BUILDING CODE

for the

STATE OF WISCONSIN

Effective July 29, 1942

Issued by
INDUSTRIAL COMMISSION OF WISCONSIN
MADISON

STATE PUBLICATIONS COVERING LAWS RELATIVE TO BUILDINGS AND BUILDING WORK

Issued by the Industrial Commission

Boiler Code
Building Code (Order from Bureau of Purchases, State Capitol, Madison)
Construction, General Orders on Safety in,
Dusts, Fumes, Vapors and Gases, General Orders on,
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MADISON, WISCONSIN

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INDUSTRIAL COMMISSION OF WISCONSIN

BUILDING CODE

INTRODUCTION

The Building Code has been adopted by the Industrial Commission in discharge of its duties under Sections 101.01 to 101.28, inclusive, of the statutes of Wisconsin. It supplements the requirement of Section 101.06, to the effect that "every employer and every owner of a place of employment or a public building now or hereafter constructed shall so construct, repair or maintain such place of employment or public building and every architect shall so prepare the plans for the construction of such place of employment or public building as to render the same safe."

The orders contained in this code are binding alike upon every employer and every owner of a place of employment or a public building, upon builders, and upon architects, who prepare plans for the construction of places of employment or public buildings.

The terms "owner", "employer", "place of employment" and "public building" are herein used as defined in the statutes.

The term "owner" includes "every person, firm, corporation, state, county, town, city, village, manager, representative, officer, or other person having ownership, control, or custody of any place of employment or public building, or of the construction, repair, or maintenance of any public building, or who prepares plans for the construction of any place of employment or public building."

By "employer" is meant "every person, firm or corporation, agent, manager, representative or other person having control or custody of any employment, place of employment, or any employe."

By "place of employment" is meant "every place where, either temporarily or permanently, any industry, trade, or business is carried on, or where any person is directly or indirectly employed by another for direct or indirect gain or profit, but not including private domestic service or agricultural pursuits which do not involve the use of mechanical power."

The term "public building" is defined to include "any structure used in whole or in part as a place of resort, assemblage, lodging, trade, traffic, occupancy, or use by the public, or by three or more tenants."

The original Building Code, effective October 9, 1914, was prepared by the Industrial Commission with the advice and assistance of a Building Code Advisory Committee composed of the following named persons:

A. C. Eschweiler, Architect, Milwaukee.
C. F. Ringer, former Inspector of Buildings, Milwaukee.
Howland Russell, Architect, Milwaukee.
C. A. Halbert, Civil Engineer, Madison.
Sidney J. Williams, Deputy, Industrial Commission.

In addition to the original code, other revised building codes have been issued from time to time with effective dates as follows: October 15, 1915, September 15, 1918, January 9, 1920, September 30, 1921 (reprinted in 1925 and 1927), and April 16, 1931 (reprinted in 1934).

Some of the editions contained only minor changes or incorporated new orders adopted after previous codes had been published, but the present issue, effective July 29, 1942, has been extensively revised and augmented. This revision has been accomplished with the advice and assistance of the following advisory committee:

Peter Brust, Milwaukee, Chairman, State Association of Wisconsin Architects and Wisconsin Chapter, American Institute of Architects.
Leon M. Gurda, Milwaukee, City of Milwaukee.
Jay Hathaway, Madison, Wisconsin State Federation of Labor.
Adolph Holub, Wausau, Wisconsin Association of Real Estate Brokers.
Roger Kirchhoff, Madison, State Architect.
O. T. Nelson, Madison, Secretary, Industrial Commission.

*Roy L. Petersen, Kenosha, League of Wisconsin Municipalities.
Peter T. Schoemann, Milwaukee, Wisconsin State Federation of Labor.
S. M. Siesel, Milwaukee, Master Builders Association of Wisconsin.
J. B. Wilkinson, Milwaukee, Fire Insurance Rating Bureau.
C. A. Willson, Madison, Engineering Society of Wisconsin.

Wm. Gaethke, Deputy Inspector of Buildings, Milwaukee, represented Mr. Gurda at the advisory committee meetings.

Administration

The Building Code is enforced by the Industrial Commission in cooperation with municipal and other local officials, who are required by law to enforce all orders of the commission which are germane to their respective duties (Wisconsin Statutes, Section 101.28). With the Building Code as a foundation, city ordinances may go more into detail, if desired, or may contain more stringent requirements than those of the state code, but this Building Code contains minimum standards and requirements which apply to cities and the state generally, and no local ordinance or code may be less stringent.

Appeal

Any person who considers any part of the Building Code, or any official's interpretation of the code, to be unreasonable, may appeal to the commission to interpret, modify, or suspend the same. (Wisconsin Statutes, Sections 101.15 to 101.17).

* Resigned.

Chapter 1

SCOPE OF BUILDING CODE

Order 5000. New Buildings and Additions.

This code shall apply to all new buildings, structures, and also to additions to existing buildings and structures, except as in Order 5003.

(a) Existing Buildings. Buildings and structures erected prior to the effective date of the first Building Code (October 9, 1914) shall comply with the General Orders on Existing Buildings, issued by the Industrial Commission.

Order 5001. Alterations.

This code shall also apply to all alterations in any building or structure which affects the structural strength, fire hazard, exits, lighting or sanitary condition of any new or existing building or structure. This code does not apply to ordinary nonstructural changes or minor repairs necessary for the maintenance of any building or structure.

Order 5002. Change of Use.

When the use of a building or structure is changed and the requirements for the new use are more stringent than those for the previous use then such building or structure shall be made to comply with the requirements for the new use as provided in this code.

If, upon an inspection of a building or structure, it is found that its use was changed since the effective date of the first Building Code (October 9, 1914) and that it does not comply with the requirements of the Building Code in effect at the time of such change, it shall then be made to comply with the code requirements in effect at the time of change in use.

Order 5003. Exemption From Code Requirements.

This code does not apply to the following buildings:

(1) Dwellings, and outbuildings in connection therewith, such as barns and private garages.

(2) Apartment buildings used exclusively as the residence of not more than two families.

(3) Buildings used exclusively for agricultural purposes which are not within the limits of a city or an incorporated village.

(4) Temporary buildings or sheds used exclusively for construction purposes, not exceeding two stories in height, and not used for living quarters.

Order 5004. Local Regulations.

This code shall not limit the power of cities, villages and towns to make, or enforce, additional or more stringent regulations, provided the same do not conflict with this code or with any other order of the Industrial Commission.

Chapter 2

ENFORCEMENT OF CODE

Order 5010. Approval of Plans and Specifications.

Complete plans and specifications for all buildings and structures in the following classifications shall be submitted to the Industrial Commission for approval before letting contracts or commencing work.

Theaters and assembly halls.

Schools and other places of instruction.

Apartment buildings, hotels and places of detention.

Hazardous occupancies.

Factories, office and mercantile buildings.

The submission of plans and specifications for factories, office and mercantile buildings containing less than 50,000 net cubic feet of space is waived, providing they have no floor or roof spans greater than 30 feet and are not more than 2 stories high. Buildings, however, for which submission of plans and specifications are waived shall comply with the requirements of this code.

All plans shall be submitted in triplicate and work shall not be started until plans are approved. The following data shall be a part of, or shall accompany, all plans submitted for approval.

(a) The location and grades of adjoining streets, alleys, lot lines and any other buildings on the same lot or property.

(b) Name of owner.

(c) Intended use or uses of all rooms, and the number of persons to be accommodated therein.

(d) Assumed bearing value of soil.

(e) Assumed live loads.

(f) Assumed dead loads, itemized.

(g) Assumed unit stresses for structural materials.

(h) Stress diagrams for all trusses.

(i) Typical calculations for slabs, beams, girders and columns.

Complete structural calculations shall be furnished upon request of the Industrial Commission or other authorized approving official. All plans and specifications shall be sealed or stamped by a registered architect or professional engineer, or signed by any other designer.

This order shall apply to additions and alterations, as well as to new buildings, and shall also apply to all cases where there is a change of occupancy or use of a building.

In cities where plans are examined, and building permits are issued, by a city building official in a manner approved by the Industrial Commission, additional approval by the Industrial Commission is not required.

This order shall not apply to sanitary appliances, such as water supply and sewage disposal systems, chemical and septic toilets, and similar equipment, which shall be submitted for approval, and installed, in accordance with the regulations of the State Board of Health.

After being approved, plans and specifications shall not be changed in any respect which may involve any provisions of this code, except with the written consent of the approving official.

Note: The approval of a plan or specification is not to be construed as the assumption of any responsibility for the design.

Order 5011. Evidence of Approval.

The architect, professional engineer, builder or owner shall keep at the building one set of plans bearing the stamp of approval.

Order 5012. Approval of Materials, Methods and Devices.

All materials, methods of construction and devices designed for use in the construction, alteration or equipment of buildings or structures under this code and not specifically mentioned in this code shall not be so used until approved in writing by the Industrial Commission, except sanitary appliances, which shall be approved in accordance with the State Plumbing Code issued by the State Board of Health. The data, tests and other evidence necessary to prove the merits of such material, method of construction or device shall be determined by the Industrial Commission.

EXTRACT FROM THE WISCONSIN STATUTES

RESPONSIBILITY OF OWNER OR EMPLOYER.

101.06. Employer's duty to furnish safe employment and place. Every employer shall furnish employment which shall be safe for the employes therein and shall furnish a place of employment which shall be safe for employes therein and for frequenters thereof and shall furnish and use safety devices and safeguards, and shall adopt and use methods and processes reasonably adequate to render such employment and places of employment safe, and shall do every other thing reasonably necessary to protect the life, health, safety, and welfare of such employes and frequenters. Every employer and every owner of a place of employment or a public building now or hereafter constructed shall so construct, repair or maintain such place of employment or public building, and every architect shall so prepare the plans for the construction of such place of employment or public building, as to render the same safe.

PENALTIES FOR VIOLATION OF CODE REQUIREMENTS.

101.28. Penalty for violations. If any employer, employe, owner, or other person shall violate any provisions of sections 101.01 to 101.13, inclusive, of the statutes, or shall do any act prohibited in sections 101.01 to 101.29, inclusive, or shall fail or refuse to perform any duty lawfully enjoined, within the time prescribed by the commission, for which no penalty has been specifically provided, or shall fail, neglect or refuse to obey any lawful order given or made by the commission, or any judgment, or decree made by any court in connection with the provisions of sections 101.01 to 101.29, inclusive, for each such violation, failure or refusal, such employer, employe, owner or other person shall forfeit and pay into the state treasury a sum not less than ten dollars nor more than one hundred dollars for each such offense. It shall be the duty of all officers of the state, the counties and municipalities, upon request of the industrial commission, to enforce in their respective departments, all lawful orders of the industrial commission, insofar as the same may be applicable and consistent with the general duties of such officers.

101.18. Per diem unit of violations. Every day during which any person, persons, corporation or any officer, agent or employe thereof, shall fail to observe and comply with any order of the commission or to perform any duty enjoined by sections 101.01 to 101.29, inclusive, shall constitute a separate and distinct violation of such order, or of said sections as the case may be.

APPEAL ON REASONABLENESS OF CODE REQUIREMENTS.

101.15. Petition and hearing on reasonableness of orders.

(1) Any employer or other person interested either because of ownership in or occupation of any property affected by any such order, or otherwise, may petition for a hearing on the reasonableness of any order of the commission in the manner provided in sections 101.01 to 101.29, inclusive.

(2) Such petition for hearing shall be by verified petition filed with the commission, setting out specifically and in full detail the order upon which a hearing is desired and every reason why such order is unreasonable, and every issue to be considered by the commission on the hearing. The petitioner shall be deemed to have finally waived all objections to any irregularities and illegalities in the order upon which a hearing is sought other than those set forth in the petition. All hearings of the commission shall be open to the public.

(3) Upon receipt of such petition, if the issues raised in such petition have theretofore been adequately considered, the commission shall determine the same by confirming without hearing its previous determination, or if such hearing is necessary to determine the issues raised, the commission shall order a hearing thereon and consider and determine the matter or matters in question at such times as shall be prescribed. Notice of the time and place of such hearing shall be given to the petitioner and to such other persons as the commission may find directly interested in such decision.

(4) Upon such investigation, if it shall be found that the order complained of is unjust or unreasonable the commission shall substitute therefor such other order as shall be just and reasonable.

(5) Whenever at the time of the final determination upon such hearing it shall be found that further time is reasonably necessary for compliance with the order of the commission, the commission shall grant such time as may be reasonably necessary for such compliance.

Note: Blank forms for petition for modification of an order may be secured from the Industrial Commission.

Chapter 3

DEFINITIONS AND STANDARDS

Order 5100. Fire-Resistive Construction.

1. A building is of fire-resistive construction if all the walls, partitions, piers, columns, floors, ceilings, roof and stairs are built of incombustible material, except as hereinafter provided, and if all metallic structural members are protected by an incombustible fire-resistive covering, all as specified in this order.

2. All exterior walls shall be of masonry or reinforced concrete of not less than four-hour fire-resistive construction as specified in Order 5105. All inner court walls shall be of masonry or reinforced concrete of not less than three-hour fire-resistive construction as specified in Order 5105.

3. Interior partitions shall be constructed of incombustible materials and shall be of not less than one-hour fire-resistive construction as specified in Order 5105, except that dividing partitions in stores, offices, or similar places not exceeding 2000 square feet in area occupied by one tenant only may be constructed of wood panels or similar light construction.

4. Enclosures for elevator or dumb waiter shafts, vent shafts, stair wells, waste paper chutes and other similar vertical shafts shall be of two-hour fire-resistive construction as specified in Order 5105, with all interior openings therein protected by fire-resistive doors or windows as specified in Order 5109.

5. Structural framework shall be of structural steel or reinforced concrete. All structural steel members, not including structural members for elevators and elevator enclosures shall be thoroughly fire-protected with not less than four-hour fire-resistive protection for columns, beams and girders and three-hour fire-resistive protection for floors, for all buildings more than 8 stories or 85 feet in height; and with not less than three-hour fire-resistive protection for columns, beams and girders and two-hour fire-resistive

protection for floors, for all buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in Order 5104.

6. All reinforced concrete columns, beams and girders shall be thoroughly fire-protected with four-hour fire-resistive protection, and all floors, joists and slabs shall be thoroughly fire-protected with not less than three-hour fire-resistive protection for all buildings more than 8 stories or 85 feet in height; and with not less than three-hour fire-resistive protection for columns, beams and girders and two-hour fire-resistive protection for all floors, joists and slabs, for all buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in Order 5104.

7. Floor construction shall consist of any approved floor system providing not less than three-hour fire-resistive construction for all buildings more than 8 stories or 85 feet in height; and providing not less than two-hour fire-resistive construction, for buildings which are 8 stories or 85 feet or less in height. All such fire-resistive protection shall be as specified in Order 5106.

8. Roofs shall be constructed as specified for floors, except that wood sheathing of not less than 2½ inch nominal thickness may be used for buildings not more than 8 stories or 85 feet in height when all of such sheathing is more than 25 feet distant from any floor, balcony or gallery, or wood sheathing of not less than 1 inch nominal thickness may be used at any distance not exceeding 5 feet from a two-hour fire-resistive attic floor, and when such sheathing is covered on the outside by a fire-retardent roof covering, except as provided under occupancy requirements.

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

10. Doors and windows may be of wood except as otherwise specified under occupancy requirements and in Orders 5117, 5119, 5120 and 5201.

11. Projections from the building, including bays, oriels, and penthouses, together with other roof structures shall

be constructed of incombustible material as specified in this order.

12. Wood may be used for finished floors and also for trim, including picture molds, chair rails, wainscoting and baseboards, if spaces between wood sleepers and wood grounds are fire-stopped with incombustible materials.

13. Acoustical materials may be used on ceilings and on walls from a level 6 feet above the floor provided they are attached directly thereto, and all spaces between wood grounds are fire-stopped with incombustible materials.

Order 5101. Mill Construction.

1. In a building of mill construction the structural frame shall consist of steel or iron which shall be fire-protected, of reinforced concrete, of masonry, or of heavy timbers, except that in buildings not exceeding one story in height the structural steel or iron may have the fire-protection omitted.

2. Exterior and court walls shall be of four-hour fire-resistive construction as specified in Order 5105.

3. All wood columns in the structural frame shall be directly superimposed, one above the other, and shall be provided with steel or cast iron caps, unless the floor or roof beams and girders are carried on blocks securely fastened to the columns and with the loads transmitted to the columns by metal ring or similar type connectors, or by caps of otherwise suitable material. They shall not rest on wood bolsters or floor timbers. Wood bolsters may be used to support roof timbers. No wood column shall be less than 8 inches nominal in its least dimension, and no beam, girder or joist shall be less than 6 inches nominal in its least dimension nor less than 45 square inches in cross-sectional area. In no case shall masonry or reinforced concrete be supported on wood construction except tile or concrete floor finishes not more than 3 inches in thickness.

4. For structural steel or iron members, the fire-protection shall be not less than three-hour fire-resistive protection for columns and not less than two-hour fire-resistive protection for beams, girders and floor systems, as specified in Order 5104.

5. All reinforcement in concrete columns shall be fire-protected with not less than three-hour fire-resistive protection, and all joists, beams, girders, slabs and steel floors with not less than two-hour fire-resistive protection outside of all steel reinforcing as specified in Order 5104.

6. Wood floor construction shall be of tongued and grooved, or splined lumber not less than 3 inches nominal thickness, with a top layer of flooring of one inch nominal thickness laid thereon, or of solid lumber placed on edge and securely spiked together to make a floor not less than 4 inches nominal thickness.

7. Roof construction shall be as specified for floors, except that the minimum nominal thickness shall be 2½ inches. Roof covering shall be a fire-retardent roofing as specified in Order 5107 and shall be required over all combustible roof construction.

8. Enclosures for elevator or dumb waiter shafts, vent shafts, stair wells, waste paper chutes, and other similar vertical shafts shall be of two-hour fire-resistive construction as specified in Order 5105, with all interior openings therein protected by fire-resistive doors as specified in Order 5109.

9. Stair construction may be of wood in buildings not exceeding 3 stories in height. In buildings 4 or more stories in height all stairs and stair construction shall be as required for Fire-Resistive Construction specified in Order 5100.

10. Doors and windows may be of wood except as otherwise specified under occupancy requirements in this code.

Order 5102. Ordinary Construction.

1. A building is of ordinary construction if all enclosing walls are constructed of incombustible material, and the roof has a fire-retardent covering as specified in Order 5107.

2. The structural framework shall be of steel, iron, reinforced concrete, masonry or wood. Fire-protection of steel, iron or wood structural members may be omitted, except that all members carrying masonry in buildings more than one story in height shall be fire-protected with not less than one-hour fire-protection, as specified in Order 5104.

3. Floors, roof and partitions may be of wood, but no joist, rafter or stud shall be less than 2 inches in nominal thickness. In all buildings the first story floor construction above a basement, if of metal or wood, shall be protected on the under side by one-hour fire-resistive construction, and in buildings of 4 stories or more in height the lower side of all metal or wood floor or roof construction shall be protected by a ceiling of one-hour fire-resistive construction as specified in Order 5106, unless otherwise provided under occupancy requirements.

4. Stairs may be of steel, iron, reinforced concrete, masonry or wood, with enclosures as specified under occupancy requirements.

5. Bays, oriels and similar projections from the walls shall be constructed of incombustible materials as specified in this order. Penthouses and other roof structures shall be of not less than one-hour fire-resistive construction as specified in Order 5106.

Order 5103. Frame Construction.

1. A building is of frame construction if the structural parts and enclosing walls are of wood, or of wood in combination with other materials. If such enclosing walls are veneered, encased or faced with stone, brick, tile, concrete, plaster or metal, the building is also termed a frame building.

Order 5104. Fire-Resistive Standards—Structural Members.

MINIMUM THICKNESS IN INCHES FOR VARIOUS FIRE-RESISTING MATERIALS

Struct. Steel Parts to be Protected	Fire-Resisting Material Used	Minimum Thickness of Material in Inches For the Following Fire-Resistive Periods			
		4 Hr.	3 Hr.	2 Hr.	1 Hr.
Steel or Cast Iron Columns: All Members of Primary Trusses or Primary Girders.	Concrete	2	2	1½	1
	Gunite	2	1½	1	¾
	Brick of Clay, Shale, Concrete or Sand Lime All Spaces Filled	3¾	3¾	2¼	2¼
	Clay Tile or Haydite or Waylite or Concrete Block or Gypsum Block or Poured Gypsum. All Spaces Filled. Metal Ties in Horizontal Joints.	2 Thicknesses 2 Inches Each	4	2	2
	Portland Cement Plaster on Metal Lath			1½ with ½ air space	1
	Clay Tile, End Const. have less than 26% voids with all Spaces Filled and Metal Ties in Horizontal Joints	3¾	3¾	1¾ No Filling	1¾ No Filling
Webs and Flanges of Steel Beams and Secondary Girders	Concrete	2	2	1½	1
	Gunite	2	1½	1	¾
	Brick of Clay, Shale, Concrete or Sand Lime	2¼	2¼	2¼	2¼
	Clay Tile, Concrete Block, Gypsum Block or Poured Gypsum	2	2	2	2
	Metal Lath and Gypsum or Portland Cement Plaster	.....	.....	1½	1
Reinforcing Steel in Columns, Beams, Girders & Trusses	Concrete	1½	1½	1½	1
Reinforcing Steel in Reinforced Concrete Joists	Concrete	1¼	1¼	1	¾
Reinforcing Steel in Reinforced Concrete Slabs	Concrete	1	1	¾	¾
Reinforcing Steel in Reinforced Concrete Slabs	Gypsum	1	1	¾	¾

Concrete shall have a coarse aggregate of limestone, calcareous gravel, traprock, blast furnace slag, burnt clay, burnt shale or other coarse aggregates containing not more than 65 per cent of siliceous material such as granite, sandstone, chert, flint or quartz.

Other materials, assemblies and thicknesses of necessary strength and durability for the use intended and which have successfully performed under tests made by a recog-

nized laboratory in accordance with the requirements of the "Standard Specifications for Fire Tests of Building Construction and Materials" (C19–33) of the American Society for Testing Materials, shall be accepted for specific ratings in addition to those prescribed in this order.

Order 5105. Fire-Resistive Standards—Walls and Partitions.

Wall Construction	Minimum Thickness in Inches, Face to Face			
	4 Hr.	3 Hr.	2 Hr.	1 Hr.
Solid Brick, Load Bearing, Unplastered	8	8	8	8
Solid Brick, Non-Load Bearing, Unplastered	8	8	4	4
Solid Brick, Load Bearing, Plastered Two Sides	8	8	8	8
Solid Brick, Non-Load Bearing, Plastered Two Sides	8	8	4	4
Hollow Clay Tile, Load Bearing, Unplastered	12 4-Cell	12 3-Cell	8 3-Cell	8 2-Cell
Hollow Clay Tile, Non-Load Bearing, Unplastered	12 4-Cell	8 3-Cell	6 2-Cell	4 1-Cell
Hollow Clay Tile, Load Bearing, Plastered Two Sides	12 3-Cell	8 3-Cell	8 2-Cell	8 2-Cell
Hollow Clay Tile, Non-Load Bearing, Plastered Two Sides	12 3-Cell	8 3-Cell	4 1-Cell	3 1-Cell
Concrete Block, Load Bearing, Unplastered	12	12	8	8
Concrete Block, Non-Load Bearing, Unplastered	12	12	6	4
Concrete Block, Load Bearing, Plastered Two Sides	12	8	8	8
Concrete Block, Non-Load Bearing, Plastered Two Sides	12	8	4	3
Solid Plain Concrete, Load Bearing	8	8	8	6
Solid Plain Concrete, Non-Load Bearing	8	6	4	4
Solid Reinforced Concrete, Load Bearing	6	5	4	4
Solid Reinforced Concrete, Non-Load Bearing	6	5	4	3
Solid Gypsum Block, Non-Load Bearing, Unplastered	6	6	3	3
Solid Gypsum Block, Non-Load Bearing, Plastered Two Sides	6	4	3	3
Hollow Gypsum Block, Non-Load Bearing, Unplastered	8	8	4	4
Hollow Gypsum Block, Non-Load Bearing, Plastered Two Sides	8	8	4	4
Solid Cement or Gypsum Plaster on Metal Base, Non-Load Bearing	----	----	2	2
Hollow Partitions, Lath and plaster shall have a minimum thickness of ⅝ inch. Lath may be of metal or ⅜ inch perforated gypsum. If constructed of wood studs, they shall be fire-stopped.	----	----	----	5

Other materials, assemblies and thicknesses of necessary strength and durability for the use intended and which have successfully performed under tests made by a recog-

nized laboratory in accordance with the requirements of the "Standard Specifications for Fire Tests of Building Construction and Materials" (C19–33) of the American Society for Testing Materials, shall be accepted for specific ratings in addition to those prescribed in this order.

Thicknesses as established in this order shall be construed as establishing minimum requirements for fire-resistance and shall not preclude the application of other requirements of this code where considerations of strength, durability or stability require greater thicknesses.

Where plaster is required in this order it shall have a minimum thickness of ½ inch except that for hollow partitions the thickness shall be not less than ⅜ inch. Either Portland cement or gypsum plaster may be used.

Order 5106. Fire-Resistive Floor Construction.

Fire-resistive floor construction shall be accepted for the following respective degrees of fire-resistive protection when constructed as specified in this order. They shall be constructed entirely of incombustible materials.

1. Four-Hour Construction. Four-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than 4 inches in thickness, or shall consist of hollow masonry slabs or arches not less than 4 inches in thickness with a top covering of not less than 2 inches of solid masonry, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this order. Except in the case of steel joisted construction, all reinforcing, tie rods and supporting structural members in such floors shall be protected with not less than four-hour fire-resistive construction as specified in Order 5104.

2. Three-Hour Construction. Three-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than 2½ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 4 inches in thickness with a top covering of solid masonry not less than 1½ inches in thickness, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this order. Except in the case of steel joisted construction

all reinforcing, tie rods and supporting structural members in such floor construction shall be protected with not less than three-hour fire-resistive construction as specified in Order 5104.

3. Two-Hour Construction. Two-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs or arches not less than 2½ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 3 inches in thickness with a top covering of not less than one inch of solid masonry, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this order. Except in the case of steel joisted construction all reinforcing, tie rods and supporting structural members in such floor construction shall be protected with not less than two-hour fire-resistive construction as specified in Order 5104.

4. One-Hour Construction. One-hour fire-resistive floor construction shall consist of reinforced concrete, gypsum or solid masonry slabs not less than 2½ inches in thickness, or shall consist of hollow masonry slabs or arches not less than 3 inches in thickness with all joints in such hollow unit construction thoroughly filled with cement or gypsum mortar, or shall consist of steel joists or steel floor construction protected with fire-resistive materials as tabulated in this order, or shall consist of wood joisted construction with a double wood floor on top (the sub-floor not less than ¾ inch thick, and the total thickness of the two layers not less than 1¼ inches thick) and with a fire-resistive ceiling as tabulated in this order, securely fastened to or suspended from the under side of such joists, except that the metal lath and plaster ceiling shall not be required below the lowest floor joist over unusable space.

Except in the case of steel joisted construction, all reinforcing, tie rods and supporting structural members shall be protected with not less than one-hour fire-resistive construction as specified in Order 5104.

MINIMUM PROTECTION FOR METAL AND WOOD JOISTS BASED ON TIME PERIODS FOR VARIOUS INSULATING MATERIALS

Joists to be Protected	Insulating Material	Minimum thickness of material in inches for the following fire-resistive materials			
		4 Hr.	3 Hr.	2 Hr.	1 Hr.
Ceiling protection of steel joists, where incombustible slab not less than 2½ in. thick is placed above	Metal or wire lath and gypsum or Portland cement plaster, concrete, burned clay products or gypsum	2	1½	1	¾
	Gunite	1½	1	¾	¾
Ceiling protection of wood joists with double floor on top	Metal or wire lath and gypsum or Portland cement plaster. ⅜ in. perforated gypsum lath, ½ in. gypsum plaster, joints reinforced with 3 in. wide strips of metal lath.				¾

5. All flat ceilings where the ceiling protection for beams, girders or flat slabs is suspended to form a free air space between the member and the protection, the protection thicknesses may be ½ inch less than required in the tabulation contained in this order for flat ceiling protection, but no thickness shall be less than ¾ inch minimum protection of metal and wood joists.

In any reinforced concrete floor construction which includes a metal lath and cement or gypsum plastered ceiling on the under side, not less than ¾ inch thick, the required slab thickness may be reduced ½ inch but in no case shall be less than 2½ inches thick.

Order 5107. Fire-Retardent Roof Coverings.

Fire-retardent roof coverings have no time resistance ratings by governmental testing laboratories. The Underwriters' Laboratories in their "List of Inspected Fire Protection Equipment and Materials" classifies their degree of fire-resistance by the letters A, B and C. Class A roof coverings have the highest resistance and Class C the lowest.

Roof coverings on buildings of fire-resistive and mill construction shall be not less than Class A, or equal, those on buildings of ordinary construction shall be not less than Class B, or equal, and those on frame buildings shall be not less than Class C, or equal.

The Industrial Commission will accept roof coverings for different fire-resistance values as established by, and if installed according to, the requirements of the Underwriters' Laboratories.

Note: The Underwriters' Laboratories "List of Inspected Materials" is obtainable from the Fire Insurance Rating Bureaus and Fire Insurance Agencies.

The Industrial Commission will approve, subject to the provisions of this order, any roof covering which has developed the required fire-resistance in tests as specified in the "Standard Specifications of Fire Tests of Building Construction and Materials" (A.S.T.M. Designation C19–33) when conducted by a nationally recognized testing laboratory.

Order 5108. Occupancy Separations.

When a building is used for more than one occupancy purpose, each part of the building comprising a distinct occupancy division shall be separated from any other occupancy division as provided for under the occupancy requirements of this code.

Occupancy separations shall be classed as "Absolute", "Special" and "Ordinary" and shall apply to both horizontal and vertical separations.

1. An absolute occupancy separation shall have no openings therein and shall be of not less than four-hour fire-resistive construction as specified in Orders 5105 and 5106.

2. A special occupancy separation shall be of not less than three-hour fire-resistive construction as specified in Orders 5105 and 5106. All openings in walls forming such separation shall be protected on each side thereof by self-closing fire-resistive doors as specified in Order 5109, and such doors shall be kept normally closed. The total width of all openings in any such separating wall in any one story shall not exceed 25 per cent of the length of the wall in that story and no single opening shall have an area greater than 120 square feet.

All openings in floors forming this type of separation shall be protected by vertical enclosures extending above and below such openings. The walls of such vertical enclosures shall be of not less than two-hour fire-resistive construction as specified in Order 5105 and all openings therein shall be protected on one side thereof by self-closing one-

hour fire-resistive doors as specified in Order 5109, and such doors shall be kept normally closed.

3. An ordinary occupancy separation shall be of not less than one-hour fire-resistive construction as specified in Orders 5105 and 5106. All openings in such separations shall be protected by self-closing fire-resistive doors as specified in Order 5109, and such doors shall be kept normally closed.

Order 5109. Fire-Resistive Doors.

Fire-resistive doors have no time resistance rating established by governmental agencies. It will be the policy of the Industrial Commission to approve, subject to the provisions of this order, any door given a rating by the Underwriters' laboratories in their "List of Fire Protection Equipment and Materials," listed as Class A, B, C, D and E having varying degrees of resistance, and suitable for various locations.

Class A doors, or equal, shall be used for all openings in 3 and 4 hour fire-resistive walls. Class B doors, or equal, shall be used in openings in walls enclosing vertical shafts whenever fire-resistive doors are required. Doors for elevator shafts shall be of Class B type or equal. Class C doors, or equal, shall be used in openings in corridor partitions in fire-resistive buildings, except that wood doors of solid flush type, 1¾ inches thick may be used in such buildings which are less than 85 feet in height. Class D and E doors, or better, shall be used in outside wall openings where required for fire escapes.

Note: The Underwriters' Laboratories "List of Inspected Materials" is obtainable from the Fire Insurance Rating Bureaus and Fire Insurance Companies.

Order 5110. Fire-Resistive Windows.

1. Windows shall be of a design approved by the Industrial Commission for the intended use as provided under occupancy classifications. The term "window" in this order shall include the frame, sash and all other parts of a complete assembly. Approved wired glass ¼ inch in thickness shall be used for glazing.

2. Windows shall be limited to sizes for which effective fire-resistance has been demonstrated by actual fire test,

and which in no case exceed 84 square feet in area and 12 feet in greatest dimension. Such windows may be combined in multiple assemblies when separated by approved metal mullions, which shall be considered non-bearing.

3. Individual glass lights shall not exceed 720 square inches in area, and 54 inches in vertical and 48 inches in horizontal dimension.

Note: It will be the policy of the Industrial Commission to approve, subject to the provisions of this order, any window bearing the inspection manifest of the Underwriters' Laboratories for the situation of installation.

Order 5111. Glass Block.

1. Use. Approved glass block may be used in non-load bearing panels in walls where ordinary glass will be permitted, unless specifically prohibited by occupancy requirements of this code.

2. Installation. Glass block panels shall not exceed 120 square feet in unsupported area, with a maximum height of 12 feet and a maximum width of 16 feet. The horizontal and vertical mortar joints between each block shall be composed of one part of Portland cement, one part of lime and 4 parts of sand, or its equivalent.

All panels over 6 feet in width shall be supported on each side by chases, not less than 1½ inches in depth, of metal or other incombustible material.

Approved continuous metal bond ties shall be provided in each horizontal mortar joint for block of nominal 12 x 12 inch size and in at least every third joint for block of smaller dimension.

Provision shall be made in all panels for expansion, using approved expansion material not less than ½ inch thick for heads and lintels and not less than ¼ inch thick for jambs.

Order 5112. Height of Building.

The height of a building is measured at the center line of its principal front, from the sidewalk grade (or, if setting back from the sidewalk, from the grade of the ground adjoining the building) to the highest part of the roof, if a flat roof, or to a point ⅔ of the height of the roof, if a gabled or hipped roof. If the grade of the lot or adjoining sidewalk in the rear or alongside of the building falls

below the grade at the front, the height shall be measured at the center of the lowest side.

Order 5113. Basement: First Floor: Number of Stories.

A basement is a story whose floorline is below grade at any entrance or exit and whose ceiling is not more than 5 feet above grade at any such entrance or exit. The first floor is the floor next above the basement, or the lowest floor if there is no basement. The number of stories of a building includes all stories except the basement.

Order 5114. Street: Alley: Court.

1. A street is any public thoroughfare 30 feet or more in width.

2. An alley is any public thoroughfare less than 30 feet, but not less than 10 feet, in width.

3. A court is an open, unoccupied space other than a street or alley and bounded on one or more sides by the walls of a building.

Order 5115. Standard Exit.

Every door which serves as a required exit from a public passageway, stairway or building shall be a standard exit door unless exempted by the occupancy requirements of this code.

Note: For required exits see Orders 5406, 5510, 5608, 5709.

Every standard exit door shall swing outward or toward the natural means of egress (except as below). It shall be level with the floor, and shall be so hung that, when open, it will not block any part of the required width of any other doorway, passageway, stairway or fire escape. No revolving door, and no sliding door except where it opens onto a stairway enclosure or serves as a horizontal exit, shall be considered as a standard exit door.

A standard exit door shall have such fastenings or hardware that it can be opened from the inside without using a key, by pushing against a single bar or plate, or turning a single knob or handle; it shall not be locked, barred, or bolted at any time while the building is occupied.

A standard exit doorway shall not be less than 6 feet 4 inches high by 3 feet 4 inches wide, except where especially provided under occupancy classifications and in Order 5120. Where double doors are provided with or without mullions, the width of each single door may be reduced to 2 feet 6 inches.

In every building which is used at night, a red exit light shall be placed over every emergency exit door and also over every exit door where other doors or openings may cause confusion.

Doors, windows or other openings which are not exits but which give the appearance of exits shall be effectively guarded.

Order 5116. Stairways.

1. Definition. By a stairway is meant one or more flights of steps and the necessary platforms connecting them to form a continuous passage from one level to another within a building or structure.

2. Width. Every required exit stairway, whether enclosed or not, shall be not less than 3 feet 8 inches wide, of which not more than 4 inches on each side may be occupied by a handrail. Every platform shall be at least as wide as the stairway, measuring at right angles to the direction of travel. Every straight-run platform shall measure at least 3 feet in the direction of travel. Wherever a door opens onto a stairway, a platform shall be provided extending at least the full width of the door in the direction of travel.

Note: If other stairways are provided in addition to those required by this code, such additional stairways need not conform to the width requirements of this code.

3. Handrails. All stairways and steps of more than 3 risers shall have at least one handrail. Stairways and steps 5 feet or more in width, or open on both sides, shall have a handrail on each side. Where only one handrail is required it shall be placed on the left hand side as one mounts the stairs, or on the open side, if any.

Stairways which are more than 8 feet wide shall be divided by center rails into widths not more than 8 feet nor less than 3 feet 8 inches. Rails shall be not less than 2 feet 6 inches vertically above the nose of treads or 3 feet 6 inches above the platform. Railings on open sides of stairways and platforms shall be provided with an inter-

mediate member at mid-height, or with vertical members having a maximum spacing of 11 inches; or its equivalent in safety.

Stairways on the outside of buildings and an integral part thereof, having more than 3 risers shall have a handrail at each side, and if the stairway is more than 50 feet wide, one or more intermediate handrails shall be provided.

4. Risers and Treads. All stairways and steps required as exits by this code shall have a uniform rise of not more than 7¾ inches and a uniform tread of not less than 9½ inches, measuring from tread to tread, and from riser to riser. No winders shall be used. There shall not be more than 18, nor less than 3 risers between platforms or between floor and platform and not more than 22 risers from floor to floor with no platform.

Stairways and steps not required as exits by this code shall have a uniform rise of not more than 8 inches and a uniform tread of not less than 9 inches. If winders are used, the tread shall be at least 7 inches wide at a point one foot from the narrow end.

For stairways to elevated walks, platforms and runways in places of employment see Order 15 of the General Orders on Safety issued by the Industrial Commission.

The edges of all treads and the edges of all stairway landings shall be finished with a non-slippery surface not less than 3 inches in width.

Order 5117. Smokeproof Stair Tower.

A smokeproof stair tower shall be an enclosed stairway which is entirely cut off from the building and which is reached by means of open balconies or platforms. The stairways, landings, platforms and balconies shall be of incombustible material throughout. The enclosing walls shall be of not less than four-hour fire-resistive construction as specified in Order 5105, and the floors and ceilings of not less than two-hour fire-resistive construction as specified in Order 5106.

The doors leading from the buildings to the balconies and from the balconies to the stairways shall be fire-resistive doors as specified in Order 5109, and all openings within

10 feet of any balcony shall be protected with fire-resistive windows as specified in Order 5110, or fire-resistive doors.

Each balcony shall be open on at least one side, with a railing not less than 3 feet high on all open sides.

Order 5118. Interior Enclosed Stairway.

An interior enclosed stairway shall be completely enclosed with walls of not less than two-hour fire-resistive construction as specified in Order 5105, except that in ordinary or frame buildings and in mill or fire-resistive buildings not more than 3 stories in height one-hour fire-resistive enclosures may be used. All doors opening into such enclosures shall be as specified in Order 5109.

The enclosure shall include at each floor level a portion of such floor which will be at least as wide as the stairway; and such enclosure shall also include the passageway of the first floor level (if any) leading from the stairway to an outside door, so as to afford uninterrupted passage from the uppermost floor to such outside door without leaving the enclosure.

If windows are placed in any such enclosure they shall be fixed fire-resistive windows as specified in Order 5110, except in outside walls.

Order 5119. Horizontal Exit.

1. A horizontal exit shall consist of one or more openings through or around an exterior wall or occupancy separation, or of one or more bridges or balconies connecting two buildings or parts of buildings entirely separated by occupancy separations as described in Order 5108.

2. Openings used in connection with horizontal exits shall be protected by fire-resistive doors as specified in Order 5109. If swinging doors are installed in pairs, they shall be arranged to swing in opposite directions; with direction of travel indicated by signs, except that where the travel is in one direction only, both doors shall swing in that direction. Such doors shall be kept continuously unlocked whenever the building is occupied and be normally closed or be self-closing and equipped with fusible links.

3. Floors in horizontal exits shall have a slope of not more than one foot in 6.

4. All doors and windows within 10 feet of any balcony or bridge shall be fire-resistive doors as specified in Order 5109, or fire-resistive windows as specified in Order 5110, except that if such doors or windows are in the same plane, this requirement shall apply only to those within 5 feet of the balcony or bridge.

5. The floor on each side of a horizontal exit and all passageways leading thereto shall be kept clear and unobstructed at all times.

Order 5120. Fire Escapes.

1. Location. Every fire escape shall be so located as to lead directly to a street, alley, or open court connected with a street.

Every fire escape shall be placed against a blank wall if possible. If such a location is not possible then every wall opening which is less than 6 feet distant horizontally from any tread or platform of the fire escape shall be protected by a fire-resistive door as specified in Order 5109 or by a fire-resistive window as specified in Order 5110.

2. Exits to Fire Escapes. Every fire escape shall be accessible from a public passageway or shall be directly accessible from each occupied room. Exits to fire escapes shall be standard exit doors as specified in Order 5115, except that doors to "A" fire escapes may be not less than 2 feet 6 inches wide.

3. Design and Fabrication. Each part of every fire escape (except counterweights for balanced stairways) shall be designed and constructed to carry a live load of 100 pounds per square foot of horizontal area over the entire fire escape. Each part of every fire escape shall be designed and constructed in accordance with the requirements of Order 5324, except that the unit stresses therein specified shall be reduced by one-fourth. The minimum sections and sizes specified below shall be increased whenever necessary so that under full load the allowable unit stresses will not be exceeded.

No other material than wrought iron, soft steel or medium steel shall be used for any part of a fire escape, except for weights, separators and ornaments. No bar material less than ¼ inch thick shall be used in the construction of any fire escape, except for separators, ornaments, structural shapes over 3 inches and rigidly built up treads and platforms of approved design. In the fabrication of a fire escape, all connections or joints shall be made by riveting, bolting or welding in an approved manner. All bolts or rivets, except for ornamental work, shall be not less than ⅜ inch in diameter.

4. Platforms. Each platform on an "A" fire escape shall be at least 28 inches wide; each platform on a "B" fire escape shall be at least 3 feet 4 inches wide. Such widths shall be the clear distance between stringers, measuring at the narrowest point. Each platform shall extend at least 4 inches beyond the jambs of exit opening. The above minimum widths and lengths shall be increased, wherever necessary, so that no exit door or window will, when open, block any part of the required width of the fire escape.

Every platform shall consist of either,

(1) Flat bars on edge, not less than 1 x ¼ inch; but not less than 1¼ x ¼ inch where bolts and separators are used; bars shall not be more than 1¼ inches center to center.

(2) ½ inch or ⅝ inch square bars with sharp edge up, not more than 1½ inches center to center.

(3) ⅝ inch round bars, not more than 1½ inches center to center.

Platform and treads may be solid if covered by a roof.

The platform frame shall consist of not less than 2 x ⅜ inch flat bars on edge or equivalent, provided the brackets are not more than 4 feet apart. If brackets are more than 4 feet apart, the frame shall be correspondingly stronger and stiffer. Every platform wider than 30 inches, if made of square or round bars, shall have a third frame bar through the center; if made of flat bars, the platform shall have separators and bolts through the center. Frame bars shall not project more than ¼ inch above platform bars, except around the outside of platform.

There shall be a platform at each story above the first, and intermediate platforms if floors are more than 18 feet apart vertically.

Platforms shall not be more than 8 inches below the door sill.

5. Brackets. Brackets for a 28 inch or 30 inch platform, when spaced not more than 4 feet apart, shall be made of not less than ⅞ inch square bars or 1½ x 1½ x ¼ inch angles; such bars or angles shall be larger if the platform is wider or if the brackets are farther apart. Each bracket shall be fastened at the top to the wall by a through bolt (at least ⅞ inch diameter), nut, and washer (at least 4 inch diameter). The slope of the lower bracket bar shall be not less than 30 degrees with the horizontal. The lower bar shall have a washer or shoulder to give sufficient bearing against the wall.

The strength of the wall to which brackets are to be attached shall be carefully considered in determining the spacing, shape and inside connection of brackets, so that under full load the wall will not be unduly strained. Where it is necessary to install brackets adjacent to wall openings they shall be located at a suitable distance therefrom, or the wall shall be properly reinforced.

6. Stairways. Each stairway of an "A" fire escape shall be at least 24 inches wide between stringers; such stairway shall have a uniform rise of not more than 8 inches and a uniform run of not less than 8 inches.

Each stairway of a "B" fire escape shall be at least 3 feet 4 inches wide between stringers; such stairway shall have a uniform rise of not more than 8 inches, and a uniform run of not less than 9 inches.

Note: The rise is the vertical distance from the extreme edge of any step to the corresponding extreme edge of the next step. The run is the horizontal distance between the same points.

Stairway stringers shall consist of either

(1) A 5 inch channel or larger.
(2) Two angles 2 x 2 x ¼ inch or larger.
(3) Two flat bars 2 x ⅜ inch or larger.
(4) One flat bar 6 x ¼ inch or larger.

If two angles or two flat bars are used, they shall be properly tied together by lattice bars, vertical as well as horizontal. If flat bars are used, every stairway of more than 10 risers shall have lateral bracing. The connection of stringers to platform, at top and bottom, shall be at least equal in strength to the stringers and shall safely carry the full live and dead loads. If stringers are carried by intermediate brackets, the stringers shall have a horizontal bearing on the brackets and shall be properly and securely connected thereto.

Treads shall consist of either flat or square bars, (not round), of the size and spacing specified for platforms. An "A" tread shall consist of at least six square bars, or seven flat bars. A "B" tread shall consist of at least seven square bars, or eight flat bars. A "B" tread made of flat bars shall have separators and bolt through the center. A "B" tread made of square bars shall be trussed.

Treads and platforms may be solid if covered by a roof.

7. Balanced Stairway. All "B" fire escapes, and all fire escapes on schools, theaters, and assembly halls, either shall reach to the ground or shall have a balanced stairway reaching to the ground. "A" fire escapes which are not on schools, theaters, or assembly halls, may terminate in a platform at least 3 feet long, located not more than 10 feet above the ground.

Every balanced stairway shall conform to the requirements for other stairways except that the stringers and top rail may be lighter if they are properly trussed. The counterbalancing device shall be attached to both sides of the stairway equally, or a special attachment shall be used to prevent warping or twisting. The counterbalancing device shall operate gradually and easily as the live load is applied. Cable counterweights are not permitted.

Treads for "A" balanced stairways may be made as follows: two 1¼ x 1¼ x ¼ inch angles at front and back; two 1¼ x ¼ inch bars between, lying flatwise; one inch space between bars. Treads for "B" balanced stairways may be made as follows: two 1½ x 1½ x ¼ inch angles at front and back; two 1½ x ¼ inch bars between, lying flatwise; one inch space between bars. All such treads shall be strongly fastened together with cross bars not more than 14 inches apart.

8. Railings. Railings shall be provided on all open sides of platforms and stairways, and on both sides of balanced stairways. Either a railing or a handrail fastened to wall shall be provided on each side of all "B" fire escape stair-

ways. Railings shall be at least 3 feet high, measuring vertically from floor of platform or from nose of step.

Every railing shall have posts, not more than 5 feet apart made of not less than 1½ x 1½ x ¼ inch angles or tees, or 1¼ inch pipe; top rail not less than 1¼ x 1¼ x ¼ inch angle or equivalent; center rail not less than 1¼ x $\frac{5}{16}$ flat bar or equivalent. All connections shall be such as to make the railing stiff; two bolts (⅜ inch or larger) shall be used at the foot of each post wherever possible, or at least one ½ inch bolt shall be used. Railings shall be continuous. No projections on the inside of the railing shall be permitted. Where a railing returns to the wall, it shall be fastened thereto with a through bolt (at least ⅝ inch diameter), nut, and washer; or (in reinforced concrete) with an approved insert; or the railing shall be made equally secure with a diagonal brace extending at least 3 feet horizontally and 3 feet vertically.

All outside railings which are more than 60 feet above grade shall be at least 6 feet high, measuring vertically from floor of platform or from nose of step. Such railings shall be of special design approved by the Industrial Commission, having not less than four longitudinal rails, and vertical lattice bars not more than 8 inches apart, and proper stiffening braces or brackets.

9. Ladder to Roof. Every fire escape which extends higher than the second floor shall be provided with a ladder leading from the upper platform to the roof, unless the fire escape stairway leads to the roof. The ladder shall have stringers not less than 1¼ inch pipe, or not less than 2 x ⅜ inch flat bars, at least 17 inches apart in the clear. The rungs shall be not less than ½ inch square or ⅝ inch round bars, 14 inches center to center. The stringers shall be securely tied together at intervals no greater than every fifth rung. The stringers of each ladder shall extend not less than 4 feet above the roof coping and return to within 2 feet of the roof, with the top rung of the ladder level with the coping.

10. Other Types of Fire Escapes. Sliding or chute fire escapes may be used, upon the approval of the Industrial Commission, in place of "A" or "B" fire escapes. Every sliding fire escape shall be provided with a ladder constructed

as in Order 5120–9, extending from 5 feet above grade, to 4 feet above the roof coping.

Order 5121. Standpipes.

1. Standpipe systems are designed for two classes of service: (a) for use by fire departments or others trained in handling heavy streams from 2½ inch hose, and (b) for use by occupants of a building on incipient fires. These are referred to in these orders as Fire Department, and First Aid Standpipes, respectively. The features of each system may be combined in a single equipment, if served by an automatic water supply conforming to Order 5121–2(g) or 2(h). All threads on hose and hose connections shall be interchangeable with those of the public fire department.

2. Fire Department Standpipes.

(a) Shall be provided for all buildings exceeding 60 feet in height. Required standpipes shall be installed as construction progresses, to make them available to the fire department in the topmost floor constructed.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 30 feet by a nozzle attached to 100 feet of hose connected to the standpipe. When two or more standpipes are required, they shall be cross connected at the bottom, and equipped with individual controlling valves located not higher than the first story.

(c) Standpipes shall be protected against mechanical and fire damage, with outlets in stairway enclosures; where stairways are not enclosed, outlets shall be at inside or outside of outside walls, within one foot of a fire tower, interior stairway or fire escape. Dry standpipes shall be accessible for inspection and not concealed.

(d) No required standpipe shall be less than 4 inches in diameter, and not less than 6 inches in diameter for buildings exceeding 75 feet in height. Material shall be steel or wrought iron pipe with approved fittings, designed for a working pressure of 100 pounds in excess of the static pressure due to elevation. An approved 2½ inch hose valve shall be located at each story, not over 5 feet above the floor level. An approved pressure reducing device shall be in-

stalled at hose valves where the pressure would otherwise be in excess of 50 pounds.

(e) An approved siamese connection with a check valve in each inlet shall be installed on a 4 inch pipe connecting with each standpipe system and shall be marked "To Standpipe". The elevation of the connection shall be not over 3 feet above the sidewalk or ground. An automatic drip valve shall be installed where necessary to prevent freezing. In buildings with several standpipes, more than one siamese connection may be required.

(f) Fire department standpipes need not be equipped with attached hose.

(g) Automatic water supplies will not ordinarily be required, except as provided in Order 5121–2(h), or where judged necessary by reason of the high combustibility or potential hazard of the occupancy. When required, they shall be designed to provide not less than 40 pounds flowing pressure at the top outlet, with volume for two fire streams. Any of the following supplies will be acceptable:

1. Connection to city water works system when providing required minimum volume and pressure.

2. Gravity tank of not less than 3500 gallons capacity, elevated 50 feet above the top story.

3. Pressure tank of 5250 gallons gross capacity (3500 gallons water capacity).

4. Automatic pump or pumps, with combined effective capacity of 500 gallons per minute.

(h) An automatic water supply from an approved fire pump shall be provided in buildings over 150 feet high, or in buildings over 10,000 square feet in area per floor and requiring a standpipe. The capacity of the pump shall be not less than 500 gallons per minute for a 4 inch standpipe, 750 gallons per minute for two interconnected 4 inch or single 6 inch standpipes, and 1000 gallons per minute for larger systems.

3. First Aid Standpipes.

(a) Shall be provided as required in Orders 5414, 5533, 5721 of this code.

(b) Standpipes shall be sufficient in number so that any part of every floor area can be reached within 20 feet by a nozzle attached to not more than 75 feet of hose connected to a standpipe.

Note: Standpipe outlets should be located in occupied areas, and usually at interior columns in large area buildings. Asylums and places of detention may require special arrangements. It should be possible in all cases to direct the stream into all important enclosures such as closets, etc.

(c) No required standpipe shall be less than 2 inches in diameter, and not less than 2½ inches in diameter for buildings 5 stories or more in height. Material shall be wrought iron or steel and pipe and fittings shall be of suitable weight for the pressure used. An approved 1½ inch hose valve shall be located in each story, not more than 5 feet above the floor level; valves of the gate type shall be equipped with a suitable open drip connection. An approved pressure-reducing device shall be installed at hose valves where pressure would otherwise be over 50 pounds.

(d) Not more than 75 feet of hose shall be attached to each outlet. Hose shall be of unlined linen construction, 1½ inches in diameter, with a ½ inch nozzle attached, and shall be located in approved cabinets or racks.

(e) Water supply shall be automatic, and be designed for 70 gallons per minute for 30 minutes with 25 pounds flowing pressure at the top outlet. Such supply may be from city connection, gravity tank, pressure tank or pump.

Note: Data on the design of standpipe systems can be found in the Standards of the National Board of Fire Underwriters for the Installation of Standpipe and Hose Systems. The Industrial Commission will ordinarily approve any installation which is approved by the Underwriters.

Order 5122. Fire Extinguishers.

Where fire extinguishers are required, they shall be of a type approved by the Industrial Commission. All fire extinguishers shall be charged in accordance with the instructions of the manufacturer.

Extinguishers shall be conspicuously located where they will always be readily accessible and so distributed as to be immediately available in event of fire. They shall be hung on hangers or set on brackets or shelves so that the top of the extinguisher is not more than 5 feet above the floor.

Note: The Industrial Commission will ordinarily approve any extinguisher which bears the Underwriters' label and which is of the size, and suitable, for the hazard for which it is intended. Consult the Industrial Commission for lists of approved extinguishers.

Order 5123. Automatic Sprinklers.

1. Required automatic sprinkler systems shall be designed and constructed in conformity with good established practice. Only materials and devices approved by the Industrial Commission may be used. Reinstallation of used sprinkler heads is prohibited, and other secondhand devices may be installed by special permission only.

2. Where an automatic sprinkler system is required throughout a building, supply shall be from a city water main, or from a gravity or pressure tank. If the city water supply is inadequate in either pressure or volume, a tank of not less than 5000 gallons capacity shall be provided. The bottom of a gravity tank shall be not less than 35 feet above the under side of the roof.

3. Where automatic sprinklers are required in a basement only, the supply shall be from a city water main. Where there is no city water supply, such basement sprinklers need not be installed; but at such time as a city supply becomes available, such required basement sprinklers shall be installed.

4. Every basement sprinkler system shall also include sprinklers in all shafts (except elevator shafts) leading to the story above.

5. Every sprinkler system shall have a suitable audible alarm and an approved siamese connection marked "To Automatic Sprinklers", and otherwise conforming to Order 5121–2(e).

Note: It will be the policy of the Industrial Commission to approve equipment conforming to Standards of the National Board of Fire Underwriters for Sprinkler Equipments, also materials and devices currently listed by the Underwriters' Laboratories. The Commission reserves the right to order a sprinkler system in any building, regardless of height or number of persons, if the occupancy is especially hazardous.

Chapter 4

GENERAL REQUIREMENTS

Order 5200. Design and Supervision.

Every new building containing more than 50,000 cubic feet of usable space, or addition to a building which by reason of such addition results in a building containing over 50,000 cubic feet of usable space, or structural alteration to a building containing over 50,000 cubic feet of usable space shall be designed by an architect or engineer in accordance with the provisions of this code; and shall be constructed under the supervision of an architect or engineer who shall be responsible for its erection in accordance with the plans and specifications of the designer. No change from the original plans and specifications shall be made except with the knowledge and consent of the designer, and as provided in Order 5010 of this code.

No owner shall construct or alter any building, or portion of a building, or permit any building to be constructed or altered, except in accordance with the provisions of this section.

Note: By the term "architect" or "engineer" above, is meant "registered architect" or "registered professional engineer", as defined in the Architects and Professional Engineers Registration Act, Section 101.31 of the Wisconsin Statutes.

Order 5201. Height and Class of Construction.

All buildings higher than 75 feet above the adjacent grade shall be of fire-resistive construction.

Buildings of mill construction shall not exceed a height of 75 feet in which height there shall not be more than 7 stories; provided, that the height of a building erected on sloping ground may be not to exceed 75 feet plus a vertical distance equal to the vertical change in slope along the length of any side of such building, but in no case shall such height exceed 85 feet above the adjacent finished ground level. Towers, other than tanks, spires and steeples erected as a part of the building and not used for habitation or

storage may extend not to exceed 20 feet above such height limit.

Buildings of ordinary construction shall not exceed a height of 50 feet in which height there shall be not more than 4 stories; provided, that the height of a building erected on sloping ground may be 50 feet plus a vertical distance equal to the vertical change in slope along and in the length of any side of such building, but in no case shall such height exceed 60 feet above the adjacent finished ground level. Towers, other than tanks, spires and steeples not exceeding 20 per cent of the roof area, erected as a part of such building and not used for habitation or storage may extend not to exceed 15 feet above such height limit.

Buildings of frame construction shall not exceed a height of 35 feet in which height there shall be not more than 2 stories, except as provided in Order 5701; provided, that the height of a building erected on sloping ground may be 35 feet plus a vertical distance equal to the vertical change in slope along the length of any side of such building, but in no case shall such height exceed 40 feet above the adjacent finished ground level. Spires, towers, other than tanks, or steeples not exceeding 20 per cent of the roof area, erected as a part of such building and not used for habitation or storage may extend not to exceed 20 feet above such height limit.

In every building more than 4 stories in height, all doors, windows and other openings in outside walls shall be protected with fire-resistive doors or shutters as specified in Order 5109 or fire-resistive windows as specified in Order 5110, unless such openings are on streets or on alleys or outer courts 20 feet or more in width.

Note: See Chapter 343.461 of the Wisconsin Statutes for statute law regulating height of buildings throughout the state of Wisconsin.

Order 5202. Windows.

Every room in which one or more persons live, sleep, or are employed, (except storage rooms or other rooms where the nature of the occupancy will not permit) shall be lighted by a window or windows opening directly upon a street or alley, or upon a court (as defined in Order 5204) on the same lot with the building. The windows shall be so constructed and distributed as to afford proper light and ventilation. Every building more than 40 feet deep (measuring at right angles to the windows) shall have windows on at least two sides.

Exception: The provisions of this order may be waived for factory, office or mercantile buildings if provisions are made for proper artificial lighting, and if ventilation is provided in accordance with the provisions of the Heating, Ventilation and Air Conditioning Code.

Order 5203. Window Cleaners.

Windows in public buildings and places of employment which cannot be cleaned from within, the tops of which are more than 20 feet above the ground floor, flat roof, balcony or permanent platform shall be equipped with approved means to protect the window cleaners; such means shall consist of,

1. A safety belt for each window cleaner, which belt shall be fastened at each end to a permanent device that shall be firmly attached to the window frame, or to the building proper; or
2. A substantial portable platform that is projected through the window or supported from the ground, floor, roof or platform level, for the window cleaner to stand upon, and that is equipped with an approved handrail and toeboard; or
3. A substantial swinging scaffold equipped with standard handrails, toeboards and life line; or
4. A substantial chair scaffold equipped with a safety belt, or
5. Other equally efficient devices.

Order 5204. Definitions of Courts.

1. By inner court is meant an open air shaft or court surrounded on all sides by walls.
2. By inner lot line court is meant a court bounded on one side and both ends by walls and on the remaining side by a lot line.
3. By outer court is meant a court bounded on three sides with walls and on the remaining side by a street, alley or other open space not less than 15 feet wide.
4. By outer lot line court is meant a court with one side on a lot line and opening to a street or open space not less than 15 feet wide.

Order 5205. Size of Courts.

In applying the following requirements, a building from 30 to 43 feet high shall be considered as having at least 3 stories, and each additional 13 feet shall be considered an additional story.

Outer lot line courts shall be not less than 3 feet wide for a court 2 stories or less in height and 40 feet or less in length, measured from the lot line to the wall of the building. For each additional story in height, the width of such court shall be increased one foot; and for each additional 15 feet or fraction thereof in length, the width of such court shall be further increased one foot.

Outer courts between wings or parts of the same building, or between different buildings on the same lot, shall be not less than 6 feet wide for a court 2 stories or less in height and 40 feet or less in length. For each additional story in height, the width of such court shall be increased one foot, and for each additional 10 feet or fraction thereof in length, the width of such court shall be further increased one foot.

Where outer courts or outer lot line courts open at each end to a street or other open space not less than 15 feet wide, the above lengths may be doubled.

Inner lot line courts one story high shall be not less than 4 feet wide and not less than 40 square feet in area. Inner lot line courts two stories high shall be not less than 6 feet wide and not less than 60 square feet in area. For every additional story every such inner lot line court shall be increased by at least one lineal foot in its length and one lineal foot in its width.

Inner courts shall be not less than 10 feet in width nor less than 150 square feet in area for courts two stories or less in height; and for every additional story every such inner court shall be increased by at least one lineal foot in its length and one lineal foot in its width.

Courts shall not be covered by a roof or skylight but the entire required area shall be open and unobstructed from the bottom thereof to the sky. No fire escape or stairway shall be constructed in any court unless the court be enlarged proportionately.

Walls of inner courts whose least horizontal dimension is less than one-fourth the height, shall be faced with material with a permanent white surface or shall be painted white at least every two years.

No buildings shall be altered or enlarged to encroach upon space reserved under this code for light and air on the lots or parcels of ground on which such building is erected.

Order 5206. Ventilation of Courts.

At the bottom of every shaft or inner court there shall be sufficient access to such shaft or court to enable it to be properly cleaned out. Every inner court which is required under Order 5202 and which is more than one story in height shall have an intake for fresh air, leading from the street or other open space. The area of such intake in square feet shall equal at least .002 of the number of cubic feet contained in said court, but such area need not be more than 50 square feet. Every intake shall be of not less than two-hour fire-resistive construction and unless said intake is used as a passageway for persons, there shall be no openings into the same other than the inlet and outlet.

Order 5210. Chimneys.

1. The walls of all chimneys shall be built of brick or other approved fire-resistive material, except that a metal smoke stack may be provided as specified in Order 5211. No chimney shall rest upon a flooring of wood, nor shall any wood be built into, or in contact with any chimney. The foundation of every chimney, flue, or stack shall be designed and built in conformity with the requirements for foundations for buildings. In no case shall a chimney be corbeled out more than 8 inches from the wall, and in every case the corbeling shall consist of at least 5 courses of brick. Chimneys shall extend at least 3 feet above flat roofs and not less than 2 feet above the ridge of gable and hip roofs, and lime-cement or cement mortar shall be used in the laying of chimney masonry above the roof line.

2. Every masonry chimney shall have walls at least 8 inches in solid thickness, except that in a chimney with a flue not larger than 260 square inches where a fire clay or other suitable refractory clay flue lining is used for the full

height of the chimney the walls shall not be less than 4 inches in solid thickness. No smoke flue shall have a cross sectional area less than 64 square inches, except that flue linings 7 inches by 7 inches inside, or 8 inches in diameter inside, may be used.

3. All flue linings shall be adapted to withstand reasonably high temperatures and flue gases and shall have a softening point not lower than 2,000 degrees Fahrenheit. Flue linings shall be not less than ⅝ inch in thickness and shall be built in as the outer walls of the chimney are constructed. Flue linings shall start from a point not less than 8 inches below the bottom of the smoke pipe intakes and shall be continuous to a point not less than 4 inches above the enclosing walls. Flue linings for gas or fuel oil apparatus shall be of salt glazed fire clay equipped with bell and spigot joints, or of other approved material.

4. There shall be but one connection to a flue irrespective of the type of fuel used except for a clean-out door at the base or for the purpose of blowing off low pressure boilers. Exhaust for Diesel engines may also be provided if approved in writing by the Industrial Commission.

5. Every chimney shall be designed to withstand the following wind pressure in pounds per square foot over the diametrical area:

Square Chimneys	30
Polygonal Chimneys	25
Round Chimneys	20

Order 5211. Metal Smokestacks.

Steel or iron smokestacks may be used in place of masonry chimneys specified in Order 5210, in which case the thickness of the metal shall be not less than $\frac{3}{16}$ inch for heights up to 40 feet and ¼ inch for greater heights. Such stacks when used for manufacturing, for high pressure boilers, furnaces or other similar heating or manufacturing appliances shall be lined with fire brick for a distance of not less than 25 feet from the place where the smoke pipe enters and shall be protected on the outside up to and through the roof of the building with 8 inches of masonry, or a metal shield which provides an 8 inch ventilated air space between such shield and the stack. All stacks shall

be properly guyed when the height of the stack exceeds 15 times its least diameter.

Exception: Public utility or industrial power plants are exempted from the protection requirements of this paragraph if they are of fire-resistive construction.

Smokestacks under 30 feet in height may be constructed of not less than No. 10 U.S. Gauge steel, with either welded or riveted joints, and may be mounted directly upon masonry chimneys or foundations or upon industrial heating or power boilers provided all of which are designed to support the stack load. A clearance of not less than 6 inches shall be maintained at all times around such smokestack and any inflammable material within 12 inches of such smokestack shall be protected by ¼ inch of asbestos covered by sheet metal.

Order 5212. Smoke Pipes.

No smoke pipe or breeching serving boilers, furnaces or other similar heating appliances shall pass through any floor, outside window or door, nor through any combustible roof or combustible outside wall, nor through any closet, attic or similarly concealed space.

Where necessary to pass through any partition of non-fire-resistive construction, every smoke pipe shall be encased with incombustible material at least 4 inches thick or with a double safety thimble made of two concentric rings of sheet metal with at least one inch open air space between and with the outer ring covered with at least ¼ inch asbestos.

No part of any smoke pipe shall be placed nearer to any non-fire-resistive partition or wall than the diameter of the pipe, nor nearer to any non-fire-resistive ceiling than 1½ times the diameter; but the above distances may be reduced by one-half, if the wall or ceiling is covered with not less than ¼ inch asbestos board covered with sheet metal, or with equivalent protection.

Order 5213. Steam and Hot Water Pipes.

No steam pipe or pipe carrying hot water at a temperature exceeding 180 degrees shall be placed within one inch of any woodwork. Every such steam or hot water pipe

passing through a combustible floor, ceiling or partition, shall be protected by a metal tube one inch larger in diameter than the pipe and shall be provided with a metal cap. All wooden boxes or casings enclosing steam or hot water pipes, or wooden covers to recesses in walls in which steam pipes are placed, shall be lined with metal.

Order 5214. Ducts.

Every warm air, fresh air and vent duct contained in or passing through a combustible partition or floor shall be placed inside another duct arranged to maintain a ¼ inch air space between the two ducts, or shall be securely covered with ¼ inch corrugated asbestos. The bend at the bottom of the vertical duct shall be kept at least 2 inches from any woodwork.

Exception: Asbestos paper weighing not less than 12 pounds per square may be used as covering on forced air installations.

Every vertical warm air duct, or group of ducts, in all buildings included in the theater, school and hotel classifications shall be enclosed with, or constructed of, incombustible material at least 2 inches thick, lined with metal or smoothly finished on the inside; except that frame buildings not more than two stories in height may have metal ducts if protected as specified in the first paragraph of this order.

Order 5215. Registers.

All register boxes shall be of metal and shall either be of double construction or be covered with asbestos not less than ⅛ inch thick.

Exception: Asbestos paper weighing not less than 12 pounds per square may be used as covering on forced air installations.

Order 5216. Floor Protection.

All stoves and ranges used for cooking, heating or laundry purposes using solid or liquid fuel, and which are more than 16 square feet in horizontal area or which have a flame at the bottom shall be placed on a fire-resistive floor projecting at least 2 feet on each side. If such floor rests on or is in contact with any combustible material, then the fire-resistive floor layer shall be at least 5 inches thick and shall be hollow, with air spaces running horizontally

through the same. The air spaces shall be open at both ends and shall be so placed that air can circulate through them; the horizontal area of the air spaces shall equal at least one-half the horizontal area of the slab.

The air spaces may be secured by using hollow tile placed end to end, or by imbedding wrought or sheet iron pipes in a layer of concrete. The air spaces should parallel the short dimension of the slab.

If the stove or range is raised at least 6 inches above the floor and such air space is not enclosed, then the fire-resistant floor layer may be reduced to not less than 2 inch solid thickness, without air spaces, provided it is covered with sheet metal.

All stoves and ranges using solid or liquid fuel and which are not more than 16 square feet in horizontal area and not having a flame at the bottom shall, if placed on a combustible floor, be raised at least 6 inches above the floor, and such air space shall not be enclosed. Such floor shall be protected with a stove board of sheet metal or asbestos, projecting at least one foot on all sides.

Gas ranges, domestic hot water heaters and hot plates shall be supported at least 6 inches above any wood floor or other combustible material and, if less than 12 inches above the floor, the wood shall be protected by a metal shield, or such equipment may rest on a masonry support.

Note: The above dimension of 6 inches may be reduced to 3½ inches if the bottom is suitably protected with a metal shield.

Order 5217. Wall and Ceiling Protection.

All stoves and ranges used for cooking or laundry purposes and all domestic hot water heaters shall be placed at least 24 inches away from any combustible wall, partition or ceiling, except that such distance may be reduced to 12 inches if the wall, partition or ceiling is protected with at least ¼ inch asbestos board covered with sheet metal, or with an equivalent protection.

The above distances may be reduced one-half in the case of stoves and ranges less than 16 square feet in area, and also in the case of gas ranges of greater area if proper insulation is incorporated in the back of the range.

Order 5218. Gas Vents.

All gas ranges, except those for domestic use, hot water heaters, and other gas fired equipment shall be provided with vent pipes conforming to the requirements for smoke pipes as specified in Order 5212.

Order 5219. Gas and Oil Lamps: Gas Service.

1. Gas and oil lamps shall not be used where electricity is available, except in private apartments.

2. Gas and oil lamps shall be placed at least 6 feet above the floor level, at least 6 inches from any combustible partition or wall, and at least 2 feet (measured from top of flame) below any combustible ceiling unless properly protected by a metal shield with at least 2 inches of air space above. Swinging brackets shall be provided with a guard or stop so that the light cannot come nearer to the partition or wall than one foot. In aisles and public passageways, every such light shall be protected by an incombustible guard unless the light is at least 7 feet above the floor. Gas and oil lights shall be kept at least 2 feet from any drape or window curtain.

3. Every gas supply main shall have a service cock outside of the building, so placed and maintained that it can be shut off at any time without entering the building.

Order 5220. Electrical Work.

All electrical work shall conform to the Wisconsin State Electrical Code, comprising Orders 1000–1499, inclusive, of the Industrial Commission.

Order 5221. Location and Maintenance of Exits.

Every exit mentioned in Orders 5114 to 5119, inclusive, shall lead to a street, alley or open court connected with a street. All such exits and all passageways leading to and from the same, shall be kept in good repair and unobstructed at all times.

GENERAL SANITATION REQUIREMENTS

Order 5250. Toilet Rooms Required.

Every place of employment and public building shall have adequate toilet rooms as provided in the occupancy classifications of this code, completely enclosed and so arranged as to insure privacy.

Order 5251. Toilet Rooms for the Two Sexes.

Where the two sexes are accommodated, separate toilet rooms shall be provided except

(1) In apartment houses;

(2) If approved in writing by the Industrial Commission or the State Board of Health, or their authorized agents, in buildings accommodating not more than 5 persons of both sexes, provided the door of such toilet room is kept locked and the key is kept in a place accessible to all such persons. But whenever the number of such persons shall exceed 5, separate toilet rooms shall be provided.

Entrances to toilet rooms for the two sexes shall be properly separated, by screens or otherwise, and shall, wherever possible, be at least 20 feet apart.

Order 5252. Sex Designated.

Wherever women are employed or accommodated, each toilet room shall be distinctly marked with regard to the sex which uses it, and no person shall be allowed to use a toilet room assigned to the other sex, except as provided in Order 5251. The door or room labels shall be the words MEN, or WOMEN, respectively, in letters not less than one inch in height.

Order 5253. Location, Light and Ventilation.

Every toilet or bathroom shall be so located as to open to outside light and air, by windows or skylights opening directly upon a street, alley or court, except as provided in Order 5254.

The glass area for a toilet room containing one closet or urinal shall be at least 4 square feet, with 2 square feet additional for each additional closet or urinal.

No toilet room shall have a movable window or ventilator opening on any elevator shaft, or on any court which contains windows of sleeping or living rooms above.

Every toilet room having more than one fixture (closets and urinals) shall be ventilated in accordance with the provisions of Order 5848 of the Heating, Ventilation and Air Conditioning Code issued by the Industrial Commission, except that this requirement shall not apply to chemical or septic toilets which are installed in accordance with the provisions of the Chemical Toilet Code or the Septic Toilet Code issued by the State Board of Health.

Note: The size of gravity vent ducts, if surmounted with effective siphon type hoods, may be determined as follows: $\frac{A \times 2}{300}$ = net cross sectional area of vent duct in square feet. Where A = floor area in the toilet room in square feet.

The following are minimum vents as calculated for toilet rooms of average size:

Number of fixtures	Diameter round pipe duct
One or two	6 inches
Three or four	8 inches
Five or six	9 inches
Seven	10 inches
Eight to ten	12 inches

Order 5254. Location Without Outside Windows; When Permitted.

Toilet rooms will be permitted without windows if they are ventilated in accordance with the requirements of Order 5848 of the Heating, Ventilation and Air Conditioning Code issued by the Industrial Commission.

Order 5255. Artificial Light.

Every toilet room, except in connection with private rooms or apartments, shall be artificially lighted during the entire period that the building is occupied, wherever and whenever adequate natural light is not available, so that all parts of the room, especially the toilet compartments shall be provided with artificial light intensity of not less than 2.5 foot candles at the floor level.

Order 5256. Size.

Every toilet room shall have at least 14 square feet of floor area with a minimum width of 3 feet, and at least

100 cubic feet of air space for each water-closet and each urinal in addition to the space required for lavatories if installed within the toilet room.

Order 5257. Floor and Base.

Every toilet room, except those installed and used only in connection with private apartments, shall have the entire floor and the side walls to a height of not less than 6 inches made waterproof with ceramic tile, terrazzo, painted concrete, marble, slate, monolithic asphalt or other approved material impervious to water.

Order 5258. Walls and Ceilings.

The walls and ceilings of every toilet room shall be completely covered with smooth plaster, glazed brick or tile, galvanized or enameled metal, or other equivalent smooth, non-absorbent material. Wood may be used only if it is smooth and well covered with two coats of body paint and one coat of enamel paint or spar varnish. But wood shall not be used for partitions between toilet rooms, nor for partitions which separate a toilet room from any room used by the opposite sex. All such partitions shall be made soundproof.

The interior surface of walls and partitions shall be of light color to improve illumination and facilitate cleaning.

Order 5259. Enclosure of Fixtures.

The fixtures (closets and urinals) in every toilet room shall be arranged to secure privacy in use. Water-closets shall be enclosed with partitions. Urinals shall be placed against walls and arranged individually. Individual floor type urinals shall be placed not less than 24 inches center to center and the space between urinals shall be filled flush with the front and top with non-absorbent material.

Exception: The above requirements need not apply to toilet rooms accommodating only a single closet or urinal.

A space of 6 to 12 inches shall be left between the floor and the bottom of each partition. The top of the partition shall be from 5½ to 6 feet above the floor. Doors with the top 5½ to 6 feet above the floor, and the bottom 6 to 12 inches above the floor, shall be provided for all water-closet

compartments. All partitions and doors shall be of material and finish required for walls and ceilings under Order 5258.

The water-closet compartments in toilet rooms shall be not less than 30 inches in width, and shall be not less than 54 inches in depth with a clearance of not less than 24 inches between the fixture and the compartment door when closed. Compartment doors which are hung to swing inward shall clear the fixture not less than 2 inches.

Note: Section 146.08, of the Wisconsin Statutes provides that not more than 50 per cent of the toilet compartments of any public toilet room of any public building, other than licensed hotels and resorts, shall be kept locked.

Order 5260. Fixtures.

Only individual water-closets of porcelain or vitreous china shall be used. Water-closet seats shall be of wood or other non-heat absorbing material, and shall be finished with varnish or other substance so as to be impervious to water. In public buildings, places of employment and all other public places except apartments, the water-closets shall have projecting lips, or elongated bowls, and open front seats.

Only individual urinals of porcelain or vitreous china shall be used. Such individual urinals shall be set into the floor, the floor graded to the urinal, and the urinals shall be equipped with an effective automatic or foot operated flushing device.

Order 5261. Protection From Freezing.

All water-closets and urinals and the pipes connecting therewith shall be properly protected against freezing, so that such water-closets and urinals will be in proper condition for use at all times.

Note: Toilet rooms should be adequately heated in cold weather. Heating equipment should be arranged to permit cleaning of floors and walls.

Order 5262. Disposal of Sewage.

Each water-closet and urinal, and each lavatory or slop sink, located in a toilet room shall be connected with a sewer and water system, where such systems are available. In locations where a sewer system is not available, or cannot be made available, the disposal of human waste may be accomplished as follows:

(1) Sewage treatment tank and disposal system.

Note: For detailed requirements on such systems see State Plumbing Code.

(2) Where the local conditions make it impractical to install such system, outdoor toilets, as described in Order 5263, or other facilities, such as chemical or septic toilets installed in accordance with the provisions of the Chemical Toilet Code or the Septic Toilet Code issued by the State Board of Health, may be used; provided that in the case of places of employment for more than ten persons, schools larger than two rooms, and apartment houses, water flush toilets as herein described shall be provided, unless outdoor toilets or other facilities are permitted in writing by the Industrial Commission or the State Board of Health. In every case where chemical or septic toilets are installed, the approval of plans and specifications therefor by the State Board of Health shall be secured before work is started.

Order 5263. Outdoor Toilets.

Outdoor toilets shall comply with Orders 5250 to 5259, inclusive, and in addition:

(1) No privy, with or without a leaching pit or other container, shall be erected or maintained within 50 feet of any well, 10 feet of the line of any street or other public thoroughfare, 5 feet of the property line between premises or 25 feet of the door or window of any building.

(2) Located on ground that is well drained, and where there is no possibility of contaminating any drinking water supply.

(3) Provided with suitable approach, such as concrete, gravel or cinder walk.

(4) The foundations shall be of concrete or other masonry.

(5) The vault shall extend at least 6 inches above ground, be as dark as possible, and be proof against entrance by flies, rats, or other vermin. The upper portion shall be of concrete, or of brick or stone laid in cement

mortar. If in poorly drained soil, the entire vault shall be of concrete, or brick, or stone, laid in cement mortar.

(6) All windows, ventilators and other openings shall be screened to prevent the entrance of flies, and all doors shall be self-closing. A separate ventilator shall be provided for the vault and shall extend from the vault to not less than one foot above the roof and be provided with an effective ventilating hood.

(7) The entire installation shall be kept clean and sanitary. Milk of lime (freshly slaked lime) or other equally effective disinfectant shall be used in the vault and in the urinal trough in sufficient quantities, and at frequent intervals. The floors, seats and urinals shall be scrubbed as often as necessary. The vault shall be cleaned out at proper intervals.

Note: See the Wisconsin Code for Rural School Privies issued by the State Board of Health.

Order 5264. Maintenance and Housekeeping.

1. Maintenance of Toilets. Every toilet room, and every part thereof, including walls, floor, ceiling and fixture therein, shall be kept clean, efficient, and in good repair.

In every toilet room, sufficient toilet paper made of material which will not interfere with the operation of the system, or obstruct the fixtures, shall be provided.

Indecent or suggestive marks, pictures, or words are forbidden in toilet rooms, and such defacement when found shall be removed at once.

2. Service Closet. A service closet conforming with requirements for construction of toilet rooms shall be provided and supplied with mop, broom, bucket, soap, toilet paper, and toweling necessary for sanitary upkeep of toilet rooms.

Chapter 5

STRUCTURAL REQUIREMENTS

SECTION 1. DESIGN LOADS.

Order 5300. Floor, Roof and Sidewalk Loads.

1. Dead Loads. All buildings and structures, and parts thereof, shall be designed and constructed to support in addition to the minimum superimposed live loads specified in this order, the actual dead weight of all component members; and in addition thereto, an allowance for the weight of partitions, ceiling and floor finish, and concentrated loads such as safes, mechanical apparatus and similar equipment.

2. Live Loads. All buildings and structures, and parts thereof, shall be designed and constructed to support the following minimum superimposed live loads uniformly distributed in pounds per square foot of horizontal area, in addition to the dead load:

Theaters and assembly halls with fixed seats:	
Auditorium	50
Lobbies, corridors and passageways	80
Stairways	80
Assembly halls without fixed seats:	
Auditorium	100
Lobbies, corridors and passageways	80
Stairways	80
School, library, museum classification:	
Instruction rooms, study rooms, reading rooms, exhibition rooms, art display rooms, laboratories	50
Vocational rooms	100
Library book stacks	100
Lobbies, corridors and passageways	80
Stairways	80
Apartment, hotel, place of detention classification:	
Living rooms, sleeping rooms	40
Lobbies, corridors, passageways	80
Offices and similar areas	60
Stairways	80
Dining Rooms	100

Office buildings:	
Offices	50
Commercial	100
Stairways	80
Mercantile establishments:	
All floor areas and stairways	100
Factories and workshops:	
All floor areas and stairways	100
Garages:	
All floor areas	8000 pound axle load in any possible position or 80 pounds per square foot. (Whichever produces the greater stress.)
Grandstands, reviewing stands, bleachers:	
All areas	100
Stages, in theaters and assembly halls	150
Roofs	30
Sidewalks	250

The above live load requirements shall be considered only as a minimum. In every case where the loading is greater than this minimum, the design of the building or structures, or part thereof, shall be for the actual load and loading conditions.

The following reductions in assumed live loads shall be permitted in designing girders, columns, piers and walls in fire-resistive buildings.

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

2. A reduction of one per cent of the total live load used in the design of girders shall be allowed for each 20 square feet of tributary floor area, with a maximum allowable reduction of 15 per cent. This reduction shall not be carried into the columns nor shall such reduction be used in the design of buildings to be used or occupied as warehouses or for storage purposes.

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

Warehouses and Storage Buildings

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

Manufacturing Buildings, Stores and Garages

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

All Other Buildings

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

The following reductions in assumed live loads shall be permitted in designing columns, piers and walls in buildings of mill and ordinary construction.

Warehouses and Storage Buildings

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

Manufacturing Buildings, Stores and Garages

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

All Other Buildings

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

Order 5301. Wind Pressure.

Every building shall be designed to resist a horizontal wind pressure of not less than 20 pounds for every square foot of exposed surface, in addition to the dead loads and the live loads specified above.

If the overturning moment due to wind pressure exceeds 75 per cent of the moment of stability of the structure due to dead load only, the structure shall be anchored to its foundations, which shall be of sufficient weight to insure the stability of the structure; and sufficient diagonal bracing or rigid connections between uprights and horizontal members shall be provided to resist distortion.

The overturning moment may be disregarded in a structure less than 100 feet in height if the height does not exceed twice the width.

When the stress due to wind in any member is not greater than 50 per cent of the stress due to the dead and live loads, it may be neglected. When the wind stress is greater than 50 per cent of the dead and live load stresses, then the sum of all these stresses shall not exceed 150 per cent of the stresses hereinafter provided.

Order 5302. Foundations.

The permissible loads on natural earth shall not be more than the following, in tons per square foot:

Quick sand and alluvial soils	½
Soft clay	1
Ordinary clay and sand together in layers, wet and spongy	2
Clay or fine sand, firm and dry	3
Sand, compact and well cemented	4
Gravel and coarse sand, well packed	5
Hard pan or shale	6
Rock	Not more than 20 per cent of the ultimate crushing strength of such rock.

Where material at footing excavation level is such as to permit loads in excess of 2 tons per square foot, and the design is for loading in excess of 2 tons per square foot, 2 inch hand auger test holes shall be bored at intervals not exceeding 30 feet in any direction within the building area to a depth of at least 5 feet below the base of the footings,

to determine the character of the underlying material. Allowable loading shall be in accordance with the above table for the material encountered.

The maximum, or safe working load for piles shall be determined by the following formula:

$$L = \frac{2\,W\,H}{S + 0.1} \text{ for steam hammer}$$

$$L = \frac{2\,W\,H}{S + 1} \text{ for drop hammer}$$

in which formula

L = safe load in pounds
W = weight of hammer in pounds
H = fall of hammer in feet
S = penetration or sinking of the pile under the last blow, in inches.

In no case shall the maximum load on a timber pile exceed 500 pounds per square inch of the section of the pile at mid length.

SECTION 2. MASONRY CONSTRUCTION.

Order 5303. Masonry Construction—General Requirement.

The requirements of Orders 5303 to 5313, inclusive, herein shall apply to the construction of all masonry footings, foundations, walls, columns, piers and similar work under this code.

Order 5304. Natural Building Stone and Cast Stone.

1. Rubble Masonry. The stresses in rubble stone masonry, due to all dead and live loads, shall not exceed 100 pounds per square inch when laid in lime-cement mortar, or 140 pounds per square inch when laid in Portland cement mortar.

2. Ashlar Masonry. The stresses in ashlar or carefully coursed masonry, due to all dead and live loads shall not exceed the following at any point:

Kind of Stone	Laid In Lime-Cement Mortar (Pounds per Square Inch)	Laid In Cement Mortar (Pounds per Square Inch)
Granite	640	800
Limestone	400	500
Marble	400	500
Cast Stone	400	500
Sandstone	320	400

3. Weather Resistance of Stone. All natural building stone to be used in masonry exposed to the weather or frost action shall be such that the strength and structure of the stone will not be affected by the weathering or frost action.

Note: Where the weather resistance of a stone is questioned this will require freezing and thawing tests as prescribed under the specification of the American Society for Testing Materials.

4. All cast stone shall be branded with a permanent identification mark of the manufacturer which shall be registered with the Industrial Commission.

The average compressive strength of cast stone taken on four representative samples at the age of 28 days or when delivered on the job shall be not less than 5000 pounds per square inch with an individual minimum of 4500 pounds per square inch, and the average absorption of such samples shall be not more than 7 per cent of their dry weight, with an individual maximum of 8 per cent.

Tests of cast stone specimens shall be made in accordance with the "Tentative Specifications for Cast Stone" (Serial Designation P–3–A29T) of the American Concrete Institute.

Order 5305. Building Brick.

1. Definition. By **Building Brick** is meant a structural unit of burned clay or shale, sand lime or concrete, usually solid and about 8 inches by 3¾ inches by 2¼ inches in size.

2. Structure. All building brick shall be rectangular in form, free from cracks, laminations and other defects which may interfere with proper laying of the brick or impair the strength or permanence of the structure.

3. Manufacture. Concrete building brick shall be manufactured from a mixture of Portland cement and approved aggregates, such as sand, gravel, crushed stone, bituminous

or anthracite cinders, burned clay or shale, or blast furnace slag.

4. Identification. All building brick shall be of distinctive design or appearance, or marked so that the identity of the manufacturer may be known at any time.

5. Strength and Absorption.

(a) The strength and absorption of all building brick manufactured from burned clay or shale and used in exterior or exposed locations shall conform to the following minimum requirements:

Compressive Strength (bricks flatwise) lbs. per square inch average gross area		Water Absorption by 5 Hour Boiling per cent		C/B Ratio	
Average of 5 Bricks	Individual Minimum	Average of 5 Bricks	Individual Maximum	Average of 5 Bricks	Individual Maximum
2500	2000	20	25	0.70	0.75

Note: The ratio C/B is the ratio of absorption by 24 hour submersion in water at room temperature to that after 5 hour submersion in boiling water.

If the average compressive strength is greater than 8000 pounds per square inch and the average water absorption is less than 10 per cent by weight after 5 hour submersion in boiling water, the requirement for C/B ratio shall be waived.

(b) The strength and absorption of all building brick manufactured from burned clay or shale and used exclusively for backup or interior construction shall conform to the following minimum requirements:

Compressive Strength (bricks flatwise) lbs. per square inch average gross area		Water Absorption by 5 Hour Boiling per cent		C/B Ratio	
Average of 5 Bricks	Individual Minimum	Average of 5 Bricks	Individual Maximum	Average of 5 Bricks	Individual Maximum
2500	2000	20	25	0.85	0.90

(c) The strength of all concrete and sand-lime brick used in masonry construction shall conform to the following minimum requirements:

Compressive Strength (Bricks Flatwise) Pounds Per Square Inch Average Gross Area		Modulus of Rupture (Bricks Flatwise) Pounds Per Square Inch	
Average of 5 Tests	Individual Minimum	Average of 5 Tests	Individual Minimum
2500	2000	450	300

3. Tests. Typical specimens of all types of building brick shall be tested originally to prove compliance with the provisions of this code, and all concrete and sand-lime brick shall be retested at intervals of not more than one year. Further tests may be demanded at any time there is reasonable suspicion of non-conformance to the requirements of this code.

The testing of all brick shall be in accordance with the Standard Methods of Testing Brick (A.S.T.M. Designation C 67) of the American Society for Testing Materials.

Order 5306. Hollow Building Units.

1. Definitions.

(a) Hollow tile are the products of surface clay, shale, fireclay, or admixtures thereof, moulded to permanent hollow form for use as masonry units in building construction.

(b) Hollow concrete masonry units are the products of Portland Cement and suitable aggregates such as sand, gravel, crushed stone, bituminous or anthracite cinders, burned clay or shale or blast-furnace slag, moulded to permanent hollow form for use as masonry units in building construction.

2. Hollow Tile Used in Bearing and Exterior Walls.

(a) Strength and Absorption. All hollow tile used in bearing and exterior walls shall conform to the following minimum requirements for strength and absorption:

Compressive Strength (Based on Gross Area) Pounds per square inch				Absorption per cent		
End Construction Tile		Side Construction Tile				
Average of Five Tests	Individual Minimum	Average of Five Tests	Individual Minimum	Average of Five Tests	Individual Maximum	Individual Minimum
1100	1000	1000	900	5 to 16	19	4

(b) Number of Cells. Load bearing tile shall conform to the following requirements as to the minimum number of cells per unit in the direction of wall thickness:

Nominal Horizontal Thickness of Tile as Laid in Wall, in inches	Minimum Number of Cells in Direction of Wall Thickness
4	1
6	2
8	2
10	2
12	3

Note: Cells, as used herein, are hollow spaces enclosed within the perimeter of the exterior shells, and having a minimum dimension of not less than ⅛ inch and a cross sectional area of not less than one square inch.

In double-shell tile the two voids between exterior and interior shells on either side of the tile shall be considered as one cell in thickness of wall when their combined width is not less than ½ inch, provided the short webs between the inner and outer shells are not greater in number and thickness than the long transverse webs holding the inner shells.

(c) Shell and Web Thickness. The average over-all thickness of the shells, measured between the inner and extreme outer surfaces of end-construction hollow tile, shall be not less than ¾ inch, except that in double-shell tile the combined average over-all thickness of the inner and outer shell shall be not less than ¾ inch. The thickness of the webs shall be not less than ½ inch.

The average over-all thickness of the shells, measured between the inner and extreme outer surfaces of side-construction hollow tile, shall be not less than ⅝ inch, except that in double-shell tile the combined average over-all thickness of the inner and outer shell shall be not less than ¾ inch. The thickness of the webs shall be not less than ½ inch.

(d) Branding. All clay tile shall be branded with a distinctive indentation on the shell. Clay tile which comply with all requirements for exterior construction and bearing walls shall have the word BEARING impressed on them. All clay tile shall bear the name, initials or trade-mark of the manufacturer.

(e) Tests. Typical specimens of all sizes and designs of hollow tile used in exterior or bearing walls shall be tested originally to prove compliance with this code, and thereafter as directed by the Industrial Commission. Tile shall be sampled and tested in accordance with the Standard Methods of Sampling and Testing Structural Clay Tile (A.S.T.M. Designation C–112) of the American Society for Testing Materials.

3. Hollow Concrete Masonry Units Used in Bearing and Exterior Walls.

(a) Compressive Strength. All hollow concrete masonry units used in exterior and bearing walls shall have a compressive strength of not less than 1000 pounds per square inch gross area as laid in the wall.

The average strength of any group of test specimens of hollow concrete masonry units shall be not less than the above requirements. The strength of any individual test specimen shall not be less than 900 pounds per square inch gross area.

(b) Absorption. Hollow concrete masonry units used in walls which will be exposed to the weather or soil in finished work shall not absorb more than 14 pounds of water per cubic foot of concrete actually contained. Units which are protected from the weather or soil with one course of brick or its equivalent need not conform to these absorption requirements.

(c) Branding. All hollow concrete masonry units used in exterior or bearing walls shall be branded with a distinctive indentation or waterproof stencilled mark, and shall bear the name, initials, or trade-mark of the manufacturer. A facsimile of each individual brand shall be filed with the Industrial Commission.

(d) Tests. Typical specimens of all sizes and designs of hollow concrete masonry units used in exterior or bearing walls shall be tested in an approved manner, originally to prove compliance with the requirements of this code, and thereafter at intervals of not more than one year. Further tests may be demanded at any time there is reasonable suspicion of non-conformance to the requirements of this code.

Hollow concrete masonry units shall be sampled and tested in accordance with the methods of sampling and testing concrete masonry units (A.S.T.M. Designation C 140–39) of the American Society for Testing Materials.

4. Clay Tile Used in Non-Bearing Partitions.

(a) Weight. The weight of hollow clay tile used in non-bearing partitions shall be not less than the following:

Dimension	Minimum No. of cells in unit	Minimum No. of cells in direction of wall thickness	Minimum Average Weight, lb. per sq. ft. of tile	Individual Minimum Weight, lb. per square foot of tile
2x12x12	3	1	14	13
3x12x12	3	1	15	14
4x12x12	3	1	16	15
6x12x12	3	1	22	21
6x12x12	4	2	25	24
8x12x12	4	2	30	28
10x12x12	4	2	35	33
12x12x12	4	2	40	38

Note: The weights above are for scored tile. If any of the faces are unscored, the weights shall be increased 0.5 lb. per square foot of unscored area.

No dimension shall vary more than 3 per cent from the specified dimensions for any form of tile.

The requirements for minimum weights of hollow clay tile used in non-bearing partitions shall be waived if the over-all thickness of the shells, measured between the inner and extreme outer surfaces, is not less than $\frac{5}{8}$ inch and the thickness of webs is not less than $\frac{1}{2}$ inch.

(b) Shape and Structure. All hollow clay tile used in non-bearing partitions shall be reasonably free from laminations and from such cracks, blisters, surface roughness and other defects which would interfere with the proper setting of the tile, or impair the strength, permanence or fire protection value of the construction.

The depth of curvature or warpage of any face, shall not exceed 3 per cent of the greatest dimension of such face, but in no case more than $\frac{1}{4}$ inch.

Surfaces of all tile intended for the direct application of plaster or stucco shall be scratched or scored. When scored, each groove shall be not less than $\frac{1}{8}$ inch nor more than $\frac{3}{16}$ inch in depth, nor more than 1 inch in width. The area covered by the grooves shall not exceed 50 per cent of the area of the scored faces.

(c) Branding. All hollow clay tile used in non-bearing partitions shall be branded with a distinctive indentation. All hollow clay tile not suitable for use in bearing and exterior walls but used in non-bearing partitions shall have the word PARTITION impressed on them.

All hollow clay tile used in partition work shall bear the name, initials or trade-mark of the manufacturer.

5. Hollow Concrete Masonry Units Used in Non-Bearing Partitions. All hollow concrete masonry units used in non-bearing partitions shall comply with the requirements for use in bearing and exterior walls, or shall be branded with a distinctive impression to identify them for use only in non-bearing partitions.

6. Clay Tile and Hollow Concrete Masonry Units Used in Floor Construction.

(a) General Requirements. Where hollow clay tile or hollow concrete masonry units are used in concrete floor construction in a way that the whole or any portion of a tile or block is subjected to a load, the requirements which apply to tile or block used in exterior and bearing construction shall be complied with.

Where hollow clay tile or hollow concrete masonry units are used in concrete floor construction in a way that no portion of a tile or block is subjected to a load, the requirements which apply to tile or blocks used in partitions shall be complied with.

(b) Branding. All clay tile or concrete masonry units used in floor construction shall bear the name, initials or trade-mark of the manufacturer.

Order 5307. Allowable Unit Stresses in Masonry.

The compressive stresses in masonry walls, partitions, piers and similar bearing masonry shall not exceed the following in pounds per square inch:

Kind of Masonry	Kind of Mortar		
	Lime	Lime-Portland Cement	Portland Cement
Brick	90	140	175
Hollow Concrete Masonry Units	----	85	100
Hollow Clay Tile	----	85	100

Where a combination of two or more building units is used, the minimum requirements shall apply to the masonry.

Order 5308. Mortar.

All cement used in the making of mortar for embedding masonry and for other structural purposes under this code shall conform to the requirements of the standard specifications for these materials issued by the American Society for Testing Materials having designation listed as follows:

Specifications for Portland Cement—C 150–41

Lime putty for mortar shall be made by slaking quicklime to a smooth paste, and shall be stored and protected for a period of not less than 10 days before being used in the making of mortar. Where pulverized quicklime is used, the storing period may be reduced to 48 hours.

Hydrated lime shall be considered the equivalent of lime putty for all uses hereunder.

Lime mortar shall consist of one part of lime putty, or dry hydrated lime, to not more than three parts of approved sand, all measurements by volume.

Lime-cement mortar shall consist of one part of lime putty, or dry hydrated lime, and one part of Portland cement added to not more than six parts of approved sand, all measurements by volume.

In lime or lime-cement mortars any desired part of the lime may be replaced with an equal volume of Portland Cement.

Cement mortar shall consist of one part of Portland Cement and not more than three parts of approved sand, except that lime putty, or dry hydrated lime, in volume equal to not more than 15 per cent of the volume of Portland Cement may be added to the mortar.

Note: Approved sand for mortar shall conform to the Tentative Specifications for Concrete Aggregates (A.S.T.M. Designation C33–40) of the American Society for Testing Materials.

Order 5309. Bearing Masonry Walls, Bearing Partitions and Piers.

1. General Requirements. All masonry units used in the construction of bearing walls, bearing partitions and piers shall conform in all respects to the requirements for bearing units.

The unit stresses in bearing masonry walls, partitions and piers shall not exceed those specified in Orders 5304 and 5307.

Cement mortar shall be used for all masonry which will have one or more faces in contact with soil. Lime-cement mortar or cement mortar shall be used for all masonry in isolated piers, parapet walls, chimneys where exposed to the weather, and for all hollow masonry units. All other masonry may be laid in cement mortar, lime-cement mortar or lime mortar.

2. Masonry Bond. In brick masonry, or in combination brick and other masonry units, the bonding of each tier of units to that adjoining shall be secured by means of a full header course of brick every sixth course of brick, or equivalent. The use of metal ties for bonding masonry is not approved.

Note: By equivalent is meant that one-sixth of the volume of a wall shall be header, or bond, units.

Where masonry units are larger than brick, the bond courses shall be placed at intervals not exceeding 16 inches.

3. Use of Hollow Clay Tile and Hollow Concrete Masonry Units. Approved clay tile and concrete masonry units may be used in bearing and exterior walls of buildings not more than 3 stories, or 45 feet in height, or in panel walls in buildings of any height. In determining this height the basement or foundation wall shall be considered a story if constructed of clay tile or concrete masonry units.

Concentrated loads shall be transmitted to hollow clay tile or hollow concrete block masonry by at least 3 courses of brick or equivalent concrete or by a metal plate of sufficient thickness and size to distribute the load to the webs and shells in such a manner as not to exceed the unit stress.

Where hollow clay tile or hollow concrete masonry units are used in party walls, there shall be not less than two such units, each 8 inches in thickness as a minimum, used in making up the thickness of the wall unless solid masonry is used for building all chases, recesses, framing of all openings, and for the support, anchorage, and protection of all joists and beams carried into such wall.

Clay tile and concrete masonry units used in bearing walls shall be well bedded in mortar. The net bearing area

of all clay tile and concrete masonry units as laid in the wall shall be such that the allowable unit stress in the mortar is not exceeded.

All clay tile laid with cells vertical shall be laid in Portland cement mortar. All clay tile laid with cells horizontal and all concrete masonry units shall be laid in cement-lime mortar, or better.

4. Height and Thickness. All bearing walls, party walls and standard division walls, except as hereinafter provided, shall be not less than 12 inches thick in the upper 3 stories, increasing 4 inches in thickness for each 3 stories, or fraction, below. No such 3 story height shall exceed 40 feet.

A building not more than 3 stories in height may have 8 inch bearing walls in the upper story, provided such story is not more than 10 feet high in the clear, and the span is not more than 20 feet, and the wall is not more than 30 feet long between cross walls, offsets or pilasters.

A building not more than one story in height may have 8 inch bearing walls, provided the clear story height is not more than 12 feet, the roof span is not more than 25 feet, and the distance between cross walls, offsets or pilasters is not more than 20 feet. All other one story buildings shall have all bearing walls not less than 12 inches thick.

All bearing masonry walls shall have substantial lateral support at right angles to the wall face at intervals, measured either vertically or horizontally, not exceeding 18 times the wall thickness. Such lateral support shall be obtained by masonry cross walls, piers or buttresses when the limiting distance is measured horizontally, or by floors or roof when the limiting distance is measured vertically.

Masonry walls which are in contact with the soil in any story shall be increased 4 inches in thickness in that story, except that for places of abode as specified in Order 5700, not over 2 stories in height 12 inch walls will be accepted if substantial lateral supports consisting of masonry walls, offsets or pilasters are provided at intervals not to exceed 20 feet.

Rubble and rough cut stone walls shall be 4 inches thicker than required for walls of artificially formed units or of ashlar masonry.

Stone and similar solid facing not less than 4 inches thick may be considered as part of the required thickness of a wall if bonded to the backing as required for brickwork. No such wall shall be less than 12 inches thick.

5. Piers. In all buildings, the section of masonry supporting trusses or girders shall be considered as isolated piers, the least dimension of which, in inches, shall be not less than one-thirtieth of the span of the truss, or girder, in inches, and the height shall not exceed 12 times the minimum horizontal dimension.

The height of masonry piers which are not built into, and as a part of bearing walls, shall be not more than 10 times the minimum horizontal dimension.

6. Chases, Recesses and Openings. There shall be no chases in 8 inch walls or in any pier. No chase in any wall shall be deeper than ⅓ the wall thickness. No horizontal chase shall exceed 4 feet in length nor shall the horizontal projection of any diagonal chase exceed 4 feet. No vertical chase shall be closer than 2 feet to any pilaster, cross wall, end wall or other stiffener.

The aggregate area of recesses and chases in the wall of any one story shall not exceed ¼ the whole area of the face of the wall in that story. No chases or recesses shall be permitted in any wall which will reduce the fire-resistance of such wall below the minimum required by this code.

The maximum percentage of openings in the horizontal cross section of any wall shall not exceed 50 per cent, unless the wall is increased 4 inches in thickness, or such portions of the wall between openings shall be as required for piers for the entire wall height.

Order 5310. Non-Bearing Masonry Walls.

1. General Requirements. All exterior non-bearing masonry walls if constructed with one course of brick to the weather may be backed with common brick, concrete masonry units, or non-bearing clay tile, conforming to the requirements of Orders 5305–5b and 5306–4 and 5. If walls are built of concrete masonry units or clay tile, with or without exterior stucco, such walls shall be constructed of concrete masonry units or clay tile conforming to the requirements of Order 5306–2 and 3.

Interior non-bearing partition walls may be built of materials conforming to the requirements of Orders 5305–5b and 5306–5 and 6, or of gypsum block or other approved materials.

Lime, lime-cement or cement mortar shall be used for all non-bearing masonry, except as follows:

(a) Lime mortar shall not be used in habitually wet or damp locations.

(b) Gypsum shall be used for gypsum masonry.

(c) Gypsum may be used for interior clay tile masonry.

2. Masonry Bond and Anchorage. In non-load bearing brick masonry or in combinations of brick and other masonry units, the bonding of each tier of units to that adjoining, shall be secured by means of a full header course of brick or other units placed at intervals not exceeding 32 inches. The height of such bond course shall not exceed 5 inches and the width of bed joint used to effect the masonry bond shall be at least 4 inches.

All exterior and interior non-bearing walls and partitions shall be securely anchored to columns and supporting members by means of substantial ties of at least No. 13 U. S. Standard gage metal, spaced not more than 24 inches center to center.

3. Height and Thickness. Interior non-bearing masonry walls which are supported by fire-resistive construction and have tight contact with not less than 2 hour fire-resistive construction at the top, shall be not more than 36 times their thickness in clear height. Similar non-bearing walls which contact less than 2 hour fire-resistive support at the top shall be not more than 24 times their thickness in clear height. Plastering shall be included in computing the thickness.

The thickness of exterior non-bearing walls shall be not less than 1/24 of the clear height and not less than 1/30 of the horizontal distance between vertical supports, but in no case less than 8 inches.

Order 5311. Cavity Walls.

Exterior non-bearing walls may be built with a facing of 4 inches of building brick complying with the requirements of Order 5305–5a, and a backing of either building brick complying with the requirements of Order 5305–5b, or hollow building units complying with the requirements of Order 5306–2 to 4 inclusive. Such walls shall have an air space between the facing and backing of not less than 2 inches nor more than 2½ inches, and shall be bonded to each other with galvanized metal ties at least ¼ inch thick every 16 inches in height and 24 inches in width. The maximum height between supports shall be 10 feet. For heights greater than 10 feet between supports, the thickness of the backing shall be increased 2 inches for each 5 feet, or fraction thereof. The wall shall be anchored to the supporting framework with metal ties at least ⅛ inch thick, spaced not more than 24 inches center to center.

A waterproofing membrane shall be installed at the bottom of the wall cavity. It shall pass through both the exterior facing course and the backing in such a manner as to drain outward the water which might penetrate the facing. Open vertical joints, or weep holes, shall be provided every 3 feet horizontally in the facing above the membrane.

Order 5312. Bonding and Anchoring Stone and Cast Stone Veneers.

1. For bearing walls, stone shall be bonded to the backing every 16 inches of wall height with bond courses at least 4 inches in height, and the width of bed joint used to effect the masonry bond shall be at least 4 inches.

2. For non-bearing walls, individual stones shall be anchored to the supporting framework and dowelled to each other at all horizontal joints, and anchored to the backing at all horizontal joints and at vertical joints so that one anchor is provided for every 6 square feet of wall surface. All anchors shall be not less than ¼ square inch in cross section and made of wrought iron galvanized after forming, or of commercial bronze.

3. The backing of all stone or cast stone bearing or non-bearing walls shall be of brick conforming to the requirements of Order 5305–5b, or other solid material weighing at least 130 pounds per cubic foot.

Order 5313. Parapet Walls.

Parapet walls not less than 8 inches in thickness and 2 feet in height shall be provided on all exterior, division and party walls of masonry or concrete, where such walls connect with roofs other than roofs of fire-resistive construction; but this order shall not apply:

(1) To buildings where frame construction would be permitted under the provisions of this code.

(2) To walls which face streets, or alleys.

(3) To walls where not less than 10 feet of vacant space is maintained between the wall and the boundary line between premises.

(4) To walls which are not less than 10 feet from other buildings on the same premises.

All parapet walls shall be properly coped with incombustible, weatherproof material.

SECTION 3. CONCRETE CONSTRUCTION.

Order 5314. Concrete Materials.

1. Portland Cement. Portland cement shall conform to the "Standard Specifications for Portland Cement" (A. S. T. M. Serial Designation: C9–38) or the "Standard Specifications for High-Early-Strength Portland Cement" (A. S. T. M. Serial Designation: C74–39).

2. Concrete Aggregates. Concrete aggregates, except lightweight aggregates, shall conform to the "Standard Specifications for Concrete Aggregates" (A.S.T.M. Designation C33–39) including the methods of sampling and testing.

Lightweight aggregates for concrete shall conform to the "Standard Specifications for Lightweight Aggregates for Concrete", (A.S.T.M. Designation C130–39) including the methods of sampling and testing.

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 reinforcing bars.

3. Water. Water used in mixing concrete shall be clean, and free from injurious amounts of oil, acid, alkali, organic matter or other harmful substances.

4. Metal Reinforcement. Metal reinforcement shall conform to the requirements of the "Standard Specifications for Billet-Steel Bars for Concrete Reinforcement" (A.S.T.M. Serial Designation: A15–39), or for "Rail-Steel Bars for Concrete Reinforcement" (A.S.T.M. Serial Designation: A16–35), or for "Welded Steel Wire Fabric for Concrete Reinforcement" (A.S.T.M. Serial Designation: A185–37).

5. Storage of Materials. Cement and aggregates shall be stored in such a manner as to prevent deterioration or the intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall be removed completely from the premises.

Order 5315. Concrete Proportions, Mixing, and Strength.

1. Proportions. The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface.

The methods of measuring concrete materials shall be such that the proportions can be controlled accurately and checked easily at any time during the work. Wherever practicable such measurement shall be by weight rather than by volume.

2. Mixing. The concrete shall be mixed until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. In machine mixing, only batchmixers shall be used. Each batch shall be mixed not less than one minute after all the materials are in the mixer and must be discharged completely before the mixer is recharged. Machine mixers shall have a peripheral speed of approximately 200 feet per minute.

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in the "Standard Specifications for Ready-Mixed Concrete" (A.S.T.M. Serial Designation C94–38).

3. Strength. For the design of reinforced concrete structures, the value of f'_c used for determining the working stresses as stipulated in Order 5322–3 shall be based on the specified minimum ultimate 28-day compressive strength of the concrete, or on the specified minimum ultimate compressive strength at the earlier age at which the concrete may be expected to receive its full load. All plans, submitted for approval or used on the job, shall show clearly the assumed strength of concrete at the specified age for which all parts of the structure were designed.

All concrete exposed to the action of the weather shall have a water-content of not to exceed six gallons per sack of cement.

When average aggregates are to be used and no preliminary tests are to be made, the water-content to be used for various desired strengths of concrete shall be as indicated in the following table:

Water-Content, U. S. Gallons per 94 lb. Sack of Cement	7½	6¾	6
Assumed Compressive Strength at 28 Days, lb. per sq. in.	2000	2500	3000

In computing the water-content, surface water carried by the aggregates must be included. Water-content other than shown in the above table may be used, provided that the strength-quality of the concrete proposed for use in the structure shall be established by tests made in advance of the start of the work, using suitable consistencies and in accordance with the "Standard Method of Making Compression Tests of Concrete" (A.S.T.M. Serial Designation: C39–39). A curve representing the relation between the water-content and the average 28-day compressive strength or earlier strength at which the concrete is to receive its full working load, shall be established for a range of values including all the compressive strengths indicated on the plans.

The curve shall be established by at least three points, each point representing average values from at least four test specimens. The maximum allowable water-content for

the concrete for the structure shall be as determined from this curve and shall correspond to a strength which is fifteen per cent greater than that indicated on the plans. No substitutions shall be made in the materials used on the work without additional tests in accordance herewith to show that the quality of the concrete is satisfactory.

4. Curing and Protection Against Cold Weather. In all concrete structures, concrete made with normal Portland cement shall be maintained in a moist condition for at least the first seven days after placing, and high-early-strength concrete shall be so maintained for at least the first three days.

Adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing weather. No frozen materials or materials containing ice shall be used.

All concrete materials and all reinforcement, forms, fillers and ground with which the concrete is to come in contact, shall be free from frost. Whenever the temperature of the surrounding air is below 40 degrees Fahrenheit, all concrete when placed in the forms shall have a temperature of between 60 and 90 degrees Fahrenheit and shall be maintained at a temperature of not less than 50 degrees Fahrenheit for at least 72 hours for normal concrete or 24 hours for high-early-strength concrete, or for as much more time as is necessary to insure proper rate of curing of the concrete. The housing, covering or other protection used in connection with curing shall remain in place and intact at least 24 hours after the artificial heating is discontinued. No dependence shall be placed on salt or other chemicals for the prevention of freezing.

5. Forms and Shoring for Concrete Structures. Forms shall be substantially constructed to carry dead loads and impact imposed during pouring operations. Except for wall forms, they shall remain in place until the concrete has attained the designed strength, which shall be established by recognized laboratory reports on test cylinders. When the minimum temperature is less than 50 degrees Fahrenheit, such cylinders shall be stored under the same conditions as exist in the actual concrete they represent.

In all concrete construction the shores shall be designed to carry the dead load of all concrete which has not attained its designed strength, and all shores shall remain in place until the concrete they support shall have attained its designed strength, and, in multistoried structures, shoring shall not under any circumstances be removed from a lower story until the concrete ceiling construction of the next higher story shall have attained its designed strength. The term "designed strength" is defined in Order 5322.

Order 5316. Flexure of Beams, Frames, and Slabs.

1. Condition of Design. All members of frames or continuous construction shall be designed to resist at all sections the maximum moments and shears produced by dead load, live load and wind load, as determined by some one of the approximate methods of elastic frame analysis. Any reasonable assumptions may be adopted as to relative stiffness of columns and floor members. The assumptions made should be consistent throughout the analysis. The following will serve as a guide to satisfactory design.

The stiffness, K, of a member is defined as EI divided by l or h. The modulus of elasticity for concrete shall be assumed as 1000 f'_c, and that for steel as 30,000,000 lbs. per sq. in. In the analysis of continuous frames, center to center distances, l and h, shall be used in the determination of moments.

In computing the value of I of slabs, beams, girders, and columns, the reinforcement may be neglected. In T-shaped sections allowance shall be made for the effect of the flange. The additional width of haunched floor members near supports may be neglected in computing moments, but may be considered to resist moment and shear. The additional depth of haunched floor members may be considered as resisting moment only when a complete analysis is made taking into account the variation in depth. Otherwise the minimum depth should be used to find moment and to resist the resulting moment. However, in any case, the actual depth may be assumed to resist shear.

Moments at faces of supports may be used for design of beams and girders. Solid or ribbed slabs with clear spans of not more than ten feet that are built integrally with their

supports may be designed as continuous slabs on knife edge supports with spans equal to the clear spans of the slab and the width of beams otherwise neglected. The span length of members that are not built integrally with their supports shall be the clear span plus the depth of the beam or slab but shall not exceed the distance between centers of upports.

The clear distance between lateral supports of a beam shall not exceed thirty-two times the least width of compression flange.

2. Requirements for T-Beams. In T-beam construction the slab and beam shall be built integrally or otherwise effectively bonded together. The effective flange width to be used in the design of symmetrical T-beams shall not exceed one-fourth of the span length of the beam, and its overhanging width on either side of the web shall not exceed eight times the thickness of the slab nor one-half the clear distance to the next beam.

For beams having a flange on one side only, the effective overhanging flange width shall not exceed one-twelfth of the span length of the beam, nor six times the thickness of the slab, nor one-half the clear distance to the next beam.

Where the principal reinforcement in a slab which is considered as the flange of a T-beam (not a joist in concrete joist floors) is parallel to the beam, transverse reinforcement shall be provided in the top of the slab. This reinforcement shall be designed to carry the load on the portion of the slab assumed as the flange of the T-beam. The spacing of the bars shall not exceed five times the thickness of the flange, nor in any case eighteen inches.

Provision shall be made for the compressive stress at the support in continuous T-beam construction, care being taken that the provisions relating to the spacing of bars, and the placing of concrete shall be fully met.

The overhanging portion of the flange of the beam shall not be considered as effective in computing the shear and diagonal tension resistance of T-beams.

Isolated beams in which the T-form is used only for the purpose of providing additional compression area, shall have a flange thickness not less than one-half the width of

the web and a total flange width not more than four times the web thickness.

3. Compression Steel in Flexural Members. Compression steel in beams, girders, or slabs shall be anchored by ties or stirrups not less than ¼ inch in diameter spaced not farther apart than 16 bar diameters, or 48 tie diameters. Such stirrups or ties shall be used throughout the distance where the compression steel is required.

4. Concrete Joist Floor Construction. Concrete joist floor construction consists of concrete joists and slabs placed monolithically with or without burned clay or concrete tile fillers. The joists shall not be farther apart than thirty inches face to face. The joists shall be not less than four inches wide, nor of a depth more than three times the width.

When burned clay or concrete tile fillers, of material having a unit compressive strength at least equal to that of the designed strength of the concrete in the joists are used, and the fillers are so placed that the joints in alternate rows are staggered, the vertical shells of the fillers in contact with the joists may be included in the calculations involving shear or negative bending moment. No other portion of the fillers may be included in the design calculations.

The concrete slab over the fillers shall be not less than one and one-half inches in thickness, nor less in thickness than one-twelfth of the clear distance between joists.

Where removable forms or fillers are used, the thickness of the concrete slab shall not be less than one-twelfth of the clear distance between joists and in no case less than two inches. Such slab shall be reinforced at right angles to the joists with a minimum of .049 sq. in. of reinforcing steel per foot of width, and in slabs on which the prescribed live load does not exceed fifty lbs. per sq. ft., no additional reinforcement shall be required.

When the finish used as a wearing surface is placed monolithically with the structural slab in buildings of the warehouse or industrial class, the thickness of the concrete over the fillers shall be one-half inch greater than the thickness used for design purposes.

Where the slab contains conduits or pipes, the thickness shall not be less than one-half inch plus the total over-all

depth of such conduits or pipes at any point. Such conduits or pipes shall be so located as not to impair the strength of the construction.

5. Flat Slabs and Two-Way Slabs with Supports on Four Sides. Structures of these types shall be designed in accordance with the provisions of the 1940 Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

Order 5317. Shear and Diagonal Tension.

1. General. Due to the composite character of reinforced concrete beams the action of reinforcement in resisting diagonal tension is not susceptible of exact analysis. Hence the design of web reinforcement is based on empirical or modified rational methods which have been developed from tests and the observation of existing structures.

Vertical stirrups, bent-up longitudinal bars or both, add greatly to the resistance to shear or diagonal tension. This is especially true if adequate bond resistance is provided, either in the form of low bond stress or effective anchorage of the reinforcement. The importance of bond resistance is such that high working stresses are permitted only when all of the reinforcement is anchored properly. Therefore the requirements of Order 5318 on Bond and Anchorage are intimately related to the provisions of this order.

2. Unit Shearing Stress. The shearing unit stress used as a measure of diagonal tension shall be computed by the formula $v = \frac{V}{bjd}$. For beams of I or T section the width of the concrete web or stem shall be used.

In concrete joist floor construction where burned clay or concrete tile are used, the shells of the tile in contact with the joists may be used in computing the shearing stress provided that the net compressive strength of the shells of the tile equals that of the concrete in the joists and provided that the joints in alternate rows of tile are staggered.

3. Use of Web Reinforcement. Where the shearing unit stress in a beam or joist exceeds $0.02\ f'_c$, web reinforcement shall be provided at all sections for the shear in excess of this amount.

Web reinforcement may consist of vertical or inclined stirrups or bent-up longitudinal reinforcement or a combination thereof. Bars inclined at an angle less than 15 degrees with the axis of the beam shall not be considered as web reinforcement.

Stirrups or bent-up longitudinal bars to be considered effective as web reinforcement shall be anchored at both ends in accordance with the requirements of Order 5318–4.

4. Spacing of Web Reinforcement. Where web reinforcement is required it shall be so spaced that every 45 degree line (representing a potential crack) extending from the mid-depth of the beam to the longitudinal tension bars shall be crossed by at least one line of web reinforcement. If a shearing unit stress in excess of $0.06\ f'_c$ is used, every such line shall be crossed by at least two such lines of web reinforcement.

Order 5318. Bond and Anchorage.

1. Unit Bond Stress. In flexural members in which the tensile reinforcement is parallel to the compression face, the bond stress at any cross section shall be computed by the formula $u = \frac{V}{\Sigma o\, jd}$. In beams of variable depth to which this formula does not apply special provision must be made for the end anchorage of all tensile reinforcement.

2. Ordinary Anchorage of Longitudinal Steel for Normal Bond Stresses. In restrained or continuous beams the negative tensile reinforcement shall extend into or through the supporting member in such a manner as to develop the maximum tension in the bar with a normal bond stress. Within any such span every reinforcing bar shall extend at least twelve diameters beyond the point at which it is no longer needed to resist stress. One-fourth of the area of the positive reinforcement in any such span shall extend at least twelve diameters into the support.

In simply supported beams and the freely supported ends of continuous beams, one-half of the area of the positive reinforcement shall extend at least twelve diameters into the support.

3. Special Anchorage of Longitudinal Steel for High Bond Stresses. Tests show that special anchorage is equivalent to increased bond resistance. Consequently, with special anchorage higher bond stresses may be allowed than

could be permitted for unanchored reinforcement. Since resistance to diagonal tension failure is primarily a function of bond resistance, increased shearing stresses are also permissible when special precautions are taken to prevent slipping of the reinforcement.

When these higher stresses are used, all of the longitudinal bars shall be provided with special anchorage except those which are bent across the web at an angle not less than 15 degrees with the neutral plane and made continuous with the reinforcement along the opposite face of the beam.

Special anchorage, being a device to provide for increased bond and shearing stress, shall be limited to a maximum stress of 10,000 lbs. per sq. in. in the bar so anchored. This special anchorage may be an extension of the bar or a hook. In either case the additional length of bar shall provide the needed anchorage by normal bond stress, assumed to be uniformly distributed over the additional embedded surface. A properly dimensioned hook is one in which the bar is bent in a full semi-circle, with a radius of bend not less than three diameters, plus an extension at the free end of at least four bar diameters. Right angle or other abrupt bends, which do not engage a structural steel member, are not to be considered as anchorage unless the radius of the bend is at least four bar diameters and the total length from beginning of the bend to the free end of the bar is at least sixteen bar diameters.

4. Anchorage of Web Reinforcement. The stress in web reinforcement shall not exceed the capacity of its anchorage in the upper or lower one-half of the effective depth of the beam. Web reinforcement which is provided by bending into an inclined position one or more longitudinal bars where not required to resist bending, may be considered completely anchored by continuity with the main tensile reinforcement, or by embedment of the requisite length in the upper or lower half of the beam. Hooks may be substituted for a portion of such embedment.

Stirrups shall be anchored at both ends by one of the following methods, or by a combination thereof:

a. Rigid attachment, as by welding, to the main longitudinal reinforcement.

b. Bending around a longitudinal rod in the form of a U-shaped stirrup or hook.

c. A hook placed as close to the upper or lower surface of the beam as the requirements of fire and rust protection will permit. The stress developed by bond between the mid-depth of the beam and the center of the hook may be added to the capacity of the hook.

d. An adequate length of embedment in the upper or lower one-half of the depth of the beam, whether straight or bent. Anchorage of this type alone shall not be relied on for stirrups in cases where the shearing stress in the web exceeds $0.06\ f'_c$.

Order 5319. Columns.

1. Limiting Dimensions. The following sections apply to a short column, for which the unsupported height is not greater than 10 times the least lateral dimension. When the unsupported height exceeds this value the design shall be modified as shown in Order 5319–4. The unsupported height may be defined as the distance from the bottom of a slab, column capital, or beam to the top of the floor below. Principal columns in buildings shall have a minimum diameter or thickness of 10 inches. Posts, bearing walls, piers, or mullions that are not continuous from story to story shall have a minimum diameter or thickness of 6 inches.

2. Spiral Columns. The maximum allowable axial load on columns reinforced with longitudinal bars and closely spaced spirals enclosing a circular core shall be as follows:

$$P = A_c\ (0.30\ f'_c + p_c\ f_s)$$

in which the vertical steel $p_c = 0.02$ to 0.08,

the spiral steel $p' = \dfrac{f'_c}{400{,}000} + \dfrac{p_c}{10}$, and

A_c is the area within the outer circumference of the spiral hooping.

The minimum number of vertical bars shall be six, and the minimum diameter of bar shall be $\frac{5}{8}$ inch. Spirals shall be at least $\frac{1}{4}$ inch in diameter and shall not be spaced less than $1\frac{1}{2}$ inches nor more than 3 inches apart.

3. Tied Columns. The maximum allowable axial load on columns reinforced with longitudinal bars and separate lateral ties shall be as follows:

$P = A_g\ (0.18\ f'_c + 0.70\ p_g\ f_s)$

in which the vertical steel $p_g = 0.01$ to 0.04, and

A_g is the gross area of the column section.

The minimum number of vertical bars shall be four, and the minimum diameter of bar shall be ⅜ inch. Lateral ties shall be at least ¼ inch in diameter and shall be spaced apart not over 16 bar diameters, 48 tie diameters, or the least dimension of the column. When there are more than four vertical bars, additional ties shall be provided so that every longitudinal bar is held firmly in its designed position.

4. Long Columns. The maximum allowable load P' on an axially loaded reinforced concrete column having a height, h, greater than 10 times its least lateral dimension, d, is given by the formula:

$$P' = P\left[1.3 - .03\ \frac{h}{d}\right]$$

in which P = the allowable axial load on a normal short column.

5. Bending Moments in Columns. Columns in building frames shall be designed to resist the maximum moments and shears produced by dead load, live load, and wind load, as determined by some approximate method of elastic frame analysis. Assumptions as to relative rigidity of columns and floor members shall be consistent throughout and agree with the methods used in the analysis of floor members. Recognized methods of analysis shall be followed in calculating the stresses due to combined axial load and bending. The gross area of both spiral and tied columns may be used in these computations.

Order 5320. Plain and Reinforced Concrete Walls and Piers.

1. Definitions. Plain concrete shall be defined as that which is reinforced with less than 0.0025 times the cross-sectional area of the wall, either vertically or horizontally.

2. Thickness. The thickness of walls built of concrete having a 28-day compressive strength of 2000 lbs. per sq. in. or better may be 20 per cent less than that of other forms of masonry walls.

Exterior basement walls of either plain or reinforced concrete shall be not less than 8 inches thick.

3. Working Stresses. The allowable working stresses in reinforced concrete bearing walls with minimum reinforcement specified above shall be $0.25\ f'_c$ for walls having a ratio of height to thickness of 10 or less, and shall be reduced proportionately to $0.15\ f'_c$ for walls having a ratio of height to thickness of 25. When the reinforcement in bearing walls is designed, placed, tied, and anchored in position as for tied columns, the allowable working stresses for tied columns may be used. The length of wall to be considered effective for each concentrated load shall not exceed the width of the bearing plus four times the wall thickness nor shall it exceed the center to center distance between loads.

4. Non-Bearing Walls. Non-bearing panel and enclosure walls of reinforced concrete shall have a thickness of not less than 5 inches and not less than one-thirtieth the distance between the supporting or enclosing members.

Order 5321. Footings.

1. Bending Moment. The external moment on any section shall be determined by passing through the section a vertical plane which extends completely across the footing, and computing the moment of the forces acting over the entire area of the footing on one side of said plane.

The greatest bending moment to be used in the design of an isolated footing shall be the moment computed in the manner just described at sections located as follows:

a. At the face of the column, pedestal or wall, for footings supporting a concrete column, pedestal or wall.

b. Halfway between the middle and the edge of the wall, for footings under masonry walls.

c. Halfway between the face of the column or pedestal and the edge of the metallic base, for footings under metallic bases.

The width resisting compression at any section shall be assumed as the entire width of the top of the footing at the section under consideration.

In one-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to the bending moment and the reinforcement thus determined shall be distributed uniformly across the full width of the section.

In two-way reinforced footings, the total tensile reinforcement at any section shall provide a moment of resistance at least equal to eighty-five per cent of the bending moment.

In two-way square footings, the reinforcement extending in each direction shall be distributed uniformly across the full width of the footing.

In two-way rectangular footings, the reinforcement in the long direction shall be distributed uniformly across the full width of the footing. In the case of the reinforcement in the short direction, that portion determined by the following formula shall be uniformly distributed across a band-width (B) centered with respect to the center line of the column or pedestal and having a width equal to the length of the short side of the footing. The remainder of the reinforcement shall be uniformly distributed in the outer portions of the footing.

$$\frac{\text{Reinforcement in band-width } (B)}{\text{Total reinforcement in short dimension}} = \frac{2}{(S+1)}$$

In this formula, "S" is the ratio of the long side to the short side of the footing.

2. Anchorage of Bars in Footing Slabs. All bars in footing slabs shall be anchored by means of standard hooks. The outer faces of these hooks shall be not less than three inches nor more than six inches from the face of the footing.

3. Shear and Bond. The critical section for shear to be used as a measure of diagonal tension shall be assumed as a vertical section obtained by passing a series of vertical planes through the footing, each of which is parallel to a corresponding face of the column, pedestal, or wall and located a distance therefrom equal to the effective depth for footings on soil, and one-half the effective depth for footings on piles.

Each face of the critical section as defined above shall be considered as resisting an external shear equal to the load on an area bounded by said face of the critical section for shear, two diagonal lines drawn from the column or pedestal corners and making 45 degree angles with the principal axes of the footing, and that portion of the corresponding edge or edges of the footing intercepted between the two diagonals.

Critical sections for bond shall be assumed at the same planes as those prescribed for bending moment; also at all other vertical planes where changes of section or of reinforcement occur.

Computations for shear to be used as a measure of bond shall be based on the same section and loading as prescribed for bending moment.

The total tensile reinforcement at any section shall provide a bond resistance at least equal to the bond requirement as computed from the following percentages of the external shear at the section:

a. In one-way reinforced footings, 100 per cent.

b. In two-way reinforced footings, 85 per cent.

In computing the external shear on any section through a footing supported on piles, the entire reaction from any pile whose center is located six inches or more outside the section shall be assumed as producing shear on the section; the reaction from any pile whose center is located six inches or more inside the section shall be assumed as producing no shear on the section. For intermediate positions of the pile center, the portion of the pile reaction to be assumed as producing shear on the section shall be based on straight-line interpolation between full value at six inches outside the section and zero value at six inches inside the section.

4. Transfer of Stress at Base of Column. The stress in the longitudinal reinforcement of a column or pedestal shall be transferred to its supporting pedestal or footing either by extending the longitudinal bars into the supporting member, or by dowels.

In case the transfer of stress in the reinforcement is accomplished by extension of the longitudinal bars, they shall extend into the supporting member the distance re-

quired to transfer to the concrete, by allowable bond stress, their full working value.

In cases where dowels are used, their total sectional area shall be not less than the sectional area of the longitudinal reinforcement in the member from which the stress is being transferred. In no case shall the number of dowels per ber be less than four and the diameter of the dowels not exceed the diameter of the column bars by more n one-eighth inch.

Dowels shall extend up into the column or pedestal a distance at least equal to that required for lap of longitudinal column bars and down into the supporting pedestal or footing the distance required to transfer to the concrete, by allowable bond stress, the full working value of the dowel.

The compressive stress in the concrete at the base of a column or pedestal shall be considered as being transferred by bearing to the top of the supporting pedestal or footing. The unit compressive stress on the loaded area shall not exceed the bearing stress allowable for the quality of concrete in the supporting member as limited by the ratio of the loaded area to the supporting area.

In sloped or stepped footings, the supporting area for bearing may be taken as the top horizontal surface of the footing, or assumed as the area of the lower base of the largest frustum of a pyramid or cone contained wholly within the footing and having for its upper base the area actually loaded, and having side slopes of one vertical to two horizontal.

5. Pedestals and Footings (Plain Concrete). The allowable compressive unit stress on the gross area of a concentrically loaded pedestal shall not exceed $0.25\ f'_c$. Where this stress is exceeded, reinforcement shall be provided and the member designed as a reinforced concrete column.

The depth and width of a pedestal or footing of plain concrete shall be such that the tension in the concrete shall not exceed $.03\ f'_c$, and the average shearing stress shall not exceed $.02\ f'_c$ taken on sections as prescribed heretofore for reinforced concrete footings.

6. Footings Supporting Round Columns. In computing the stresses in footings which support a round or octagonal concrete column or pedestal, the "face" of the column or pedestal shall be taken as the side of a square having an area equal to the area enclosed within the perimeter of the column or pedestal.

7. Minimum Edge-Thickness. In reinforced concrete footings, the thickness above the reinforcement at the edge shall be not less than six inches for footings on soil, nor less than twelve inches for footings on piles.

In plain concrete footings, the thickness at the edge shall be not less than eight inches for footings on soil, nor less than fourteen inches above the tops of the piles for footings on piles.

Order 5322. Allowable Working Stresses.

1. Concrete Strength. The strength of concrete is fixed by the water-content as described in Order 5315–3. Reinforced concrete used under this code shall have a compressive strength of at least 2000 lbs. per sq. in., and no credit shall be given for strengths in excess of 3000 lbs. per sq. in.

2. Modular Ratio. The modular ratio, n, shall be assumed equal to $\frac{30{,}000}{f'_c}$.

3. Allowable Unit Stresses in Concrete.

Flexure:	
Extreme fiber stress in compression	
Positive moment at mid-span	$f_c = 0.40\ f'_c$
Negative moment near supports	$f_c = 0.45\ f'_c$
Extreme fiber in tension	
For plain concrete footings only	$f_t = 0.03\ f'_c$
Shear:	
Beams without web reinforcement and without special anchorage of longitudinal steel	$v_c = 0.02\ f'_c$
Beams without web reinforcement but with special anchorage of longitudinal steel	$v_c = 0.03\ f'_c$
Three times these shear values may be used when beams are provided with properly designed web reinforcement.	
Flat slabs at distance, d, from edge of column capital, or drop panel	$v_c = 0.03\ f'_c$
Footings with hooked rods	$v_c = 0.03\ f'_c$

Bond (Plain rods):
Beams and slabs ..... $u = 0.04\ f'_c$
One-way footings with hooked rods ..... $u = 0.06\ f'_c$
Two-way footings with hooked rods ..... $u = 0.45\ f'_c$

Bond (Deformed rods):
Beams and slabs ..... $u = 0.05\ f'_c$
One-way footings with hooked rods ..... $u = 0.075\ f'_c$
Two-way footings with hooked rods ..... $u = 0.056\ f'_c$

Bearing:
Walls, piers, pilasters, and pedestals (maximum) (See Order 5320–3) ..... $f_c = 0.25\ f'_c$

Columns (See Order 5319)

4. Allowable Unit Stresses in Reinforcement.

Tension in Longitudinal Steel:
Structural grade steel rods ..... $f_s = 18{,}000$
Intermediate grade and hard grade steel rods (Billet steel, rail steel, or axle steel) ..... $f_s = 20{,}000$

Tension in Web Reinforcement:
All grades of steel ..... $f_s = 16{,}000$

Compression in Column Verticals:
Intermediate grade steel rods ..... $f_s = 16{,}000$
Hard grade steel rods (Billet steel, rail steel, or axle steel) ..... $f_s = 20{,}000$

Note: The symbols and notation used in the above formulas are defined as follows:

f'_c = ultimate compressive strength of concrete at age of 28 days.
f_c = compressive unit stress in extreme fibre of concrete in flexure or axial compression in concrete in columns.
f_t = tensile unit stress in extreme fibre of concrete.
v_c = unit shearing stress in concrete.
u = bond stress per unit area of surface of bar.
f_s = tensile unit stress in reinforcement.

Order 5323. Reinforced Gypsum Concrete.

1. Materials.

(a) The term "gypsum" as used in this Chapter shall mean calcined gypsum manufactured from gypsum meeting the requirements of the American Society for Testing Materials' Standard Specifications for Gypsum C22–25, (American Standard A49.1–1933).

(b) Gypsum concrete shall consist of a mixture of gypsum and water, with or without wood chips, fiber or other approved aggregate.

(c) Precast gypsum concrete shall contain not more than three per cent and cast-in-place gypsum concrete not more than twelve and one-half per cent of wood chips, shavings, or fiber measured as a percentage by weight of the dry mix.

(d) Wood chips, shavings, or fiber used in gypsum concrete shall be dry, soft wood, uniform and clean in appearance. They shall pass a 1-inch screen and shall be not more than $\frac{1}{16}$ inch in thickness.

(e) Steel bar and wire reinforcing shall meet the requirements of Order 5314–4.

2. Minimum Thickness.

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

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

3. Design.

(a) Reinforced gypsum concrete shall be designed by methods admitting of rational analysis according to established principles of mechanics, to support the loads and withstand the forces to which it is subject without exceeding the stresses allowed in this chapter for the materials thereof except as hereinafter provided. The general assumptions and principles established for reinforced concrete shall also apply to reinforced gypsum concrete insofar as they are pertinent.

(b) For precast gypsum structural units which can not be analyzed in accordance with established principles of mechanics, the safe uniformly distributed carrying capacity shall be taken as one-fifth of the total load causing failure in a full size test panel with the load applied along two lines each distant one-fourth of the clear span from the support.

(c) Reinforced gypsum concrete shall not be used where exposed directly to the weather or where subjected to frequent or continuous wetting.

4. Strength.

(a) Gypsum concrete shall be classified according to mixture, and concrete of each class shall have a minimum strength in compression as follows:

Class 1	Neat (Containing gypsum and water only)	1800 lbs. per sq. in.
Class 2	Containing not more than three per cent by weight of wood chips or fiber	1000 lbs. per sq. in.
Class 3	Containing not more than twelve and one-half per cent by weight of wood chips or fiber	500 lbs. per sq. in.

(b) The strength of gypsum concrete shall be determined by compressive tests of five cylinders, 6 inches in diameter and 12 inches in length, from each 25 tons or fraction thereof. The test specimens shall be dried at a temperature of not less than 70 degrees Fahrenheit nor more than 100 degrees Fahrenheit in an atmosphere of not more than 50 per cent relative humidity. The specimens shall be weighed at 1-day intervals until constant weight is attained. The method of testing and application of load shall be in accordance with the requirements specified in Sections 19 and 20 of Standard Methods of Making Compression Tests of Concrete, A.S.T.M. C39–39. The average of the five specimens shall not fall below the specified minimum and in no case shall any specimen show a strength of less than 80 per cent of the specified minimum.

5. Modulus of Elasticity.

(a) In the design of structural members of reinforced gypsum concrete the following values shall be used for the modulus of elasticity:

Class 1	Neat	1,000,000 lbs. per sq. in.
Class 2	Containing not more than three per cent by weight of wood chips or fiber	600,000 lbs. per sq. in.
Class 3	Containing not more than twelve and one-half per cent by weight of wood chips or fiber	200,000 lbs. per sq. in.

6. Allowable Stresses.

(a) In the design of structural members of reinforced gypsum concrete the stresses in the concrete shall not exceed the following allowable values:

Compressive stress in bending	$0.25f_g$
Axial compressive or bearing stress	$0.20f_g$
Bond stress (reinforcement anchored)	$0.02f_g$
Shearing stress (reinforcement anchored)	$0.02f_g$

In this table (f_g) indicates the compressive strength of the gypsum concrete as specified in Section 4.

(b) The tensile stresses in reinforcing steel shall be as specified for reinforced concrete made with Portland cement.

7. Suspension System. In the construction of floors or other slabs the reinforcing shall consist of wires with continuity through multiple spans and anchored at the ends. The wires shall be supported in the top of the slab by the roof or floor beams and shall be tightly drawn down as nearly to the bottom of the slab at mid-span as fire protection requirements will allow. Provision shall be made in the framing of the end bays of this system for resisting the forces due to end anchorage of the wires. The wires shall be designed for a tension in pounds per foot width of slab equal to:

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

in which

w is the total load in lbs. per sq. ft.
L is the clear span in feet
d is the sag of the wires in feet

SECTION 4. STEEL AND IRON CONSTRUCTION.

Order 5324. Structural Steel.

1. Material. Structural steel shall be of such quality as to conform to the "Standard Specifications for Steel for Bridges and Buildings" (A.S.T.M. Serial Designation: A7–39).

2. Design Assumptions. Ordinarily beams, girders and trusses shall be designed on the basis of simple spans whose effective length is equal to the distance between centers of gravity of the members to which they deliver their end reactions.

When beams, girders and trusses are designed on the assumption of end restraint, full or partial, based on continuous or cantilever action, the columns or other members

to which they connect, shall be designed to carry the shears and moments so introduced, in addition to all other forces, without exceeding the allowable unit working stresses at any point.

3. Allowable Unit Stresses. All parts of the structure shall be so proportioned that the sum of the maximum static stresses in pounds per sq. in. shall not exceed the following:

Tension	
Rolled Steel, on net section	20,000
Rivets, on area based on nominal diameter	15,000
Compression	
Axially loaded columns, gross section $\frac{18{,}000}{1+\frac{l^2}{18{,}000\,r^2}}$	
With a maximum value of	15,000
in which l is the unbraced length of the columns, and r is the corresponding radius of gyration of the section, both in inches.	
For main compression members, $\frac{l}{r}$ shall not exceed 120.	
For bracing and other secondary members, $\frac{l}{r}$ shall not exceed 200.	
Bending	
Tension on extreme fibers of net sections of rolled shapes, plate girders, and built-up members	20,000
Compression on extreme fibers of gross sections of rolled shapes, plate girders, and built-up members, for values of $\frac{l}{b}$ not greater than 40 $\frac{22{,}500}{1+\frac{l^2}{1800\,b^2}}$	
With a maximum value of	20,000
in which l is the laterally unsupported length of the member, and b is the width of the compression flange, both in inches.	
Stress on extreme fibers of pins	30,000
Shearing	
Rivets, pins, and turned bolts in reamed or drilled holes	15,000
Unfinished bolts	10,000

Gross area of webs of beams and girders where h the clear distance between flanges in inches is not more than 60 times t, the thickness of the web in inches	12,000
Gross area of the webs of beams and girders if the web is not stiffened where h is more than 60 times t, the greatest average shear per square inch $\frac{V}{A}$, shall not exceed $\frac{18{,}000}{1+\frac{h^2}{7200\,t^2}}$	
in which V is the total shear, and A is the gross area of the web in square inches.	

Bearing	Double Shear	Single Shear
Rivets, pins, and turned bolts in reamed or drilled holes	30,000	24,000
Unfinished bolts	20,000	16,000
Expansion roller bearing per linear inch 600 times the diameter of the roller in inches		

4. Beams and Girders.

(a) Rolled beams shall be proportioned by the moment of inertia of their net section. Plate girders with webs fully spliced for tension and compression shall be so proportioned that the unit stress on the net section does not exceed the stresses specified in Section 5 as determined by the moment of inertia of the net section.

(b) Plate girder webs shall have a thickness of not less than 1/160 of the unsupported distance between the flanges.

(c) Web splices shall consist of plates on each side of the web capable of transmitting the full stress through the splice connections.

(d) Stiffeners. Stiffeners shall be required on the webs of rolled beams and plate girders at the ends, and at points of concentrated loads, and at other points where h, the clear distance between flanges, is greater than $85\ t\ \sqrt{18000\ (A/V-1)}$, in which t is the thickness of the web. When stiffeners are required, the distance in inches between them shall not be greater than $85\ t\ \sqrt{18000\ (A/V-1)}$, or not greater than 6 feet. When

h is greater than 60 times t, the thickness of the web of a plate girder, stiffeners shall be required at distances not greater than 6 feet apart. Stiffeners under or over concentrated loads shall be proportioned to distribute such loads into the web.

Plate girder stiffeners shall generally be in pairs, one on each side of the web, and shall have a close bearing against the flange angles at points of concentrated loading; stiffeners over the end bearings shall be on plate fillers. The pitch of rivets in stiffeners shall not exceed 6 inches.

(e) Flange plates of all girders shall be limited in width so as not to extend more than 6 inches or more than 12 times the thickness of thinnest plate beyond the outer row of rivets connecting them to the angles.

(f) Crane runway girders and the supporting framework shall be proportioned to resist the greatest horizontal stresses caused by the operation of the cranes.

(g) Rivets connecting the flanges to the web at points of direct load on the flange between stiffeners shall be proportioned to carry the resultant of the longitudinal and transverse shears.

(h) Rivets connecting the flanges to the webs of plate girders and of columns subjected to bending shall be so spaced as to carry the increment of the flange stress between the rivets.

5. Column Bases and Anchor Bolts.

(a) Loads. Proper provision shall be made to transfer the column loads, and moments if any, to the footings and foundations.

(b) Alignment. Column bases shall be set level and to correct elevation with full bearing on the masonry.

(c) Finishing. Column bases shall be finished to accord with the following requirements:

1. Rolled steel bearing plates, 2 inches or less in thickness, may be used without planing, provided a satisfactory contact bearing is obtained; rolled steel bearing plates, over 2 inches, but 4 inches or less in thickness, may be straightened by pressing (planed on all bearing surfaces if presses are not available) to obtain a satisfactory contact bearing; rolled steel bearing plates, over 4 inches in thickness, shall be planed on all bearing surfaces (except as noted under 3).

2. Column bases other than rolled steel bearing plates shall be planed on all bearing surfaces (except as noted under 3).

3. The bottom surfaces of bearing plates and column bases which rest on masonry foundations and are grouted to insure full bearing contact need not be planed.

(d) Anchor Bolts. Anchor bolts shall be of sufficient size and number to develop the computed stress.

6. Minimum Thickness of Material.

(a) Main Material. The minimum thickness of steel except for linings, fillers, and the webs of rolled beams and channels, shall be: for exterior construction—$\frac{5}{16}$ inch; for interior construction—$\frac{1}{4}$ inch. (These provisions do not apply to light structures such as skylights, marques, fire escapes, or light miscellaneous steel work.)

(b) Gusset Plates. Gusset plates for trusses with end reactions greater than 35,000 pounds shall be not less than $\frac{3}{8}$ inch thick.

(c) Angles. The widths of the outstanding legs of angles in compression (except where reinforced by plates) shall not exceed 12 times the thickness for girder flanges and 16 times the thickness for other members.

(d) Compression Members. In compression members consisting of segments connected by cover plates or lacing, or segments connected by webs, the thickness of the webs of the segments shall be not less than $\frac{1}{42}$ of the unsupported distance between the nearest rivet lines, or the roots of the flanges in case of rolled sections. The thickness of the cover plates or webs connecting the segments shall be not less than 1/40 of the unsupported distance between the nearest lines of their connecting rivets, or the roots of their flanges in case of rolled sections.

(e) Corrosion. Provision shall be made for parts subject to corrosive agents, either by increasing the thickness of material or by effective protection.

7. Welded Connections. Unless otherwise indicated by the designer, all connections shall be designed as flexible. They shall permit the ends of the beam to rotate sufficiently to accommodate its deflection by providing for a horizontal

displacement of the top flange as determined by the following formula:

$e = \frac{SL}{3{,}625{,}000}$, in which e = the horizontal displacement between the top and bottom of the beam at its end in inches, S = the flexural unit stress in the beam at mid-span, lb. per sq. in., and L = the span of the beam in feet.

Special care is necessary when welding at temperatures below 25 degrees Fahrenheit in order to avoid poor workmanship, under chilling, large residual stresses, and undue cracking, local preheating of the base metal shall be avoided and the welding operation shall be protected from too rapid cooling caused by strong winds.

The size of fillet welds should be selected with regard to the inherent efficiency of small welds, the necessity of making connections in small space and the limitations of welding technique. Practical evaluation of these factors has established the ¼ inch and the $\frac{5}{16}$ inch fillet welds as standard sizes for structural welding.

All welding shall be done by skilled workmen who shall give satisfactory proof of their skill and ability with the process to be used on the proposed work.

Welded joints shall be proportional so that the stresses caused therein shall not exceed the following values:

Shear on section through weld throat	11,300
Tension on section through weld throat	13,000
Compression on section through throat of butt weld	18,000

Fiber stresses due to bending shall not exceed the values prescribed above for tension and compression, respectively. Stress in a fillet weld shall be considered as shear, for any direction of the applied stress.

In designing welded joints, adequate provision shall be made for bending stresses due to eccentricity, if any, in the disposition or sections of base metal parts.

8. Shop Painting.

(a) Shop Coat. Before leaving the shop, all steel work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter. Except where encased in concrete, all steel work shall be given one coat of approved metal protection, applied thoroughly and evenly and well worked into the joints and other open spaces. All paint shall be applied to dry surfaces.

(b) Inaccessible Parts. Parts inaccessible after assembly shall be given two coats of shop paint of different colors.

(c) Contact Surfaces. Contact surfaces shall be cleaned, by effective means, before assembly, but not painted.

(d) Finished Surfaces. Machine finished surfaces shall be protected against corrosion by a suitable coating.

9. Erection.

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

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

(c) Erection Stresses. Wherever piles of material, erection equipment or other loads are carried during erection, proper provision shall be made to take care of stresses resulting from the same.

(d) Alignment. No riveting shall be done until the structure has been properly aligned.

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

(f) Turned Bolts. Holes for turned bolts to be inserted in the field shall be reamed in the field.

(g) Field Painting. All field rivets and bolts, also all serious abrasions to the shop coat, shall be spot painted with the material used for the shop coat, or an equivalent, and all mud and other firmly attached and objectionable foreign materials shall be removed, before general field painting.

Responsibility for this touch-up and cleaning, as well as for general field painting, shall be allocated in accordance

with accepted local practices and this allocation shall be set forth explicitly in the contract.

Order 5325. Steel Joist Construction.

1. Definition. Steel joist construction shall consist of decks or top slabs defined in Order 5325–7 supported by separate steel members referred to as steel joists. Any steel member suitable for supporting floors and roofs between the main supporting girders, trusses, beams, or walls when used as hereinafter stipulated shall be known as a "steel joist". Such steel joists may be made of hot or cold formed sections, strip or sheet steel, riveted or welded together, or by expanding.

2. Limits of Span and Spacing. The span of steel joists shall not exceed 24 times the depth of the steel portion of the steel joist. The span of open web steel joists shall not exceed 550 times the least radius of gyration of the top chord around a vertical axis, and in case the top chord consists of a flat top section continuous with a center web, the radius of gyration of the top plate alone shall be taken.

The spacing of steel joists shall not exceed 24 inches on centers for floors nor 30 inches on centers for roofs, except when used to support steel or wood roof decks. In no case shall the spacing exceed the safe span of the top slab, deck, or flooring over the said joists.

Where these spans or spacings are exceeded the requirements for steel joist construction shall not apply, but the steel members shall be designed in accordance with the requirements of Order 5324.

3. Materials. All steel used shall conform to the "Standard Specifications for Steel for Bridges and Buildings" (A.S.T.M. Serial Designation: A7–39). All steel joists shall receive one coat of asphalt base paint applied by dipping or spraying, or an equivalent protective covering, before leaving the shop.

4. Design of Steel Joists. An open web steel joist built up of bars or other sections, or one fabricated by expanding a rolled section, shall be designed as a truss. The compressive stress in chord members and diagonals of the joist shall not exceed those given in Order 5324–3, for main members. The tensile stress shall not exceed 18000 pounds per square inch in any member. The minimum shear to be used in designing the web members at any point in an open web steel joist shall not be less than 50 per cent of the required maximum end reaction for such steel joist.

A solid web steel joist shall be designed as a beam in accordance with the requirements of Order 5324–3, except that the basic working stress shall not exceed 18000 pounds per square inch.

In the completed structure, the top chords of open web steel joists or the top flanges of solid web steel joists may be considered as being stayed laterally when the deck or top slab over the steel joists complies with the provisions of Order 5325–7.

All joints and connections of an open web steel joist shall be capable of withstanding a load at least 3 times the designed load and shall be sufficiently rugged to resist the stresses incident to transportation and erection when handled in a reasonable manner.

All elements of an open web joist shall have their lines of center of gravity meet at a point if practicable; if not, stresses arising from eccentricity shall be included with other stresses in designing these elements.

Ends of steel joists shall be designed to resist the bending produced by the eccentricity of the reaction at the support.

5. Erection. The ends of steel joists shall extend a distance of at least 4 inches onto masonry or reinforced concrete supports and at least 2½ inches on steel supports. Every third steel joist on concrete or masonry supports shall be anchored thereto with an anchor equivalent to a ⅜ inch round. The ends of all steel joists supported on masonry walls shall be bedded in mortar. All steel joists supported on steel beams shall be secured thereto with an anchor made of not less than a ⅞ inch bar fastened over the flanges of the supporting beams.

During the construction period, care shall be exercised to prevent excessive concentrated or moving loads. The construction contractor shall provide for adequate distribution of such loads so that the carrying capacity of any steel joist is not exceeded during that period. When erected and bridged, the total concentrated load on any one steel joist

shall not exceed 800 pounds and in the case of open web steel joists, such concentrated load shall not be imposed between panel points.

6. Bridging. As soon as steel joists have been erected, bridging shall be installed between them before the application of construction loads. This bridging shall be adequate to safely support the top chords or flanges against lateral ...ment during the construction period and shall hold the ... joists in a vertical plane passing through the bearings. ... steel joists at the ends of panels shall be braced laterally by anchors or ties at each line of bridging. If diagonal bridging is used in which all diagonal members will resist only tension, they shall not be less than a $\frac{1}{4}$ inch round rod, and these diagonals shall be supplemented by a continuous strut adequately attached to the top chords or flanges of all steel joists so bridged. This top strut shall be equivalent as a strut to a ½ inch round steel bar. If diagonal members are used which are capable of resisting both tension and compression, the top strut may be omitted. In case bridging in the form of horizontally placed beam or angle sections is provided, it must be so connected to the steel joists that it will support the top chords or flanges against lateral movement and hold the steel joists in a vertical plane. Fourteen gauge wire diagonals shall be used to secure the bottom chords or flanges at each line of bridging of this type. Wire may be omitted when bridging which restrains both top and bottom chords or flanges is used. When the spacing of steel joists exceeds 30 inches on centers in roofs, sag rods may be used in lieu of any of the above types of bridging. Rows of bridging shall be not more than 7 feet apart, or more than 7 feet from supports.

7. Decks and Top Slabs. Decks or top slabs over steel joists may be of concrete or gypsum poured on metal lath centering attached to the top chords or flanges of steel joists as required elsewhere in this section or on removable centering provided the top chords or flanges of the steel joists are properly stayed by the concrete or gypsum slab. Other equally suitable permanent centering may be used, provided it is substantially attached to the top chords or flanges as required elsewhere in this section and provided these attachments (or the centering itself) are securely anchored into the concrete or gypsum slab. Precast concrete or precast gypsum slabs when securely attached to the top chords or flanges and anchored thereto and brought to a firm bearing, wood decks as stipulated below, and corrugated or other steel roof decks securely anchored to the top chords or flanges may be used over steel joists. Any attachment or pair of attachments when applied shall be capable of staying the top chord or flange laterally in both directions and in the case of open web steel joists, shall be spaced not farther apart than the panel point spacing. Decks or top slabs over steel joists shall not be assumed to carry any part of the compression stress in the steel joist.

Flat wood decks of single thickness of one inch nominal material shall not have a span of more than 20 inches for floors, or 30 inches for roofs. All such decks shall be securely fastened to the wood nailer strips.

Poured structural slabs of concrete, gypsum or other similar material shall not be less than 2 inches thick. They shall be poured upon ⅜ inch ribbed metal lath weighing not less than 4 pounds per square yard for spans not exceeding 24 inches and upon ¾ inch rib lath weighing not less than 4.5 pounds per square yard for spans not exceeding 30 inches. Other material equally suitable as a form or centering for casting concrete or gypsum slabs may be used in place of rib lath. Rib lath or other centering which remains in place shall be substantially attached to the top chord or flange of each steel joist at intervals of not over 8 inches. Such slabs shall be reinforced with mesh or rods, in addition to the rib lath, except that when slabs are to be covered with a wood strip top floor, the rib lath or centering may, if adequate, serve also as the reinforcement.

Any material used as centering for the top slab shall be installed so as not to exert an undue lateral pull on the top chords or flanges of the steel joists.

Order 5326. Wrought Iron.

The requirements for design, fabrication and erection of steel for buildings and structures under Order 5324 shall apply to wrought iron, except that the following stresses in pounds per square inch shall not be exceeded:

Tension on net section	12,000
Compression, on short lengths or where lateral deflection is prevented, on gross section of columns	10,000

$$12{,}000 - 60\frac{L}{r}$$

in which L = length in inches
r = radius of gyration in inches

Bending. On extreme fibres if lateral deflection is prevented	12,000

Wrought iron shall conform to the Standard Specifications for Refined Wrought Iron Plates, Serial Designation A42–18.

Order 5327. Cast Iron.

The following unit stresses in pounds per square inch shall not be exceeded in cast iron:

Tension on net section	0
Compression, on short lengths or where lateral deflection is prevented, on gross section of columns	10,000

$$10{,}000 - 40\frac{L}{r}$$

in which L = length in inches
r = radius of gyration in inches

Tension in the extreme fibre if lateral deflection is prevented	3,000

The material and workmanship of cast iron members shall be equal in all respects to that described in the American Society for Testing Materials Specifications for Gray-Iron Castings, Serial Designation A48–29.

All columns resting on, or supporting, other columns shall have their ends machine faced to a plane surface perpendicular to the axis.

SECTION 5. WOOD CONSTRUCTION.

Order 5328. Wood Construction.

1. Quality of Material. The quality and design of all wood used in the construction of all buildings and structures or parts thereof, shall conform to the minimum standards under this section.

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

All wood structural members shall be of sufficient quality, size, and strength, as to carry their imposed loads safely and without exceeding the allowable working stresses as specified in this order.

The requirements stated are a minimum standard and apply primarily to conventional types of construction.

The substitution of materials other than those called for in the code will be permitted when shown by an approved authority to be equal to or better than those specified.

Workmanship in fabrication, preparation, installation, joining of wood members and the connectors and mechanical devices for the fastening thereof, shall conform throughout to good engineering practice.

Where wood is used in parts of a building or structure habitually exposed to moisture, ample ventilation or sufficient preservative treatment, or both, shall be provided.

2. Allowable Working Stresses. In the design and construction of structures and structural members of wood the following unit stresses, in pounds per square inch, shall not be exceeded:

WORKING STRESSES APPLICABLE TO MATERIAL USED UNDER CONTINUOUS DRY ... DITIONS

Species	Commercial Grade Name	Rules Under Which Graded	Allowable Unit Stresses in Pounds per Square Inch for Joists, Planks, Beams and Stringers				
			Tension and Extreme Fibre in Bending	Maximum Horizontal Shear	Compression		Modulus of Elasticity
					Perpendicular to Grain	Parallel to Grain $\frac{L}{D}$ is 10 or less	
Western Red Cedar	Structural	West Coast Lumbermen's Assn. Jan. 1, 1941	1000	100	200	800	1, 000, 000
Southern Cypress	1400 # f Southern Cypress 1100 # f Southern Cypress	Nat'l Hardwood Lumber Assn. Jan. 1, 1941	1400 1100	120 100	300 300	1200 1000	1, 200, 000
Rock Elm	1800 # f Rock Elm 1600 # f Rock Elm 1400 # f Rock Elm 1200 # f Rock Elm	Nat'l Hardwood Lumber Assn. Jan. 1, 1941	1800 1600 1400 1200	120 120 120 100	500 500 500 500	1300 1200 1000	1, 300, 000
Douglas Fir (Coast Region)	Dense Select Structural Select Structural 1200 # f Framing and Joist 900 # f Framing and Joist	West Coast Lumbermen's Assn. Jan. 1, 1941	1800 1600 1200 900	105 90	380 345 325 325	1300 1200 1100 880	1, 600, 000
Douglas Fir (Inland Empire)	Select Structural Structural Common Structural	Western Pine Association April 1, 1939	1800 1600 1200	105 90	380 335 315	1466 1175 1050	1, 600, 000 1, 500, 000 1, 500, 000
Eastern Hemlock (includes Wisconsin Hemlock)	Select Structural 1000 SG Eastern Hemlock 900 SG Eastern Hemlock 800 SG Eastern Hemlock	Northern Hemlock and Hardwood Mfgrs. Assn. June 27, 1941	1100 1000 900 800	70 52 52 52	300 300 300 300	700	1, 100, 000
West Coast Hemlock	No. 1 Dimension	West Coast Lumbermen's Assn. Jan. 1, 1941	1040	100	300	720	1, 400, 000
Oak	1800 # f Oak, Red and White 1600 # f Oak, Red and White 1400 # f Oak, Red and White 1200 # f Oak, Red and White	Nat'l Hardwood Lumber Assn. Jan. 1, 1941	1800 1600 1400 1200	120 120 120 100	500 500 500 500	1100 1000 900	1, 500, 000

WORKING STRESSES APPLICABLE TO MATERIAL USED UNDER CONTINUOUS DRY CONDITIONS—Continued

Species	Commercial Grade Name	Rules Under Which Graded	Allowable Unit Stresses in Pounds per Square Inch for Joists, Planks, Beams and Stringers				
			Tension and Extreme Fibre in Bending	Maximum Horizontal Shear	Compression		Modulus of Elasticity
					Perpendicular to Grain	Parallel to Grain $\frac{L}{D}$ is 10 or less	
Norway Pine	1000 SG Norway Pine 900 SG Norway Pine 800 SG Norway Pine	Northern Hemlock and Hardwood Mfgrs. Assn. June 27, 1941	1000 900 800	64 64 64	300 300 300		1, 200, 000
Southern Pine, Longleaf	Select Structural Prime Structural Merchantable Structural Struct. Sq. Edge and Sound No. 1 Structural No. 1 L. L. Dimension No. 2 L. L.–1050 f Dimension	Southern Pine Inspection, Bureau of Southern Pine Assn. May 28, 1940	2000 1800 1600 1600 1400 1400 1050	100 100 100 100 100 100 100	380 380 380 380 380 380 380	1450 1300 1200 1200 1000	1, 600, 000
Southern Pine, Shortleaf	Dense Select Structural Dense Structural Dense Str. Sq. Edge and Sound Dense #1 Structural No. 1 Dense Dimension No. 1 Dimension No. 2 Dense–1050f Dimension No. 2 Med. Grain–900 f Dim.	Southern Pine Inspection, Bureau of Southern Pine Assn. May 28, 1940	2000 1800 1600 1400 1400 1200 1050 900	100 100 100 100 100 100 100 100	380 380 380 380 380 380 380 380	1450 1300 1200 1000	1, 600, 000
Eastern Spruce	1200 # f Eastern Spruce 1100 # f Eastern Spruce 1000 # f Eastern Spruce	Northeastern Lumber Mfgrs. Assn. April 1, 1938	1200 1100 1000	90 80 80	250 250 250		1, 200, 000

3. Exterior Walls. Walls shall be designed to carry safely not less than the designated wind load (see chapter on Working Stresses) acting inwardly or outwardly combined with the dead load and one-half the full live load, or dead and full live load whichever is the greater.

Anchorage shall be provided to resist safely the vertical ig forces (see note) and to prevent any sliding or over- ing. This shall include not only anchorage to the undation, but also anchorage of the roof to the walls. roper tying of the walls at the corners shall be required.

Note: As a specific basis for design of roofs and anchorage, a suction or vertical lifting force of 20 pounds per square foot shall be used, assuming two-thirds of the dead load is acting to resist the vertical force.

Ledger or ribbon boards used to support joists shall be not less than 1 by 4 inches nominal, shall be recessed into the studs, and securely nailed with not less than two ten penny nails to each stud. The ends of joists adjoining studs shall be securely spiked to the studs.

In bearing walls and partitions no stud shall be cut more than one-third its depth to receive piping and duct work. If more depth is required, the partition studs shall be increased accordingly.

4. Interior Partitions. Walls shall be designed to carry safely the full dead and live loads.

In stud construction the bearing partitions shall be provided at the top with double plates, each at least 2 inches (nominal) thick and of same width as the stud. When the joists are placed directly above each stud, a single top plate may be used. If properly fire stopped, studs may run through the floor and rest on girders or on partition plates.

Partitions not resting upon girders, or of which the studs do not rest on partition plates below, shall have sole plates of dimensions not less than that of the studs.

Partitions unsupported by walls shall be supported on girders or two or more joists, or on sole plates if placed at an angle to the joists.

Non-bearing partitions of stud construction shall be provided with at least one 2 inch plate on top and bottom of same width as stud or be otherwise properly fire stopped at floor lines.

Angles at corners where stud walls or partitions meet shall be framed solid so no lath can extend from one room to another.

Openings in stud partitions and walls shall be framed around with double studs at each side and double headers across the top resting on the short stud at each end. The double header shall be placed on edge and shall be trussed above for all openings over 4 feet in width or where more than two studs are cut away.

Wood lath, furring or framing shall be placed not less than 2 inches from any chimney and not less than 4 inches from the back of any fireplace.

5. Floors Supported on Wooden Framework. When enclosing walls are of wood, each joist, beam, and girder in the wall shall be securely spiked or anchored to the wall construction so as to stay in place and to resist safely all lifts and inward and outward pressures as prescribed in this code.

Girders shall be anchored to the walls and fastened to each other where they intersect or abut to resist safely an outward force equal to the wind pressure.

Floor joists framing into the side of wood girders shall be supported on metal joist hangers or on a bearing strip or ledger board on the side of the girders. Size of ledger shall be at least 2 by 3 inches. The notch in the end of the joist shall be not more than one-fourth of the joist depth.

The ends of joists, whether resting upon girders or bearing partitions or abutted against the girders, shall be securely tied to the girders or to each other so as to resist safely an outward thrust on the walls equal to the required wind pressure, or spreading action of the roof, whichever is the greater.

The top or bottom edges of joists may be notched in the outer one-fourth of the length not to exceed one-sixth of the joist depth. Notching the top or bottom edge of joists will not be permitted in the middle half of the length of any joist.

Header joists over 6 feet long, and tail joists over 12 feet long, shall be hung in approved stirrup irons or joist hangers.

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

Wood cross bridging shall be placed between joists if the ... is over 8 feet. The distance between lines of bridging ...etween bridging and bearing shall not exceed 8 feet. ...ood cross bridging properly fitted and securely nailed to joists shall be not less than 3 square inches in cross sectional area.

Metal cross bridging of equal or greater strength may be used in place of the wood cross bridging.

Solid bridging extending the full height of the joist shall be placed between floor joists which cross bearing partitions. Solid bridging shall be placed between joists at the edge of flooring where the attic space is only partially covered.

6. Fire Stopping. Fire stops shall be provided at all intersections of interior and exterior walls with floors, ceilings and roof in such manner as to effectively cut off communication by fire through hollow concealed spaces and prevent both vertical and horizontal drafts.

Furred walls shall have fire stopping placed immediately above and below the junction of any floor construction with the walls, or shall be fire stopped the full depth of the joist.

All spaces between chimneys and wood framing shall be solidly filled with incombustible material at floor levels.

All fire stopping as required in this section shall be not less than 2 inches in thickness and not less in width than the enclosed space within the partition except as provided for chimneys.

7. Floors Supported on Masonry Walls. Every girder and beam which enters, or rests on, a masonry wall shall have a bearing of at least 4 inches thereon.

Wood members entering masonry party or fire walls shall be separated from the opposite side of the wall and from beams entering the opposite side of the wall by 4 inches of masonry. The ends of the joists, beams and girders shall be splayed or fire-cut to a bevel of not less than 3 inches in their depth.

Where girders and beams enter masonry they shall be provided with wall plates, boxes or anchors of an approved self-releasing type so arranged as to leave an air space of not less than ½ inch at sides and ends of member. The ends of girders shall not be sealed in; provided, that where ends of timbers are pressure treated with creosote or other approved preservative, they may be sealed in.

Anchors for each tier of joists more than 5 feet above grade shall be provided where they enter masonry walls, and also where they are parallel to masonry walls. Such anchors shall be $\frac{3}{16}$ inch by 1¼ inch iron, or equal, not less than 20 inches long, fitted with a ⅜ inch by 6 inch pin at the wall end, and shall be spaced not more than 6 feet apart. The pin shall be placed horizontally in the wall and 4 inches from the opposite face of such wall. Such anchors shall in all cases occur on the opposite ends of the same run of joists, and where the length of joists is less than the distance across a building, the ends of joists shall be lapped and spiked so as to form a continuous tie across the building. Anchors shall be placed across the top of joists that run parallel to the wall, and shall be fastened to the ends of joists below the neutral axis.

8. Wooden Trusses and Built-Up Members. Wood trusses and similar framing shall have all joints accurately cut and fitted together so that each bearing is true and drawn tightly to full bearing.

All wood trusses shall be securely fastened to the supports and each truss shall be secured in position laterally by bracing the top and bottom chords at points not more than 25 feet apart.

All girders and beams built-up of strips, boards or dimension lumber shall be fastened together by glueing, nailing, spiking or bolting in a manner to develop the full strength of the parts. The stiffness of all members, and the strength of all joints, splices and laps, shall be fully developed.

9. Posts and Columns. Wood posts, when used in basements, shall bear on a cement base which shall extend not less than 3 inches above the finish floor. The base shall bear directly on the post footing.

tural framing are of incombustible material, there shall be no area restriction.

No building shall be limited in area when divided into sections which do not exceed the maximum areas tabulated in this order. Such division walls shall have not less than a four-hour fire-resistive rating as specified in Order 5105 and shall extend at least 3 feet above the roof unless the roof is of fire-resistive construction. All openings in such walls shall be protected with fire-resistive doors as specified for special occupancy separation except that such doors may normally remain open if held in that position by fusible links.

Order 5402. Number and Location of Exits.

Every building and every story thereof shall have at least two exits, with the following exceptions:

(1) First and second story storage rooms not over 3000 square feet in area.

(2) The second story of a two story building, provided such story is used only for offices; is not over 3000 square feet in area; and has a stairway enclosed with not less than one-hour fire-resistive construction, as specified in Order 5105, leading directly to the outside and not leading to the basement. Such enclosure shall be unpierced except for the entrance and exit doors.

Additional exits shall be provided so that no part of any factory or mercantile building having contents which are liable to burn with extreme rapidity or from which poisonous fumes may be liberated or explosions occur in case of fire, will be more than 75 feet distant from an exit. In other buildings in this classification this distance may be increased to 100 feet and where approved sprinklers are provided throughout the building, a further increase to 150 feet will be permitted. All of the above distances are to be measured along public passageways and aisles.

Exits in all buildings of this classification shall be so located and distributed so as to afford the best possible egress.

Order 5403. Type of Exits.

At least one-half of the exits above required shall be stairways as specified in Orders 5116–5118. The other

exits shall be either stairways or horizontal exits as specified in Order 5119, or fire escapes as specified in Order 5120. No fire escape, however, will be accepted as a required exit on any building more than 5 stories or 55 feet in height. In a two story building, an outside wooden stairway may be used as an exit.

Every building which will accommodate more than 50 persons above the second story shall have at least two stairways.

Wherever stairways are required under this classification, ramps with a slope not greater than one foot in 6 feet may be substituted. Ramps shall comply with all the requirements for stairways as to construction, enclosures, width, landing and lighting, and shall be surfaced with an approved non-slip material. Handrails shall not be required where the slope of the ramp is less than one foot in ten feet.

Order 5404. Total Width.

In a building not provided with horizontal exits, the total width of stairways shall be not less than the following:

(a) In ordinary or frame buildings, 60 inches per 100 persons; if sprinklered, 40 inches per 100 persons.

(b) In fire-resistive and mill buildings:

	Fire-resistive Sprinklered	Fire-resistive not Sprinklered	Mill Sprinklered	Mill not Sprinklered	
----------	30	50	40	60	in. per 100 persons on 2nd floor
plus	15	25	20	30	in. per 100 persons on 3rd floor
plus	12	20	16	24	in. per 100 persons on 4th floor
plus	9	15	12	18	in. per 100 persons on 5th floor
plus	6	10	8	12	in. per 100 persons on 6th floor
plus	3	5	4	6	in. per 100 persons on 7th floor
plus	0	0	0	0	in. per 100 persons on 8th and above
but in no case shall such total width be less than					
	30	50	40	60	in. per 100 persons on any one floor.

Standard fire escapes (Order 5120) may be substituted for stairways to the extent of not more than one-third of the required total width, subject to the provisions of Order 5402.

If horizontal exits (Order 5119), are provided for any floor, the number of persons accommodated on such floor may be increased at the rate of 100 persons for each 40

Short columns or posts are those having an L/d ratio of 10 or less in which L = unsupported length in inches and d the least side in inches.

Safe load for short columns may be obtained by the formula

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

which $\frac{P}{A}$ represents the working stress for the column and S represents the safe unit compressive stress parallel to the grain given in the table of working stresses.

For columns of the intermediate class, that is, with $\frac{L}{d}$ ratios between 11 and K, the following formula is recommended:

$$\frac{P}{A} = S\left[1 - \frac{1}{3}\left(\frac{L}{K\,d}\right)^4\right]$$

in which $K = 0.64\sqrt{\frac{E}{S}}$

and E = the modulus of elasticity given in the table of working stresses.

For columns having $\frac{L}{d}$ ratios greater than K the following formula is recommended:

$$\frac{P}{A} = \frac{0.274E}{\left(\frac{L}{d}\right)^2}$$

Chapter 6

FACTORIES, OFFICE AND MERCANTILE BUILDINGS

Order 5400. Scope.

This classification includes all factories and workshops (including all places where manual labor is employed), office buildings, telegraph and telephone offices, mercantile establishments where commodities are bought or sold, taverns, warehouses, railroad stations, exhibition buildings, and places where not more than 100 persons assemble for recreation, entertainment, worship, or dining purposes.

Order 5401. Construction, Height and Allowable Area.

Buildings in this classification shall be of the type of construction, and shall not exceed the number of stories as specified in this order. The floor area of any such building shall not exceed that permitted for the corresponding type of construction and number of stories.

Types of Construction	Number of Stories	Maximum Floor Areas (Sq. Ft.) When Building Fronts on		
		1 Street	2 Streets	3 or more Streets
Fire-Resistive	No Restrictions			
Mill Construction	6 or 7 stories	6000	9000	12000
	4 and 5 stories	10000	15000	18000
	2 and 3 stories	15000	18000	20000
	1 story	20000	25000	30000
Ordinary Construction	4 stories	6000	9000	12000
	2 and 3 stories	7500	11000	15000
	1 story	12000	15000	20000
Frame Construction	2 stories	5000	6000	7000
	1 story	10000	12000	14000

When the entire building is protected by an approved automatic sprinkler system, the above areas may be increased 66⅔ per cent. In one story mill-constructed buildings provided with approved automatic sprinklers and in one story buildings of ordinary construction, whose contents are incombustible, and whose floors, roofs and struc-

inches of width of such exits, provided such increase shall not exceed 100 per cent of the number of persons accommodated by the stairways.

Example: As examples of calculations under this order where the same number of persons are to be accommodated on each floor, the following table shows the number accommodated by two stairways of minimum width (each 44 inches wide):

(a) Frame and ordinary buildings, 147 persons total, above first story; if sprinklered, 220 persons.

(b) Fire-resistive and mill buildings:

Height of building	Fire-resistive Sprinklered	Fire-resistive not Sprinklered	Mill Sprinklered	Mill not Sprinklered	
2 stories	293	175	220	147	Persons on each floor
3 stories	195	117	147	98	Persons on each floor
4 stories	154	92	116	77	Persons on each floor
5 stories	133	80	100	67	Persons on each floor
6 stories	122	73	92	61	Persons on each floor
More than 6 stories	117	70	----	----	Persons on each floor

Where one minimum stairway and one "A" fire escape are provided, take ¾ of the above numbers; subject to the limitations of Order 5402.

Order 5405. Capacity of Buildings.

In calculating the aggregate width of exits, the capacity of the building shall be established as follows:

Stores, first floor and basement	30 sq. ft. per person
Stores, second floor and above	60 " " " "
Dining Rooms, Cafes, Taverns, etc.	10 " " " "
Places of Seated Assemblage	7 " " " "
Warehouses	300 " " " "
Factories and Offices	75 " " " "

The above figures are based on the net area of each occupied space. Where dining rooms, cafes, dance halls and places of seated assemblage accommodate more than 100 persons, see Order 5501.

In other occupancies not specified above, the capacity shall be determined by the actual number of persons liable to be accommodated therein and no greater number of persons will be permitted therein.

Order 5406. Exit Doors.

Every door which serves as an exit from a room accommodating more than 10 persons, or which is an exit from a public passageway or stairway shall be a standard exit door as specified in Order 5115, except that such exit door need not swing outward if it accommodates less than 25 persons, is not located at the foot of a stairway, or is not more than 4 risers above the outside grade.

Every exit doorway from each floor, other than the principal entrance on the first floor, shall be indicated by an approved illuminated sign over the door bearing the word EXIT or OUT in plain letters not less than 5 inches in height.

Order 5407. Passageways.

Where there is not direct access to outside exit doors, safe and continuous passageways, aisles or corridors leading directly to every exit shall be maintained at all times on all floors of all buildings. Every passageway, aisle or corridor shall conform in width to the rule for width of stairways as specified in Order 5404. Widths shall be measured in the clear, at their narrowest points produced by any projection, radiator, pipe or other object and the required width shall be maintained clear and unobstructed at all times.

Order 5408. Enclosure of Stairways and Shafts.

All stairways, ramps and elevator shafts in buildings three or more stories in height, including landings shall be enclosed as follows:

(1) Fire-resistive buildings, not less than two-hour fire-resistive construction as specified in Order 5105.

(2) Mill constructed buildings, not less than two-hour fire-resistive construction as specified in Order 5105.

(3) Ordinary constructed buildings, not less than one-hour fire-resistive construction as specified in Order 5105.

(4) Frame constructed buildings, not less than one-hour fire-resistive construction as specified in Order 5105.

All doors opening into such enclosures shall be as specified in Order 5109, and all windows shall be of wire glass and metal frames and sash.

Exception: Monumental stairs leading from the street floor to the second floor or to a basement used for commercial purposes need not be enclosed, provided they are effectively cut off at the second floor (and b[illegible]nt) by partitions having fire-resistance as specified above.

[illegible] **Elevators and Elevator Enclosures:** For requirements gov[illegible]e installation and operation of elevators, and the construction a[illegible]tection of elevator shaftways, see the Elevator Code issued by ti[illegible]lustrial Commission, which code applies to all public buildings a[illegible]places of employment.

Order 5409. Opening to Roof.

Every building, or section of a building, 2 stories or more in height shall have a permanent means of access to the roof from the inside. Where such access consists of a scuttle in the roof, the opening shall be not less than 20 by 30 inches and there shall be a permanent ladder or stairway leading thereto.

Order 5410. Trap Doors and Floor Openings.

Every opening through any floor or through any roof used by the public or by employees shall be guarded by a substantial enclosure or rail not less than 3 feet 6 inches high. Floor openings in buildings of more than 2 stories, unless enclosed with fire-resistive enclosures as specified in Order 5408 shall be protected by fire-resistive doors as specified in Order 5109.

Order 5411. Lighting.

All stairways, fire escapes and exits and the passageways leading thereto when used at night shall be properly illuminated to facilitate egress. The intensity of illumination shall be not less than 2.5 foot candles.

All gas jets or gas lights in factories or workshops where combustible material is used, shall be properly enclosed by globes or wire cages, or otherwise properly guarded.

For detailed requirements applying to the lighting of places of employment see the Industrial Lighting Code issued by the Industrial Commission.

Order 5412. Sanitary Equipment.

1. Toilets.

(a) Toilets Required. Toilet facilities shall be provided and maintained in connection with every public building and place of employment under this classification.

(b) Toilets in Public Buildings. In all public buildings under this classification, separate toilet rooms shall be provided for males and females, except as in Order 5251 and as otherwise provided hereunder.

In public places where stimulating drinks, such as beer, wines and other alcoholic beverages, are served for consumption on the premises, except in dining rooms, restaurants and similar places where the serving of drinks is only incidental to the regular food service, and where no public bar is provided, toilet fixtures shall be provided in connection with the area served, for the sex (or sexes) served, as follows:

One water-closet for every 40 females, or fraction;

One water-closet for every 75 males, or fraction, and

Where there are more than 25 males accommodated there shall be one urinal for every 50 males, or fraction thereof, in excess of 25.

The numbers indicated above refer to the number of persons that can be accommodated at the same time, and shall be determined on the basis specified in Order 5405.

In toilet rooms used by males, all water-closets shall have an elongated bowl or projecting lip and open front self-rising seat without cover. In toilet rooms used by females, all water-closets shall have open front seat, without cover. All urinals shall be of the type and construction as specified in Order 5260.

In public occupancies other than those where stimulating drinks (as defined above) are served for consumption on the premises, one water-closet of the type described above shall be provided in connection therewith for each sex accommodated. Except that a small mercantile establishment where normally not more than 25 patrons are expected to be on the premises at the same time, need have in connection therewith only one toilet room to accommodate both the public and employees.

(c) Toilets in Places of Employment. See Order 2203 of the General Orders on Sanitation following this order.

(d) General Requirements. For general toilet room requirements in regard to location, construction, ventilation, fixtures, etc., see Orders 5250 to 5264, inclusive.

Where toilet rooms used by males and females adjoin, walls between such toilet rooms, if of studding with lath and plaster, the lath shall be of metal.

2. Drinking Water. Sufficient pure drinking water piped from mains, or in sanitary containers, shall be provided in connection with every public building under this classification. Drinking fountains separate from other fixtures and constructed as provided in Section 53(c) of the State Plumbing Code, or individual drinking cups of a type approved by the State Board of Health, shall be provided, except in places where food or drink is served and in public buildings where normally not more than 25 patrons are expected to be on the premises at the same time. Drinking fountains shall not be placed in toilet rooms.

For drinking water requirements in places of employment see Order 2217 of the General Orders on Sanitation following this order.

See also Section 146.07 of the Statutes of Wisconsin which prohibits the use of common drinking cups.

3. Washing Facilities. In every public building and in every place of employment, except as provided in Order 2213, wash bowls shall be provided in connection with toilet rooms, one for every 2 water-closets or urinals, or fraction. Clean individual cloth or paper towels and soap shall be provided in connection with every lavatory installation. The installation of a towel for common use, or the use of any common towel is not permissible.

See also Orders 2213 to 2215, inclusive.

Note: The following Orders 2203, 2213, 2214, 2215, 2217 and 2218 are taken from the General Orders on Sanitation issued by the Industrial Commission. For further requirements on sanitation, see that publication.

Order 2203. Number of Closets and Urinals.

In every place of employment, whether heretofore or hereafter constructed, one water-closet shall be provided for every 20 persons, or fraction thereof, of either sex.

In addition thereto, where more than 10 males are employed, one urinal shall be provided for every 40 males, or fraction. Where not more than 10 males are employed, either a urinal shall be provided or the water-closet shall have a projecting lip and self-rising seat.

The above requirements shall be computed on the basis of the maximum number of employees on any one shift.

In all new installations only individual urinals shall be used. Such individual urinals shall be of porcelain or vitreous china, set into the floor, the floor graded to the urinal, and shall be equipped with an effective automatic tank or valve or satisfactory foot operating flushing device.

All water-closets hereafter installed shall have projecting lips and open front seats.

Order 2213. Lavatories Near Toilet Rooms.

Adequate washing facilities shall be provided in or adjacent to every toilet room. In new installations there shall be at least one lavatory for every five fixtures (closets and urinals) or fraction.

Note: (1) One lavatory for every 2 or 3 fixtures is recommended.
(2) See Order 2215 on material from which lavatories shall be made.

SECTION 2. GENERAL SANITATION IN ALL PLACES OF EMPLOYMENT.

Order 2214. Washing Facilities.

1. Lavatories. Adequate washing facilities shall be provided, (1) in all places of employment where lead, arsenic, or other poisonous or injurious materials are handled by the employees, and, (2) in places of employment where food is prepared or manufactured, and, (3) in glue factories, foundries, machine shops and other places of employment where the employees' hands become dirty or greasy, except that in industries of the last mentioned class, located in small towns, where the employees go home at noon, this requirement may be waived by the Industrial Commission. In the above places of employment there shall be at least one lavatory for every 10 employees, or fraction, and hot water shall be provided. Stoppered troughs for common use of water are prohibited.

Note: (1) Washing facilities where the employee must necessarily wash in running water are recommended. A large trough without stop-

per, where each person washes from an individual faucet, is generally better than separate bowls.

(2) One lavatory or faucet for every 5 employees is recommended.

(3) Adequate washing facilities are recommended for all places of employment.

(4) Wash rooms should be constructed according to the requirements for toilet rooms, as far as possible.

All lavatories shall be made of porcelain, enameled iron, or other impervious material.

2. Showers. Adequate shower facilities shall be provided in accordance with the following requirements:

(1) In all places of employment where lead, arsenic, or other poisonous or injurious materials are handled by the employees, at least one shower shall be provided for every 10 employees, or fraction, who handle or come in contact with such materials.

(2) In glue factories, foundries, machine shops, mines, and other places of employment where the employees become dirty or greasy, at least one shower for every 20 such employees, or fraction, shall be provided.

(3) Showers shall be provided with hot and cold water and be equipped with a hot and cold regulating valve to prevent scalding. The regulating device shall be so located that it can be operated without standing under the shower. Supply or feed pipes to showers shall be placed overhead or protected, to avoid the possibility of a person coming in contact with the hot water pipes.

(4) Each shower room or compartment shall be constructed of material impervious to moisture, and the floor under each shower head shall be of such construction, or be provided with a suitable sanitary device, so as to prevent slipping.

3. Soap. Where washing facilities are provided in places of employment, there shall be provided an adequate quantity of bland, non-irritating, non-abrasive soap which shall effectively cleanse the skin.

Order 2215. Towels.

In all places of employment the use of towels in common is prohibited. Where washing facilities are required, individual cloth towels or paper towels shall be furnished by the employer.

Order 2217. Drinking Water.

Each place of employment shall be supplied with sufficient pure drinking water and the faucets or outlets for the same shall be placed convenient to the employees, but not in toilet rooms. Common drinking cups are prohibited. Sanitary drinking fountains shall be installed or individual cups shall be provided by the employers.

See Section 53 (c) of the State Plumbing Code for required construction of sanitary drinking fountains.

Where running water is not available, a covered drinking water container shall be provided. The container shall be cleaned and sterilized at frequent intervals and kept in a sanitary condition and in good repair.

Order 2218. Rest Rooms.

Rest rooms shall be provided in all places where 5 or more women are employed. Each rest room shall be suitably furnished for the purpose of reclining. In buildings where individual offices are leased or rented, at least one rest room shall be provided to serve the occupants of the building.

Every rest room shall be properly lighted, heated and ventilated. See the Heating, Ventilation and Air Conditioning Code for heating and ventilation requirements.

Order 5413. Isolation of Hazards.

All heating boilers and furnaces, power boilers, fuel rooms, storage vaults for paints, oils and similar combustibles, and other similar hazards in a building shall be isolated from the rest of the building by at least a two-hour fire-resistive enclosure as specified in Orders 5105 and 5106. Space heaters fired with various fuels, if approved by the Industrial Commission, may be used without an enclosure.

Note: For heating and ventilation in factories, office and mercantile buildings, etc., see the Heating, Ventilation and Air Conditioning Code issued by the Industrial Commission.

Order 5414. Standpipes and Fire Extinguishers.

For exterior standpipes see Order 5121.

Standard interior first aid standpipes, as specified in Order 5121 shall be provided in all buildings of more than 2 stories and more than 3000 square feet undivided floor area, where flammable material or any other hazardous condi-

tion is present, unless an approved automatic sprinkler system is provided.

Wherever water supply of sufficient pressure is not available, two standard fire extinguishers as specified in Order 5122 shall be provided on each floor in place of each required interior standpipe.

Order 5415. Automatic Sprinklers.

A complete automatic sprinkler system, as specified in Order 5123, shall be provided in every building of this classification, except office buildings not used for mercantile purposes, where more than 50 persons are employed or accommodated above the third story except as provided below.

In every such building where more than 50 persons are employed or accommodated above the second story, an automatic sprinkler system shall be provided in the basement and sub-basements, except where there is no city water supply.

An office building in which one or more of the lower floors is used for mercantile purposes, shall be classed as a mercantile building, except that no sprinklers will be required in such portions of the building as are used for offices only.

No sprinklers will be required in a building of fire-resistive construction whose contents are not readily combustible.

Order 5416. Fire Alarm.

A fire alarm system shall be provided in every factory or workshop where more than 10 persons are employed above the second story, except buildings which are provided with a complete automatic sprinkler system, and except fire-resistive buildings whose contents are practically incombustible.

Order 5417. Floor Load Signs.

In every factory, workshop, warehouse, or other building where material is piled, notices of a permanent character shall be painted or otherwise prominently displayed, stating the live load in pounds per square foot which the floor is designed to carry. Such notices shall be placed in full view, on each floor.

Where floors are always used for the storage of some particular material, the walls shall be marked to the height to which the material shall be piled without exceeding the safe load.

Order 5418. Signs Indicating Number of Persons.

In all buildings of this classification where 50 or more persons are accommodated on any floor above the second, notices shall be prominently displayed stating the maximum number of persons on each floor for whom stairways and other exits have been provided according to Orders 5402–5406. Such notices shall be placed in full view, on each floor.

Order 5419. No Smoking Signs.

Smoking shall not be permitted in retail establishments where flammable materials are handled or sold. Suitable signs bearing the words "No Smoking" shall be erected in all places where such hazard exists.

Chapter 7

THEATERS AND ASSEMBLY HALLS

SECTION 1. SCOPE AND CLASSIFICATION.

Order 5500. Theaters.

In the theater classification, are included all buildings or parts of buildings, containing an assembly hall, having a stage which may be equipped with curtains or permanent or movable scenery, or which is otherwise adaptable to the showing of plays, operas, motion pictures or similar forms of entertainment.

Order 5501. Assembly Halls.

In the assembly hall classification, are included all buildings, or parts of buildings, other than theaters, which will accommodate more than 100 persons for entertainment, recreation, instruction, worship or dining purposes.

Note: Every assembly hall which will accommodate not more than 100 persons shall conform to the requirements of Chapter 6, covering factories, office and mercantile buildings.

SECTION 2. CONSTRUCTION REQUIREMENTS.

Order 5502. Class of Construction.

The capacities of buildings or parts of buildings in this classification for the various types of construction shall not exceed, and shall comply, with the following requirements:

MAXIMUM CAPACITIES

Type of Construction	With Stage	Without Stage
Fire-Resistive	No Limit	No Limit
Mill	750	1000
Ordinary	500	750
Frame	300	750

Where a building of this classification is erected of frame construction the following restrictions shall apply:

(1) Not more than one story in height without a balcony, and with no basement except a heating and fuel room

enclosed with four-hour fire-resistive construction as specified in Orders 5105 and 5106, with all interior openings protected as specified in Order 5109.

(2) Located at least 20 feet from any other building or adjoining property line.

(3) Is not built in connection with a building used for any other purpose.

(4) Is provided with foundation walls and piers of masonry construction.

(5) Where motion picture booths are required they shall be enclosed with four-hour fire-resistive construction.

Exception: In places of worship a full basement and a balcony seating not more than 30 persons may be provided.

In any theater or assembly hall, balconies which accommodate more than 100 persons shall be of fire-resistive construction as specified in Order 5100.

Order 5503. Height Above Grade.

(1) Theaters. The height of the sills of the principal entrance doors to any theater, as defined in Order 5500, shall be not more than 18 inches above the outside grade at that point. The floor level at the highest row of seats on the main floor shall not be more than 6 feet above the outside grade at the main entrance; the floor level at the lowest row of seats on the main floor shall be not more than 6 feet below or above, the grade at the nearest exit.

(2) Assembly Halls and Roof Gardens Above First Story. Where assembly halls are provided above the first story, the following limitations of occupancy, type of construction and exit facilities shall apply:

Type of Construction	Maximum No. of Occupants	Height Above Grade
Fire-Resistive	No Limit	No Limit*
Fire-Resistive, Mill or Ordinary	400	2nd Story or 22 feet
Fire-Resistive, Mill or Ordinary	200	3rd Story or 35 feet

* One smokeproof stair tower from the level of the assembly hall leading directly to the exterior at street grade shall be provided for every 750 persons capacity, or fraction thereof. These stairways shall be at least 44 inches wide and shall be in addition to other required stairways in the building.

(3) An assembly hall may be placed in the basement of a fire-resistive building if the capacity does not exceed 2500 persons or in a building of mill or ordinary construc-

tion if the capacity does not exceed 400 persons and the floor level is not more than 7 feet below the highest level at any exit.

Order 5504. Exposure and Courts.

Every theater or assembly hall which accommodates more than 600 persons shall have at least 3 walls abutting on streets, alleys, or open courts.

The wall containing the main entrance to any theater or assembly hall shall abut on a street. The lobby or passageway leading from the main entrance doors to the foyer or auditorium shall be direct and unobstructed and of a minimum width equal to the sum of the widths of the main entrance doors. There shall be no openings from other occupancies to such a corridor or passageway.

The width of every exit court shall be at least 6 feet for an occupancy not exceeding 500 persons, and shall be increased at the rate of one foot per each 500 persons additional. Every such court shall lead to a public thoroughfare, either directly, or through a passageway of equal width, not less than 8 feet high enclosed with unpierced four-hour fire-resistive walls, ceiling and floor as specified in Orders 5105 and 5106. The floor and ceiling shall be designed for a live load of not less than 150 pounds per square foot. No such court, or passageway shall be used for storage or any other purpose whatsoever.

Order 5505. Separation From Other Occupancies.

Every theater and assembly hall shall be separated from any other occupancy by an absolute occupancy separation as specified in Order 5108, except that a special occupancy separation as specified in Order 5108 may be used between an assembly hall accommodating not more than 750 persons and any other non-hazardous occupancy. Where a special occupancy separation is permitted in this order, a single fire-resistive door may be used for the protection of openings.

For assembly halls of unlimited capacity located on upper floors of fire-resistive buildings which are served by elevators, the elevator openings may be permitted under the requirements for special occupancy separation specified in

Order 5108, but otherwise, absolute occupancy separation is required.

No garage, chemical laboratory or other occupancy where flammable or explosive liquids or gases are used or stored shall be located in the same building with a theater or assembly hall.

Order 5506. Capacity.

The following table includes various types of occupancy within the scope of this section, together with the method to be used in determining the capacity.

No greater number of persons than the number thus established shall be permitted in any theater or assembly hall.

Use or Occupancy	Basis of Capacity
Arenas and Field Houses	4 sq. ft. per person. Use seated areas only.
Assembly Halls, with Stage	7 sq. ft. per person.
Banquet Halls	10 sq. ft. per person.
Churches (Auditoriums)	7 sq. ft. per person.
Churches (Dining Rooms)	10 sq. ft. per person.
Dance Halls	10 sq. ft. per person.
Dining Rooms	10 sq. ft. per person.
Gymnasiums	6 sq. ft. per person for seated space. 15 sq. ft. per person for unseated space.
Lecture Halls	7 sq. ft. per person.
Lodge Halls	6 sq. ft. per person for seated space. 15 sq. ft. per person for unseated space.
School Auditoriums	7 sq. ft. per person.
Skating Rinks	15 sq. ft. per person.
Theaters	7 sq. ft. per person.
Theater Lobbies	7 sq. ft. per person.

Note: The capacity of theaters and theater lobbies must be combined to determine the theater capacity.

Order 5507. Number and Location of Exits.

Every floor and balcony of a theater and assembly hall shall be provided with not less than two exits, placed as far apart as practicable, and so located that if any exit is blocked, some other exit will still be available from every part.

Where more than 600 persons are accommodated there shall be at least 3 exits, and where more than 1000 persons are accommodated there shall be at least 4 exits.

Exits shall be distributed on all sides which adjoin streets, alleys or open courts.

Order 5508. Type of Exits.

The required exits from any part of a theater or assembly hall shall be exit doorways, stairways or ramps.

All exits to grade from a higher or lower level shall be stairways or approved ramps. In all theaters and in assembly halls having a capacity of more than 400 persons, where the exit rise is not more than 3 feet approved ramps shall be used. By approved ramp is meant an incline located inside the building and having a slope of not more than one foot of rise in 8 feet.

Stairway exits shall be interior stairways, or smokeproof towers as specified in Order 5117; except that "B" type fire escapes may be used as exits from balconies for not more than one-half the required exit width, if located against blank walls.

Order 5509. Stairways.

Every stairway in a theater or assembly hall, except stairways from the main floor to the first balcony, shall be enclosed as specified in Orders 5116 and 5117. No closet or open space shall be placed under any stairway, platform or landing.

Stairways and steps which have more than three risers shall have handrails on both sides.

Every stairway used by the public in a theater or assembly hall, shall have a uniform rise of not more than 7½ inches and a uniform tread of not less than 10 inches, measuring from tread to tread and from riser to riser. No winders shall be used and there shall be not less than 3 nor more than 16 risers in any run.

Note: See Order 5116 for general stairway requirements.

Order 5510. Exit Doorways and Doors.

Every required single exit doorway shall contain a standard exit door as specified in Order 5115. For double doors, with or without mullions, the width of each door may be reduced to 2 feet 6 inches.

No single door, or leaf of a double door, shall be more than 3 feet 6 inches wide, and no two doors shall be hinged together.

No rolling, sliding or revolving door shall be counted as an exit from any theater or assembly hall, nor shall any such door be permitted where it would be liable to be used by the public as an exit.

Sills at all exit doorways shall be level and flush with adjacent inside floors and ramps. Where an aisle or passageway leads to an exit from either side of the exit doorway there shall be a level floor space at the doorway subtending the width of the aisle and the doorway.

Order 5511. Exit Lights.

In every theater and assembly hall, except church auditoriums, exit lights shall be provided immediately over all exit doorways, and in such other places as may be necessary to direct the occupants to exit doorways and to a street, alley or exit court. The installation of such exit lights shall comply in all respects with the provisions of Section 134.1 of the Wisconsin State Electrical Code.

Every light over an exit doorway shall be a red illuminated sign bearing the word EXIT or OUT in plain letters not less than 5 inches in height.

All exit lights shall remain lighted during each occupancy and until the occupants have left the building.

Order 5512. Width of Exits.

The total width of exits from every theater and assembly hall, and from every part thereof, shall not be less than the following: Buildings of fire-resistive construction, 36 inches per 100 persons. Buildings of ordinary construction, 40 inches per 100 persons. Buildings of frame construction, 44 inches per 100 persons.

In theaters, the width of the front entrance shall be not less than ⅓ of the total required exit width.

Order 5513. Seating.

All seats, chairs and benches shall be placed not less than 32 inches back to back measured horizontally, except that

for grandstands and bleachers without back rests this dimension may be reduced to 24 inches. For benches without arms, grandstand and bleacher seats, the seating capacity shall be established by allowing one sitting or seat to each 18 inches of length.

All seats, chairs and benches, except chairs in boxes or l[illegible]s, shall be securely fastened to the floor; or if the f[illegible] level, the seats or chairs may be fastened together i[illegible]oups of 4 or more. Loose chairs or seats shall not be u[illegible]d unless a special permit is secured from the Industrial C[illegible]mmission.

There shall not be more than 12 seats in a row between aisles, nor more than 6 seats in a row which has an aisle on one side only, except that for grandstands and bleachers without back rests and with a railing along the front, these figures may be doubled. No aisles will be required for such grandstands or bleachers where the seats extend to the floor or ground without a railing along the front.

No seat bench or platform on which seats are placed shall be more than 22 inches in height of riser.

No seat bench, or other platform or floor area on which seats are placed, or the top seat of any bleachers shall be nearer the ceiling than 8 feet, nor nearer to the bottom of any truss or girder than 6 feet 4 inches.

The requirements of this order do not apply to restaurants, dining or dance halls.

Order 5514. Width of Aisles.

Aisles having seats on both sides shall not be less than 2 feet 10 inches wide at the beginning and shall increase in width toward the exits at the rate of ¼ inch per foot of run; or the aisle may have a uniform width not less than the average width of the foregoing calculation. No wall aisle shall be less than 3 feet wide and no other straight aisle shall be less than 3 feet 6 inches wide.

There shall be a cross aisle leading to each required side exit. Cross aisles shall not be less than 6 feet 8 inches back to back of adjacent rows of seats.

Order 5515. Lobbies and Foyers.

The width of lobbies and foyers shall be determined on the same basis as required for exits in Order 5512, but shall

in no case be less than 5 feet wide, and shall be so designed and apportioned as to prevent congestion and confusion. Lobbies and foyers which serve as means of egress shall be at least equal in combined width to the required width of the stairways, passageways, aisles or exit doorways leading to them.

Order 5516. Inclines and Aisle Steps.

To overcome any difference in level between courts, corridors, lobbies, passageways or aisles required, or used, in egress from a theater or an assembly hall, approved ramps as specified in Order 5508 shall be employed where the difference in elevation does not exceed 3 feet, except that this requirement need not apply to balconies.

Steps in balcony aisles shall extend the full width of the aisle and shall have a uniform rise and run as specified in Order 5509. No handrails will be required.

Order 5517. Obstruction.

All lobbies, aisles, passageways and doorways shall be kept free from furniture, drapes, display equipment, merchandise, vending machines and other obstructions, and no person except an employee shall be allowed to stand in, or occupy, any of the aisles, passageways, corridors or lobbies during any performance or public gathering. Except that patrons may be allowed to wait in a lobby or similar space if such use does not encroach upon the required clear width of the exits. Such waiting shall be restricted to areas separated from the required exit ways by fixed railings not less than 42 inches high. In entrance lobbies only, the exit space may be divided by railings not less than 36 inches high set up in the direction of travel in an approved manner for the regulation of ingress and egress.

A booth or counter for the sale of package merchandise may be placed in the lobby or foyer of a theater where there is sufficient excess space so that the front of the booth or counter can be located not less than 5 feet back of the line marking the width of the lobby or foyer required for exit purposes.

Order 5518. Mirrors and False Openings.

No mirror shall be placed in any part of a theater or assembly hall used by the public for exit purposes, including lobbies, corridors, stairways, ramps or any other exit facility. Where a mirror is used in an auditorium, it shall be placed flush with the wall and with the bottom at least 7 feet above any floor, balcony, gallery or platform.

No false opening or decorative device giving the appearance of a door or window, where none exists, shall be placed in any part of a theater or assembly hall used by the public.

Order 5519. Decorations.

Fabric decorations used in theaters and assembly halls shall be flame proof.

Order 5520. Elevator and Vent Shafts.

Enclosures for elevator and vent shafts shall be of two-hour fire-resistive construction as specified in Order 5105 and all openings therein protected by fire-resistive doors or windows as specified in Orders 5109 and 5110.

Order 5521. Stage Separation.

In every theater and assembly hall the stage shall be completely separated from the auditorium by a proscenium wall of four-hour fire-resistive construction as specified in Order 5105, except as follows:

(1) In theaters and assembly halls having a capacity not exceeding 500 persons, the proscenium wall shall be of two-hour fire-resistive construction as specified in Order 5105, or better.

(2) In theaters and assembly halls an open stage or platform will be permitted without the proscenium wall separation from the auditorium, provided the stage or platform is not more than 6 feet higher or wider than the proscenium opening.

Order 5522. Proscenium Wall.

The proscenium wall shall extend from an incombustible foundation, or from the lowest fireproof floor below the stage floor, to the highest adjoining roof, except that where a four-hour fire-resistive wall is required it shall extend at least 2 feet above the highest adjoining roof.

There shall be not more than two openings in the proscenium wall below the level of the auditorium floor, and not more than two openings other than the proscenium opening, in the proscenium wall above the level of the auditorium floor, except that in addition to the above openings there may be one opening to provide access through the proscenium wall to the orchestra pit.

Each such opening shall not exceed 21 square feet in area and shall be protected by a fire-resistive door as specified in Order 5109, or equal.

Order 5523. Proscenium Curtain.

Where a proscenium wall is required for the separation of a stage from an auditorium, the proscenium opening if more than 60 feet in width shall be provided with a rigid metal curtain conforming to the regulations contained in Appendix P of the Building Code recommended by the National Board of Underwriters, Fifth Edition, Revised Reprint, 1934. For a proscenium opening 60 feet or less in width, a rigid metal curtain or a curtain of asbestos conforming to the following specifications, or of equivalent approved construction, shall be used.

Asbestos curtains shall be substantially woven of asbestos fiber not less than 95 per cent pure, and shall weigh not less than 2½ pounds per square yard. There shall be incorporated into the yarn before weaving, either monel metal, nickle, brass or other metal or alloy, having not less strength than these metals at temperatures up to 1700 degrees Fahrenheit and no less resistance to corrosion at ordinary temperatures. All seams shall be vertical, shall be lapped not less than one inch and shall be sewed in two rows with not less than $\frac{1}{16}$ inch pure asbestos twine. At the top and bottom of the curtain a 2½ inch (or larger) steel pipe shall be placed and shall be securely fastened in, and covered by, the curtain. The curtain shall overlap the proscenium wall not less than 12 inches at each side and at the top, and shall be guided at each side by metallic loops or rings sliding on a ⅜ inch steel cable or No. 6 U.S. standard guage wire.

In addition to any decoration, the curtain shall be painted on both sides with a mineral paint having a silicate of soda

binder, which will completely fill the cloth. Filler paint shall have not less than 4 parts of casein in each 10 parts of silicate of soda. The paint shall be well brushed into the cloth so that no light or smoke can come through.

For curtains of any type, the connections between curtain and wall shall be made as nearly smoke-proof as possible. Smoke grooves or pockets shall be of structural steel shapes and plates not less than ¼ inch thick. These grooves or pockets shall be not less than 14 inches deep and 6 inches wide and shall be set back from the face of the arch at least 6 inches. They shall extend from the stage floor to a point 3 feet above the top of the raised curtain, and shall be securely bolted to the proscenium wall.

Provision shall be made to prevent the curtain from leaving or binding on the guides under any conditions. Appropriate limit chains shall be provided to stop the downward travel of the top of the curtain at a line not less than 12 inches above the top of the proscenium opening. No part of a curtain, nor any of the curtain guides, or equipment, shall be supported by, or fastened to, any combustible material.

The hoisting apparatus for the curtain shall be designed with a factor of safety of 8 or more.

Besides the regular operating mechanism, there shall be an emergency device which will allow the curtain to drop by gravity. The device shall be so arranged that it can be easily operated by hand from each side of the stage and from the fly galleries, and also that its operation will be controlled by 135 degree fusible links, or other approved heat release devices, placed on each side of the stage, and when thus operated the curtain shall descend at its normal rate of speed.

The curtain and its operating mechanism shall be so designed and constructed at all points, whether specifically mentioned or not, as to form an efficient and reliable barrier against fire and smoke, according to the best practice.

Detailed plans and specifications for all curtains and their operating mechanism shall be submitted to the Industrial Commission for approval before installation.

Order 5524. Automatic Smoke Outlet.

Where a fireproof proscenium curtain is required, or provided, the stage shall be provided with one or more automatic smoke outlets, constructed of metal or other incombustible material, placed near the center and above the highest part of the stage, and having a combined area equal to not less than 8 per cent of the area of the stage floor. Vertical louver openings shall be placed not less than 3 feet above the roof and shall be not less than twice the area of the shaft. The smoke outlet shall be designed and constructed so as to open by gravity, and so as to effectively overcome the effects of neglect, rust, dirt, frost, snow, heat, twisting, or warping of the frame work. The louvers, or dampers in the openings shall be held closed by cotton or hemp cords running to the stage floor close to each stage door. Fusible links, or other approved heat release devices, shall be inserted in each cord near the outlets.

Order 5525. Stage Vestibules.

All entrances to the stage shall be vestibuled in such manner as to protect the curtain, scenery, and auditorium from drafts of air.

Order 5526. Footlight Trough.

The footlight trough shall be made of, or lined with, incombustible material.

Order 5527. Fireproof Paint.

All stage scenery, properties, curtains, and decorations made of combustible material, and all woodwork in or about the stage, shall be effectively flame-proofed.

Order 5528. Stage Accessory Rooms.

All dressing rooms, property rooms, and other storage or workrooms shall be built of incombustible material throughout, and shall be separated from the stage by a special occupancy separation as specified in Order 5108.

No dressing room or employes' room shall be placed more than one story below the grade line, and no dressing room shall be placed above or below the auditorium unless separated therefrom by a special occupancy separation as specified in Order 5108.

rder 5529. Boiler and Furnace Rooms.

Every boiler or furnace room, including breeching and el room, shall be enclosed with a special occupancy sepa- tion as specified in Order 5108, except that in the case of assembly hall accommodating not more than 300 persons dinary occupancy separation as specified in Order 0 be used.

G ired appliances used for heating water shall be ca in a boiler or furnace room.

rder 5530. Lights and Lighting.

Electric lights shall be used for lighting where electric rrent is available. No oil lamps or other open lights shall e used in or about any stage containing scenery.

No gas lighting of any kind shall be used on any stage ntaining scenery, nor in any property room, storage room, ene dock, or fly gallery, except in localities where elec- icity is not available.

In all theaters and assembly halls, all stairways, passage- ays, and exit doors shall be properly lighted and shall main lighted throughout every performance or entertain- ent and until the audience has left the building.

rder 5532. Sanitary Equipment.

1. Toilets and Urinals. Separate toilet rooms in connec- on with the auditorium shall be provided for males and males. One water-closet shall be installed for each 200 males or fraction, and one water-closet and one urinal r each 300 males or fraction, assuming the audience to be ually divided between males and females; except that in ance halls there shall be provided one water-closet for each 00 females or fraction, one water-closet for each 300 males r fraction and one urinal for each 150 males or fraction.

Where stimulating drinks, such as beer, wines and other lcoholic beverages, are served for consumption on the remises, there shall be provided one water-closet for every 0 females, or fraction, one water-closet for every 150 ales, or fraction, and one urinal for every 50 males, or raction; except that where the capacity in such places ex- eeds 300 persons, the ratio of the number of fixtures to

the number of persons accommodated in excess of 300 need be only one-half of the above.

There shall be separate water-closets provided for males and females in connection with the stage of every theater and assembly hall which is equipped for the showing of stage productions.

In theaters where motion picture machines are run continuously for a period of more than 2 hours without at least 10 minutes intermission for the motion picture machine operator for each 2 hour period, toilets shall be provided in direct connection with the motion picture booth.

For general toilet room requirements see Orders 5250 to 5264, inclusive.

2. Drinking Water. Separate drinking fountains of a type approved by the State Board of Health shall be provided for the stage and auditorium where water supply is available. Drinking fountains shall not be placed in toilet rooms.

3. Washing Facilities. Washbowls shall be provided in connection with toilet rooms, one for every two closets and urinals, or fraction.

Order 5533. Standpipes.

Where proper water supply is available, at least one first aid standpipe, as specified in Order 5121, shall be provided on the stage of every theater and assembly hall where a fire curtain is required. Each hose shall be not more than 75 feet long, and where such hose will not reach every part of the stage section additional hose connections and hose, or additional standpipes, shall be provided.

Order 5534. Fire Extinguishers.

Standard fire extinguishers of an appropriate type as specified in Order 5122 shall be provided for all theaters and assembly halls as follows:

Two on stage, if scenery is used.

One on stage, if no scenery is used.

One in motion picture booth, or in ticket office if there is no booth.

One in dressing room section.

Extinguishers shall be properly exposed to view and always accessible.

Order 5535. Automatic Sprinklers.

In every theater and assembly hall where a proscenium curtain is required, approved automatic sprinklers, as specified in Order 5123, shall be provided under the stage, under the stage roof, and in the dressing rooms, but not in the automatic smoke outlet.

Order 5540. Motion Picture Machine Booths, General.

Every motion picture machine using nitro-cellulose film, together with all auxiliary and associated equipment, shall be enclosed in a booth so arranged as to permit the operator to walk freely on either side and in back of the machine. At least 48 square feet in area shall be provided for one machine, and 24 square feet additional for each machine over one. The ceiling height shall be not less than 7 feet.

Order 5541. Construction of Booth.

The floor of each motion picture booth shall be constructed of masonry or reinforced concrete, or shall be covered with not less than 2 inches of fire-resistive material. The walls and ceiling shall be not less than two-hour fire-resistive construction as specified in Order 5105.

Order 5542. Doors.

The door to the booth shall be not larger than necessary for the safe and proper use and maintenance of the booth and equipment, but in no case shall its dimensions be smaller than 2 feet by 5 feet or larger than 3 feet by 7 feet. The top of the door shall be not less than 12 inches below the ceiling of the booth.

The door shall be a tight-fitting self-closing fire door as specified in Order 5109, shall open outwardly, and shall not be equipped with any latch.

Order 5543. Openings.

Two openings for each motion picture machine may be provided. The one for the operator's view shall not be larger than 200 square inches and the one for projection not larger than 120 square inches. Where separate stereopticon, spot, or floodlight machines are installed, not more than one opening shall be provided for each such machine

for both the operator's view and the projection of light. All such openings shall be as small as practicable.

Each opening shall be provided with an approved gravity shutter set into guides not less than one inch at sides and bottom, and overlapping the top of the opening by at least one inch when closed. Shutters shall be not less than No. 10 U.S. Standard gauge iron or equivalent, arranged to move freely in guides of like material and thickness bolted to the wall. Each shutter shall be suspended by a cord, and shall be so arranged that closing is by gravity action. A fusible link shall be provided in the cord over each shutter. A link shall also be provided over each magazine, which on operating will close all shutters. A manual release shall be provided near each exit door by which all shutters can be closed simultaneously. Shutters shall not be blocked open nor held open in any manner except by the harness of cords and links as herein described.

Order 5544. Ventilation of Booths.

Every booth or room housing projection, sound or any other equipment which vitiates good air conditions or requires the attention of an attendant shall be ventilated as required by Order 5843 of the Heating, Ventilation and Air Conditioning Code issued by the Industrial Commission. Fresh air intakes in booth walls, except for outside air, shall not exceed 72 square inches in area, nor be more than 3 inches above the floor. They shall be equipped with automatic shutters as described for projection openings.

Order 5545. Relief Outlets.

Every booth or room housing projection, sound or other equipment which constitutes a fire, smoke, explosion or fuming hazard shall be equipped with one or more gravity outlets extending upward from the ceiling through the roof. The net area of such gravity relief outlets shall be equal to one per cent of the room or booth floor area, but not less than 12 inches in diameter. Such outlets shall be constructed as sheet metal ducts having double walls with ½ inch air space between, or better construction. Where a relief outlet passes through, or is within 18 inches of any combustible construction, or passes through any other occu-

pancy, approved masonry flues as specified for chimneys, Order 5210, shall be used. The relief outlets shall be equipped, at the booth or room outlets, with a gravity shutter which will open automatically under excessive heat conditions. The automatic shutter shall normally be tightly cl[illegible] where mechanical exhaust ventilation is required in th[illegible]ne room.

Or[illegible]er 5546. Electric Wiring.

All lights and electric wiring, also motors, arc lamps, rheostats, and associated electrical equipment shall conform in type and arrangement to the requirements of the Wisconsin State Electrical Code.

Order 5547. Motion Picture Machine.

Every projection machine shall be securely fastened to the floor, and together with sound head and other associated equipment, shall be of safe design. No part of the film shall be outside of a tight metal inclosure during projection, and the feed and take-up reels shall have rivetted, flanged, or welded joints. A shutter shall be placed in front of the condenser, arranged so as to be closed except when held open by the operator, or by some mechanical device which will assure immediate closure when operation of the machine is stopped.

Order 5548. Fire Protection in Booth; Care and Use of Film.

All shelves, furniture and fixtures shall be incombustible. No combustible material shall be permitted to be within such booth, except films and film cement not exceeding one pint. Smoking is prohibited. Heating equipment in booths shall be limited to steam, warm air, hot water or electric convection heaters with low surface temperature elements. Radiators shall be protected by ¼ inch mesh screen with the top sloped at least 45 degrees to the horizontal.

Films not in process of rewinding, examination or projection shall be kept in metal containers. Up to 40 pounds of film may be kept in the projection booth in Interstate Commerce Commission shipping containers. Excess over 40 pounds shall be kept in an approved film cabinet, but the total quantity of film in any booth shall not exceed 125 pounds.

Rewinding in the projection booth is prohibited unless done in an approved enclosed type rewind machine. An approved can with self-closing hinged cover shall be provided for scrap film.

Up to 125 pounds of film in addition to that permitted in a projection booth, may be kept in containers as specified above, providing this excess is in a rewind room of not less than 80 square feet area, and of the construction specified in Orders 5541 and 5542. Such room shall have a vent of at least 50 square inches area extending upward to the outside of the building, with a clearance to combustible material conforming to Order 5545. Furniture and heating shall be as for the projection booth, and smoking is prohibited.

Note: In the foregoing order the weight of a 1000 foot roll of 35 millimeter film is assumed as 5 pounds.

Order 5549. Portable Booths.

Every portable booth used to confine the fire hazards of a motion picture machine shall be of approved design conforming to the requirements for permanent booths.

Every booth used for more than 3 consecutive performances in one location will be considered a permanent booth.

Order 5550. Maintenance.

All theaters and assembly halls, and all parts thereof, shall be kept clean, sanitary and in good repair.

Chapter 8

SCHOOLS AND OTHER PLACES OF INSTRUCTION

Order 5600. Scope.

The requirements of this chapter, Orders 5600 to 5619, inclusive, shall apply to all public, parochial and private schools, universities, colleges, academies, seminaries, libraries, museums and art galleries; including all buildings or parts of buildings used for the purpose of acquiring knowledge.

Order 5601. Maximum Height.

No building which accommodates pupils below senior or junior high school grades shall be more than 3 stories high, nor shall the topmost floor level be more than 35 feet above the grade at any outside exit door.

No building which is used as a senior or junior high school shall be more than 4 stories high, nor shall the topmost floor level be more than 48 feet above the grade at any outside exit door.

Order 5602. Class of Construction.

Every building not more than one story in height may be of frame construction as specified in Order 5103.

Every building which is more than one story, but not more than two stories in height, shall be of ordinary construction as specified in Order 5102, or better, except as provided in Order 5603.

Every building which is more than 2 stories in height shall be of fire-resistive construction as specified in Order 5100, except that in a 3 story building ordinary construction, as specified in Order 5102, may be used above the third floor level.

Order 5603. First Floor Fire-Resistive.

In all 2 story buildings having more than 4 class, study, or recitation rooms of ordinary size (750 square feet in area) on any floor, the first floor shall be of at least two-hour fire-resistive construction as specified in Order 5106 unless all of the stairways and corridors throughout the building, including stairs, walls, ceilings and floors, are of at least two-hour fire-resistive construction as specified in Orders 5104 to 5107 inclusive. In all other 2 story buildings, the basement ceiling shall be of one-hour fire-resistive construction as specified in Order 5106, or better.

Order 5604. Subdivisions and Fire Stops.

Every building of this classification which is built in connection with a building of a lower grade of construction shall be separated from such other building by walls of four-hour fire-resistive construction as specified in Order 5105, and all communicating openings shall be protected by fire-resistive doors as specified in Order 5109 or equal. If such openings are used as a means of egress, they shall be kept normally open during the occupancy of the building.

Order 5605. Exposure and Courts.

No wall containing windows which light a class, study, recitation or reading room shall be less than 30 feet away from any opposite building, structure or lot line, or opposite court wall; except that the distance from such opposite court wall may be reduced to not less than 20 feet provided light rays at an angle of 30 degrees are not thereby obstructed from entering the entire upper half of any such window.

Order 5606. Number, Location and Type of Exits.

The number and location of exits shall be such that, in case any exit or passageway is blocked at any point, some other exit will still be accessible through public passageways, from every room used by the public or by the occupants generally. Except that in a high school, university, college, library or museum building, not more than 2 class rooms of ordinary size (750 square feet) may be placed between an exit and the end of the building, provided that the exit doors from such class rooms are not more than 10 feet beyond the exit. In a one-room building, only one exit will be required.

In buildings of more than one story there shall be at least 2 stairway exits, each leading directly out of doors.

The remaining exits shall be either such stairways or horizontal exits as specified in Order 5119. Where such stairways lead to the basement they shall be enclosed below the first floor as specified in Order 5118.

In buildings of more than 2 stories all stairways shall be [illegible]ed as specified in Orders 5117–5118.

[illegible] escapes may only be used as exits from the temporary end of incomplete or unit type buildings, as approved in writing by the Industrial Commission. Such fire escapes shall be of the "B" type where more than 100 persons can be accommodated above the first floor.

Handrails shall be provided on both sides of all exit stairs used by pupils.

Closets shall not be placed below stairways or stairway landings.

Order 5607. Total Width of Exits.

The total width of exits from any floor shall be not less than the following rates, based on the total capacity of such floor and of the floors above:

Fire-resistive buildings, 30 inches per 100 persons.

Ordinary or frame buildings, 40 inches per 100 persons.

Where permitted under Order 5606, standard fire escapes may be used for not to exceed one-third of the above total widths.

The capacity of a school building shall be established by the actual number of fixed seats in rooms where such are used, or by the number of persons which may be accommodated. (See Order 5611) The capacity of a library, museum, or art gallery shall be established on the basis of 100 square feet of total floor area of the building, exclusive of stairways and elevators, to each person, except that for library reading rooms this area shall be reduced to 20 square feet per person for the space so occupied.

Order 5608. Exit Doors.

Exit doors shall comply with the requirements of Order 5115, except that in elementary schools the width may be reduced to 3 feet. The aggregate width of exit doors shall be as required in Order 5607. No single door or leaf of a double door shall be more than 42 inches wide.

Order 5609. Passageways.

Corridors and passageways shall be so designed as to prevent congestion and confusion and shall be provided with windows and artificial light so as to maintain a light intensity throughout of not less than 2.5 foot candles at the floor line whenever the building is occupied.

The minimum unobstructed width of corridors and passageways which are used by the public or by the occupants generally, shall be determined in the same manner as specified for stairways in Order 5607, but in no case shall this width be less than 4 feet. Corridors and passageways serving as a means of egress shall be at least equal in combined width to the required width of the stairways or passageways leading to them.

Order 5610. Access to Attic and Roof.

Every building more than one story in height shall have permanent means of access to the roof and attic space from inside the building. Where a scuttle opening is provided, the opening shall be not less than 20 x 30 inches, with a permanent enclosure for a stairway or ladder leading thereto.

Order 5611. Floor Space and Height of Ceiling.

All class and recitation rooms shall have a minimum floor space of 18 square feet per person. Rooms used only for study purposes shall have a minimum floor space of 15 square feet per person.

All rooms used for educational purposes shall be not less than 12 feet high in the clear. Toilet rooms, service rooms, store rooms and similar spaces shall be not less than 8 feet high in the clear.

Note: The following are recommended by the Department of Public Instruction:

(1) A standard class room should be from 22 feet to 23 feet in width and from 31 feet to [illegible] feet in length.

(2) Although the minimum space between the first window and the front blackboard is required to be 4 feet, a 6 foot space is recommended. This space should be left entirely blank.

(3) Blackboards should be not less than 24 inches above the floor for even the smallest children; 30 to 34 inches is recommended for front blackboards. Blackboards should not be higher than 48 inches; 42 inches is recommended.

(4) Ample bulletin board space the full width of the blackboards ould be provided in all rooms and especially in the kindergarten and imary rooms. This is in addition to tack boards over the blackboards.

Note on Windows: For window requirements see the School Lighting ode issued by the Industrial Commission.

rder 5612. Basement Rooms.

class, recitation, study, laboratory, domestic science ary room shall have its floor more than 2 feet below joining grade. Industrial arts rooms, shops, toilet ms and other rooms used by pupils (not including play ooms) shall have floors not more than 4 feet below grade. The walls and floor where exposed to soil shall be water-proof and damp-proof.

Order 5613. Assembly Rooms.

A room which seats, or which can accommodate, 100 or more persons shall conform to the requirements of Chapter 7 (Theaters and Assembly Halls) of this code except that the minimum width of any exit doorway used exclusively by elementary school children may be 3 feet; but in any case the aggregate width of such doorways shall be in accordance with Chapter 7.

Order 5614. Seats, Desks and Aisles.

Seats, chairs and desks in class, recitation, or study rooms seating more than 50 persons shall be securely fastened to the floor; or seats shall be fastened together in groups of 4 or more, or in groups of 2 seats and 2 desks. Except that this requirement shall not apply to desks and chairs used by teachers, or to chairs, tables and equipment used in kindergarten rooms.

Class, recitation and study rooms shall have aisles along all walls.

In elementary school rooms, the intermediate aisles shall be not less than 18 inches and the wall aisles not less than 30 inches in width.

In high school rooms, and in all other class, recitation and study rooms, the intermediate aisles shall be not less than 20 inches and wall aisles not less than 30 inches in width.

Where rooms are used for assembly purposes, seats and aisles shall conform to the requirements of Orders 5513–5517 of this code.

Order 5615. Heating Plants.

In every building more than one story in height, all heating plants and fuel rooms shall be enclosed with not less than four-hour fire-resistive construction as specified in Orders 5105 and 5106. All openings shall be protected with self-closing fire-resistive doors as specified in Order 5109.

In one story buildings all heating plants and fuel rooms shall be enclosed with not less than two-hour fire-resistive construction as specified in Orders 5105 and 5106, except that this requirement shall not apply to buildings where jacketed stoves or school room heaters are permitted. All openings shall be protected by self-closing fire-resistive doors as specified in Order 5109.

Order 5616. Sanitary Equipment.

1. Toilets. School buildings shall have the following toilet equipment:

(a) In high schools, one water-closet for every 30 females or fraction.

One water-closet for every 60 males or fraction and one urinal for every 30 males or fraction.

(b) In junior high and elementary schools, one water-closet for every 25 females or fraction, one water-closet for every 50 males or fraction and one urinal for every 25 males or fraction.

2. Drinking Water. One drinking fountain shall be installed in each story and basement, for each 6000 square feet of floor area, or fraction. Drinking fountains shall not be installed in toilet rooms.

3. Washing Facilities. Lavatories shall be provided in connection with toilet rooms in the ratio of one lavatory for every two toilet fixtures (closets and urinals).

4. Cloakrooms and Wardrobes. In every school building, there shall be provision for the placing and storage of the wraps of occupants. Such provision shall consist of wardrobes, lockers, or cloakrooms, constructed and arranged in a manner to insure and facilitate the ventilation and sanita-

ion of contents. Ventilation shall conform to the provisions f Order 5847 of the Heating, Ventilation and Air Condi-ioning Code.

Note: This prohibits the use of corridors, vestibules, etc., for cloak-oom purposes, unless ventilated lockers are provided. Open hooks and angers will not be approved.

Note on Heating and Ventilation: For heating and ventilation in ools, libraries, etc., see the Heating, Ventilation and Air Condition-de issued by the Industrial Commission, which code applies to all buildings and places of employment.

er 5617. Artificial Lighting.

Each class, study or recitation room of standard size (31 o 33 feet long by 22 to 23 feet wide) shall be equipped with t least 6 artificial lighting units symmetrically spaced.

Where electric service is available at least one circuit of 5 amperes capacity (see Wisconsin State Electrical Code) hall be supplied to each standard room.

Note: For general requirements which apply to the natural and arti-cial lighting of schools see the School Lighting Code issued by the ndustrial Commission.

rder 5618. Fire Extinguishers.

In every building, standard fire extinguishers, as speci-ed in Order 5122, shall be provided in the proportion of ne extinguisher to each 2500 square feet, or fraction, of oor area, but there shall be at least one fire extinguisher n each floor including basement. In addition to the fire xtinguishers for general protection there shall be at least ne extinguisher of appropriate type and size in each lab-ratory, shop or other vocational room. Every fire extin-uisher shall be prominently exposed to view and always ccessible.

rder 5619. Fire Alarms.

Every building two stories or more in height shall be rovided with a proper alarm or gongs which can be op-rated from any story, including basement, and can be eard throughout the building, with the operating device rominently located and distinctly marked. Such alarm ystem shall be tested at least once a week.

Chapter 9

APARTMENT BUILDINGS, HOTELS AND PLACES OF DETENTION

Order 5700. Scope.

The requirements of this chapter shall apply to all apartment buildings, rooming houses, hotels, dormitories, convents, hospitals, asylums, jails and other places of abode or detention.

By **Place of Abode** is meant a building, or part of a building, such as an apartment building, rooming house, hotel, dormitory, convent, hospital, as follows:

(1) Occupied as the residence of 3 or more families living independently, or occupied by 2 such families and also used for business purposes, or

(2) Occupied for sleeping or lodging purposes by 3 or more persons not members of the same family.

By **Place of Detention** is meant a building, or part of a building, used as a place of abode and wherein persons are forcibly confined, such as asylums and jails.

Note: The attorney general has ruled that all persons committed to an insane asylum by court order come within the meaning of the words "forcibly confined". Also that the words "forcibly confined" apply to all persons confined without their consent.

Order 5701. Class of Construction.

All places of abode which are more than 3 stories in height shall be of fire-resistive construction as specified in Order 5100.

All 3 story places of abode, other than hospitals and places of detention, shall be at least of ordinary construction as specified in Order 5102, except that a 3 story apartment building which will accommodate not more than one family on each floor and a 3 story hotel or rooming house which will accommodate not more than 6 persons on each floor may be of frame construction as specified in Order 5103, except as provided in Order 5702.

All places of detention and all hospitals of 3 or more teries shall be of fire-resistive construction as specified in Order 5100.

Order 5702. First Floor Fire-Resistive.

In 3 story buildings, except those having not more than ne family on each floor, the first floor and its supports shall e less than three-hour fire-resistive construction as pe d in Order 5106; except that in a 3 story apartment ou which will accommodate not more than 4 families, r a story hotel or rooming house which will accommodate ot more than 30 persons, above the first story, the base- ient ceiling shall be of not less than one-hour fire-resistive onstruction as specified in Order 5106 or shall be protected y automatic sprinklers as specified in Order 5123. Spaces etween floor joists, below or above stud partitions where he studs extend through one or more stories, shall be re-stopped.

Order 5703. Garage and Business Separation.

In every building in which a lower story is used for arage purposes, the ceiling over the garage shall be of un- ierced four-hour fire-resistive construction as specified in Order 5106. Stairways from garages leading to the upper tories shall be separated from the garage area with walls f four-hour fire-resistive construction as specified in Order 105, with openings protected as specified for special occu- ancy separation, Order 5108 (2).

In a building more than 2 stories in height where the ower story is used for business purposes, other than the azards listed in Chapter 10 of this code, the ceiling over he lower story shall be of not less than one-hour fire- esistive construction as specified in Order 5106.

Order 5704. Corridor and Dividing Partitions.

All 3 story places of abode which have more than one apartment or 8 rooms on any floor, shall have the public passageways enclosed with partitions of not less than one- hour fire-resistive construction as specified in Order 5105. f there is more than one apartment on any floor, such apartments shall be separated by such partitions. If there

are more than 8 rooms on any floor, they shall be divided by such partitions into groups of not more than 8 rooms each.

Doors in such corridor partitions may be solid slab doors, 1¾ inches in thickness, and need not be self-closing.

Order 5705. Court Walls.

The walls of courts and similar interior shafts for light and air shall be of not less than three-hour fire-resistive construction as specified in Order 5105, except that when the building is permitted to be of ordinary construction, the court walls may be of one-hour fire-resistive construction.

Order 5706. Yards.

Behind every apartment house, the rear of which does not abut on an alley or street, there shall be a yard across the entire width of the lot, open and unobstructed from the ground to the sky. The width of the yard behind a 2 story building shall be either:

(1) At least 5 feet of unobstructed width; or

(2) At least 10 feet from the rear lot line to the building line, of which at least 3 feet shall be unobstructed, and the remainder may be occupied by an open (or screened) porch.

For apartment houses of more than 2 stories, the unobstructed width of the entire yard shall be increased one foot for each additional story, except in the case of corner lots.

No apartment house shall be placed behind any other building unless there is at least 50 feet between the buildings.

Order 5707. Number, Location and Type of Exits.

There shall be at least 2 exits accessible from each room or apartment by means of stairways, ramps or horizontal exits. The number and location of such exits shall be such that in case any exit or passageway is blocked at any point, some other exit will still be accessible through public passageways from every room or apartment, except that in fire resistive buildings a total area of not more than 1200 square feet may be placed between an exit and the end of the

uilding, and except in 2 story buildings where there are ot more than 2 apartments on the second floor, one exit nay be through the adjoining apartment provided a con- ecting door containing a glass panel is provided in the artition separating the 2 apartments. The lock or locks n such doors shall be of a type which can be unlocked from ither side without the use of a key.

Exits shall be distributed so that the entrance to each oom or apartment will be not more than 50 feet distant rom an exit, measuring along public passageways, if in a uilding of non-fire-resistive construction, or 75 feet in a ire-resistive building.

At least one-half of the required exits, in buildings of nore than one story, shall be stairways as specified in Order 5116. The remaining exits shall be either stairways, or horizontal exits; or fire escapes may be used as exits from doors which are not more than 40 feet above grade if they are placed against blank walls. Every building which accommodates more than one family, or 8 persons, above the second story shall have at least 2 stairways.

Apartment buildings 3 stories or less in height whose floors and supporting members are of not less than two-hour fire-resistive construction, as specified in Order 5106, and which have a plan so arranged that not more than 2 occupancies on any floor make use of a common stairway, may be constructed with one common stairway as a single exit, provided the walls between occupancies and those enclosing the stairway are of two-hour fire-resistive construction as specified in Order 5105. In this case the stairways must be of not less than two-hour fire-resistive construction, must lead directly to the outside and have all interior openings protected by approved fire-resistive doors as specified in Order 5109.

Order 5708. Aggregate Width of Exits.

The aggregate width of exits shall be as provided for in Order 5404.

Order 5709. Exit Doors.

Exit doors shall be as specified in Order 5115; except that a door which is used by not more than 6 families, or

40 persons, shall be not less than 3 feet wide and shall not be required to open outward.

Order 5710. Passageways.

Every public passageway leading from an exit shall be at least as wide as the required width of such exit. Every public passageway leading to an exit shall be at least 3 feet wide. The required width shall be kept clear and unobstructed at all times.

Order 5711. Lighting of Exits.

In every building which accommodates more than 4 families, or 30 persons, and in every building which accommodates transients, the public passageways and stairways and exit doors shall be illuminated from one hour after sunset to one hour before sunrise. This illumination shall include lights at all intersections of passageways, at all exits, and at the head, foot and landing of every stairway. The lights at emergency exit doors shall be red lights and shall be accompanied by a sign bearing the words "exit" or "out", in plain letters.

Order 5712. Enclosure of Stairways and Shafts.

1. In 3 story buildings all stairways shall be enclosed as provided in Orders 5117 or 5118, with one-hour fire-resistive partitions, as specified in Order 5105, or better, unless the building is either of fire-resistive construction or equipped throughout with automatic sprinklers. The doors may be omitted in the stories above the basement in one stairway enclosure. In all 3 story buildings accommodating more than 2 families, or 15 persons, above the first story, all basement stairways shall be enclosed with two-hour fire-resistive partitions as specified in Order 5105.

In buildings more than 3 stories in height, all stairways shall be enclosed with two-hour fire-resistive partitions, as specified in Order 5105; except that one stairway may be unenclosed in the first and second stories, provided such stairway does not lead to the basement.

In all buildings more than 2 stories in height in which the first story is used for business purposes, at least one stairway shall be enclosed in the first story with an un-

pierced wall of two-hour fire-resistive construction, as specified in Order 5105, and such stairway shall not connect with the basement.

2. Every elevator shaftway, dumbwaiter shaftway, clothes chute, waste paper chute, pipe shafts and other similar vertical shafts in buildings more than 2 stories in height shall be enclosed with two-hour fire-resistive partitions, as described in Order 5105, except that for 3 story buildings, one-hour fire-resistive partitions may be used where the enclosure does not pass through a business portion. In all cases the basement enclosure shall be of not less than four-hour fire-resistive construction.

Order 5713. Toilet Rooms.

Every apartment shall have a water-closet in a bathroom or separate compartment; except that where there are apartments consisting of not more than 3 rooms, there shall be at least one water-closet for every 2 such apartments. All other buildings in this classification shall have at least one water-closet for every 15 rooms or fraction thereof.

Rooms with private water-closets shall not be considered in counting either the number of rooms or the number of fixtures.

Water-closets and urinals, and the pipes connected therewith, shall be protected against freezing as provided in Order 5261.

Order 5714. Washing Facilities.

In every building of this classification where water supply is available or can be made available, there shall be at least one sink or wash bowl in connection with each toilet fixture. In apartment houses there shall be such a sink or wash bowl in each apartment.

Order 5715. Repairs.

Every building of this classification, and all parts thereof, shall be kept in good repair and the roof shall be maintained to prevent leakage. All rainwater shall be so drained and conveyed therefrom to prevent dampness in the walls and ceilings.

Order 5716. Cleanliness.

Every building shall be kept clean, and shall also be kept free from any accumulation of dirt, filth, rubbish, garbage, or other matter in or on the same or in the yards, courts, passages, areas or alleys connected with or belonging to the same.

Order 5717. Size of Rooms.

Every sleeping room shall be of sufficient size to afford at least 400 cubic feet of air space for each occupant over 12 years of age, and 200 cubic feet for each occupant under 12 years, except that a minimum of 150 cubic feet may be provided for infants in hospital nurseries. No greater number of occupants than the number thus established, shall be permitted in any such room.

Order 5718. Basement Rooms.

No living or sleeping room shall have its floor level below the adjoining yard, court, alley or street grade.

No rooms wherein persons are forcibly confined shall be located in a basement.

Order 5719. Windows.

The outside windows in every sleeping or living room shall have a total sash area of at least one-tenth of the floor area of the room, but not less than 12 square feet. The top of at least one such window shall be not less than 6½ feet above the floor, and the upper half thereof shall be made so as to open the full width.

Order 5720. Isolation of Fire Hazards.

All boiler and furnace rooms, including fuel rooms and breeching, all laundries, drying rooms, carpenter shops, paint shops, and other hazardous work rooms and storage rooms in all buildings accommodating transients, and in hospitals, asylums and other places of detention, shall be enclosed with a four-hour fire-resistive enclosure as specified in Orders 5105 and 5106. All openings shall be protected by self-closing fire-resistive doors as specified in Order 5109.

In all other buildings under this classification, such rooms shall be enclosed with two-hour fire-resistive enclosures as specified in Orders 5105 and 5106, or better.

Order 5721. Fire Protection Equipment.

1. Standard first-aid standpipes shall be provided in every building which is more than 2 stories high and accommodates 20 or more transients, and in all hospitals, asylums and other places of detention.

2. In the above buildings where adequate water supply is not available, and in buildings accommodating less than 20 transients where first-aid standpipes are not provided, a standard fire extinguisher shall be placed on each floor at the head of each stairway and at each elevator or group of elevators.

Order 5722. Fire Alarm.

In every building which accommodates 20 or more transients, there shall be a proper alarm or gongs which can be operated from any story and can be heard throughout the building. Every such alarm system shall be tested at least once every week.

Order 5723. Scuttle.

Every building more than one story in height which accommodates more than 4 families, or 30 persons, shall have a permanent means of access to the roof from the inside. The opening shall be not less than 20 x 30 inches and there shall be a permanent ladder or stairway leading thereto.

Order 5724. Directions for Escape.

In every room liable to be used by transients, a notice shall be conspicuously posted giving complete and plain directions for reaching at least two exits.

In addition to this, a red exit light shall be provided over each exit on every floor.

Chapter 10

HAZARDOUS OCCUPANCIES

Order 5750. Garages.

1. Definitions.

A garage is a building, or part of a building, which accommodates or houses self-propelled vehicles. For the purpose of this code the term vehicle includes land, air and water vehicles.

A private garage is one used in connection with a private residence for the purpose of housing self-propelled vehicles owned by the occupant of the residence and used only for personal or family service.

2. Construction Requirements.

(a) All garages, except private garages, which are more than 500 square feet in area shall have walls and roof of ordinary construction, as specified in Order 5102, or better, and all floors of vehicle storage rooms, salesrooms, and repair shops shall be of not less than four-hour fire-resistive construction, as specified in Order 5106.

Exceptions:

(1) A garage not more than one story in height and 2,000 square feet in area may have walls and roof of frame construction if located at least 100 feet from any other building or boundary line between premises.

(2) A hangar for the storage of not more than one airplane or a boat house for the storage of not more than one motor boat may be of frame construction if located at least 15 feet from any property line or other building.

(b) All walls, or parts of walls, nearer than 5 feet to a boundary line between premises or to any other building shall be unpierced; all walls, or parts of walls, nearer than 10 feet, but not nearer than 5 feet, to a boundary line between premises or to any other building shall have all openings therein protected by means of fire-resistive doors and windows as specified in Orders 5109 and 5110.

(c) Where a garage, other than a private garage, is built in connection with a building used for other purposes, it shall be separated therefrom by means of unpierced four-hour fire-resistive walls, as specified in Order 5105, and un-

e below the level of the driveway or grade at such equip-
ient.

(f) There shall be no basement or other open space
nder the floor of the dispensing area outside of the build-
ng. There shall be no basement or other open space under
he floor of any filling station building, unless:

(1) The main floor level is at least 6 inches above
driveway or grade at the dispensing equipment, and

(2) There is no outside door, window or other wall
pening to such under floor space, except fuel chutes or
ther similar vertical openings having a tight-fitting cover,
with the bottom of such opening at least 6 inches above the
driveway or grade at the dispensing equipment.

(3) The floor and enclosure of the under floor space
is of four-hour fire-resistive construction as specified in
Orders 5105 and 5106.

(4) The under floor space is effectively vented by
gravity means.

Note: For requirements applying to floor pits, see Order 5750.

Order 5752. Automobile Tire or Battery Shops.

1. Any building, or part of a building, in which tires are repaired or fitted to vehicles shall be constructed, equipped and maintained as a garage under Order 5750.

2. Any building or part of a building, in which electric storage batteries are charged, repaired, or are installed in vehicles shall be constructed, equipped and maintained as a garage under Order 5750.

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