. 55-A &amp; B-64.</td>
</tr>
<tr>
<td>ICBO</td>
<td>Roofing Tile. Recommended Standards 67.</td>
</tr>
</tbody>
</table>

Legend:

UL — Underwriters' Laboratories 207 East Ohio St., Chicago 11, Ill.
RCS & HSB — Red Cedar Shingle and Handsplit Shake Bureau 5510 White Building, Seattle, Washington 98101
ICBO — International Conf. of Bldg. Officials, 50 S. Los Robles, Pasadena, Calif.
CHAPTER 33
EXITS AND OCCUPANT LOADS

Section 3300. GENERAL.

(a) Purpose. In addition to the other requirements of this Building Code, this Chapter shall require, govern and determine the occupant loads and exit facilities of buildings, structures, or any portion thereof. (A through I and J Occupancies.) (See Chapter 23 for structural loading.)

(b) Scope. Every building or portion thereof shall be provided with exits as required by this Chapter. (A through I and J Occupancies.) (See Section 3325 for Group I and J Occupancies.)

(c) Determination of Occupant Load. The occupant load permitted in any building or portion thereof shall be determined by dividing the floor area assigned to that use by the square foot per occupant as set forth in Table No. 33-A. When the number of square feet per occupant is not given for a particular occupancy it shall be determined by the Department based on the area given for the occupancy which it most nearly resembles. In determining the occupant load, all portions of the building shall be presumed to be occupied at the same time, except as otherwise determined by the Department. (See Section 3302 for Primary Exit Requirements.)

EXCEPTION:

1. The occupant load of an area having fixed seats shall be determined by the number of fixed seats installed. Aisles serving the fixed seats and not used for other purposes shall not contribute to the occupant load.

2. Where benches or pews are used, the number of seats shall be based on one person for each twenty-one (21) inches of length of the pew or bench. Where booths are used in dining areas, the number of seats shall be based on one person for each twenty-four (24) inches.

(d) Overcrowding. The number of occupants of any building or portion thereof shall not exceed the permitted or posted capacity.

(e) Mixed Occupancies. The capacity of a building containing mixed occupancies shall be determined by adding the number of occupants of each occupancy as set forth using Table No. 33-A for calculations.

(f) More Than One Purpose. The capacity of a building or portion thereof which is used for more than one purpose shall be determined by the occupant load which gives the largest number of persons.

(g) Exit Obstructions. Obstructions shall not project into or be placed within the width or height of an exit except those permitted in Section 3305 (b).

EXCEPTION: Door hardware.

(h) Posting of Room Capacity. Any room in a Group A or B Occupancy, and eating and drinking establishments of Group F Occupancy, having an occupant load of more than fifty (50), shall have the capacity of the room posted in a conspicuous place near the main exit from the room. The posted signs shall be maintained in a legible manner by the owner or his authorized agent, and shall indicate the number of occupants permitted for each room use as determined by the Department.

(i) Changes in Elevation. Changes in elevation of less than twelve (12) inches along any exit shall be made by means of ramps. (See Section 3306.)

(j) Prohibitions. Required exiting shall not be through a boiler or furnace room.

Section 3301. DEFINITIONS. For purposes of this Chapter, certain terms are defined as follows:
Balcony, Exterior Exit is a landing or porch on an exterior wall of a building serving as a required mean of egress.

Exit is a continuous and unobstructed means of egress to a public way. This may include intervening doors, doorways, corridors, exterior exit balconies, ramps, stairways, horizontal exits, exit passageways, exit courts and yards.

Exit Court is a yard or court providing egress to a public way for one or more required exits.

Exit Passageway is an enclosed or open means of egress connecting a required exit or exit court with a public way.

Exit, Horizontal is a means of passage from one building into another building, or from one section of a building into another section of the same building through a separation wall that has a minimum fire resistance of one-hour.

Exit, Vertical is a means of egress between two or more floors, or other levels, and shall include approved exterior stairways, fire escapes, ramps and interior stairways.

Floor Area is the area included within the interior dimensions of the exterior walls.

Occupant Load is the total number of persons that may occupy a building or portion thereof at any one time, as determined by this Chapter.

Panic Hardware is an approved device which will unlatch a door if subjected to pressure. (See Chapter 43.)

Public Way is an unobstructed right of way, ten (10) feet or more in width, appropriated and available for free passage of the general public.

Stairway. (See Chapter 4.)

Stairway, Exit is one (1) or more flights of stairs and the necessary landings, platforms and handrails connecting them to form a continuous and uninterrupted passage from one (1) floor to another. (See Chapter 4 for further definition.)

Stairway, Monumental is one which is ornamental and not required.

Stairway, Private is a stairway serving one tenant only and not serving as a required exit.

Section 3302. EXITS REQUIRED.

(a) Determination of Number of Exits.

1. Every building or floor, including basements, cellars, penthouses or occupied roofs, shall provide two (2) means of exit, except as otherwise approved by the Department. Portions or areas of buildings shall provide means of exit as indicated in (For occupant loads, see Table 33-A.)

2. Each mezzanine used for other than storage purposes, if greater in area than two thousand (2000) square feet, or if more than sixty (60) feet in any dimension shall have at least two (2) stairways to an adjacent floor.

3. Every building, floor or portion thereof having an occupant load of 500 to 999 shall have at least three exits.

4. Every building, floor or portion thereof, having an occupant load of 1000 or more shall have at least four (4) exits.

5. The number of exits required from any story of a building shall be determined by using the occupant load of that story, plus the percentages of the occupant loads of floors which exit through the level under consideration as follows:

A. Fifty (50) percent of the occupant load in the first adjacent story above and fifty (50) percent of the first adjacent story below when the story below exits through the level under consideration.

B. Twenty-five (25) percent of the occupant load in the story immediately beyond the first adjacent story.

6. The maximum number of exits required for any story shall be maintained until egress is provided from the structure as required in Section 3310 and/or 3311.

7. For purposes of this Section, basement or cellars and occupied roofs shall be provided with exits as required for stories. Floors above the second story, basements and cellars used for other than service of the building shall have not less than two exits.
8. For additional requirements for Groups A, B, C, D, E and special hazard occupancies, see Sections 3315, 3316, 3317, 3318, 3319 and 3321.

(b) Widths. The total width of exits in feet shall be at least the total occupant load served, divided by fifty (50), but not less than those indicated in Section 3305 (b). Such width of exits shall be divided approximately equally among the separate exits. The total widths required from any story of a building shall be determined by using the occupant load of that story, plus the percentages of the occupant loads of floors that exit through the level under consideration as follows: (See other portions of this Chapter for minimum widths.)

1. Fifty (50) percent of the occupant load in the first adjacent story above and first adjacent story below, when the story below exits through the level under consideration.

2. Twenty-five (25) percent of the occupant load in the story immediately beyond the first adjacent story.

3. The required exit width from any story of a building shall be maintained until egress is provided from the building.

(c) Height. Except as otherwise indicated in other portions of this Building Code or Chapter, the height of the means of exit (corridors, passageways, etc.) shall be at least seven (7) feet.

(d) Arrangement of Exits. Exits shall be so arranged that if one becomes blocked another will be available.

(e) Distance to Exits. No point in an unsprinklered building shall be more than one hundred and fifty (150) feet from an exterior exit door, a horizontal exit, an exit passageway, or an enclosed stairway, measured along the line of travel. The distance between exits may be increased to six hundred (600) feet in buildings equipped with a complete automatic fire extinguishing system throughout and installed in accordance with the requirements of Chapter 38.

Section 3303. EXIT DOORS.

(a) General. This Section shall apply to every exit door serving an occupant load for more than ten (10), or serving hazardous rooms or areas. Subsections (g) and (h) of this Section shall apply to all doors, regardless of occupant load.

(b) Swing. Unless required by special occupancy provisions, exit doors shall swing in the direction of exit travel when serving an occupant load of thirty (30) or more. Doors shall not project into a corridor, passageway, horizontal exits or into the public way. For purposes of this Chapter, a door, when fully opened, shall be when the door is at a right angle to the opening (90 degrees).

EXCEPTIONS:

1. Except in Group D Occupancies, exit doors may swing into the corridor not to exceed one (1) foot when such corridors exceed six (6) feet in width. The required width of the corridor shall not be decreased by such projection.

2. Doors may swing into a corridor from areas that are infrequently used and the doors are locked at all times.

(c) Type of Lock or Latch. Interior and exterior doors (including corridor, stairway and outside doors), when equipped with lock or latch, shall be of a type that can be opened from the inside without the use of key or special knowledge. The use of flush or surface type bolts is prohibited.

(d) Width and Height. Door openings shall provide a minimum clear width of thirty-four (34) inches and shall have a minimum height of seventy-eight (78) inches. The leaf of an exit door shall not exceed four (4) feet in width.

(e) Special Doors. Revolving, sliding and overhead doors shall not be used as required exits. Double acting doors, equipped with self-closing devices, may be used in a horizontal separation and in building entrances, when specifically approved by the Department and where permitted by other portions of this Building Code. (See Chapters 18 and 19.) Each leaf of such doors shall be provided with a view panel of wire glass one hundred and forty-four (144) square inches in area.

(f) Access. Every exit door opening shall provide immediate access to an approved means of egress from the building.

(g) Change in Floor Level at Doors. Regardless of the occupant load, there shall be a floor or landing on each side of an exit door. The floor or landing shall be level with, or not more than two (2) inches lower than the threshold of the doorway. (See Section 3305 (f) for landings.)

EXCEPTION: In individual units of Group H Occupancies, a door may open at the top step of a flight of stairs. Such door shall not
swing over the top step at the landing. The landing shall be not more than seven and one-half (7½) inches below the floor level.

(h) Door Identification and Marking. Exit doors shall be marked in accordance with other provisions of this Section and Building Code. Stairway doors shall be marked, on the stairway side, with the appropriate floor number. Such marking shall be conspicuous and the lettering shall be not less than two (2) inches in height. Glass doors, where permitted, shall be marked in such a manner so as to prevent injury to any person. (See Chapter 54.)

(i) Under-Cut Doors. For ventilation purposes only, doors that are not required to be fire resistive may be undercut not to exceed two (2) inches.

Section 3304. INTERIOR AND EXTERIOR EXIT CORRIDORS.

(a) General. This Section shall apply to every exit corridor and exterior exit balcony serving as a required exit.

(b) Width. Every corridor or exterior exit balcony shall be at least forty-four (44) inches in width. (For special requirements for Group C and D Occupancies, see Sections 3317 and 3318.)

(c) Projections. The width of corridors shall be unobstructed, regardless of occupant load. (See Sections 3303 (b) and Handrails Permitted.)

(d) Access to Exits. When more than one exit is required, they shall be so arranged that it is possible to go in either direction from any point in a corridor or exterior exit balcony to a separate exit, except from dead ends permitted by this Section.

(e) Dead End. Corridors and exterior exit balconies with dead ends, which do not exceed twenty (20) feet in length, are permitted in all types of protected (one-hour or more fire-resistive) buildings and in all occupancies, except C and D.

EXCEPTION: Where a dead end corridor is provided with fire sprinklers, installed in the full length of the dead end corridor, in accordance with the provisions of Chapter 38, and such fire sprinklers are spaced not to exceed ten (10) feet on center, such dead end corridor shall not exceed fifty (50) feet in length.

For purposes of this Section, a dead end corridor is a corridor which provides only one means of egress when two or more are required. Dead end corridors, as permitted by this Section, shall comply with the following requirements:

1. All doors opening on a dead end corridor shall have one (1) hour fire resistive rating and shall be provided with approved self-closing devices. (See Chapter 43.)

2. Branch corridors shall not be permitted from a dead end corridor.

3. Glass doors, glass in doors or glass in the walls of dead end corridors, shall not be permitted.

EXCEPTION: Wire glass, as provided for in Chapter 43 and Table 33-B shall be acceptable.

(f) Construction. Walls and ceilings of corridors shall be at least one-hour fire-resistive construction. In lieu of this requirement, a fire sprinkler system may be substituted. (See Chapter 5.) Floors, walls, and ceilings of exterior exit balconies shall have the same period of fire resistance as required for the floors, walls and ceilings of the building.

(g) Openings. Where corridor walls are required to be one-hour fire-resistive construction, every interior door opening shall be protected as set forth in Table No. 33-B. Other interior openings, except ventilation louvers equipped with approved automatic fire dampers, shall be one-fourth (¼) inch fixed wire glass set in approved metal or wood frames. The total area of all openings other than doors, in any portion of an interior corridor shall not exceed twenty-five (25) per cent of the area of the corridor wall of the room which it is separating from the corridor.

1. Individual glass lights shall not exceed twelve hundred (1200) square inches and any single window shall not exceed the limits specified in Chapter 43.

EXCEPTION: In corridors of Group F and G occupancies, interior openings may have fixed plain glass, as specified in Chapter 54, of unlimited area, provided the corridors are at least six (6) feet in width and do not serve as means of exit for other floors in the building. Such corridors shall have exits at each extremity. All portions of the floor served,
whose occupant loads are tributary to the corridor, shall have access to at least one additional exit leading to the exterior of the building except where an approved automatic fire-extinguishing system is installed throughout the story in which such corridors are located.

Section 3305. STAIRWAYS.

(a) General. Every stairway serving any building or portion thereof shall conform to the requirements of this Section.

EXCEPTION: Stairs or ladders used only to attend equipment are exempt from the requirements of this Section. Ladders shall extend a minimum of two (2) feet above the floor, roof, parapet or landing.

(b) Width. Stairways serving an occupant load of more than fifty (50) shall be at least forty-four (44) inches in width. Stairways serving an occupant load of fifty or less may be thirty (30) inches wide. Trim and handrails shall not reduce the required width by more than three and one-half (3½) inches on each side. (See Section 3317 and 3318 for special requirements.)

(c) Rise and Run. The rise of every step in a stairway shall not exceed seven and one-half (7½) inches and the run shall be at least ten (10) inches. Except as provided under Subsection (d), (e) and Section 3325, the maximum variations in the height of risers and the width of treads in any one flight shall be one-fourth (¼) inch.

(d) Winding Stairways. Winders may be used in private stairways of Group H occupancies, if the required stairway width is provided at a point twelve (12) inches from the side of the stairway where the treads are narrower. In no case shall any width of run be less than six (6) inches at any point. All risers in one flight between landings shall have identical dimensions within a one-fourth (¼) inch tolerance.

(e) Curved Stairways. Curved stairways may be used as an exit provided the minimum width or run is not less than ten (10) inches, at a point twelve (12) inches from the side of the stairway where the treads are narrower. All risers in any one flight between landings shall have identical dimensions within a one-fourth (¼) inch tolerance.

(f) Landings. Every landing shall have a dimension measured in the direction of travel equal to the width of the stairway. Such dimension need not exceed four (4) feet when the stair has a straight run. Landings, when provided, shall not be reduced in width by more than four and one-half (4½) inches by a door when fully open. (See Section 3303 (g).)

(g) Basement, Cellar Stairways. Where a basement or cellar stairway and a stairway to an upper story terminate in the same exit enclosure, an approved barrier shall be provided to prevent persons from continuing on into the basement or cellar. Directional exit lights shall be provided as set forth in Section 3312 (b).

EXCEPTIONS:
1. Stairways forty-four (44) inches or less in width may have one handrail.
2. Handrails shall not be required for private stairways having less than four risers.

1. Handrails shall be placed not less than thirty (30) inches nor more than thirty-four (34) inches above the nosing of treads.

(i) Guardrails. See Chapter 17.

(j) Distance between Landings. The vertical distance between landings shall not exceed twelve (12) feet and six (6) inches.

(k) Interior Stairways. Interior stairways shall be constructed as specified in Chapters 17 through 22.

1. Where there is enclosed usable space under stairs or ramps, fire sprinklers shall be installed as required by Chapter 38 and the walls and soffits of the enclosed space shall be protected on the enclosed side as required for one-hour fire-resistive construction. (See Section 3308 (f).)

(l) Exterior Stairways. Exterior stairs shall be of incombustible material except that on Type III buildings, not exceeding two stories in height, and on Type V buildings, such stairways may be of wood at least two (2) inches in nominal thickness.

1. Where there is enclosed usable space under stairs, the wall and soffits of the enclosed space shall be protected on the enclosed side as required for one-hour fire-resistive construction.
(m) Stairway to Roof. Buildings four (4) or more stories in height shall be provided with a stairway to the roof surface unless the roof has a slope greater than four (4) in twelve (12). In buildings three (3) stories or less in height, an access only shall be provided. Such access openings shall be of at least thirty (30) inches in its smallest dimension. All hatches shall be of an approved pre-fabricated metal type. (See Chapter 52 for stairways to service equipment.) If the stairway opening or hatch is within eight (8) feet of the roof edge, guard rails shall be provided. (See Chapter 17 for guardrails.)

(n) Headroom. Every stairway shall be provided with a clear vertical opening (headroom) throughout its entire length and width of at least six feet six inches (6'6").

(o) Escalators. Escalators shall not be considered as a required exit. (See Chapter 38 for fire-sprinklers.)

(p) Obstructions. There shall be no obstructions in a stairway.

Section 3306. RAMPS.

(a) General. A ramp conforming to the requirements of this Section may be used as an exit.

(b) Width. The width of ramps shall be the same as required for corridors or stairways.

(c) Slope. The maximum pitch of a ramp shall not exceed one (1) in eight (8).

(d) Handrails. All ramps shall have handrails as required for stairways, except that intermediate handrails shall not be required.

(e) Construction. Ramps shall be constructed and enclosed as required for stairways.

(f) Surface. The surface of ramps shall be roughened or shall be of nonslip materials.

(g) Vehicle Exit Facilities. Where ramps are used for the transfer of automobiles from one floor to another, such ramps shall meet the ground level at least twenty (20) feet inside the property line of such building where vehicles shall exit.

Section 3307. HORIZONTAL EXIT.

(a) Used as a Required Exit. A horizontal exit may be considered as a required exit when such conforms to the provisions of this Chapter.

(b) Openings. All openings in a separation wall shall be protected by a fire assembly having a fire-resistive rating of at least one hour. (See Section 3304 (g) for fire sprinklered buildings or corridors.)

(c) Discharge Area. A horizontal exit shall lead into a floor area having a capacity for an occupant load not less than the occupant load served by such exit. The capacity shall be determined by allowing three (3) square feet of net clear floor area per ambulatory occupant and twenty (20) square feet per non-ambulatory occupant. The area into which the horizontal exit leads shall be provided with exits other than additional horizontal exits as required by Section 3302.

Section 3308. EXIT ENCLOSURES.

(a) General. Every interior stairway or ramp shall be enclosed as specified in this Section.

EXCEPTIONS:

1. In other than Group D and E Occupancies, an enclosure need not be required for a stairway or ramp serving one (1) adjacent floor and not connected with corridors or stairways serving other floors. This exception shall apply to basements or cellars when such are provided with fire sprinklers throughout. This exception shall apply only to the first two (2) floors, above grade, of the building.

2. An enclosure will not be required for escalators if fire sprinklers are installed and in accordance with the provisions of Chapter 38.

3. The enclosure for private stairways need not be provided when such stairway is provided with fire sprinklers, installed in accordance with the provisions of Chapter 38, and such stairway does not interconnect with more than one adjacent floor.

(b) Enclosure Construction. Enclosure walls shall be of at least two-hour fire-resistive construction in buildings more than four (4) stories in height and shall be of at least one-hour fire-resistive construction elsewhere.

(c) Openings into Enclosures. There shall be no openings into exit enclosures except fire doors and openings in exterior walls. All exit doors in an exit enclosure shall be protected as set forth in Table No. 33-B.

(d) Extent of Enclosure. Stairway and ramp enclosures shall include landings, parts of floors connecting stairway flights and corridors on the ground floor leading from the stairway to the exterior of the building.
(e) Barrier. A stairway in an exit enclosure shall not continue below the grade level exit unless an approved barrier is provided at the ground floor level to prevent persons from accidentally continuing into the basement or cellar.

Section 3309. SMOKEPROOF ENCLOSURES.
(Deleted).

Section 3310. EXIT OUTLETS.

(a) Discharge. Every exit shall discharge into a public way, exit court, or exit passageway.

Section 3311. EXIT COURTS AND EXIT PASSAGEWAYS.

(a) Discharge. Every exit court shall discharge into a public way, or exit passageway. Exit passageways shall be without openings, other than required exits, and shall have walls, floors and ceilings of the same period of fire resistance as the walls, floors and ceilings of the building with a minimum of one-hour fire-resistant construction.

(b) Width. Every exit court or exit passageway shall be at least as wide as the required total width of the tributary exits, based on the occupant load served.

1. The required width of exit courts or exit passageways shall be unobstructed except as permitted in corridors. (See Section 3304 (c).)

2. 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 guardrail at least three (3) feet in height. The guardrail shall make an angle of not more than 30 degrees with the axis of the exit court.

(c) Slope. The slope of exit courts shall not exceed 1 in 10. The slope of exit passageways shall not exceed 1 in 8. (For handrail requirements, see Section 3306 (d).)

(d) Number of Exits. Every exit court shall be provided with exits as required by Section 3302.

(e) Openings. All openings into an exit court less than ten (10) feet in width shall be protected by fire assemblies having a three-fourths (¾) hour fire-resistant rating.

EXCEPTION: Openings more than ten (10) feet above the floor of the exit court may be unprotected.

Section 3312. EXIT ILLUMINATION AND EXIT SIGNS.

(a) Exit Illumination. Exit areas shall be illuminated at all times the building is occupied and shall be provided with light having an intensity of at least five (5) foot candles at floor level. (See Chapter 53 for emergency power.)

EXCEPTION: One (1) foot candle intensity shall be acceptable in theatre aisles.

(b) Exit Lights. At every required exit doorway, and elsewhere as required in order to clearly indicate the direction of egress. An exit light with letters at least five (5) inches high, shall be provided. The letters of such sign shall be white on a green field. Exit lights shall be installed in a manner that the lettering indicating "Exit" can be seen. Exit lights shall be provided in all A through H Occupancies when the occupant load is ten (10) or more. In H Occupancies, where the exit facilities do not serve the entire building, such as a one-story motel without corridors, an exit light need not be provided. Circuits shall be provided as indicated in Chapter 53.

1. In Group A, B and C occupancies, lights shall be kept burning at all times during which the building is occupied. In other occupancies requiring exit lights, such lights shall be kept burning from sunset to sunrise or when the building is occupied.

(c) Illumination of Exit Signs. Exit signs shall be provided with a minimum of two (2) fifteen (15) watt white lamps.

(d) Electrical. See Chapter 53 for additional requirements.

Section 3313. AISLES.

(a) General. Every portion of every building in which the following are installed: seats, tables, merchandise, equipment or similar materials, shall be provided with aisles leading to an exit.

(b) Width. Every aisle shall be at least three (3) feet wide if serving only one side, and at least three feet six inches (3'6") wide if serving both sides. Such minimum width shall be measured at the point farthest from an exit, cross aisle, or foyer and shall be increased by one and one-half (1½) inches for each five (5) feet in length toward the exit, cross aisle, or foyer.

1. With continental spacing, as set forth in Section 3314 (a) 1, side aisles shall be at least forty-four (44) inches in width.
(c) **Distance 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 be not more than one hundred and fifty (150) feet.

(d) **Aisle Spacing.** With standard spacing, as set forth in Section 3314 (a) 1, aisles shall be so located that there will be not more than six (6) intervening seats between any seat and the nearest aisle unless otherwise approved by the Department.

1. With continental spacing, as set forth in Section 3314 (a) 1, the number of intervening seats may be increased to 29 where exit doors are provided along each side aisle of the row of seats at the rate of one pair of exit doors for each five (5) rows of seats. Such exit doors shall provide a minimum clear width of sixty-six (66) inches.

(e) **Cross Aisles.** Aisles shall terminate in a cross aisle, foyer or exit. The width of the cross aisle shall be at least the sum of the required width of the widest aisle plus 50 per cent of the total required width of the remaining aisles leading thereto. In Groups A, B and C occupancies, aisles shall not provide a dead end greater than twenty (20) feet in length.

(f) **Vomitories.** Vomitories connecting the foyer or main exit with the cross aisles shall have a total width at least the sum of the required width of the widest aisles leading thereto plus 50 per cent of the total required width of the remaining aisles leading thereto.

(g) **Slope.** The slope portion of aisles shall not exceed one (1) foot fall in eight (8) feet.

**Section 3314. SEATS.**

(a) **Spacing.** With standard seating, the spacing of rows of seats from back-to-back shall be at least thirty-three (33) inches, nor less than twenty-seven (27) inches plus the sum of the thickness of the back and inclination of the back.

1. With continental seating, the spacing of rows of unoccupied seats shall provide a clear width measured horizontally as follows: (Automatic or self-rising seats shall be measured in the seat-up position, other seats shall be measured in the seat-down position.)
   - Eighteen (18) inches clear for rows of 18 seats or less.
   - Twenty (20) inches clear for rows of 35 seats or less.
   - Twenty-one (21) inches clear for rows of 45 seats or less.
   - Twenty-two (22) inches clear for rows of 46 seats or more.

(b) **Width.** The width of any seat shall be at least eighteen (18) inches.

(c) **Other Seats.** Seats used in grandstand, bleachers and reviewing stands shall conform to Section 3322.

**ADDITIONAL EXIT REQUIREMENTS**

(A, B, C, D, E, Occupancies and Special Hazards)

**Section 3315. 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 (½) of the total occupancy load but shall be at least the total required width of all aisles, exit passageways and stairways leading thereto, and shall connect to a stairway or ramp leading to a public way.

(b) **Side Exits.** Every auditorium or room of a Group A Occupancy shall be provided with exits on each side. The exits on each side of the auditorium or room shall be of sufficient width to accommodate one-third (1/3) of the total occupant load served. The side exits shall be located in the one-third (1/3) portion of the auditorium or room, farthest removed from the main exit and each other.

(c) **Balcony Exits.** Every balcony having an occupant load of more than fifty (50) shall be provided with a minimum of two (2) exits. Balcony exits shall open directly onto an exterior stairway or into an approved stairway or ramp. When there is more than one balcony, exits shall open into an exterior or enclosed stairway or ramp. Balcony exits shall be accessible from a cross aisle. The number and distribution of exits shall be as otherwise specified in this Chapter.

(d) **Panic Hardware.** Exit doors from a Group A Occupancy shall be provided with approved panic type hardware. The use of latch or lock is prohibited unless approved by the Department.

**Section 3316. GROUP B OCCUPANCIES.**

(a) **Divisions 1, 2 and 3.** Division 1 and 2 Occupancies shall have exits as required by Section 3315. In Group B, Division 3 Occupancies having an occupant load of more than 100, exit doors shall not be provided with a latch or lock unless it is panic hardware.
EXCEPTION: Group B Division 2 and 3 Occupancies, such as restaurants, bars, bowling alleys, auditoriums and similar commercial uses, and in churches, panic hardware may be omitted from the main exit when the main exit consists of a single door or one (1) pair of doors.

(b) Division 4. In Group B Division 4 Occupancies having an occupant load of more than 100, exit doors shall not be provided with a latch or lock unless it is panic hardware. Panic hardware may be waived on gates surrounding stadiums, when the gates are under constant supervision while the public is present and provided safe dispersal areas based upon three (3) square feet per occupant are located between the stadium and the fence. The required dispersal area shall be located at least fifty (50) feet from the stadium. See Section 3322 (l) for exits from dispersal areas.

(c) Skating Rinks. Skating rinks shall be located at or near the adjacent ground level and exits shall be by means of ramps.

Section 3317. GROUP C OCCUPANCIES.

(a) Corridors and Exterior Exit Balconies. The width of a corridor in a Group C Occupancy shall be the width required by Section 3302 (b) plus two (2) feet but no corridor shall be less than six (6) feet in width.

1. Corridor walls and ceilings shall be of at least one-hour fire-resistive construction.

EXCEPTION: When all rooms used for instruction or assembly purposes have at least one-half (½) the required exits directly to the exterior, one-hour fire-resistive construction of corridor walls and ceilings is not required.

2. Any change of elevation of less than two (2) feet in a corridor or exterior exit balcony shall require ramps.

(b) Exits 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 provide at least two (2) exit stairs and the required exit width shall be equally divided between such stairs, provided that no stair serving an occupant load of more than 100 shall be less than five (5) feet in clear width.

EXCEPTION: This Subsection does not apply to rooms used for maintenance, storage, and similar purposes.

(d) Doors. The width of required exit doors from corridors, passageways and stairs shall be not more than two (2) feet narrower than the width required by Section 3317 (a). Exit doors in classrooms, locker rooms, libraries, dining areas, gymnasiurns and auditorium having an occupant load of more than ten (10), shall swing in the direction of egress.

(e) Rooms Below Grade. One exit accessible to every room below grade shall lead directly to the exterior at grade level.

(f) Panic Hardware. Exit doors from rooms having an occupant load of more than 100 and from corridors leading to the exterior, shall not be provided with a latch or lock unless it is panic hardware.

(g) Fences and Gates. School grounds may be fenced in and gates equipped with locks provided safe dispersal areas located at least fifty (50) feet from the buildings are available for persons between buildings and fences. Dispersal areas shall be based upon an area of at least three (3) square feet per occupant. Gates shall not be permitted across corridors or passageways leading to such dispersal areas unless they comply with exit requirements. (See Section 3322 for exits from dispersal areas.)

Section 3318. GROUP D OCCUPANCIES.

(a) Separate Access. Every room in a Group D Occupancy shall have access to at least two (2) approved means of egress from the building without passage through intervening rooms other than corridors or lobbies. All required exit doors shall open in direction of exit travel.

(b) Minimum Size of Exits. Every exit opening through which patients are transported in wheelchairs, stretchers, or beds shall be of sufficient width to permit the ready passage of such equipment, but shall have a clear width of at least forty-four (44) inches. Projections of any type shall not be permitted within the required width.

(c) Corridors. The minimum clear width of a corridor shall be forty-four (44) inches, except that corridors serving any area housing one or more non-ambulatory persons shall be at least eight (8) feet in width. There shall be no change of elevation in a corridor serving non-ambulatory persons unless ramps are used. Dead end corridors shall not be permitted.
(d) Basement Exits. One exit accessible to every room below grade shall lead directly to the exterior at grade level.

(e) Panic Hardware. Exit doors shall not be provided with a locking device unless such is approved panic hardware. Patient room doors shall be readily openable from either side without the use of keys.

EXCEPTION: Requirements of this Chapter shall not be so construed as to prevent the use of any locks or safety devices where it is necessary to forcibly restrain the inmates. This exception shall apply only when approved by the Department.

(f) Locking Devices. In buildings housing occupancies in which the personal liberties of inmates or patients are restrained within the building and which are constructed in conformance with the special provisions of Chapter 9, the exterior doors may be fastened with locks, provided that room doors shall not be fastened by other means than doorknobs or similar devices which can be opened readily from the corridor side without the use of keys, or any special knowledge or effort.

Section 3319. GROUP E OCCUPANCIES.

(a) Separate Exits. Every portion of a Group E Occupancy having a floor area of two hundred (200) square feet or more shall be served by at least two (2) separate exits.

1. In Divisions 1 and 2, no portion of any room shall be more than seventy-five (75) feet from an exit.

Section 3320. GROUP F, G AND H OCCUPANCIES.

No special requirements.

Section 3321. SPECIAL HAZARDS.

(a) Boiler Room. Every boiler or furnace room containing an incinerator or L-P gas, natural gas, or liquid fuel-fired equipment, shall be provided with at least two (2) means of egress, one to the outside, unless otherwise approved by the Department. All interior openings shall be protected as set forth in Table No. 33-B.

Section 3322. REVIEWING STANDS, GRANDSTANDS AND BLEACHERS.

(a) Scope. All reviewing stands, grandstands, and bleachers shall conform to the provisions of this Section.

(b) Definitions. For the purpose of this Section certain terms are defined as follows:

Exit. Exit shall be deemed to be that point which opens directly into a safe dispersal area or public way. All measurements are to be made to that point when determining the permissible distance of travel.

Safe Dispersal Area. Safe dispersal area shall mean an area which will accommodate a number of persons equal to the total capacity of the stand and building it serves, in such a manner that no person within the area need be closer than fifty (50) feet from the stand or building. Dispersal areas shall be based upon an area of at least three (3) feet per person.

(c) Height of Stands. Stands employing combustible framing shall be limited to eleven (11) rows or nine (9) feet in height.

(d) Design Requirements. (See Bleachers, Chapter 23 for unit live loads.) This shall apply to reviewing stands and grandstands as well as bleachers.

(e) Spacing of Seats.

1. Row Spacing. The minimum spacing of row seats measured from back to back shall be: Twenty-two (22) inches for seats without backrests in open air stands; thirty (30) inches for seats with backrests, and thirty-three (33) inches for chair seating.

A. There shall be a space of at least twelve (12) inches between the back of each seat and the front of the seat immediately behind it.

2. Rise Between Rows. The maximum rise from one row of seats to the next shall not exceed sixteen (16) inches.

3. Seating Capacity. For determining the seating capacity of a stand, the width of any seat shall be eighteen (18) inches.

4. Number of Seats Between Aisles. The number of seats between any seat and an aisle shall not be greater than:

15 for open air stands with seats without backrests.

9 for open air stands with seats having backrests.
9 for seats without backrests within buildings.

6 for seats with backrests in buildings.

(f) Aisles.

1. Aisles Required. Aisles shall be provided in all stands.

EXCEPTION: Aisles may be omitted when all of the following conditions exist:

A. Seats are without backrests.
B. The rise from row to row does not exceed twelve (12) inches per row.
C. The number of rows does not exceed eleven in height.
D. The top seating board is not over ten (10) feet above grade.
E. The first seating board is not more than twenty (20) inches above grade.

2. Obstructions. Obstructions shall not be placed in the required width of an aisle or exitway.

3. Stairs Required. When an aisle is elevated more than eight (8) inches above grade, the aisle shall be provided with a stairway or ramp whose width is at least the width of the aisle.

4. Dead End. Vertical aisles shall not have a dead end more than sixteen (16) rows in depth regardless of the number of exits required.

5. Width. Aisles shall have a minimum width of forty-two (42) inches.

(g) Stairs and Ramps.

1. Scope. The requirements of this Section shall apply to all stairs and ramps except for portions that pass through the seating area.

2. Stair Rise and Run. The maximum rise of treads shall not exceed eight (8) inches and the minimum width of the run shall be eleven (11) inches. The maximum variations in the width of treads in any one flight shall not be more than one-fourth ({\scriptfrac{1}{4}}) inch and the maximum variation in the height of two (2) adjacent risers shall not exceed one-fourth ({\scriptfrac{1}{4}}) inch.

3. Ramp Slope. The slope of a ramp shall not exceed one (1) in eight (8). Ramps shall be roughened or shall be of approved nonslip material.

4. Handrails. A ramp with a slope exceeding one (1) in ten (10) shall have handrails. Stairs from stands shall be provided with handrails. Handrails shall conform to Section 3305 (h).

(h) Guardrails. Guardrails shall be required in all locations where the top of a seat plank is more than four (4) feet above the grade and at the front of stands elevated more than two (2) feet above grade. Where only sections of stands are used, guardrails shall be provided as required in this Section.

1. Railings shall be forty-two (42) inches above the rear of a seat plank or forty-two (42) inches above the rear of the steps in an aisle when the guardrail is parallel and adjacent to the aisle.

EXCEPTION: The height may be reduced to thirty-six (36) inches for guardrails located in front of the grandstand.

2. A midrail shall be placed adjacent to any seat to limit the open distance above the top of any part of a seat to ten (10) inches where the seat is at the extreme and/or at the extreme rear of the bleachers or grandstand. The intervening space shall have one additional rail midway in the openings.

EXCEPTION: Railings may be omitted when stands are placed directly against a wall or fence giving equivalent protection.

3. Stairs and ramps shall be provided with guardrails.

4. Handrails at the front of stands and adjacent to an aisle shall be designed to resist a load of fifty (50) pounds per lineal foot applied at the top rail. Other handrails shall be designed to resist a load of twenty (20) pounds.

(i) Footboards. Footboards shall be provided for all rows of seats above the third row, or beginning at such point where the seating plank is more than two (2) feet above grade.
EXCEPTION: Where the same level is used for both seats and footrests, and these levels are not less than twenty-two (22) inches in width, footrests will not be required.

(j) Exits.

1. Distance to Exit. The line of travel to an exit shall be not more than one hundred fifty (150) feet. For stands with seats without backrests this distance may be measured by direct line from a seat to the exit from the stand.

2. Aisle used as Exit. An aisle may be considered as only one exit unless it is continuous at both ends to a legal building exit or to a safe dispersal area.

3. Two Exits Required. A stand with the first seating board not more than twenty (20) inches above grade or floor may be considered to have two (2) exits when the bottom of the stand is open at both ends.

A. Every stand or section of a stand within a building shall have at least two (2) means of egress when the stand accommodates more than fifty (50) persons.

B. Every open air stand having seats without backrests shall have at least two (2) means of egress when the stand accommodates more than three hundred (300) persons.

4. Three Exits Required. Three exits shall be required for stands within a building when there are more than three hundred (300) occupants within a stand, and for open air stands with seats without backrests where a stand or section of a stand accommodates more than one thousand (1000) occupants.

5. Four Exits Required. Four exits shall be required when a stand or section of a stand accommodates more than one thousand (1000) occupants.

EXCEPTION: For an open air stand with seats without backrests, four exits need not be provided unless there are accommodations for more than three thousand (3000) occupants.

6. Determination of Exit Width. The total width of exits in feet shall be not less than the total occupant load divided by fifty (50).

EXCEPTION: For open air stands with seats without backrests, the total width of exits in feet shall be not less than the total occupant load served divided by one hundred fifty (150) when exiting by stairs, and divided by two hundred (200) when exiting by ramps or horizontally. When both horizontal and stair exits are used, the total width of exits shall be determined by using both figures as applicable.

7. Minimum Exit Width. Exits shall not be less than forty-two (42) inches in width.

8. Exit Arrangements. Exits shall be arranged a reasonable distance apart. When but two (2) exits are provided, they shall be spaced not less than one-fifth (1/5) of the perimeter apart.

(k) Securing of Chairs.

1. Raised Stands. Chairs and benches used on raised stands shall be secured to the platforms upon which they are placed.

EXCEPTION: When less than twenty-five (25) chairs are used upon a single raised platform, the fastening of seats to the platform may be omitted.

2. Ground Seats. When more than five hundred (500) loose chairs are used in connection with athletic events, chairs shall be fastened together in groups of not less than three (3) and shall be tied or staked to the ground.

(l) Dispersal Area Exits. Each safe dispersal area shall have at least two (2) exits. If more than six thousand (6000) persons are to be accommodated within such an area, there shall be a minimum of three (3) exits, and for more than nine thousand (9000) persons, there shall be at least four (4) exits. The aggregate clear width of exits from a safe dispersal area shall be determined on the basis of at least one (1) exit unit of twenty-two (22) inches for each five hundred (500) persons to be accommodated and no exit shall be less than forty-four (44) inches in width. Exits shall be a reasonable distance apart but shall be spaced at least one-fifth (1/5) of the perimeter of the area apart from each other.

33-12
Section 3323. STAGE EXITS.

(a) Required. At least one exit, not less than thirty-six (36) inches in width, shall be provided from each side of the stage, opening directly, or by means of a passageway not less than thirty-six (36) inches in width, to a street or exit court. An exit stair or ladder, not less than eighteen (18) inches in width, shall be provided for egress from each fly gallery. Each tier of dressing rooms shall be provided with at least two (2) means of egress, each not less than thirty (30) inches wide and all such stairs shall be constructed as required by this Chapter. The stairs or ladder required by this Section need not be enclosed.

Section 3324. MOTION PICTURE PROJECTION ROOM EXITS.

(a) Required. Every projection room shall be provided with at least one (1) exit or as may be required by Table 33-A. The door opening shall be at least thirty (30) inches in width and not less than seventy-eight (78) inches in height.

(b) Protection. All entrances to a projection room shall be protected by a self-closing assembly having a three-fourths (¾) hour fire-resistive rating. Such doors shall open outward and lead to the proper exits as required in this Chapter.

Section 3325. EXITS, GROUP I AND J OCCUPANCIES.

(a) Purpose. In addition to the other requirements of this Building Code, this Section shall govern the requirements for exit facilities of buildings or structures used for Group I and J Occupancies.

(b) Required Exits. Every Group I and J Occupancy shall be provided with at least two (2) exits and as required by this Chapter.

(c) Occupant Loads. The determination of occupant loads shall be as indicated in Table 33-A.

(d) Doors.

1. Exit doors required by this Section shall provide a minimum clear width of opening of thirty-four (34) inches and shall have a minimum height of eighty (80) inches.

2. Doors opening into a stairway shall open onto a floor or landing. Doors swinging away from the stairs may open on the top step of a flight of stairs without the requirement for a landing. This shall apply only for individual units. Exterior landings shall not be more than seven and one-half (7½) inches below the floor level.

3. Glass doors shall conform to the requirements of Chapter 54.

(e) Stairways.

1. Stairways shall provide at least thirty (30) inches of clear width.

2. The rise of every step in a stairway shall not exceed eight (8) inches and the run shall be not less than nine (9) inches.

3. Winders may be installed if the required width of run is provided at a point not more than twelve (12) inches from the side of the stairway where the treads are narrower, but in no case shall any width of run be less than six (6) inches at any point. Curved stairs may be used as a required exit if complying with requirements for exit stairs, including a minimum ten (10) inch width of run.

4. Landings. Every landing shall have a dimension measured in the direction of travel equal to the width of the stairway. Such dimension need not exceed four (4) feet when the stair has a straight run. Landings, when provided, shall not be reduced in width by more than four and one-half (4½) inches by a door when fully open. (See Section 3325 (e) 2.)

5. There shall be not more than twelve (12) feet vertically between landings.

6. Handrails shall be provided on each side of a stairway except that stairways less than forty-four (44) inches in width need provide only one (1) handrail. Handrails shall not reduce the required width of stairway. Handrails shall be placed not less than thirty (30) inches nor more than thirty-four (34) inches above the nosing of treads.

7. Every stairway shall provide headroom clearance of at least six (6) feet six (6) inches of clear opening throughout such stairway.

8. Interior stairways shall be constructed of materials as provided for in Chapters 20 and 22.

9. Exterior stairways shall be constructed of incombustible materials except that wood, at least two (2) inches in nominal thickness may be used.

(ENTIRE CHAPTER REVISED — ORD. 526 — 1966)
**TABLE 33-A**

(Method of Computation for Occupant Loads and Exits)
(See Notes 1, 2, and 3)

<table>
<thead>
<tr>
<th>SQUARE FEET PER OCCUPANT</th>
<th>USE</th>
<th>ROOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings2 – Floors2 Rooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>Aircraft Hangars (No repair)</td>
<td>30</td>
</tr>
<tr>
<td>300</td>
<td>Aircraft Hangars (Repair)</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Assembly (Concentrated Use)</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Auditoriums</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Bowling Alleys (Assembly areas)</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Churches and Chapels</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Dance Floors and Halls</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Lodge Rooms</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Meeting Rooms</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Reviewing Stands</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Stadiums:</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Field Houses—Gyms (Seating area)</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>Field Houses—Gyms (Other areas)</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Theatres</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Assembly (Medium Concentrated Use)</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Assembly (Less Concentrated Use)</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Conference Rooms</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Dining Rooms</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Drinking Establishments/Rooms</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Exhibit Rooms</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Lounges</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Skating Rinks</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>Stages</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>Banquet Areas</td>
<td>50</td>
</tr>
<tr>
<td>80</td>
<td>Children’s Homes</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>Classrooms</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>Dormitories</td>
<td>20</td>
</tr>
<tr>
<td>300</td>
<td>Dwellings</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>Factories</td>
<td>30</td>
</tr>
<tr>
<td>300</td>
<td>Garages (No repair)</td>
<td>30</td>
</tr>
<tr>
<td>150</td>
<td>Garages (Repair)</td>
<td>10</td>
</tr>
<tr>
<td>500</td>
<td>Greenhouses</td>
<td>30</td>
</tr>
<tr>
<td>100</td>
<td>Group E Occupancy</td>
<td>5</td>
</tr>
<tr>
<td>80</td>
<td>Homes for the Aged</td>
<td>5</td>
</tr>
<tr>
<td>80</td>
<td>Hospitals</td>
<td>5</td>
</tr>
<tr>
<td>200</td>
<td>Hotels and Apartments</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>Kitchens (Commercial)</td>
<td>30</td>
</tr>
<tr>
<td>50</td>
<td>Libraries and Reading Rooms</td>
<td>50</td>
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<tr>
<td>50</td>
<td>Locker Rooms</td>
<td>30</td>
</tr>
<tr>
<td>300</td>
<td>Mechanical Equipment Rooms</td>
<td>30</td>
</tr>
<tr>
<td>80</td>
<td>Nursing Homes</td>
<td>5</td>
</tr>
<tr>
<td>100</td>
<td>Office Buildings and Offices</td>
<td>30</td>
</tr>
<tr>
<td>300</td>
<td>Row Dwelling Buildings</td>
<td>10</td>
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<tr>
<td>80</td>
<td>Sanitariums</td>
<td>5</td>
</tr>
<tr>
<td>200</td>
<td>Senior Homes</td>
<td>10</td>
</tr>
<tr>
<td>50</td>
<td>School Shops &amp; Vocational Rooms</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>Stores — Retail Sales</td>
<td>50</td>
</tr>
<tr>
<td>20</td>
<td>Basement</td>
<td>50</td>
</tr>
<tr>
<td>30</td>
<td>Ground Floor</td>
<td>50</td>
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<tr>
<td>50</td>
<td>Upper Floors</td>
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<tr>
<td>SQUARE FEET PER OCCUPANT</td>
<td>USE</td>
<td>ROOMS</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Buildings² - Floors²</td>
<td></td>
<td>Rooms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Req. When occupant load exceeds 2 or More Exits</td>
</tr>
<tr>
<td>50</td>
<td>Swimming Pools (Inside or on roof of building)</td>
<td>50</td>
</tr>
<tr>
<td>300</td>
<td>Warehouses</td>
<td>30</td>
</tr>
<tr>
<td>100</td>
<td>All other Occupancies — as approved by the Department</td>
<td>50</td>
</tr>
</tbody>
</table>

1. Refer to Sections 3315 through 3321 for other specific requirements.
2. Minimum of two (2) exits required from all buildings and floors.
3. See Section 3302 for additional exits.
TABLE 33-B

(Requirements for Dual Purpose Fire-Exit Doors)\(^1\)

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>EXIT DOORS TO CORRIDORS</th>
<th>DOORS TO EXIT ENCLOSURES</th>
<th>BOILER AND FURNACE ROOM DOORS</th>
<th>CORRIDOR DOORS IN AREA SEPARATION WALLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(\frac{3}{4}) 2</td>
<td>720</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>B</td>
<td>(\frac{3}{4}) 2</td>
<td>1200</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>C</td>
<td>(\frac{3}{4}) 2</td>
<td>1200</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>D-1</td>
<td>(\frac{3}{4}) 2, 3</td>
<td>720</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>D-2</td>
<td>(\frac{3}{4}) 2</td>
<td>1200</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>E-1</td>
<td>(\frac{3}{4}) 2</td>
<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
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</tr>
<tr>
<td>E-2</td>
<td>(\frac{3}{4}) 2</td>
<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>E-3</td>
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<td>100</td>
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<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>E-4</td>
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<td>A or B 1(\frac{1}{2}) A or B</td>
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<tr>
<td>E-5</td>
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</tr>
<tr>
<td>F-1</td>
<td>(\frac{3}{4}) 2</td>
<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>F-2</td>
<td>(\frac{3}{4}) 2</td>
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<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>F-3</td>
<td>(\frac{3}{4}) 2</td>
<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
<tr>
<td>G</td>
<td>(\frac{3}{4}) 2</td>
<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
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<td>H</td>
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<td>100</td>
<td>A or B 1(\frac{1}{2}) A or B</td>
<td>0 A 1(\frac{1}{2}) 0 A</td>
</tr>
</tbody>
</table>

A. Self-closing.
B. Automatic self-closing doors when activated by a magnetic device (See Chapter 43).
C. None required, except in dead-end corridors.
1. For occupancy separations and protection of openings. See Table 5-B.
2. Doors, with a minimum thickness of one and three-fourth inch (1\(\frac{3}{4}\)") solid wood may be permitted. Wire glass shall be installed in approved metal or wood frames. (See Chapter 43.)
3. Except jails, prisons, etc. where open barred cells are provided.
4. Less than 5 stories in height, one hour is permitted.
5. Automatic closing at 135 degree F. fusible link, or equal, when not used in conjunction with a required exit.
6. Doors rated over one (1) hour shall be provided with a label by a recognized testing laboratory.
7. Wire glass
CHAPTER 34
SKYLIGHTS

Section 3401. SKYLIGHTS.

(a) General. Except for Groups I and J Occupancies all skylights shall be constructed with metal frames. Frames of skylights shall be designed to carry loads required for roofs as specified in Chapter 23. All skylights, installed on roofs which slope at an angle less than thirty degrees (30°) from the horizontal, shall be set at least six inches (6”) above the roof. The curbs on which the skylight rests shall be constructed in conformance with the type of construction required for the building.

For the purpose of this Chapter, a skylight is a glazed opening in the roof. See Chapter 4.

(b) Glass. All glass in skylights shall be wire glass, except as follows:

1. Skylights over vertical shafts, extending through two (2) or more stories in height, shall be glazed with ordinary glass, provided however, that wire glass may be used if ventilation equal to at least one-eighth (1/8) the cross-sectional area of the shaft but never less than four (4) square feet is provided at the top of such shaft.

2. Ordinary glass may be used in skylights for greenhouses.

(c) Support. Spacing between supports for flat wired glass in skylights shall not exceed twenty-five (25) inches. Corrugated wired glass may have supports five (5) feet apart in the direction of the corrugation.

The use of wood frames in skylights in greenhouses may be permitted when such are located in Fire Zone No. 3, only.

(d) Protection. Where ordinary glass is permitted, a screen constructed of wire not smaller than No. 12 U.S. Gage, with a mesh not larger than one (1) inch, shall be provided under such glass. The screen shall be substantially supported below the glass.

(e) Floor or Sidewalk Light Transmission. Glass used for the transmission of light in floors or sidewalks, shall be supported by metal or reinforced concrete frames. All portions of the floor lights or sidewalk lights shall be of the same strength as is required by this Building Code for floor or sidewalk construction, except in cases where the floor is surrounded by a railing at least three feet six inches (3’6”) in height, in which case the construction shall be calculated for not less than roof loads.

(f) Plastic Skylights. For plastic skylights, see Chapter 60.
CHAPTER 35
BAYS, PORCHES, AND BALCONIES

Section 3501. BAY AND ORIEL WINDOWS.

Construction of walls and floors in bay and oriel windows shall conform to the construction permitted for exterior walls and floors of the type of construction of the building to which they are attached. The roof covering of a bay or oriel window shall conform to the requirements for roofing of the main roof of the building.

Section 3502. BALCONIES AND PORCHES.

Exterior balconies attached to or supported by walls required to be of masonry shall have brackets or beams constructed of incombustible material. Railings shall be provided for exterior balconies, landings, or porches which are more than thirty (30) inches above grade. Such railings shall be at least thirty-six (36) inches in height above the floor. Any intermediate member in open-type railings shall be spaced not more than nine (9) inches apart.

See Chapter 23 for Design Loads.
CHAPTER 36
PENTHOUSE AND ROOF STRUCTURES

Section 3601. SCOPE.

In addition to other provisions of this Building Code, the provisions of this Chapter shall govern the construction of roof structures, penthouses, roof spires and towers.

Section 3602. DEFINITIONS.

For the purpose of this Chapter the following shall be defined as set forth in this Section.

Penthouse. Penthouse is a structure built above or on the roof of a building and such structure is totally enclosed and used for habitation. If the area or aggregate areas of such penthouses exceeds an occupant load of fifty (50) persons, such shall be considered an additional story. (See Roof Structures).

Roof Structures. A roof structure is a structure above or on the roof of a building including, but not necessarily restricted, to the following: Cooling towers, tanks, elevator machinery housing, service equipment, heating or cooling equipment; spires or towers or any other projection above the roof except another story or penthouse. (See Penthouse).

Section 3603. GENERAL.

(a) Area. The aggregate area of penthouses shall not exceed an occupant load of fifty (50) persons. The aggregate area of all penthouses and roof structures shall not exceed seventy-five (75) percent of the area of the roof. When the penthouse or roof structure coincides with the building front wall, the width of such penthouse or roof structure shall be not more than three-fourths (¾) of the building. The area shall be classified as a story when exceeding these requirements.

(b) Prohibited Occupancy. Roof structures or penthouses shall not be used for storage or manufacturing purposes.

(c) Construction. Roof structures and penthouses shall be constructed with walls, floors and roofs as required for the main portion of the building.

EXCEPTIONS:

1. On Types I and II buildings, the exterior walls and roof of penthouses which are five (5) feet or more from the adjacent property line, may be of one (1) hour fire-resistive incombustible construction.

2. Walls five (5) feet or more from the exterior wall of a Type III building may be of one (1) hour fire-resistive incombustible construction.

3. Roof structures housing only utilities and located where unprotected openings are permitted, may be of unprotected incombustible construction.

4. Wood flagpoles.

Section 3604. TOWERS AND SPIRES ON ROOFS.

(a) General. Towers or spires shall have exterior walls constructed of incombustible materials. Towers or spires shall not occupy more than three-fourths (¾) of the street frontage of the roof of any building.

(b) Wind Loads. Towers and spires shall be designed to withstand a wind load from any direction as set forth in Chapter 23, in addition to any other imposed loads.
CHAPTER 37
CHIMNEYS AND VENTS

Section 3700. GENERAL

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, maintenance, repair and approval of all chimneys, vents and connectors. All commercial or industrial incinerator stacks, chimneys or vents shall comply to this Chapter and Chapter 48.

(b) Special Engineered Vent System Tables. Special engineered vent system tables may be used in determining vent and vent connector sizing when such are approved by a nationally recognized agency.

(c) Prohibitions.

1. Chimney Termination Below Ceiling (Shelf or Bracket) Prohibited. The construction or use of a shelf or bracket type chimney is prohibited.

2. The use of flue-fed type incinerators is prohibited except as set forth in Chapter 48.

(d) Breechings. See Chapter 48 for commercial incinerator breechings.

(e) Existing Chimneys.

1. When an existing chimney is unlined and indications are that the chimney indicates flue-gas leakage, an approved liner or another vent shall be installed.

2. When inspection by the Department reveals that an existing chimney is not safe for the intended application, such chimney shall be rebuilt, replaced or repaired to conform to the requirements of this Chapter.

3. Existing unlined chimneys having not less than four (4) inch (nominal) brick walls, may be used for the venting of domestic gas-fired free standing incinerators and other listed gas fired appliances, when such chimneys meet the other requirements of this Section.

(f) New Chimneys and Flues Required. In buildings where the existing chimney can only be reached through a crawl space for inspection and cleaning, a new chimney or vent shall be constructed.

(g) Starting Level and Support. Only vents and factory built chimneys may start at any desired level. Vents shall be securely anchored to the building so that they cannot be dislodged in any direction. Straps shall be at least No. 26 gauge galvanized steel, and shall be installed at intervals of not more than five feet (5'), and at every change in direction.

(h) Offsetting Inlets. Where two or more inlets are provided in any vent or chimney, such inlets shall be offset in such a manner that no portion of any inlet shall be opposite to other inlets.

Section 3701. DEFINITIONS

Except as otherwise provided, terms and symbols used in this Chapter shall be defined as follows:

Chimney, Factory-Built is an approved listed chimney.

Chimney, Masonry is a chimney of solid masonry units, bricks, stones, listed hollow masonry units or reinforced concrete.
Chimney, Metal is a field-constructed chimney of metal.

Chimney Classifications:

Chimney, Residential Appliance Type is an approved factory-built or masonry chimney suitable for removing products of combustion from residential type appliances producing combustion gases not in excess of 1000°F measured at the appliance flue outlet.

Chimney, Low-Heat Appliance Type is a factory-built, masonry or metal chimney suitable for removing the products of combustion from fuel-burning low-heat appliances producing combustion gases not in excess of 1000°F under normal operating conditions but capable of producing combustion gases of 1400°F during intermittent forced firing for periods up to one hour. All temperatures shall be measured at the appliance flue outlet.

Chimney, Medium-Heat Appliance Type is a factory-built, masonry or metal chimney suitable for removing the products of combustion from fuel-burning medium-heat appliances producing combustion gases not in excess of 2000°F measured at the appliance flue outlet.

Chimney, High-Heat Appliance Type is a factory-built, masonry or metal chimney suitable for removing the products of combustion from fuel-burning high-heat appliances producing combustion gases in excess of 2000°F measured at the appliance flue outlet.

Chimney Connector. The pipe which connects a fuel burning appliance to a chimney.

Chimney Liner. The lining material of fire clay or other approved material that meets the requirements of ASTM C-27 (UBC-37-1-64).

Combustible Material is any material not defined in Chapter 4 as incombustible material.

Draft Hood 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, 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.

Firebrick is a refractory brick which meets the requirements of ASTM Standard C-27 (UBC-37-1-64).

Listed refers to products which are shown in a list published by an approved testing agency, qualified and equipped for experimental testing, and maintaining an adequate periodic inspection of current production of listed models and whose listing states that the product complies with nationally recognized safety requirements.

Metal Pipe, Single Wall is an unlisted sheet metal hollow cylinder used for conveying products of combustion.

Power Exhauster is a fan installed in or on a chimney, vent, or the connector to a chimney or vent, to induce a draft at the connected appliance.

Vent is a conduit or passageway, vertical or nearly so, for conveying products of combustion to the outside atmosphere.

Vent Connector is the pipe used to connect a listed gas appliance to a chimney or vent.

Venting System is the vent, vent connector, and cowl cap assembled to form a continuous open passageway from the appliance to the outside atmosphere for the purpose of removing combustion gases.

1. Types of Venting Systems:

A. Type B and Type B-W: A gas venting system consisting of vent piping, fittings and cowl cap listed for use with listed gas appliances with draft hoods.
B. Type L is a venting system consisting of listed vent piping and fittings for use with oil-burning appliances listed for use with Type L or with listed gas appliances.

Section 3702. CHIMNEYS

(a) Requirements. Every chimney shall be constructed, and every venting system shall be installed, in accordance with the applicable requirements of this Chapter.

(b) Draft. Every chimney, vent or venting system shall be capable of producing a draft
at the appliance not less than that required for the safe operation of the appliance connected thereto.

1. A power exhauster may be used, except with incinerators, to increase insufficient draft. (See Chapter 48 for Incinerators).

2. When an exhauster is used, provision shall be made to shut off the fuel supply to the appliance in the event of failure of the exhauster.

(c) Structural Design. Chimneys shall be designed, anchored, supported, and reinforced as required in this Chapter and Chapters 23 and 28. Chimneys shall not support any structural load other than their own weight unless designed to act as supporting members. Chimneys in wood-frame buildings shall be anchored laterally at the ceiling line and at each floor line which is more than six feet (6') above grade, except when entirely within the framework.

(d) Walls. Every masonry chimney shall have walls of masonry units, bricks, stones, listed masonry units, reinforced concrete or equivalent solid thickness of hollow masonry and lined with suitable liners in accordance with the following requirements:

1. Masonry Chimneys for Residential-Type Appliances. Masonry chimneys shall be constructed of solid masonry units or reinforced concrete with walls not less than four inches (4'') thick or rubble stone masonry not less than twelve inches (12'') thick. A chimney liner shall be provided in accordance with item (e) of this Section.

2. Masonry Chimneys for Low-Heat Appliances. Masonry chimneys shall be constructed of solid masonry units or reinforced concrete with walls not less than eight inches (8'') thick, except that rubble stone masonry shall be not less than twelve inches (12'') thick. A chimney liner shall be provided in accordance with item (e) of this Section.

3. Masonry Chimneys for Medium-Heat Appliances. Masonry chimneys for medium-heat appliances shall be constructed of solid masonry units or of reinforced concrete not less than eight inches (8'') thick, except that stone masonry shall be not less than twelve inches (12'') thick; and, in addition, shall be lined with not less than four and one-half (4½'') of firebrick laid in a solid bed of fire clay mortar with solidly filled head, bed and wall joints, commencing not less than two feet (2') below the chimney connector entrance and extending for a distance of at least twenty-five feet (25') above the chimney connector entrance. Chimneys extending twenty-five feet (25') or less above the chimney connector shall be lined to the top.

4. Masonry Chimneys for High-Heat Appliances. Masonry chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or of reinforced concrete of not less than eight inches (8'') in thickness, with an air space of not less than two inches (2'') between the walls. The inside of the interior walls shall be of not less than four and one-half inches (4½'') firebrick in thickness laid in a solid bed of fire clay mortar with solidly filled head, bed and wall joints.

(e) Lining. Fire clay chimney lining shall be not less than five-eighths inch (5/8'') thick. The lining shall extend from eight inches (8'') below the lowest inlet or, in the case of fireplaces, from the throat of the fireplace to a point above enclosing masonry walls. Fire clay chimney linings shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fire clay mortar, with close-fitting joints left smooth on the inside. Firebrick, not less than two inches (2'') thick, may be used in lieu of fire clay chimney lining as set forth in Table No. 37-A.

(f) Area. Chimney passageways shall not be smaller in area than the vent connection on the appliance attached thereto nor less than as set forth in Table 37-A unless engineering methods approved by the Department have been used to design the system. (See Section 3700 (b)).

(g) Height. Unless otherwise required elsewhere in this Chapter, every masonry chimney shall extend at least three feet (3') above the part of the roof through which it passes and at least three feet (3') above the highest elevation of any part of a building within ten feet (10') of the chimney.

(h) Corbeling. Masonry chimneys shall not be corbeled from a wall more than six inches (6''); nor shall a masonry chimney be corbeled
from a wall which is less than twelve inches (12'') in thickness unless it projects equally on each side of the wall. In the second story of a two-story building of Group I Occupancy, corbeling of masonry chimneys on the exterior of the enclosing walls may equal the wall thickness. In any case, the corbeling shall not exceed one-inch (1'') projection for each course of brick.

(i) Change in Size or Shape. Changes in the size or shape of a masonry chimney, where the chimney passes through the roof, shall not be permitted within a distance of six inches (6'') above or below the roof joists or rafters.

(j) Separation of Masonry Chimney Passageways. When more than one passageway is contained in the same chimney, masonry separation at least four inches (4'') thick, bonded into the masonry wall of the chimney, shall be provided to separate such passageways.

(k) Inlets. Every inlet to any masonry chimney shall enter the side thereof and shall be of not less than 24 gauge in thickness of metal or five-eighths inch (5/8'') thick refractory material.

(l) Clearance. Combustible material shall not be placed within four inches (4'') of smoke chamber walls or masonry walls when built within a structure, or within one inch (1'') when the chimney is built entirely outside the structure. For special conditions covering fireplaces see Section 3711.

(m) Termination. All commercial and industrial incinerator chimneys shall terminate in a substantially constructed spark arrester of 10 gauge mesh net free opening not exceeding three-fourths inch (¾ '').

(n) Cleanouts. An accessible approved clean-out opening with a tight-fitting cover shall be provided at least twelve inches (12'') below the lowest inlet opening into any chimney provided, however, that no clean-out shall be required for Type B or B.W. or Type L vents, venting only gas appliances, and equipped with cowl caps conforming to this Section.

Section 3703. TYPES OF CHIMNEYS AND VENTS REQUIRED

The type of chimney to serve the various classifications of appliances shall be as set forth in Tables No. 37-B and No. 37-C.

Section 3704. METAL CHIMNEYS

(a) Design. Metal chimneys shall be listed or have a minimum thickness equal to No. 10 U.S. gauge steel and shall be designed and constructed as specified in this Chapter, Chapters 23 and 27.

(b) Construction and Support. Unlisted metal chimneys shall be riveted or welded and, unless structurally self-supporting, shall be guyed securely, or firmly anchored to or otherwise supported by the building or structure served thereby.

Metal chimneys used for high-heat appliances shall be lined with four and one-half inch (4 ½'') firebrick laid in fire clay mortar extending not less than twenty-five feet (25') above the chimney connector entrance, or 2000° insulating castable refractory or as indicated in Table 37-E.

(c) Cleanouts. Cleanout openings shall be provided at the base of every metal chimney in accordance with the requirements of this Chapter.

(d) Exterior Chimneys. Metal chimneys, or parts thereof, attached on the exterior of a building, shall have a clearance of at least twenty-four inches (24'') from combustible walls and four inches (4'') from incombustible walls. Such chimneys shall provide a clearance of at least twenty-four inches (24'') in any direction from a door, window, or other wall opening or from an exit.

(e) Interior Chimneys. Metal chimneys, or parts thereof, in a building other than a one-story building, shall be enclosed above the story in which the appliance served thereby is located, in walls of incombustible construction having a fire-restrictive rating of not less than one hour, with a space on all sides between the chimney and the enclosing walls sufficient to render the entire chimney accessible for examination and repair.

The enclosing walls shall be without openings.

EXCEPTION: Doorways equipped with a fire assembly having a one-hour fire-resistant rating may be permitted at each floor level for inspection purposes.

Where such chimney passes through a ceiling or roof constructed of combustible materials, it shall be guarded by an approved ventilating thimble extending not less than nine inches (9'') below and nine inches (9'') above such ceiling or roof construction. Such thimbles shall be of a size to provide a clearance on all sides of the chimney of not less than eighteen inches (18''); provided that for stacks of low-heat appliances, the clearance may be reduced to not less than six inches (6''). Metal chimneys shall not be carried up inside of ventilating ducts unless such ducts are constructed.
and installed as required by this Building Code for chimneys and which are used solely for exhaust of air from the room or space in which the appliances served by the metal chimney are located.

Section 3705. TYPES OF CHIMNEYS

(a) Factory-built Chimneys. Factory-built chimneys are listed chimneys and shall be installed in strict accordance with the terms of their listings and the manufacturer's instructions.

(b) Masonry Chimneys. Masonry chimneys shall be constructed to meet the requirements of Section 3702.

(c) Metal Chimneys. Metal chimneys shall be constructed to meet the requirements of Section 3704.

Section 3706. USE OF VENTING SYSTEMS

(a) Type B Gas Vents. Type B gas vents shall be used only with listed gas appliances with drafthoods but shall not be used for venting the following:

1. Incinerators.
2. Appliances which may be converted readily to the use of solid or liquid fuels.
3. Combination gas-oil burning appliances.
4. Appliances listed for use with chimneys only.
5. Any appliance which produces flue products in excess of 550° F. at the inlet of the divertor or draft regulator.

(b) Type BW Gas Vents. Type BW vents shall be used only with vented recessed gas wall furnaces listed for use with such vents.

(c) Type L Venting System. Type L venting systems shall be used only with appliances listed for such use.

(d) Metal Pipe Used as a Vent. Single wall metal pipe vents may be used to vent gas appliances in accordance with the following:

1. The pipe shall be of sheet copper not lighter than No. 23 B. & S. gauge or of galvanized steel not lighter than No. 24 gauge.
2. Single wall metal pipe vents shall be used only for runs directly from the space in which the appliance is located through the roof or exterior wall to the outer air.

3. Single wall metal pipe vents shall not originate in any unoccupied attic or concealed space and shall not pass through any attic, inside wall, concealed space nor through any floor or ceiling. Such vent shall not extend more than three feet (3') above the roof through which it passes.

4. Metal pipe vents shall not be used outside unless such are adequately insulated.

Section 3707. INSTALLATION REQUIREMENTS FOR VENTS

(a) Termination. Each vent shall extend above the roof surface through its flashing and shall terminate in an approved listed cap with a venting capacity at least that of the vent. The outlet opening of any such vent shall be at least twenty-four inches (24") from any portion of the building, at least ten feet (10') from any of that portion of the building or structure which extends at an angle of more than 45 degrees upward from the horizontal. Such vent outlet shall not terminate less than ten feet (10') from any door, window or air intake.

1. Gravity operated vents shall not terminate less than five feet (5') in vertical height above the lower skirt of the draft hood of the highest connected appliance.

2. Venting system exhausters may be used in lieu of natural draft vents for any gas appliance, except incinerators. (See Chapter 48 for incinerators.) When exhausters are used with gas appliances requiring venting, provisions shall be made to prevent the flow of gas to the main burner in the event of failure of the exhaust system.

A. Vent connectors serving gas appliances vented by natural draft shall not be connected into the discharge side of power exhausters.

B. The exit terminals of exhaust-equipped gas venting systems shall be located at least nine inches (9") from any building opening and not less than two feet (2') from an adjacent building, and not less than seven feet (7') above grade, when located adjacent to public walkways.
3. A Type BW gas vent or combination of Type BW and Type B shall terminate at an elevation at least twelve feet (12') above the bottom of the wall furnace.

(b) Clearances. All vents shall be installed with clearances to combustibles as specified in this Section, or in accordance with individual listings.

1. Single wall metal pipe may be used as a gas vent only provided it is installed with minimum clearances from combustible materials as follows:
   
   A. Appliances without draft hoods, eighteen inches (18”).
   
   B. Boilers and furnaces equipped with listed conversion burners and draft hoods, nine inches (9”).
   
   C. Listed appliances with draft hoods, except incinerators, six inches (6”).

2. Metal pipe vent passing through an exterior wall constructed of combustible material shall be guarded at the point of passage by a ventilating metal thimble not smaller than the following:
   
   A. For listed gas-burning appliances with draft hoods, except incinerators, four inches (4”) larger in diameter than the vent pipe, unless there is a run of not less than six feet (6’) of vent pipe in the open, between the draft hood outlet and the thimble, in which case the thimble may be two inches (2”) larger in diameter than the vent pipe.
   
   B. For incinerators and appliances without draft hoods, twelve inches (12”) larger in diameter than the vent pipe.

3. Metal pipe vent passing through a roof constructed of combustible material shall be guarded at the point of passage as specified for exterior wall by Sub-Section 2, or by metal thimbles not less than four inches (4") larger in diameter than the pipe with the annular space filled with mineral wool or other approved non-combustible insulating material.

(c) Protection. Provisions shall be made to prevent mechanical injury to Type B vents where such extend through walls, floors or roofs.

(d) Support. All portions of gas vents and chimneys shall be properly supported for their weight and design. Listed gas vents and factory-built chimneys shall be supported and spaced in accordance with their listings and the manufacturer’s instructions.

(e) Size. Every gravity vent shall be of a size not less than that of the draft hood collar on the appliance attached thereto. In no case shall the area be less than the area of three-inch (3") diameter pipe. When more than one appliance vents into a vent, the vent area shall be not less than the area of the largest vent connector plus 50 per cent of the areas of the additional vent connectors.

EXCEPTION: The size of gravity vents and their connectors shall not govern where engineered methods approved by the Department have been used to design the venting system.

(f) Vent Offsets. Unless part of an engineered venting system, vents shall not have more than two offsets of not more than 45 degrees from the vertical, provided that if such offset is more than three feet (3’) in length it shall be supported for the weight and design to maintain proper clearances, to prevent physical damage and to prevent separation of the joints.

1. When approved by the Department, a vent may have one offset of not more than 60 degrees from the vertical, and if more than three feet (3’) in length, shall be supported for the weight and design to maintain proper clearances, to prevent physical damage, and to prevent separation of the joints.

2. Any angle greater than 45 degrees from the vertical is considered horizontal. The total horizontal run of a vent, plus the horizontal vent connection, shall not be greater than 75 per cent of the vertical height of the vent. In no case shall the total length horizontal be greater than fifteen feet (15’).
Section 3708 CHIMNEY CONNECTORS AND VENT CONNECTORS

(a) Materials. Chimney connectors shall be of metal construction of not less than the following gauges:

<table>
<thead>
<tr>
<th>Galvanized Sheet Gauge No.</th>
<th>Diameter of Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Less than 6''</td>
</tr>
<tr>
<td>26</td>
<td>Less than 10''</td>
</tr>
<tr>
<td>22</td>
<td>10'' to 12''</td>
</tr>
<tr>
<td>20</td>
<td>14'' to 16''</td>
</tr>
<tr>
<td>16</td>
<td>Over 16''</td>
</tr>
</tbody>
</table>

1. Vent connectors serving listed appliances with draft hoods may be constructed of Type B, or when the former is not required, of single wall metal, provided such meet the limitations of use specified in this Chapter.

2. Vent connectors constructed of single wall metal, serving gas appliances, shall be of U. S. Standard Gauge for the diameters indicated.

<table>
<thead>
<tr>
<th>Diameter (inches)</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>28</td>
</tr>
<tr>
<td>6-9</td>
<td>26</td>
</tr>
<tr>
<td>10 or over</td>
<td>24</td>
</tr>
</tbody>
</table>

(b) Installation.

1. Interconnections. Two or more vent or chimney connectors shall not be joined unless the common connector, the manifold and the vent or chimney are properly sized to serve the appliances connected thereto and adequate draft is available to remove all products of combustion to the outdoors. Gas and oil appliances, so connected, shall be equipped with primary safety controls.

A. Connectors serving gravity vent type appliances shall not be connected to a chimney, vent or venting system served by a power exhauster unless the connection is made on the negative pressure side of the power exhauster.

2. Clearance. Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table No. 37-D.

3. Size. The connector for its entire length shall be not smaller than the flue collar of the appliance unless otherwise recommended by the appliance, chimney or vent manufacturer, approved by the Department, or a part of an engineered venting system.

4. Location. When the connector used for a gas appliance having a draft hood is located in or passes through an attic, crawl space or other cold area, that portion of the connector shall be of listed Type B vent material.

5. Length. All connectors shall be as short and straight as possible. An appliance shall be located as close as practicable to the chimney, gas vent or venting system. The connector shall be not longer than 75 per cent of the portion of the chimney or vent above the inlet connection unless a part of an engineered venting system.

6. Passage through walls. Connectors for listed gas appliances with draft hoods other than incinerators may pass through walls or partitions constructed of combustible material if made of listed Type B, or Type L material and installed with not less than listed clearances to combustible material. Connectors shall be exposed to view throughout their length.

A. Connectors serving low-, medium- or high-heat appliances as classified in Table No. 37-B shall not pass through walls or partitions but shall be located in the same space as the appliance and shall be visible throughout their entire length.

7. Resistance. Connectors shall be installed so as to avoid sharp turns or other construction features which would create excessive resistance to the flow of combustion gases. Devices which will obstruct the free flow of combustion gases shall not be installed in a connector, chimney or vent. This shall not be construed to prohibit the use of devices specifically listed for installation in a connector such as draft regulators and safety controls.

8. Joints. Chimney and vent connectors shall be securely supported and
joints fastened with sheet metal screws, rivets, or other approved means.

9. Connection. A connector to a masonry chimney shall extend through the wall to the inner face of liner but not beyond, and shall be firmly cemented to masonry. A thimble may be used to facilitate removal of the connector for cleaning, in which case the thimble shall be permanently cemented in place with high-temperature cement. (See Section 3702 (k).

A. Connectors shall not pass through any floor or ceiling.

B. Chimneys or vents shall not have connector openings in more than one story of a building unless provision is made for effectively closing such openings with devices made of incombustible materials whenever their use is discontinued temporarily, and completely closing the opening.

10. Fireplace. A connector shall not be connected to a chimney serving a fireplace unless the fireplace opening or the chimney which vents the fireplace is permanently sealed below the connection.

11. Dampers. Manually operated dampers shall not be placed in chimneys, vents or chimney or vent connectors of liquid- or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers.

A. Automatically operated dampers shall be of approved type designed to maintain a safe damper opening at all times and arranged to prevent firing of the burner unless the damper is opened to a safe position.

12. Draft regulators. A draft regulator shall be installed in the connector serving a liquid fuel-burning appliance unless the appliance is approved for use without such.

A. A draft regulator may be installed in the connector serving a listed gas incinerator when recommended by the incinerator manufacturer. Such draft regulators shall be installed in accordance with the installation instructions accompanying the incinerator.

B. A draft regulator furnished as part of a listed gas appliance shall be installed in the connector serving the appliance.

A draft regulator when used shall be installed in the same room or enclosure as the appliance in such a manner that no difference in pressure between air in the vicinity of the regulator and the combustion air supply will be permitted.

13. Pitch. Chimney or vent connectors shall have a rise of not less than one-fourth inch (¼") to the foot of run.

14. Support. Vent connectors shall be securely supported for the weight and design to maintain proper clearances, to prevent physical damage, and to prevent separation of the joints.

Section 3709. SPECIAL VENTING ARRANGEMENTS

Listed appliances having sealed combustion chambers and which are so constructed and installed that all air for combustion is derived from outside the building and all flue gases are discharged to the outside atmosphere shall be considered as properly vented when installed in accordance with their listing and manufacturer's instructions. Venting requirements as set forth in this Chapter need not apply, except as provided for in Chapter 51 and 52.
### TABLE NO. 37-A
MINIMUM PASSAGE AREAS FOR MASONRY CHIMNEYS

<table>
<thead>
<tr>
<th>Type of Masonry Chimney</th>
<th>MINIMUM CROSS-SECTIONAL AREA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Round</td>
</tr>
<tr>
<td>Residential</td>
<td>50 Sq. In.</td>
</tr>
<tr>
<td>Fireplace ²</td>
<td>1/12 of opening</td>
</tr>
</tbody>
</table>

1 Areas for medium- and high-heat chimneys shall be determined using accepted engineering methods and as approved by the Department.

2 Where fireplaces open on more than one side, the fireplace opening shall be measured along the greatest dimension.
**TABLE NO. 37-B**

**CHIMNEY SELECTION CHART—**

**TYPES OF APPLIANCES TO BE USED WITH EACH TYPE CHIMNEY**

(SEE TABLE NO. 37-C FOR GAS APPLIANCES)

<table>
<thead>
<tr>
<th>COLUMN I</th>
<th>COLUMN II</th>
<th>COLUMN III</th>
<th>COLUMN IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chimneys for Residential Appliances</td>
<td>Chimneys for Low Heat Appliances</td>
<td>Chimneys for Medium Heat Appliances</td>
<td>Chimneys for High Heat Appliances</td>
</tr>
<tr>
<td>1. Factory Built (Residential)</td>
<td>1. Factory Built (low heat)</td>
<td>1. Factory Built (medium heat)</td>
<td>1. Masonry (high heat type)</td>
</tr>
<tr>
<td>Appliances such as:</td>
<td></td>
<td>Columns I and II, and Appliances such as:</td>
<td>Columns I, II and III, and Appliances such as:</td>
</tr>
<tr>
<td>1. Ranges</td>
<td>All appliances shown in Column I. Heating equipment other than residential.</td>
<td>1. Alabaster gypsum kilns</td>
<td>1. Bessemer retorts and cupolas</td>
</tr>
<tr>
<td>2. Warm-air furnaces</td>
<td>Appliances such as:</td>
<td>2. Annealing furnaces</td>
<td>2. Billet and bloom furnaces</td>
</tr>
<tr>
<td>5. Low pressure steam boilers (not over 15 p.s.i.g.)</td>
<td>3. Boiling vats, for fibre</td>
<td>5. Feed, fertilizer and pulp driers</td>
<td>5. Brass Furnaces</td>
</tr>
<tr>
<td></td>
<td>11. Hot air furnaces</td>
<td>13. Steam boilers operating at over 50 p.s.i.g.</td>
<td>13. Pot-arches</td>
</tr>
<tr>
<td></td>
<td>13. Rosin melting furnaces</td>
<td>15. Wood distilling furnaces</td>
<td>15. Regenerative furnaces</td>
</tr>
<tr>
<td></td>
<td>not over 50 p.s.i.g.</td>
<td>17. Incinerators (Commercial</td>
<td>17. Stacks, carburetor or super heating furnaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and Industrial)</td>
<td>18. Vitreous enameling ovens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18. Crematories</td>
<td>19. Wood carbonizing furnaces</td>
</tr>
</tbody>
</table>

*May be used to vent Domestic Incinerators in Group I Occupancies if constructed of four inch (4") brick and does not leak flue gas, provided the incinerator is listed.*
TABLE NO. 37-C
VENTING SYSTEM SELECTION CHART
(TYPE OF VENTING SYSTEM)

<table>
<thead>
<tr>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type B Gas Round</td>
<td>Type BW Gas</td>
<td>Type L</td>
<td>Metal Pipe</td>
</tr>
<tr>
<td>All listed gas appliances with draft hoods such as:</td>
<td>1. Recessed wall furnaces</td>
<td>1. Low temperature flue gas appliances listed for use with Type L venting systems</td>
<td>(Single wall)</td>
</tr>
<tr>
<td>1. Central furnaces</td>
<td></td>
<td>2. Gas appliances shown in Column I</td>
<td>1. Exterior domestic incinerator installations only</td>
</tr>
<tr>
<td>2. Floor furnaces</td>
<td></td>
<td></td>
<td>2. Residential and low-heat appliances</td>
</tr>
<tr>
<td>3. Heating boilers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Ranges and ovens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Recessed wall furnaces (above wall section)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Room and unit heaters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Water heaters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Duct Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Horizontal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE NO. 37-D
CONNECTOR CLEARANCES

<table>
<thead>
<tr>
<th>DESCRIPTION OF APPLIANCE</th>
<th>MINIMUM CLEARANCES (Inches) 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>RESIDENTIAL APPLIANCES</td>
<td></td>
</tr>
<tr>
<td>Column I (Table No. 37-B)</td>
<td></td>
</tr>
<tr>
<td>Gas appliances without draft hoods</td>
<td>18</td>
</tr>
<tr>
<td>Electric, gas and oil incinerators</td>
<td>18</td>
</tr>
<tr>
<td>Oil and solid-fuel appliances</td>
<td>18</td>
</tr>
<tr>
<td>Unlisted gas appliance with draft hoods</td>
<td>9</td>
</tr>
<tr>
<td>Boilers and furnaces equipped with listed burner and with draft hood</td>
<td>6</td>
</tr>
<tr>
<td>COMMERCIAL-INDUSTRIAL APPLIANCES</td>
<td></td>
</tr>
<tr>
<td>Low-heat Appliances, Column II (Table No. 37-B)</td>
<td></td>
</tr>
<tr>
<td>Gas, oil, and solid-fuel boilers, furnaces and water heaters</td>
<td>18</td>
</tr>
<tr>
<td>Ranges, restaurant type</td>
<td>18</td>
</tr>
<tr>
<td>Oil unit heaters</td>
<td>18</td>
</tr>
<tr>
<td>Unlisted gas unit heaters</td>
<td>18</td>
</tr>
<tr>
<td>Listed gas unit heaters with draft hoods</td>
<td>6</td>
</tr>
<tr>
<td>Other low-heat industrial appliances</td>
<td>18</td>
</tr>
<tr>
<td>Medium-heat Appliances, Column III (Table No. 37-B)</td>
<td></td>
</tr>
<tr>
<td>All gas, oil, and solid-fuel appliances</td>
<td>36</td>
</tr>
</tbody>
</table>

1 These clearances apply except if the listing of an appliance specifies different clearances in which case the listed clearance takes precedence.
2 If listed Type B, or Type L vent material is used, the clearance may be in accordance with the vent-material listing.
TABLE NO. 37-E
INSULATING CASTABLE LINING FOR METAL STACKS FOR INCINERATORS

<table>
<thead>
<tr>
<th>Stack diameter</th>
<th>Lining thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 thru 14&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>15 thru 20&quot;</td>
<td>2½&quot;</td>
</tr>
<tr>
<td>21 thru 30&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>Over 30&quot;</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>

Section 3715. STANDARDS

Unless otherwise specified in other Sections of this Building Code the following standards shall apply:

<table>
<thead>
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Legend:

USASI: United States of America Standards Institute
10 E. 40th St.
New York, N.Y. 10016

ASTM: American Standards for Testing and Materials
1916 Race St., Philadelphia, Pa. 19103

NFPA: National Fire Protection Association
60 Batterymarch St., Boston, Mass. 02110
CHAPTER 38
FIRE PROTECTION SYSTEMS

Section 3800. GENERAL.

(a) Scope. The provisions of this Chapter shall require and govern the installation, repair, operation and maintenance of fire protection systems in all Group A through H Occupancies.

(b) Draft Stops (for fire sprinklered buildings). (See Chapter 31.)

(c) Not Required. Where fire protection systems are not required by this Building Code and are installed in a building, the installation shall meet all the requirements of this Chapter except that a central alarm connection need not be provided.

(d) Fire Sprinkler Shut-off. Fire sprinkler systems shall not be shut-off or disconnected after normal working hours (8:00 A.M. to 5:00 P.M.) without notification to the Fire Department. The Fire Department shall be notified when the system is reactivated and put in service. (Ord. 24-1967)

(e) Threads. All threads provided for fire department connections, hose outlets or any other threads to be used for the connection of the fire department hose, shall be as required by the Fire Department.

(f) Signs. A sign shall be provided on the door of the entrance to the room housing the fire protection controls. The lettering for such sign shall be of a conspicuous color and shall be at least four (4) inches in height and shall read "Sprinkler Control Valves" and/or "Standpipe Control Valves," or other types of systems. (See Section 3805 (h) for additional signs.)

(g) Multiple Fire Protection Equipment. Where more than one fire protection system is installed in a building or structure, such systems shall be inter-connected in such a manner so that if one system is activated, all alarm systems will be activated.

(h) Multiple Extinguishing Systems. Where more than one (1) extinguishing system is installed in a building or structure, the systems shall be inter-connected in a manner that the fire department connection will serve all systems.

(i) Other Extinguishing Systems. A substitute extinguishing system may be installed in lieu of, or in addition to, a required system when approved by the Department and Fire Department.

(j) Maintenance. The owner, tenant or lessee of every building or structure shall be responsible for the care and maintenance of all fire protection systems, including equipment and devices, to insure the safety and welfare of the occupants. Fire protection systems, except range hood protections, shall not be disconnected or otherwise rendered unserviceable without first notifying the Fire Department. (See Section 3800 (d).) When installations of required fire protection systems are interrupted for repairs or other necessary reasons, the owner, tenant or lessee shall immediately advise the Fire Department and shall diligently prosecute the restoration of the protection. (See Chapter I for penalties.)

(k) Material and Equipment. All materials and equipment used in a fire protection system shall be approved, consistent with the requirements of this Building Code and the Standards as indicated in Section 3820.

(l) Plans. Plans shall be submitted in accordance with Chapter 3 of this Building Code and approved by the Department and the Fire Department.

Section 3801. DEFINITIONS. For purposes of this Chapter certain terms are defined as follows:
Approved. See Chapter 4.

Approved Extinguishing Agents. As approved by the Department and Fire Department.

Central Station System. An approved system of electrically supervised circuits employing a direct circuit connection between signalling devices at the protected premises and signal receiving equipment in a remote station, such as the Fire Alarm Headquarters or other location acceptable to the Fire Department.

Fire Alarm System. An approved integrally supervised system consisting of manual stations which will actuate audible and/or visual alarm signals throughout the building or structure.

Fire Detection System. An approved integrally supervised system of either smoke or heat responsive devices, so connected by wiring or tubing to operate an audible and/or visual alarm system throughout the building or structure and activate an annunciator or coded signal at a pre-determined location.

Fire Protection System. Shall include fire sprinkler systems, fire alarm systems, fire detection systems, standpipe systems, carbon dioxide systems, special extinguishing systems, audible and/or visual alarms, water supplies or other extinguishing media suitable for the specific purpose for which they are designed and installed.

Fire Sprinkler Systems. An arrangement of open or closed fire sprinkler heads, automatically or manually operated, attached to piping containing an approved extinguishing agent.

Grade. Shall be as determined in Chapter 4.

Standpipe System. A system of wet or dry piping, including the necessary appurtenances.

Window or Window Opening. Shall be the glazed surface opening and shall be at least twenty-four (24) inches in its smallest dimension. Window or window openings shall not be considered as such if covered or filled with any of the following:

1. Glass in excess of one-fourth (\(\frac{1}{4}\)) inch in thickness.
2. Safety glass.
4. Plastics when not approved for such use by the Department.

5. Metal bars exceeding one-fourth (\(\frac{1}{4}\)) inch in any cross sectional dimension.

Section 3802. FIRE SPRINKLER SYSTEMS.

(a) Where Required. Fire sprinkler systems shall be installed and maintained in full operating condition as specified in this Building Code, Chapter and the Standards herein, in the following locations:

1. In every story, cellar, basement, penthouse or roof structure of all buildings when there is not provided at least twenty (20) square feet of opening entirely above the adjoining grade level in each fifty (50) lineal feet or fraction thereof exterior wall in the story, cellar, basement, penthouse or roof structure, on at least two (2) sides of the building. Openings shall have a minimum dimension of not less than twenty-four (24) inches. Such openings shall not be obstructed in a manner that fire fighting or rescue cannot be accomplished from the exterior.

EXCEPTION: Where windows are provided in the exterior walls of cellars as indicated in Section (a) 2-B of this Section, and the floor area of such cellar exceeds fifteen hundred (1500) square feet, such cellar shall be provided with fire sprinklers in accordance with the requirements of Chapter 38.

2. For purposes of this Chapter, an opening shall qualify as follows:

A. Doors may be included in the determination of openings in exterior walls when such doors are provided with glass of a minimum dimension of twenty-four (24) inches. When such doors are provided with glass in excess of fifty (50) per cent, the entire door shall receive credit as if it were fully glazed.

B. Windows shall provide a glazed opening of not less than twenty-four (24) inches in its least dimension. Windows located below grade shall provide a masonry, concrete or metal (minimum 20 gauge) enclosing wall, the full depth of such window and four (4) inches above the surrounding ground level. A four (4) inch well below the bottom level of the window shall be provided and such shall be filled with masonry, concrete or
washed gravel. The minimum distance from all portions of the window, measured horizontally to the wall shall be at least four (4) feet.

3. When all sides of a building are less than fifty (50) feet in length, the required window areas may be in proportion to the actual length, provided the least dimension of the window or windows shall comply with other requirements of this Chapter.

4. In open parking or storage garages in the following areas:
   A. Those portions of such buildings or structures which exceed sixty-five (65) feet in height above grade.
   B. On levels below grade when required windows or openings are not provided.
   C. In hazardous areas within the building or structure.

5. In all buildings or structures housing Group E Occupancies, regardless of area.

EXCEPTION: Repair garages less than 1200 square feet.

6. Stages of any size in the following locations:
   A. Protection of the proscenium arch.
   B. Protection under the gridiron.
   C. Protection under the stage floor.
   D. Protection of all tie and fly galleries.
   E. Protection, without limitations, of all areas adjacent to the stage such as
      - Dressing rooms
      - Store rooms
      - Property rooms
      - Carpenter shops
      - Paint shops
      - Passageways

7. Under platform floors. (See Chapter 4 for definitions.)

8. Spray painting rooms, booths or shops, or any area where painting, brushing, dipping or mixing is regularly conducted using flammable materials.

9. Rooms or areas used for incineration, trash or laundry collection areas and at the top of all chutes.

10. In all existing buildings or structures where a fire hazard exists.

11. Underground or overhead passageways or tunnels which exceed six (6) feet in width or height and is more than ten (10) feet in length.

12. Unenclosed vertical openings between floors, where permitted by other Sections of this Building Code.

   A. Fire sprinklers shall be provided in the ceiling over escalators, and the sprinklers shall be spaced six (6) feet on center.

(b) Specific Areas.

1. In addition to the other requirements of fire sprinklers for stages, a line of open type fire sprinklers shall be installed on the stage side and immediately back of the proscenium arch or curtain, not more than five (5) feet above such arch and spaced not more than six (6) feet on center. The system shall be controlled by manually operated quick opening valves located on each side of the proscenium opening, not more than five (5) feet above the stage floor.

2. Where fire sprinklers are required for aircraft hangars, a deluge system shall be installed in accordance with Pamphlet 409, NFPA, as indicated in the Standards. (See Section 3820.)

(c) Partial Fire Sprinkler Systems. A maximum of ten (10) fire sprinkler heads may be supplied from the domestic system, provided that the water supply shall be adequate to supply such fire sprinklers. (See Standards, Section 3820.)

(d) Tags. A legible tag describing the use of the water control valve, as approved by the Department and Fire Department, shall be placed on the water control. The tag shall be of a distinctive red color.

(e) Water Supply. (See Section 3808.)

Section 3803. Formerly "FIRE SPRINKLER DETAILED REQUIREMENTS". (See Section 3802.)
Section 3804. FIRE SPRINKLER ALARMS.

(a) Connection and Location. Approved audible horn and visual light devices shall be connected to every fire sprinkler system and such alarm devices shall be located on the exterior of the building within twenty-five (25) feet of the fire department connection except where the fire department connection serves more than one building and is installed on a yard main. When such occurs, the alarm devices shall be located on the exterior of each building.

(b) Additional Alarms. Additional horn and/or light type devices shall be within visual and/or hearing distance of all areas within such building. (Ord. 24 — 1967)

(c) Not Required. Alarms and alarm attachments shall not be required for partial fire sprinkler systems. (See Section 3802 (c).)

Section 3805. FIRE DEPARTMENT CONNECTIONS. (See Section 3807 (e) for temporary standpipes.)

(a) Required. All fire sprinkler and standpipe systems shall be provided with at least one two-way fire department connection. Each inlet of the fire department connection shall be at least two and one-half (2½) inches in diameter. The pipe from the standpipe system to the hose connection shall in no case be smaller than four (4) inches. The pipe from the fire sprinkler system to the hose connection shall in no case be smaller than four (4) inches. Single fire department connections may be installed when such is approved by the Department and the Fire Department.

(b) Connections. Fire department connections shall be arranged in such a manner that the use of any one connection will serve all the fire sprinklers and standpipes within the building.

(c) Location. Fire department connections shall be located and be visible on a street front or in a location approved by the Department and Fire Department. Such connections shall be located so that immediate access can be made by the Fire Department. Obstructions such as fences, bushes, trees, walls or any other similar object, shall not be permitted for new or existing installations.

(d) Height. Fire department connections shall be not less than one foot six inches (1'6") and not more than three feet six inches (3'6") in elevation, measured from the ground level to the center line of the inlets.

(e) Projection. Where the fire department connection would project beyond the property line or into the public way, flush type fire department connections shall be provided.

(f) Hose Threads. Hose threads shall be fire department type and shall not be recessed.

(g) Fittings. Fire department inlet connections shall be fitted with check valves, ball and drip valves, caps and chains.

(h) Signs. A metal sign with raised letters at least one (1) inch in height, shall be mounted on all fire department connections serving fire sprinklers and/or standpipes. Such signs shall read "Automatic Sprinklers" and/or "Standpipe".

(i) Not Required. Fire department connection shall not be required for partial fire sprinkler systems. (See Section 3802 (c).)

Section 3806. STANDPIPE SYSTEMS.

(a) Where Required. Wet standpipes shall be installed in buildings or structures four (4) or more stories in height above grade, and shall be installed and maintained in full operating condition as specified in this Chapter and the Standards herein.

EXCEPTION: Open parking garages may provide dry standpipes in lieu of wet standpipes. Such standpipes shall conform to all the requirements of wet standpipes, except water supply.

(b) Location. Outlets shall be located within ten (10) feet of the opening of a required stairway but in no case shall the outlet be located in a stairway.

EXCEPTION: Where this Building Code permits a horizontal fire separation in a corridor, a standpipe and the required outlets shall be provided on each side of such separation. The standpipe outlets shall be located more than five (5) feet from either side of the fire separation. (See Chapters 18, 19, 20, and 21 for horizontal separation.)

(c) Distance. The maximum distance from the required standpipe outlets to any point of the building or structure shall not exceed one hundred (100) feet in the line of travel.

(d) Size.

1. Building or portions thereof having four (4) or more stories in height shall be equipped with one or more four (4) inch standpipes extending from the lowest portion of the building to a height five (5) feet above the finished floor of the topmost story.

2. Building or portions thereof having seven (7) or more stories shall be equipped with one or more six (6) inch standpipes.
extending from the lowest portion of the building to the roof. At least one (1), two and one-half (2½) inch fire department two-way connection shall be provided, connected to a standpipe, on each building roof top.

(e) Hose and Extinguishers. Hose shall not be required for standpipes as outlined in this Section. A two and one-half (2½) gallon approved water-air pressure type extinguisher shall be provided at each standpipe location, at each floor level.

(f) Material. Standpipes shall be constructed of standard wrought-iron, steel or Type L hard drawn copper pipe and fittings, as approved by the Department. Copper tube and fittings shall be joined with a low temperature brazing alloy. 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.

(g) Capacity. Standpipes of four (4) inch or six (6) inch size shall be capable of discharging a minimum of two hundred fifty (250) gallons per minute, or a minimum of five hundred (500) gallons per minute where more than one standpipe is required, with a residual pressure of at least thirty (30) psi at the highest outlet of each standpipe.

(h) Outlets.

1. At each floor level, and not more than six (6) feet above the floor, there shall be connected to each standpipe, a two and one-half (2½) inch hose valve with cap and chain. There shall also be connected to each standpipe, a one and one-half (1½) inch hose valve with cap and chain.

2. Where standpipes are required to extend through the roof, an approved hydrant or manifold shall be provided. The main control valve on a roof hydrant or manifold shall be located in a heated area and equipped with an automatic drain. Such valves shall be accessible and plainly marked. (See Section 3806 (d) 2.)

(i) Water Supply. (See Section 3808.)

Section 3807. STANDPIPES FOR BUILDINGS UNDER CONSTRUCTION OR DEMOLITION.

(a) General. Standpipes required by this Section may be temporary or permanent in nature, with or without a water supply; provided, however, that such standpipes shall remain in service until the permanent installation is complete and in service.

(b) Number Required. Every building or structure four or more stories in height, above grade, shall be equipped with one or more standpipes at least four (4) inches in diameter. A sufficient number of standpipes with hose(s) shall be provided so that every portion of the building can be reached therefrom. The hose shall be approved lined hose, at least one hundred (100) feet in length.

(c) Construction. Standpipes, either temporary or permanent in nature, shall be constructed of standard wrought-iron or steel or Type L hard drawn copper tube, and all pipe, fittings and valves shall be extra heavy pattern when the working pressure will exceed one hundred seventy-five (175) pounds per square inch.

(d) Height. The standpipe systems shall be carried up with each floor and shall be installed and ready for use as each floor progresses. Standpipes shall be not more than one floor below the highest forms or staging.

(e) Fire Department Connections. (See Section 3805.) At the street level there shall be provided for each temporary or permanent standpipe installation one or more two-way fire department inlet connections. Fire department inlet connections shall be prominently marked and readily and easily accessible at all times.

(f) Outlets. At each floor level, and on each standpipe, there shall be provided one — two and one-half (2½) inch hose outlet and one — two and one-half (2½) inch hose valve with cap and chain. At each floor level and on each standpipe there shall be provided one — one and one-half (1½) inch hose outlet and one — one and one-half (1½) inch hose valve with cap and chain. Outlets shall be located not more than six (6) feet above floor level.

(g) Standpipes for Buildings under Demolition. Where a building is being demolished, and a standpipe is existing within such building, such standpipe shall be maintained in an operable condition so as to be available for use by the Fire Department. Such standpipe shall be demolished with the building but in no case shall the standpipe be more than one floor below the floor above being demolished.

Section 3808. WATER SUPPLY AND OTHER EXTINGUISHING SUPPLY MEDIA.

(a) Required. All fire sprinkler systems and wet standpipes shall be provided with at least one (1) automatic water supply of adequate pressure, capacity and reliability. Other types of extinguishing media, as permitted by this Building Code, shall supply the extinguishing
material in quantities adequate to perform the function intended.

(b) Insufficient Pressure. When the City water pressure is insufficient to produce the required volume and pressures as required in this Chapter and Standards, an approved booster pump system of adequate capacity and pressure shall be installed and maintained in operating condition at all times.

(c) Booster Pumps. Booster pumps shall be of an approved type and shall have a rated capacity sufficient to produce and maintain the required volumes and pressures. Booster pumps shall be equipped with a controller which will provide both automatic and manual operation. Booster pumps taking suction from a street water main shall be installed on a bypass. 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. Booster pumps shall be installed in a separate non-combustible room or pump house of at least one-hour fire-resistive construction, with-floor drain and curbed door opening, or in a completely sprinklered area. All doors shall be equipped with a self-closing device and the doors shall be rated three-fourths (¾) hour fire-resistive.

(d) Combined Water Supply. Where both sprinklers and standpipes are installed, they shall have a common water main as their combined source of supply. The connection shall not be made to any City water main of less than four (4) inches in diameter. The common water supply for both standpipes and sprinkler systems shall be at least the largest connection required for either.

(e) Combination Domestic Water Supply. A fire sprinkler system may be connected to the domestic water supply system provided the supply system is of adequate pressure, capacity and size for the combined fire sprinkler system and domestic water needs. A check valve shall be installed in the fire sprinkler supply line to prevent contamination of the domestic water.

(f) Size. The water supply for complete or partial fire sprinkler systems shall be sized in accordance with Pamphlet 13, NFPA, in regard to the quantity of heads, as indicated in the Standards. (See Section 3820.)

(g) Standpipes.

1. Standpipes shall be connected to a street water main at least equal to the size of the largest standpipe within the building. The size of the water service at the base of the standpipe risers shall be at least the size of the largest standpipe.

Section 3809. FIRE DETECTION SYSTEMS.

(a) Where Required. A complete fire detection system shall be required, installed and maintained in all new and existing C and D Occupancies. (See Section 3815 for existing C and D Occupancies.)

EXCEPTION: Day nurseries and Group C Occupancies, when the occupant load does not exceed twenty (20) persons and the building is not more than one (1) story in height and is constructed of at least one (1) hour fire-resistive materials throughout.

(b) Approval. Fire detection system shall be approved for the particular application and shall be used for the detection and signalling in the event of fire only.

(c) Distances. Approved fire detecting devices shall be installed not to exceed the lineal or square footage allowances specified, based on the Standards as indicated in Section 3820.

(d) Not Required. A fire detection system may be installed in lieu of a fire sprinkler system when approved by both the Department and Fire Department. When a fire sprinkler system is installed in any building or area where a fire detection system was originally required, the detection system need not be provided. (Ord. 24 — 1967)

(e) Manual Pull Stations. Manual pull stations, conforming to the requirements of Section 3810, shall be installed in conjunction with fire detection systems.

(f) Power Supply. Electric power supply shall be provided from the most reliable source obtainable at the building. The power supply for fire detection systems shall be provided at a point ahead of the main disconnect.

(g) Detailed Requirements. All fire detection systems shall be of the closed circuit type and shall be electrically or mechanically supervised. In addition, such systems shall comply with the following:

1. All wiring shall conform to the requirements of Chapter 53 and NFPA Pamphlet No. 72 as indicated in the Standards. (See Section 3820.)
2. Audible alarms, of approved horn type, shall be provided. In Group D Occupan­cies, audible and visual alarms shall be provided.

A. The operation of any detection device shall cause all audible or visual alarms to operate.

B. Visual and audible alarms shall be provided in occupancies housing the hard of hearing.

C. Alarms sounding devices shall be horns of an approved type. They shall provide a distinctive tone and shall be used for no other purpose than that of a fire alarm. They shall be located so as to be effectively heard above all other sounds, by all the occupants, in every occupied space within the building.

3. A pre-signal system may be installed in Group D Occupan­cies. Pre-signal systems shall not be installed in other occupan­cies, unless approved by the Department and Fire Depart­ment.

A. Where a pre-signal system is installed, twenty-four (24) hour personnel supervision shall be provided at a location designated by the Fire Department in order that the alarm signal can be actuated in the event of fire or other emergency.

4. Each floor shall be zoned separately. If the floor area exceeds twenty thousand (20,000) square feet, additional zoning shall be provided. In no case shall the length of any zone exceed two hundred (200) feet in any direction.

A. Zoning indicator panels and controls shall be located as approved by the Department and Fire Depart­ment. Annunciators shall lock in until the system is re-set.

5. All systems shall be tested semi-annually.

A. Accurate logs shall be maintained on the premises indicating box numbers, location and type of devices tested. Any defect, modification or repair shall be logged and shall be available to the Fire Department.

(a) Where Required. A fire alarm system shall be required, installed and maintained in all new and existing A, B, C, D, and H Occupan­cies. (See Section 3815 for existing build­ings.)

EXCEPTIONS:

1. H Occupan­cies when less than 5 stories in height.

2. Churches.

3. Day nurseries and Group C Occupan­cies, when the occupant load does not exceed twenty (20) persons and the building is not more than one story in height and is constructed of at least one (1) hour fire-resistant materials.

(b) Approval. Manual pull stations shall be approved for the particular application and shall be used for fire protective signaling purposes only. Alarm boxes shall be painted a distinctive red color.

(c) Detailed Requirements. Fire alarm sys­tems shall be of the closed circuit type and shall be electrically or mechanically supervised. In addition, such systems shall comply with the following:

1. All wiring shall conform to the require­ments of Chapter 53 and NFPA Pam­phlet No. 72 as indicated in the Stand­ards. (See Section 3820.)

2. Audible alarms, of the approved horn type, shall be provided. In Group D Occu­pan­cies, audible and visual alarms shall be provided.

A. The operation of any fire alarm de­vice shall cause all audible or visual alarms to operate.

B. Visual and audible alarms shall be provided in occupancies housing the hard of hearing.

C. Alarm sounding devices shall be horns of the approved type. They shall provide a distinctive tone and shall be used for no other purpose than that of a fire alarm. They shall be of such character and so located as to be effectively heard above all other sounds, by all the occupants, in every occupied space within the building.

3. A pre-signal system may be installed in Group D Occupan­cies. Pre-signal sys­tems shall not be installed in other occ-
cupancies, unless approved by the Department and Fire Department.

A. Where a pre-signal system is installed, twenty-four (24) hour personnel supervision shall be provided at a location designated by the Fire Department, in order that the alarm signal can be actuated in the event of fire or other emergency.

4. The height of manual pull station boxes shall be not more than six (6) feet and not less than four and one-half (4½) feet, measured vertically from the floor level.

5. Each floor shall be zoned separately. If the floor area exceeds twenty-thousand (20,000) square feet, additional zoning shall be provided. In no case shall the length of any zone exceed two hundred (200) feet in any direction.

A. Zoning indicator panels and controls shall be located as approved by the Department and Fire Department. Annunciators shall lock in until the system is re-set.

6. All systems shall be tested semi-annually.

A. Accurate logs shall be maintained on the premises indicating box number, location and type of device tested. Any defect, modification or repair shall be logged and shall be available to the Fire Department.

(d) Location. Manual pull stations shall be located in each corridor of each story, basement or cellar, so that from each corridor door, not more than one hundred (100) feet will be traversed in order to reach a manual station. Stations shall be located as near as possible, and not more than five (5) feet from each stair exit. Where corridors are not provided, manual stations shall be located so that no point in the building is more than one hundred (100) feet from a station. Where a stage is provided, a manual pull station shall be located adjacent to the lighting control panel. Manual pull stations shall be located at or near each exit from the building.

(e) Coding. Coded stations shall be coded in conformance with the particular Standard(s) as indicated in Section 3820 (Standards).

(f) Power Supply. Electric power supply shall be provided from the most reliable source obtainable at the building. The power supply for the fire detection systems shall be provided at a point ahead of the main disconnect.

Section 3811. CARBON DIOXIDE (CO₂) AND DRY CHEMICAL SYSTEMS.

(a) Where Required. CO₂ or dry chemical systems shall be required and installed in range hoods and connecting duct systems where used in conjunction with frying and cooking operations in all food preparation centers within any Group A through H Occupancy.

EXCEPTIONS:

1. Single story new or existing restaurants, Group F Occupancy, with an occupant load of less than fifty (50), as determined by Table 33-A of this Building Code.

2. Churches, when the food preparation center is not used more than eight (8) hours per week.

3. Schools, when the food preparation center is not used more than eight (8) hours per week.

4. Dwelling units.

(b) Definitions. For purposes of this Section, the following definitions shall apply:

CO₂ shall mean carbon dioxide gas.

Dry Chemical shall mean any approved dry chemical used for extinguishing fires.

(c) Detailed Requirements. (General). All required systems shall comply with the following including an operational test:

1. Where natural or liquified petroleum gas is used in conjunction with cooking appliances, a manual reset safety valve shall be installed on the gas service line to prevent the gas from flowing into the burner or pilot in the event of failure or shutdown.

2. A manual station controlling the extinguishing system shall be located at or near one of the exits from the area, and in no case nearer than ten (10) feet from the range hood unless approved by the Department.

3. Manual stations shall be securely mounted not less than four and one-half (4½) feet or more than six (6) feet from the floor.

4. All range hoods and duct systems equipped with fire extinguishing systems as required by this Section shall provide both automatic and manual actuation and at least one alarm device.
5. The system shall be maintained in full operating capacity as required by this Building Code and shall be serviced every six months. A sign posted adjacent to the station shall indicate the operation of the system.

6. All nozzles shall be accessible for cleaning and replacement.

(d) Detailed Requirements (CO₂) Systems.
In addition to the requirements of this Chapter, the following shall apply:

1. CO₂ systems shall be approved and installed in accordance with requirements of this Section, and where applicable, in accordance with the Standards herein. (See Section 3820.)

2. Where multiple hoods are served, each hood shall provide a separate actuator and a separate CO₂ supply.

3. The area of any hood shall be calculated on the basis of a square or rectangle, regardless of shape.

4. Total CO₂ requirements for hoods shall be calculated on the following accumulative basis:
   - A. Open area of hood (sq.ft.) ÷ 0.6 = pounds of CO₂.
   - B. Volume of hood (cu.ft.) (minimum depth of 2 feet) ÷ 8.0 = pounds of CO₂.
   - C. Hoods located over liquid surface operations. Liquid surface area (sq. ft.) ÷ 0.4 = lbs. CO₂ (10 lbs. minimum).
   - D. Volume of plenum (cu.ft.) ÷ 8.0 = pounds of CO₂.
   - E. Volume of duct to fire damper (cu. ft.) ÷ 8.0 = pounds of CO₂.
   - F. Duct above fire damper, minimum 10 lbs. of CO₂.
   - G. In addition to the calculations, an additional ten (10) pounds of CO₂ shall be provided as a safety factor.

5. Upon activation of the extinguishing system, the fan(s) shall cease to operate; the gas valve shall shut the pilot and burner(s) off; and the fire damper shall actuate into the closed position.

6. Duct systems from range hoods shall be equipped with approved fire dampers unless as otherwise approved by the Department. Pneumatic closing devices shall be installed on all fire dampers. (See Chapter 52.)

7. CO₂ storage bottles shall be located at least fifteen (15) feet from the range or range hood. In no case shall the temperature in the storage area exceed one hundred twenty (120) degrees Fahrenheit or be less than thirty-two (32) degrees Fahrenheit.

8. Where a CO₂ system is installed, an electric warning light of ten (10) watts or more shall be provided on the CO₂ bottle or system which will illuminate when the bottle or system is depleted. The light shall be of a distinctive red color and shall be located in a conspicuous location.

(e) Detailed Requirements (Dry Chemical).
In addition to the applicable requirements of this Chapter, the following shall apply:

1. Dry chemical systems shall bear the label of approval of an approved recognized testing laboratory, shall be installed in accordance with such laboratory specifications, and shall be approved by the Department and Fire Department.

2. The size of hood and duct covered by single system shall not exceed the testing laboratory specifications.

3. Dry chemical agent used shall be non-toxic.

4. Multiple hoods may be protected by common system if in conformance with an approved recognized testing laboratory specifications.

5. Fire dampers and fan shut-off switches shall not be permitted.

   EXCEPTION: Multi-story building served by common exhaust duct shall be fire dampered at each hood or as required by the Department. (See Chapter 52.)

6. Dry chemical bottles shall be located at least fifteen (15) feet from range or range hood, or as approved by the Department and Fire Department.

7. A ten (10) pound approved portable Type CO₂ extinguisher shall be provided and located not more than fifteen (15) feet and not less than ten (10) feet from the hazard.
Section 3812. FIRE HYDRANTS. Fire hydrants installed on public or private property shall be located and installed as directed by the Fire Department. Hydrants shall conform to the standards of the City Board of Water Commissioners and the Fire Department. Hydrants shall not be installed on a water main of less than six (6) inches in diameter. All hydrants shall be painted in conformance with the requirements of the City Board of Water Commissioners.

(Ord. 24 — 1967)

Section 3813. SERVICE STATIONS INSIDE BUILDINGS.

(a) Where Required. A carbon dioxide system shall be installed where gasoline pumps are located inside any building or structure.

(b) Detailed Requirements. The system shall be controlled by a device with a thirty (30) second delay and shall be equipped with an audible and visual 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.

Section 3814. CENTRAL STATIONS.

(a) Central Stations Required. All required fire protection systems shall be connected to an approved central station; or the City alarm signaling system, when approved by the Fire Department.

Section 3815. EXISTING BUILDING COMPLIANCE. (Fire Detection and Alarm Systems).

(a) Legal. This Chapter of the Building Code shall become in force upon final passage of this Ordinance by City Council.

EXCEPTION: The requirements in the following Sections for existing buildings or structures shall be completed not later than January 1, 1973:

Section 3809 — Fire Detection System
Section 3810 — Fire Alarm System

Section 3820. STANDARDS. Unless as otherwise provided for in other portions of this Building Code, the following Standards shall apply.

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<tr>
<td>USASI</td>
<td>Wrought-Copper and Bronze Solder Joint Pressure Fittings, B-16.22, 1963</td>
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<td>Foam Water Sprinkler and Spray Systems, Pamphlet 16, 1964</td>
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<td>NFPA</td>
<td>Supervision of Valves, Pamphlet 26, 1958</td>
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<td>NFPA</td>
<td>Aircraft Hangars, Pamphlet 409, 1967</td>
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Legend:

USASI  United States of America Standards Institute  
       10 East 40th Street  
       New York, New York 10016  

ASTM  American Society for Testing and Materials  
       1916 Race Street  
       Philadelphia, Pa. 19103  

NFPA  National Fire Protection Association  
       60 Batterymarch Street  
       Boston, Mass. 02110  

(Entire Chapter Revised — Ord. 545-1966)
CHAPTER 39
STAGES AND PLATFORMS

Section 3900. SCOPE.

In addition to the other requirements of this Building Code, this Chapter shall govern the requirements for stages and platforms.

Section 3901. STAGES AND PLATFORMS DEFINED.

See Chapter 4.

Section 3902. GRIDIRONS.

Gridirons, fly galleries, and pinrails shall be constructed of incombustible materials but protection of steel and iron members may be omitted. Gridirons and fly galleries shall be designed to support the live loads as indicated in Chapter 23.

1. Each loft block well shall be designed to support two-hundred and fifty (250) pounds per lineal foot and the head block well shall be designed to support the aggregate weight of all the loft block wells served. The head block well shall be provided with an adequate strongback or lateral brace to offset torque.

2. The main counterweight sheave beam shall be designed to support a horizontal and vertical uniformly distributed live load sufficient to accommodate the weight imposed by the total number of loft blocks in the gridiron. The sheave blocks shall be designed to accommodate the maximum load for the loft blocks served with a safety factor of five (5).

Section 3903. ROOMS ACCESSORY TO STAGE.

Rooms accessory to a stage shall be separated from each other by at least a one-hour incombustible fire separation.

Section 3904. PROSCENIUM WALLS.

(a) Construction. Stages shall be completely separated from the auditorium by a proscenium wall of at least one (1) hour incombustible construction. The proscenium wall shall extend to the underside of the roof deck over the auditorium. (See Chapter 38 for fire sprinklers under stages.)

(b) Openings. All openings other than proscenium openings, shall be protected with fire dampers as required in Chapter 52.

Section 3905. STAGE FLOORS.

(a) Construction. All portions of stage floors shall be of Type I construction except that portion of the stage which extends back from and six (6) feet beyond the full width of the proscenium on each side, which may be constructed of steel or heavy timbers covered with a wood floor of at least two (2) inches nominal thickness. No portion of the combustible construction, except the floor finish, shall be carried through the proscenium opening. All portions of the stage floor shall be designed as prescribed in Chapter 23.

(b) Openings. Openings through stage floors shall be equipped with tight-fitting trap doors of wood at least two (2) inches in nominal thickness.

Section 3906. PLATFORMS.

(a) Construction. Walls and ceilings of an enclosed platform, in an assembly room, shall be constructed of at least one-hour fire-resistant materials. (See Chapter 38 for fire sprinklers under platforms.)

(b) Accessory Rooms. Rooms accessory to a platform shall be separated from each other by at least a one-hour fire-resistant separation.

Section 3907. STAGE EXITS.

At least one continuous exit, not less than thirty-six (36) inches in width, shall be provided from each side of the stage, opening directly or by means of a passageway, to a street or exit court.

1. An exit stair, at least two feet six inches (3'6") wide, shall be provided for egress from each fly gallery.

2. Each tier of dressing rooms shall be provided with at least two (2) means of egress and each shall be at least two feet six inches (2'6") in width.

3. Stairs required in this Sections need not be enclosed.

4. Stairs shall be constructed as specified in Chapter 33.

Section 3908. SWITCHBOARD.

An incombustible protecting hood shall be provided over the full length of the stage switchboard.
Section 3909. FLAME-RETARDING REQUIREMENTS.

Combustible scenery, drops, props, decorations, or other combustible effects shall not be placed or utilized on any stage or enclosed platform unless the materials have been treated with an effective fire-retardant solution. All materials shall be maintained in a non-flammable condition as approved by the Fire Department.

Section 3910. FIRE PROTECTION SYSTEMS.

Fire protection systems shall be installed as required in Chapter 38.

(Entire Chapter Ord. 94 — 1968)
CHAPTER 40
MOTION PICTURE MACHINE
ROOMS OR BOOTHS
July 1971

Section 4000. GENERAL.
(a) General. In addition to the other require-
ments of this Building Code, this Chapter shall
 govern the requirements for Motion Picture Ma-
chine Rooms or Booths.
(b) Scope. The provisions of this Chapter
shall apply only where ribbon type motion
picture film, larger than 8mm. is used or is
intended to be used. (See Chapter 53 for
electrical requirements).
(c) Projection Room Required. Every motion
picture machine, using ribbon type film as set
forth in this Chapter, together with all electrical
devices, rheostats, and machines, located in any
Group A, B, and C Occupancy shall be inclosed in
a projection room of a size which will permit the
operator access to all parts of the machine.

Section 4001. CONSTRUCTION.
(a) Construction. Every projection room or
booth shall be constructed of incombustible ma-
terials throughout.
(b) Ceilings. The ceiling shall provide a height
of at least seven (7) feet from the finished floor.
(c) Floor Area. The room or booth shall pro-
vide a floor area of at least eighty (80) square
feet. Forty(40) square feet shall be provided for
each additional machine in excess of one.

Section 4002. EXITS. (See Chapter 33).

Section 4003. VENTILATION. (See Chapter 52).

Section 4004. SANITARY FACILITIES. San-
itary facilities shall be required in all motion
picture machine rooms or booths except those located in churches or schools. (See
Chapter 50).

Section 4005. FLAMMABLE FILM. The use or
storage of flammable film (for example nitro-ce-
lulose), in any new or existing Group A through H
Occupancy buildings, is hereby prohibited.

Section 4010. STANDARDS.
Unless as otherwise specified in other por-
tions of this Building Code, the following stand-
ards shall apply:

Organziation    Title of Publication
USASI    Specifications for Safety Photographic
Film, Pamphlet PH 1.25—1965

Legend
USASI    United States of America Standards In-
stitute
10 East 40th Street
New York City, N.Y. 10016
CHAPTER 41
DOMESTIC APPLIANCES

Section 4101. GENERAL.

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, repair and replacement of domestic appliances as herein defined.

(b) Water Supply Connection. All connections made to a potable water supply system, including water by-passes for water conditioning appliances, for purposes of installing, altering, repairing or replacing appliances, as herein defined, shall conform to the provisions of this Chapter and, where applicable, with Chapter 50 of this Building Code.

Section 4102. DEFINITIONS.

The following words, phrases, terms and their derivatives shall be interpreted as set forth in this Section.

Air Break (drainage system). A piping arrangement in which a drain from an appliance discharges indirectly into a plumbing fixture at a point below the flood level rim of such fixture.

Air Gap (drainage system). The unobstructed vertical distance through the free atmosphere between the domestic appliance waste pipe outlet and the flood level rim of the receptacle into which it is discharging.

Air Gap (water distribution system). The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to the domestic appliance and the flood level rim of the receptacle.

Anchors. (see supports).

Approved. (see Chapter 4).

Backflow. The flow of water or other liquids, mixtures or substances into the distributing piping system of potable water from any source other than its intended source.

Back-siphonage is one type of backflow.

Backflow Preventor. A backflow preventor is a device or means to prevent backflow.

1. Atmospheric Type — (Vacuum Breaker — Atmospheric): A device designed for installation in a water line, without any control valves downstream, to close against its inlet seat and introduce air into its outlet side when water ceases to flow through it.

2. Pressure Type — (Vacuum Breaker — Pressure): A device designed for installation in a water line, to close against its inlet seat and introduce air into its outlet side when inlet water pressure drops below the outlet water pressure.

3. Reduced Pressure Zone Type: An assembly of differential valves and check valves including an automatically opened spillage port to the atmosphere.

Back-Siphonage: The flowing back of used, contaminated, or polluted water from a plumbing fixture, or other sources into a potable water supply pipe due to a negative pressure in such pipe.

Connection to Water Supply System shall not be construed to include connections to existing faucets.

Drainage System. A drainage system means and includes all piping within public or private premises which conveys sewage, storm water, or other liquid waste, and includes the building sewer.

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-section area.

Flood Level. The flood level in reference to an appliance or fixture means the level at which water begins to overflow from the top or rim of the appliance or fixture.

Flood Level Rim. The flood level rim is the top edge of the receptacle from which water overflows.

Ice Makers shall mean any type of refrigeration which is connected to the water supply for the purpose of making ice.

Indirect Waste Pipe. A waste pipe which does not connect directly with a drainage system, but which
discharges into the drainage system through an air break or air gap, into a trap, plumbing fixture, receptor, interceptor, or other approved point of disposal.

**Repair or Replacement** shall include the repair or replacement of domestic appliances as defined in this Chapter. In addition, repair or replacement shall include garbage disposal units and dishwashers where they are connected directly to the sanitary sewer system, including the necessary replacement of tail pipes and traps. This shall not be construed to include the providing of additional openings into or the relocation of existing openings to another location in the sanitary drainage system.

**Receptor.** A plumbing fixture which is intended to receive the discharge from indirect waste piping, is directly connected to the drainage system and is properly trapped and vented and which is installed as provided for in Chapter 50.

**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.

**Supports, Hangers and Anchors.** Supports, hangers and anchors are devices for securing pipes, appurtenances and devices to walls, ceilings or floors.

**Used.** Used, when applied to material, or equipment, means removed from previous installations.

**Vacuum Breaker.** See Backflow Preventer.

**Water Conditioning Appliances.** The term water conditioning appliances shall include equipment which is not connected to a drainage system or is only indirectly connected to a drainage system and which is designed to soften or otherwise treat water: including necessary water by-passes.

**Domestic Appliances** shall mean any and all apparatus and equipment where the same is connected to a potable water supply system and which is not connected to a drainage system or is only indirectly connected to a drainage system, as herein defined and shall include the following:

1. Clothes Washing Machines. (Capacity not to exceed 20 lbs.)
2. Dishwashing Machines. (For Dwelling Unit use only)
3. Evaporative Coolers. (Window and free standing type only)
4. Humidifiers. (Free standing type only)
5. Ice Making Machines. (Dwelling Unit use only)
6. Water Conditioning Appliances which are provided with a maximum capacity of 120,000 grains. (Excludes a direct connection to the closed portion of a steam or hot water heating system)
7. Water Heaters. (Not in excess of 80 gallons water storage capacity; not in excess of 76,000 BTU input rating; and does not include gas or venting)

**EXCEPTION:** This definition (Domestic Appliances) shall, for purposes of repair and replacement, include garbage disposers, dishwashing and clothes washing machines directly connected to the drainage system.

**Water Distributing Pipes.** A water-distributing pipe in a building is a pipe which conveys water from the water service pipe to the domestic appliance, plumbing fixtures branch or other plumbing outlets.

**Water Service Pipe.** Water service pipe is the pipe from the water main or other source of water supply to the building served.

**Water Heaters.** The term water heater shall include those which provide a water storage capacity not to exceed eighty (80) gallons; provides a BTU input capacity not to exceed 76,000; and is not used primarily for building heating purposes.

**Water Supply System.** The water supply system of a building consists of the water distributing pipes, and the necessary connecting pipes, fittings, control valves, and all appurtenances on a particular premise.

Section 4103. GENERAL REQUIREMENTS.

(a) **Installation.** All appliances shall be installed in a manner to afford access for cleaning, repair and replacement.

(b) **Vertical Pipe Supports.** Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents but in no case less than at every other story height.

(c) **Hanger and Anchors.** Hangers and anchors shall be metal of sufficient strength to support the pipe and its contents and shall be attached to the building construction.

(d) **Openings.** Openings through walls, floors and ceilings shall be filled with incombustible materials.

Section 4104. JOINTS AND CONNECTIONS

(a) **Watertight.** All joints and connections shall be made watertight.

(b) **Threaded Joints.** All burrs shall be removed. Pipe ends shall be reamed out to the size of the bore, and all chips shall be removed. Pipe joint cement shall be permitted on male threads only.

(c) **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.
(d) Flared Joints. All flared joints for soft-copper water tubing shall be made with approved fittings. The tubing shall be expanded with a proper flaring tool.

(e) Slip Joints. Slip joints shall not be concealed.

(f) Ground Joints. Ground joint brass connections which allow adjustment of tubing but provide a rigid joint when made up shall be considered as slip joints.

Section 4105. AIR GAPS, AIR BREAKS AND PREVENTORS.

(a) Protection of Water Supply. All appliances, except water heaters and water conditioning appliances, shall be supplied with water through an air gap or air break or shall be provided with a backflow preventor, conforming to the following:

1. Air Gap. The minimum required air gap shall be measured vertically from the end of the faucets, spout, or supply pipe down to the flood level rim of the fixtures or vessel.

A. The minimum required air gap shall be twice the diameter of the effective opening.

2. Backflow Preventor. Atmospheric-type backflow preventors, where required, shall be installed between the control valve and the appliance so the preventor will not be subjected to water pressure except the back pressure incidental to water flowing to the appliance.

A. Backflow preventors shall be constructed of corrosion-resistant material of design and proportions which will not deteriorate or deform under reasonable service conditions.

3. Air Break. The water discharge from a portable appliance into a plumbing fixture may be through an air break.

Section 4106. WASTE OUTLETS.

(a) General. Waste from appliances shall be discharged into open plumbing fixture or receptor, properly trapped, vented and connected to the drainage system, or if located below the building drain, as defined in Chapter 50, such appliances may discharge to a sump. Discharge from devices, other than plumbing fixtures, supplied with potable water through an air gap or an approved vacuum breaker or discharge from devices producing condensate and not subject to a vacuum, at times, which could cause back-siphonage, may discharge through an air break. Clear water waste may also discharge to an approved dry well or to other approved point of disposal.

(b) Prohibited Waste. Toxic, corrosive, flammable, or explosive substance, or other liquid, vapor, gas or substance of any kind, harmful to the drainage system, shall not discharged into a plumbing fixture.

(c) Standpipe for Clothes Washing Machine. A standpipe may be used as a receptor when installed as provided for in Chapter 50.

Section 4107. WATER SUPPLY AND DISTRIBUTION.

(a) Protection Against Freezing. All piping, tanks, appliances and devices, where subject to freezing temperatures, shall be effectively protected.

(b) Water Pipes, Tubing and Fitting. Water supply and discharge piping used for appliances shall consist of brass, copper, lead, cast iron, wrought iron, open-hearth iron, or steel or NSF approved plastic pipe, with appropriate approved fittings; provided, however, approved type flexible connections with a shut off valve ahead of such connection shall be permitted for use as water supply and flexible discharge piping shall be permitted also for appliances which are portable or subject to vibration. All threaded ferrous pipe and fittings shall be galvanized (zinc-coated) or cement lined.

(c) Drainage of Water Pipes. All water supply pipes shall be so graded or pitched that the entire system or parts thereof can be drained.

(d) Sizing Water Piping. Water supply pipes for appliances shall be not less in size than the water connection of such units, provided washing machines require not less than one-half (1/2) inch lines and that the pressure at the appliance connection be not less than 8psig flowing pressure.

Section 4108. TEMPERATURE PRESSURE RELIEF VALVES.

(a) General. Approved combination temperature-pressure relief valves or separate temperature and pressure relief valves, shall be installed on closed water systems. Combination temperature-pressure or individual temperature relief valves shall be of the thermostatic self-closing type. The pressure side of the valve shall be set to relieve at a minimum of one hundred and sixty five (165) pounds per square inch (psi). The temperature side of the valve shall be set to relieve at two hundred fifty (250) degrees Fahrenheit, and shall be capable of discharging sufficient hot water to prevent any further rise in temperature within the water heater. All temperature relief valves shall provide a relief capacity equal to or greater than the rated BTU input of the water heater.

(b) Outlet Waste. The outlet of temperature and pressure relief valve shall not be connected to the drainage system as a direct waste. The discharge pipe from temperature and pressure relief valves shall be piped so as to drain into a receptor, sump, open fixture or other disposal location as approved by the Department.

(c) Location. Thermostatic self-closing type combination temperature pressure relief valves shall be placed within six (6) inches of the top of the tank, or directly above the tank on the hot water side and in no case more than three (3) inches away from...
such tank. Required vacuum-relief valves shall be placed as close to the tank as possible. There shall be no check valve or shutoff valve between a relief valve and the heater or tank for which it is installed.

(d) **Size of Outlet.** The cross-section area of the relief waste shall be equal to or greater than that of the discharged outlet.

**Section 4109. USED MATERIALS AND WATER HEATERS.**

(a) **Approval.** Used materials and water heaters shall not be permitted unless as otherwise approved by the Department.

(b) **Potable Water Piping Material.** Material that has been used for other than potable-water supply shall not be used for pipe, tubing, or fittings in a potable-water supply system.

**Section 4110. MATERIALS.**

All materials, appliances and heaters shall be approved and used in accordance with limitations imposed throughout this Building Code and shall meet established technical standards of quality and strength necessary to produce reasonable safe and sanitary installations.

**Section 4115. STANDARDS.**

Unless otherwise provided for in other Sections of this Building Code, the following standards shall apply.

(1) In addition, those applicable standards listed in the Standards Section of Chapter 50 of this Building Code.

**Section 2. Emergency.** The Council hereby finds and declares that this ordinance, amendatory to the Building Code, is necessary to the immediate preservation of the public health and public safety, declares that it is enacted for these purposes, and determines that it shall take effect immediately after final passage and publication.
CHAPTER 42
INTERIOR FINISH

Section 4200. GENERAL

(a) Scope. In addition to the other requirements of this Building Code, the provisions of this Chapter shall govern interior finishes in all buildings, structures or utilities. For purposes of this Chapter, interior finish shall mean interior wainscoting, paneling or other finish applied structurally or for decoration, acoustical correction, surface insulation or similar purposes. Pyroxylin or similar finishes shall not be applied, which as dry films produce excessive smoke or toxic fumes when exposed to fire.

(b) Non-Applicable. Requirements for finishes shall not apply to trim, doors, windows or their frames, nor to materials which are less than one-twenty-eighth (1/28) inch (0.036) in thickness cemented to the surface of walls or ceilings, when such materials have flame-spread characteristics no greater than paper of this thickness cemented to an incombustible backing.

Section 4201. TESTING AND CLASSIFICATION OF MATERIALS

(a) Testing. Tests shall be made by an approved testing agency to establish flame-spread characteristics and to show that materials when cemented or otherwise fastened in place will not readily become detached when subjected to room temperatures of 300°F. for 25 minutes. Flame-spread characteristics shall be determined by the standards herein. (See Section 4212).

(b) Classification. The classes of materials based upon their flame-spread characteristics shall be as set forth in Table No. 42-A.

Section 4202. APPLICATION OF CONTROLLED INTERIOR FINISH

(a) Interior finish materials applied to walls and ceilings shall be tested as specified in this Chapter and regulated for purposes of limiting flame-spread by the following provisions:

1. When walls and ceilings are required by any provision in this Building Code to be of fire-resistive or incombustible construction, the finish material of any class shall be applied directly against such fire-resistive construction or to furring strips not exceeding one and three-fourths (1 ¾) inches applied directly against such surfaces. The intervening spaces between such furring strips shall be filled with inorganic or Class I material or shall be fire-stopped as specified in Chapter 25 of this Building Code.

2. Where walls and ceilings are required to be of fire-resistive or incombustible construction and walls are set out or ceilings are dropped distances greater than specified in paragraph 1 of this Section, Class I finish materials shall be used except where the finish materials are protected on both sides by automatic fire-extinguishing systems or are attached to an incombustible backing or to furring strips installed as specified in paragraph 1. The hangers and assembly members of such dropped ceiling that are below the main ceiling line shall be of incombustible materials. The construction of each set-out wall shall be of fire-resistive construction as required elsewhere in this Building Code. See Chapter 25 for fire-stopping.

3. 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 installed and fire-stopped as specified in paragraph 1.

4. All interior wall or ceiling finish other than Class I materials which is less than one-fourth (¼) inch thick shall be applied directly against an incombustible backing unless the qualifying tests were made with the material suspended from the incombustible backing.

Section 4203. FINISHES BASED ON OCCUPANCY

(a) The minimum flame-spread classification of interior finish, as determined by tests under the standards of this Chapter, shall be based on use or occupancy as set forth in Table No. 42-B.

EXCEPTIONS: 1. Except in Group D Occupancies, and in enclosed vertical exitways, Class II may be used in other

exitways and rooms on wainscoting extending not more than forty-eight (48) inches above the floor and for tack and bulletin boards covering not more than five percent of the gross wall area of the rooms.

2. Where approved full-fire-extinguishing system protection is provided, the flame-spread classification rating may be one classification higher but in no case shall materials having a classification greater than Class III be used.

3. The exposed faces of Type III H-T structural members and Type III H-T decking and planking, where otherwise permissible under this Building Code, are excluded from flame-spread requirements.

Section 4204. DRAPERIES, BLINDS AND DECORATIONS

(See Chapter 5).

Section 4210. TABLES

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<tbody>
<tr>
<td>MINIMUM INTERIOR FINISH CLASSIFICATION</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupancy Group</th>
<th>Enclosed Vertical Exitway</th>
<th>Other Exitways</th>
<th>Rooms or Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>I</td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>B</td>
<td>I</td>
<td>II</td>
<td>III*</td>
</tr>
<tr>
<td>C</td>
<td>I</td>
<td>II</td>
<td>III*</td>
</tr>
<tr>
<td>D</td>
<td>I</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>E</td>
<td>I</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>I</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>I</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>No restrictions</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>I</td>
<td>No restrictions</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>J</td>
<td>No restrictions</td>
<td>II</td>
<td>III</td>
</tr>
</tbody>
</table>

*No room or area shall contain more than five thousand (5000) square feet of Class III material.
Section 4212. STANDARDS

Unless otherwise specified in other portions of this Building Code, the following standard shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>Method of Test for Surface Burning Characteristics of Building Materials, Pamphlet E 84-67</td>
</tr>
</tbody>
</table>

Legend:

ASTM American Society for Testing and Materials
1916 Race Street, Philadelphia, Pa. 19103
CHAPTER 43
FIRE-RESISTIVE STANDARDS

Section 4300. GENERAL

In addition to all the other requirements of this Building Code, fire-resistant materials shall meet the requirements for fire-resistant construction given in this Chapter.

Section 4301. 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 4301 (b), and shall conform to the standards in this Chapter.

(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. Only material or assembly of materials of construction tested in accordance with the requirements set forth in ASTM Standard E-119 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 111.

(c) Lath. Gypsum lath shall be at least three-eighths (3/8) inch in thickness and shall be perforated with holes at least three-fourths (3/4) inch in diameter, except where plain or a Type X lath or fire resistive gypsum lath is required. Perforated gypsum lath shall have one hole for not more than each sixteen (16) square inches of lath surface. Application shall be as specified in Chapter 47.

(d) Plaster. Plaster shall be gypsum or portland cement plaster at least one-half (1/2) inch thick and shall conform to Chapter 47.

(e) Concrete.

1. Grade A concrete is concrete in which at least 60 per cent of the coarse aggregate consists of pumice, limestone, calcerous gravel, trap rock, blast furnace slag, or burned clay or shale.

2. Grade B concrete is concrete in which at least 60 per cent of the coarse aggregate consists of granite, sandstone, cinders, or a mixture of any of these aggregates with aggregates for Grade A concrete.

3. Grade C concrete is any concrete not classified as Grade A or B.

4. Light weight aggregate concrete is concrete in which the aggregate is a rotary kiln expanded shale aggregate. The maximum permissible unit weight shall be one hundred and ten (110) pounds per cubic foot.

5. 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 4302. PROTECTION OF STRUCTURAL MEMBERS

(a) Protective Coverings.

1. Thickness of Protection. The thickness of fire-resistive materials for protection of structural members shall be at least 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 embedded in each transverse joint, where joints are more than sixteen (16) inches apart, and shall be spaced not more than sixteen (16) inches in other cases. Soffit tile protecting beam and girder flanges shall be secured to the flange. Metal 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 (6) inches wound around or attached to the member. The sum of the cross-sectional area in each direction shall be at least 0.025 square inches per foot.

4. **Embedment of Pipes.** Conduits and pipes shall not be embedded within the required thickness of fire protection of structural members.

5. **Column Jacketing.** Where the fire-resistive 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 (6) feet from the floor with an adequate protective covering.

6. **Ceiling Protection.** Where a ceiling is used for fire protection of floors or roofs, the construction and their supporting structural members (beams and girders) need not be individually fire protected except where such members support loads from more than one floor or roof. Ceilings shall be continuous, but may have openings for combustible pipes, ducts, and electrical outlets. The areas of pipes and outlet openings through the ceiling shall aggregate not more than one hundred (100) square inches in each one hundred (100) square feet of ceiling area. All duct openings in such ceiling shall be protected by approved fire dampers. (See Chapter 52).

(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 (1) inch of the surface of the fire protection.
to a dishwasher connection of a disposer, or a baffled
sink tailpiece after going through a looped connec-
tion, the loop of which shall be at least as high as
the underside of the sink counter.

5009.2. Clear Water Wastes. Water lifts, ex-
pansion tanks, cooling jackets, sprinkler systems, drip
or overflow pans, or similar devices which waste clear
water only shall discharge into a sump, or drain into
a trapped fixture. For requirements for draining re-
liet outlet wastes, see Section 5010.6.1.

When drip pans under cooling coils having a
capacity in excess of 3 tons of refrigeration dis-
charge to the sanitary drainage system, the discharge
shall be through an air break into a specially provided
trapped receptor. The discharge line from pans under
cooling coils of three tons or less shall be at least
three-fourths (3/4) inch size and may discharge
through an approved fitting into a sink tailpiece or a
washing machine stand pipe. A bathtub overflow may
be used to drain such pans through an approved
fitting, provided permanent access of ample size im-
mediately back of such connection is provided.

5009.3. Special Waste Pipes. 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 espe-
cially suited to resist damage by such wastes.

5009.4. Pools. Wastes from scum gutter
drains, skimmer drains, or deck drains serving walks
around pools shall discharge as an indirect waste.

Section 5010. WATER SUPPLY AND DISTRIBUTION.

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.

5010.1.2. Nonpotable Water. Nonpotable
water may be used for irrigation, cooling or industrial
uses where it cannot contaminate or pollute water or
food products intended for human consumption, for
flushing water closets and urinals, and for other pur-
poses not requiring potable water; provided, how-
ever, that non-potable water shall be reasonably safe-
guarded to prevent its use for drinking, culinary, and
other domestic purposes.

5010.2. Identification of Piping. All piping
carrying non-potable water shall be adequately and
durably identified by a distinctive green colored point
with one (1) inch white paint banding around pipe at
four (4) foot intervals so that it is readily distinguish-
ed from piping carrying potable water.

5010.3. Protection of Potable-Water Supply.

5010.3.1. Backflow. The water distribution
system shall be protected against backflow. Every fix-
ture-supply pipe shall be protected from backflow
by having the opening from which the water flows
spaced a distance above the flood-level rim of the
receptacle into which the water flows sufficient to pro-
vide an air gap of at least twice the diameter of the
effective opening. Where it is not possible to provide a
minimum air gap, the fixture shall be equipped with
an accessibly located backflow preventer complying
with this Section. The type of backflow preventer
used shall be based on the degree of hazard.

Where it is not possible to provide either a mini-
mum 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.
TABLE 5010.3.1.
MINIMUM AIR GAPS FOR GENERALLY USED PLUMBING FIXTURES

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Minimum Air Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatories with effective openings not greater than 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 3/4 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>
<tr>
<td>Effective openings greater than 1 inch</td>
<td>(3)</td>
</tr>
</tbody>
</table>

1. Side walls, ribs, or similar obstruction 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.

2. Vertical walls, ribs, or similar obstruction 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.

3. $2 \times \text{effective opening}$.

4. $3 \times \text{effective opening}$.

5010.3.2. 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.

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.

Backflow preventers shall not be installed on inlet side of control valve.

Backflow preventers shall be made of corrosion resistant material of design and proportions which will not deteriorate or deform under reasonable service conditions.

5010.4. Separate Trenches. The underground water service pipe and the building drain or building sewer shall be not less than ten (10) feet apart horizontally and shall be separated by undisturbed or compacted earth except when installed in open utility tunnels. When this condition cannot be met, relief from this Section may be requested from the Department by setting forth in writing the reasons why such conditions cannot be met and the details of the proposed alternate.

5010.5. Pumps and Other Appliances. Water pumps, tanks, filters, softeners, and all other appliances and devices shall be protected against contamination.

5010.6. Water Supply Tanks. Potable water-supply tanks shall be properly designed to prevent contamination and the entrance of foreign materials or insects into the water supply. Soil or waste lines shall not pass directly over such tanks. Interior of tanks shall be accessible.

5010.6.1. Pressure Tanks, Boilers, and Relief Valves. If the discharge or waste from such equipment is connected by piping to the drainage system, it shall be connected as an indirect waste.

5010.6.2. Cleaning, Lining, Painting, or Repairing 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 potability of the water supply when the tank is returned to service. Tanks shall be dis­
connected from the system during such operation to prevent any foreign fluid or substance from entering
the distribution piping.

5010.6.3. Water-Supply Tanks (House Tanks). 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.

5010.6.4. Overflow for Water-Supply Tanks. Overflow pipes for gravity tanks shall discharge
above any six (6) inches of a roof or catch basin or shall discharge over an open, water-supplied
sink. Adequate overflow pipes shall be provided and properly screened against the entrance of insects and
vermin.

5010.6.5. 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 over­
flow, but in no case shall the elevation be less than
four (4) inches above the overflow.

5010.6.6. Drains. Water-supply tanks shall be
provided with valved drain lines located at their lowest
point and discharged as an indirect waste or as required for overflow pipes in paragraph 5010.6.4.
Each tank shall be provided 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>1 1/2</td>
<td>751 to 1500</td>
</tr>
<tr>
<td>2</td>
<td>1501 to 3000</td>
</tr>
<tr>
<td>2 1/2</td>
<td>3001 to 5000</td>
</tr>
<tr>
<td>3</td>
<td>5001 to 7500</td>
</tr>
<tr>
<td>4</td>
<td>Over 7500</td>
</tr>
</tbody>
</table>

Each drain line shall be equipped with a valve
of the same diameter as the pipe.

5010.7. Materials.

5010.7.1. Water-Distributing Pipe, Tubing
and Fittings. Materials for water-distributing pipes and tubing shall be brass, copper, lead, cast iron,
wrought iron, open-hearth iron, steel, or stainless steel piping, Grade 409, Schedules G & H, with appropriate
approved fittings. All threaded ferrous pipe and fittings shall be galvanized (zinc-coated) or cement
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 Section 5020.

5010.7.2. Water Service Pipe. All of the ma­
terials approved in 5010.7.1 may also be used for water service pipe.

5010.8. 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 materi­
als that would produce toxic conditions in a potable-water system shall be used for piping, tubing, or fittings.

5010.9.1. Water-Supply Control. A main shut­
off valve on the water-service pipe shall be provided
near the curb and an accessible shut-off valve with a drip valve shall be provided inside near the en­
trance of the water-service pipe into the building.

5010.9.2. Tank Controls. Supply lines taken
from pressure or gravity tanks shall be valved at or
near their source.

5010.9.3. Separate Secondary Valves. Sep­
parate valves, always accessible, shall be provided for
each hot and cold-water riser. A separate hot and
cold-water valve shall be provided controlling each
and 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.

5010.9.4. Individual Controls. Individual con­
trols shall be provided for all water closets and for
any fixture isolated from a group.

5010.9.5. Draining of Water Pipes. Water
pipes shall be graded or pitched so that the entire
system or parts thereof can be drained. Sill-cocks
shall be provided with stop and waste valves to facil­
itate winter draining.

5010.9.6. Line Valves. Valves in the water-sup­
ply distribution system, except those immediately con­
trolling 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-sections area of the nominal size of the
pipe in which the valve is installed.

5010.10. Water Distribution Piping.

5010.10.1. Water-Service Pipe. The water-
service pipe from the street main to the water-dis­
bution 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 three-fourths (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 but shall be at
least one (1) inch in size. Water-service pipe of cop­
per tubing shall be no lighter than Type L.

5010.10.2. Demand Load. The demand load
in the building water-supply system shall be based on
the number and kind of fixtures installed and the probable simultaneous use of these fixtures.

5010.10.3. Procedure in Sizing Water-Distri­
bution System. The size of the water-distribution
system shall conform to good engineering practice. However, at least three-fourth (3/4) inch pipe shall be used for any portion of the potable water distribution piping supplying more than one bathroom group of 3 fixtures.

5010.10.4. Size of Fixture-Supply Pipe. The minimum size of a fixture-supply pipe shall be as set forth in Table 5010.10.4.

Table 5010.10.4

<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 and sill cocks</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.

5010.10.5. Minimum Pressure. Minimum, fairly constant, service pressure at the point of outlet discharge shall be not less than eight (8) pounds per square inch for all fixtures except for direct flush-valves, for which it shall be not less than 15 pounds 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.

5010.11. Auxiliary Pressure.

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.

Booster Pump. When a booster pump is used on an auxiliary pressure system and the possibility exists that a pressure of five (5) pounds 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.

5010.12. 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.

5010.13. 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 an extent that no pressure hazard to the piping system will exist.


5010.15. Safety Devices.

5010.15.1. Pressure Relief Valves, Temperature Relief Valves, and Combination Temperature and Pressure Relief Valves. Pressure relief valves, temperature relief valves, and combination temperature and pressure relief valves of the thermostatic self-closing type shall be placed 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, and shall be capable of discharging sufficient hot water to prevent any further rise in temperature.

5010.15.2. Approvals. Pressure relief valves, temperature relief valves, and combination temperature and pressure relief valves which meet the requirements of this Chapter shall be considered acceptable provided each valve has a metallic plate stamped or etched with manufacturer’s rated relief discharge capacity. Relief valve capacity shall be equal to or greater than the rated Btu input of the heater or heat exchanger.

5010.15.3. Vacuum Relief. Copper tanks other than spherical tanks shall be provided with vacuum-relief valves.

5010.15.4. Relief-Valve Location. Extended thermostatic self-closing type combination temperature-pressure relief valves shall have the element placed in the tank within six (6) inches of the top. Valves without extended element shall be placed directly above the tank on the hot water side and not more than three (3) inches away from such tank. Vacuum-relief valves shall be placed as close to the tanks as possible. There shall be no check or shut-off valve between a relief valve and the heater or tank for which it is installed.

5010.15.5. Relief Outlet Wastes. The outlet of a pressure relief valve, a temperature relief valve, or a combination temperature and pressure relief valve shall not be connected to the drainage system as a direct waste. The discharge pipe from pressure relief valves, temperature relief valves, and combination temperature and pressure relief valves shall be piped and turned down to drain into a sump or into a plumbing fixture.
5010.15.6. 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.

5010.16. Water Used for Cooling. 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. Pipe, tubing and fittings for drainage systems shall comply with the provisions in Section 5003.

5011.1.1. Above-Ground Piping Within Buildings. Soil and waste piping for a drainage system within a building shall be of not less than service weight cast iron, galvanized wrought iron, galvanized open hearth iron, galvanized steel, stainless steel piping grade 409, Schedules G and H, lead, brass, copper pipe or of copper tube. Plastic piping bearing the markings NSF-DWV manufactured in accordance with commercial standards CS 270-65 and CS 272-65 and installed in accordance with practices set forth in the appendices in those standards, may be used in group H, I and J occupancies not exceeding two (2) stories in height. See also Section 5003.

5011.1.2. Underground Drainage Piping Within Buildings. All underground building drains shall be of hub type cast iron, service weight or heavier.

5011.2. Separate Trenches. The underground water service pipe and the building drain or building sewer shall be not less than ten (10) feet apart horizontally and shall be separated by undisturbed or compacted earth except when installed in open utility tunnels. When this condition cannot be met, relief from this Section may be requested from the Department by setting forth in writing the reasons why such conditions cannot be met and the details of the proposed alternate.

5011.3. 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 non-metallic drains may be laid upon an approved concrete pad if installed in accordance with paragraph 5011.2.

5011.4. Drainage Piping Installation. Connections to horizontal drainage branches shall be made with combination Y and 1/8 bends, Y's, or long turn TV's. Horizontal drainage piping shall be installed at a uniform slope not less than that permitted in Table 5011.4.

<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>

5011.5. Fixture Units.

5011.5.1. Values for Fixtures. Fixture-unit values as given in Table 5011.5.1. 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 5011.5.1
**FIXTURE UNITS PER FIXTURE OR GROUP**

<table>
<thead>
<tr>
<th>Fixture type</th>
<th>Fixture-unit value as load factor</th>
<th>Minimum size of trap (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 bathroom group consisting of water closet, lavatory, and bathtub or shower stall.</td>
<td>Tank water closet: 6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flushometer valve, water closet: 8</td>
<td></td>
</tr>
<tr>
<td>Bathtub(^1) (with or without overhead shower)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Bathtub</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Bidet</td>
<td>3</td>
<td>Nominal: 1½</td>
</tr>
<tr>
<td>Combination sink-and-tray</td>
<td>4</td>
<td>Separate traps: 1½</td>
</tr>
<tr>
<td>Combination sink-and-tray with food-disposal unit</td>
<td></td>
<td></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 drain(^2)</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></td>
</tr>
<tr>
<td>Lavatory, surgeon's</td>
<td>2</td>
<td></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>1½</td>
</tr>
<tr>
<td>Showers (group) per head(^2)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Sinks: (^3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgeon's</td>
<td>3</td>
<td>1½</td>
</tr>
<tr>
<td>Flushing rim (with valve)</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>Service (Trap standard)</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Service (P Trap)(^4)</td>
<td>2</td>
<td>2</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(^5) (each 2-foot section)</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Wash sink(^6) (circular or multiple), each set of faucets</td>
<td>2</td>
<td>1½</td>
</tr>
<tr>
<td>Water closet:</td>
<td>4</td>
<td>Nominal: 3</td>
</tr>
<tr>
<td>Tank-operated</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Valve-operated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) A shower head over a bathtub does not increase the fixture value.

\(^2\) See pars. 5011.5.2 for method of computing unit value of fixtures not listed in table 5011.5.1 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 1½- or 1½-inch traps have the same load value; larger P.O. plugs have greater flow rate. 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.
5011.5.2. Fixtures not listed in Table 5011.5.1. shall be estimated in accordance with Table 5011.5.2.

Table 5011.5.2

<table>
<thead>
<tr>
<th>Fixture drain or</th>
<th>Fixture unit value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap size</td>
<td></td>
</tr>
<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>

5011.6. Determination of Sizes of Soil and Waste Piping. 5011.6.1. 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 5011.6.1 and Table 5011.6.1A.

Table 5011.6.1

**BUILDING DRAINS AND SEWERS.**

<table>
<thead>
<tr>
<th>Diameter of pipe (inches)</th>
<th>1/16 inch</th>
<th>1/8 inch</th>
<th>1/4 inch</th>
<th>1/2 inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>22</td>
<td>24</td>
<td>26</td>
<td>29</td>
</tr>
<tr>
<td>2 1/2</td>
<td>27</td>
<td>31</td>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>3</td>
<td><strong>22</strong></td>
<td><strong>27</strong></td>
<td><strong>31</strong></td>
<td><strong>36</strong></td>
</tr>
<tr>
<td>4</td>
<td>180</td>
<td>216</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>390</td>
<td>480</td>
<td>575</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>700</td>
<td>840</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1,400</td>
<td>1,600</td>
<td>1,900</td>
<td>2,300</td>
</tr>
<tr>
<td>10</td>
<td>2,500</td>
<td>2,900</td>
<td>3,500</td>
<td>4,200</td>
</tr>
<tr>
<td>12</td>
<td>3,900</td>
<td>4,600</td>
<td>5,600</td>
<td>6,700</td>
</tr>
</tbody>
</table>

* — Includes branches of the building drain.
** — Not over 2 water closets.
*** Not over 6 water closets.

All groups A through I occupancies shall have at least one building drain and building sewer of not less than four (4) inches.

Table 5011.6.1A

**HORIZONTAL FIXTURE BRANCHES AND STACKS**

<table>
<thead>
<tr>
<th>Diameter of pipe (inches)</th>
<th>Any horizontal fixture branch</th>
<th>Stack of not more than 2 stories in height or 2 branch intervals</th>
<th>Stack of not more than 3 stories in height or 3 branch intervals</th>
<th>More than three stories in height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total for Stack</td>
</tr>
<tr>
<td>1 1/4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 1/2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>24</td>
</tr>
<tr>
<td>2 1/2</td>
<td>12</td>
<td>20</td>
<td>20</td>
<td>42</td>
</tr>
<tr>
<td>3</td>
<td><strong>20</strong></td>
<td><strong>30</strong></td>
<td><strong>30</strong></td>
<td><strong>60</strong></td>
</tr>
<tr>
<td>4</td>
<td>160</td>
<td>240</td>
<td>340</td>
<td>500</td>
</tr>
<tr>
<td>5</td>
<td>360</td>
<td>540</td>
<td>540</td>
<td>1,100</td>
</tr>
<tr>
<td>6</td>
<td>620</td>
<td>930</td>
<td>960</td>
<td>1,900</td>
</tr>
<tr>
<td>8</td>
<td>1,400</td>
<td>2,100</td>
<td>2,200</td>
<td>3,600</td>
</tr>
<tr>
<td>10</td>
<td>2,500</td>
<td>3,800</td>
<td>5,600</td>
<td>1,000</td>
</tr>
<tr>
<td>12</td>
<td>3,900</td>
<td>6,000</td>
<td>8,400</td>
<td>1,500</td>
</tr>
</tbody>
</table>

*Does not include branches of the building drain. Also minimum size for food waste grinder is 2 inches.
**Not over 2 water closets.
***Not over 6 water closets.
5011.6.2. Minimum Size of Soil and Waste Stacks. No soil or waste stack shall be smaller than the largest horizontal branch connected thereto.

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 which shall be not less than three (3) inches in diameter or the size of the building drain, whichever is the lesser.

The stack which vents a water closet on a building drain system at the greatest distance from the building sewer shall be at least three (3) inches.

5011.6.3. Future Fixtures. When provision is made for the future installation of fixtures, the fixtures provided for shall be considered in determining the required sizes of drain pipes. Construction to provide for future fixture installation shall be terminated with a plugged fitting or fittings at the stack and shall be vented as required in Section 5012.

5011.6.4. Underground Drainage Piping. No portion of the drainage system installed underground or below a basement or cellar floor shall be less than two (2) inches in diameter.

5011.6.5. Offsets.

An offset in a vertical stack, with a change of direction of 45° or less, may be considered a straight vertical stack, provided the total number of fixture units installed on the stack is 50 per cent or less than the total allowed by column 2 of Table 5011.6.1A and that no horizontal branch connected to the stack within two (2) feet above or below the offset.

An offset of 45° or less in the stack, except as permitted in paragraph immediately preceding, shall be vented as required in paragraph 5012.14.

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.

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 required diameter of the offset and the stack below it shall be as determined for a building drain.

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 5011.6.1.
3. The portion of the stack below the offset shall be sized as a separate stack with the fixture unit load attached to the upper portion of the stack being considered as connecting to the lower portion of the stack in one branch interval and shall be sized to meet the requirements of column 2 or 3 and 4, Table 5011.6.1A. A relief vent for the offset shall be installed as provided in Section 5012.14.

5011.7. Sumps and Receiving Tanks. Building subdrains shall discharge into a sump or receiving tank with a gas-tight cover. Sewage shall be lifted and discharged into the building sewer by pumps, ejectors, or similar efficient method. Sumps or tanks shall either be automatically discharged or be of sufficient capacity to hold the maximum accumulated sewage and waste for a period of not less than 24 hours, provided that sewage shall be purged from the sump at intervals not exceeding 12 hours. Water-operated ejectors are prohibited.

An ejector shall be used on sumps serving one or more water closets. The discharge pipe from the sump pump shall be of adequate size to handle the discharge from the pump, but in no event smaller than the pump discharge. The size and design of a sump pump shall be determined by the capacity of the sump to be served, the discharge head, and the discharge frequency.

A horizontal check valve shall be installed in each pump discharge line. The discharge pipe from the sump pump or ejector to the drainage system shall be connected through a branch "Y" fitting. The drain into which the sump pump or ejector discharges shall be of sufficient size to receive the combined flow from the building and the sump pump or ejector. For size of vents, see Section 5012.11.5.

Section 5012. VENTS AND VENTING.

5012.1. Materials. Vent pipes shall be of cast iron, galvanized wrought iron, galvanized open hearth iron, galvanized steel, stainless steel piping grade 409, Schedules G & H, brass, copper, or lead conforming to provisions of Section 5003. Plastic piping bearing the markings NSF-DWV manufactured in accordance with commercial standards CS 270-65 and CS 272-65 and installed in accordance with practices set forth in the appendices in those standards, may be used in group H, I and J occupancies not exceeding two (2) stories in height. See also Section 5003.

Fittings shall conform to the type of pipe used, except that cast iron steam pattern or galvanized malleable-iron fittings may be used with threaded pipe. (ORD. 1 - Jan. 1972)

5012.2. Minimum Stack Vent. 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 which shall be not less than three (3) inches in diameter or the size of the building drain, whichever is the lesser.
5012.3. Protection of Trap Seals.

5012.3.1. Individual Vents. The seal of every fixture trap in a plumbing system shall be protected by a properly installed individual vent except as otherwise provided in this Section.

5012.3.2. Stack Vents. Every soil or waste stack shall be extended vertically as a stack vent to at least six (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 six (6) inches above the flood level rim of the highest fixture with a single extension from the point of joining to the open air.

5012.4. 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 to two or more branch intervals. The vent stack shall terminate independently in the open air outside the building or shall be connected with the stack vent as prescribed in paragraph 5012.3.2 and shall connect with the soil or waste stack through, or below the lowest horizontal waste branch or with the building drain.

5012.4.1. Extensions through Roof. Extensions of vent pipes through a roof shall be terminated at least six (6) inches above it and shall be properly flashed. Where a roof is to be used for occupancy, the extensions shall be run at least six (6) feet above the roof.

5012.4.2. 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 adjacent building, nor shall any such vent terminal be within twelve (12) feet horizontally from such an opening unless it is at least three (3) feet above the top of such opening.

5012.4.3. Extensions Through Wall. Vent terminals extending through a wall shall be at least twelve (12) feet horizontally from any building line.

5012.4.4. Frost Closure. Where excessive vapor creates a possibility of frost closure, the vent extension through a roof shall be at least three (3) inches in diameter. When increasing the size of the vent terminal, the change in diameter shall be made inside the building.

5012.5. Vent Pipe Grades and Connections.

5012.5.1. Grades. Vent and branch vent pipes shall be free from drops or sags and be graded and connected to drip back to the soil or waste pipe or vent stack by gravity.

5012.5.2. 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 six (6) inches above the flood level rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

5012.5.3. Connection to Vent Stack. A connection between a vent pipe and a vent stack shall be at least six (6) inches above the flood level rim of the highest fixture served by the vent. Vertical vent pipes forming branch vents, relief vents, circuit vents, or loop vents shall be at least six (6) inches above the flood level rim of the highest fixture served.

5012.6. Fixture Vents.

5012.6.1. 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 5012.6.1.

**TABLE 5012.6.1**
DISTANCE OF TRAP FROM VENT

<table>
<thead>
<tr>
<th>Size of Fixture Drain (Inches)</th>
<th>Permissible Length in Feet</th>
<th>Longturn TY or Combination Y and 1/8 bend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sanitary Tee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ft. In.</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>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>
<tr>
<td>5</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

They shall be turned to provide an opening downward. They shall be effectively screened and shall meet the requirements of paragraph 5012.4.2.

5012.4. Frost Closure. Where excessive vapor creating a possibility of frost closure, the vent extension through a roof shall be at least three (3) inches in diameter. When increasing the size of the vent terminal, the change in diameter shall be made inside the building.

5012.5. Vent Pipe Grades and Connections.

5012.5.1. Grades. Vent and branch vent pipes shall be free from drops or sags and be graded and connected to drip back to the soil or waste pipe or vent stack by gravity.

5012.5.2. 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 six (6) inches above the flood level rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

5012.5.3. Connection to Vent Stack. A connection between a vent pipe and a vent stack shall be at least six (6) inches above the flood level rim of the highest fixture served by the vent. Vertical vent pipes forming branch vents, relief vents, circuit vents, or loop vents shall be at least six (6) inches above the flood level rim of the highest fixture served.

5012.6. Fixture Vents.

5012.6.1. 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 5012.6.1.

**TABLE 5012.6.1**
DISTANCE OF TRAP FROM VENT

<table>
<thead>
<tr>
<th>Size of Fixture Drain (Inches)</th>
<th>Permissible Length in Feet</th>
<th>Longturn TY or Combination Y and 1/8 bend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sanitary Tee</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4 inch slope</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/2 inch slope</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ft. In.</td>
<td></td>
</tr>
<tr>
<td>1/4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>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>
<tr>
<td>5</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

They shall be turned to provide an opening downward. They shall be effectively screened and shall meet the requirements of paragraph 5012.4.2.

5012.4. Frost Closure. Where excessive vapor creating a possibility of frost closure, the vent extension through a roof shall be at least three (3) inches in diameter. When increasing the size of the vent terminal, the change in diameter shall be made inside the building.

5012.5. Vent Pipe Grades and Connections.

5012.5.1. Grades. Vent and branch vent pipes shall be free from drops or sags and be graded and connected to drip back to the soil or waste pipe or vent stack by gravity.

5012.5.2. 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 six (6) inches above the flood level rim of the fixture it is venting before offsetting horizontally or before connecting to the branch vent.

5012.5.3. Connection to Vent Stack. A connection between a vent pipe and a vent stack shall be at least six (6) inches above the flood level rim of the highest fixture served by the vent. Vertical vent pipes forming branch vents, relief vents, circuit vents, or loop vents shall be at least six (6) inches above the flood level rim of the highest fixture served.

5012.6. Fixture Vents.

5012.6.1. 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 5012.6.1.
5012.6.2 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 top of the dip of the trap.

5012.7. Common Vent. 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 five (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 the distance between center lines of discharges in the vertical stack shall be not less than 5 diameters of the pipe, and the connections, slope, and length are within the limits of paragraph 5012.6.1.

5012.8. Wet Venting.

5012.8.1. 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:

Not more than one fixture unit is drained into a one and one-half (1 1/2) inch diameter wet vent or not more than four fixture units drain into a two (2) inch diameter wet vent.

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.

5012.8.2 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 two (2) inches in diameter.

5012.8.3 Multistory Bathroom Groups. On the lower floors of a multi-story building the waste pipe from one or two lavatories may be used as a wet vent for one or two bathtubs or showers provided:

The wet vent and its extension to the vent stack is two (2) inches in diameter.

Each water closet below the top floor is individually back vented.

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>2 1/2</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>

EXCEPTION: In multistory bathroom groups, wet vented in accordance with paragraph 5012.8.3, the water closets below the top floor need not be individually vented if the two (2) inch waste connects directly into the water closet bend at a 45° angle to the horizontal portion of the bend in the direction of flow, or if a special stack fitting is used which consists of a three (3) inch water closet opening and two side outlets each one and one-half (1 1/2) or two (2) inches in diameter, having their invert above the center line of, but below the top of the three (3) inch water opening.

Side inlet closet bends with inlet entering above the invert and having a sanitary throat are permitted only in cases where the fixture connecting thereto is vented. In no case shall the inlet be used to vent a bathroom group without being washed by a fixture. Waste connections to lead closet bends are prohibited.

5012.9 Stack Venting. A group of fixtures consisting of one bathroom group and a kitchen sink or combination fixture may be installed in a one-story building or on the top floor of a building without individual fixture vents except as indicated in paragraph 5012.10 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 5012.6.1.

5012.10 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.

5012.11 Circuit and Loop Vents.

5012.11.1 Battery Venting. A branch soil or waste pipe to which two but not more than eight (8) floor set water closets, 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. The vertical portion of a circuit or loop vent venting such battery of water closets may be used as a drain for not more than 2 fixture units. 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.

5012.11.2 Dual Relief Vents. Two circuit vented horizontal branches serving a total of not more than eight (8) water closets (as indicated in paragraph 5012.11.1) in the same branch interval shall have a dual relief vent. Where the vents are joined, the point of joining shall be at least six (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.

5012.11.3 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.
5012.11.4. Fixtures Connected Back to Back or Side by Side in Battery. Fixtures connected to one horizontal branch through a double TY or a sanitary tee, in a vertical position, may be installed on a common vent for each two fixtures back to back or side by side or double connection. The common vent must be installed in a vertical position.

5012.11.5. 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 5012.16.6 and 5012.16.7.

5012.12. Pneumatic Ejectors. Pneumatic ejectors shall have separate system of venting extending to the open air.

5012.13. Relief Vents. 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 three (3) feet above the floor level.


5012.14.1. Venting Required. Offsets in soil or waste stacks, except as permitted in paragraph 5011.6.5 shall be vented as provided in paragraph 5012.14.2 or 5012.14.3.

5012.14.2. Separate Venting. 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.

5012.14.3. Offset Reliefs. 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.

5012.15. Vent Headers. 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 5012.16.7, 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.

5012.16. Size and Length of Vents.

5012.16.1. 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.

5012.16.2. 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.

5012.16.3. 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.

5012.16.4. Size of Vent Stack. A vent stack or main vent shall have a diameter of at least one-half (1/2) the diameter of the soil or waste stack, but in no case less than one and one-half (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 5012.16.7.

5012.16.5. Size of Relief Vent. The diameter of a relief vent shall be not less than one and one-fourth (1 1/4) inches nor less than one-half (1/2) the diameter of the drain to which it is connected.

5012.16.6. Size of Circuit or Loop Vent. The Diameter of a circuit or loop vent shall be not less than one-half (1/2) the diameter of the horizontal soil or waste branch or the diameter of the vent stack, whichever is the smaller. See Table 5012.16.6.
### TABLE 5012.16.6

**HORIZONTAL CIRCUIT AND LOOP VENT SIZING TABLE**

<table>
<thead>
<tr>
<th>Soil or Waste Pipe Diameter (inches)</th>
<th>Fixture Units: Number not exceeding</th>
<th>Diameter of Circuit or Loop Vent (feet)</th>
<th>Horizental length, not exceeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 1/2&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1 1/2</td>
<td>10</td>
<td>20</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>---</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>---</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>---</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>---</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>1100</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

5012.16.7. Size of Vent Piping. The size of vent piping shall be determined from its length and total of fixture-units connected thereto as provided in Table 5012.16.7.

### TABLE 5012.16.7

**SIZE AND LENGTH OF VENTS**

<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>Maximum length of Vent (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4</td>
<td>2</td>
<td>30</td>
<td>1100</td>
</tr>
<tr>
<td>1 1/2</td>
<td>8</td>
<td>50</td>
<td>150</td>
</tr>
<tr>
<td>1 1/2</td>
<td>10</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>26</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>---</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>---</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>---</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
<td>---</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>---</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>---</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>500</td>
<td>---</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>200</td>
<td>---</td>
<td>35</td>
</tr>
<tr>
<td>5</td>
<td>500</td>
<td>---</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>1100</td>
<td>---</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>350</td>
<td>---</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>620</td>
<td>---</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>960</td>
<td>---</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>1900</td>
<td>---</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>600</td>
<td>---</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>1400</td>
<td>---</td>
<td>50</td>
</tr>
<tr>
<td>8</td>
<td>2200</td>
<td>---</td>
<td>40</td>
</tr>
<tr>
<td>8</td>
<td>3600</td>
<td>---</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>1000</td>
<td>---</td>
<td>25</td>
</tr>
<tr>
<td>10</td>
<td>2500</td>
<td>---</td>
<td>75</td>
</tr>
<tr>
<td>10</td>
<td>3800</td>
<td>---</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>5600</td>
<td>---</td>
<td>30</td>
</tr>
</tbody>
</table>
5012.16.7.1. How to Compute Vent Stack Sizes. 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 seventy-six (76) feet. Table 5012.16.7 shows that a seventy-six (76) foot length would require two and one-half (2 1/2) inch pipe.

The same vent stack connected to the header has a total length of 86 feet. This still requires two and one-half (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 three (3) inch pipe, according to the table. The same vent stack connected to the header will have a length of 109 feet, and still require three (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 three (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 roof, will be based on a total developed length of 178 feet with a total connected load of 630 fixture units. Required here is a 4 inch diameter pipe.

The four (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.

This same method shall be used in determining vent stack sizes for any installation, however complex.


5012.17.1. 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.
5013.2.5. 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 ten (10) feet downstream from any branch to the building drain or from any soil stack.

5013.2.6. 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 5013.2.5, relative location of connections, shall also apply to this paragraph.

5013.3. Size of Leaders and Storm Drains.

5013.3.1. Vertical Leaders. Vertical leaders shall be sized on the maximum projected roof area, according to the following table unless the run off is controlled by engineered weir-type drains:

<table>
<thead>
<tr>
<th>TABLE 5013.3.1</th>
<th>SIZE OF VERTICAL LEADERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of leader or conductor* (inches)</td>
<td>Maximum projected roof area (sq. ft.)</td>
</tr>
<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.

5013.3.2. Building Storm Drains. The size of the building storm drain or any of its horizontal branches having a slope of one-half (1/2) inch or less per foot, shall be based upon the maximum projected roof area to be handled according to the following table unless the flow is controlled by an engineered system:

<table>
<thead>
<tr>
<th>TABLE 5013.3.2</th>
<th>SIZE OF HORIZONTAL STORM DRAINS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of drain (inches)</td>
<td>1/8 inch</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>

5013.3.3. Size of Combined Drains and Sewers. The size of the building drain and building storm drain to the point of combining into one system shall be as required for separate storm and sanitary systems.

The size of the combined building drain or sewer shall be determined from Table 5013.3.2 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 four (4) inches in diameter or smaller than the building storm or sanitary drain emptying into it.

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.

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.

5013.3.4. Values for Continuous Flow. Where a continuous or semicontinuous discharge into the building storm drain or building storm sewer from a pump, air conditioning plant, or similar device occurs, each gallon per minute of discharge shall be computed as being equivalent to forty-eight (48) square feet of roof area.

Section 5014. TESTS.

5014.1. Material and Labor for Tests. The equipment, material, power, and labor necessary for the inspections and tests required by this Chapter shall be furnished by the plumber.

5014.2. Tests of Drainage and Vent Systems. All the piping of the plumbing system shall be tested with water or air.

5014.3. Methods of Testing Drainage and Vent Systems.

5014.3.1. Water Pressure 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 ten (10) foot head of water. In testing successive sections at least the upper ten (10) feet of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost ten (10) feet of the system) shall have been submitted to a test of less than ten (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.
5014.3.2. 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.

5014.3.3. 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 pressure to balance a column of mercury ten (10) inches in height. This pressure shall be held without introduction of additional air for a period of at least fifteen (15) minutes.

5014.4. Test of Water-Supply System. 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.

5014.5. Test of Interior Leaders or Down Spouts. Leaders or downspouts and branches within a building shall be tested by water or air in accordance with paragraph 5014.3.1 or 5014.3.3.

5014.6. Test of Defective Plumbing. 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 5020. STANDARDS.

Unless otherwise provided for in other portions of this Chapter, applicable sections of any one of the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>USASI</td>
<td>Cast-Iron Threaded Drainage Fittings, B16.12 - 1965</td>
</tr>
<tr>
<td></td>
<td>Cast-Iron Screwed Fittings, 125 and 250 lb. B16.4 - 1963</td>
</tr>
<tr>
<td></td>
<td>Cast-Iron Soil Pipe and Fittings, A 40.1 - 1935</td>
</tr>
<tr>
<td></td>
<td>Threaded Cast-Iron Pipe for Drainage, Vent, and Waste Services, A40.5 - 1943</td>
</tr>
<tr>
<td></td>
<td>Malleable-Iron Screwed Fittings, 150 and 300 lb. B16.3 - 1963 (Revision and Consolidation of B16.3 - 1951 and B16.19 - 1951)</td>
</tr>
</tbody>
</table>

Seamless Copper Water Tube, Specification for H23.1 - 1967 (ASTM B88 - 66a)

Cast Bronze Fittings for Flared Copper Tubes, B16.26 - 1967

Seamless Copper Tube, Specification for H23.3 - 1967 (ASTM B75-66)

Wrought Copper and Bronze Solder-Joint Pressure Fittings B16.22 - 1963

Standard Strength Clay Sewer Pipe, Specifications for A 106.3 - 1967

Cement-Mortar Lining for Cast-Iron Pipe and Fittings for Water, Specifications for A21.4 - 1964 (AWWA - C104-64)

Zinc-Coated (Galvanized) Wrought Iron Sheets, Specifications for G8.8 - 1937 (ASTM - A163.36)

Pipe Threads B2.1 - 1945

Seamless and Welded Ferritic Stainless Steel Tubing for General Service, Spec. for (ASTM A268-64) B36.36-1966

DMAPHCC Standard Plumbing Diagrams

ASTM Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses, Specifications for, A 120 - 66

Welded Wrought-Iron Pipe, Spec. for, A 72-66

Seamless Brass Tube, Spec. for B135 - 67

Seamless Copper Pipe, Standard Sizes, Spec. for B42 - 66

Seamless Copper Water Tube, Spec. for, B88-66a

Seamless Copper Tube, Spec. for, B75 - 66

Standard Strength Clay Sewer Pipe, Spec. for, C13 - 65T

Extra Strength Clay Pipe, Spec. for, C200 - 65T

Concrete Sewer, Storm Drain, and Culvert Pipe, Spec. for, C14 - 67

Joints for Circular Concrete Sewer and Culvert Pipe, Using Flexible, Watertight, Rubber Gaskets, Spec. for, C443 - 67
Rubber Gaskets for Cast Iron Soil Pipe and Fittings, Spec. and Tests for, C564 - 65 T

Zinc-Coated (Galvanized) Wrought-Iron Sheets Spec. for A163 - 66

Compression Joints for Vitrified Clay Bell and Spigot Pipe, Spec. for, C425 - 66T

Brass Plate, Sheet, Strip, and Rolled Bar, Spec. for B36 - 67

Leaded Brass Plate, Strip, and Rolled Bar, Spec. for B 121 - 66

Copper Sheet, Strip, Plate, and Rolled Bar, Spec. for B 152 - 66

Solder Metal, Spec. for, B 32 - 66T

AWWA — Coal-Tar Enamel. (Protective Coating) 7A.6 - 1940

Legend
USASI — United States of America Standards Institute 10 East 40th Street, New York, N. Y. 10016


A.W.W.A. — American Water Works Association No. 2 Park Avenue, New York, N.Y. 10016

DMAPHCC — Denver Metropolitan Association of Plumbing, Heating, Cooling Contractors, 2727 West 6th Avenue, Denver, Colo. 80204
# TABLE 50-A

PLACES OF ASSEMBLY -- Minimum Fixtures Required

<table>
<thead>
<tr>
<th>Number of Males</th>
<th>Males***</th>
<th>Number of Females</th>
<th>Females***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Closets</td>
<td>Lavatories</td>
<td>Urinals</td>
</tr>
<tr>
<td>1-30</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>31-60</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>61-100</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>101-250</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>251-425</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>426-600</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>601-775</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>776-950</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>951-1125</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1126-1300</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1301-1500</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>1501-1700</td>
<td>5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>1701-1900</td>
<td>6</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>1901-2100</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>2100-2350</td>
<td>7</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>2351-2600*</td>
<td>7</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

**NOTES:**

*Water Closet, Lavatories — Provide one (1) water closet and one (1) lavatory for each additional five hundred males in excess of two thousand six hundred (2600).

*Urinals — Provide one (1) urinal for each additional two hundred (200) males, or fraction thereof, starting at two thousand six hundred (2600).

**Water Closets — Provide one (1) water closet for each additional two hundred (200) females in excess of two thousand nine hundred (2900).

**Lavatories — Provide one (1) lavatory for each additional six hundred (600) females, in excess of two thousand nine hundred (2900).

**Service Sinks — Provide one (1) service sink per floor.

**Drinking Fountains — Provide one (1) drinking fountain per floor except in places where food or drink is normally served and when approved by the Department.
TABLE 50-B

TAVERNS, LOUNGES — Minimum Fixtures Required

<table>
<thead>
<tr>
<th>Number of Males</th>
<th>Number of Females</th>
<th>Water Closets</th>
<th>Lavatories</th>
<th>Urinals</th>
<th>Males***</th>
<th>Water Closets</th>
<th>Lavatories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-30</td>
<td>1-30</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>31-60</td>
<td>31-60</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>61-90</td>
<td>61-90</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>91-120</td>
<td>91-120</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>121-150</td>
<td>121-150</td>
<td>3</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>151-180</td>
<td>151-180</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>181-240</td>
<td>181-240</td>
<td>5</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>241-270</td>
<td>241-270</td>
<td>5</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>271-300*</td>
<td>271-300**</td>
<td>6</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

NOTES:
*Water Closets, Lavatories — Provide one (1) water closet and one (1) lavatory for each additional sixty (60) males in excess of three hundred (300).
*Urinals — Provide one (1) urinal for each additional thirty (30) males in excess of three hundred (300).
***Water Closets — Provide one (1) water closet for each additional thirty (30) females in excess of three hundred (300).
**Lavatories — Provide one (1) lavatory for each additional sixty (60) females in excess of three hundred (300).
***Drinking Fountains — Provide one (1) drinking fountain per floor except in places where food or drink is normally served, and when approved by the Department.

TABLE 50-C

DORMITORIES — Minimum Fixtures Required

<table>
<thead>
<tr>
<th>Number of Males</th>
<th>Number of Females</th>
<th>Water Closets</th>
<th>Lavatories</th>
<th>Urinals</th>
<th>Water Closets</th>
<th>Lavatories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 for each 10</td>
<td>1 for each 12</td>
<td>1 for each 25</td>
<td>1 for each 8</td>
<td>1 for each 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. Urinals — Provide one (1) urinal for each additional fifty (50) males in excess of one hundred fifty (150).
2. Dental Lavatories — Separate dental lavatories shall be provided in community toilet rooms in a ratio of one (1) for each fifty (50) persons.
3. Bathtubs or Showers — Provide one (1) bathtub or shower for each eight (8) persons. For women’s dormitories, additional bathtubs shall be installed at the ratio of one (1) for each thirty (30) women. Over one hundred fifty (150) persons, add one (1) fixture for each twenty (20) persons.
4. Drinking Fountains — Provide one (1) drinking fountain for each seventy-five (75) persons with a minimum of one (1) per floor.
5. Laundry Trays — Provide one laundry tray for each fifty (50) persons. In excess of one hundred (100) persons provide one (1) laundry tray or one (1) automatic laundry washing machine for each additional fifty (50) persons.
6. Service Sinks — Provide one (1) service sink for each floor.
TABLE 50-D

DWELLING UNITS OR APARTMENTS -- Minimum Fixtures Required

<table>
<thead>
<tr>
<th>Water Closets</th>
<th>Lavatories</th>
<th>Bathtubs or Showers</th>
<th>Kitchen Sink</th>
<th>Garbage Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
<td>1 each</td>
</tr>
</tbody>
</table>

NOTES:

Laundry Facilities:
1. In addition, buildings with one or two dwelling units shall provide a capped rough in for a laundry facility in each unit.
2. In buildings with 3 or more dwelling units or apartments, provide one (1) double laundry tray for the first ten (10) units or apartments. In excess of ten (10) units or apartments, provide one (1) double laundry tray or one (1) automatic laundry washing machine for each additional fifteen (15) units or apartments. Such equipment shall be accessible to all units or apartments.
3. Location of laundry facilities and connections shall be approved by the Department.

TABLE 50-E

INDUSTRIAL, EMPLOYEES, PUBLIC BUILDINGS -- Minimum Fixtures Required

<table>
<thead>
<tr>
<th>Number of Males</th>
<th>Males***</th>
<th>Number of Females</th>
<th>Females***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Closets</td>
<td>Lavatories</td>
<td>Urinals</td>
</tr>
<tr>
<td>1 - 10</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11 - 30</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>31 - 60</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>61 - 90</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>91 - 120</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>121 - 150</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>151 - 180</td>
<td>6</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>181 - 210</td>
<td>7</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>211 - 240*</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

NOTES:

*Water Closets -- Provide one (1) water closet for each additional thirty (30) males in excess of two hundred forty (240).
*Lavatories -- Provide one (1) lavatory for each additional forty (40) males in excess of two hundred forty (240).
*Urinals -- Provide one (1) urinal for each additional sixty (60) males in excess of two hundred forty (240).
**Water Closets -- Provide one (1) water closet for each additional twenty (20) females in excess of one hundred eighty (180).
**Lavatories -- Provide one (1) lavatory for each additional forty (40) females in excess of one hundred eighty (180).
***Drinking Fountains -- In addition, provide one (1) drinking fountain for each seventy-five (75) persons with a minimum of one (1) for each floor.
***Service Sink -- In addition, provide one (1) service sink for each floor.
### TABLE 50-F

**INSTITUTIONAL (Health) -- Minimum Fixtures Required***

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Water Closets</th>
<th>Urinals</th>
<th>Lavatories</th>
<th>Bathtubs with Showers or Showers</th>
<th>Drinking Fountains</th>
<th>Service Sinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Department (Centralized Facilities)</td>
<td>1 for each 4 patients ***</td>
<td>1 for each 10 patients</td>
<td>1 for each 10 patients</td>
<td>1 for each nursing station but not less than 1 per floor</td>
<td>1 for each unit or department</td>
<td></td>
</tr>
<tr>
<td>Individual patient room or ward room</td>
<td>1 in each patient room or ward room</td>
<td>1 for each 4 beds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waiting Rooms</td>
<td>1 each sex</td>
<td>1 each sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td>(Same as Public) See Table 50-E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
*Enclosed water closets for individual patient rooms or ward rooms shall be directly connected to not more than two (2) patient rooms or ward rooms, serving not more than a total of four (4) beds.*

**Bubbler fountains shall not be connected to a water faucet or lavatory.**

**Individual patient room or ward room facilities, as outlined in Note * shall be mandatory with centralized water closets, lavatories and bath facilities as optional.**

Exception: Mental Hospitals.

### TABLE 50-G

**INSTITUTIONS (Penal) -- MINIMUM FIXTURES REQUIRED**

<table>
<thead>
<tr>
<th>Type of Occupancy</th>
<th>Water Closets</th>
<th>Urinals</th>
<th>Lavatories</th>
<th>Bathtubs or Showers</th>
<th>Drinking Fountains</th>
<th>Service Sink</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cells</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1 each cell block floor</td>
<td>1 each cell block floor</td>
<td>1 per floor</td>
</tr>
<tr>
<td>Exercise Room</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1 each area</td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td>Same as Public</td>
<td>See Table 50-E</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

50-34
### TABLE 50-H

**INSTITUTIONAL (Nursery) -- Minimum Fixtures Required**

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Closets</td>
<td>Lavatories</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
<td>------------</td>
</tr>
<tr>
<td>1 for each 25</td>
<td>1 for each 10</td>
<td>1 for each 50</td>
</tr>
</tbody>
</table>

**NOTES:**
1. **Bathtubs or Showers** -- Provide one (1) bathtub or shower for each ten (10) persons.
2. **Drinking Fountains** -- Provide one (1) drinking fountain for each fifty (50) persons with a minimum of one (1) per floor.
3. **Service Sinks** -- Provide one (1) per unit or department.

### TABLE 50-I

**SCHOOLS AND OTHER PLACES OF INSTRUCTION -- Minimum Fixtures Required**

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>MALES</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Closets</td>
<td>Lavatories</td>
</tr>
<tr>
<td>Elementary and</td>
<td>1 for each 40</td>
<td>1 for each 2 toilet fixtures (closets &amp; urinals)</td>
</tr>
<tr>
<td>Junior High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All others</td>
<td>1 for each 75</td>
<td>1 for each 2 toilet fixtures (closets &amp; urinals)</td>
</tr>
</tbody>
</table>

**NOTES:**
1. **Showers** -- Provide one (1) shower for each five (5) pupils of a gym or pool class.
2. **Drinking Fountains** -- Provide one (1) drinking fountain for each one hundred (100) pupils but at least one (1) per floor.
3. **Service Sinks** -- In addition, provide one (1) service sink on each floor.

### TABLE 50-J

**TEMPORARY FACILITIES-WORKING MEN -- Minimum Fixtures Required**

SEE CHAPTER 5
### TABLE 50-K
**ASSUMED OCCUPANT LOAD**

<table>
<thead>
<tr>
<th>Use or Occupancy</th>
<th>Basis for Determining Occupant Load</th>
<th>Sec. 5007.18.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arenas or Field Houses</td>
<td>One (1) person for each seven (7) sq. ft. seating area projected horizontally. (Or fixed seating capacity).</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Armories</td>
<td>One (1) person for each thirty (30) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Assembly Halls</td>
<td>One (1) person for each seven (7) sq. ft. seating area projected horizontally. (Or fixed seating capacity).</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Auditoriums</td>
<td>One (1) person for each seven (7) sq. ft. seating area projected horizontally. (Or fixed seating capacity).</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Banquet Rooms</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Barber Shops</td>
<td>One (1) person for each thirty (30) sq. ft. gross floor area.</td>
<td>J and Table 50-E</td>
</tr>
<tr>
<td>Beauty Parlors</td>
<td>One (1) person for each thirty (30) sq. ft. gross floor area.</td>
<td>J and Table 50-E</td>
</tr>
<tr>
<td>Billiard Rooms</td>
<td>One (1) person for each fifteen (15) sq. ft. gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Bowling Alleys</td>
<td>See Section 5007.18.2 A Exceptions.</td>
<td>A</td>
</tr>
<tr>
<td>Cafes</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross public floor area and one (1) person for each two hundred (200) sq. ft. of gross preparation area.</td>
<td>B and Table 50-B</td>
</tr>
<tr>
<td>Cafeterias</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross public floor area and one (1) person for each two hundred (200) sq. ft. of gross preparation area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Churches</td>
<td>See Section 5007.18.2 A Exceptions.</td>
<td>A</td>
</tr>
<tr>
<td>Dance Floors</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Day Nurseries</td>
<td>One (1) person for each one hundred fifty (150) sq. ft. gross floor area.</td>
<td>I and Table 50-H</td>
</tr>
<tr>
<td>Dining Rooms</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Use or Occupancy</td>
<td>Basis for Determining Occupant Load</td>
<td>Sec. 5007.18.2</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Dormitories</td>
<td>One (1) person for each fifty (50) sq. ft. of gross floor area.</td>
<td>C and Table 50-C</td>
</tr>
<tr>
<td>Drive-In Restaurants</td>
<td>Three (3) persons for each vehicle space.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Drive-In Theaters</td>
<td>Three (3) persons for each vehicle space.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Dwelling Units</td>
<td>See Section 5007.18.2(e).</td>
<td>E and Table 50-D</td>
</tr>
<tr>
<td>Employment (General Places Of)</td>
<td>One (1) person for each one hundred (100) sq. ft. of gross floor area.</td>
<td>J and Table 50-E</td>
</tr>
<tr>
<td>Foundries</td>
<td>One (1) person for each five hundred sq. ft. of gross floor area.</td>
<td>F and Table 50-E</td>
</tr>
<tr>
<td>Gymnasiums</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Homes for the Aged</td>
<td>One (1) person for each eighty (80) sq. ft. of gross floor area.</td>
<td>G and Table 50-F</td>
</tr>
<tr>
<td>Hospitals</td>
<td>One (1) person for each eighty (80) sq. ft. of gross floor area.</td>
<td>G and Table 50-F</td>
</tr>
<tr>
<td>Hotels</td>
<td>See Section 5007.18.2 D Exceptions.</td>
<td>D</td>
</tr>
<tr>
<td>Libraries (Public)</td>
<td>See Section 5007.18.2 A Exceptions.</td>
<td>A</td>
</tr>
<tr>
<td>Lodges</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>B and Table 50-A</td>
</tr>
<tr>
<td>Lounges</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross public floor area and one (1) person for each two hundred (200) sq. ft. of gross preparation area.</td>
<td>B and Table 50-B</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>One (1) person for each three hundred (300) sq. ft. of gross floor area.</td>
<td>F and Table 50-E</td>
</tr>
<tr>
<td>Meeting Rooms</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Mental Hospitals</td>
<td>See Hospitals</td>
<td></td>
</tr>
<tr>
<td>Motels</td>
<td>See Section 5007.18.2 D</td>
<td>D</td>
</tr>
<tr>
<td>Nursing Homes</td>
<td>One (1) person for each eighty (80) sq. ft. of gross floor area.</td>
<td>G and Table 50-F</td>
</tr>
</tbody>
</table>
### TABLE 50-K -- Continued

<table>
<thead>
<tr>
<th>Use or Occupancy</th>
<th>Basis for Determining Occupant Load</th>
<th>Sec. 5007.18.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices</td>
<td>One (1) person for each one hundred (100) sq. ft. of gross floor area.</td>
<td>J and Table 50-E</td>
</tr>
<tr>
<td>Orphanages</td>
<td>One (1) person for each one hundred fifty (150) sq. ft. of gross floor area.</td>
<td>I and Table 50-H</td>
</tr>
<tr>
<td>Parking Lots</td>
<td>See Section 5007.18.2. F Exception</td>
<td>F</td>
</tr>
<tr>
<td>Penal Institutions</td>
<td>Not Applicable.</td>
<td>H and Table 50-G</td>
</tr>
<tr>
<td>Restaurants</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross public floor area and one (1) person for each two hundred (200) sq. ft. of gross preparation area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Retail Establishments</td>
<td>One (1) person for each one hundred fifty (150) sq. ft. of gross sales area (See Exception).</td>
<td>J and Table 50-E</td>
</tr>
<tr>
<td>Sanitariums</td>
<td>One (1) person for each eighty (80) sq. ft. of gross floor area.</td>
<td>G and Table 50-F</td>
</tr>
<tr>
<td>Schools, Class, Recitation and Library Reading Rooms</td>
<td>One (1) person for each twenty (20) sq. ft. of gross floor area.</td>
<td>K and Table 50-I</td>
</tr>
<tr>
<td>Study Rooms</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td></td>
</tr>
<tr>
<td>Class rooms seated with Tablet arm chairs or seats without desks</td>
<td>One (1) person for each ten (10) sq. ft. of gross floor area.</td>
<td></td>
</tr>
<tr>
<td>Shops and Vocational Rooms</td>
<td>One (1) person for each three hundred (300) sq. ft. of gross floor area.</td>
<td></td>
</tr>
<tr>
<td>Skating Rinks</td>
<td>One (1) person for each one hundred (100) sq. ft. of gross floor area.</td>
<td>(a) and Table 50-A</td>
</tr>
<tr>
<td>Stadiums</td>
<td>One (1) person for each seven (7) sq. ft. of seating area projected horizontally. (Or fixed seating capacity).</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Stages</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross floor area.</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Taverns</td>
<td>One (1) person for each fifteen (15) sq. ft. of gross public floor area and one (1) person for each two hundred (200) sq. ft. of gross preparation area.</td>
<td>B and Table 50-B</td>
</tr>
</tbody>
</table>
### TABLE 50-K -- Continued

<table>
<thead>
<tr>
<th>Use or Occupancy</th>
<th>Basis for Determining Occupant Load</th>
<th>Sec. 5007.18.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theaters</td>
<td>One (1) person for each seven (7) sq. ft. of seating area projected horizontally. (Or fixed seating capacity).</td>
<td>A and Table 50-A</td>
</tr>
<tr>
<td>Tourist Courts</td>
<td>See Section 5007.18.2 D</td>
<td>D</td>
</tr>
<tr>
<td>Warehouses</td>
<td>See Section 5007.18.2 F Exception.</td>
<td>F</td>
</tr>
<tr>
<td>Workshops</td>
<td>One (1) person for each three hundred (300) sq. ft. of gross floor area.</td>
<td>F and Table 50-E</td>
</tr>
</tbody>
</table>
CHAPTER 54
GLASS AND GLAZING
JULY 1971

Section 5401. SCOPE

All glass and glazing in exterior wall openings and hazardous locations named in Section 5406 shall conform to the regulations specified in this Chapter and the Standards.

No person shall knowingly fabricate, assemble, glaze, install or cause to be installed glazing materials other than safety glazing materials for use in hazardous locations named in Section 5406.

See Chapters 17 through 22 of this Building Code for additional glass requirements where openings are required to be fire protected and Chapter 60 for openings glazed with plastics.

Section 5402. IDENTIFICATION

Each light shall bear the manufacturer's label designating the type and thickness of glass.

Each light of safety glazing material installed in a hazardous location shall be permanently labeled by etching, sandblasting, firing of ceramic material, or other approved suitable means applied to the safety glazing material. The label shall identify the manufacturer, the nominal thickness and the type of safety glazing material, and a statement that the material meets the test requirements of the American National Standards Institute Standard Z-97.1-1966.

Section 5403. AREA LIMITATIONS

The area of individual lights of ordinary (annealed) glass exposed to wind loads shall be not more than that set forth in Table No. 54-A and shall be designed to withstand wind loads as indicated in Chapter 23 and this Chapter.

Section 5404. GLAZING

Lights shall be installed in and completely surrounded by frames with the minimum frame laps and glass edge clearances as set forth in Table No. 54-C.

EXCEPTION: Where firm support is not provided at all edges, the means of installation shall meet the approval of the Department.

Section 5405. LOUVERED WINDOWS

Louvered windows may be exempted from the provisions of this Chapter if the individual lights are less than one and one-half square feet (1 1/2 sq. ft.) in area.

Section 5406. HAZARDOUS LOCATIONS AND SAFETY GLAZING MATERIALS

Glass lights installed in hazardous locations as defined herein shall be glazed with safety glazing materials.

Hazardous locations shall consist of one or any of the following:

1. Framed or unframed glass entrance doors in Occupancy Groups A, B, C, D, F2, H, I.

2. Sliding glass doors, storm doors, shower doors, bathtub enclosures, and fixed glass panels adjacent to entrance and exit doors in Occupancy Groups A, B, C, D, F2, H, I.

3. Glass lights subject to impact or installed in hazardous locations shall comply with the size and thickness requirements set forth in Table No. 54-D.

Safety glazing material shall mean any glazing material such as tempered glass, laminated glass, wire glass, or rigid plastic, which meets the test requirements of the American National Standards Institute Standard Z-97.1-1966.

Section 5407. WIND LOADING FOR EXTERIOR GLASS

Where wind loading is required in any exterior wall by Chapter 23 of this Building Code, Table 54-A shall apply as to the amount of square footage permitted as it relates to the thickness of glass and pounds per square foot of pressure exerted.
TABLE 54-A
REQUIRED NOMINAL THICKNESS OF
ORDINARY ANNEALED GLASS—EXTERIOR
Safety Factor 2.5

1. Areas may be increased or decreased according to Table 54-B.
2. Areas shown are for panes of glass firmly supported on four sides and mounted in a vertical position. Glass mounted at a slope not to exceed one horizontal to five vertical may be considered as vertical.
TABLE 54-B
AREA ADJUSTMENT FACTORS FOR VARIOUS TYPES OF GLASS

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laminated</td>
<td>0.6</td>
</tr>
<tr>
<td>Wired</td>
<td>0.5</td>
</tr>
<tr>
<td>Heat Strengthened</td>
<td>2</td>
</tr>
<tr>
<td>Fully Tempered</td>
<td>4</td>
</tr>
<tr>
<td>Hermetically Sealed Double-Glazed Units</td>
<td>1.5</td>
</tr>
<tr>
<td>Rough Rolled</td>
<td>1</td>
</tr>
<tr>
<td>Sand Blasted</td>
<td>0.4</td>
</tr>
<tr>
<td>Ordinary Plate or Sheet Glass</td>
<td>1</td>
</tr>
</tbody>
</table>

Multiply maximum permissible area of ordinary glass by this value to establish maximum permissible area of glass type to be used. Applicable to glass of thickness equal to or greater than three-sixteenths (3/16) inch.
### TABLE NO. 54-C
### MINIMUM GLAZING REQUIREMENTS

<table>
<thead>
<tr>
<th>GLASS AREA</th>
<th>FIXED WINDOWS AND OPENABLE WINDOWS OTHER THAN HORIZONTAL SLIDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 6 Sq. Ft.</td>
</tr>
<tr>
<td>Minimum Frame Lap (^4)</td>
<td>(\frac{1}{4})''</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance (^4)</td>
<td>(\frac{1}{8}, 1.2)''</td>
</tr>
<tr>
<td>Continuous Metal Stop Beads (^3)</td>
<td>Not Required</td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
</tr>
</tbody>
</table>

**METAL SLIDING DOORS AND HORIZONTAL SLIDING WINDOWS**

<table>
<thead>
<tr>
<th>GLASS AREA</th>
<th>Up to 14 Sq. Ft.</th>
<th>14 to 32 Sq. Ft.</th>
<th>32 to 50 Sq. Ft.</th>
<th>Over 50 Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Glass Frame Lap (^4)</td>
<td>(\frac{1}{4})''</td>
<td>(\frac{5}{16})''</td>
<td>(\frac{3}{8})''</td>
<td>(\frac{1}{2})''</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance (^4)</td>
<td>(\frac{1}{8}, 2)''</td>
<td>(\frac{3}{16})''</td>
<td>(\frac{1}{4})''</td>
<td>(\frac{1}{4})''</td>
</tr>
<tr>
<td>Continuous Metal Stop Beads (^3)</td>
<td>Required</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Glass edge clearance in fixed openings shall be at least that required to provide for wind or earthquake drift.
2. Glass edge clearance at all sides of pane shall be a minimum of three-sixteenths (3/16) inch where height of glass exceeds three (3) feet.
3. Plastic beads, gaskets and channel type gaskets, wood beads or putty on wood windows and putty on steel windows, may be acceptable when approved by the Department.
4. Any deviation shall require approval of the Department. *Resilient setting material shall not be required when metal enclosed drive-in or channel type gasket glazing is employed.
### TABLE NO. 54-D

**IMPACT LOADS — GLASS**

<table>
<thead>
<tr>
<th>GLASS TYPE</th>
<th>INDIVIDUAL OPENING AREA</th>
<th>REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular plate, sheet or rolled (annealed)</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or protective screen firmly attached on each exposed side if not divided by a muntin, or decorated²³</td>
</tr>
<tr>
<td>Regular plate, sheet or rolled (annealed), surfaced sandblasted, etched, or otherwise depreciated</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or protective screen firmly attached on each exposed side, if not divided by a muntin, or decorated³²⁴</td>
</tr>
<tr>
<td>Regular plate, sheet or rolled (annealed) obscure</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or screen firmly attached on each side, if not divided by a muntin, or decorated³</td>
</tr>
<tr>
<td>Laminated</td>
<td>Over 6 square feet</td>
<td>At least 1/4&quot; thick</td>
</tr>
<tr>
<td>Fully Tempered</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick</td>
</tr>
<tr>
<td>Wired</td>
<td>Over 6 square feet</td>
<td>At least 1/4&quot; thick</td>
</tr>
<tr>
<td>Frameless</td>
<td>All Glass Doors</td>
<td>Shall be fully tempered glass</td>
</tr>
</tbody>
</table>

¹ Glass less than single strength (SS) in thickness shall not be used.
² If short dimension is larger than twenty-four inches (24") glass shall be double strength (DS) or thicker.
³ See Chapter 17 for shower areas.
⁴ Decoration shall be sufficient to make glass plainly visible.

**Section 5409. STANDARDS**

Unless otherwise provided in this Building Code, the standards as set forth in this Chapter shall prevail.

**Organization**

American National Standards Institute

**Title of Publication**

Standard Z-97.1 – 1966
CHAPTER 54
GLASS AND GLAZING

Section 5401. SCOPE

All glass and glazing in exterior wall openings and hazardous locations named in Section 5406 shall conform to the regulations specified in this Chapter and the Standards.

See Chapters 17 through 22 of this Building Code for additional glass requirements where openings are required to be fire protected and Chapter 60 for openings glazed with plastics.

Section 5402. IDENTIFICATION

Each light shall bear the manufacturer's label designating the type and thickness of glass. Each light with special performance characteristics such as laminated, heat-strengthened, fully tempered, or insulated shall bear the manufacturer’s identification showing the special characteristic and thickness by etching or other permanent means, and need not be labeled.

Section 5403. AREA LIMITATIONS

The area of individual lights of ordinary (annealed) glass exposed to wind loads shall be not more than that set forth in Table No. 54-A and shall be designed to withstand wind loads as indicated in Chapter 23 and this Chapter.

Section 5404. GLAZING

Lights shall be installed in and completely surrounded by frames with the minimum frame laps and glass edge clearances as set forth in Table No. 54-C.

EXCEPTION: Where firm support is not provided at all edges, the means of installation shall meet the approval of the Department.

Section 5405. LOUVERED WINDOWS

Louvered windows may be exempted from the provisions of this Chapter if the individual lights are less than one and one-half square feet (1 1/2 sq. ft.) in area.

Section 5406. IMPACT

Glass lights subject to impact hazards and in the following locations shall comply with Table No. 54-D.

1. Glass doors and wall panels of bathtub and shower enclosures. For plastics, see Chapter 60.
2. Glass lights of glass panel doors.

Section 5407. WIND LOADING FOR EXTERIOR GLASS

Where wind loading is required in any exterior wall by Chapter 23 of this Building Code, Table 54-A shall apply as to the amount of square footage permitted as it relates to the thickness of glass and pounds per square foot of pressure exerted.
TABLE 54-A
REQUIRED NOMINAL THICKNESS OF ORDINARY ANNEALED GLASS—EXTERIOR

Safety Factor 2.5

1. Areas may be increased or decreased according to Table 54-B.
2. Areas shown are for panes of glass firmly supported on four sides and mounted in a vertical position. Glass mounted at a slope not to exceed one horizontal to five vertical may be considered as vertical.
### TABLE 54-B

**AREA ADJUSTMENT FACTORS FOR VARIOUS TYPES OF GLASS**

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laminated</td>
<td>0.6</td>
</tr>
<tr>
<td>Wired</td>
<td>0.5</td>
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<td>Hermetically Sealed Double-Glazed Units</td>
<td>1.5</td>
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<tr>
<td>Rough Rolled</td>
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</tr>
<tr>
<td>Sand Blasted</td>
<td>0.4</td>
</tr>
<tr>
<td>Ordinary Plate or Sheet Glass</td>
<td>1</td>
</tr>
</tbody>
</table>

Multiply maximum permissible area of ordinary glass by this value to establish maximum permissible area of glass type to be used. Applicable to glass of thickness equal to or greater than three-sixteenths (3/16) inch.
### TABLE NO. 54-C

**MINIMUM GLAZING REQUIREMENTS**

<table>
<thead>
<tr>
<th>GLASS AREA</th>
<th>FIXED WINDOWS AND OPENABLE WINDOWS OTHER THAN HORIZONTAL SLIDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Up to 6 Sq. Ft.</td>
</tr>
<tr>
<td>Minimum Frame Lap</td>
<td>$\frac{1}{4}''$</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance</td>
<td>$\frac{1}{8}, 1, 2$</td>
</tr>
<tr>
<td>Continuous Metal Stop Beads</td>
<td>Required</td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
</tr>
</tbody>
</table>

**METAL SLIDING DOORS AND HORIZONTAL SLIDING WINDOWS**

<table>
<thead>
<tr>
<th>GLASS AREA</th>
<th>Up to 14 Sq. Ft.</th>
<th>14 to 32 Sq. Ft.</th>
<th>32 to 50 Sq. Ft.</th>
<th>Over 50 Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Glass Frame Lap</td>
<td>$\frac{1}{4}''$</td>
<td>$\frac{5}{16}''$</td>
<td>$\frac{3}{8}''$</td>
<td>$\frac{1}{2}''$</td>
</tr>
<tr>
<td>Minimum Glass Edge Clearance</td>
<td>$\frac{1}{8}, 2$</td>
<td>$\frac{3}{16}''$</td>
<td>$\frac{1}{4}''$</td>
<td>$\frac{1}{4}''$</td>
</tr>
<tr>
<td>Continuous Metal Stop Beads</td>
<td>Required</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilient Setting Material</td>
<td>Not Required</td>
<td>Required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Glass edge clearance in fixed openings shall be at least that required to provide for wind or Earthquake drift.
2. Glass edge clearance at all sides of pane shall be a minimum of three-sixteenths (3/16) inch where height of glass exceeds three (3) feet.
3. Plastic beads, gaskets and channel type gaskets, wood beads or putty on wood windows and putty on steel windows, may be acceptable when approved by the Department.
4. Any deviation shall require approval of the Department. *Resilient setting material shall not be required when metal enclosed drive-in or channel type gasket glazing is employed.*
### Table No. 54-D

**Glass Doors**

**Impact Loads — Glass**

<table>
<thead>
<tr>
<th>Glass Type</th>
<th>Individual Opening Area</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular plate, sheet or rolled (annealed)</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or protective screen firmly attached on each exposed side if not divided by a muntin, or decorated.</td>
</tr>
<tr>
<td>Regular plate, sheet or rolled (annealed), surfaced sandblasted, etched, or otherwise depreciated</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or protective screen firmly attached on each exposed side, if not divided by a muntin, or decorated.</td>
</tr>
<tr>
<td>Regular plate, sheet or rolled (annealed) obscure</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick. Shall be protected by a push-bar or screen firmly attached on each side, if not divided by a muntin, or decorated.</td>
</tr>
<tr>
<td>Laminated</td>
<td>Over 6 square feet</td>
<td>At least ¼&quot; thick</td>
</tr>
<tr>
<td>Fully Tempered</td>
<td>Over 6 square feet</td>
<td>At least 3/16&quot; thick</td>
</tr>
<tr>
<td>Wired</td>
<td>Over 6 square feet</td>
<td>At least ¼&quot; thick</td>
</tr>
<tr>
<td>Frameless All Glass Doors</td>
<td></td>
<td>Shall be fully tempered glass</td>
</tr>
</tbody>
</table>

---

1. Glass less than single strength (SS) in thickness shall not be used.
2. If short dimension is larger than twenty-four inches (24") glass shall be double strength (DS) or thicker.
3. (See Chapter 17 for shower areas).
4. Decoration shall be sufficient to make glass plainly visible.

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**Section 5410. Standards**

Unless otherwise provided in this Building Code, the standards as set forth in this Chapter shall prevail.

**Organization**

Federal Specifications

**Legend:**

General Services Administration
Denver Federal Center, Building 41
Denver, Colorado 80225

**Title of Publication**

DD-G-451 (a) 1. 1951. Glass, flat and corrugated, for glazing, mirrors, and other uses. FSC-5620
CHAPTER 55
VERTICAL TRANSPORTATION

Section 5500. GENERAL

(a) Scope. In addition to the other requirements of this Building Code, this Chapter shall govern the installation, repair, maintenance and approval of all elevators, escalators, dumbwaiters, stage-lifts, man-lifts, hoists, and derricks, when used in conjunction with the construction or demolition of any building, structure or utility.

(b) Permit. Prior to the erection or use of any hoist, elevator or derrick a permit shall be obtained and the fee shall be as required in the fee schedule as set forth in Chapter 3. This requirement shall also apply to prefabricated hoists.

(c) Prohibitions

1. Hoists shall not be operated until such have been inspected and approved by the Department.

2. Mast tower cantilevered platform type automatic hoist shall not be permitted when the height exceeds twenty-five (25) feet unless operated by a certified operator and unless the tower is guyed and provided with the safety barricades and gates as approved by the Department.

3. A working platform or equipment which is not required for the operation of the elevator or its appurtenances shall not be located above the top of an elevator car.

4. Belted elevator hoisting machines shall not be permitted.

5. Platform elevators with more than two (2) points of suspension or support shall not be permitted.

6. Stacking machines shall not be used as an elevator.

7. No person shall perform any work on any installation regulated by this Chapter other than ordinary maintenance, without compliance with Chapter 3 of this Building Code.

8. Private residence elevators or inclined lifts shall be prohibited from all buildings except single family dwellings.

9. Hand powered elevators shall not be permitted in new construction and existing installations shall not be motorized.

10. Manlifts shall not be permitted except when approved by the Department.

11. Sidewalk elevators shall not be permitted on the public way.

(d) Unsafe. For installations found by the Department to be unsafe, see Chapter 1.

(e) Accident Reports.

1. Every person, firm, or corporation, owning, controlling, operating or using as owners, lessee, or agent any vertical transportation equipment within the City shall report any accident occurring thereon or caused thereby involving a person or damages to the transportation or equipment or to its enclosures, to the Department immediately after such accident.
2. When an accident involves damage to any portion of the elevator hoist or derrick, the equipment shall not be operated until such has been approved by the Department. The Department, if it is deemed necessary, may order the discontinuance of the service until a new certificate has been issued.

3. Portions of the damaged construction or operating mechanism shall not be removed from the premises until permission has been granted by the Department.

(f) Existing Installations. Alterations to an installation regulated by this Chapter, not in excess of fifty (50) per cent of the value of such installation shall conform to the requirements of this Chapter as nearly as practicable, where alterations in excess of fifty (50) per cent of the value of such installation are provided or change in power or control is provided, full conformity shall be required.

(g) Size and Access. Elevator machine rooms shall be of a sufficient size as to permit the safe and adequate maintenance of the elevator machinery. The elevator machinery rooms shall be provided with a safe and accessible means of entry.

(h) Allowable Equipment. Elevator machine rooms and elevator hoistways shall contain only that equipment, piping and wiring pertaining to the elevator or its operation.

EXCEPTION: Fire protection equipment may be installed in machine rooms as required in Chapter 38.

(i) Elevator Hoistway Openings. During construction of the elevator, all elevator hoistway openings shall be provided with an approved barricade.

(j) Riding on Loads Prohibited. No person shall be permitted to ride on loads, hooks, or slings of any derrick, hoist or crane.

EXCEPTIONS: 1. Riggers may ride loads supported by high lines at projects like dams, bridges, etc., when it is necessary to spot the load. Only authorized workmen shall be permitted to ride such loads, and all parts of the hoisting equipment shall provide a factor of safety of ten (10) or more.

2. A concrete bucket tender, with authorization to do so, may ride the bucket when it is necessary for greater safety. All parts of the load-handling equipment shall provide a factor of safety of ten (10) or more when a man rides the bucket.

3. Workmen may ride a single structural member for the purpose of connecting the member to the erected structure.

4. In certain isolated instances, workers may ride the hook to or from a special job at an elevated point, where climbing would present a greater hazard, provided that they are protected by a safety belt.

(k) Emergency Elevators. All new and existing buildings in excess of ten (10) stories in height above the street level and with automatic passenger elevators, shall be so equipped that each elevator serving the areas above the tenth floor shall be capable of becoming an emergency elevator(s). The elevator(s) shall be equipped to operate with emergency service.

The electrical service for all elevators shall be connected on the supply side of the main disconnecting means. (See Chapter 53).

In addition to the other requirements of this Chapter, emergency elevator service shall comply with the following:

1. The emergency service shall be placed in operation by means of a two position "ON-OFF" keyed switch located on the face of the car station coverplate or in a centrally located lobby fixture. When this keyed switch is placed in the "ON" position the elevator shall be removed from normal operation and shall be operable from the car station floor buttons only. The car shall be placed in operation by pressure of a car station floor button, the elevator doors shall close automatically and the elevator shall proceed to the floor selected. The elevator shall not stop in answer to any corridor call. Upon arrival of the elevator at the selected floor, the elevator doors shall open automatically and remain open until another call is registered by pushing another car station floor button.

2. Placing the elevator on emergency service shall automatically cancel all existing car calls for that particular elevator.

3. By returning the keyed switch in the car station or lobby fixture to the "OFF" position the elevator shall return to normal operation.

4. Emergency key or keys shall be placed in a permanently attached metal container with opaque "Break Glass" cover. The container shall be located within ten (10) feet of the main exit of the building, unless otherwise approved by the Department.
5. The operation of the emergency service 
switch in one elevator shall, in addition to 
the above, also cut out all light beam or 
electronic door protective devices on all 
elevators in the bank of elevators. The ele­ 
vators shall operate with protection from 
door edge reopening devices only. 
(Ord. 97 — 1968)

Section 5501. DEFINITIONS

Except as otherwise provided, terms and 
symbols used in this Chapter shall be defined as 
follows:

Belt Driven Elevator. A belt driven elevator 
is one in which the driving mechanism is con­ 
ected to a prime mover by a single or multiple 
belts, and where multiple belts are used, the 
direction of motion of the elevator car is 
changed without reversal of the prime mover.

Boom-type Excavator means a power-oper­ 
ated crane-type excavating machine, usually 
used for digging or moving materials. Some 
excavators of this type are commonly known as 
dipper stickshovels, back -diggers, trench hoe 
shovels, draglines, grab buckets, clamshell, or 
orange peel excavators.

Bricklayer's or mason's suspended scaffold 
means a heavily constructed suspended scaffold 
built to withstand the weight of workmen and 
the storage of materials, such as bricks, mortar, 
cement blocks, etc. Such is intended for use 
in conjunction with heavy material accumulated 
on the scaffold. The load, including workmen to 
be placed thereon, shall be limited to a maxi­ 
mum of one hundred pounds (100 lbs.) per 
square foot of scaffold platform.

Cab means an enclosure for housing the 
operator and the hoisting mechanism, power 
plant, or other equipment controlling a crane or 
boom-type excavator.

Crane means a boom-type machine for lift­ 
ing, lowering, or swinging a load and moving it 
laterally, in which the hoisting mechanism is an 
integral part of the machine. Such may be 
driven manually or by power and may be a fixed 
or mobile machine.

Derrick means an apparatus, for hoisting or 
swinging loads, consisting of a mast supported 
by guys or braces. Such usually has a boom, 
hinged at the lower end, for carrying the load 
and may be power- or hand-operated.

Douglas Fir or equivalent means “selected 
lumber” or other suitable material of proper 
size, to provide structural members having 
strength at least equal to the specified Douglas 
Fir members. (See definition of “selected lum­ 
ber” under “lumber.”)

Dumbwaiter is a hoisting and lowering 
mechanism equipped with a car, the floor area 
of which does not exceed nine (9) square feet, 
whose compartment height does not exceed 
four (4) feet, the capacity of which does not 
exceed 500 pounds and which is used exclu­ 
sively for carrying small packages and freight.

Elevator. A hoisting and lowering mechan­ 
ism equipped with a car or platform which 
moves in guides in a substantially vertical direc­ 
tion and which serves two (2) or more floors of 
a building or structure.

Escalator. A power-driven, inclined, con­ 
tinuous stairway used for raising or lowering 
passengers.

Hand Power Elevator. An elevator utilizing 
manual energy to move the car.

Hoist means any apparatus by which a pull­ 
ing and releasing action can be transmitted 
through ropes, wire ropes, or chains to bring 
about the raising or lowering of loads.

Hoistway. A shaftway for the travel of one 
or more elevators or dumbwaiters. Such shall 
include the pit and terminates at the underside 
of the overhead machinery space floor or grat­ 
ing, or at the underside of the roof where the 
hoistway does not penetrate the roof.

Hoistway Enclosure. The fixed structure, 
consisting of vertical walls or partitions, which 
isolates the hoistway from all other portions of 
the building or from an adjacent hoistway and 
in which the hoistway doors and door assemblies 
are installed.

Hoistway Door or Gate Locking Device. A 
device which secures a hoistway door or gate in 
the closed position and prevents such from 
opening from the landing side except under cer­ 
tain specified conditions.

Lumber. “Structural plank” means Douglas 
Fir suitable for scaffold planks. The following 
characteristics and limiting provisions apply:

Allowable bending stress: 1,000 pounds 
per square inch.

Medium seasoning checks.

Close grain.
Slope of grain not more than 1 in 12.

Knots allowed only if sound, tight, well-scattered, and limited in same to the following approximate maximums:

One \( \frac{3}{8}'' \), two \( \frac{3}{4}'' \), and two \( \frac{1}{2}'' \) knots permitted in 10'', 12'', and 14'' face widths respectively.

**NOTES:** Well-scattered means that the sum of the sizes of all knots in any six inches (6'') of length of a piece shall not exceed twice the size of the largest knot permitted. More than one (1) knot of maximum permissible size must not be in the same six inches (6'') of length, and the combination of knots must not be serious.

"Selected lumber" means Douglas fir that has been graded, under standards as high as those followed by the West Coast Lumber Inspection Bureau in April, 1956, as suitable for a bending stress of 1,500 psi. Small material like boards, sheathing, studs, and light framing are not normally assigned a 1,500 psi stress rating, but such material is considered to be "selected lumber" if it has been assigned the same lumber grade as the larger pieces that are rated at 1500 psi bending.

**NOTE:** Construction grade lumber described in paragraphs 120-b, 122-b, 123-b, 124-b of the March 15, 1956, Standard Grading and Dressing Rules No. 15, published by West Coast Lumberman's Association, satisfies the above definition.

**Lumber Size.** Unless otherwise stated, the lumber sizes referred to in this Chapter mean nominal sizes and thus include both the rough and dressed members of those nominal sizes.

**Loading device** means a mobile mechanical-powered machine of the skip-loader type used for picking up materials and loading or dumping them into haulage vehicles, bins, or hoppers, excluding fork lifts, boom-type excavators, and endless belt or chain conveyors.

**Manlift.** A power driven, vertical, continuous belt device equipped with steps or other mechanical means of supporting a man, in order to raise or lower him from floor to floor.

**Mast Tower Platform** is a single vertical member on which a cantilevered platform, suitable for carrying material, may be moved up and down.

**Platform** means an elevated working level for persons.

**Scaffold** means the complete scaffold structure, including the platform and all supporting members.

**Sidewalk Lift.** A freight elevator which operates between a sidewalk or other area exterior to the building and floor levels inside the building below such area, which has no landing opening into the building at its upper limit of travel, and which is not used to carry vehicles.

**Skip** means a container with sides in which materials are hoisted.
Section 5502. HOISTWAYS AND ENCLOSURES

(a) Enclosures. Hoistway enclosures shall conform to the requirements of Chapters 30 and 43.

(b) Projections. The side of the hoistway containing the exit from the car shall be free from projections and present a smooth, even surface on the inside of such hoistway throughout its entire length for a distance equal to the clear opening plus four (4) inches on both sides of the opening.

(c) Side Exits. Where an elevator is located in an adjacent hoistway, and the distance between the car platforms does not exceed two feet six inches (2'6"), and where there are no intervening hoistway partitions, counterweights or fixed obstructions, other than separate beams between the cars, a side emergency-exit door shall be provided in each adjacent car. The exit door shall be provided with car door electric contacts.

Section 5503. PERIODIC INSPECTIONS

(a) Inspections. Any owner, lessee, or manager shall not use or place in operation any equipment regulated by this Chapter after each successive six (6) months of use; after being moved from one location to another; or after being out of use for more than thirty (30) days without obtaining an inspection by the Department.

(b) Inspection Fees. Inspection fees shall be paid to the Department by the owner, lessee or manager of the building or structure in which an elevator, escalator, dumbwaiter, manlift or stage lift is installed.

EXCEPTION: Fees shall not be required of the City, State of Colorado or the United States Government.

<table>
<thead>
<tr>
<th>Type of Inspection</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevators (each unit)</td>
<td>$4.50</td>
</tr>
<tr>
<td>Three (3) landings or less</td>
<td>$4.50</td>
</tr>
<tr>
<td>Over three (3) landings</td>
<td>$4.50</td>
</tr>
<tr>
<td>$.25 for each landing over three (3)</td>
<td></td>
</tr>
<tr>
<td>Escalators</td>
<td>$4.50 (each unit)</td>
</tr>
<tr>
<td>Dumbwaiters</td>
<td>$4.50 (each unit)</td>
</tr>
<tr>
<td>Stage lifts</td>
<td>$4.50 (each unit)</td>
</tr>
<tr>
<td>Man lifts</td>
<td>$4.50 (each unit)</td>
</tr>
</tbody>
</table>

*For escalators: This shall mean each unit, floor to floor, in either direction.

(c) Elevators, Escalators, Dumbwaiters, Stage Lifts, Man Lifts.

1. Certificate and Owners Requirements. A certificate, issued by the Department for elevators, escalators, dumbwaiters, stage lifts, man lifts shall indicate the date or dates of inspection, and the load that may be safely carried. Such shall be framed in a conspicuous place as approved by the Department. Prior to the issuance of such certificate the owner or operating agent shall, at his expense, cause to be checked by a City licensed elevator contractor, the following:

A. All hoistway door or gate interlocking devices to determine if the equipment can operate with the doors in an open position.

B. All hoisting and counter-weight ropes to determine if sufficient wear or breaks justify replacing of the rope. In addition, the owner or operating agent shall cause the following work and tests to be made by such contractor at the following intervals:

All hoisting ropes of winding drum type machines shall be re-shackled every year for overhead machines and every two (2) years for semi-basement or basement machines.

The car safety device shall be tested without load at the slowest possible speed every year and at full load at the
rated car speed every
two (2) years on drum
elevators and every five
(5) years on traction
machines.

The overspeed govern­
or actuating the safety
device shall be checked
calibration every three (3) years.

2. The owner or operating agent shall
cause the equipment to be marked
or tagged so as to indicate the con­
tractor's name and the date when
such test or work was performed.

Section 5520. CONSTRUCTION OR DEMO­
LITION HOISTS, DERRICKS AND CRANES

(a) Scope. In addition to the other require­
ments of this Chapter and Building Code, this
Section shall govern the installation, mainten­
ance, repair and approval of all construction or
demolition hoists, cranes and derricks and their appurtenances.

Section 5521. CONSTRUCTION TOWERS

(a) General. Towers shall rest upon solid
foundations. Towers constructed of material
other than wood shall provide strength, sta­
bility, and durability at least equivalent to those
built in accordance with Section 5521 (c). (See
Section 5521 (d) for metal towers).

(b) Hoppers. The hopper brackets on all
towers shall be designed and constructed with
a safety factor of at least six (6). Bolts, or
equivalent, shall be used for attaching all large
hoppers or critical load bearing members, in­
cluding all horizontal supporting members that
are in contact with the hopper. For purposes of
this Chapter, a large hopper is one having a
capacity of one-half (½) cubic yard or more.

(c) Wooden Towers. Wooden members for
tower corner posts may be built up of two (2)
inch laminated material pursuant to the Table
55-A. The wooden members, such as splice
pads, braces, etc., shall be bolted. Bolts, less
than one-half (½) inch in diameter, shall not
be permitted.

1. Lumber for tower construction shall
be the equivalent of Douglas fir
"selected lumber," as defined in
this Chapter.

2. The nominal sizes of the various
members in wooden towers shall be
as specified in Table 55-A, or larger.

3. Not more than two (2) diagonal
braces may be omitted or removed
from a panel pointin the tower, but
if such is accomplished, braces are
not to be omitted from the next
panel above or below.

4. The diagonal cross bracing shall be
placed on each of the four (4) sides
of the tower and between horizontal
cross ties, except at loading and un­
loading station.

5. Post Splices. The splices of corner
posts, if one-piece material, shall be
provided with square butt joints and
with at least two (2) pads or scabs
on the adjacent sides. The pads or
scabs shall be of the same width
as the corner posts and at least two
(2) inches in thickness, and shall
extend at least two (2) feet on each
side of the joint.

6. Guys. Whenever wooden towers are
independent of the building, such
shall be guyed at each corner post
every thirty-two (32) feet in height
by at least a three-eighths (3/8) inch
wire rope or galvanized steel strand.
The anchor shall be designed to de­
velop the strength of the guy.

7. Extra Loads. Where spouting equip­
ment or other load, in addition to
the loaded cage or bucket, is
supported by the tower, the tower
shall be built in such manner as to
s a f e I y withstand any and all
stresses.

8. Tower Booms. Whenever a boom is
supported by the tower, the boom
anchor shall be located at a level
where guy lines are attached, and
the upper fastening of the falls
which raise and lower the boom
shall be placed at a distance of at
least one-half (½) of the length of
the boom above the boom anchor
and at a level supported by the
guys. The guy lines and anchors
supporting these two points shall be
designed to carry the extra load
caulsed by the boom and its load.

9. Access. A safe means of access shall
be provided to the top of each
wooden tower. This may normally
be accomplished by means of an attached side rail ladder, however, if a safe means of approach is provided from some point on the building or a ladder landing, the tower ladder need not extend below that point.

(d) Metal Construction Towers.

1. **Design.** All metal construction hoisting towers, masts, etc., shall be substantially constructed, and of such design that expected loads will not stress any members beyond the limits established by applicable engineering formula. The design shall also provide ample strength for loads imposed by the use of booms attached to a tower or mast. The maximum load, as specified by the manufacturers, shall not be exceeded.

2. **Foundation and Anchorage.** All metal construction hoisting towers, masts, etc., shall be placed on firm and substantial foundations and securely guyed or braced against swaying or tipping. Particular attention shall be given to the need for anchorage at the top of the towers and also at the bucket-dumping positions, where such equipment is used.

3. **Guying.** Metal construction hoisting towers, masts, etc., shall be supported by guys or anchored to a building or structure in accordance with manufacturer’s recommendations, provided, however, that such support or anchorage shall be installed at vertical intervals not exceeding forty (40) feet with at least three-eighths (3/8) inch wire rope or equivalent. This interval of spacing may be increased and the number of guys reduced only if the design and method of construction provide adequate strength to resist all lateral forces.

4. **Assembled Towers.** Positive connections, such as those made with bolts or pins, shall join the various segments from which assembled towers are constructed.

5. **Removal of bracing.** When necessary to remove diagonal bracing from two or more adjacent panels of the tower, some other bracing or reinforcement of equivalent strength shall be provided.

Section 5522. CONSTRUCTION ELEVATORS

(a) **Elevator Landing Gates and Barriers.** Standard railings and toe-boards shall be placed on the open sides of runways connecting the elevator tower to the structure. If a gate is not required by this Chapter, a bar forty-two (42) inches high and set back at least eighteen (18) inches from the tower shall be installed at all openings into the tower.

(b) **Enclosures.** Except for entrance, towers shall be enclosed on all sides adjacent to or within three (3) feet of any floor, landing, scaffold, or walkway to a height of at least six (6) feet. The enclosure shall be by means of wire mesh, slatted partitions, planks or plywood. Wire mesh shall be at least No. 18 gauge, with openings not exceeding one-half (½) inch in thickness and spaced not more than two (2) inches apart.

(c) **Landing Gates.** Construction elevators with three (3) or more landings (including the bottom one) shall have a slatted or solid gate at least six (6) feet high at all landings. Vertical sliding gates shall be counterweighted. Hinged gates are acceptable. (See Section 5523 (d) for requirement).

(d) **Inside Building.** If cages are to be used in an elevator shaft inside a building, the shaft opening shall be enclosed with a solid partition.

1. If one elevator in a shaft is put into service before the others are completed, that part of the shaft in which it operates shall be separated from the other part of the shaft by a continuous partition of solid material or a wire screen with two (2) inch or smaller mesh.

Section 5523. CONSTRUCTION MATERIAL ELEVATORS

(a) **General.** No employer shall permit any person to ride in an elevator provided for hoisting material, except when oiling or repairing guides, unless such elevator is in compliance with the requirements of Section 5524.

**EXCEPTION:** Permanent elevators being used temporarily for hoisting shall have a Department certified operator in the car.

(b) **Cage Construction.** The cage sling frame shall be made of Douglas fir “Selected Lum-
ber" or of structural steel and designed in accordance with accepted engineering practice to provide a factor of safety not less than four (4). Main members shall be bolted or welded.

1. The cage platform shall be a solid floor built of wood at least two (2) inches thick, or equivalent, and shall be securely attached to the frame.

(c) Hoisting Loose Materials. Cages for hoisting brick, tile or loose material shall have the unused sides enclosed to a height of forty-two (42) inches with boards or the equivalent of No. 16 U. S. Standard wire gauge screen, two (2) inch or smaller, mesh to protect workmen from falling material.

1. When construction buggies or wheelbarrows are hoisted on the cage, provisions shall be made to prevent their movement on the cage, and if buggies or wheelbarrows are loaded with loose material, all unused open sides of the cage shall be enclosed at least to a height of forty-two (42) inches.

(d) Signaling Device. In addition to the signal arrangements called for in this Chapter, the following shall be provided to prevent unexpected movement of any cage that a worker could board at a landing: Each landing gate on construction material elevators with three (3) or more landings (including the bottom one) shall be equipped with an adequate latching device and an electrical contact so designed and installed that a circuit which lights a green bulb is closed whenever all gates are closed. This bulb is to be in clear view of the operator, and the cage is not to be moved unless the bulb is glowing.

1. The following sign shall be placed on all cages or platforms of installations not designed for handling men and shall state as follows: "BUILDING DEPARTMENT OF THE CITY AND COUNTY OF DENVER PROHIBITS RIDING THIS CAGE OR PLATFORM." Size of letters shall be not less than two (2) inches in height.

(e) Sheave Beams and Bearings. The overhead sheave beams shall be of sufficient size and strength to safely carry four (4) times the maximum weight of cage and contents. They shall be Douglas Fir "selected lumber," as defined in this Chapter, or equivalent.

Such shall be bolted together. In all cases the sheave bearings shall be mounted on top of beams and securely bolted. Open bearings shall not be permitted.

1. All sheave bearings shall be lined with babbit, or other equivalent bearing metal, or have ball or roller bearings, and shall be provided with adequate means for lubrication.

(f) Sheave Dimensions. The minimum dimensions for all material elevator sheaves shall be as given in Table 55-B. Axles shall provide a minimum factor of safety of eight (8) based on the static load, a condition that will be fulfilled by following listed sizes indicated in Table 55-B, if the wire rope is not over loaded and the bearings abut against the sheave hub.

(g) Wire Rope. Hoisting rope shall be wire rope, plow steel, or equivalent, providing flexibility at least equal to that of standard plow steel hoisting rope composed of six (6) strands of nineteen (19) wires each.

1. All hoisting rope used in normal construction elevator service shall be wire rope providing a factor of safety of at least five (5), when new; which shall be calculated by dividing the breaking strength of the rope, as given in the manufacturer's published tables, by the total load to be hoisted, including the weight of the wire rope when fully let out.

2. Defective or badly worn wire ropes shall not be permitted, and no rope shall be used in which more than ten per cent (10%) of the total wires are broken in any running foot of said rope.

(h) Wire Rope Clips. Rope fastenings shall be substantially and securely made and maintained. The minimum number of clips for wire rope and attachments shall be as indicated in the manufacturer's tables, and rope end attachments shall be as indicated in the manufacturer's tables, but in no case shall less than three (3) such clips be permitted. All clips shall have the "U" side placed on the dead end of the rope. The clips shall be spaced at a distance equal to at least six (6) times the diameter of the rope. All sharp edges shall be prevented from coming into contact with the rope.

(i) Hoist Brake. Every hoist shall be equipped with a proper brake capable of sustaining the maximum load in any position.

(j) Hoist Operator. Each hoist operator shall have a covering over him as protection from falling material.

(k) Hoisting Ropes. Wire hoisting ropes in exposed locations within seven (7) feet of floor or ground shall be guarded by enclosure or fenced with standard railing.
Inspection and Maintenance. Hoisting machinery shall be thoroughly inspected each day it is to be used, with special attention given to brakes and other safety appliances. All hazardous defects found shall be corrected prior to further use of the equipment.

Rope Marking. Hoisting ropes shall be accurately marked, or equivalent steps taken, to indicate when the load has reached certain important positions, including top and bottom landings.

Section 5524. CONSTRUCTION ELEVATORS FOR HOISTING MEN (Other than permanent elevators on a temporary basis).

Construction elevators on which people ride shall comply with the provisions of this Section and all of Section 5523 except for those parts of Section 5523 (c), (c-1), (d) and (d-1) which are inconsistent with this Section.

(a) Car Attendant. Each elevator on which people ride shall be controlled by a Department approved attendant in the cage.

(b) Dead-man Control. Every machine used to hoist men shall be equipped with a control that will return to the "stop" position when the hand of the hoist operator is removed from the control lever. The brakes shall be automatically applied and the power from the machine cut off whenever the control lever is in the "stop" position.

(c) Brakes. The hoist machine shall be equipped with two (2) brakes, either of which is capable of stopping and holding a fully loaded cage. One shall be an automatic brake that will be applied whenever the power fails, is shut off, or when the power control lever is in the "off" position. The other brake shall be a hand or foot brake that operates on the hoist drum.

(d) Broken-rope Safety Device. The car shall be equipped with a broken-rope safety device, or equivalent, that will hold the car and capacity load in its guides in the event the rope separates. This safety device shall be tested on every installation. If the hoisting rope is so long and heavy that, in the event of breakage near the hoist drum, its inertia would interfere with the proper operation of a broken rope safety device, a governor-actuated, or equivalent, safety device shall be installed as a substitute.

1. Rope shall not be used for the purpose of raising or lowering men, when more than ten per cent (10%) of the total wires are broken in any running foot of said rope, or when the wires on the crown of the strands are worn down to less than sixty per cent (60%) of their original area, or when, by superficial inspection, the rope shows serious defects, such as a marked reduction in diameter or excessive corrosion.

2. All hoists shall be provided with an efficient device which will bring the cage to a stop at the top and bottom limits of travel.

3. The speed of the "cage" shall not exceed two hundred (200) feet per minute.

(e) Drum Flanges. The drums of construction hoists used for hoisting men shall have flanges which extend at least two (2) inches radially beyond the last layer of rope when all the rope is coiled on the drum.

1. Sheave and drum diameters shall not be less than the minimum recommended for this service by the manufacturer of the wire rope being used. The following table lists diameter dimensions that will not vary greatly from minimum values normally recommended.

<table>
<thead>
<tr>
<th>Rope Type</th>
<th>Diameter Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-strand 19-wire rope</td>
<td>40 times rope diameter</td>
</tr>
<tr>
<td>6-strand 27-wire rope</td>
<td>27 times rope diameter</td>
</tr>
<tr>
<td>8-strand 19-wire rope</td>
<td>32 times rope diameter</td>
</tr>
</tbody>
</table>

2. Gages shall have the top covered with boards not less than two (2) inches thick and the three (3) sides enclosed to a height of six (6) feet with ¾ (three-fourths) inch plywood, or some equivalent such as one (1) inch boards or No. 16 U.S. Standard gauge wire screen, not over two (2) inch mesh, fastened in a secure and substantial manner.

3. In lieu of a construction elevator, installations complying with the requirements for elevators may be used as construction elevators for hoisting men or materials, provided that such have car tops equivalent to that required by item 2 of this sub-section. Incomplete elevators in this category may also be used for construction services, provided that the major part of the installation is ready for service and the hazards that result from the incomplete items are controlled by measures at least equivalent to those in this Chapter.
Section 5525. HOISTING

(a) Operator. Hoisting machines shall be operated only by regularly assigned and City certified operators.

1. Each hoist operator shall have a covering over him as protection from falling material.

(b) Hoisting Operations. Only those persons whose duties require their services shall be in the hoist room or station.

1. There shall be no conversation involving the hoist operator while the hoist is in motion, or while he is attending to signals, except to receive orders or instructions.

2. The hoist shall be operated with extreme caution when workmen are being hoisted or lowered.

3. The hoist operator shall be kept fully informed on any changes in conditions of the work that affect hoisting operations.

4. The hoist shall not be operated during oiling of parts.

(c) Construction Hoisting Signals. Bell, whistle, or electric signals shall be provided on all hoists, except hoists where the hoist operator has a clear and unobstructed view of the load or signal man, in which case a manual system (see Fig. 1) of signaling may be used. Wiring for electrical signal systems shall be so arranged that an electrical failure will not result in a false signal to move the load.

(d) Posting Signals. The employer shall post a copy of the hoisting signals in a conspicuous place at the operator's place of duty and all landing levels of all elevators.

(e) Bell Signals. The following signals shall be used on all elevators and hoisting machines, unless manual signals (see Figure 1) or telephone are used:

   One bell or whistle, to stop
   Two bells or whistles, to go up
   Three bells or whistles, to go down
   Four bells or whistles, to go slow

(f) Derrick Signals. Whenever derricks are used for hoisting materials, the following signals shall be used unless manual signals are used. (See Figure 1).

Note: The signals are given with two (2) different sounding bells.

One bell, to hoist
Two bells, to lower
Three bells, to stop
Four bells, to go slow

(g) Crane Signals. Manual signals shall be used where signals are needed for safe crane operation, unless for special reasons a bell or telephone system is appropriately used.

Section 5526. MOBILE TOWERS, HOISTS, AND SIMILAR EQUIPMENT.

(Does not include cranes or earth moving machines).

(a) General. High lift truck, mobile hoist, or similar self-propelled equipment used in delivering materials to elevated platforms more than twelve (12) feet high, shall not be in motion while the load is being hoisted. Hoisting shall not proceed beyond the height needed for ground clearance until travel is completed, except for the final, lateral motion of a few feet needed in placing the elevated load in its final position just above platforms.

(b) Soil. A substantial plank or steel matting shall be provided where the ground is uneven, loose, soft, or filled, and shall extend far enough beyond the width and length of the wheel base to provide a substantial foundation.

(c) Transport. The platform of a mobile hoist unit used to transport any rolling equipment, such as wheelbarrows, concrete buggies, etc., shall be provided with an adequate means to hold such equipment and its load securely in place.

(d) Other Requirements. All mobile towers, hoists, and similar equipment shall comply with applicable provisions of Sections 5520 and 5523.

(e) Canopy Guard. The Department may require lift trucks, mobile hoists, or similar units to be equipped with canopy guards of strength adequate to withstand, without undue deformation, the impact of falling objects which are normally handled or stored.
Section 5527. MAST TOWERS AND HOISTS

(a) General. Any mast tower that has a cantilevered hoisting platform operating on a vertical mast or mastlike structure shall be stationary when in use. Such shall conform to Sections 5520 and 5523. (See Section 5500 (c) for Prohibitions).

1. The area on the ground or bottom landing that is under the cantilevered platform shall be surrounded on at least three (3) sides by the equivalent of a standard railing.

Section 5528. GIN POLES

(a) General. Gin poles shall be of high quality, defect-free material, such as selected timber, structural metal, or steel pipe. The pole and all component parts shall provide a factor of safety of at least four (4).

1. Gin poles shall be held as nearly perpendicular as possible, with only enough slope to clear the load to be lifted. At least three (3) guy wires or ropes shall be provided.

2. If a winding drum is provided, such shall be equipped with a friction brake and positive pawl or dog.

3. Every gin pole shall be securely fastened at the bottom to prevent such from kicking out during operation.

Section 5529. SLINGS

The slings used with derricks, or other hoisting apparatus, shall be made of wire rope, certified alloy steel chains, manila or sisal rope of sufficient strength to carry the imposed loads, with a safety factor of at least six (6). The factor of safety, based upon the sling’s original strength, shall be increased to eight (8) or more if the sling is not reasonably new.

Slings shall be of proper size and type to handle the load without overstress or slipping. Double choker slings shall be provided on all horizontal loads over twelve feet (12’) in length that include two (2) or more pieces of material.

Section 5530. RAILINGS AND TOEBOARDS.

(See Chapter 59, Standards).

Section 5531. SUSPENDED, POWER-DRIVEN SCAFFOLDS.

(See Chapter 59, Standards).

Section 5532. BOATSWAIN’S CHAIRS.

(See Chapter 59, Standards).

Section 5533. DERRICKS AND CRANES

(a) Derricks and Cranes. Derricks shall be constructed of metal or select structural Douglas fir, with proper metal braces and fittings. Derricks shall be of proper strength and size for the work to be performed, and shall be anchored so as to prevent them from tipping or collapsing. Guyed derricks shall have at least six (6) guys. This number shall not be reduced, unless a study by the Department determines that the proposed guy arrangement will provide a safety factor of at least three and one-half (3 1/2) under all circumstances.

1. Reinforcing steel shall not be permitted for guy line anchors.

(b) Brakes. The hoisting drum of all hand-power hoists shall be equipped with an effective brake, and shall be provided with a safety dog of sufficient strength to hold the load in any position.

1. All ropes, chains, and blocks shall be of sufficient size and strength to safely raise, lower, or sustain the load under all circumstances.

2. The maximum allowable working load of new chains and ropes shall be based on manufacturer’s tables.

3. Ropes shall be attached to drums in a manner that will not interfere with proper winding.

(c) Wire Rope Clips. Wire rope fastenings shall be substantially and securely made and maintained. The minimum number of clips for wire rope end attachments shall be as indicated in manufacturer’s tables, but in no case shall less than three (3) clips be used. All clips shall have the “U” side placed on the dead end of the rope. The clips shall be spaced at a distance equal to at least six (6) times the diameter of the rope. All sharp edges shall be prevented from coming into contact with the rope.

(d) Moving Rope Guards. Wire hoisting ropes and similar moving ropes in exposed locations within seven (7) feet of ground or floor, except for free end section, shall be guarded by an enclosure or fenced with standard railings.
(e) Safe Derrick Load. The load on any boom or extension to a boom on any derrick shall not exceed the safe load indicated by the manufacturer.

1. Every derrick shall be plainly marked on the length of the boom, the rated load, and the corresponding radius.

(f) Crane Capacity. Every boom-type mobile crane shall have a legible capacity chart or data plate, conveniently located on or in the crane, containing manufacturer's rated loads at the maximum and minimum radius and at least two (2) other points for the various boom length, counterweight, and outrigger arrangements. This information shall be given for boom positions, both parallel and transverse to the line of travel.

1. Any boom or extension to a boom, designed by other than a recognized manufacturer or structural engineer, shall be tested before use, and at any other time requested by the Department, with a vertical load at least twenty-five per cent (25%) greater than the load which it is intended to lift, and with a lateral load equal to one-half (½) the load it is intended to lift vertically, or with a lateral load equal to the maximum efforts of the swinging device, if of a swing type.

(g) Crane Boom Stops. Devices to prevent the boom from falling over backward shall be provided on cranes and on other equipment with booms that present similar hazards.

(h) Boom Dog. Any crane boom that depends upon a dog and ratchet arrangement to hold it in position shall have the dog readily visible to the operator, or shall be provided with a visible, directly connected, positive telltale device.

(i) Oiling Platform. Crane booms with outrig blocks or similar equipment, requiring a man to climb out onto the boom for oiling or other regular service, shall be equipped with an oiler's walkway, or platform and grab irons for safe access, except for those booms that can be and are safely lowered to the ground for this purpose.

(j) Safety Glass. All glass in the cabs of cranes or derricks shall be of a shatterproof type. Wire glass or equivalent is acceptable except for those sections, like windshields, through which the operator must frequently view his operations.

**Section 5534. TABLES**

**TABLE NO. 55-A**

<table>
<thead>
<tr>
<th>Cage or Bucket Capacity Up to</th>
<th>Vertical Distance Measured From Top</th>
<th>Post Sizes</th>
<th>Guide Sizes</th>
<th>Horizontal Tie Sizes</th>
<th>Diagonal Brace Sizes</th>
<th>Maximum Tie Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 lb. Top to 72'</td>
<td>4x4</td>
<td>2 1/2 x 3 1/2</td>
<td>1x6</td>
<td>1x6</td>
<td>6'</td>
<td></td>
</tr>
<tr>
<td>500 lb. 72 to 198</td>
<td>4x6</td>
<td>2 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>72 to 126</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>1x6</td>
<td>1x6</td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>126 to 198</td>
<td>6x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>6</td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>Top to 72'</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>6</td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>Top to 126</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>6</td>
</tr>
<tr>
<td>1,000 lb. or 1/4 cu. yd.</td>
<td>Top to 198</td>
<td>6x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>6</td>
</tr>
<tr>
<td>2,000 lb. or 1/2 cu. yd.</td>
<td>Top to 80'</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>1x8</td>
<td>8</td>
</tr>
<tr>
<td>2,000 lb. or 1/2 cu. yd.</td>
<td>Top to 80'</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>1x8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2,000 lb. or 1/2 cu. yd.</td>
<td>Top to 80'</td>
<td>6x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>Top to 80'</td>
<td>4x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>80 to 128</td>
<td>6x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>128 to 208</td>
<td>6x6</td>
<td>3 1/2 x 3 1/2</td>
<td>2x6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>4,000 lb. or 1 cu. yd.</td>
<td>128 to 208</td>
<td>6x8</td>
<td>3 1/2 x 3 1/2</td>
<td>2x8</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

55-12
### TABLE NO. 55-B

<table>
<thead>
<tr>
<th>Diameter of Hoisting rope, inches</th>
<th>Diameter of Sheave, inches</th>
<th>Axle Diameter, inches (See Sub-Section (f) for limitations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/16</td>
<td>7 1/2</td>
<td>11/16</td>
</tr>
<tr>
<td>3/8</td>
<td>9</td>
<td>15/16</td>
</tr>
<tr>
<td>1/2</td>
<td>12</td>
<td>1 3/16</td>
</tr>
<tr>
<td>5/8</td>
<td>14</td>
<td>1 7/16</td>
</tr>
<tr>
<td>3/4</td>
<td>16</td>
<td>1 11/16</td>
</tr>
<tr>
<td>7/8</td>
<td>18</td>
<td>1 15/16</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>2 3/16</td>
</tr>
</tbody>
</table>

**Note:** Diameter of sheaves shall be measured at bottom of groove.

1. All sheaves shall be of iron or steel, and of sufficient strength to support the loads to which they will be subjected.
2. The grooves of all sheaves shall be machined and shall be concentric with the axis.
3. All sheaves shall have axles of a grade at least equal to cold rolled shafting.

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### Section 5535. FIGURES

**STANDARD HAND SIGNALS FOR CRANES AND DERRICKS**

1. **Hoist**
2. **Lower**
3. **Stop**
4. **Swing**
5. **Boom Up**
6. **Boom Down**
7. **Travel**
8. **Make Movement Slowly**
9. **Emergency Stop**

55-13
Section 5540. STANDARDS

Unless as otherwise specified, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASA</td>
<td>Safety Code for Elevators, Dumbwaiters and Moving Walks, A 17.1—1965</td>
</tr>
<tr>
<td></td>
<td>Practice for the Inspection of Elevators, Inspectors Manual, A 17.2—1960</td>
</tr>
<tr>
<td></td>
<td>Safety Requirements for Workmen's Hoists, A 10.4—1963</td>
</tr>
<tr>
<td></td>
<td>Safety Code for Manlifts, A 90.1—1949, Reaffirmed 1956</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>USASI</td>
<td>Safety Code &amp; ETC.</td>
</tr>
</tbody>
</table>

Legend:

USASI United States of America Standards Institute
10 East 40th Street
New York, N.Y. 10016
CHAPTER 56
SIGNS

Section 5600. GENERAL

(a) Scope. In addition to the requirements of this Building Code, this Chapter shall govern the installation, repair, maintenance and approval of all signs.

(b) Purpose. The purpose of this Chapter is to provide the minimum standards to safeguard life, health, property, and public welfare by regulating and controlling the design, quality of materials, construction, location, electrification, and maintenance of all signs, billboards, and marquees not located within buildings. (For interior signs and outline lighting see Chapter 53.)

(c) Identification and Marking. Each sign hereafter erected or remodeled shall bear in a prominent position thereon a clearly legible identification plate stating the name of the person, firm, or corporation, responsible for its construction and erection. Electrical signs shall be marked with input amperes at full load input.

(d) Maintenance. Every sign, including those specifically exempt from this Chapter in respect to permits and permit fees, shall be maintained in good structural condition at all times. All signs shall be kept neatly painted including all metal parts and supports thereof that are not galvanized or of rust resisting metals. The owner of the sign shall maintain the premises within twenty (20) feet of such signs in a clean, sanitary and inoffensive condition, free and clear of all obnoxious substances, rubbish and weeds. The Department shall inspect and shall have the authority to order the painting, repair, alteration, or removal, of a sign which shall constitute a hazard to safety, health, or public welfare, by reason of inadequate maintenance, dilapidation, cleaning, obsolescence, or abandonment.

Section 5601. EXISTING SIGNS

(a) General. Signs existing on the effective date of this ordinance which do conform to the provisions of this Chapter when removed from their fast shall not be re-erected unless the location and the erection thereof are made to conform to the provisions of this Chapter or any other ordinance or regulation.

(b) Not in Use. Any sign now or hereafter existing which no longer advertises a bona fide business, product or service shall be taken down and removed by the owner, agent, or person having the beneficial use of the premises upon which such sign may be found within ninety (90) days after written notification from the Department and upon failure to comply with such notice within the time specified in such order, the Department is hereby authorized to cause removal of such sign and any expense incidental thereto shall be paid by the owner of the premises on which such sign is located. Such costs may be charged to the owner of the premises involved in the manner provided for in Chapter 1. (City’s lien for costs.)

Section 5602. PROHIBITED SIGNS

(a) General. No person shall paste or otherwise fasten any paper or other material, paint, stencil or write any number, sign name, or any disfiguring mark on any sidewalk, curb, gutter, street, any post or pole, any other sign, building, fence, or other structure, unless sanctioned by the provisions of this Building Code or the Manager of Public Works, nor shall any of the said subjects be defaced in any manner.

(b) All signs prohibited by the Zoning Ordinance are also prohibited.

(c) Obstruction of Traffic Control Devices. It shall be unlawful to erect or maintain any
sign which constitutes a traffic hazard and is a
detriment to traffic safety by obstructing the
vision of drivers or detracting from the
visibility and prominence of any official
traffic control device.

Section 5603. PROTECTION OF PUBLIC
(a) General. The temporary occupancy of
the sidewalk or the street or other public
property in the case of construction, removal,
repair, alteration, maintenance of a sign or
marquee, shall not be deemed to be a viola-
tion of this ordinance, provided the space
occupied is roped off, fenced off, or other-
wise isolated when necessary for public con-
venience and protection. A permit shall be
required from the Department and approved
by the Manager of Public Works.

(b) Bonds. Prior to the issuance of any
permit for a sign which is located over public
property or which may require any work over
public property, the erector shall furnish a
bond in accordance with the requirements of
the Revised Municipal Code.

Section 5604. DEFINITIONS AND ABBREVIATIONS.
All definitions found in the Zoning Ordi-
nance of the City and County of Denver,
Section 619 shall apply also to this Building
Code.

Electric Sign. The electric sign shall mean
any sign containing electrical wiring but not
including signs illuminated by exterior light
sources.

Incombustible Materials. (See Chapter 4.)
Plastic Materials. Are materials made wholly
or partially from standardized plastics listed
and described in Chapter 60 of this Building
Code.

Projection. Projection means the distance
by which a sign projects or extends over
private or public property.

Sign Structure. Sign structure shall mean
any support, uprights, braces, and frame work
of the sign.

Structure. (See Chapter 4.)

Section 5605. PERMITS, FEES & INSPECTIONS
Shall be as required in Chapter 3 of this
Building Code.
(a) Permit Application.

EXCEPTION: The following signs and
sign work shall not require a sign per-
mit. These exemptions shall not be
construed as relieving the owner of
the sign from the responsibility of its
erection and maintenance, and its
compliance with the provisions of this
Building Code and Revised Municipal
Code or other laws or ordinances regu-
lating the same.

1. Painting— Painting, repainting, or
cleaning of a sign or the changing
of the advertising copy or the mes-
gages of a sign, except that a
change in the name of the use-by-
right or in the type of use-by-
right, or change in the sign struc-
ture or the removing of a sign
from its fast shall require a permit.

2. Signs required or specifically au-
thorized for a public purpose by
any law, statute or ordinance; may
be of any type, number, area,
height above grade, location, illu-
mination, or animation, author-
ized by the law, statute or ordi-
nance under which the signs are
required or authorized.

3. Signs limited in content to name
of occupant and address of prem-
ises; signs of danger or a caution-
ary nature which are limited to:
wall and ground signs; not more
than two per street front for each
dwelling unit; not more than four
square feet per sign in area; not
more than 10 feet in height above
grade: may be illuminated only
from a concealed light source
which does not flash, blink or
fluctuate; shall not be animated.

4. Signs in the nature of corner-
stones, commemorative tables and
historical signs which are limited to:
wall and ground signs; nor
more than two per Zone Lot; not
more than six square feet per sign
in area; not more than six feet in
height above grade; may be illumi-
nated only from a concealed light
source which does not flash, blink
or fluctuate; shall not be animat-
ed.

5. Signs which identify by name or
number individual buildings with-
in institutional or residential
building group complexes and
which are limited to: wall and
ground signs; not more than four
signs per building; not more than
20 square feet per sign in area; not
more than 12 feet in height above grade; any location on the Zone Lot may be illuminated from a light source which does not flash, blink or fluctuate and if directly illuminated does not exceed 25 watts per bulb, shall not be animated.

6. Signs in the nature of decorations, clearly incidental and customary and commonly associated with any national, local or religious holiday; provided that such signs shall be displayed for a period of not more than 60 consecutive days nor more than 60 days in any one year; and may be of any type; number; area; height; location; illumination and animation.

7. Signs in the display window of a business use which are incorporated into a display of merchandise or a display relating to services offered on the same Zone Lot and limited to: window signs; one sign per five feet of window frontage; not more than four square feet per sign in area; ground level windows only; may be illuminated only from a concealed light source which does not flash, blink or fluctuate; shall not be animated.

8. Signs that identify or advertise the sale, lease or rental of a particular structure or land area and limited to: wall, window and ground signs; one sign per Zone Lot; not more than five square feet in area per face; not more than six feet above grade; no illumination; and no animation.

9. Signs commonly associated with and limited to information and directions relating to the Permitted Use on the Zone Lot on which the sign is located, provided that each such sign is limited to wall, window and ground signs; not more than 100 square inches per sign in area; not more than eight feet in height above grade; may be illuminated only from a concealed light source which does not flash, blink or fluctuate; shall not be animated except that gauges and dials may be animated to the extent necessary to display correct measurement.

Section 5606. DESIGN
(a) General. Signs and structures shall be designed and constructed to resist wind and seismic forces as specified in this Section and Chapter 23 of this Building Code. All bracing systems shall be designed and constructed to transfer lateral forces to the foundations. For signs on buildings the dead and lateral loads shall be transmitted through the structural frame of the building to the ground in such a manner as not to overstress any of the elements thereof.

The overturning moment produced from lateral forces shall in no case exceed two-thirds (2/3) of the dead load resisting moment. Uplift due to overturning shall be adequately resisted by proper anchorage to the ground or to the structural frame of the building. The weight of earth superimposed over footings may be used in determining the dead load resisting moment. Such earth shall be carefully placed and thoroughly compacted.

(b) Wind Loads. Sign and sign structures shall be designed and constructed to resist wind forces as specified in Chapter 23 of this Building Code.

(c) Seismic Loads. Signs and sign structures shall be designed and constructed to resist seismic forces as specified in Chapter 23 of this Building Code.

(d) Combined Loads. Wind loads and seismic loads need not be combined in the design of signs or sign structures; only that loading producing the larger stresses need be used. Vertical design loads, except roof live loads, shall be assumed to be acting simultaneously with the wind or seismic loads.

(e) Allowable Stresses. The design of wood, concrete, or steel members, shall conform to the requirements of Chapters 25, 26 and 27 of this Building Code. Loads, both vertical and horizontal, exerted on the soil shall not produce stresses exceeding those specified in Chapters 23 and 28 of this Building Code.

1. The working stresses of wire rope and its fastenings shall not exceed twenty-five (25%) of the ultimate strength of the rope or fasteners. Working stresses for wind loads combined with dead loads may be increased as specified in Chapter 23 of this Building Code.

Section 5607. CONSTRUCTION
(a) General. The supports for all signs or sign structures shall not be placed in or upon the public right-of-way or public easement.
(b) Supports. All supports for signs or sign structures shall be securely built, constructed, and erected, in conformance with the requirements of this Building Code.

(c) Materials. Materials or construction for signs and sign structures shall be of the quality and grade as specified for buildings in this Building Code. The materials and details of construction shall, in the absence of specified requirements, conform to the following:

1. Structural steel shall be of such quality as to conform with the ASTM A-36 Standards. Secondary members in contact with, or directly supporting the display surface, may be formed of light gauge steel, provided such members are designed in accordance with the specification of the design of light gauge steel as specified in the ASTM A-245 and ASTM A-303 Standards and the American Iron and Steel Institute Specification of Design of Light Gauge Steel Structural Members, and shall be galvanized secondary members, when formed integrally with the display surface, shall be at least No. 24 gauge in thickness. When not formed integrally with the display surface, the minimum thickness of a secondary member shall be No. 12 gauge. The minimum thickness of hot-rolled steel members furnishing structural support for signs shall be one-fourth (1/4) inch except that if galvanized such members shall be at least one-eighth (1/8) inch thick. Steel pipes shall be of such quality as to conform with the ASTM A-36 Standards.

2. Anchors and supports for signs of wood which are embedded in the soil, or within six (6) inches of the soil, shall be of all heartwood of a durable species, or shall be pressure treated with an approved preservative before erection. Such members shall be marked or branded by an approved agency.

(d) Restrictions on Combustible Materials. All sign structures, except those signs specified in Section 5606 (a) erected in Fire Zone No. 1 shall have structural members of incombustible material.

Wall signs and arcade signs shall be constructed of incombustible material except as provided in Subsection (e) of this Section. No combustible materials other than approved plastic shall be used in construction of electric signs. (See Section 5604 for approved Plastics.)

(e) Nonstructural Trim. Nonstructural trim may be of wood, metal, approved plastics, or any combination thereof.

(f) Anchorage. Members supporting unbraced signs shall be so proportioned that the bearing loads imposed on the soil in either direction horizontal or vertical, shall not exceed safe values. Braced ground signs shall be anchored to resist specified wind or seismic loads acting in any direction. Anchors and supports shall be designed for safe bearing loads on the soil for effective resistance to pull-out amounting to a force twenty-five (25) per cent greater than the required resistance to overturning. Anchors and supports shall penetrate to a depth of at least three (3) feet. Anchors and supports shall be guarded and protected when near driveways, parking lots, or similar locations where they could be damaged by moving vehicles.

1. Signs attached to masonry, concrete, or steel shall be safely and securely fastened thereto by means of metal anchors, bolts, or approved expansion screws of sufficient size and anchorage to support safely the loads applied.

2. Wood blocks or plugs or anchors with wood used in connection with screws or nails shall not be considered proper anchorage except in a case of signs attached to wood framing.

(g) Display Surfaces. Display surfaces in all types of signs may be made of metal, other approved materials or glass in accordance with the area limitation set forth in Table 56-A of this Building Code.

(h) Approved Materials. Any material not consistent with this Chapter shall be approved in the manner provided for in Chapter 1 of this Building Code. Signs, other than electrical signs, the display surface may be constructed of combustible materials when such is approved by the Department.

Section 5608. CLEARANCE

(a) Clearance from Power Lines. Signs shall not be located with less than three (3) feet
horizontal nor eight (8) feet vertical clearance from overhead electric conductors which are energized in excess of 750 volts.

(b) Clearance from other Structures. Signs or structures shall not be erected in such a manner that any portion of its surface or supports will interfere in any way with free use of any fire escape, exit, or standpipe. Signs shall not obstruct any window to such an extent that any light or ventilation is reduced to a point below that required by this Building Code, any law, or ordinances.

Section 5609. GROUND SIGNS

(a) General. Ground signs may be constructed of any material meeting the requirements of this Building Code, except as provided in Section 5607 of this Building Code.

(b) Design. Supports for ground signs shall not be placed upon public right of way or public easements and shall be designed in accordance with the requirements specified in Section 5606 of this Building Code.

Section 5610. WALL SIGNS

(a) General. Wall signs shall be constructed of incombustible material except as provided in Section 5607 of this Building Code.

(b) Design. Projecting wall signs shall be designed in accordance with the requirements specified in Section 5606 of this Building Code.

(c) Projection. Wall signs shall not have a projection over public property greater than the distance set forth in Table 56-B, nor shall extend above any adjacent parapet or roof of the supporting buildings. Signs or sign structures shall not project into any public alley more than eight (8) inches and be at least fourteen (14) feet from the floor of such alley.

Section 5611. ARCADE SIGNS

(a) General. Arcade signs shall be constructed of incombustible material except as provided in Section 5607 of this Building Code.

(b) Design. Arcade signs which project from the wall of a building or structure shall be designed in accordance with the requirements in Section 5606 of this Building Code.

(c) Projection. Arcade signs shall not have a projection greater than the distance set forth in Table 56-C.

(d) Wall signs. Arcade signs which are wall signs shall be designed in accordance with the requirements specified in 5610 of this Building Code.

Section 5612. ELECTRIC SIGNS

(a) General. Electric signs shall be constructed of incombustible material except as provided in Section 5607 (c) of this Building Code. Electric signs shall be water tight, except that service holes fitted with waterproof covers shall be provided to each compartment of such signs.

(b) Regulations

1. Installation. Electrical signs shall not be erected or maintained which do not comply with Chapter 53 (Electrical of this Building Code.)

2. Interference with Radio or Television. Electric equipment or electrical apparatus of any kind which causes interference with radio or television reception shall not be used in the operation of illuminated signs. Whenever interference is caused by an unfiltered or improperly filtered or otherwise defective sign, or by any other electrical device or apparatus connected to the sign, the Department shall order the sign disconnected until repairs are made.

Section 5613. TEMPORARY FABRIC SIGNS

(a) General. Fabric temporary signs shall not exceed one hundred (100) square feet in area. Such temporary fabric signs may remain in place for a period not exceeding thirty (30) days.

(b) Design. Every temporary fabric sign shall be supported and attached with wire rope of three-eighths (3/8) inch minimum diameter. Strings, fiber ropes, or wood slats shall not be permitted for support or anchorage purposes.

(c) Protection. Temporary fabric signs, when ten (10) feet or more above the ground may project not more than six (6) inches over public property or beyond the building line.

When extending over public property more than six (6) inches such temporary signs shall maintain a minimum clearance of not less than twenty (20) feet.

Section 5614. MISCELLANEOUS REGULATIONS

(a) Balloons, Search Lights. Balloons or similar types of objects and search lights are pro-
hibited unless approved by the Department and the Department of Public Works. See Article 332 of the Revised Municipal Code.

(b) Other Obstructions. No person shall erect or maintain upon or over any public street or thoroughfare, either temporarily or permanently, any object, contrivance, structure, or device, except as are authorized by this Building Code, the Revised Municipal Code or other ordinances of the City and then only in accordance with the provisions thereof.

Section 5615. PROHIBITIONS
It shall be unlawful for any person, firm, or corporation to do or cause to be done, or perform or cause to be performed any act contrary to or in violation of any of the provisions of this Building Code.

| Section 5616. TABLES |

**TABLE 56-A**
SIZE, THICKNESS, AND TYPE OF GLASS PANELS IN SIGNS

<table>
<thead>
<tr>
<th>MAXIMUM SIZE OF EXPOSED GLASS PANEL</th>
<th>MINIMUM THICKNESS OF GLASS (in inches)</th>
<th>TYPE OF GLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY DIMENSION (in inches)</td>
<td>AREA (in square inches)</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>500</td>
<td>1/8 Plain, Plate or Wired</td>
</tr>
<tr>
<td>45</td>
<td>700</td>
<td>3/16 Plain, Plate or Wired</td>
</tr>
<tr>
<td>144</td>
<td>3,600</td>
<td>1/4 Plain, Plate or Wired</td>
</tr>
<tr>
<td>over 144</td>
<td>over 3,600</td>
<td>1/4 Wired Glass</td>
</tr>
</tbody>
</table>

**TABLE 56-B**
PROJECTION OF WALL SIGNS

<table>
<thead>
<tr>
<th>MINIMUM HEIGHT OF LOWEST POINT OF SIGN ABOVE SIDEWALK OR GROUND</th>
<th>MAXIMUM AMOUNT OF PROJECTION OVER PUBLIC PROPERTY BEYOND STRUCTURE OR BUILDING WALL STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 feet</td>
<td>No projection permitted</td>
</tr>
<tr>
<td>10 feet and over</td>
<td>Not more than 2 feet projection at any point</td>
</tr>
</tbody>
</table>

**TABLE 56-C**
PROJECTION OF ARCADE SIGNS

<table>
<thead>
<tr>
<th>MINIMUM HEIGHT OF LOWEST POINT OF SIGN ABOVE SIDEWALK OR GROUND</th>
<th>MAXIMUM AMOUNT OF PROJECTION BEYOND THE STRUCTURE OR BUILDING WALL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10 feet</td>
<td>No projection</td>
</tr>
<tr>
<td>10 feet</td>
<td>No more than 4 feet projection at any point</td>
</tr>
<tr>
<td>11 feet</td>
<td>Not more than 5 feet projection at any point</td>
</tr>
<tr>
<td>12 feet and over</td>
<td>Not more than 6 feet projection at any point</td>
</tr>
</tbody>
</table>
Section 5617. STANDARDS

Unless as otherwise specified in other portions of this Building Code the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI</td>
<td>Specific Design of Light Gauge Steel Structural Members</td>
</tr>
<tr>
<td>ASTM</td>
<td>Spec. for Structural Steel, A36-67</td>
</tr>
<tr>
<td>ASTM</td>
<td>Spec. for Flat-Rolled Carbon Steel Sheets of Structural Quality, A 245-64</td>
</tr>
<tr>
<td>ASTM</td>
<td>Spec. for Hot-Rolled Carbon Steel Strip of Structural Quality, A 303-64</td>
</tr>
</tbody>
</table>

Legend:

AISI  American Iron and Steel Institute
      150 East Forty-Second Street
      New York, N.Y.

ASTM  American Society for Testing and Materials
      1916 Race Street
      Philadelphia, Pa. 19103

ORD-538 - Dec. 1971
CHAPTER 57
BOILERS AND PRESSURE VESSELS

July 1971

Section 5700. SCOPE

In addition to the other requirements of this Building Code, this Chapter shall govern the maintenance and safety of all hot water boilers, steam boilers, steam cleaners, steam generators, presently installed or hereafter erected. This Chapter shall also govern the annual inspection and fees imposed for such inspections.

Section 5701. GENERAL

(a) Equipment. Such equipment shall be of an approved type, bear the label of a nationally recognized testing laboratory, and conform to the requirements of this Building Code. Burners shall conform to Chapter 51.

(b) Type of Fuel. Gas or oil appliances shall not be converted from the fuel specified on the manufacturer's rating plate for use with a different fuel without consulting the manufacturer for complete instructions and being approved for safety by the Department for the fuel to be used.

(c) Stationary Engineer Required.
(See Chapter 2-B)

(d) Combustion Air. Combustion air shall be as required in Chapter 51, and shall be a permanent opening with no restrictions, open directly to the outside atmosphere.

(e) Boiler Rooms. Boiler rooms shall be maintained free of rubbish and storage, and shall meet the requirements for fire separation based on the occupancies in which the boiler is located. Such boiler rooms shall be of at least one hour fire-resistive construction. Enclosures may be waived when in the opinion of the Department, such enclosures are not necessary, or would tend to increase a hazard.

EXCEPTION: Enclosures shall not be waived when such boilers are located in Dry Cleaning Plants, White Rooms, chemical rooms where corrosive materials are present, and Group D and E Occupancies.

(f) Prohibition. Steam cleaners and steam generators shall not be maintained on the floor of any garage, wash rack, auto wash, or any building where gasoline or butane propelled devices such as automobiles, trucks, or like devices can be driven in.

Section 5702. INSPECTIONS

(a) Owners to Require Inspection. All persons owning or using any boiler or pressure vessel shall have the same inspected, other than those in use in I occupancies, at least once each year thereafter. If upon completion of the inspection, the equipment is in safe and satisfactory condition, the Department shall issue a certificate stating that such equipment is safe for use, and the maximum pressure at which any such equipment may be worked.

(b) Major Repairs. Equipment shall not be used after major repairs until an inspection has been made by the Department and the above certificate shall have been re-issued by the Department to the effect that such repairing has been properly done, and that such equipment may be safely used.
(c) Owners to Provide Facilities. Every person owning or having possession or control of any such equipment subject to inspection as aforesaid shall provide, at his own expense, proper arrangements and facilities for attaching the instruments of inspection. Immediately before the time set for such inspection, every such person shall remove all scale, dirt, soot, and sediment in, beneath and around such equipment; shall fill the same with water, when so ment to do by the Department and shall have all main stop valves and other valves and connections on such equipment perfectly tight, so that the Department may be able to apply hydrostatic pressure, leaving all said equipment in clean condition for inspection.

(d) Equipment—How Tested—Additional Fee. All equipment when required to be tested by hydrostatic pressure, shall be filled with water by the owner or users, and they shall furnish the necessary labor required to work and handle the pumps in applying the test. When leaks occur which prevent a successful test, the Department shall make a second test upon receiving notice that all leaks have been repaired. If, upon making a second test, such equipment is still defective, the owner or user thereof shall, for each subsequent test pay an additional inspection fee as herein provided, but in no case shall the Department give an order for a certificate until fully satisfied of the safety of the equipment.

(e) Hydrostatic Pressure. It shall be the duty of the Department to inspect all such equipment as often as once each year, by conducting a hydrostatic pressure test where such test by the Department shall be deemed necessary; and by making a careful external and where possible, an internal examination. In all cases where hydrostatic pressure test is used, an internal examination of said equipment shall where possible, afterwards be made. The hydrostatic pressure used in such test shall not exceed the maximum working pressure of said equipment by more than fifty (50) per cent.

(f) Test Formulae. In certifying the working pressure permitted on each such equipment, the Department shall use approved test formulae.

(g) Drill Inspection. Any such equipment having been in use eight years or more, and its condition being such that, in the opinion of the Department, the same should be drilled in order that the exact thickness and condition thereof may be ascertained, such equipment shall be drilled by the owner or user at points in such equipment as the Department may direct, and the steam and/or water pressure or other pressure allowed shall be governed by such ascertained thickness and general condition of the equipment. Drilling and plugging shall be performed at the expense of the owner or user.

(h) Seller’s Inspection. All manufacturers, junk dealers, or any other persons selling such equipment, either new or used, shall, before painting the same, have it inspected by the Department, and shall have in their possession a certificate issued by the said inspector showing the amount of pressure per square inch the equipment is permitted to carry. Such certificate shall be furnished by the seller to the buyer for reuse.

(i) Welding. All welding shall be performed in accordance with the requirements of Chapter 58.

(j) Electrical. All electrical wiring shall conform to the requirements of Chapter 53.

(k) Boiler Settings. Boiler settings shall be as required for furnace settings in Chapter 52 and Chapter 58.

Section 5703. ANNUAL INSPECTION FEES

<table>
<thead>
<tr>
<th>Power Boilers</th>
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<tbody>
<tr>
<td>Horse power</td>
<td>Fee</td>
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<tr>
<td>0 to 50</td>
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</tr>
<tr>
<td>51 to 100</td>
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</tr>
<tr>
<td>101 to 250</td>
<td>20.00</td>
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<tr>
<td>251 to 500</td>
<td>25.00</td>
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<tr>
<td>501 to 1000</td>
<td>30.00</td>
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<tr>
<td>1001 and over</td>
<td>35.00</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Heating Boilers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast-Iron, 15 Lbs. Per Sq. In. or Less in Pressure</td>
<td>Fee</td>
</tr>
<tr>
<td>0 to 1,400 sq. ft. radiation</td>
<td>$10.00</td>
</tr>
<tr>
<td>1,401 to 5,000</td>
<td>15.00</td>
</tr>
<tr>
<td>5,001 to 10,000</td>
<td>20.00</td>
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<tr>
<td>10,001 to 25,000</td>
<td>25.00</td>
</tr>
<tr>
<td>25,001 and over</td>
<td>30.00</td>
</tr>
</tbody>
</table>

All inspections, other than the normal required, shall be assessed $10.00 for each additional inspection.

The fee for unfired pressure vessels shall be $10.00 each.

NOTE: Saturday, Sunday and holiday inspection fees shall be double the above schedule, with a minimum of $20.00.
Section 5704. CONDEMNATION

Any boiler or pressure vessel, which in the opinion of the Department constitutes a hazard, shall be red tagged and condemned in accordance with the provisions of Chapter 1 of this Building Code.

Section 5705. HARTFORD TEE AND EQUALIZING PIPE REQUIREMENTS

(a) General. An equalizing pipe shall be connected between the steam header and the return header. The size of such pipe shall be the same as the steam header to a point not less than six (6) inches below the water line of the boiler. Reduction may be made at this point to the same size as the return header or piping. A tee or welded connection shall be installed in the equalizing pipe, prior to reduction in size, and located at a point two (2) inches below the operating water line of the boiler. The two (2) inches below water line shall be measured from the top of the side opening of the tee or top of the side weld connection. The use of "Y" lateral type fittings or weld are also permitted in place of straight type tees. When "Y" fittings are used, the branch of side outlet of "Y" shall be installed to run down, or in an inverted position. If threaded tee is used, a close nipple shall be used between tee and an elbow and such ell shall point downward. From the inverted "Y" or the elbow, a pipe shall be run downward and parallel to the equalizing pipe to a point near the floor line. All direct return piping from the system shall be connected to this pipe and the size of such pipe shall be not less in internal cross sectional area than the total cross sectional area of the connected return piping.

(b) Return or Vacuum Pumps. Where boiler return pumps or vacuum pumps are used as a means of returning condensate to the boiler instead of gravity return, the size of the pipe connecting to a Hartford connection shall be one size larger than the outlet or discharge connection of the pump. If the distance between the pump and the boiler is over thirty (30) feet, the size of the pipe shall be increased to compensate for increased pressure loss. Check valves shall be installed in this pipe between the pump and the boiler.

Where boiler return pumps or combination return and vacuum pumps are used to return condensate to the boiler, they may be connected through a Hartford Tee and Loop Connection or direct to the boiler return piping. Pipe from pump to boiler shall be run up in a vertical position from pump to above the water line of the boiler, or to ceiling if ceiling is less than three (3) feet carried across to the boiler at that height, then dropped to below water line of the boiler and connected to a Hartford Tee or direct to boiler return piping with necessary check valves installed.

Section 5706. SAFETY OR RELIEF VALVES AND REDUCING VALVES

(a) General. All steam boilers, hot water boilers and generators, or any type of pressure vessel used for steam generation, for processing, or for building heating systems and tanks, and other equipment used for the purpose of generating or storing of hot water under pressure, shall be equipped with a side outlet type and approved ASME-NB pressure safety or relief valve(s), approved for the type of equipment on which it is installed, and for the temperatures, pressures and fluids with which it is to operate. Such valves shall be rated at maximum unit capacity or not less than the burner output capacity. The requirements for temperature relief valves shall be those as required for pressure relief valves, except that temperature relief valves shall be of an approved type and need not bear the seal of the ASME-NB. For purposes of this Chapter, ASME-NB shall mean American Society of Mechanical Engineers-National Board.

Approved combination type pressure and temperature relief valves may be permitted on tanks up to 100 gallon storage capacity; however, tanks in excess of 100 gallon storage capacity shall be equipped with separated valves for relief of temperature and pressure.

1. When the horsepower of a steam boiler or generator is in excess of five hundred (500) horsepower, a second relief valve of adequate size to handle the boiler output shall be installed. Such valve shall be permanently marked indicating pressure and capacity rating.

2. Required side outlet type relief valves shall be installed on top of boilers and at the heat exchanger. Stops, valves or other obstructions that will prevent the full pressure of the heating system from being applied to the relief valves at all times, are prohibited.

(Ord. 39 - 1966)

(b) Location. All relief valves shall be installed in openings by the manufacturer of the equipment. If such openings are not provided, the valves shall be installed in the piping of the equipment as close to the equipment as possible. Pressure relief valves shall be installed in the cold water supply piping as close to the heater or tank as practicable, so the valve will be under the same constant water pressure as the equipment. Valves or stop cacks shall not be permitted between boiler or pressure vessel and pressure valves except on boilers in excess of 1,000 horsepower and having two or more relief valves. Reduction in the size of the relief valve connections shall not be permitted.

(c) Test Lever. All relief valves shall be provided with a suitable type hand test lever and chain, so the relief may be checked each day.
(d) **Valve Seals.**

1. The seal provided by the manufacturer of the relief valve to seal valves at designated pressure or temperature shall not be broken without special permission of the Department. If permission is given to change or reset the valve, such valve, such valve shall be resealed in the presence of an authorized representative of the Building Department and permanently tagged and marked to indicate the new setting permitted.

2. Where the seal on any type relief valve is found broken without permission of the Department, the equipment on which the valve is installed shall not be placed in service until a new valve, of proper size and type, has been installed on the equipment, and such valve is tagged and sealed in an approved manner.

**EXCEPTION:** If, however, the equipment cannot be ordered out of service, the relief valve shall be immediately checked. If found to be operating properly, the valve shall be resealed and tagged in an approved manner.

(e) **Discharge.** Safety or relief valve discharge openings shall be piped the full size of the relief opening to a location where the discharge cannot be injurious to the plant, the building, or personnel. If the discharge pipe from the relief valve is piped to the outside of the building, provisions shall be made to secure proper drainage and prevent freeze-up. Discharge pipe from the relief valve, piped to the inside of the building shall be piped to within six (6) inches of the boiler room floor, or to an approved plumbing receptacle. The boiler room floor shall be provided with a drain or an approved plumbing receptacle connected to the sewer and the drain pipe from such device shall be not less than one nominal iron pipe size larger than the drain outlet of the relief valve.

The discharge end of the pipe from any relief valve shall be open to the atmosphere so as to provide a minimum air gap between the overflow rim to the receptacle of the sewer opening or floor drain of twice the inside pipe diameter of the relief valve discharge pipe.

(f) **Pressure Valves.**

1. On all closed building heating systems, in addition to the compression tank, an approved type of pressure reducing valve and pressure relief valve shall be installed. The reducing valve shall be capable of reducing the water supply pressure to the safe operating requirements of the heating system. This valve shall be of at least one-half (½) inch nominal iron pipe size and shall be installed in the makeup water supply line. Combination pressure reducing and relief valves are prohibited.

2. An approved pressure relief valve shall be provided on all closed heating systems. The capacity and size of the relief valve shall be in accord with the Btu generating capacity of the heat exchanger or boiler. Relief valves less than one-half (½) inch pipe size shall not be installed in any closed system or on a large system, where the Btu capacity of the system is greater than the capacity of any one relief valve to provide adequate protection, two or more valves shall be provided to meet the Btu generating capacity.

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Section 5707. **Water Level & Steam Pressure Gauges and Try-Cocks**

(a) **General.** Each low pressure steam boiler shall be equipped with:

1. A water level gauge glass mounted so that the mid-point of the glass is at the normal water level of the boiler.

2. At least two hand operated try-cocks mounted one and one-half (1½) inches above and one and one-half (1½) inches below the normal water level of the boiler.

3. A steam pressure gauge mounted on or at the top of the boiler.

(b) **Gauge Glass and Try-Cocks.** The gauge glass and try-cocks may be mounted directly onto the boiler, independent of all other connections. If the boiler is equipped with a separate water column on which the gauge glass and try-cocks are installed, and this water column is connected to the boiler by means of pipe and fittings, the bottom of the water column shall be provided with a proper size blow down valve. The size of such valve shall be at least the size of the piping connection of the water column to the boiler and shall be of the gate valve type. Wherever separate water columns are to be connected to boilers, the water columns shall be piped to the boiler using...
plugged crosses for all 90° bends in such piping.

(c) Steam Gauge. A steam gauge shall be provided so as to be clearly visible from the operating floor or normal access area at all times. It shall be the low pressure type with easily read numerals, at least four and one-half (4½) inches in diameter and with a maximum rating of one and one-half (1½) times the maximum operating pressure of the boiler. Such gauge may be mounted directly on the boiler or at the top of the water column and shall have a syphon loop, between the gauge and the boiler connection.

Section 5708. BLOW-OFF VALVES

(a) General. Each steam boiler shall be provided with a proper size blow-off or drain valve or valves of the quick opening or one-fourth (¼) turn type. Such blow-off or drain valves shall be installed in the opening of the boiler provided by the manufacturer or in the return header at the boiler and shall be so installed that the boiler will be completely drained. The blow-off or drain valve shall be at least three-fourths (¾) inch size for boilers of up to 1,000 square feet of radiation capacity; one (1) inch for boilers up to 3,000 square feet of radiation capacity; and one and one-fourth (1¼) inches for boilers up to 8,000 square feet of radiation capacity. The blow-off or drain valve shall not be connected directly to any sanitary sewer system. When drained to a sewer, it shall drain to an open floor drain, approved receptor, or to a regular blow-off tank or sump. The temperature of the discharge water shall not exceed 180° F. when it enters the sanitary sewer system. The blow-off or drain may discharge into an approved leeching pit.

(b) Blow-off and Sump Tanks.
1. Blow-off or sump tanks shall be installed where either are necessary to properly blow down or drain the boiler or where the boiler is set or pitted below the level of the boiler room or below the low point of any floor drain connected to the sewer.

2. Where sump or blow-off tanks are installed below the level of sewer piping and it is necessary to raise the water so that it can be properly drained into the sewer, an automatic power driven pump shall be provided to lift the water, and such pump shall operate by means of a float in the sump or tank when the water reaches a pre-determined height.

3. All piping between blow-off and drain valves and connecting to sump or flash tank shall be connected directly to the tank and shall be at least the size piping of the blow-off or drain valve. Such pipe and fittings shall be capable of withstanding the full pressure of the boiler.

Section 5709. LOW WATER CUT-OFF CONTROLS—WATER FEEDERS

(a) General. An external low water cut-off control shall be installed on all fuel fired steam boilers or generators in such a manner so that the fuel firing device will shut off when the level of the water is within one (1) inch of the bottom of the gauge glass. The use of internal type low water cut-off valves is prohibited.

1. A water feeder may be installed to operate and maintain the water at the proper operating level in steam boilers. A water feeder shall not be installed on any boiler which is not equipped with a low water cut-off control. Combination feeders and low water cut-offs are permitted.

2. The quick hook-up type of low water cut-off or combination feeder and cut-off that are attached or connected to the gauge glass connections of a steam boiler are permitted on steam boilers not in excess of 2,000 square feet of radiation capacity or the equivalent in boiler horsepower. All boilers larger in size shall use the type of low water cut-off or feeder combination that is attached directly to the boiler by means of separate pipe connection, one above the water line of the boiler, the other at least twelve (12) inches below the normal operating water line of the boiler. The connecting pipe to the boiler shall be at least one (1) inch iron pipe size. Such pipe shall have a blow-off valve installed at the lower connection.

3. Each type of low water control and combination-type feeder and control shall be equipped with a quick-opening valve. This valve shall be the full size of the opening provided at the bottom of the control. Flushing valves shall be provided with permanently marked tags carrying instructions to the operator to flush the low water control at least once a week.

(b) Special Types. Special types of low water cut-offs and water feeders that are supplied by the manufacturers of boilers as part of the boiler equipment or built into the boiler if approved, are acceptable, if the necessary safety protection is provided.

(Ord. 39 — 1966)
CHAPTER 58

STEAM AND HOT WATER HEATING SYSTEMS AND PROCESS PIPING

Section 5801. GENERAL.

(a) Scope. The provisions of this Chapter shall govern the construction, installation, alteration and repair of all steam and water heating installations for heating, cooling and certain process piping for all steam and hot water systems unless otherwise provided for in this Building Code.

(b) Equipment. All equipment used for steam or water heating systems and related process piping shall bear the seal of a recognized testing laboratory or shall be approved for safety by the Building Official.

(c) Type of Fuel. Gas or oil appliances shall not be converted from the fuel specified on the rating plate for use to a different fuel without consulting the manufacturer for complete instructions and being approved for safety by the Building Official. See Chapter 51.

(d) Installation. The installation of systems governed by this Chapter shall conform to the manufacturer's instructions in addition to the requirements of this Building Code. The contractor shall attach operating instructions of a permanent type to the appliance or system. The manufacturers' rating data and the name plate shall be attached.

(e) Access. Irrespective of other provisions of this Building Code, clearances shall be maintained around all boilers, generators, heaters, tanks and all other equipment so as to permit inspection, servicing, repair or replacement and normal visibility of all gauges.

(f) Boiler Room. Every boiler room shall be separated in accordance with the requirements of this Building Code. See Chapter 52.

(g) High Pressure Steam and Hot Water Heating Systems. All pipe, fittings, valves, traps, pumps or other equipment to be installed on high pressure installations shall be fabricated of approved materials suitable for the pressures and temperatures intended.

(h) Materials. All materials shall be of an approved type and shall be designed for the pressures and temperatures at which they are to be operated, for the materials they are to handle and for their intended use, and shall meet established technical standards of quality and strength necessary to produce reasonably safe installations. Established technical standards are listed in Section 5827.

(i) Valves on Boilers. In high pressure systems, all high temperature generating equipment shall have suitable type shut off valves installed as close to the outlets of the equipment as possible, both on flow and return piping. Such valves shall be of the material suitable to the service, pressures and temperatures of the systems.

(j) Generators and Pressure Vessels. Steam boilers and generators operating at pressures in excess of 100 psig (pounds per square inch gauge) shall, in addition to the required hand shut-off valve, be provided with an approved type automatic shut-off valve. Such valve shall be capable, under test, of stopping all flow of steam from the boiler or generator to prevent excessive drop in pressure resulting from pipe or equipment failure. (See Standards.)

(k) Installation or Repairs Affecting Building Structure. When installation or repair of any system regulated by this Chapter affects the building structure, proper headers or other supports conforming to other portions of this Building Code shall be installed.

(l) Temporary Heating During Construction. All heating equipment used during construction, other than approved portable units, shall be wired and operated so that all controls function in a normal manner.

(m) Prohibitions. Gas, liquid or solid fuel burning appliances shall not be installed in garages unless otherwise permitted by other portions of this Building Code.

The installation of piping shall not be permitted in the shafts, pits or penthouses of elevators.

Used equipment shall not be installed unless approved for safe use by the Building Official prior to installation.

Cast iron boilers and cast iron radiation shall not be permitted on steam or water heating systems operating at pressures in excess of 15 psig for steam and 30 psig for water, unless such boilers or radiation are designed and tested for higher working pressures and so certified by the manufacturer.

Section 5802. DEFINITIONS.

(a) Bevel. When the adjacent edges of a butt joint are cut from either one or both sides so as to enclose a V or two Vs, they are known as single or double V bevel, respectively. Similarly, when the adjacent edges of a butt joint are cut from either one or both sides so as to enclose a U or two U's, they are known as single U bevel or double U bevel, respectively. See Figure No. 6.
(b) Butt weld. A weld in a butt joint.

c) Corner Joints. Corner joints are similar to tee joints except that one member does not extend beyond the other member.

d) Fillet Weld. A weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other in a lap joint, tee joint or corner joint. See Figures No. 4 and No. 5.

e) Fusion Joint. The melting together of filler metal and base metal, or of base metal only, which results in coalescence.

(f) Gas Cutting. See Oxy-Acetylene Cutting.

(g) Heating Boilers. Heating boilers shall include: hot water boilers operating at temperatures not in excess of 240° F. and steam boilers operating at pressures not in excess of 15 psi gauge, used for heating buildings or structures.

(h) High Pressure and Temperature.

1. Steam. Any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power, and processing, operating at pressures in excess of fifteen (15) psig, shall be classed as high pressure.

2. Hot Water. Any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing hot water for heating or processing, operating at pressures in excess of (45) psig and temperatures in excess of 250° F., shall be classed as high pressure.

(i) Hot Water Forced Circulation System. A hot water forced circulation system is one that has a booster or circulating pump installed to mechanically circulate the water in the system.

(j) Hot Water Gravity System. A gravity circulated system is one that depends on the difference in the weight or difference in the density between the hot water and the cold water to create circulation within the piping system.

(k) Low Pressure and Temperature.

1. Steam. Any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing steam for heating, power, and processing, operating at pressures of fifteen (15) psig or less, shall be classed as low pressure.

2. Hot Water. Any boiler, generator, pressure vessel, system, piping, or equipment used for the purpose of heating or distributing hot water for heating or processing at pressures of 45 psig or less and temperatures of 250° F. or less, shall be classed as low pressure.

(l) Lap Joints. Lap joints are formed when the surfaces of two parallel plates are in contact with each other and the edges of the two plates adjacent to the point of contact are not in line.

(m) Oxy-Acetylene Cutting. An oxygen-cutting process wherein the severing of metals is effected by means of the chemical reaction of oxygen with the base metal at elevated temperatures, the necessary temperature being maintained by means of gas flames obtained from the combustion of acetylene with oxygen.

(n) Power and Industrial Piping. All piping used for the conveying of steam, water, and condensate in power houses, oil refineries, industrial plants, atomic plants or mills and mines or similar occupancy either underground, on the ground or suspended above ground, outside or inside of buildings, under low pressure or pressures to the highest limits of the piping, shall be classed as industrial piping.

(o) Root of Joint. That portion of a joint to be welded where the members approach closest to each other. In cross-section the root of the joint may be either a point, a line or an area. See Figure No. 1.

(p) Root of Weld. The points, as shown in cross-section, at which the bottom of the weld intersects the base metal surfaces. See Figure No. 2.

(q) Seal Weld. Any weld used primarily to obtain tightness.

(r) Size of Weld.

For Equal Leg Fillet Welds. The leg length of the largest isosceles right-triangle which can be inscribed within the fillet-weld cross-section. See Figure No. 3.

For Unequal Leg Fillet Welds. The leg lengths of the largest right-triangle which can be inscribed within the fillet-weld cross-section. See Figure No. 3.

(s) Strength Weld. A weld design to have a pre-determined strength and primarily intended to secure a mechanically strong joint. The weld may be continuous or intermittent.

(t) Throat of a Fillet Weld.

Theoretical. The distance from the beginning of the root of the joint perpendicular to the hypotenuse of the largest right-triangle that can be inscribed within the fillet-weld cross-section. See Figures No. 4 and No. 5.

Actual. The shortest distance from the root of a fillet-weld to its face. See Figures No. 4 and No. 5.

(u) Tee Joints. Tee joints are formed when one of the plates to be welded is perpendicular to another plate and extends beyond it in two directions to form a "T".
(v) Unit Heaters. A steam or hot water unit heater is a heater in which the heating element is supplied heat from a steam or hot water heating system.

Section 5803. BOILERS OR GENERATORS (STEAM AND HOT WATER).

(a) General. All boilers or generators used to generate heat in the form of steam or hot water shall be erected, assembled, or installed in accordance with the manufacturer's recommendations and the requirements of this Building Code.

(b) Foundations.

1. All boilers or generators shall be set or erected on a masonry or concrete foundation or other approved foundation capable of properly supporting the weight of the boiler or generator under full operating load.

2. Brick foundations for boilers or generators may be acceptable if the construction is of hard-pressed brick and cement mortar. If the brick foundation forms part of the combustion chamber or is exposed to extreme heat, proper provision shall be made for the expansion and insulation of the brick work.

3. Boilers, generators, or other equipment shall not be installed unless proper provision to support or carry the weight of the structure in addition to the equipment loaded weight has been incorporated in the building structure.

(c) Access. Adequate space shall be provided in all boiler rooms for the erection or installation of the boiler or boilers and the equipment to be used. All equipment shall be accessible for service and repairs.

(d) Venting. See Chapter 37.

Section 5804. HEADERS AND CONNECTIONS ON STEAM BOILERS.

(a) Sectional Boilers.

1. Steam Headers. Steam outlets or openings in all cast iron sectional type steam boilers shall be connected into a common steam header. The size of such header, for boilers having not more than two steam outlets shall be not less in nominal diameter than the nominal diameter of the larger of such outlets. The size of such header for boilers having more than two steam openings shall be increased one pipe size for each additional two steam outlets. Reducing the size of the openings between boiler and header is prohibited. All steam headers shall be installed so as to permit expansion of the boiler. Rigid type headers having the steam openings connected directly into a header pipe placed directly over such openings without the use of any fittings are prohibited. Offset headers shall be placed or installed to the right or left side of the steam openings of the boiler by use of 90° fittings. The riser pipes from the steam openings shall be connected into the horizontal header by the use of elbows and flanges placed either in the riser pipe or in the horizontal pipe running from the riser to the header. The final connections to the header may be made by welding or with screw type fittings.

2. Return Headers. Return openings in all cast iron sectional type steam boilers shall be connected into a common return header. The size of the return header shall be not less in area than one-half \( \frac{1}{2} \) the area of the steam header. Total area of connections from return openings to header shall be equal to the area of the return header. Where more than two return openings are provided on a boiler, the openings selected to connect into the return header shall be those at either end of the boiler so that complete circulation through the boiler may be attained. If the return openings or openings selected on the boiler are larger in area than is required for a return header, such opening or openings may be reduced so that the total area will be not less than the area required for a return header. Where return openings of boilers are reduced, eccentric bushings or eccentric fittings shall be used. Where return headers connect to boiler return openings, the use ofells is prohibited. Tees shall be used and so installed that one opening of the tee is in line with the opening of the boiler. This opening shall be capped-off full size.

(b) Steel Boilers. A header is not required of fire-box type steam generators or other types having only one steam opening and one return opening. Piping connections shall be offset to provide for expansion. A Hartford Loop and Tee connection shall be installed.

Section 5805. BOILERS IN PARALLEL BATTERIES.

(a) General. Where boilers are installed in batteries of two or more, with cross-connected steam and return headers, such boilers shall be installed so that the operating water line or level of all boilers to be operated as a unit will be at the same level.
(b) Sectional Type Boilers. All sectional type boilers used in series or in batteries with other sectional type boilers shall have separate headers for steam and return connections as provided for individual boilers. Each boiler shall have valves on the supply and return piping so that it may be shut off from other boilers operating in same battery without interfering or affecting operation of such other boilers.

The steam supply to the common header or main steam supply piping shall be taken from the individual header of each boiler. The return to each boiler shall connect to a common header that in turn is connected to each boiler return header. On steel boilers, the steam outlet may be connected directly to main steam header on main steam supply piping; but an equalizing pipe and main steam supply piping shall be taken from the supply and return piping so that it may be connected directly to main steam header on main steam supply piping but an equalizing pipe and Hartford Connection shall be installed on gravity return systems where the boiler is used for low pressure service. Boilers shall also be valved so they can operate as individual units.

Section 5806. HARTFORD TEE AND EQUALIZING PIPE REQUIREMENTS.

(a) General. An equalizing pipe shall be connected between the steam header and the return header. The size of such pipe shall be the same as the steam header to a point not less than six (6) inches below the water line of the boiler. Reduction may be made at this point to the same size as the return header or piping. A tee or welded connection shall be installed in the equalizing pipe, prior to reduction in size, and located at a point two (2) inches below the operating water line of the boiler. The two (2) inches below water line shall be measured from the top of the side opening of the tee or top of the side weld connection. The use of "Y" lateral type fittings or welds are also permitted in place of straight type tees. When "Y" fittings are used, the branch of side outlet of "Y" shall be installed to run down, or in an inverted position. If threaded tee is used, a close nipple shall be used between tee and an elbow and such elbow shall point downward. From the inverted "Y" or the elbow, a pipe shall be run downward and parallel to the equalizing pipe to a point near the floor line. All direct return piping from the system shall be connected to this pipe and the size of such pipe shall be not less than the burner output capacity; however, such valves may be installed, for the temperatures, pressures and fluids with which it is to operate. Such valves shall be rated as maximum unit capacity or not less than the burner output capacity. The requirements for temperature relief valves shall be those as required for pressure relief valves, except that temperature relief valves shall be of an approved type and need not bear the seal of the ASME-NB. For purposes of this Chapter, ASME-NB shall mean American Society of Mechanical Engineers-National Board.

Approved combination type pressure and temperature relief valves may be permitted on tanks up to 100 gallon storage capacity; however, tanks in excess of 100 gallon storage capacity shall be equipped with separated valves for relief of temperature and pressure.

1. Where boiler return pumps or combination return and vacuum pumps are used to return condensate to the boiler, they may be connected through a Hartford Tee and Loop Connection or direct to boiler return piping. Pipe from pump to boiler shall be run up in a vertical position from pump to height not less than three (3) feet above the water line of the boiler, or to ceiling if ceiling is less than three (3) feet carried across to the boiler at that height, then dropped to below water line of the boiler and connected to a Hartford Tee or direct to boiler return piping with necessary check valves installed.

Section 5807. SAFETY OR RELIEF VALVES AND REDUCING VALVES.

(a) General. All steam boilers, hot water boilers and generators, or any type of pressure vessel used for steam generation, for processing, or for building heating systems and tanks, and other equipment used for the purpose of generating or storing of hot water under pressure, shall be equipped with a side outlet type and approved ASME-NB pressure safety or relief valve(s), approved for the type of equipment on which it is installed, and for the temperatures, pressures and fluids with which it is to operate. Such valves shall be rated as maximum unit capacity or not less than the burner output capacity. The requirements for temperature relief valves shall be those as required for pressure relief valves, except that temperature relief valves shall be of an approved type and need not bear the seal of the ASME-NB. For purposes of this Chapter, ASME-NB shall mean American Society of Mechanical Engineers-National Board.

1. When the horsepower of a steam boiler or generator is in excess of five hundred (500) horsepower, a second relief valve of adequate size to handle the boiler output shall be installed. Such valve shall be permanently marked showing pressure and capacity rating.

2. Valves on hot water boilers and generators and hot water pressure vessels or building heating systems shall be of the type designed for hot water use and bear the ASME-NB permanent rating label indicating the capacity of the valve in BTU's and the pressure at which they are to operate. When the equipment has a heat input rating in excess of 15,000,000 BTU's, a sec-
3. Required side outlet type relief valves shall be installed on top of boilers and at the heat exchanger. Stops, valves or other obstructions that will prevent the full pressure of the heating system from being applied to the relief valves at all times, are prohibited.

(Ord. 40 — 1966)

(b) Location. All relief valves shall be installed in openings by the manufacturer of the equipment. If such openings are not provided, the valves shall be installed in the piping of the equipment as close to the equipment as possible. Pressure relief valves shall be installed in the cold water supply piping as close to the heater or tank as practicable, so the valve will be under the same constant water pressure as the equipment. Valves or stop cocks shall not be permitted between boiler or pressure vessel and pressure valves except on boilers in excess of 1000 horsepower and having two or more relief valves. Reduction in the size of the relief valve connections shall not be permitted.

(c) Test Lever. All relief valves shall be provided with a suitable type hand test lever.

(d) Valve Setting. All valves shall be tested after installation to indicate that they relieve at the pressure or temperature set and designated on the valve. Any valve failing to open within 10 per cent of setting marked shall be considered defective, and shall be replaced.

(e) Valve Seals.

1. The seal provided by the manufacturer of the relief valve to seal valves at designated pressure or temperature shall not be broken without special permission of the Building Official. If permission is given to change or reset the valve, such valve shall be resealed in the presence of an authorized representative of the Building Inspection Department and permanently tagged and marked to indicate the new setting permitted.

2. Where the seal on any type relief valve is found broken without permission of the Building Official, the equipment on which the valve is installed shall be ordered out of service and shall not be placed in service until a new valve, of proper size and type, has been installed on the equipment, and such new valve is tagged and sealed in an approved manner.

Exception: If, however, the equipment cannot be ordered out of service, the valve shall be immediately checked. If found to be operating properly, the valve shall be resealed and tagged in an approved manner.

(f) Discharge. Safety or relief valve discharge openings shall be piped the full size of the relief opening to a location where the discharge can- not be injurious to the plant, the building, or to personnel. If the discharge pipe from the relief valve is piped to the outside of the building, provisions shall be made to secure proper drainage and prevent freeze-up. Discharge pipe from the relief valve, piped to the inside of the building shall be piped to within six (6) inches of the boiler room floor, or to an approved plumbing receptacle. The boiler room floor shall be provided with a drain or an approved plumbing receptacle connected to the sewer and the drain pipe from such device shall be not less than one nominal iron pipe size larger than the drain outlet of the relief valve.

The discharge end of the pipe from any relief valve shall be open to the atmosphere so as to provide a minimum air gap between the overflow rim to the receptacle of the sewer opening or floor drain of twice the inside pipe diameter of the relief valve discharge pipe.

(g) Pressure Valves.

1. On all closed building heating systems, in addition to the compression tank, an approved type of pressure reducing valve and pressure relief valve shall be installed. The reducing valve shall be capable of reducing the water supply pressure to the safe operating requirements of the heating system. This valve shall be of not less than one-half (1/2) inch nominal iron pipe size and shall be installed in the makeup water supply line. Combination pressure reducing and relief valves are prohibited.

2. An approved pressure relief valve shall be installed on all closed heating systems. The capacity and size of the relief valve shall be in accord with the Btu generating capacity of the heat exchanger or boiler. Relief valves less than one-half (1/2) inch pipe size shall not be installed in any closed hot water system. On large systems, where the Btu capacity of the system is greater than the capacity of any one relief valve to provide adequate protection, two or more valves shall be provided to meet the Btu generating capacity.

Section 5808. WATER LEVEL & STEAM PRESSURE GAUGES AND TRY-COCKS.

(a) Each low pressure steam boiler shall be equipped with:

1. A water level gauge glass mounted so that the mid-point of the glass is at the normal water level of the boiler,

2. At least two hand operated Try-Cocks mounted on and one-half (1 1/2) inches above and one and one-half (1 1/2) inches below the normal water level of the boiler,
3. A steam pressure gauge mounted on or at the top of the boiler.

(b) Gauge Glass and Try-Cocks. The gauge glass and try-cocks may be mounted directly on the boiler, independent of all other connections. If the boiler is equipped with a separate water column on which the gauge glass and try-cocks are installed, and this water column is connected to the boiler by means of pipe and fittings, the bottom of the water column shall be provided with a proper size blow down valve. The size of such valve shall be at least the size of the piping connection of the water column to the boiler and shall be of the gate valve type. Wherever separate water columns are to be connected to boilers, the water columns shall be piped to the boiler using plugged crosses for all 90° bends in such piping.

(c) Steam Gauge. The steam gauge shall be installed so as to be clearly visible from the operating floor or normal access area at all times. It shall be the low pressure type with easily read numerals, at least four and one-half (4½) inches in diameter and with a maximum rating of one and one-half (1½) times the maximum operating pressure of the boiler. Such gauge may be mounted directly on the boiler or at the top of the water column and shall have a syphon loop, between the gauge and the boiler connection.

Section 5809. BLOW-OFF VALVES.

(a) General. Each steam boiler shall be provided with a proper size blow-off or drain valve or valves of the quick opening or one-fourth (¼) turn type. Such blow-off or drain valves shall be installed in the opening of the boiler provided by the manufacturer or in the return header at the boiler and shall be so installed that the boiler will be completely drained. The blow-off or drain valve shall be at least three-fourths (¾) inch size for boilers of up to 1000 square feet of radiation capacity; one (1) inch for boilers up to 3000 square feet of radiation capacity; and one-fourth (¼) inches for boilers up to 8000 square feet of radiation capacity; and one and one-half (1½) inches for boilers in excess of 8000 square feet of radiation capacity. The blow-off or drain valve shall not be connected directly to any sanitary sewer system. When drained to a sewer, it shall drain to an open floor drain, approved receptor, or to a regular blow-off tank or sump. The temperature of the discharge water shall not exceed 180° F when it enters the sanitary sewer system. The blow-off or drain may discharge into an approved leeching pit.

(b) Blow-off and Sump Tanks.

1. Blow-off or sump tanks shall be installed where either are necessary to properly blow down or drain the boiler or where the boiler is set or pitted below the level of the boiler room or below the low point of any floor drain connected to the sewer.

2. Where sump or blow-off tanks are installed below the level of sewer piping and it is necessary to raise the water so that it can be properly drained into the sewer, an automatic power driven pump shall be provided to lift the water, and such pump shall operate by means of a float in the sump or tank when the water reaches a predetermined height.

3. All piping between blow-off and drain valves and connecting to sump or flash tank shall be connected directly to the tank and shall not be less than the size piping of the blow-off or drain valve. Such pipe and fittings shall be capable of withstanding the full pressure of the boiler.

Section 5810. LOW WATER CUT-OFF CONTROLS — WATER FEEDERS.

(a) General. An external low water cut-off control shall be installed on all fuel fired steam boilers or generators in such a manner so that the fuel firing device will shut off when the level of the water is within one (1) inch of the bottom of the gauge glass. The use of internal type low water cut-off valves is prohibited.

1. A water feeder may be installed to operate and maintain the water at the proper operating level in steam boilers. A water feeder shall not be installed on any boiler which is not equipped with a low water cut-off control. Combination feeders and low water cut-offs are permitted.

2. The quick hook-up type of low water cut-off or combination feeder and cut-off that are attached or connected to the gauge glass connections of a steam boiler are permitted on steam boilers not in excess of 2000 square feet of radiation capacity or the equivalent in boiler horsepower. All boilers larger in size shall use the type of low water cut-off or feeder combination that is attached directly to the boiler by means of separate pipe connection, one above the water line of the boiler, the other at least twelve (12) inches below the normal operating water line of the boiler. The connecting pipe to the boiler shall be not less than one (1) inch iron pipe size. Such pipe shall have a blow-off valve installed at the lower connection.

3. Each type of low water control and combination-type feeder and control shall be equipped with a flushing valve, gate valve, or quick-opening valve. This valve shall be the full size of the opening provided at the bottom of the control. Flushing valves shall be provided with permanently marked tags carrying instructions to the operator to flush the low water control at least once a week.
(b) Special Types. Special types of low water cut-offs and water feeders that are supplied by the manufacturers of boilers as part of the boiler equipment or built into the boiler, if approved, are acceptable, if the necessary safety protection is provided.

(Ord. 40 — 1966)

Section 5811. PIPING FOR STEAM AND HOT WATER HEATING SYSTEMS.

(a) General. All steel and wrought iron pipe shall be at least schedule 40 pipe, or pipe or tubing of equivalent working pressure and tensile strength. Brass or copper pipe, and copper or steel tubing may be used on hot water heating installations, if the system is designed to operate within such pipe or tubing working pressure rating.

(b) Reaming. All pipe or tubing shall be reamed after cutting to not less than full internal dimensions.

(c) Pipe Joining. Steel or wrought iron piping may be joined by welding or by the use of screw or flanged fittings. Copper or tinned steel tubing may be joined by brazing, soldering or approved compression fittings.

(d) Pipe Support. Pipe and piping shall be properly hung and supported to permit expansion and contraction. "U" bends, swing joints or expansion joints shall be installed so as to permit free expansion and contraction of the piping. Swing joints or "U" bends shall be fabricated of equivalent working pressure and shall be suitable for the pressures and temperatures at which the installation is designed to operate. Expansion joints of either the slip sleeve or corrugated copper type may be used where such joints meet the temperature and pressure requirements of the installation.

1. All piping shall be securely supported on substantial incombustible supports or hangers. Such supports or hangers shall be securely fastened to an adequate support or structural member. The hangers or supports shall be so spaced that there shall be no undue stress or strain on the pipe, joints, fittings, or valves and so that sagging will not occur in the pipe between points of suspension under normal operating conditions.

2. The piping shall be securely fastened to proper type anchor foundations where necessary to prevent undue stress or strain on boilers or equipment due to weight of the pipe or expansion and contraction.

(e) Piping Through Walls, Floors, etc. Piping passing through walls, ceilings, floors, beams, or any portion of the building structure, shall be free to expand and contract and shall not be embedded in plaster, concrete, or masonry. Such piping shall be provided with metal sleeves or thimbles when passing through concrete or masonry walls, ceilings, floors or beams, and such sleeves or thimbles shall be at least three-eighths (3/8) inch larger than the outside diameter of the pipe plus the insulation. Openings through wooden floors, ceilings, walls, and beams shall be at least three-eighths (3/8) inch larger than the outside diameter of the pipe or the pipe plus insulation. When copper tubing is installed in a concrete slab or in the earth below a slab it shall be installed in a sleeve with a diameter not less than three-fourths (3/4) inch greater than the outside diameter of the tubing; the tubing shall be arranged to permit expansion and contraction without damage to the tubing or to the building structure; and all joints shall be made with solders or copper brazing rods having a melting point of 1100° or higher. Where steel pipe is installed in a concrete slab or in the earth below a slab, it shall be installed in a casing or conduit, and such steel pipe shall be protected against corrosion. The casing or conduit shall be laid in a straight line and shall extend into accessible portions of the building to permit the removal or insertion of the pipe when the casing or conduit is in place. Corrosion protection shall consist of a thick coating of bituminous material, applied in molten condition, with a wrapping of asbestos fabric saturated with bitumens. Mill wrapped pipe shall be acceptable if all joints are protected in substantially the same manner as the original pipe. The Building Official shall approve the type of sleeve and insulation to be used on piping carrying steam, water or other fluids at temperatures in excess of 300° F. (See Section 5819 for radiant heating systems.)

(f) Vertical Piping Secured. Vertical piping shall be secured at sufficiently close intervals to keep the piping in alignment and carry the weight of the pipe and contents but in no case less than at every other story height.

(g) Branch Main Stress. Where the main steam supply or hot water supply piping or the main return piping of a system is divided into two or more branch mains or returns, such branches from the main piping shall be taken off with tees and elbows or "Y" branch fittings, so installed and connected that no undue stresses or strains from pipe expansion or other causes shall be placed on the pipe fittings or threads at the point or points of junction of the piping.

(h) Bull-Heading Tee. The use of bull-heading tee connections is prohibited where the side opening of a tee is connected to the main piping and where two branch connections are taken off of the run of the tee thereby forming a rigid connection.

(i) Welding. Where welding is used as a means of connection or joining branch mains to the main steam piping or return piping, provisions shall be made for the expansion of the pipe.
at this point so that no undue stresses or strains shall be placed on the welds or piping. The bullheading or rigid tee is prohibited on this type of connection.

(i) Connections from Mains, Branch Mains or Return Piping. All connections from the mains, branch mains, or return piping of a steam system to radiators or to supply risers running to upper floors of a building shall be taken off at the top of the supply or return piping by use of a 45 degree or 90 degree elbow where fittings are used, or welded into the top of the piping where the welded method of connection is used.

(k) Cold Water Supply to Hot Water Tank. The cold water supply to a hot water tank used for processing shall be discharged within three (3) inches of the bottom of the tank either by direct connection at this point or by means of a pipe or tube inside of the tank. There shall be installed, on the cold water line close to the tank, a hand shut-off valve and a check valve. The check valve shall be installed so that hot water can not flow back from the tank through the cold water supply piping.

(l) Approved Materials.

1. All threads on pipe, fittings, valves, flanges, and similar shall conform to American Standard Taper Pipe Threads.

2. Required gaskets shall be made of material approved for the pressure and temperature to which they are to be subjected. Rubber shall not be used where pressures exceed 15 psig steam and 45 psig water or on temperatures greater than 250° F.

3. Threaded joints shall be made up with an approved thread compound or lubricant.

4. Flanges, screw type, cast iron or steel, or, of the forged integral type may be used up to their working pressure and temperature ratings. All companion flanges shall have matching facing and drilling.

5. All pipe fittings and valves used on high pressure installation shall be of the type designed for the pressures and temperatures of the installation.

6. All pipe and piping used on high pressure-high temperature installations shall be of the required weight and strength suitable for the type service and pressures intended. Stress relieving may be required by the Department for high pressure-high temperature welded installations.

Section 5812. PITCH OF PIPING.

(a) General. All piping shall be properly pitched or graded for proper venting. Wherever practical, the water pipe shall be so pitched that the air or gases flowing to a high point or vent point will flow in the same direction as the water.

(b) Steam Mains. All steam mains shall be pitched or graded in the direction of the flow of steam from the boiler. The grade or pitch shall be at least one (1) inch per each twenty (20) feet of horizontal pipe run. The high point shall be established at or near the boiler. The pitch or grade shall be carried to the end or ends of the steam mains. The ends of the steam mains shall be properly dripped and connected into the return piping of the system so that the condensate will be carried back to the boiler directly or to a boiler return pump or return trap.

(c) Branches.

1. All branches to radiators or to supply risers on steam heating systems shall pitch up from the point of connection to main or return piping at least one (1) inch per each four (4) feet of horizontal run. If the horizontal run from the main to the radiator or riser on the steam system is over eight (8) feet in length such run shall be increased one pipe size.

2. If the building or structural conditions are such that the branches cannot be pitched up from the connection point and must be pitched down to the point where they rise to connect into the radiator or riser, the branch shall be dripped to a steam trap at the low point and trap connected to the return piping.

(d) Grading.

1. Where necessary, due to structural conditions to regrade or elevate the steam main or mains; or where the difference in the floor or ceiling heights or levels requires that the pipe be regraded; and where the change in grade or level causes the formation of pockets in which condensate can collect and cut down the capacity of the piping, a drip pocket and steam trap shall be installed at the low point and connected to the return piping. The size of the drip connection trap and trap connection shall be adequate to drain the amount of condensate anticipated, but in no case shall the drip connection be less than three-fourths (¾) inch iron pipe size.

2. Where structural conditions of the building are such that the steam main cannot be pitched so that the steam and condensate will flow in the same direction and it becomes necessary to pitch the main piping up so that it will be necessary for the condensate to flow back against the flow of
steam, the size of the pipe main shall be increased and properly dripped.

(e) Runouts. Steam lines having runouts shall be sized so that the pressure drop does not exceed 0.25 psig per 100 feet of length in order that the critical steam velocity will not be exceeded.

Section 5813. EXPANSION TANKS.

(a) General. An expansion or compression type tank shall be installed and used on all hot water heating systems. The size of such tank shall be determined from the gallons of water contained in the system or from the square feet of radiation capacity of the system. Heating systems using convectors, baseboard radiation or radiant coils in floors, walls or ceilings shall have the tank capacity rated for the number of gallons of water in the system. The capacity of tanks sized by the square feet of radiation capacity shall be at least one gallon for each seven (7) gallons of water in the system. The capacity of tanks sized by the square feet of radiation capacity shall be at least one gallon for each 50 square feet of cast iron radiation or its equivalent radiation.

(b) Compression Type Expansion Tank Use on Closed Systems. This shall be a pressure type tank and shall be installed as recommended by the manufacturer and as approved. Tanks shall be suitable for the pressure carried in the system. See also Section 5807 (h).

(c) Open Type Expansion Tank. Expansion tanks on open type gravity system shall be vented to the atmosphere. This type of tank shall be installed at least four (4) feet above the highest radiator or connector installed on the system. A pipe of at least one (1) inch iron pipe size shall connect such tank to the supply or return main of the heating system. Valves or stops shall not be installed in such pipe. Radiator connections shall not be attached to such pipe. Such pipe shall run as directly as possible from the supply or return main to the tank. From the top of such tank, a pipe of one (1) inch iron pipe size or equal shall be carried to the boiler location and installed to within six (6) inches of the floor having a floor drain or over an open approved receptor. Such pipe shall not be connected to any sewer pipe or vent stack and shall not be vented through the roof or wall of the building. Tank and piping shall be protected from freezing.

Section 5814. LOW-WATER CUT-OFF — HOT WATER HEATING BOILERS.

(a) General. All fuel fired water heating boilers or water heaters, in excess of 400,000 BTU input, shall be provided with low water cut-off or control installed on such boiler or water heater. Such cut-off or control shall be mounted externally on the boiler or water heater. The use of internal type low water cut-off is prohibited.

(b) Electrical. The low water cut-off shall be installed in accordance with the manufacturer's instructions and wired into the electrical supply circuit controlling the firing device so that the fuel supply will be shut off when the water drops to the level at which the control is set to operate.

(Ord. 40 — 1966)

Section 5815. WATER SUPPLY CONNECTIONS.

(a) General. All hot water heating systems, boilers, generators or pressure vessels shall be provided with a permanent makeup or feed water connection to such equipment from the water supply. Such water supply piping shall be of the proper size to furnish water to the equipment; however, such piping shall be at least one-half (½) inch iron pipe size. A hand operated compression, globe or gate type valve shall be installed on this line.

(b) Water Supply. The water supply connections shall be connected to the piping of the heating system.

(c) Check Valve. A check valve of the same size as the water supply piping to the boiler shall be installed in the feed water line so that water from the heating system cannot back into the building supply pipe. Where pressure reducing feed valves are installed that have check valves incorporated, a separate check valve shall not be required.

(d) Power Driven Feed Water Pump. A power driven feed water pump capable of building up the required pressure to furnish feed water to the equipment while operating under full load conditions shall be installed on all installations where the pressure of the equipment is in excess of the water supply pressure. A feed water injector may be installed in lieu of a feed water pump on boilers rated at five (5) horsepower or less.

Section 5816. GAUGES AND THERMOMETERS.

(a) General. Altitude gauges and thermometers shall be installed on all hot water heating systems.

1. Altitude or pressure gauge or a combination of both shall be installed on all hot water heating systems. The gauge shall be installed in the outlet of the boiler or heat exchanger or as near as possible so that it will register true pressure of the boiler at all times.

2. A standard type hot water thermometer shall also be installed on all hot water boilers or heat exchangers, so located as to indicate the true temperature of the water.

3. Approved combination gauges that indicate altitude, pressure and temperature of water in systems are acceptable and may be installed.
Section 5817. HEATING WITH STEAM FROM UTILITY CENTRAL STEAM HEATING SYSTEM OR OTHER TYPES OF STEAM DISTRIBUTING SYSTEMS.

(a) General. Steam supply piping from any central heating system entering into an individual building shall be provided with a steam shut off valve of the same size as the supply pipe to the building and shall be installed near the junction of the pipe and the building basement or boiler room. Connections to the steam supply of building piping shall be made on the building or load side of such valve.

(b) Reducing Valve Required.

1. Where the steam pressure supplied from such systems is of greater pressure than the design pressure of the heating equipment or other equipment used in the building, an approved reducing valve shall be installed to regulate the steam pressure to such equipment.

2. A shut-off valve shall be installed on both sides of pressure reducing valves used to reduce the steam pressure to the operating pressure permissible in the building. If a by-pass line is installed around the pressure reducing valve, such by-pass shall be at least one-half (½) the size of the reducing valve and shall be controlled by a globe type stop valve of the same size as the by-pass line.

3. Where reducing valves are installed, a shut-off valve shall be installed on both sides of the reducing valve. The by-pass line shall be connected so that when the shut-off valves are closed, steam can be by-passed.

4. On the downstream side or low pressure side of the reducing valve, a steam gauge and low pressure relief or safety valve shall be installed, set at maximum pressure at which the low pressure heating system is designed to be operated. Such relief or safety valve shall be installed in compliance with Section 5807 of this Building Code.

(c) Return Condensate. The return condensate from a building heated by a central steam supply may be discharged either into a return condensate system or wasted into a sewer drain connection or approved leaching well. This condensate when discharging into a sanitary sewer system shall be sufficiently cooled so that the temperature of the discharge water reaching such sewer shall not be in excess of 180° F. and such discharge cannot be directly connected to any sanitary sewer system; the discharge must be to an open floor drain or a special drain connection or approved receptor. If the floor drain or drain connection to the sewer is above the level of the return piping so that it cannot flow by gravity, an automatic sump pump shall be installed into which such condensate can be discharged and pumped from the sump to the sewer drain.

Section 5818. GAS, OIL AND SOLID FUEL BURNERS.

(a) All burners shall be in compliance with Chapter 51 and all other burners shall be approved.

Section 5819. RADIANT HEATING SYSTEMS.

(a) General. The installation of all types of radiant heating systems, where the source of heat is obtained from heated pipes or tubing, embedded in the walls, floors or ceilings of the structure to be heated, shall be designed or installed in strict accordance with the approved standard methods for the design and installation of such systems and this Building Code.

(b) Approved Piping. All pipe used shall be of standard weight iron or steel pipe, copper tubing, or other approved types of materials suitable for the type of installation and design.

(c) Piping Embedded. Where pipes or tubing forming a radiant heating panel are embedded in the structure of the building, all steel and iron pipe shall be joined together by welding with the electric arc or oxygen-acetylene methods; and all copper tubing shall be joined together with solders or copper brazing rods having a melting point of 1100° F. or higher. The use of screw fittings, compression fitting, flare fittings, or other means of joining the pipes or tubing together shall not be permitted.

(d) Piping Exposed. Where piping of a radiant heating system is exposed and accessible, as in a boiler room or basement, the use of fittings, unions and other standard methods of connecting the piping together and making necessary connection to boiler or pumps, compression tank, relief valves, and water supply piping, are permitted.

(e) Testing. All piping or copper tubing installed as a portion of a radiant heating system that will be imbedded in the walls, floors or ceilings of the building it is designed to heat, shall be thoroughly tested for leaks by the hydrostatic test method, by applying a pressure of not less than one hundred (100) psi water pressure or one and one-half (1 ½) times the operating pressure, whichever is the greater. A pressure gauge shall be connected to the piping and after the pressure has been raised, the hydrostatic pressure connection shall be disconnected and the systems under pressure shall remain at the test pressure for a sufficient period of time to determine whether any leaks exist in the system. Leaks shall be indicated by the pressure drop on the
gauge. Minimum test period shall be four (4) consecutive hours. All tests for tightness on radiant piping systems shall be approved by the Building Official.

Section 5820. CHIMNEYS, FLUES, VENTS AND COMBUSTION AIR.

(a) All chimneys, flues, vents and combustion air shall meet the requirements of Chapters 37 and 51.

Section 5821. BLOW OFF TANKS.

(a) General. Blow off tanks constructed of steel shall be designed and fabricated in accordance with recognized and accepted methods of construction.

1. For boilers carrying 100 psi steam pressure or less, the tanks shall be constructed of not less than one-fourth (¼) inch steel, both heads and shell.

2. For boilers carrying in excess of 100 psi pressure, tanks shall be fabricated of heavier material adequately designed for the pressures carried.

(b) Size. The size of the tank shall be indicated by the blow down requirements and the tank installed shall be large enough to blow down one gauge glass of water from one boiler or from any one of a battery of boilers interconnected.

1. The size of the tank shall be of sufficient capacity so the blow down water from the boiler will only fill one-half the capacity of the tank and the remaining area of the tank shall be available for the vapor displacement.

(c) Discharge. The discharge from the boiler or boilers shall enter the tank above the high water level or surface of the water in such tank. A baffle plate shall be installed in the tank in line with the inlet pipe from the boiler and shall be at least twelve (12) inches from the discharge opening from the boiler into the tank. The outlet opening or discharge from the tank shall be at least two times the area of the inlet pipe and such outlet pipe shall have an internal pipe built into the tank, and extending downward to within four (4) inches of the bottom of the tank. The discharge pipe shall be connected to a sewer through a running trap, or to an approved leaching well.

(d) Venting.

1. All blow-off tanks shall be properly vented to the outside atmosphere. Such vent pipes shall be at least four (4) times the area of the inlet pipe from the boiler and in no case shall such pipe be less than two (2) inch iron pipe size.

2. The vent pipe shall be run as directly as possible to the outside atmosphere and in a suitable location so that any steam or water discharged by the blow down of the boiler would not be dangerous or injurious to life or property.

3. The vent shall be free of any pockets or sags that might collect or hold water and cause an obstruction of the pipe and build up pressure in the tank. The end of the vent pipe shall be protected from the possibility of any obstruction.

(e) Manhole. Each blow down tank shall be provided with a suitable size man hole for the inspection and cleaning of the tank.

Section 5822. HOT WATER STORAGE TANKS, HOT WATER HEATERS, TANKLESS TYPE WATER HEATERS AND EQUIPMENT—CONSTRUCTION AND MOUNTING.

(a) General. All hot water storage tanks with a capacity of 100 gallons or more and tankless heaters with a capacity of 200 gallons per hour or more shall be installed in compliance with the technical provisions of this Section, Chapter and Code. Such tanks used for storage of hot water at city water pressure, shall be constructed of metal and shall have a working pressure rating of at least 150 psig.

(b) Approved Tanks. Tanks shall be permanently labeled or stamped by the manufacturer with the manufacturer’s warranty that it has been tested to at least 200 psig hydraulic or hydrostatic pressure, together with the maximum working pressure at which it may be installed. Tanks shall not be installed if the working pressure is greater than forty-two and one-half (42½) per cent of the warranty test pressure stamped thereon, or if it will normally be subjected to pressures in excess of its rated working pressure.

Tanks constructed and not in for 100 psig work pressure may be used, provided that there be installed in the supply piping to the tank an approved type of pressure reducing valve that will reduce the pressure to or below 100 psig and that tank be equipped with a pressure relief valve equal in size to either the supply or discharge line whichever is the larger.

(c) Tankless Water Heaters. Tankless water heaters shall have permanently stamped or marked upon them their design working pressure.

(d) Indirect Type Water Heaters. Indirect water heaters shall have permanently stamped or marked upon them their design working pressure.

(e) Direct-Fired. Direct fired-gas, liquid or solid fuel water heaters shall have permanently stamped or marked on them their design working pressure, and this shall be the maximum permissible working pressure of the tank or heater. If the pressure of the water supply to the heater is in excess of the designed working pressure, a reducing valve shall be installed to lower the pres-
sure to the rated working pressure permitted on the heater or tank, whichever is the lesser. Safeguards shall be provided to prevent the water heater from being subjected to pressures from any source that is in excess of the rated working pressure or a heater shall be installed that has a rating such as to withstand any pressures to which the heater may be subjected.

(f) Foundation.

1. All tanks shall be installed on a suitable type stand or concrete foundation capable of supporting the combined weight of the tank and contents.

2. Tank stands shall be constructed of fabricated steel; beams, or channels welded or bolted together or steel pipe and malleable iron fittings or welded to form adequate support for the tank and contents. When pipe is used for the cross member on which the tank shall rest, such pipe shall be of double strength or extra heavy pipe or two pipes, one inside the other, the inner pipe to be of the next size smaller than the pipe used as the cross pipe or bearing pipe.

3. Tank stands shall be supported directly from floor or tank foundation and not from a partition or building wall unless such wall is designed to carry the additional load. When tanks are installed in the basement, and the floor under tank stand is not capable of supporting the weight of tank and contents, such floors shall be reinforced to be capable of carrying the weight. All stand legs, resting on concrete (basement) floor, shall be set on either round or square bearing plates, not less than one-half (½) inch thick and sized so that stress or load on concrete at its perimeter shall not exceed two hundred (200) pounds per lineal inch of perimeter.

4. Tank installations on other floors of buildings, where the weight must be supported by the building structure, shall be subject to prior approval by the Building Official.

Section 5823. BOILING OUT PROCEDURE FOR STEAM BOILERS AND GENERATORS.

(a) All steam boilers or steam generators shall be boiled-out prior to being put into service. The following procedure shall be followed:

1. The chemicals shall be completely dissolved in water before being placed in unit.

2. The chemicals may be either pumped into the unit through chemical feed connection or poured through an upper opening on the unit.

Either of the four compounds of chemicals are acceptable. The concentrations listed apply to all the water in the unit usually at normal operating water level.

<table>
<thead>
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<th>CHEMICAL CONCENTRATIONS</th>
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<tbody>
<tr>
<td>1. Trisodium Phosphate</td>
</tr>
<tr>
<td>(Na₃PO₄·12H₂O) ........ 2500 ppm</td>
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<tr>
<td>Caustic Soda (NaOH) .......... 2500 ppm</td>
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<tr>
<td>2. Trisodium Phosphate</td>
</tr>
<tr>
<td>(Na₃PO₄·12H₂O) ........ 5000 ppm</td>
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</tr>
<tr>
<td>Soda Ash (Na₂CO₃) .......... 1500 ppm</td>
</tr>
<tr>
<td>4. Caustic Soda (NaOH) .......... 3000 ppm</td>
</tr>
<tr>
<td>Soda Ash (Na₂CO₃) .......... 3000 ppm</td>
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</tbody>
</table>

Section 5824. CLEANING PROCEDURE—HOT WATER SYSTEM.

(a) Hot water systems shall be cleaned according to the recommendations of the manufacturers of the component water carrying parts and as approved by the Building Official before such system is placed in service.

Section 5825. BOILER AND GENERATOR SETTINGS AND CLEARANCES.

(a) Mounting.

1. Boilers, unless approved for other mounting or setting, shall be mounted on floors of fire-resistive construction with non-combustible flooring and surface finish and with no combustible material against the underside thereof or on fire-resistive slabs or on fire-resistive arches having no combustible material against the underside thereof. Such construction shall extend not less than twelve (12) inches beyond the boiler on all sides, and where solid fuel is used, it shall extend not less than forty-eight (48) inches at the front or sides where ashes are removed.

2. Boilers may be mounted on floors other than as specified in paragraph (1), provided the boiler is such that flame or hot gases do not come in contact with its base, and provided the floor under the appliance is protected with hollow masonry not less than four (4) inches thick covered with sheet metal of not less than twenty-four (24) gauges. Such masonry shall be laid with ends unsealed and joints matched in such a manner as to provide a free circulation of air from side to side through the masonry.
3. Boilers which are arranged so that flame or hot gases come in contact with the base, may be mounted on floors other than as specified above, provided the floor under the appliance is protected by two courses of four (4) inch hollow masonry, with courses laid at right angles and with ends unsealed and joints matched in a manner to provide a free circulation of air through each masonry course. Top of such masonry base shall be surfaced with a metal plate not less than 20 gauge.

4. All boilers shall be approved or bear the seal of a national recognized laboratory.

5. Boilers of the water-base type may be mounted on floors other than as specified in paragraph (1) above, provided the water chamber extends under the whole of the ash pit and the firebox, or under the whole of the ash pit and the firebox, or under the whole of the firing chamber if there is no ash pit.

6. Steam or hot water unit heaters shall be installed to provide a minimum clearance of one (1) inch.

(b) Clearance to Combustible Material.

1. All steam and hot water heating appliances shall have a clearance to combustible material as specified in this Chapter and the following Table 1.

### TABLE 1

<table>
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<th>Minimum Clearance, Inches</th>
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<tr>
<th>Above Boiler</th>
<th>Jacket Sides and Rear</th>
<th>Front SEE Note 1</th>
<th>Projecting Flue Box or Draft Hood</th>
<th>Flue Pipe or Vent Connector</th>
</tr>
</thead>
</table>

I. Steam or Hot Water Heat Exchanger-Steam not over 15 pounds gauge pressure and hot water not over 250°F........ 1 1 1 1

II. Heating Boilers—Steam Boilers operating at not over 15 pounds gauge pressure and hot water boilers operating at not in excess of 250°F of the water-wall type or having a jacket or lining of masonry or other satisfactory material.

Burning liquid fuel.......................................................... 6 6 24 18 18
Burning gas fuel.............................................................. 6 6 18 9 9
Burning solid fuel............................................................ 6 6 48 18 18

III. Boilers, other than above.

Burning liquid fuel.......................................................... 18 18 48 18 18
Burning gas fuel.............................................................. 18 18 9 9
Burning solid fuel............................................................ 18 18 48 18 18

Notes: (1) Front clearance shall be sufficient for servicing the burner and boiler.

(2) This clearance may be reduced to 6 inches for gas burning boilers that have been tested by an approved agency and found to have flue gas temperatures not exceeding 550°F. This clearance does not apply to approved Type B gas vents used and installed in accordance with the conditions of such approval.

(3) For liquid fuel burning boilers that are approved specifically for installation with lesser clearances, flue pipes may be installed in accordance with the conditions of such approval.

**EXCEPTIONS:**

(1) Boilers approved specifically for installation with clearance less than specified in Table 1 may be installed in accordance with the condition of such approval.

(2) Boilers shall not be installed in confined spaces such as alcoves or closets unless equipment has been approved specifically for such installation and is installed in accordance with the conditions of such approval.
(c) Separation of Equipment. Direct fired heating equipment shall be separated from other air handling equipment by a fire partition wall of at least one hour fire resistive construction.

EXCEPTIONS:

1. Combination heating and cooling equipment need not comply to the above if the heating and cooling equipment is an approved single package or tandem unit.
2. I and J Occupancies.

(d) Boiler Room. Every boiler or combination boiler and cooling unit shall be installed in a space which allows a minimum clearance of twenty-four (24) inches on all service sides. Such room shall be constructed of at least one (1) hour fire-resistive material and the door shall be a Class C fire door or a one and three-quarter (1 ¾) inch solid wood core door. Such door shall be equipped with an automatic self-closer. Combination air shall be provided to such room in conformance with Chapter 51. Storage or living quarters shall not be permitted in any boiler or similar heating equipment room. (See Occupancy Sections for other type separations).

EXCEPTION:

1. I and J Occupancies, except for combustion air requirements as set forth in Chapter 51.

(e) Steam and Hot Water Pipes. Steam and hot water pipes shall be installed with a clearance of at least one (1) inch to all combustible material except as specified below.

1. Low Pressure. At points where pipes carrying steam or hot water under pressures not over 15 pounds per square inch gauge emerge from a floor, wall or ceiling, the clearance at the opening through the floor, wall, or ceiling shall be at least three-eights (3/8) inch. Such openings shall be rodent proof.

2. High Pressure. Clearance to combustible material for high pressure steam pipes and high temperature hot water pipes shall be subject to approval. Covers for such openings shall be required and subject to approval.

3. Hot water pipes on a system with automatic firing and with limit controls such that water temperature at the boiler cannot exceed 250°F. may be installed with no clearance to combustible material.

(f) Pipes Through Shelving. Steam pipes and hot water pipes passing through stock shelving shall be covered with incombustible insulation not less than 1 inch in thickness.

 Wooden boxes or casings enclosing steam or hot water heating pipes, or wooden covers of recesses in walls in which such pipes are placed shall have not less than two (2) inch clearance from such pipes.

Insulation used on steam or hot water pipes shall be of non-combustible material. Coverings shall be an approved flame proof material.

Where steam pipes or hot water pipes pass through a floor, wall or ceiling of fire-resistive construction, the openings shall be filled with non-combustible material but which will permit pipe expansion.

(g) Antifreeze Solutions for Radiant Heating Coils. Antifreeze solutions used in radiant heating coils within a building shall not contain any liquid with a flash point less than 225°F.

(h) Air Cooling Equipment. (See Chapter 49).

(i) Flue Exhausters. Flue exhausters may be used with large gas fired sectional boilers and other large hot water and steam boilers when adequate natural draft cannot be secured by the building flue or chimney. Where a flue exhauster is used with gas burning appliances, it shall be subject to approval and provisions shall be made to prevent the flow of gas to the main burners in the event of failure of the flue gas exhaust system.

Section 5826. WELDING OF PIPE JOINTS.

(a) General. All welded connections shall be so designed and fabricated as to permit thorough penetration of the welds to the bottom of the joints and all welds shall be made in conformance with the general requirements specified herein and by the American Welding Society.

(b) Materials. The materials to be welded shall be of good weldable quality, free from laminations, split seams, harmful ingredients, and other defects. The filler metal, electrodes, and welding wire or rods shall be suitable for use with the base metals to be welded.

(c) Preparation for Welded Joints.

1. Butt Welds. Butt welds may be of either the single “V,” double “V” or “U” bevel. The edges of the parts to be jointed shall be beveled and spaced as required and the welding procedure shall be such as to insure complete penetration of the deposited metal to the bottom of the joint and thorough fusion of the deposited metal with the base metal. Ferrules or backing strips inside the pipe may be used if properly secured and thoroughly fused to the weld. Care shall be exercised not to burn through the ferrule or backing strips or rings. Welds shall have no depressions at the edges below the surface of the parts joined, and shall be so built up that a gradual
increase in thickness from edge to center is accomplished.

2. **Fillet Welds.** Fillet welds may be either of the single or double fillet type, and the welding procedure shall be such as to insure complete penetration and thorough fusion of the deposited metal with the base metal. No fillet weld shall have a throat less than 0.75 times the nominal size of the weld.

3. **Seal Welds.** Seal welds shall not be considered as contributing to the strength of the joints. Seal welds may be of either butt or fillet type and shall be made as small in cross-section as practicable to insure tightness and minimize heating of the parts sealed. When applied to pipe joints where strength is supplied by other parts, the seal welding shall be accomplished so as to avoid undue straining of the joint structure due to temperature changes.

(d) **Cast Iron and Non-Ferrous Materials.** Where welding of cast iron and non-ferrous materials is permitted, they shall be welded with suitable filler metal and method as recommended by the American Welding Society and approved by the Building Official.

(e) **Welding Flanges, Valves, Fittings and Other Piping Equipment.**

1. Flanges, valves, fittings and other piping equipment which is to be welded shall be provided with suitable welding ends. The design of such ends shall be such that no damage will result from proper welding or stress-relieving which would render the equipment inoperative or unsafe for service.

2. Tees, bends, branch connections, swages and other fittings may be formed from pipe provided the design and fabrication conform to the requirements of this Section.

(f) **Welding Procedure.**

1. Beveling shall be by machine, however, this may be performed with a torch if the surfaces are thoroughly cleaned of scale and oxidation after the work has been performed.

2. Surfaces for welding shall be thoroughly cleaned and shall be free from paint, oil, rust or scale prior to welding.

3. Before welding, the piping or other equipment shall be carefully aligned. This alignment shall be preserved during welding.

4. The length of tack welds shall be approximately twice the thickness of the thinner material joined. Tack welds shall be kept below the outside surface and shall be melted out during welding or otherwise removed.

5. All welds shall be of sound metal, thoroughly fused to the base metal.

6. Excess weld metal shall not project within the pipe.

7. All butt welds shall be reinforced as follows: The thickness of the reinforcement shall be one-half the thickness of the parent metal.

(g) **Preheating and Stress Relieving.** Welded pipe joints under the provisions of this Chapter shall be preheated and stress relieved as follows:

1. **Carbon Steel Pipe—Preheating.**
   A. Carbon steel pipe that has a wall thickness of one-half (½) inch or greater and that has a carbon content of 0.35% or more shall have the welding zone preheated from 400 degrees to 600 degrees F.

2. **Carbon Steel Pipe—Stress Relieving.**
   A. Carbon steel pipe that has a wall thickness of one-half (½) inch or greater and that has a carbon content of 0.35% or more, shall have the weld stress relieved by heating to a temperature of 1225 degrees F. and held for a period of one-half (½) hour per one-half (½) inch of thickness of pipe and shall be allowed to cool slowly in still air.

3. **Low Alloy Piping Materials.**
   A. The welded zone shall be preheated to a temperature of from 400 degrees to 600 degrees F.

   B. When the nominal wall thickness is one-half (½) inch or greater, the weld shall be uniformly heated to a temperature of not less than 1375 degrees F. and held at that temperature for a period of not less than one-hour for each one-half (½) inch of thickness and then allowed to cool in still air.

4. When making the local stress relief, the following conditions shall be complied with:
   A. For welded joints in piping, the width of the heated circumferential band shall be at least three times the width of the widest part of the welding groove, but in no case less than twice the width of the weld reinforcement.
B. For welded nozzless or other welded attachments, the width of the heated circumferential band around the entire header and nozzle, with attachment in center, shall be at least 12 times the thickness of the header wall, plus the diameter of the nozzle or attachment.

C. At the termination of the soaking period, the zone weld shall be wrapped with 3 or 4 layers of asbestos in order to assure slow and uniform cooling. When test data is required, tempsticks or indicating or recording type pyrometer shall be used in recording the temperature of the stress relieving operation.

(h) Testing.

1. All welded piping work shall be inspected for the pressure tests specified. Welds may be checked by trepanning out a coupon large enough to show a clear cross-section of the weld. Such coupon shall be ground smooth at both sections of the weld and deeply etched for examination. Both etched sections of the weld shall pass examination required for the fractured surfaces of the weld in nick-break test specimen. If the weld proves satisfactory, the hole shall be closed by welding in a steel plug or other suitable piece of material, care being taken to minimize strains due to heating.

2. Piping and associated equipment fabricated with welded joints shall be capable of withstanding hydrostatic shell tests of not less than 1 1/2 times the working pressure or as specified.

(i) Acceptance and Rejection.

1. General sweating of any weld is cause for its rejection, complete removal and rewelding.

2. If inspection of a weld indicates failure to meet the test prescribed, such weld shall be rejected.

Section 5827. STANDARDS. Unless as otherwise specified in other Sections of this code, the following standards shall apply:

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<td>Part II, Net Load Recommendations Heating Boilers, Baseboard, Convector, Finned Tube, Testing and Rating Codes for Boiler-Burners Units, 1959</td>
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<td>Part III, Pipe Sizes and Design, 1945</td>
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<td>Part V, Graphical Symbols for Use on Drawings and Scheme for the Identification of Piping Systems, 1950</td>
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<td></td>
<td>Spec. for Threadless Copper Pipe, B 302-66a</td>
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<td></td>
<td>Spec. for General Requirements for Wrought Seamless Copper and Copper-Alloy Pipe and Tube, B 251-67</td>
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<tr>
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<td>Spec. for Copper Silicon Alloy Seamless Pipe and Tube, B 315-66a</td>
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<td>Spec. for Solvent Welded (SEP Size) Cellulose Acetate Butyrate Pipe D1503-67T</td>
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<tr>
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<td>Spec. for IPS Rigid Poly (Vinyl Chloride (PVS) Plastic Pipe D 1785-67</td>
</tr>
<tr>
<td>API</td>
<td>5-L Pipe Used for Petroleum Installations, April, 1957</td>
</tr>
</tbody>
</table>

Legend:

MCAA—Mechanical Contractors Association of America, Inc.

IBRM—The Institute of Boiler and Radiator Manufacturers

SBI—Steel Boiler Institute

ASHRAE—American Society of Heating Refrigerating and Air Conditioning Engineers

AGA—American Gas Association

ASME—American Society of Mechanical Engineers

ABMA—American Boiler Manufacturers Association

ASTM—American Society for Testing and Materials

USASI—United States of America Standards Institute

API—American Petroleum Institute
FIG. 1 - ROOT OF JOINT

FIG. 2 - ROOT OF WELD
TYPICAL WELDS

FIG. 3 - SIZE OF FILLET WELDS

FIG. 4 - CONCAVE FILLET WELD

FIG. 5 - CONVEX FILLET WELD

FIG. 6 - TYPES OF GROOVE WELDS.
CHAPTER 59
SAFETY REQUIREMENTS

Section 5900. SCOPE

(a) General. This Chapter shall establish minimum safety requirements wherever employment exists in connection with the construction, alteration, repairing or renovation of any building, structure or utility. This Chapter shall also include the erection and maintenance requirements for barricades, walkways, railings and fences as they pertain to construction and excavations on public or private property.

(b) Loads. Structures, or parts of structures, or any floor or temporary support, or scaffold, covered walkways or bridge, or any device or equipment shall not be loaded in excess of the safe carrying capacity.

(c) Warning Signs and Lights.
1. During the hours of darkness, amber lights shall be placed on or about all barricades and covered walkways.
2. The space under the covered walkway roof and the approaches thereto shall be kept well lighted, with artificial lighting, continuously between sunset and sunrise.

(d) Hard Hats. All men on any construction job shall be required to wear approved type hard hats.

(e) Dust. All controllable dust resulting from construction operations shall be settled in a manner as approved by the Department.

(f) Sanitary Facilities. Toilet facilities shall be provided in accordance with the requirements of Chapter 5 of this Building Code.

(g) Transportation Approval. Trucks and other equipment used by the contractor shall not interfere with or block either vehicular or pedestrian traffic, except as approved by the Department.

(h) Rubbish and Waste. 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 construction operations.

(i) Extinguishers. When cutting torches are required on any construction, approved type extinguishers shall be provided. The number of such extinguishers shall be that specified by the Department.

Section 5901. ON PUBLIC PROPERTY

(a) General. It shall be unlawful for any person, firm or corporation to utilize any City property for the construction of any building, structure or utility; storage or placement of materials or equipment; placement of barricade, or the erection of fences or covered walkways, except in accordance with the provisions of this Chapter and Building Code and in pursuance of approval by the Department, Traffic Engineer, City Engineer and as otherwise required by the Revised Municipal Code.

(b) Protection. 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 and the Revised Municipal Code.

(c) Storage. Storage of material required for construction work shall not be permitted in the alley or on public sidewalk, except as otherwise approved by the Department of Public Works.

(d) Indemnity. Every person, firm or corporation to whom permission has been granted by the Department of Public Works under the terms of this Chapter and the Revised Municipal Code to utilize public property shall at all times assume full responsibility for such. 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 all their agents and employees from any and all responsibility, liability, loss, or damage resulting
to any persons or property or caused by or incidental as aforesaid.

(e) Damage to Public Property. As a condition of obtaining a Building Permit, the permittee assumes liability for any damage to public property occasioned by such construction operations.

(f) Permit. A permit shall be required for all covered walkways, fences, barricades and railings prior to the erection of same.

(g) Protection of Utilities. Materials or equipment used in or required for construction work shall not be placed or stored so as to obstruct free and convenient approach to any fire hydrant, fire or police alarm box, any utility box, or to any catch basin or manhole, or so as to interfere with the free flow of water in any street or alley gutter. Every street lamp, utility box, fire or police alarm box, fire hydrant, and every catch basin and manhole that might be damaged by any work being performed or by the placement or storage of any materials and equipment shall be protected adequately against such damage. This protection shall be maintained as long as it is necessary and shall be completely removed as soon as the status of the work permits.

Section 5902. SITE PREPARATION

(a) Temporary Utilities. When necessary to maintain any power, water, or other lines during construction work, such lines shall be temporarily relocated or protected to the satisfaction of the Department and utility company and in accordance with applicable ordinances and this Building Code.

Section 5903. PUBLIC AND OTHER GROUND LEVEL PROTECTION

(a) General. A covered walkway shall be provided when the distance from the building, structure or utility to the inside edge of the sidewalk is less than ten (10) feet or when the height of the building, structure or utility exceeds the horizontal distance from the building, structure or utility to the inside edge of the sidewalk.

(b) Obstruction. Prior to construction every sidewalk or public thoroughfare adjacent to the work site shall either be closed or protected as specified elsewhere in this Chapter. All such thoroughfares which are open to the public shall be kept clear and unobstructed at all times.

(c) Covered Walkways and Railings. The height of all covered walkways shall be at least eight (8) feet. The height of all railings shall be at least four (4) feet. The width of all covered walkways shall be at least four (4) feet or as may be required by the Department to avoid congestion. A railing shall be maintained on the street side of the walkway during demolition work. A splash board, a minimum of twelve (12) inches in height, shall be provided where the walk adjoins a traffic lane.

1. The covered walkways shall be provided with adequate lighting. Such lighting shall provide a minimum of sixty (60) watt bulbs spaced every ten (10) feet. In addition to such lighting, amber lights, with a capacity of at least one hundred (100) watts, shall be provided at the exterior of the walkway, at both ends and in the center.

2. The outside edge and ends of the roof deck of the covered walkway shall be provided with an enclosure, at least forty-two (42) inches above the roof deck of the walkway.

3. Covered walkway openings for loading or unloading purposes shall be kept closed at all times except during actual loading or unloading operations.

4. The flooring of a covered walkway shall consist of planking at least two (2) inches in thickness, closely laid, or floors may be covered with three-fourths (¾) inch plywood. In either case, the floor shall be smooth. All members of the covered walkway shall be adequately braced and connected to resist displacement of members or distortion of the framework.

5. The roof of all covered walkways shall be made weatherproof.

(d) Type of Protection Required. Protection shall be provided for pedestrians and property on public property. Such protection shall be maintained in place and kept in good order for the entire length of time pedestrians on the public property may be endangered and shall be completely removed as soon as the status of the work permits.

(e) Fences and Covered Walkways. Solid walls of covered walkways shall be built and placed on the side of the walkway nearest to the new construction and shall extend the entire length of the building site and shall be turned and extended to the building line.

1. The entire structure shall be designed to carry the live and dead loads to be imposed, provided that every structure shall be designed to carry a minimum live load of at least one hundred and fifty (150) pounds per square foot, uniformly loaded.

Section 5904. STAIRS, PASSAGEWAYS AND LADDERS

All stairs, passageways and ladders shall be maintained in a safe condition.

All ladders shall meet the material and construction requirements specified in this Building Code.
Section 5905. WALKWAYS, FENCES AND BARRICADES FOR EXCAVATIONS

Walkways, fences or barricades shall be provided for excavations adjacent to the public way in accordance with the applicable portions of this Chapter and the Revised Municipal Code.

Section 5906. SANDBLASTING

(a) General. All types of sandblasting shall conform to the requirements of this Building Code.

(b) Definitions.

1. For purposes of this Building Code, the term sandblasting shall include sandblasting, shot-blasting, abrasive blasting, or any other method, employed in the treatment or cleaning of any and all surfaces, that produces particulate matter which escapes, or may escape, into the outdoor atmosphere.

2. For purposes of this Chapter, particulate matter shall include, among others, dust, abrasives, plaster, sand, cement, asbestos, or any solids or fines.

(c) Requirements. It shall be unlawful for any person, firm, or corporation to emit into the atmosphere beyond the exterior walls of a building, structure, or utility, particulate matter which is the result of any type of treatment or cleaning of any and all surfaces.

1. Description of equipment and control methods shall be submitted to the Air Pollution Control Department for evaluation prior to use.

2. Evaluated methods and equipment shall be so used that particulate matter is controlled at the source of emission. (Ord. 308, Sept. 5, 1969)

Section 5910. STANDARDS

Unless otherwise specified in other Sections of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>USASI</td>
<td>Safety Code in Building Construction, A 10.2-1944</td>
</tr>
</tbody>
</table>

Legend:

USASI United States of America Standards Institute
10 East 40th Street
New York City, N.Y. 10016
CHAPTER 60

PLASTICS

Section 6001. GENERAL.

(a) Approval.

1. Plastic materials may be of any class as defined in this Chapter. Prior to approval of plastic material for use, the manufacturer of such plastic material shall file with the Department such technical data as may be considered relevant to the proposed use of the plastic material. This data shall include the physical properties of the material, its chemical composition and properties, weather resistance, electrical properties, fire resistance, burning and flame spread characteristics, products of combustion and co-efficient of expansion.

2. Upon review of the data furnished, the Department shall determine the adequacy of the material offered and if it is found that the material is satisfactory for the use intended, may approve the material subject to the limitations specified in this Chapter.

(b) Identification.

1. Each plastic material shall be identified by the manufacturer with a number, trade name designation or other means of identification satisfactory to the Department, including the fire classification.

2. Plastic materials indicated on drawings or specifications shall be identified on such drawings or specifications by accepted designation.

3. Each sheet, roll or container of plastic employed in buildings or structures shall be identified with a mark, or other device which will identify the material as that indicated in the drawings or specifications.

Section 6002. DEFINITIONS.

(a) Plastic Materials.

1. Plastic materials are those made wholly or principally from standardized plastics listed and described in the Standards.

2. An approved plastic material is one which the Department has found to be suitable functionally for the purpose for which it is intended, and which burns no faster than two and one-half (2½) inches per minute in sheets sixty-thousandths (.060) of an inch in thickness when tested in accordance with the American Society of Testing Materials standard specifications titled "Tentative Method for Flammability of Rigid Plastics over Fifty-thousandths of an Inch in Thickness," or which is not consumed in less than two minutes when tested in accordance with standard specifications titled "Tentative Method of Test for Flammability of Plastics Fifty-thousandths of an Inch and Under in Thickness" with the thickness of the plastic material determined by Method "B" of the standard specifications titled "Tentative Methods of Test for Thickness of Solid Electrical Insulation."

Section 6003. CLASSIFICATION.

(a) Class A Plastics. Class A plastic materials shall be those reinforced or unreinforced approved plastic materials which are self-extinguishing when tested in accordance with the test procedures described in this Chapter.

(b) Class B Plastics. Class B plastic materials shall be those approved plastic materials which are reinforced with glass fiber or other incombustible material amounting to at least 1.5 ounces per square foot and at least 20 percent by weight of the plastic panel or sheet.

(c) Class C Plastics. Class C plastic materials shall be those approved plastic materials which are reinforced with glass fiber or other incombustible material amounting to at least 10 percent by weight of the plastic panel or sheet.

(d) Class D Plastics. Class D plastic materials shall be those approved plastic materials other than Class A, B, or C, which meet the requirements of Section 6002.

Section 6004. INSTALLATION.

(a) General. In addition to the provisions set forth in this Section, all installations approved plastics for wall, ceiling or interior finish, with the exception of those used for light transmitting purposes, shall comply with Chapter 42.

(b) Fastenings. Fastenings shall be adequate to withstand design loads as prescribed elsewhere in this Building Code. Proper allowance shall be made for expansion and contraction of plastic materials in accordance with accepted data on
coefficient of expansion of the material and any material in conjunction with which it is employed.

(c) Structural Requirements. All approved plastic materials and assemblies shall be of adequate strength and durability to withstand the design loads as prescribed elsewhere in this Building Code. If required, substantiating data shall be submitted on allowable working stresses.

Section 6005. INTERIOR FINISH.

(a) Permitted Uses. Approved plastics may be used in all types of buildings for interior finish provided that installations for other than light transmitting purposes shall comply with Chapter 42.

Section 6006. PLASTIC WALL PANELS AND GLAZING.

(a) Permitted Uses. Plastic wall panels shall mean plastic sheets fastened directly to structural members, to structural panels or to sheathing of exterior walls.

(b) Permitted Uses for Class A and B Plastics. Class A and B plastic wall panels shall be permitted in walls which are not required to have a fire-resistive rating or in wall openings which are not required to be wire-glazed or have other fire-resistive protection. (See Section 6012 for other uses.)

1. Panels shall not be installed at a height greater than twenty (20) feet above grade in buildings located within Fire Zone No. 1, unless as otherwise provided.

2. The inside surface of panels shall not constitute more than ten (10) percent of the exposed interior surface area of the wall of a public assembly area or required exit.

3. In types other than Type V construction, the aggregate area of such panels shall not exceed thirty (30) percent of the area of the wall in which the panels are installed. The panels shall be so distributed that the wall area of any story occupied by panels does not exceed thirty (30) percent of the wall area of that story. The area of the wall of any room in the structure occupied by panels shall not exceed thirty (30) percent of the interior surface of that wall.

4. No single assembly consisting of wall panels or group of wall panels and no run of contiguously mounted panels shall exceed one hundred (100) feet in length or twelve (12) feet in height.

5. In buildings of other than Type V construction, single assemblies or runs of contiguously mounted plastic wall panels up to forty (40) feet in length shall be separated longitudinally by a section of the required incombustible or fire resistive wall construction equal in length to twenty (20) percent of the length of the assembly or run or four (4) feet in length, whichever is greater. Assemblies or runs over forty (40) feet in length shall be separated by a section of the required incombustible or fire resistive wall construction at least eight (8) feet in length.

6. In buildings other than Type V construction, assemblies or runs of plastic wall panels shall be separated vertically by a section of required incombustible or fire resistive wall construction of a height of at least four (4) feet or a height equal to fifty (50) percent of the height of the highest panel in the next lower assembly or run, whichever is greater.

7. In Type V construction, Class A and B panels may be used wherever the installation of ordinary wood panels or plywood sheathing with the surface exposed is permitted.

8. If sprinkler protection is provided for the plastic installation, the permissible percentage of area occupied by plastic panels and the area of a single assembly or a contiguous run may be doubled and required separations between assemblies or contiguous runs may be reduced by fifty (50) percent.

(c) Permitted Uses for Class C and D Plastics. Class C and D plastic sheets may be used as plastic wall panels subject to the conditions specified for Class A and B plastics provided that

1. In types other than Type V construction the aggregate area of plastic panels shall not exceed twenty (20) percent of the area of the wall in which the panels are installed.

2. The panels shall be so distributed that the wall area of any story occupied by panels does not exceed twenty (20) percent of the wall area of that story.

3. The area of the exterior wall of any room in the structure occupied by panels shall not exceed twenty (20) percent of the interior surface of that wall.

4. Single assemblies or runs of panels in such construction shall not be in excess of fifty (50) feet in length or eight (8) feet in height.

(d) The Glazing of Unprotected Openings. Doors, sash and framed openings not required to be fire protected may be glazed or equipped with
transparent or translucent approved plastic materials subject to the height and percentage of wall area limitations and separation requirements specified in this Chapter. (See Chapter 38 for window requirements.)

(e) Combination of Plastic Panels and Glazing. Combinations of plastic glazing and wall panels shall be subject to the height and percentage of wall area limitations and separation requirements applicable to the class of plastics employed in the wall panel installation.

Section 6007. ROOF PANELS.

(a) General. Transparent or translucent lighting panels of approved plastics may be used in roofs not required to have a fire-resistive rating and in all roofs where automatic fire sprinkler protection is provided throughout the entire building or structure except in buildings or structures of Group A through E occupancies, provided:

1. That the roof is sloped at least four (4) inches in twelve (12) inches or steeper on structures, and that the panels conform to the slope of the roof.

2. Plastic panel areas, limited as specified in Subsection 6007(b), shall be separated from each other by a distance of at least eight (8) feet measured laterally and by a minimum distance of four (4) feet measured along the slope of the roof, but the separation distance along the slope shall not, in any case, be less than fifty (50) percent of the length of the longest plastic panel in the next lower assembly or run.

3. All plastic roof panels shall be attached directly to the building framework or shall be mounted individually in steel or other approved metal frames.

4. Corrugated panels shall be pitched in the direction of the corrugations.

5. Panels shall not be installed in walls where openings in such walls are required to be fire protected.

6. Exposed edges of plastic panels shall not project beyond the face of a building wall.

(b) Area Limitations. Plastic sections installed on roofs required to have a fire retardant roofing shall conform to the following limitations:

1. Sections of Class A plastics shall not exceed three hundred (300) square feet in area, and the aggregate area of such sections shall not exceed 33% of the floor area of the room or occupancy sheltered by the roof.

2. Sections of Class B plastics shall not exceed three hundred (300) square feet in area, and the aggregate area of such sections shall not exceed 25 percent of the floor area of the room or occupancy sheltered by the roof.

3. Sections of Class C and D plastics shall not exceed one hundred (100) square feet in area, and the aggregate area of such sections shall not exceed 15 percent of the floor area of the room or occupancy sheltered by the roof.

Section 6008. SKYLIGHTS.

(a) General. In lieu of glass, approved plastics may be used in skylights provided that the skylight is not installed over a shaft or stair well or over public assembly areas and provided that the plastic shall be mounted above the roof on an incombustible or metal-clad curb rising at least twelve (12) inches for buildings of office (F-1) or commercial or industrial occupancies, and six (6) inches for buildings of other occupancy types. The curb height shall be measured from the top surface of the roof covering, and the plastic units shall be installed on the roof with a minimum distance of five (5) feet between them and not less than five (5) feet from any exterior wall. In no case shall such panels and units be installed within the fire exposure separation required for fire protected openings in walls.

(b) Permitted Uses for Class A Plastics. Class A plastics may be used for skylights subject to the requirements of this Section.

1. The maximum area within the required curb shall not exceed three hundred (300) square feet for flat or corrugated plastic sheets nor shall the aggregate area of such units exceed 30 percent of the floor area of any room sheltered by a roof in which the units are installed.

2. Flat or corrugated units shall slope from the horizontal at least three (3) inches in twelve (12) inches and the high edge shall not exceed ten (10) feet from the bottom of the inclined plane. Corrugations shall be parallel to the inclined plane.

3. Dome-shaped units shall rise above the mounting flange a minimum distance equal to 10 percent of its maximum span but in no case shall the rise be less than five (5) inches.

4. The exposed edges of plastic domes shall be metal protected.

(c) Permitted Uses for Class B Plastics. Class B plastic sheets or domes may be employed in skylights under conditions specified in Subsection 6008(b) except that the aggregate area shall not exceed 25 percent of the floor area sheltered by the roof upon which the skylight is erected.
(d) Permitted Uses for Class C and D Plastics. Except as provided in Subsections 1 and 2 of this Section, Class C and D plastics may be used in skylights under the conditions specified in Subsection 6008(b).

1. The maximum area enclosed within the required curb shall not exceed one hundred (100) square feet for flat or corrugated plastic sheets nor shall the aggregate area of such units exceed 15 percent of the floor area of any room sheltered by a roof in which the units are installed.

2. Flat or corrugated units shall slope from the horizontal at least four (4) inches in twelve (12) inches and the high end shall not exceed eight (8) feet from the bottom of the inclined plane.

Section 6009. LIGHT TRANSMITTING PANELS IN MONITORS AND SAWTOOTH ROOFS.

(a) General. Where a fire-resistive rating is not required for roofs, approved plastics may be used with or without sash. The lower edge of the plastic material shall be at least six (6) inches above the horizontal surface of the roof. The areas of such plastic panels shall be separated from each other by a section of incombustible material or by a section of the roofing material of the structure, which section shall be equal in length to one-tenth (1/10) of the length of the plastic section, or five (5) feet, whichever is greater.

(b) Permitted Uses.

1. Class A and B plastics may be used, provided that the maximum length of a section of plastic panels shall not exceed one hundred (100) feet, and the distance between the upper and lower edges shall not exceed ten (10) feet.

2. Class C and D plastics may be used, provided that the maximum length of a section of plastic panels shall not exceed fifty (50) feet and the distance between the upper and lower edges shall not exceed eight (8) feet.

Section 6010. PLASTIC LIGHT DIFFUSING CEILINGS.

(a) Definitions. Plastic light diffusing ceilings shall mean installations of plastic panels suspended below lighting fixtures for the purpose of diffusing light throughout a room or space. They shall not include plastic diffusers which are parts of electric or ventilating fixtures unless the aggregate area of the diffusers exceeds 30 percent of the area of the room or space.

(b) Installation Requirements.

1. Plastic light diffusing ceilings shall not be installed in assembly areas or in required exits or corridors or in buildings or structures of Group D or E occupancies. In other rooms or spaces, panels of any class of approved plastics may be installed as light diffusing ceilings in accordance with the following provisions:

A. Where the aggregate area of plastics in light diffusing ceilings exceeds 30 percent of the ceiling area of the room or space, such plastics shall conform to the requirements of Chapter 42.

B. Plastics which have a heat distortion temperature of 225 degrees F. or less as established by the American Society for Testing Materials standard titled “Standard Method for Test for Deflection Temperature of Plastics under Load” and the panels of which have been indicated in appropriate tests by an approved testing laboratory to fall from their mountings at an ambient temperature at least 200° F. below the ignition temperature of the material, shall be exempt from all finish requirements, provided the maximum length of plastic panels weighing more than two (2) ounces per square foot do not exceed six (6) feet, and the weight of the plastic materials does not exceed eight (8) ounces per square foot in any case.

2. Plastic light diffusing ceiling shall not be permitted below sprinklers unless tests by a nationally recognized laboratory indicate they will not interfere with the action of sprinklers, or unless sprinklers in the quantity required by Chapter 38 are also placed below the plastic ceiling.

3. In building or structures of other than Type V construction, all hanging supports and fastenings shall be of incombustible material. Hangers shall be at least No. 12 U. S. Standard Gauge galvanized wire, or equivalent, and shall be spaced so as to support the weight of the ceiling assembly safely.

4. The maximum anticipated service temperature in the space between the panel and the ceiling shall not exceed the manufacturer's recommended maximum service temperature for the plastics employed in the panel.
5. Piping carrying gas or volatile combustible fluid shall not be located in the space above a plastic light diffusing ceiling.

Section 6011. PARTITIONS.

(a) Construction.

1. Where partitions are not required to be of incombustible or fire-resistant construction, Class A plastics may be used for the construction of the entire partition.

2. Approved plastics may be used to provide the light transmitting medium in partitions where plain glass is permitted, provided the aggregate area of plastic so installed does not exceed one-third of the area of the partition in which it is installed.

3. Approved plastics may be installed in openings in movable partitions made of metal or other incombustible material, provided the aggregate area of plastic so installed does exceed one-half of the area of the partition in which it is installed.

Section 6012. EXTERIOR VENEER, SPANDREL FACINGS-AND-DECORATIVE PANELS.

(a) General. Approved plastics may be applied as veneers or installed as facings or decorative panels on walls, spandrels, or structural members as provided herein.

1. In Fire Zone No. 1 spandrel wall sections meeting structural requirements of Chapter 16 may be faced with an approved plastic veneer or decorative panel on the exterior surface provided that no single plastic panel exceeds twenty-five (25) square feet in area and provided that the panel is located not less than thirty (30) feet from a party line or faces upon a street or alley or other open space not less than fifty (50) feet in width. Outside Fire Zone No. 1 approved plastics may be applied as veneers or decorative panels on walls, spandrels or structural members provided that on buildings or structures of other than Type V construction the plastic panels shall be separated vertically by a section of incombustible material at least four (4) feet in height and at least two (2) feet horizontally.

2. Such veneers or decorative panels shall be attached to the building or structure with incombustible supports and in such a manner to withstand imposed wind loads. The distance between engaged edge of the panels and the exterior wall shall not exceed four (4) inches.

Section 6013. Awnings and Canopies.

Class A and B plastics may be used in awnings and canopies and all such awnings and canopies shall be constructed in accordance with provisions governing projections and appendages.

Section 6014. GREENHOUSES.

Approved plastics may be used in lieu of plain glass in greenhouses, in Fire Zone No. 3 only.

Section 6015. SIGNS AND SIMILAR STRUCTURES.

The use of plastics in signs and similar structures shall comply with the requirements of Chapter 56.

Section 6020. STANDARDS.

Unless as specified in other Sections of this Building Code, the following standards shall apply:

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCA</td>
<td>Technical Data on Plastics—1961</td>
</tr>
<tr>
<td>ASTM</td>
<td>Flammability of Rigid Plastics over 0.050 Inches in Thickness D635 - 63</td>
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<tr>
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<td>Flammability of Plastics 0.050 Inches and Under in Thickness D568 - 61</td>
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<td>Thickness of Solid Electrical Insulation D374 - 57 T</td>
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<td></td>
<td>Deflection Temperature of Plastics Under Load D648-56</td>
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Legend

MCA—Manufacturing Chemists' Association, Inc.
1825 Connecticut Avenue, N.W.
Washington 9, D. C.

ASTM—American Standards for Testing and Materials
1916 Race St., Philadelphia, Pa. 19103
CHAPTER 61
LAWN SPRINKLER SYSTEMS

Section 6101. GENERAL.

(a) Scope. The application of this Chapter is intended to provide for the safe design, construction and installation of lawn sprinkler systems that are connected to the potable water supply.

(b) Purpose. This Chapter is intended to provide safeguards to health and safety and to set minimum standards of installation consistent with good engineering practices.

(c) Application. For the purpose of this Chapter, the term "lawn sprinkler system" shall include apparatus and equipment affixed permanently to the property in the lawn, ground, flower beds or fence normally used for the purposes of irrigation, and connected to the water supply. "Connection to the water supply" shall be construed to mean connections to the hose bibs, as well as permanent connections to the water supply line.

Section 6102. DEFINITIONS.

(a) Approved. See Chapter 4.

(b) Back Flow. Back flow indicates the reverse flow of water into the distributing pipes of a potable supply of water from the sprinkler system, or any source or sources other than its original intake. Back siphonage is one type of back flow.

(c) Back Flow Preventor. A back flow preventor is a device or means to check or stop water from flowing into a potable supply of water from the sprinkler system.

(d) Diameter. Diameter indicates the nominal size for pipe and tubing as designated commercially.

(e) Sprinkler Distribution Pipe. A sprinkler distribution pipe is a water line not under continuous pressure conveying water from the control valves to the sprinkler heads.

(f) Control Valves. Control valves are the valves controlling distribution of water from the sprinkler supply line to sprinkler distribution pipe and the valves may be installed singly or in a manifold.

(g) Pressure Lines. A pressure line is a water line designed or intended to contain water under continuous working pressure.

(h) Service Line. A service line is a pipe or pipes conveying water from water main into the property.

(i) Vacuum Breaker. Same as Back Flow Preventor.

Section 6103. CONSTRUCTION AND INSTALLATION.

(a) Minimum Depth of Pipe. The minimum depth of all sprinkler lines shall be as specified by the manufacturer. When drainage is necessary, the pipes shall be sloped to drain, and drain valves shall be installed at all low points in such lines, except that the drains shall not be required for non-rigid plastic lines. Drain valves shall drain into a sump or gravel pocket of proper size.

(b) Cross Connections. Cross connections shall not be made between the potable supply of water and any well or other source of water.

(c) Connection to Water Supply. Connection to the potable water supply may be made either to the service line or to the water main line. Suitable provisions shall be provided to drain the sprinkler supply line.

(d) Installation of Vacuum Breaker. An approved vacuum breaker or back flow preventor shall be installed in all lawn sprinkler systems. Such vacuum breaker or back flow preventor shall be installed at least six (6) inches above the highest sprinkler head, in the lawn, and shall be located at the top of the loop in the main water supply line and shall be installed so as to prevent back siphonage into the potable water supply.

(e) Size of Pipe. Sprinkler systems shall not be connected to any water supply line of less than one-half (½) of an inch in diameter.

(f) Materials for Pressure Lines. Pipe consisting of copper tubing, galvanized iron, lead, cast iron, or other approved types, shall be used for all pressure lines within the building and to all control valves, outside the building. In addition, tubing under pressure to remote control hydraulic valves shall be included as pressure lines. Asbestos cement pipe or other material approved by the Department may be used in lines three (3) inches or more in diameter, outside the building.

(g) Materials for Sprinkler Distribution Pipe. All sprinkler distribution pipe shall be capable of withstanding a continuous working pressure of 75 pounds per square inch (75 psi).

(h) Fittings and Connections. Fittings and connections shall be made from non-corrosive materials and shall be installed according to manufacturer's instructions.
(i) Identification Marking. Each length of pipe, and each pipe fitting, sprinkler head, valve, or device used in a lawn sprinkler system shall have cast, stamped, or indelibly marked on it, the manufacturer's name and type. Pipe shall be marked continuously on its length showing manufacturer's mark or name, type or classification.

Section 6108. STANDARDS. Unless as otherwise specified in other Sections of this Building Code, the following standards shall apply. (See Chapter 50 for additional requirements.)

<table>
<thead>
<tr>
<th>Organization</th>
<th>Title of Publication</th>
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<tbody>
<tr>
<td>(Commercial Standards)</td>
<td>Rigid Unplasticized Polyvinyl Chloride Pipe, CS No. 207-60</td>
<td>SPI—Society of Plastics Industry, Inc. 250 Park Avenue, New York, New York</td>
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