

**ARTICLE IX
GENERAL CONSTRUCTION REQUIREMENTS**

SECTION 900. WORKMANSHIP.

Workmanship in the fabrication, preparation and installation of materials shall conform to generally accepted good practice. Specific provisions of this article shall not be deemed to suspend any requirements of good practice, but shall be regarded as supplementing or emphasizing them, and shall be controlling. The North Carolina Building Code Council shall, as may be necessary, promulgate rules in accordance with section 143-141 G.S. embodying the requirements of such generally accepted good practice.

SECTION 901. WORKING STRESSES, GENERAL.

(a). Every building or structure hereafter erected and all new construction in the alteration of an existing building or structure shall be so designed and constructed that the working stresses fixed in this article are not exceeded. In using these stresses, the effects of all loads and conditions of loading and the influence of all forces, affecting the design and strength of the several parts shall be taken into account.

(b). Higher stresses than specified in this article may be used only if it is clearly established, by test or other approved evidence, that material of a higher grade or a superior workmanship is to be employed. The use of higher stresses, however, shall not be allowed until a statement, giving the reasons for such permission, together with the facts and circumstances on which it is based, is placed on file and made a part of the official record of the permit.

SECTION 902. EXCAVATIONS.

1. General.

(a). Until provision for permanent support has been made, excavations shall be properly guarded and protected to prevent the same from becoming dangerous to life or limb, and, where necessary, shall be sheetpiled or braced to prevent the adjoining earth from caving in, by the person causing the excavation to be made.

(b). The person causing any excavation to be made shall prevent the movement of the earth in the adjoining property and the trees and natural objects thereon or therein and maintain or restore all public sidewalks, curbs, pavements and the property of public utilities located within street lines, which may be affected by the excavation.

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2. Support of neighboring buildings and structures.

(a). When an excavation extends not more than 10 feet below curb level or below the surface of the ground where there is no such curb level, the owner of a building or structure adjacent to the excavation, the safety of which may be affected by such excavation, shall be notified in writing by the one causing the excavation to be made at least one week before the excavation is commenced. The owner of the adjoining structure shall preserve and protect the same from injury and, when necessary, shall underpin and support the same by proper foundations. For such purpose, he shall be permitted, if necessary, to enter upon the premises where such excavation is being made.

(b). When an excavation extends more than 10 feet below curb level the person causing such excavation to be made shall, if afforded the necessary consent to enter upon the adjoining land, at his own expense, preserve and protect from injury every building or structure, the safety of which may be affected by such excavation and, when necessary, shall underpin and support the same by proper foundations, irrespective of the depth to which the foundations of such building or structure may extend. If the necessary consent is not accorded to the person making the excavation, then it shall be the duty of the person refusing such consent to preserve and protect such building or structure from injury and, when necessary, to underpin and support the same by proper foundations, and for that purpose such person shall, when necessary, be permitted to enter upon the premises where such excavation is being made.

(c). In case there is a party wall along a lot line of the premises where an excavation is being made, the person causing the excavation to be made, shall at his own expense, preserve such party wall in as safe a condition as it was before the excavation was commenced and shall, when necessary, underpin and support the same by proper foundations.

(d). In case a building or structure is so located that the curb level to which it is properly referred is at a higher level than the curb level to which the excavation is referred, such part of the necessary underpinning or foundation as may be due to the difference in the curb levels, shall be made and maintained at the joint expense of the owners of the adjoining premises at that point.

SECTION 903. FOUNDATIONS, GENERAL.

1. General requirements. Except when erected upon hardpan or solid rock or upon walls or piers on the water front, foundation walls or other permanent supports shall be carried not less than one foot below frost line and shall rest on solid ground or on

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leveled rock, or on piles or ranging timbers when solid earth or rock is not found; provided that when one-story buildings of wood frame construction, ordinary construction, noncombustible construction or unprotected metal construction do not exceed 750 square feet in area, such foundation walls or other permanent supports shall not be required.

2. Footings.

(a). Footings when needed shall consist of masonry, reinforced concrete or steel grillages. Footings of wood may be used if they are entirely below permanent water level or if they are impregnated with creosote or other approved preservative as specified for pile foundations in section 906.2.

(b). Where metal is incorporated in or forms part of a foundation, except reinforcing steel in concrete and steel grillages encased in concrete, it shall be protected from rust by paint, asphalt, concrete, or by such materials and in such manner as may be approved by the City Building Inspector.

3. Footing loads. The full dead load, including the weight of the footings, foundations, the overlying fill, and the reduced required live loads on the lowest walls, piers or columns shall be considered in proportioning and designing the footings.

4. Design.

(a). Footings shall be so designed that the pressure on the soil per unit of area shall, so far as possible, be uniform under all parts of the building or structure.

(b). The areas of footings shall be in proportion to the full dead loads, including the weight of the footings; in no case shall the full dead loads plus the live loads reduced in accordance with section 803-9 cause a pressure under the footing exceeding the soil bearing capacity permitted by section 904.

SECTION 904. SOIL BEARING VALUES.

1. Presumptive capacity.

(a). In the absence of satisfactory tests, the bearing value per square foot of different soils shall be deemed to be as follows:

Soft Clay	1.5 tons
Medium stiff clay	2.5 tons
Sand, fine, loose	2 tons
Sand, coarse, loose; compact fine sand; and loose sand-gravel mixture	3 tons
Gravel, loose; and compact coarse sand	4 tons
Sand-gravel mixture, compact	6 tons
Hardpan and exceptionally compacted or partially cemented gravels	10 tons

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Sedimentary rocks such as shales, sandstone, soft limestones -----	15	tons
Foliated rocks, bedded limestones, schist or slate.....	40	tons
Massive crystalline bed rocks, granite.....	100	tons

(b). In case a building or structure rests partly on rock or hardpan and partly on some other soil, the bearing value shall be reduced or special provisions made in the design of the structure to prevent serious differential settlements which will impair the safety of the structure.

2. Soil tests.

(a). When a doubt arises as to the safe sustaining power of the soil upon which a building or structure is to be erected, or it is desired to exceed the presumptive capacity, the City Building Inspector may direct that borings or tests be made by and at the expense of the owner of the proposed building or structure to determine the sustaining power of the soil. Whenever such a test is made the City Building Inspector shall be notified so that he may be present in person or by representative. A complete record of the test shall be filed with the City Building Inspector.

(b). The proposed safe load shall be allowed if the increment of settlement obtained under 50 per cent overload does not exceed 60 per cent of the settlement obtained under the proposed safe load. The settlement under the allowed load shall not exceed 1/2 inch. If, at the proposed safe load, the above conditions are not satisfied, the allowable bearing value shall be reduced accordingly.

3. Filled ground. No foundation of a building or structure shall be placed on fill material, organic material, or silt until the City Building Inspector has determined by test or inspection, the safe bearing value that may be assumed.

SECTION 905. FOUNDATION WALLS.

1. Materials. Foundation walls shall be built of masonry, reinforced concrete, or steel encased in masonry; provided that when structural clay tile is used it shall meet the requirements to resist frost action in the presence of moisture, in accordance with ASTM C34-41 for structural clay load bearing wall tile, grade LB X.

2. Thickness.

(a). Foundation walls shall be of adequate strength and thickness to resist lateral pressures from adjacent earth and to support their vertical loads; but the thickness shall be not less than the actual thickness of walls supported by them, except as permitted by paragraph (b) below, and shall be not less than the minimum thicknesses specified in paragraphs (c) and (d) below.

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(b). Foundation walls of 8-inch thickness may be used as foundations for dwellings with masonry-veneered wood frame walls, or with 10-inch cavity walls; provided that the dwelling is not more than 1½ stories in height and the total height of the walls including the gable, is not more than 20 feet. Such walls shall be corbelled with solid units to provide a bearing the full thickness of the wall above. The total projection shall not exceed 2 inches with individual corbels projecting not more than 1/3 the height of the unit. The top corbel course shall be not higher than the bottom of floor joists and shall be a full header course.

(c). Foundation walls shall be not less than 12 inches thick, except as follows:

(1). Solid masonry walls reinforced with at least one 3/8-inch round deformed bar, continuous from footing to top of foundation wall, for each 2 feet of length of the wall, may be 8 inches thick.

(2). Solid masonry walls that do not extend more than 5 feet below the adjacent finished ground level and hollow walls of masonry and walls of hollow units that do not extend more than 4 feet below the adjacent finished ground level, may be 8 inches thick. The depth may be increased to 7 feet with the approval of the City Building Inspector when he is satisfied that soil conditions warrant such increase. The total height of the foundation wall and the wall supported shall not exceed that permitted by section 907-5 for 8-inch walls.

(3). Foundation walls of cast-in-place concrete may be 8 inches thick; and when supporting 1-story structures, and the area within the foundation walls is not excavated, they may be 6 inches thick if the total height of the foundation wall and the wall supported is within the allowable height of 6-inch walls as specified in section 907-5 (a) (4).

(d). Foundation walls of rubble stone shall be at least 16 inches thick.

3. Waterproofing and Dampproofing. In buildings hereafter erected, if by reason of dampness in the ground, the City Building Inspector shall deem it necessary to do so, foundation walls below the adjacent ground level shall be rendered waterproof or dampproof as conditions require by some approved process.

SECTION 906. PILE FOUNDATIONS.

1. General.

(a). Piles shall be driven to solid bearing where practicable. The method of driving shall be such as not to impair their strength.

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(b). If there are indications, at any site at which piles are to be used, that conditions exist, with respect to soil constituents or changing water levels, which will cause serious deterioration of the piles, and if investigations demonstrate that such conditions actually do exist suitable protective measures against such deterioration shall be employed or the design loads shall be appropriately reduced.

(c). All piles shall be accurately spotted, driven plumb, with the butt, and point, if necessary, protected from injury during driving. Injured or broken piles shall not be used.

(d). The allowable load on piles shall be as determined by an approved formula or by a loading test, but shall not exceed the maximum loads specified in subsections 2, 3, 4 and 5, except on the basis of a loading test.

In the absence of loading tests, or substantiated adequate pile formulas, the safe bearing values for timber, concrete and steel piles shall be determined by the following formulas:

$$P = \frac{2 WH}{S+1.0} \text{ for gravity hammers.}$$

$$P = \frac{2 WH}{S+0.1} \text{ for single action steam hammers.}$$

$$P = \frac{2H (W+AP)}{S+0.1} \text{ for double acting steam hammers.}$$

Where P=safe bearing power in pounds.

W=weight, in pounds, of striking parts of hammer.

H=height of fall in feet.

A=Area of piston in square inches.

P=steam pressure in pounds per square inch at the hammer.

S=average penetration in inches per blow for the last 5 to 10 blows for gravity hammers and the last 10 to 20 blows for steam hammers.

The above formulas are applicable only when—

The hammer has a free fall.

The head of the pile is not broomed or crushed.

The penetration is reasonably quick and uniform.

There is no sensible bounce after the blow.

A fall of 15 feet shall preferably be used in applying the formula for gravity hammers.

Twice the height of the bounce shall be deducted from "H" to determine its value in the formula.

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(e). Where any doubt exists as to the safe load-carrying capacity of any pile the City Building Inspector may order a loading test to be made on the pile.

(f). The safe load-carrying capacities may be determined by means of loading tests performed on not less than two typical piles of an installation. Tests shall be made with 150 per cent of the proposed load and such tests shall be considered unsatisfactory and the results unacceptable if, after the piles being tested have been standing 24 hours, the total net settlement after deducting the rebound is more than 1/100 of an inch per ton of total test load.

(g). The use of types of piles not specifically mentioned herein, and the use of piles under conditions not specifically covered herein, may be permitted, subject to the approval of the City Building Inspector upon the submission of acceptable test data, calculations and other information relating to the structural properties and load-carrying capacity of such piles. Prior to giving such approval the City Building Inspector may require any information or demonstrations which he deems necessary for the determination of the adequacy of the design or of the suitability of the method of installation. In no case shall the allowable design load exceed that determined in accordance with the provisions of this section.

(h). If the supporting capacity of a single row of piles is sufficient to adequately support a structure, the piles shall be driven alternately to the left and right of the center line of the wall, the centers of the piles being at least $\frac{1}{2}$ of their cut-off diameter distance from the center line of the wall, except in wood frame structure where piles may be driven in a single row.

(i). The minimum distance between centers of piles not driven to rock shall be not less than twice the greatest diameter of a round pile, nor less than twice the diagonal dimension of a rectangular or rolled structural steel pile, nor less than 2 feet 6 inches. The minimum distance between centers of piles driven to rock shall be not less than the greatest diameter of a round pile plus one foot, nor less than the diagonal dimension of a rectangular or rolled structural steel pile plus one foot.

(j). Plain concrete used for capping of piles shall be not less than 12 inches above the tops of the piles, except that for one-story buildings of wood frame construction or unprotected metal construction, the thickness shall be not less than 8 inches. When reinforced concrete is used for capping, the thickness at the edge shall be not less than 12 inches above the reinforcement and 2 inches between the top of the pile and steel reinforcement placed above it. The minimum horizontal distance from the edge of the cap to the nearest pile surface shall be 3 inches and all pile caps

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shall extend 4 to 6 inches below the cut-off of the piles. Timber capping shall be of dense, sound wood not less than 6 inches thick properly joined and attached to the piles.

2. Timber piles.

(a). Timber piles shall be sound, straight timber and if round they shall have a reasonably uniform taper and shall conform to the standard Specification for Round Timber Piles, ASTM D 25-37 (ASA 06-1939). For short piles and light loads, round piles at least 8 inches in diameter at the cut-off and 6 inches in diameter at the tip may be used with the approval of the City Building Inspector. Squared timber piles less than 8 inches square, nominal, shall not be used.

(b). Where the safe load carrying capacity is not determined by tests made in accordance with subsection 1 of this section, the maximum allowable load on a timber pile shall be 20 tons.

(c). Wooden piles under buildings or structures built over water, may project above the surface a sufficient amount to raise the building above the highest water line, and the building may be placed directly thereon without other foundation.

(d). Untreated piles used in permanent construction, except where used for lightly loaded wood frame construction over water or marsh lands, shall be cut off below permanent water level.

(e). Piles of Southern Pine, Norway Pine, Douglas Fir or Red Oak when pressure treated by an empty cell process, with Grade One coal tar creosote to a net final retention of not less than 12 pounds of creosote per cubic foot may be used as follows: Where the upper portion of the pile is exposed and accessible for inspection, the cut-off may be above ground level or water level; where the upper portion of the pile will not be readily accessible for inspection, the cut-off shall be below the ground level but may be above the ground-water level provided the tops are encased in masonry footings so that no part of the pile will be exposed to the air. The tops of the cut-off piles shall be treated with three coats of hot creosote.

(f). The use of other species of wood and the use of other preservative materials and methods of treatment, conforming to recommendations of the U. S. Forest Products Laboratory, may be used subject to written approval of the City Building Inspector.

3. Concrete-filled steel pipe piles.

(a). Concrete-filled steel pipe piles shall have a nominal outside diameter of not less than $10\frac{3}{4}$ inches and a nominal wall thickness of not less than $\frac{5}{16}$ inch except that pipes having a nominal outside diameter 14 inches or over shall have a nominal wall thickness of not less than $\frac{3}{8}$ inch. The steel pipe shall con-

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form to the standard Specifications for Welded and Seamless Steel Pipe Piles, ASTM A252-46. The ends of each tube shall be faced perpendicular to its axis.

(b). Splices shall be so made and installed as to insure good alignment of the spliced parts. For each splice in excess of one, a 5 per cent reduction in allowable load shall be made, except that piles which have been spliced at the mill, or by an approved procedure in the field, to develop full section strength shall be acceptable as the equivalent of unspliced piles.

(c). The load on concrete-filled steel pipe piles shall not exceed a unit stress of $\frac{1}{4}$ of the specified concrete strength on the concrete which shall have an ultimate compressive strength at the end of 28 days of not less than 2,500 pounds, plus 9,000 pounds per square inch on the steel. Where the safe load-carrying capacities of concrete-filled steel pipe piles are not determined by tests made in accordance with subsection 1 of this section, maximum allowable loads shall be as follows:

(1) Piles driven open-ended to rock:

10 $\frac{3}{4}$ -inch Outside Diameter Pile.....	55 Tons
12 $\frac{3}{4}$ -inch Outside Diameter Pile.....	70 Tons
14-inch Outside Diameter Pile.....	80 Tons
16-inch Outside Diameter Pile.....	100 Tons
18-inch Outside Diameter Pile.....	120 Tons
20-inch Outside Diameter Pile.....	140 Tons
22-inch Outside Diameter Pile.....	150 Tons

The above loads are based on wall thicknesses of $\frac{3}{8}$ inch. They shall be reduced by 10 per cent when wall thicknesses of $\frac{5}{16}$ inch are used for piles less than 14 inches in diameter.

For each increase of $\frac{1}{16}$ inch in wall thickness, the above values may be increased by 10 per cent, with a maximum increase of 20 per cent.

(2). Piles driven open-ended to cemented hardpan which is not underlaid by a softer stratum: Not more than the values given above for rock-bearing piles but in no case more than 70 tons.

(3). Piles driven open- or closed-ended, and bearing in gravel, sand, and similar granular material which is not underlaid by a softer stratum: Not more than 50 tons.

(4) Piles driven open- or closed-ended and bearing in other materials: 30 tons if driven 40 feet or less into the ground; 40 tons if driven more than 40 feet into the ground.

4. Concrete piles.

(a). Concrete piles moulded and cured before driving shall be provided with not less than 2 per cent nor more than 4 per cent

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of longitudinal reinforcement. The steel shall be so placed that there is not less than $1\frac{1}{2}$ inches of concrete on all sides. The diameter or lateral dimension of such piles shall be not less than 8 inches at the point, and shall average not less than 10 inches throughout the length of the pile for piles up to 15 feet, nor less than 14 inches for piles up to 30 feet, nor less than 15 inches for piles up to 40 feet. For piles over 40 feet in length the diameter or lateral dimension shall be $\frac{1}{35}$ of the length, but no pile shall be required to exceed 2 feet in diameter or lateral dimension. Where the safe load-carrying capacity is not determined by tests made in accordance with subsection 1 of this section, the maximum allowable load in tons shall not exceed 2 times the average diameter or least lateral dimension in inches, nor shall it exceed 40 tons.

(b). Concrete piles cast in place shall be so made and placed as to insure the exclusion of foreign matter and to insure a continuous and full sized pile. Piles shall be driven in such order and with such spacing as to insure against distortion or injury to the finished pile and no pile shall be driven within 10 feet of a pile filled with concrete less than 24 hours old. The average diameter of such piles shall be at least 11 inches and the diameter at the point shall be at least 8 inches. The placing of the concrete through water in such piles is prohibited. Where the safe load-carrying capacity is not determined by tests made in accordance with subsection 1 of this section, the maximum load shall be 30 tons.

(c). The concrete for concrete piles shall be equal to that specified for 3,000 pound concrete. The concrete as it is placed shall be spaded or otherwise agitated to insure uniform consistency and a complete filling of the pipe or mould. The placing of the concrete of a pile, when once started shall continue uninterruptedly until the pipe or mould is entirely filled.

5. Rolled structural steel piles.

(a). Rolled structural steel piles shall conform to the standard Specifications for Steel for Bridges and Buildings, ASTM A7-46 (ASA G24.1), and shall be of H form, with flange projection not exceeding 14 times the minimum thickness of metal in either flange or web, and with total flange width at least 85 per cent of the depth of the section. No section shall have a nominal thickness of metal less than $\frac{3}{8}$ inch nor a nominal depth in the direction of the web of less than 8 inches. Rolled structural steel piles 40 feet or less in length shall not be spliced, except where special permission is granted by the City Building Inspector for the use of spliced sections, due to unforeseen field conditions.

(b). The allowable load on rolled structural steel piles shall not exceed 9,000 pounds per square inch. Where the safe load-

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carrying capacities of rolled structural steel piles are not determined by tests made in accordance with subsection 1 of this section, maximum allowable loads per pile shall be as follows:

- (1) Piles driven to practical refusal to a firm bearing on rock or on cemented hardpan which is not underlaid by a softer stratum:

<i>Size of Pile— Nominal Depth in Inches</i>	<i>Allowable Load</i>
8	40 Tons.
10	45 Tons.
12	55 Tons
14	70 Tons

- (2) Piles bearing in gravel and boulder formations not underlaid by a softer stratum: not more than 70 per cent of the rock bearing load, but in no case more than 40 tons.
- (3) Piles bearing in other materials: 30 tons unless driven more than 40 feet into the ground, 40 tons if driven more than 40 feet into the ground.

SECTION 907. MASONRY.

1. Materials.

- (a). All masonry shall be constructed of approved materials.
- (b). Dimensions specified are nominal unless otherwise stated; actual dimensions may vary from the nominal by the thickness of a mortar joint, but not to exceed one-half inch.
- (c). Except as otherwise specifically provided in this code or in rules promulgated by the North Carolina Building Code Council, the several specifications of the American Society for Testing Materials, the American Concrete Institute and the American Standards Association for the qualities of masonry building materials shall be deemed to be generally accepted standards.
- (d). Existing masonry may be used without change, if in good condition, in buildings hereafter erected or altered; provided the stresses in the masonry under the new conditions do not exceed the working stresses permitted by this code.

2. Construction.

- (a). All masonry shall be protected against freezing for at least 48 hours after being placed. Unless adequate precautions against freezing are taken, no masonry shall be built when the temperature is below 32° Fahrenheit on a rising temperature or below 40° on a falling temperature, at the point where the work is in progress. No frozen materials shall be built upon.

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(b). Except when carried independently by girders at each floor, no wall shall be built up more than 25 feet in height in advance of other walls of the building.

(c). Masonry walls that meet or intersect shall be adequately bonded or anchored. Piers having less than 4 square feet of cross-sectional area when located at an intersection with a wall shall be bonded into and built as part of that wall.

(d). Except for window-paneled backs and permissible chases and recesses, walls shall not vary in thickness between their lateral supports. When a change in thickness, due to minimum thickness requirements, occurs between floor levels, the greater thickness shall be carried up to the high floor level.

(e). Isolated piers or posts on the interior of buildings shall not be built of stone. The unsupported height of piers shall not exceed 10 times their least dimension. Hollow masonry units shall not be used for isolated piers to support beams and girders unless solidly filled with concrete or Type A mortar in which case the allowable load may be increased 25 per cent.

(f). Door and window openings in walls shall be spanned by well buttressed arches, or by lintels having bearings proportioned to their loads but not less than 4 inches.

(g). No masonry, except for interior partitions, shall be supported on wooden girders or other form of wood construction.

(h). No timber, other than nailing blocks not exceeding 2 by 4 by 8 inches in size, shall be placed in masonry walls; except that in buildings of ordinary construction, timber lintels may be placed over openings, on the inside of the wall, resting at each end not more than two inches on the wall, and chamfered or cut to serve as centers for masonry arches; and with the further exception that timber members used for decorative purposes may be set against the masonry, or may be set into the masonry where the wall exceeds 8 inches in thickness.

(i). During erection, walls shall be adequately braced and arches temporarily supported.

3. Mortar.

(a). Mortar used in masonry construction shall be classified as follows:

Type	<i>Comprehensive strength of 2-inch cubes at 28 days pounds per square inch.</i>
A.....	2,500 or above
B.....	600 to 2500
C.....	200 to 600
D.....	75 to 200

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(b). Where the classification has not been established by a compressive strength test approved by the North Carolina Building Code Council, mortars proportioned in accordance with the following table shall be assumed to be of the types indicated.

Mortar Proportions

Mortar Type	Proportions by Volume		
	Cement	Hydrated Lime or Lime Putty	Aggregate, measured in a damp and loose condition
A	1 (Portland)	0 to $\frac{1}{4}$	Not over 3 parts
B	1 (Portland)	1 to $1\frac{1}{4}$	Not over 6 parts.
B	1 (Masonry Type II*)	0	Not over 3 parts
C	1 (Portland)	2 to $2\frac{1}{2}$	Not over 9 parts
C	1 (Masonry Type I*)	0	Not over 3 parts
D	0 to $\frac{1}{2}$ (Portland)	1 to $1\frac{1}{4}$	Not over 3 parts

*As defined in Federal Specification SS-C-181 b, Masonry Cement.

(c). **Type of Mortar required.** Masonry shall be laid in Type A, Type B or Type C mortar, except as follows:

Type A mortar shall be used in foundation walls of hollow masonry units.

Type A or Type B mortar shall be used in footings, foundation walls of solid masonry units, isolated piers, load bearing or exterior walls of hollow masonry units, hollow walls and cavity walls.

Type D mortar may be used in solid masonry walls, other than parapet walls or rubble stone walls, not in contact with the soil and not less than 12 inches thick nor more than 35 feet in height, provided the walls are laterally supported at intervals not exceeding 12 times the wall thickness.

Gypsum partition tile and block shall be laid in gypsum mortar. Non-bearing partitions and fireproofing of structural clay tile may be laid in gypsum mortar. Fire brick shall be laid in fire clay mortar.

4. Working Stresses.

(a). The allowable compressive stress in pounds per square inch of gross cross-sectional area shall not exceed the following limits:

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Brick and other solid masonry units of clay or shale; sand-lime or concrete brick:

Average Compressive Strength of Units Tested in Position as Placed in the Masonry	Mortar			
	Type A	Type B	Type C	Type D
8000 plus	400	300	200	100
4500-8000	250	200	150	100
2500-4500	175	140	110	75
1500-2500	125	100	75	50

Cavity Walls and Hollow Walls:

Material	Mortar Type	
	A	B
Solid Masonry Units	125	100
Hollow Masonry Units	60	50
Plain Concrete	300	

Solid Concrete Masonry Units:

Average Compressive Strength	Mortar Type		
	A	B	C
1200 to 1800	125	100	60
1800 or higher	175	125	80

Hollow Masonry Units: Stress on gross cross-sectional area:

Type A Mortar	85
Type B Mortar	70

Plain Concrete. The allowable compressive stress on plain concrete shall not exceed 25 per cent of the ultimate compressive strength of the concrete where the ratio of height to thickness does not exceed 10.

Stone and Cast Stone:

Material	Mortar Type			
	A	B	C	D
Granite, Ashlar	800	640	500	400
Limestone, Ashlar	500	400	325	250
Marble, Ashlar	500	400	325	250
Sandstone, Ashlar	400	320	250	160
Cast Stone	400	320	250	160
Rubble Stone	140	100	80	---

(b). In walls veneered with stone, architectural terra cotta or other approved facing material, only the backing shall be assumed to take load and the working stress in such backing shall be taken as that prescribed for the type of masonry used as backing.

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(c). In walls composed of different kinds or grades of units or mortar the maximum stress shall not exceed the allowable stress for the weakest of the units and mortar of which the wall is composed.

(d). Reinforced brick masonry. See Section 907-12.

5. Solid masonry walls, except stone walls.

(a). Thickness of Bearing Walls.

(1) The thickness of solid masonry bearing walls shall be sufficient at all points to keep the combined stresses due to live, dead, and other loads for which the building is designed within the limits prescribed in subsection 4 of this section.

(2) Except as otherwise provided in paragraphs (3) to (8) below, the minimum thickness of solid masonry bearing walls other than fire walls and party walls shall be not less than 12 inches for the uppermost 35 feet of their height, and shall be increased 4 inches for each successive 35 feet or fraction thereof measured downward from the top of the wall.

(3) Where solid masonry bearing walls are stiffened at distances not greater than 12 feet apart by cross walls, or by internal or external offsets or returns at least 2 feet deep, or 12 feet vertical by reinforced concrete floors or roof, they may be 12 inches thick for the uppermost 70 feet, measured downward from the top of the wall, and shall be increased 4 inches in thickness for each successive 70 feet or fraction thereof.

(4) In residential building not more than 2 stories in height, solid masonry bearing walls may be 8 inches thick when not over 35 feet in height. Walls above foundation in one-story dwellings and one-story private garages may be 6 inches thick when not over 9 feet in height, except that the height to the peak of a gable may be 15 feet.

(5) Outside the fire limits solid masonry bearing walls of business buildings, public buildings and industrial buildings and storage buildings not more than one story high, may be 8 inches thick, provided they are reinforced at intervals, not exceeding 20 feet, by cross walls, piers or buttresses.

(6) Outside the fire limits solid masonry bearing walls, 8 inches thick, may be used for buildings not exceeding 30 feet nor 2 stories in height, the walls of which, under this code, could be of wood frame construction; provided they do not exceed 50 feet in length between cross walls, piers, or buttresses.

(7) Solid masonry bearing walls above roof level, 12 feet or less in height, enclosing penthouses or roof structures may be 8 inches thick and may be considered as neither increasing the

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height nor requiring any increase in the thickness of the wall below, provided the requirements for allowable stresses are complied with.

(8) Outside the fire limits, solid masonry bearing walls 8 inches thick may be used for buildings of fireproof, semi-fireproof and non-combustible Type I construction, walls not to exceed one story nor 35 feet in height and must be laterally braced in conformance with this section.

(b). **Thickness of Non bearing Exterior walls.** The thickness of non-bearing exterior walls, except fire walls and party walls, shall be not less than 8 inches for the uppermost 15 feet, and shall increase 4 inches in thickness for each successive 35 feet or fraction thereof measured downward from the top of the wall. (This section may be waived for panel walls where the panel wall assembly has fire resistive rating in accordance with Table 700 and is laterally supported in conformance with this section.)

(c). **Lateral Support.** Solid masonry walls shall be supported at right angles to the wall face at intervals not exceeding 20 times the nominal wall thickness if laid in Type A, B, or C mortar, and not exceeding 12 times the nominal wall thickness if laid in Type D mortar. Such lateral support shall conform to subsection 13 of this section.

(d). **Bond.** The facing and backing of solid masonry bearing walls shall be bonded so that not less than 4 per cent of the wall surface is composed of full length headers. The distance between adjacent full length headers shall not exceed 24 inches either vertically or horizontally. In solid brick walls more than 12 inches thick the inner joints of header courses shall be covered with another header course which shall break joints with the course below.

(e). **Other Requirements.**

(1) Under-burned clay bricks shall not be used in any part of a building or structure where exposed to the weather, nor in isolated piers, nor in such part of a bearing wall above which the wall extends more than 40 feet.

(2) Clay or shale brick laid in Type A or Type B mortar shall be wet immediately before being laid, except that very hard or vitrified brick need not be wetted.

(3) Horizontal and vertical joints in brick masonry shall be filled with mortar.

(4) Except in dwellings interior bearing walls that are less than 12 inches in thickness and support wooden floor or roof joists shall be corbeled not less than 3 inches to receive such joists, unless approved metal joist hangers are used.

6. Stone Walls.

(a). Thickness.

(1) The thickness of stone walls shall be sufficient at all points to keep the combined stresses due to live, dead, and other loads for which the building is designed within the limits prescribed in subsection 4 of this section.

(2) The minimum thickness of walls of stone ashlar shall be not less than that required for solid masonry walls in subsection 5 of this section.

(3) Rubble stone walls shall be 4 inches thicker than is required for solid masonry walls in subsection 5 of this section, but shall not be less than 16 inches thick, and shall not exceed 40 feet in height.

(b). Lateral support. Stone walls shall conform to the requirements for lateral support of solid masonry walls in subsection 5 of this section.

(c). Bond.

(1) In ashlar masonry, bond stones uniformly distributed shall be provided to the extent of not less than 10 per cent of the area and having not less than 4 inches of bond into the backing masonry.

(2) Rubble stone masonry 24 inches or less in thickness shall have bond stone with a maximum spacing of 3 feet vertically and horizontally, and if the masonry is of greater thickness than 24 inches shall have 1 bond stone for each 6 square feet of wall surface on both sides and no header stone shall be less than 12 inches long measured at right angles to the face of the masonry.

(d). Natural Beds. All stones showing pronounced cleavage shall be laid on their natural bed, except for cornices and other projecting members which shall have the grain or bedding planes vertical and at right angles to the face of the masonry.

7. Walls of hollow masonry units.

(a). Thickness and height.

(1) The thickness of walls of hollow masonry units shall be sufficient at all points to keep the combined stresses due to live, dead, and other loads for which the building is designed within the limits prescribed in subsection 4 of this section.

(2) The minimum thickness of walls of hollow masonry units shall be not less than that required for solid masonry walls in subsection 5 of this section.

(3) Load Bearing Walls of hollow masonry units shall not exceed 50 feet in height.

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(b). **Lateral support.** Walls of hollow masonry units shall be supported at right angles to the wall face at intervals not exceeding 18 times the nominal wall thickness. Such lateral support shall conform to subsection 13 of this section.

(c). **Bond.**

(1) Hollow masonry units shall have full mortar coverage of the face shells in both the horizontal and vertical joints.

(2) Where two or more hollow units are used to make up the thickness of a wall, the inner and outer courses shall be bonded at vertical intervals, not exceeding 3 feet, by lapping at least 4 inches over the unit below or by lapping with units at least 50 per cent greater in thickness than the unit below at vertical intervals not exceeding 17 inches.

(3) Brick facing or lining (which does not include veneering) when used in hollow block walls shall be bonded to the backing in accordance with paragraph (d) of subsection 5 of this section.

(4) Where walls of hollow masonry units are decreased in thickness, a course of solid masonry shall be interposed between the wall below and the thinner wall above, or the hollow units in the top course of the thicker wall shall be filled solidly with mortar or masonry.

(d). **Bearing:** In walls and piers of hollow masonry units, suitable provision shall be made for proper bearing at the ends of all beams and at points of load concentration.

8. Cavity walls and hollow walls.

(a). **Allowable stresses.** In cavity walls and hollow walls the compressive stresses in pounds per square inch of gross cross-sectional area shall be in conformity with subsection 4 of this section.

(b). **Height and thickness.**

(1) Cavity walls and hollow walls shall not exceed 35 feet in height. Cavity walls, exclusive of the cavity, and hollow walls shall be not less in thickness than required for solid masonry walls in subsection 5 of this section.

(2) In cavity walls, neither the facing nor backing shall be less than $3\frac{3}{4}$ inches in nominal thickness and the cavity shall be not less than 2 inches nor more than 3 inches in width.

(c). **Lateral support.** Cavity walls shall be supported at right angles to the wall face at intervals not exceeding 14 times, and hollow walls at intervals not exceeding 18 times the nominal wall thickness. Such lateral support shall conform to subsection 13 of this section.

(d). Bond.

(1) In hollow walls the parts of same shall be connected by bonds of brick, stone or the material of the wall, placed not more than 24 inches apart in either direction; but the parts shall not be deemed to act together in the support of loads unless such bonds are of a size and design to fully develop the strength of either part.

(2) In cavity walls the facing and backing shall be securely tied together with suitable bonding ties of adequate strength. A 3/16-inch diameter steel rod or metal tie of equivalent stiffness coated with a non-corroding metal or other approved protective coating shall be used for each 3 square feet of wall surface. Where hollow masonry units are laid with the cells vertical, rectangular ties shall be used; in other walls the ends of ties shall be bent to 90 degree angles to provide hooks not less than 2 inches long. Ties shall be embedded in horizontal joints of facing and backing. Additional bonding ties shall be provided at all openings, spaced not more than 3 feet apart around the perimeter and within 12 inches of the opening. Cavity walls of plain concrete shall be reinforced as provided for solid walls of plain concrete in subsection 11 of this section.

(e). Bearing.

(1) In hollow walls or cavity walls suitable provision shall be made at each line of floor beams and wherever load concentrations occur, to insure proper bearing.

(2) When cavity walls or hollow walls, in which the cells of hollow units are laid vertical, are decreased in thickness, the units in the top course of the thicker wall shall be filled solidly with mortar or masonry or the exposed openings in such top courses shall be covered with slabs of hard burned tile or concrete at least one inch in thickness or the openings shall be stopped in some other approved manner.

(f). **Drainage.** In cavity walls the cavity shall be kept clear of mortar droppings during construction. Approved flashing shall be installed and adequate drainage provided to keep dampness away from the backing.

9. Faced walls.

(a). **Material.** Materials used for facing shall be not less than 2 1/4 inches thick, and in no case less in thickness than 1/8 the height of the unit.

(b). **Allowable stresses.** Where bonded to the backing as prescribed below, the full cross-section of both the facing and the backing may be considered in computing the stresses.

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(c). **Thickness.** Faced walls shall be not less in thickness than is required for masonry walls of either of the types forming the facing and the backing. Where bonded to the backing as prescribed below, the facing may be considered a part of the wall thickness.

(d). **Bond.**

(1) Brick facing shall be bonded to the backing as prescribed for solid masonry walls in subsection 5 (d) of this section.

(2) Ashlar facing of either natural or cast stone shall have at least 20 per cent of the superficial area extending not less than 4 inches into the backing to form bond stones, which shall be uniformly distributed throughout the wall.

(3) When walls of hollow masonry units are faced with hollow units, the facing units shall be bonded to the backing as required for walls of hollow masonry units in subsection 7 (c) of this section.

10. Attachment of stone facing.

Every projecting stone, and, except when alternate courses are full bond courses, every stone not a bond stone shall be securely anchored to the backing with corrosion resistant metal anchors with a cross section of not less than 0.2 square inch. There shall be at least 1 anchor to each stone and not less than 2 anchors for each stone more than 2 feet in length and 3 square feet in superficial area. Facing stones not over 12 square feet in area shall have at least 1 anchor to each 4 square feet of superficial face area.

11. Solid walls of plain concrete.

(a). **Thickness.**

(1) The thickness of walls of plain concrete shall be sufficient at all points to keep the combined stresses due to live, dead, and other loads for which the building is designed within the limits prescribed in subsection 4 of this section.

(2) The minimum thickness of walls of plain concrete may be 2 inches less than that required for solid masonry walls but not less than 8 inches, except that 6-inch walls may be used where specifically permitted by subsection 5 (a) (4) of this section.

(b). **Lateral support.** Solid walls of plain concrete shall be supported at right angles to the wall face at intervals not exceeding 20 times the nominal wall thickness. Such lateral support shall conform to subsection 13 of this section.

(c). **Plain concrete.** Except as otherwise specifically provided in this section, the Building Code Requirements for Reinforced

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Concrete of the American Concrete Institute (ACI 318-51), shall be deemed to be the generally accepted good practice in plain concrete construction.

(d). **Reinforcement around openings.** Reinforcement symmetrically disposed in the thickness of the wall shall be placed not less than 1 inch above and 2 inches below openings and extend not less than 24 inches each side of such openings or be of equivalent length with hooks. The reinforcement both above and below shall consist of one $\frac{5}{8}$ -inch round rod for each 6 inches in wall thickness or fraction thereof.

12. **Reinforced brick masonry.** When designed and reinforced in accordance with recommendations of the Structural Clay Products Institute as set forth in Brick and Tile Engineering, reinforced brick masonry shall be acceptable in lieu of and under the same restrictions as reinforced concrete.

13. **Lateral support.** The lateral support required by subsections 5, 6, 7, 8 and 11 of this section shall be either vertical or horizontal. It may be obtained by cross walls, piers, or buttresses, when the limiting distance is measured horizontally, or by floors and roofs when the limiting distance is measured vertically. Sufficient bonding or anchorage shall be provided between the walls and the supports to resist the assumed wind force, acting either inward or outward. Piers or buttresses relied upon for lateral support shall have sufficient strength and stability to transfer the wind force, acting in either direction to the ground. When walls are dependent upon floors or roofs for their lateral support, provision shall be made in the building to transfer the lateral forces to the ground.

SECTION 908. REINFORCED CONCRETE.

1. **General.** Except as otherwise specifically provided in this code or in rules duly promulgated by the North Carolina Building Code Council, the Building Code Requirements for Reinforced Concrete as adopted by the American Concrete Institute (ACI 318-51) shall be deemed to be the generally accepted good practice in reinforced concrete construction.

2. **Working stresses.**

(a). Except under the specific conditions given in paragraph (b) below, design stresses shall not exceed the following:

	<i>Lbs. per sq. in.</i>
Extreme fiber of concrete in compression.....	900
Concrete in direct compression.....	500
Concrete in shear	40

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Concrete in shear when diagonal tension is resisted	
by steel	120
Bond between concrete and steel.....	80
Bond between concrete and approved deformed bars.....	100
Steel in tension, structural grade.....	18,000
Steel in tension, intermediate or hard grade or rail steel.....	20,000
Cold drawn steel wire in tension.....	20,000

(b). When evidence satisfactory to the North Carolina Building Code Council is submitted that concrete of a predetermined strength is to be used and that the design and construction will be under competent supervision, higher stresses may be used, in accordance with the Building Code Requirements for Reinforced Concrete as adopted by the American Concrete Institute.

(c). For members carrying wind stresses only, and for combined stresses due to wind and other loads, the working stresses prescribed above may be increased $33\frac{1}{3}$ per cent; provided the section thus found is not less than required by the dead-load and live-loads alone.

3. Concrete.

(a). Average concrete for reinforced concrete shall consist of 1 part portland cement and not more than 6 parts aggregate, by volume measured dry, and not more than $7\frac{1}{2}$ gallons of water per sack, 94 pounds, of cement. The aggregate shall be mixed in an approximate ratio of $2\frac{1}{2}$ parts fine aggregate and $3\frac{1}{2}$ parts coarse aggregate.

(b). Fine aggregate shall consist of clean, hard, durable uncoated grains free from deleterious materials. It shall be well graded in size from $\frac{1}{4}$ inch to fines with not more than 8 per cent passing a 100 mesh sieve.

(c). Coarse aggregate shall consist of gravel, crushed stone, or other approved inert material with similar characteristics having clean, hard, durable uncoated particles free from deleterious materials. It shall be well graded in size from $\frac{1}{4}$ -inch up to a maximum of not more than $\frac{1}{5}$ the narrowest dimension between forms nor more than $\frac{3}{4}$ of the minimum clear spacing between reinforcing bars.

(d). Controlled concrete for reinforced concrete shall be scientifically proportioned to meet the specific requirements imposed and the materials and mixture and placing shall be subjected to tests to determine fitness and proper mixtures.

(e). Concrete shall be deposited as a continuous operation in the final position to avoid segregation of the aggregate due to handling or flowing. It shall be placed at such a rate that the concrete is at all times plastic and flows readily into spaces be-

tween the reinforcement and be thoroughly compacted by suitable means.

4. Reinforcement.

(a). The steel reinforcement shall conform to accepted standards.

(b). Expanded metal lath, steel wire or fabric for the reinforcement of slabs, for lateral reinforcement of columns, or for resistance to shrinkage and temperature stresses may be used.

5. Protection of reinforcement.

(a). The reinforcement of footings and other principal structural members in which the concrete is deposited against the ground shall have not less than 3 inches of concrete between it and the ground contact surface. If concrete surfaces after removal of the forms are to be exposed to the weather or be in contact with the ground, the reinforcement shall be protected with not less than 2 inches of concrete for bars more than $\frac{5}{8}$ inch in diameter and $1\frac{1}{2}$ inches for bars $\frac{5}{8}$ inch or less in diameter.

(b). The concrete protective covering for reinforcement shall conform to the minimum thickness as follows:

For columns, beams and girders..... $1\frac{1}{2}$ inches
For solid slabs and walls $\frac{3}{4}$ inch

(c). Concrete protection for reinforcement shall in all cases be at least equal to the diameter of round bars and $1\frac{1}{2}$ times the side dimension of square bars.

6. Protection against freezing.

(a). Unless approved effective provision is made against freezing, no concrete shall be deposited when the air temperature is 40° Fahrenheit or lower.

(b). Freshly deposited concrete shall be adequately protected against freezing so long as the air temperature is 40° Fahrenheit or lower.

7. Walls.

(a). Enclosure walls of reinforced concrete shall be securely anchored at all floors. Such walls when supported by girders at each story shall be bonded or otherwise securely tied to columns or piers.

(b). In buildings of fireproof construction and semi-fireproof construction the thickness of walls of reinforced concrete shall be not less than 6 inches for the uppermost 15 feet of their height, and shall increase one inch in thickness for each successive 25 feet or fraction thereof measured downward from the top of the

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wall; provided that for walls supported by girders at each story the thickness may be, but shall not be less than 5 inches; and provided that in no case shall the thickness of any part of a bearing wall of reinforced concrete be less than $1/25$ or a panel wall $1/30$ of the unsupported height or width, whichever is the shorter, unless the walls are laterally supported by cross walls, piers or built-in columns at intervals not exceeding 25 times the thickness of the wall.

(c). In buildings of other than fireproof construction and semi-fireproof construction, the thickness of walls of reinforced concrete shall be not less than $1\frac{1}{3}$ times the thickness required for buildings of fireproof construction. In dwellings 2 stories or less in height, the walls may be 6 inches throughout.

(d). The steel reinforcement shall be not less in each direction than 0.0025 times the cross sectional area of the wall if of bars. In walls more than 10 inches in thickness the reinforcement shall be placed in 2 layers. One layer consisting of from $1/2$ to $2/3$ of the total required shall be placed not less than 2 inches nor more than $1/3$ the thickness of the wall from the exterior surface and the remainder of the reinforcement shall be placed not less than $3/4$ inch and not more than $1/3$ the thickness of the wall from the interior surface. The reinforcement shall be spaced not more than 12 inches on centers. Electrically welded fabric of proper gauge may be used if placed in conformity with accepted practice.

(e). Proper reinforcements shall be provided around all openings.

8. Removal of forms. Forms for reinforced concrete shall remain in place until the concrete has hardened. Removable floor forms, beam and girder sides, column casings and other vertical parts of forms, shall not be removed until the concrete has set sufficiently that it will not be injured by their removal, those parts of the forms and shoring that support structural members shall not be removed until such members have acquired sufficient strength to support safely their own weight and such loads as may come upon them.

SECTION 909. FIRE WALLS AND PARTY WALLS.

1. Construction.

(a.) Fire walls and party walls of masonry shall be laid in Type A or Type B mortar.

(b). Fire walls and party walls shall be constructed of solid masonry units, or of hollow masonry units faced on each side with brick, or of reinforced concrete.

(c). Where structural members project into hollow masonry units the hollow space shall be filled with noncombustible mate-

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rial the full thickness of the wall and 4 inches or more above, between and below such members.

(d). A separation of at least 8 inches of solid masonry shall be provided in all fire and party walls between combustible members which may enter such walls from opposite sides.

2. Thickness of solid masonry walls except panel walls.

(a). For business buildings and storage buildings, fire walls and party walls of solid masonry units shall be not less than 16 inches thick for the uppermost 50 feet and increase 4 inches in thickness for each additional 35 feet or fraction thereof measured downward from the top of the wall; except that where the walls are non-bearing, or where beams or girders are supported on the wall by approved metal hangers and do not enter the wall the minimum thickness may be 16 inches for the uppermost 70 feet.

(b). For other buildings, fire walls and party walls of solid masonry units shall be not less than 12 inches thick for the uppermost 35 feet and increase 4 inches in thickness for each additional 35 feet or fraction thereof measured downward from the top of the wall.

3. Thickness of brick-faced hollow masonry walls. Fire walls and party walls of hollow masonry units faced on each side with at least 4 inches of brick shall have a total thickness including the facing not less than 4 inches greater than specified in subsection 2 above for solid masonry walls.

4. Thickness of reinforced concrete walls except panel walls.

(a). For business buildings and storage buildings, fire walls and party walls of reinforced concrete shall be not less than 11 inches thick for the uppermost 35 feet and increase 2 inches in thickness for each successive 35 feet or fraction thereof measured downward from the top of the wall.

(b). For other buildings, fire walls and party walls of reinforced concrete shall be not less than 9 inches thick for the uppermost 35 feet and increase 2 inches in thickness for each successive 35 feet or fraction thereof measured downward from the top of the wall.

5. Exception to thickness requirements for panel walls.

Where fire walls or party walls are constructed as panel walls in a framework of columns and girders protected as required for fireproof construction and no panel has a height between supports greater than 12 feet, they may be of solid masonry not less than 12 inches thick or of reinforced concrete not less than 8 inches thick.

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6. To be carried to or above the roof.

Fire walls and party walls shall extend at least 3 feet above the roof; except where the roof is of fireproof or semifireproof construction in which case the fire walls and party walls shall be carried up tightly against the underside of the roof slabs.

7. Size and protection of openings.

(a). Except in sprinklered buildings, no opening in a fire wall shall exceed 120 square feet in area with no dimension greater than 12 feet, and the aggregate width of all openings at any level shall not exceed 25 per cent of the length of the wall.

(b). Every opening in a required fire wall shall be protected on each side of the wall with an approved automatic or self closing fire door; provided that when a fire wall serves also as a horizontal exit it shall have no openings other than door openings not exceeding 48 square feet in area, and one of the fire doors at each opening shall be a self-closing fire door.

SECTION 910. PARAPETS.

(a). Except as listed below, parapets shall be provided on all fire walls, party walls, and exterior walls of masonry or reinforced concrete. Parapets are not required on:

- (1) Walls connecting with roofs of fireproof construction or semifireproof construction;
- (2) A wall of a building the roof of which is at least three feet lower than the roof of, or any opening in, an adjacent building wall;
- (3) Walls facing on a street having a width of 30 feet or more;
- (4) Walls of a building which is 30 feet or more distant in all directions from property lines and from other buildings on the same property;
- (5) Walls of a building which is 30 feet or more distant in all directions from property lines but less than 30 feet distant to one or more buildings on the same property, where the total area of the building within 30 feet of each other does not exceed $1\frac{1}{2}$ times the allowable area for any one of the buildings considered;
- (6) Walls of a detached dwelling, or of a building not exceeding 1,000 square feet in area;

(b). In dwellings and in buildings in which 8-inch walls are permitted, such parapets shall be not less than 8 inches thick and carried at least two feet above the roof.

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(c). In all other buildings such parapets shall be not less than 12 inches thick, and carried not less than 3 feet above the roof.

(d). Parapets shall be properly coped with noncombustible, weatherproof material and flashed with the flashing extending through the parapet wall under the coping. All corners of all parapet walls shall be reinforced with at least one 1/4-inch round bar in every third joint, continuous around the corner and extending into the masonry at least 3 feet from the corner.

SECTION 911. CHASES AND RECESSES.

(a). No chase shall extend into a wall more than 1/3 of its thickness; but no chase shall be cut or built in an 8-inch wall or in a hollow wall or cavity wall, or within the required area of a pier, except that in dwellings not more than 2 stories high, chases not more than 4 inches deep, 24 inches high, and 30 inches wide, or the width of a window if under a window, may be built in an 8-inch wall. The backs and sides of chases in 8-inch walls shall be waterproofed and insulated.

(b). No horizontal chase shall exceed 4 feet in length, nor shall the horizontal projection of any diagonal chase exceed 4 feet.

(c). Chases shall not be cut in hollow walls, in cavity walls, or in walls of hollow or solid masonry units, but, when permitted, shall be built in.

(d). Chases shall be filled in solidly with noncombustible material within the floor thickness at each floor level.

(e). Recesses for stairways or elevators may be left in walls of buildings, but the thickness of the wall at such recess shall be not less than the required thickness of the wall at the fourth story above grade, unless reinforced by additional piers, by steel or reinforced concrete girders, or by steel or reinforced concrete columns and girders, securely anchored to walls on each side of such recesses.

(f). The aggregate area of chases and recesses in a wall shall not exceed 1/4 of the whole area of the face of the wall in any story.

(g). Chases or recesses that would reduce the thickness below the required minimum, shall not be built or cut in fire walls or fire partitions.

SECTION 912. WALL VENEERING.

1. Masonry veneering.

(a). Materials used for masonry veneering shall be of not less than the following thicknesses:

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<i>Material</i>	<i>Thickness (inches)</i>
Stone	not less than 3
Cellular architectural terra cotta.....	not less than 3
Architectural terra cotta slabs.....	not less than 1 $\frac{1}{4}$
Brick (clay, concrete, or sand-lime)	not less than 2 $\frac{1}{4}$
Cast stone	not less than 1 $\frac{1}{2}$
Structural clay tile.....	not less than 1 $\frac{3}{4}$
Flat tile	not more than 1
Other approved material.....	as approved by North Carolina Building Code Council

(b). In stone ashlar, each stone shall have a reasonably uniform thickness, but all stones need not necessarily be of the same thickness.

(c). **Height.** Masonry veneer shall not exceed 35 feet in height above foundations or other approved support.

(d). **Attachment of masonry veneering.**

(1) Masonry veneering shall be tied into the masonry backing either by a header for every 300 square inches of wall surface or by substantial, corrosion resistant metal wall ties spaced not farther apart than 16 inches vertically and 24 inches horizontally. Headers shall project at least 3 $\frac{3}{4}$ inches into the backing. Special care shall be taken to fill all joints flush with mortar around openings.

(2) Masonry veneer on wood frame structures or wood or steel framing shall be anchored by corrosion-resistant metal ties spaced not further apart than 16 inches vertically and 24 inches horizontally. Each tie shall be embedded in a stretcher course and be securely fastened to the structure.

(e). **Flashing.** Corrosion resistant flashing to prevent moisture from penetrating behind the veneer shall be provided over wall openings, or other places as may be required.

2. Metal, glass and other veneers.

(a). Veneers of metal and other materials, unless corrosion resistant, shall be protected by an approved corrosion resistant surfacing and shall be securely attached to the supporting construction with approved hangers, clips or other anchoring devices approved by the building inspector. The anchors shall be of such size, quality and spacing as to adequately fasten the material to the backing.

(b). The joints of metal and other veneers shall be protected against the weather by caulking, pointing or the use of any other method approved by the building inspector.

(c). Glass veneer shall not be attached to any exterior wall at a height of over 35 feet above grade.

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(d). Supports for metal and other veneers shall be adequately protected against the weather and moisture by painting, galvanizing or other approved methods; wood supports shall be treated with creosote or other approved preservative.

SECTION 913. REINFORCED GYPSUM CONCRETE.

1. General.

(a). Except as otherwise specifically provided in this code or in rules promulgated by the building official, the "American Standard Building Requirements for Reinforced Gypsum Concrete," ASA A59.1-1945, as approved by the American Standards Association shall be deemed to be the generally accepted good practice in reinforced gypsum concrete construction.

(b). Gypsum concrete shall not be used where exposed directly to the weather or where subjected to frequent or continuous wetting. Precautions shall be taken against saturation and freezing during construction.

2. Gypsum. The term gypsum shall mean calcined gypsum manufactured from gypsum conforming to the Standard Specifications for Gypsum—ASTM C22-41. (ASA A49.1-1941).

3. Gypsum concrete.

(a). Gypsum concrete shall consist of a mixture of gypsum and water, with or without chips, shavings or fiber or other approved aggregate. The gypsum and wood chips, shavings or fiber shall be premixed at the mill, requiring the addition of water only at the place of use.

(b). Precast gypsum concrete shall contain not more than 3 per cent and cast-in-place gypsum concrete not more than 12½ per cent of wood chips, shavings, or fiber measured as a percentage by weight of the dry mix.

(c). Wood chips, shavings, or fiber used in gypsum concrete shall be dry, soft wood, uniform and clean in appearance. They shall pass a one-inch screen and shall be not more than 1/16-inch in thickness.

4. Reinforcement. The steel reinforcement shall conform to accepted standards for concrete reinforcement.

5. Design.

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

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	<i>Lbs. per sq. in.</i>
Class 1. Neat (containing gypsum and water only).....	1800
Class 2. Containing not more than 3 per cent by weight of wood chips, shavings, or fiber.....	1000
Class 3. Containing not more than 12½ per cent by weight of wood chips, shavings, or fiber.....	500

(b). In the design of floor and roof slabs of reinforced gypsum concrete, the following values shall be used for the modulus of elasticity for the several classes of gypsum concrete:

	<i>Lbs. per sq. in.</i>
Class 1	1,000,000
Class 2	600,000
Class 3	200,000

(c). In the design of floor and roof slabs of reinforced gypsum concrete the working stresses in the concrete shall not exceed the values shown in the following table:

	<i>Class 1</i>	<i>Class 2</i>	<i>Class 3</i>
Compressive stress in bending.....	450	250	125
Axial compressive or bearing stress	360	200	100
Bond stress with reinforcement anchored	36	20	10
Shearing stress with reinforcement anchored.....	36	20	10

The working stresses in reinforcing steel shall conform to the following:

	<i>Lbs. per sq. in.</i>
Steel in tension, structural grade.....	18,000
Steel in tension, intermediate or hard grade or rail steel.....	20,000
Cold drawn steel wire in tension.....	20,000

6. **Minimum thickness.** The minimum thickness of gypsum concrete in floors and roofs shall be two inches except in the suspension system, which shall be not less than 3 inches. Hollow precast gypsum concrete units for roof construction shall be not less than 3 inches thick and the shell not less than ½-inch thick.

7. **Precast gypsum concrete units.** 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 reinforcement shall be placed symmetrically so that the unit can support its load either side up.

SECTION 914. STRUCTURAL STEEL AND CAST IRON.

1. **General.** Except as otherwise specifically provided in this code or in rules duly promulgated by the building official, the Standard Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, dated February, 1946, as adopted by the American Institute of Steel Construction, and the American Standard Building Requirements for Structural Steel as approved by the American Standards Association (A57.1-1943), shall be deemed to be the generally accepted good practice in structural steel construction.

2. **Structural Steel.**

(a). The term structural steel as used in this code refers to the material so classified by the American Institute of Steel Construction.

(b). Structural steel shall conform to the standard Specifications for Steel for Bridges and Buildings, ASTM A7-46 (ASA G24.1). Unidentified stock material, if free from surface imperfections, may be used for short sections of minor importance, or for small unimportant details, where the precise physical properties of the material would not affect the safety of the structure.

3. **Working stresses for structural steel.**

(a). The working stresses, in pounds per square inch, in structural steel shall not exceed the following:

	<i>Lbs. per sq. in.</i>
Tension, net section	20,000
Compression in columns, maximum.....	17,000
Extreme fiber stress in flexure, in tension.....	20,000
Extreme fiber stress in pins.....	30,000
Shear in web plates, maximum.....	13,000
Shear in pins and turned bolts in reamed or drilled holes.....	15,000
Bearing on pins and power-driven rivets in single shear.....	32,000
Power-driven rivets in double shear.....	40,000

(b). The ratio of unbraced length to least radius of gyration l/r for compression members and for tension members other than rods shall not exceed:

For main compression members.....	120
For bracing and other secondary members in compression.....	200
For main tension members.....	240
For bracing and other secondary members in tension.....	300

The slenderness of a main compression member may exceed 120, but not 200, provided that it is not ordinarily subject to shock or vibratory loads and provided that its unit stress under

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full design loading shall not exceed the following fraction of that stipulated under Section 15 of AISC specification for its actual ratio l/r :

$$1.6 - \frac{1}{200 r}$$

(c). In laterally unsupported structural steel members, the compressive working stress in flanges of beams and girders shall be reduced in accordance with generally accepted good practice.

(d). Welded joints constructed with base material and filler metal of prescribed quality shall be proportioned so that the stresses caused therein by the imposed loads shall not exceed the following values:

Shear on section through throat of fillet weld, or on faying surface area of filled plug or slot weld—13,600 lbs. per sq. in.

Tension on section through throat of butt weld—use corresponding allowable stress for base metal.

Compression or shear on section through throat of butt weld—use corresponding allowable stress for base metal.

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 on the throat, for any direction of the applied stress.

Plug or slot welds shall not be ascribed any value in resistance to stresses other than shear.

In case of fillet welds subjected to both shear and bending stresses, the maximum unit stress resulting from the combination shall not exceed the above specified stress for shear.

In new work, rivets or bolts in combination with welds shall not be considered as sharing the stress, and welds shall be provided to carry the entire stress for which the connection is designed.

(e). For members carrying wind stresses only, and for combined stresses due to wind and other loads, the working stresses prescribed above may be increased $33\frac{1}{3}$ per cent; provided the section thus found is not less than required by the dead-load and live-loads alone.

4. Working stresses for cast iron.

(a). The working stresses, in pounds per square inch, in cast iron, shall not exceed the following:

	<i>Lbs. per sq. in.</i>
Direct compression on short blocks.....	9,000
Extreme fiber stress in compression.....	16,000
Extreme fiber stress in tension.....	3,000
Shear	3,000

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(b). The working stresses, in pounds per square inch of cross section, for hollow cast iron columns shall vary with the ratio of unsupported length to least radius of gyration of the section, as follows:

<i>Ratio</i>	<i>Lbs. per sq. in.</i>	<i>Ratio</i>	<i>Lbs. per sq. in.</i>
70	6,200	30	7,800
60	6,600	20	8,200
50	7,000	10	8,600
40	7,400		

For intermediate ratios the working stresses shall be proportionate to those given. The maximum ratio here given shall not be exceeded.

(c). Cast iron columns shall not be subjected to tensile stresses.

5. Cast iron columns.

(a). Cast iron columns shall not have a smaller outside diameter or side than 5 inches.

(b). The thickness of metal shall be not less than 1/12 the diameter or least dimension of cross section, but not less than 3/4 of an inch.

(c). Cast iron columns not cast with one open side or back, shall have 3/8-inch holes drilled in the shaft, to permit measurement of the thickness.

6. Minimum thickness of structural steel.

The minimum thickness required for protection against crippling, buckling, and shear are prescribed in Paragraphs (b) and (c) of this section and in Paragraph (b) of Section 26, respectively. Those stipulations assume that the material is straight and true as erected, within the limits prescribed in Section 33 (q), and is not reduced by corrosion.

No further stipulations as to minimum thickness shall apply to steelwork exposed to conditions no more seriously corroding than an indoor atmosphere controlled for human comfort, subject always to the requirements of Section 34 (a).

The following stipulations (1) and (2) as to minimum thickness shall apply to exterior steelwork enclosed in a non-imperious envelope or exposed to frequent rain or snow, and to interior steelwork subject to atmospheric exposure more corrosive than that mentioned in the preceding paragraph:

- (1) Columns, studs, lintels, girders and beams; exterior trusses, exterior bracing members; one-fourth inch minimum.

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- (2) Purlins, girts, trusses and bracing members sheltered from direct exposure to rain and snow; three-sixteenths inch minimum.

The controlling thickness of rolled shapes, for the purposes of stipulations (1) and (2), shall be taken as the mean thickness of their flanges, regardless of web thickness.

Steelwork exposed to industrial fumes or vapor shall be given special protection as required in the judgment of the Engineer.

7. Column bases.

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

(b). Cast iron bases or shoes shall be not less than one inch thick in any part and they shall be planed on top, and, when resting on steel girders, on both top and bottom.

(c). Rolled steel bearing plates shall be finished in conformity with the specifications of the American Institute of Steel Construction.

(d). Columns shall be securely anchored to their foundations.

8. Lintels, box beams and girders.

(a). Cast iron lintels shall not be used for spans exceeding 6 feet. They shall be not less than $\frac{3}{4}$ of an inch in thickness at any point.

(b). When two or more rolled beams or channels are used to form a girder, they shall be connected by bolts or separators at intervals of not more than 5 feet. All beams having a depth of 12 inches or more shall have at least 2 bolts to each separator. When concentrated loads are carried from one beam to the other, or distributed between the beams, rolled or built-up diaphragms shall be used, designed with sufficient stiffness to distribute the load. Where beams are exposed, they shall be filled with concrete or spaced sufficiently far apart to permit cleaning and painting.

(c). The thickness of web in riveted girders shall be not less than $\frac{1}{170}$ of the unsupported distance between flanges or between stiffeners.

(d). The compression flanges of steel beams and girders shall be supported laterally if the length multiplied by the depth and divided by the flange area exceeds 600, unless the unit stresses are reduced in accordance with generally accepted good practice.

9. Assembling.

(a). Except where unfinished bolts are permitted, all work shall be riveted or welded; provided that where it is impossible to

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drive satisfactory rivets or to weld, turned bolts in reamed or matched drilled holes conforming to accepted practice may be used in shop or field.

(b). Riveting or welding shall be used for the connection of main members carrying live loads which produce impact and for connections subject to reversal of stresses.

(c). High Tensile Steel Bolts may be used in lieu of rivets of the same nominal diameter provided the connections are designed and constructed in accordance with the Specifications for Assembly of Structural Joints Using High Tensile Steel Bolts, approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation, January, 1951.

10. Welding.

(a). Surfaces to be welded shall be free from loose scale, slag, rust, paint or other foreign matter.

(b). Surfaces which are to be welded after erection preferably shall not receive any shop paint. If painted before erection, paint on surfaces adjacent to joints to be welded shall be thoroughly removed to expose clean steel for a distance of at least two inches from either side of the joint.

(c). Steel construction which is to be welded shall be held in the correct position by bolts, clamps, wedges, guy lines, struts or other suitable devices or by tack welds until welding has been completed.

(d). Except as otherwise specifically provided in this section or in rules duly promulgated by the North Carolina Building Code Council, the "Standard Code for Arc and Gas Welding in Building Construction," as adopted by the American Welding Society, shall be deemed to be the generally accepted good practice in arc and gas welding. Safeguards used in connection with welding and gas cutting shall comply with section 1311.

11. Arc or gas cutting.

(a). Nothing in this code shall prohibit arc or gas cutting in steel construction; provided that arc or gas cutting shall not be done on a member while it is under substantial stress, and that it is not done where the milling of surfaces is required for proper workmanship.

(b). Cut edges shall be smooth and regular in contour, and when used in the preparation of base metal parts for welding, shall be thoroughly cleaned to expose only clean metal.

(c). Cutting of holes in a member which has not been designed therefor shall not be done.

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12. Tie rods.

(a). Tie rods when required shall be not less than $\frac{3}{4}$ of an inch in diameter.

(b). Holes for tie rods in floor arches shall be placed as near the thrust of the arch as practicable.

(c). When tie rods are used the distance between tie rods in floors or roofs shall not exceed 8 times the depth of the beams nor 8 feet in any case.

13. Anchorage and bearing. Lintels, steel joists, beams, girders or trusses, supported at either end by a wall or pier, shall be properly anchored thereto and shall rest upon bearing plates or shoes of cast iron, steel or stone of such design and dimensions to distribute safely the loads on the masonry, unless the bearing surface of the lintels, steel joists or beams is sufficient to distribute the load.

14. Protection against corrosion.

(a). Except for surfaces which are to be completely covered with cement grout or mortar or completely imbedded in concrete, or which are to be welded after erection, structural steel shall have at least one coat of paint suitable for the purpose before erection, and at least one coat of a different shade than the first, after erection.

(b). Cast iron columns shall not be painted until after inspection.

(c). All scale, dirt and rust shall be completely removed before painting iron or steel.

(d). Iron or steel used under ground or under water shall be covered on all sides by not less than 3 inches of concrete.

SECTION 915. LIGHT GAUGE STEEL STRUCTURAL MEMBERS.

(a). Except as otherwise specifically provided in this code or in rules duly promulgated by the North Carolina Building Code Council, section 12—Members and Constructions Formed of Light Gauge Steel, of Bulletin V—Steel Regulations, dated January, 1947, as adopted by the American Iron and Steel Institute, shall be deemed to be generally accepted good practice in light gauge steel construction.

(b). The term light gauge steel structural members as used in this code refers to structural members cold formed to shape from sheet or strip steel less than $\frac{3}{16}$ inch in thickness.

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(c). The quality of light gauge steel for structural members shall conform to the standard Specifications for Structural Quality Flat-Hot-Rolled Carbon Steel Sheets, ASTM A245-47T and A246-47T, except as otherwise provided by rules promulgated by the North Carolina Building Code Council.

(d). Light gauge steel construction shall be braced for any loads incident to construction as well as for the designed loads.

(e). Steel studs, panels, and other light gauge members used as framing in walls, floors and roofs shall be thoroughly cleaned and given at least one coat of paint or other approved protection before leaving the shop. When, in the opinion of the city building inspector, this shop paint has deteriorated or the steel is rusty it shall be repainted.

SECTION 916. STEEL JOISTS.

1. **General.** Except as otherwise specifically provided in this code or in rules duly promulgated by the North Carolina Building Code Council, the American Standard Building Requirements for Steel Joist Construction (A87.1-1947), approved by the American Standards Association, shall be deemed to be the generally accepted good practice in steel joist construction.

2. **Material.** Steel shall conform to the requirements of the Standard Specifications for Steel for Bridges and Buildings (ASTM A7-46), except that joists formed of strip or sheet steel shall conform to Grade C of the Specifications for Structural Quality, Flat-Hot-Rolled Carbon Steel Sheets, (ASTM A-245-47T or ASTM A-246-47T).

3. **Design.**

(a). Open web steel joists shall be designed as trusses, solid web steel joists as beams. Deck or top slabs over steel joists shall not be assumed to carry any part of the compression stress to be carried by the steel joists.

(b). The maximum design stress shall not exceed 18,000 pounds per square inch.

(c). Compression chords and diagonals of open web steel joists shall not have a ratio of length (clear distance between welds or attachments) to least radius of gyration in excess of 120, nor shall the unit compression stress exceed 15,000 pounds per square inch, nor shall it exceed S as determined by the following formula, in which L is the length of the member and r is the least radius of gyration:

$$S = \frac{18,000}{1 + \frac{L^2}{18,000 r^2}}$$

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(d). Joists and component parts of joists formed of strip or sheet steel shall be designed in accordance with section 915.

4. Fabrication.

(a). All joints of the members that comprise a steel joist shall be made by connecting the members directly to one another by fusion or resistance welds, or by rivets.

(b). In the case of expanded steel joists, a portion of the metal may be left intact to form a connection.

(c). In the case of nailer joists, wood nailer strips shall be firmly attached to the top chord of the joist. Such nailer strips shall be of good grade wood at least $1\frac{1}{2}$ inch x $1\frac{1}{2}$ inch in net section.

5. Anchorage.

(a). The ends of steel joists shall extend a distance of at least 4 inches onto masonry or reinforced concrete supports, and at least 2 inches on steel supports, but not less than that needed to obtain proper bearing area. Every third steel joist bearing on concrete or masonry supports shall be anchored thereto with an anchor equivalent to a $\frac{3}{8}$ -inch round. The ends of all steel joists supported on masonry walls shall be bedded in mortar.

(b). All steel joists supported on steel beams shall be secured thereto with an anchor made of not less than a 3/16-inch round bar fastened over the flanges of the supporting beams, or other equivalent approved attachment, except that in the case of buildings having a height of more than twice the least dimension of the base, each steel joist shall be welded, bolted or riveted to the supporting steel work.

6. Span. The span of steel joists in steel joist construction shall not exceed 24 times the depth of the steel portion of the steel joist.

7. Bridging.

(a). As soon as steel joists have been erected and before application of construction loads, bridging shall be installed between them. This bridging shall be adequate to safely support the top chords or flanges against lateral movement during the construction period and shall hold the steel joists in approximately vertical plane passing through the bearings. The steel joists at the ends of panels shall be braced laterally by anchors or ties at each line of bridging.

(b). The number of lines of bridging shall be: One row, near the center, for spans up to 14 feet; two rows, approximately $\frac{1}{4}$ span apart and symmetrically located, for spans 14 to 21 feet; and 3 rows approximately equally spaced, for spans 21 to 32 feet.

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(c). In the case of nailer steel joists carrying a wood deck, the wood deck may be used as the top member of the bridging system.

8. **Decks or top slabs.** Decks or top slabs over steel joists may be of concrete or gypsum poured on metal lath centering or equally suitable permanent centering, or on removable centering, provided that top chords or flanges of the steel joists are stayed laterally by the top slab. Precast concrete top slabs, precast gypsum top slabs, wood decks, or steel decks shall be securely anchored to the top chords or flanges of the joists.

9. **Protective coating.** All steel joists shall be given one coat of asphalt base paint or an equivalent approved protective covering, before leaving the shop. When, in the opinion of the city building inspector, this shop paint has deteriorated or the steel has rusted, it shall be repainted.

SECTION 917. WOOD STRUCTURAL MEMBERS.

1. **General.** Except as otherwise specifically provided in this code or in rules duly promulgated by the North Carolina Building Code Council, the National Design Specification for Stress-Grade Lumber and its Fastenings, recommended by the National Lumber Manufacturers Association, shall be deemed to be generally accepted good practice in wood construction.

2. **Working Stresses.**

(a). Wood structural members shall be of sufficient size to carry the dead and required live loads without exceeding the allowable working stresses for the respective species and grade as given in the following tables, or as approved by the North Carolina Building Code Council in accordance with generally accepted good practice in wood construction.

(b). The stresses used for any wood of a given species shall be the lowest stresses shown in the tables for that species unless the wood is identified by the grade mark of, or certificate of inspection issued by, a lumber grading or inspection agency approved by the North Carolina Building Code Council.

(c). For members carrying wind stresses only, and for combined stresses due to wind and other loads, the working stresses given in this section may be increased 50 per cent; provided the section thus found is not less than required for dead load and live loads alone.

(d). Minimum sizes of lumber members required by this code refer to nominal sizes. American Lumber Standard dressed sizes shall be accepted as the minimum net sizes conforming to nominal sizes. Computations to determine the required sizes of members shall be based on the net dimensions (actual size) and not

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WORKING STRESSES FOR JOISTS AND PLANKS, BEAMS AND STRINGERS, POSTS AND TIMBERS

The working stresses below are for normal loading conditions. See Section 917-2 for permissible adjustments in working stresses for loads of other types, and for species and grades not given in the following table.

1		Allowable Unit Stresses in Pounds per Square Inch													
Species and Commercial Grade ¹		3	4	5	6	7					8				
		Extreme fiber in bending, tension and compression. Parallel to grain.	Horizontal shear. Parallel to grain.	Compression parallel to grain.	Modulus of elasticity.	Compression parallel to grain (for solid columns and solid struts) for ratios of length-to-least-dimension (l/d)									
						l/d 11 or less	l/d 14	l/d 17	l/d 20	l/d 23	l/d 26	l/d 30	l/d 35	l/d 40	l/d 50
DOUGLAS FIR, COAST REGION:															
Dense Select Structural	J&P-B.S.	2150	145	455	1,600,000	1550	1474	1384	1234	985	770				
Select Structural	J&P-B.S.	1800	120	415	1,450,000	1325	1277	1126	977	779					
1700 f-Dense No. 1	J&P-B.S.	1700	145	455	1,600,000	1200	1165	1033	904	843		584	430	329	210
1450 f-No. 1	J&P-B.S.	1450	120	390	1,600,000	1075	1049	919	809	772					
1100 f-No. 2	J&P	1100	110	390	1,600,000	1075	1049	919	809	772					
Dense Select Structural	P&T			455	1,600,000	1550	1474	1384	1234	985	779				
Select Structural	P&T			415	1,450,000	1450	1388	1314	1188	992	779				
Dense No. 1	P&T			455	1,600,000	1400	1344	1278	1166	990	779				
No. 1	P&T			390	1,600,000	1280	1185	1123	1054	943	779				
DOUGLAS FIR, INLAND REGION:															
Select Structural	J&P-B.S.	2150	145	455	1,600,000	1640	1509	1368	1268	995	779	584	430	329	210
Structural	J&P-B.S.	1800	100	380	1,500,000	1450	1336	1250	1133	934	730	548	403	308	197
Common Structural	J&P-B.S.	1450	95	380	1,500,000	1204	1109	1009	915	779	584	430	329	210	
Select Structural	P&T			455	1,600,000	1640	1509	1368	1268	995	779	584	430	329	210
Structural	P&T			380	1,500,000	1400	1336	1260	1133	934	730	548	403	308	197
Common Structural	P&T			380	1,500,000	1250	1204	1150	1059	915	730	548	403	308	197
HEMLOCK, EASTERN:															
Select Structural	J&P-B.S.	1300	85	360	1,100,000	850	824	792	740	656	535	402			
Prims Structural	J&P	1200	60	360	1,100,000	775	755	732	691	629	538	402	295	226	145
Common Structural	J&P	1100	60	360	1,100,000	650	638	624	601	563	508	402			
Utility Structural	J&P	950	60	360	1,100,000	600	590	580	561	532	488	403			
Select Structural	P&T			360	1,100,000	850	824	792	740	656	535	402			
HEMLOCK, WEST COAST:															
1600 f-Select Structural	J&P	1600	100	360	1,400,000	1100	1064	1022	951	840	681	511	370	288	184
1450 f-No. 2	J&P-B.S.	1450	100	360	1,400,000	1075	1042	1003	937	834	680	511	370	288	184
1100 f-No. 2	J&P	1100	90	360	1,400,000	850	834	814	781	730	654	511	370	288	184
No. 1 Hemlock Timbers	P&T			360	1,400,000	1075	1042	1003	937	834	680	511	370	288	184
PINE, NORWAY:															
Prims Structural	J&P	1200	75	360	1,200,000	900	874	843	790	707	583	438	322	247	165
Common Structural	J&P	1100	75	360	1,200,000	775	758	738	704	660	573	438	322	247	165
Utility Structural	J&P	850	75	360	1,200,000	650	640	628	608	560	490	438	322	247	165

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1		2	Allowable Unit Stresses in Pounds per Square Inch											
Species and Commercial Grade ¹			3	4	5	6	7 Compression parallel to grain (for solid columns and solid struts) for ratios of length-to-least-dimension (l/d)							
		Extreme fiber in bending "F" and tension "F _t " Parallel to grain "F _c "	Horizontal shear "H"	Compression parallel to grain "C"	Modulus of elasticity "E"	l/d 11 or less "C"	l/d 14	l/d 17	l/d 20	l/d 23	l/d 30	l/d 35	l/d 40	l/d 50
PINE, SOUTHERN LONGLEAF: ⁴														
	Select Structural Longleaf	2400	120			1750	1640	1509	1288	995	779			
	Prime Structural Longleaf	2000	120			1400	1344	1278	1165	990	779			
	Merchantable Structural Longleaf	1800	120			1300	1255	1202	1112	971	779			
	Structural S.E. & S. Longleaf	1800	120			1300	1255	1202	1112	971	779			
	No. 1 Structural Longleaf	1600	120			1150	1119	1082	1020	922	779	584	430	210
	No. 2 Longleaf	1700	160		465	1400	1344	1278	1165	990	779			
	No. 1 Longleaf	1250	100			1025	1003	977	934	855	764			
	Select Structural Longleaf					1750	1640	1509	1288	995	779			
	Prime Structural Longleaf					1400	1344	1278	1165	990	779			
	Merchantable Structural Longleaf					1300	1255	1202	1112	971	779			
	Structural S.E. & S. Longleaf					1300	1255	1202	1112	971	779			
	No. 1 Structural Longleaf					1150	1119	1082	1020	922	779			
PINE, SOUTHERN: ⁴														
	Dense Select Structural	2400	120		455	1750	1640	1509	1288	995	779			
	Dense Structural	2000	120		455	1400	1344	1278	1165	990	779			
	Dense Structural S.E. & S.	1800	120		455	1300	1255	1202	1112	971	779			
	Dense No. 1 Structural	1600	120		455	1150	1119	1082	1020	922	779			
	No. 1 Dense	1700	150		455	1400	1344	1278	1165	990	779			
	No. 1 Dense	1450	125		380	1200	1165	1123	1054	943	779	584	430	210
	No. 2 Dense	1250	100		455	1025	1003	977	934	855	764			
	No. 2 Dense	1100	85		380	875	861	846	817	774	711			
	Dense Select Structural				455	1750	1640	1509	1288	995	779			
	Dense Structural				455	1400	1344	1278	1165	990	779			
	Dense Structural S.E. & S.				465	1300	1255	1202	1112	971	779			
	Dense No. 1 Structural				455	1150	1119	1082	1020	922	779			
REDWOOD:														
	Dense Structural	1700	110		320	1450	1338	1208	986					
	Heart Structural	1300	95			1450	1338	1208	986	746	583	322	247	158
	Heart Structural					1100	1051	994	897					
SPRUCE, EASTERN:														
	Dense Structural	1450	110		300	1050	1007	958	879	739	583	322	247	158
	1450 f. Structural Grade	1300	95			1050	1007	958	879	739	583	322	247	158
	1300 f. Structural Grade	1200	95			975	941	843	790	707	583	322	247	158
	1200 f. Structural Grade					900	874							
TUPLELO:														
	1700 f Grade	1700	120		360	1225	1158	1079	948	746	583			
	1450 f Grade	1450	120			1050	1007	958	879	739	583			
	1200 f Grade	1200	120			875	851	822	773	697	584			
	1075 c Grade					1075	1030	977	897	746	583			

¹According to 1948 Standard Grading Rules.
²These grades meet the requirements for density.
³These grades are based on requirements for heartwood.
⁴The grading rules provide a basis for obtaining higher sheathing stresses of 140, 160 and 180 pounds per square inch when specified.
⁵These grades are applicable to 2 inch thickness only.

Abbreviations: J.&P., Joists and Planks; B.&S., Beams and Stringers; P.&T., Posts and Timbers; S.E. & S., Square Edge and Sound.
 When graded in accordance with var. 310 Misc. Pub. 185 U. S. Dept. of Agr.
 when graded according to var. 310 of Misc. Pub. 163 U. S. Dept. of Agr. and when the l/d ratio is 11 or less.

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the nominal sizes. If rough sizes or finish sizes exceeding American Lumber Standard dressed sizes are to be used, computations may be predicated upon such actual sizes, provided they are specified on the plans or in statement appended thereto. For convenience, nominal sizes may be shown on the plans.

(e). The building official may require the species and grade or the stress-grade of all wood used for load bearing purposes to be stated on the plans filed with the building official.

(f). "Grade", when used in connection with lumber for structural purposes, is a classification with respect to strength.

(g). The allowable compression stress perpendicular to the grain may be increased in accordance with the following factors for bearings less than 6 inches in length and located 3 inches or more from the end of the timber.

Length of Bearing (Inches) -----	1/2	1	1 1/2	2	3	4	5
Factor -----	1.75	1.38	1.25	1.19	1.13	1.10	1.00

(h). For stress under washers or small plates, the same factor may be taken as for a bearing the length of which equals the diameter of the washer.

3. **Bolting.** All bolts in wood construction shall be provided with washers of such proportions that the compression on the wood at the face of the washer will not exceed the working stresses prescribed in subsection 2 of this section.

4. **Beams, girders and joists.**

(a). Wooden beams, girders and joists shall have bearings of not less than 3 inches, except where the bearing is such that the beam, girder or joist is secured against displacement from its support and the bearing stress is within the limits fixed in subsection 2 of this section.

(b). No wooden beam, girder or joist shall be cut or pierced in any manner that would cause it to be of insufficient strength for its load.

5. **Wooden columns in lowest story.** Wooden columns in the lowest story shall rest on masonry or metal footings extending not less than 6 inches above the floor level and shall be anchored.

6. **Ground clearance of framework.** All parts of the wooden framework shall be kept at least 6 inches above ground level.

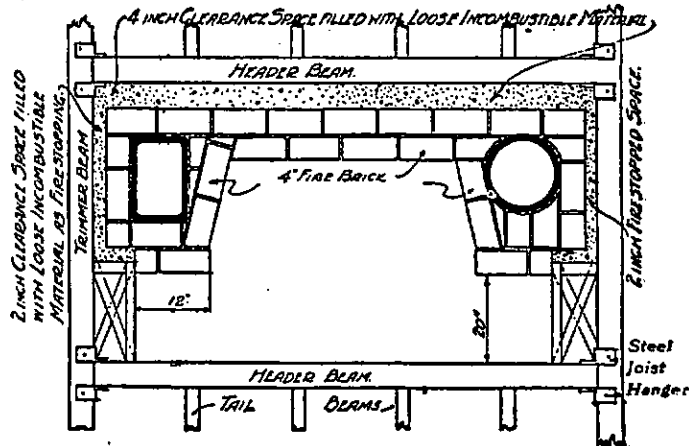


Fig. 8.
Floor framing around a fireplace

7. Framing around chimneys and fireplaces.

(a): All wooden beams and joists shall be trimmed away from chimneys and fireplaces. Headers, beams and joists shall be not less than 2 inches from the outside face of a chimney or from masonry enclosing a flue. Headers supporting trimmer arches at fireplaces shall be not less than 20 inches from the face of the chimney breast. Trimmers shall be not less than 6 inches from the inside face of the nearest flue.

(b). No woodwork shall be placed within 4 inches of the back face of a fireplace; nor shall combustible lathing, furring or studding be placed against a chimney; but this shall not prevent plastering directly on the masonry or on metal lath and furring.

(c). No wooden mantel or other woodwork shall be hereafter placed within 8 inches of either side nor within 12 inches of the top of a fireplace opening.

(d). All spaces between the masonry of chimneys or flues and wooden joists, beams or headers shall be firestopped by filling with noncombustible material.

(e). All spaces back of combustible mantels shall be filled with noncombustible material.

8. Backing for wainscoting and paneling. Except in dwellings, all spaces between combustible wainscoting or paneling and the plaster surface of the wall or partition to which it is attached shall be filled with noncombustible material.

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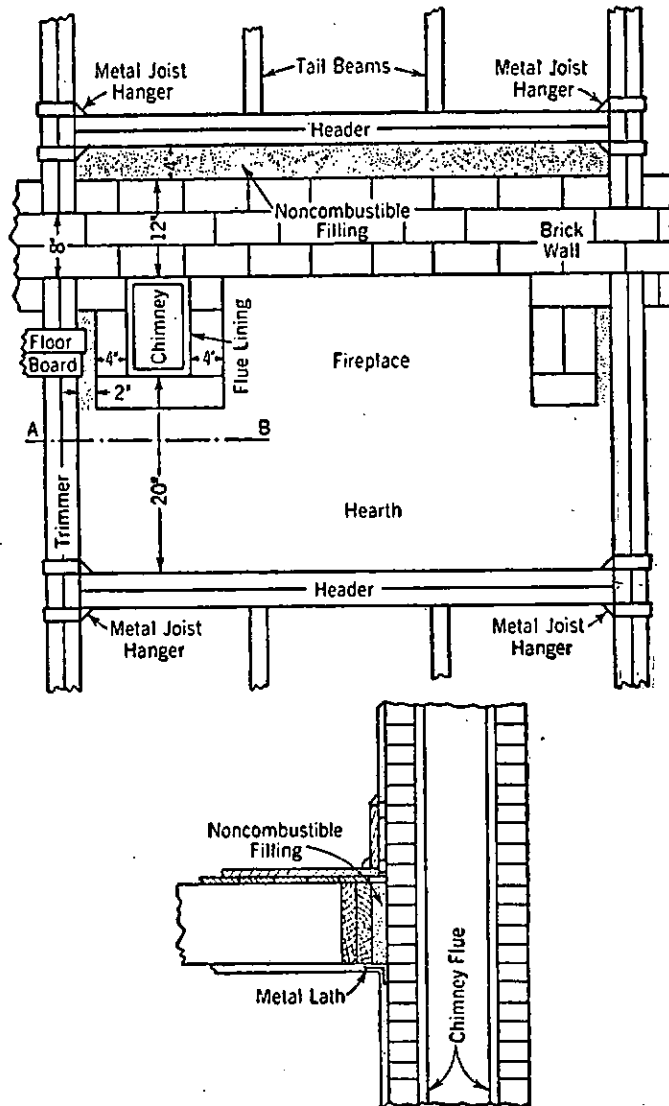


Fig. 9.
Firestopping around chimney and fireplace.

SECTION 918. FIRE PARTITIONS.

1. Construction.

(a). Fire partitions shall have fire resistance ratings of at least two hours. They shall be constructed of masonry or reinforced concrete, or other approved form of construction of noncombustible materials. Fire partitions used for load bearing shall conform to the requirements for bearing walls in sections 907 and 908, in addition to meeting the requirements of this section.

(b). Fire partitions shall be supported in each story on construction having a fire resistance rating of not less than 2 hours; provided that when they also are load bearing, the supporting construction shall have a fire resistance rating of not less than 4 hours in case the building is of fireproof construction or semi-fireproof construction, and not less than 3 hours in case of other construction.

(c). The maximum unsupported height of a fire partition shall not exceed 18 times its total thickness unless suitably reinforced and anchored at floor and ceiling or unless substantially secured to vertical supports at intervals of not over 18 times the thickness.

(d). Fire partitions shall be deemed continuous, even though the several parts are not directly over one another in successive stories if the intervening parts of the floors at the levels where offsets occur, are unpierced and of fireproof construction or semi-fireproof construction and all parts not supported directly on the foundations are carried on fireproof construction.

2. Openings.

(a). Required fire partitions shall have no openings other than required door openings, or properly protected duct openings.

(b). Each opening in a required fire partition shall be equipped with an approved fire door set in an approved door frame.

(c). Each opening in a fire partition serving as a horizontal exit shall be protected by an approved self-closing fire door.

SECTION 919. GLASS BLOCKS.

1. General. Glass blocks used in exterior or interior walls, shall have a minimum overall thickness at the mortar joint of at least $3\frac{1}{2}$ inches and all mortar surfaces shall have satisfactory treatment for mortar bonding properties.

2. Area permitted.

(a). Glass block panels in exterior walls shall not exceed 144 square feet in area nor 20 feet in any direction, between mullions

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or other suitable supports. Glass block panels in interior walls or partitions shall not exceed 250 square feet in area nor 25 feet in any direction between supports.

(b). Glass block panels when used as window protectives in accordance with section 920 shall not exceed 120 square feet in area nor 12 feet in width or height and shall have reinforcement in every horizontal mortar joint, except between the two top rows.

3. Access panels. Each story, above the first story or ground floor, shall have readily identified access panels for fire department use in every frontage and spaced not more than 50 feet apart horizontally. Each panel shall consist of a metal sash with flat glass at least 32 inches wide and 48 inches high, which shall be openable. Access and observation panels shall be installed in the glass block construction in an approved manner.

4. Installation.

(a). Glass blocks shall be laid up in mortar composed of one part portland cement, one part lime and 4 parts finely graded sand. All mortar joints shall be completely filled and pointed after the mortar has passed its initial set and shall have a thickness of at least $\frac{1}{4}$ inch and not more than $\frac{3}{8}$ inch.

(b). Horizontal mortar joints shall be reinforced with ties which shall run continuously from end to end of mortar joint, but must not "bridge" expansion joints. Where splices occur the individual lengths shall be lapped not less than 6 inches.

(c). Ties shall be formed of two parallel steel wires No. 9 gauge or larger, spaced 2 inches apart by steel cross wires No. 14 gauge or larger, welded thereto at intervals not exceeding 8 inches, and galvanized after forming or of other approved construction. They shall be located in horizontal joints as follows:

Blocks $5\frac{3}{4}$ in. high in wall, every fourth course.

Blocks $7\frac{3}{4}$ in. high in wall, every third course.

Blocks $11\frac{3}{4}$ in. high in wall, every course.

(d). Glass block panels shall be adequately supported to resist wind pressure and protected from forces caused by expansion or contraction by properly designed expansion joints which shall be entirely free of mortar.

The back of all chases shall be filled with an approved resilient material, the side of each joint lined with tightly packed oakum or other similar material and pointed with non-hardening caulking material at least $\frac{1}{2}$ inch deep. The sill shall be coated with an approved asphalt emulsion previous to laying the first course of mortar.

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(e). Where glass blocks are used as veneer in masonry construction, the glass block panels shall be self-supporting, with suitable ties into the masonry wall, and shall be clear from and not adhering to the masonry.

SECTION 920. PROTECTION OF EXTERIOR OPENINGS.

1. **Protection required.** Every building, except dwellings, churches, buildings of wood frame construction and of unprotected metal construction, and open air parking garages as covered by section 1204-7, shall have approved fire windows or other approved protectives, in every opening in the exterior walls when such opening faces on a street and is less than 30 feet from the opposite building line, or when such opening is less than 30 feet distant in a direct unobstructed line from an opening in another building, or when such opening is above and not more than 30 feet distant from any part of a neighboring roof of combustible construction, or any roof having openings within this distance; provided that such protection shall not be required for show windows facing on a street which do not extend above the first full story above grade; and provided further that such protection shall not be required when the opening to be protected and the opening against which it is to be protected are situated in walls in the same plane or in parallel planes and are facing in the same direction.

2. **Vertical separation between exterior openings.** Except in buildings of ordinary construction and noncombustible construction located outside the fire limits, or buildings of wood frame construction or unprotected metal construction, the exterior openings which are located vertically above one another and which are not protected by automatic fire windows or doors or fire windows with fixed sash shall have not less than 3 feet vertical separation between the top of one opening and the bottom of the one next above.

3. **Fire shutters.** When equipped with fire shutters, at least one in every 3 openings facing a street in each story shall have such shutters arranged to be readily opened from the outside. Distinguishing marks shall be provided on these shutters.

4. **Exit openings.** When fire doors or fire shutters are used on openings to exits or fire escapes they shall be so arranged as not to obstruct such exits or fire escapes.

5. **Glazing.** For the glazing of fire doors, when permitted, or of fire windows, only wired glass shall be used which shall be not less than 1/4-inch thick.

6. **Fire doors and other protectives.** Fire doors, fire windows, fire shutters, open sprinklers and other protectives, enumerated in the "List of Inspected Fire Protection Equipment and mate-

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rials" issued by Underwriters' Laboratories, Inc., and that are listed for the purposes intended, if installed in accordance with the Standards of the National Board of Fire Underwriters, for the "Protection of Openings in Walls and Partitions Against Fire," shall be deemed to be approved within the meaning of this section.

SECTION 921. SHAFTS.

1. Protection required.

(a). Every series of openings above one another in two or more successive floors, or floors and roof, hereafter placed or constructed in a building or hereafter enlarged or altered to change the use of the shaft, shall be so protected as to prevent fire in any story from communicating to any other story; provided that in buildings of heavy timber construction there shall be no floor opening that is not protected as prescribed in this section or in some other approved manner.

(b). The provisions of this section shall apply to all shafts used for ventilation, light, elevator, pipes, or other purpose, except stairways, air ducts, incinerator chutes, flues, shafts in building of wood frame construction, shafts in dwellings, and ramps in garages exempted by section 1204-6.

2. Shaft enclosures. The enclosing walls of shafts in residence buildings of ordinary construction or noncombustible construction or unprotected metal construction shall have a fire resistance rating of not less than 1 hour. The enclosing walls of shafts in other buildings shall be of noncombustible construction having a fire resistance rating of not less than 2 hours.

3. Openings.

Shaft enclosures shall have no openings other than those necessary for the purpose of the shaft; provided that in elevator shafts there shall be at least one door in every 30 feet of the height of such shaft. Such openings shall be protected with approved fire doors, approved fire shutters or approved fire windows.

4. Enclosure at top.

(a). Shaft enclosures extending through the roof which are to be enclosed at the top, shall be provided with a skylight of at least 10 per cent of the area of the shaft in the top story and glazed with plain glass $\frac{1}{8}$ -inch in thickness; provided that the skylight may be replaced by a window of plain glass of equivalent area in the side of the shaft if the sill of such window is not less than 2 feet above the roof and the window does not face a lot line within 10 feet, or may be replaced by approved means of ventilation.

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(b). A shaft that does not extend through the roof shall have the top enclosed with a form of construction having a fire resistance rating equal to that of the walls of the shaft.

6. **Enclosure at bottom.** A shaft that does not extend to the bottom of the building shall be enclosed at its lowest point with a floor construction of the same type as that required for the lowest floor to or through which it passes, but such shaft floor construction shall have a fire resistance rating of not less than one hour.

7. **Elevator machinery compartment.** Compartments containing machinery for operating elevators shall be separated from the elevator shafts by noncombustible construction having a fire resistance rating of not less than 2 hours, with openings therein essential for ropes, drums, sheaves and other elevator equipment, and with door openings equipped with approved fire doors.

8. **Number of elevators in shaft.** Not more than 3 elevators shall be placed hereafter in one shaft.

SECTION 922. ROOFING.

1. Materials.

(a). Every roof hereafter placed on a building shall be covered with an approved roofing of brick, concrete, tile, slate, metal, asbestos, prepared asphalt asbestos-felt shingles, or of built-up roofing finished with asphalt, slag or gravel, or other approved material.

(b). Except where roofing is of a character permitting attachment direct to frame work, it shall be applied to a solid or closely fitted deck.

(c). Roofings which are listed as Class A or B roof covering materials by Underwriters' Laboratories, Inc., shall be accepted as meeting the requirements of this section.

(d). Roofings which are listed as Class C roof covering materials by Underwriters' Laboratories, Inc., shall be accepted as meeting the requirements of this section on buildings as follows:

- (1) Dwellings.
- (2) Buildings of wood frame construction.
- (3) Buildings located outside the fire limits which do not exceed 2-stories or 30 feet in height, nor 2500 sq. ft. in area, and are not occupied as stores, factories, or warehouses.
- (4) Buildings which under this code could be of wood frame construction.

(e). The use of cork, fiber board or other approved insulation is permitted on top of the roof deck provided such insulation is covered with an approved type of fire resistive roof covering applied directly thereto.

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2. Cornices.

(a). Cornices, including those on show windows, hereafter placed on the exterior of buildings within the fire limits or on buildings over 50 feet in height outside the fire limits shall be of noncombustible materials.

(b). Except on buildings of wood frame construction, wood cornices on buildings outside the fire limits shall be covered with noncombustible material when nearer than 3 feet to a lot line other than a street line, or when within 5 feet of another building; provided that cornices attached to parapet walls need not be so covered.

(c). Continuous exterior cornices built of wood or having wood frames shall be firestopped at intervals not exceeding 20 feet.

3. Gutters and leaders. Gutters and leaders hereafter placed on buildings other than dwellings, private garages or buildings of wood frame construction, shall have weather surfaces of noncombustible material.

4. Scuttles.

(a). Unless provided with some other means of access to the roof, every building more than 35 feet in height, except dwellings with peak roofs, shall have in the roof a scuttle or trapdoor with a ladder leading thereto from the top story.

(b) Such scuttles or trapdoors shall be covered on the top and edges with sheet metal or other approved fire resistive material. The openings for same shall be at least 2 feet by 3 feet in size.

SECTION 923. PENT HOUSES AND ROOF STRUCTURES.

1. General. Except for flag poles and water tanks, and for supports of radio and television antennas less than 12 feet in height, all construction hereafter placed on the roof of a building within the fire limits or over the roof of a building more than 55 feet in height wherever located shall be of noncombustible materials except as otherwise provided in subsection 6 of this section for towers for water tanks and in subsection 7 for cooling towers. All equipment installed on roofs shall be substantially constructed and securely fastened.

2. Roof structures. The walls of roof structures hereafter erected on buildings of fireproof construction or semifireproof construction shall be constructed as fire partitions. The roofs of such roof structures shall have a fire resistance rating of not less than 2 hours. The walls and roofs of roof structures on other types of buildings, unless constructed of masonry, shall be covered on the outside with noncombustible weatherproof material.

3. Pent houses.

(a). A pent house whose area exceeds 10 per cent of the roof area shall be considered a story of the building.

(b). When an exterior wall of a pent house sets back 5 feet or more from the exterior walls of the next lower story it may be constructed as a fire partition, covered on the outside with non-combustible weatherproof material, and supported by steel or reinforced concrete girders; otherwise the walls shall conform to the requirements for exterior walls.

4. Skylights.

(a). Skylights placed over shafts, vent shafts and stair enclosures shall be glazed with plain glass not more than $\frac{1}{8}$ of an inch in thickness.

(b). Skylights other than as specified above, which are inclined less than 60° from the horizontal, hereafter placed on a building shall have the sashes and frames thereof constructed of metal and glazed with wired glass; except that skylights in foundries or buildings where acid fumes are present, may be of wood by special permission of the city building inspector.

(c). Every skylight in which plain glass is used shall be protected by a substantial wire screen with wire not lighter than number 12 gauge and having a mesh not less than $\frac{3}{4}$ of an inch nor larger than 1 inch, placed not less than 4 inches nor more than 10 inches above the glazed portion of the skylight at all points. Such screen shall extend beyond the glazing on all sides a distance not less than the height of the screen above the glazing.

(d). When a skylight is located over a stairway, public hallway or a place of assembly, a similar screen shall also be placed below the skylight, unless there is an intermediate ceiling light.

5. Dormer windows. Dormer windows hereafter erected shall be of the same type of construction as the roof on which they are placed or the side walls of the building. The top and sides shall be covered with materials prescribed for roofing in section 922.

6. Water Tanks.

(a). Water tanks of more than 500 gallons capacity hereafter placed on or in a building shall be supported on masonry, reinforced concrete or steel construction except that portion of the supporting structure which is above the roof the building may be of heavy timbers; provided that when such supporting construction is within the building it shall be protected as required for fireproof construction.

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(b). Such tanks shall have in the bottom or on the side near the bottom, a pipe or outlet, fitted with a suitable valve for discharging the contents in an emergency through an adequate drain.

(c). Such tanks shall not be placed over a stairwell or elevator shaft.

(d). All unenclosed roof tanks shall have covers sloping toward the outer edges.

(e). When hoops are used in the construction of tanks they shall be of metal, round in cross section and provision shall be made to guard against corrosion.

7. **Cooling towers.** Cooling towers in excess of 750 square feet base area inside the fire limits shall be enclosed with masonry or reinforced concrete siding. Mechanical draft cooling towers in excess of 250 square feet base area when located inside the fire limits, and when located on buildings 55 feet or more in height outside the fire limits, shall have noncombustible siding and siding supports.

8. **Roof ponds.** When roofs are used for ponds for water cooling for air conditioning or insulation the roof structure shall be designed for the imposed load and the roofing and flashing shall be in conformity with the use, and ample drainage outlets shall be provided for the discharge of the water.

SECTION 924. NON-BEARING PARTITION CONSTRUCTION.

(a). The height of non-bearing partitions other than those of metal lath and plaster and other than temporary partitions of sheet metal, wood and glass shall not exceed the following unsupported heights for a length not exceeding 20 feet between vertical supports except that the length shall not exceed 6 feet for 2-inch partitions:

<i>Thickness Exclusive of Plaster</i>	<i>Maximum Unsupported Height</i>
2 inches	9 feet
3 inches	12 feet
4 inches	15 feet
6 inches	20 feet
8 inches	25 feet

(b). When reinforced for the purpose of a greater ratio of height to thickness or for greater distance between vertical supports than given above, such non-bearing partitions shall have the reinforcement securely anchored to floor and ceiling construction in an approved manner.

SECTION 925. BASEMENT PARTITIONS.

Except in dwellings and buildings of wood frame construction, partitions in basements shall be constructed of noncombustible materials or shall have a fire resistance rating of not less than one hour, unless such partitions enclose only coal or wood bins, or unless the basement is sprinklered.

SECTION 926. BASEMENT CEILINGS.

In buildings of other than fireproof or semifireproof construction, except in one-story buildings outside the fire limits and in dwellings, the ceilings over basements shall be fire retardant ceilings as defined in section 200, unless such basements are sprinklered.

SECTION 927. FLOORS ON THE GROUND.

Floors resting directly on the ground shall be protected in an approved manner against dampness from below the floor.

SECTION 928. FLOOR DRAINAGE.

In buildings of fireproof construction or semifireproof construction occupied as factories or storage warehouses, and in buildings of heavy timber construction, hereafter erected, provision shall be made for the discharge of water from every floor and for adequate drainage from courts or other spaces receiving such discharge.

SECTION 929. GLASS FLOOR LIGHTS.

Glass floor lights in the floors between stories of a building are prohibited.

SECTION 930. LATHING AND PLASTERING.

Except as otherwise specifically provided in this code or by rules duly promulgated by the North Carolina Building Code Council, the Standard Specifications for Gypsum Plastering Including Requirements for Lathing and Furring (A42.1-1946) and Standard Specifications for Portland Cement Stucco and Portland Cement Plastering Including Requirements for Lathing and Furring (A42.2-1946 and A42.3-1946) approved by the American Standards Association shall be deemed to be generally accepted good practice for lathing and plastering.

ARTICLE X.
CHIMNEYS, FLUES AND VENTS

SECTION 1000. DEFINITIONS.

Flue means a passageway for the purpose of removing products of combustion from solid, liquid, or gas fuel.

Chimney means a vertical masonry or reinforced concrete shaft enclosing one or more flues.

Smoke pipe means a pipe or breaching connecting a heating appliance and a flue.

Gas vent means a flue for removing products of combustion from gas appliances, but not suitable for other fuels.

Type B gas vent means approved vent piping of noncombustible corrosion-resistant material of adequate strength and heat insulating value, and having bell and spigot or other acceptable joints.

Draft hood is a device placed in, and made part of, the smoke pipe or the flue from an appliance, or in the appliance itself, which is designed to (1) insure the ready escape of the products of combustion in the event of no draft, back-draft, or stoppage beyond the draft hood; (2) prevent a back-draft from entering the appliance; and (3) neutralize the effect of stack action of the chimney flue upon the operation of the appliance.

SECTION 1001. FLUES, GENERAL.

1. **Flue connections required.** Every heating apparatus or heat producing appliance requiring a flue connection shall be connected with a flue conforming to the provisions of this article. This shall not include electric appliances; gas appliances, except as specifically required in this article, nor oil fired appliances especially designed for use without flue connection.

2. **Use of nonconforming flues.** Flues not conforming to the requirements of this article for chimneys, metal smokestacks or vents for gas appliances, shall not be used unless listed by Underwriters' Laboratories, Inc., and installed in full compliance with the listing and the manufacturers' instructions, and such use is approved by the North Carolina Building Code Council.

3. **Smoke Pipe Connections.**

(a) No flue shall have smoke pipe connections in more than one story of a building, unless provision is made for effectively closing smoke pipe openings with devices made of noncombustible materials whenever their use is discontinued temporarily,

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and completely closing them with masonry when discontinued permanently.

(b) Two or more smoke pipes shall not be joined for a single flue connection, unless the smoke pipes and flue are of sufficient size to serve all the appliances thus connected.

(c) The smoke pipe of a heating appliance shall not be connected into the flue of an incinerator which has the rubbish chute identical with the smoke flue.

SECTION 1002. CHIMNEYS.

1. Construction of Chimneys.

(a) Chimneys hereafter erected within or attached to a structure shall be constructed in compliance with the provisions of this section.

(b) Chimneys shall extend at least 3 feet above the highest point where they pass through the roof of the building and at least 2 feet higher than any ridge within 10 feet of such chimney.

(c) Chimneys shall be properly capped with brick, terra cotta, stone, cast iron, concrete or other approved noncombustible, weatherproof material.

(d) Chimneys shall be wholly supported on masonry or self-supporting fireproof constructions.

(e) No chimney shall be corbeled from a wall more than 6 inches; nor shall a chimney be corbeled from a wall which is less than 12 inches in thickness unless it projects equally on each side of the wall; provided that in the second story of 2-story dwellings corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. In every case the corbeling shall not exceed one inch projection for each course of brick projected.

(f) No change in the size or shape of a chimney, where the chimney passed through the roof, shall be made within a distance of 6 inches above or below the roof joists or rafters.

2. Chimneys for heating appliances, low heat industrial appliances and portable type incinerators.

(a) Chimneys for stoves, cooking ranges, warm air, hot water, and low pressure steam heating furnaces, fireplaces, and low heat industrial appliances, other than chimneys for incinerators of nonportable type (see subsection 5), shall be constructed of solid masonry units or of reinforced concrete. The walls shall be properly bonded or tied with corrosion resistant metal anchors.

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In dwellings and buildings of like heating requirements the thickness of the chimney walls shall be not less than 4 inches. In other buildings the thickness shall be not less than 8 inches, except that rubble stone masonry shall be not less than 12 inches thick.

(b). Every such chimney hereafter erected or altered shall be lined with a flue lining conforming to the requirements below.

(c). Flue linings shall be made of fire clay or other refractory clay which will withstand the action of flue gases and resist without softening or cracking, the temperatures to which they will be subjected, but not less than 2,000° Fahrenheit, or of cast iron of approved quality, form and construction.

(d). Required clay flue linings shall be not less than $\frac{5}{8}$ of an inch thick for the smaller flues and increasing in thickness for the larger flues.

(e). Flue linings shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in type A, type B or fire clay mortar with close fitting joints left smooth on the inside.

(f). Flue linings shall start from a point not less than 8 inches below the intake, or, in the case of fireplaces, from the throat of the fireplace. They shall extend, as nearly vertical as possible, for the entire height of the chimney and be extended 4 inches above the top or cap of the chimney.

(g). Cleanouts for flues or fireplaces shall be equipped with cast iron doors and frames arranged to remain tightly closed when not in use.

(h). When two or more flues are contained in the same chimney, at least every third flue shall be separated by masonry at least 4 inches thick bonded into the masonry wall of the chimney. Where flue linings are not so separated, the joints of adjacent flue linings shall be staggered at least 7 inches.

3. **Chimneys for medium heat industrial appliances, and power boilers.** Chimneys for high pressure steam boilers, smoke houses and other medium heat appliances, other than incinerators, shall be of masonry or reinforced concrete not less than 8 inches thick; provided that stone masonry shall be not less than 12 inches thick; and in addition, shall be lined with not less than $4\frac{1}{2}$ inches of fire brick laid on the $4\frac{1}{2}$ inch bed in fire clay mortar, starting not less than 2 feet below the smoke pipe entrance and extending for a distance of at least 25 feet above the smoke pipe entrance.

4. **Chimneys for high heat industrial appliances.** Chimneys of cupolas, brass furnaces, porcelain baking kilns and other high heat appliances shall be built with double walls, each not less than

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8 inches in thickness, with an air space of not less than 2 inches between them. The inside of the interior walls shall be of fire brick not less than $4\frac{1}{2}$ inches in thickness laid on the $4\frac{1}{2}$ inch bed in fire clay mortar.

5. Chimneys for incinerators of nonportable type.

(a). Chimneys for non-fuel fired incinerators in which the grate of the combustion chamber does not exceed 9 square feet, in residence buildings, institutional buildings, churches, schools and restaurants, shall be of solid masonry or of reinforced concrete not less than 4 inches thick with a flue lining as specified in subsection 2.

(b). Chimneys for non-fuel fired incinerators in which the grate of the combustion chamber exceeds 9 square feet, in residence buildings, institutional buildings, churches, schools and restaurants, shall be of solid masonry or of reinforced concrete not less than 4 inches thick with a lining of fire brick not less than $4\frac{1}{2}$ inches thick laid on the $4\frac{1}{2}$ -inch bed for a distance of not less than 30 feet above the roof of the combustion chamber, and in clay or shale brickwork not less than 8 inches thick beyond 30 feet above the roof of the combustion chamber.

(c). Chimneys for fuel fired incinerators shall be as required for non-fuel fired incinerators with grates exceeding 9 square feet, but the fire brick lining shall extend for not less than 40 feet above the roof of the combustion chamber.

(d). Chimneys for incinerators other than covered above shall be of solid masonry or of reinforced concrete not less than 8 inches thick and have a lining of fire brick not less than $4\frac{1}{2}$ inches thick laid on the $4\frac{1}{2}$ -inch bed in fire clay, for the full height of the flue.

(e). Nothing in this section shall prohibit the connection by means of an approved smoke pipe or breeching, of an incinerator to a smoke stack or chimney serving a heat appliance provided the cross sectional area of such stack or chimney is at least 4 times that of the incinerator breeching and such stack or flue meets the requirements for the incinerator so connected.

(f). All flues for non-fuel fired incinerators shall terminate in substantially constructed spark arresters.

6. Sizes of flues.

(a). The cross sectional areas of smoke flues shall be designed and proportioned to meet the conditions of temperatures, within and without the flue, thickness of masonry, exposure, shape and material of flue and other influences.

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(b). The cross sectional areas of flues and vents for gas burning appliances shall be not less than one square inch per 7,500 hourly Btu input and in no case shall this section be less than 3 inches in diameter. Flues and vents shall have cross sectional areas at least equal to the aggregate areas of the vents of the appliances connected to them.

7. Use of flues.

(a). It shall be unlawful to use as a smoke flue, a flue hereafter constructed or placed in a building, or a flue now existing that is not already used as a smoke flue, unless it conforms to the requirements of this section.

(b). Chimneys or flues installed for the use of gas appliances but which are not suitable for solid or liquid fuels, shall be plainly and permanently labeled, "THIS FLUE IS FOR THE USE OF GAS BURNING APPLIANCES ONLY." The label shall be attached at a point near where the vent pipe enters the chimney, or with type B gas vents used in place of a chimney, at a point near where the type B gas vent enters a wall, floor or ceiling.

8. Flues to be clean.

(a). Upon the completion of a building or the alteration of existing flues, the flues shall be cleaned and left smooth on the inside.

(b). The city building inspector may require an inspection to be made to assure safe condition of the flue before permitting its use.

9. Fireplaces.

(a). The back and sides of fireplaces hereafter erected shall be of solid masonry or reinforced concrete, not less than 8 inches in thickness. A lining of fire brick at least 2 inches thick or other approved material shall be provided unless the thickness is 12 inches.

(b). Fireplaces shall have hearths of brick, stone, tile or other approved noncombustible material supported on a fireproof slab or on brick trimmer arches. Such hearths shall extend at least 20 inches outside of the chimney breast and not less than 12 inches beyond each side of the fireplace opening along the chimney breast. The combined thickness of hearth and supporting construction shall be not less than 6 inches at any point.

(c). Wooden forms or centers used in the construction of that part of the supporting construction which is below the hearth of the fireplace shall be removed when the supporting construction of the hearth is completed.

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(d). No heater shall be placed in a fireplace which does not conform to the requirements of this section or is not provided with a flue, except electric or gas heaters of a type specifically approved for such installation.

(e). Spaces between the chimney and joists, beams or girders and any combustible materials shall be firestopped by filling with noncombustible material.

SECTION 1003. METAL SMOKESTACKS.

1. Construction.

(a). Metal smokestacks shall be of adequate thickness, properly riveted or welded and, unless structurally self supporting, shall be guyed securely, or firmly anchored to or otherwise supported by the building or structure served thereby.

(b). All metal work shall be painted or galvanized.

(c). Clean-out openings shall be provided at the base of every such stack.

(d). All such stacks hereafter erected, outside or independent of a building, shall be supported on substantial foundations, so designed that the maximum average pressure for both dead and wind loads on the soil shall not exceed $\frac{2}{3}$ of the maximum allowable pressure on the soil.

(e). All metal smokestacks used for high heat appliances shall be lined with $4\frac{1}{2}$ -inch fire brick laid flat in fire clay mortar extending not less than 25 feet above the smoke pipe entrance.

2. Height. Metal smokestacks shall extend to a height of not less than 10 feet above the highest point of any roof within 25 feet.

3. Exterior stacks.

(a). Metal smokestacks, or parts thereof, hereafter erected on the exterior of a building shall have a clearance from the wall of not less than 24 inches if the wall is of wood frame construction, and not less than 4 inches if it is of any other type of construction.

(b). No such stack shall be nearer than 24 inches in any direction from a wall opening, exit or fire escape.

(c). When such stack is insulated on the exterior in some approved manner, the clearances herein prescribed may be reduced to $\frac{2}{3}$ of those specified.

4. Interior stacks.

(a). Metal smokestacks, or parts thereof, hereafter erected within a building other than a one-story building, shall be en-

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closed above the story in which the appliance served thereby is located, in walls of noncombustible construction having a fire resistance rating of not less than one hour, with a space on all sides between the stack and the enclosing walls sufficient to render the entire stack accessible for examination and repair.

(b). The enclosing walls shall be without openings, except doorways equipped with approved self-closing fire doors at various floor levels for inspection purposes.

(c). Where such a stack passes through a roof constructed of combustible materials, it shall be guarded by a galvanized iron ventilating thimble extending not less than 9 inches below and 9 inches above such roof construction. Such thimbles shall be of a size to provide a clearance on all sides of the stack of not less than 18 inches; provided that for stacks of low heat appliances the clearance may be reduced to not less than 6 inches.

(d). Smokestacks shall not be carried up inside of ventilating ducts unless such ducts are constructed as required by this article for smokestacks or smoke flues and such stacks or flues are used solely for venting the room or space in which the appliance served by the smokestack is located.

SECTION 1004. CUPOLA CHIMNEYS.

Chimneys of cupola furnaces, blast furnaces and similar devices, hereafter erected, shall extend at least 20 feet above the highest point of any roof within a radius of 50 feet thereof and be covered on the top with heavy wire netting or other approved spark arrester. No woodwork or other combustible material or construction shall be erected or placed within 3 feet of any part of such chimney.

SECTION 1005. RAISING ADJOINING CHIMNEYS.

1. **When required.** Whenever a building is hereafter erected, enlarged or raised so that a wall along a lot line or within 3 feet thereof, extends above the top of a chimney or smoke flue of a neighboring existing building, the owner of the building so erected, enlarged or raised, shall at his own expense, carry up, either independently or on his own building, all chimneys and smoke flues of such adjoining building which are within 10 feet of any portion of the wall extending above such chimney or flue.

2. **Notice to owner.** It shall be the duty of the owner of the building to be erected, enlarged or raised to notify, in writing, at least 10 days before such work is to begin, the city building inspector and the owner of the chimneys and flues affected, of his intention to carry up such chimneys and flues as herein provided.

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3. **Construction.** The construction of such chimneys and flues shall conform to the requirements of this article, but in no case shall the internal area of an extended flue be less than that of the existing flue.

SECTION 1006. FLUES AND VENTS FOR GAS APPLIANCES.

1. **Flue connections required.** Every gas appliance shall be connected to an effective flue extending to the outer air and conforming to the provisions of subsection 2 of this section, if it is included in any of the following classifications, provided that such connections shall not be required for industrial appliances of such size or character that the absence of a connection does not constitute a hazard to the occupants:

(a). Domestic appliances with input rating in excess of 50,000 Btu per hour, except domestic gas ranges.

(b). Automatically controlled appliances with input rating in excess of 5,000 Btu per hour, except automatic instantaneous water heaters of the single faucet type, where the single faucet is attached to and made a part of the appliance.

(c). Automatically controlled appliances with input rating less than 5,000 Btu per hour, unless equipped with automatic device to prevent the escape of unburned gas at the main burner or burners.

The term "automatically controlled appliance" used in paragraphs (b) and (c) refers to appliances to which the gas supply is automatically turned on and off in accordance with the demand for heat, but does not include appliances equipped with devices or controls governing the supply of gas to the main burner or burners which cannot automatically reduce the gas supply below 30 per cent of the input rating.

(d). Appliances installed in the same room, which if not vented would make the total input rating of unvented gas appliances, not including domestic gas ranges, as great as 30 Btu per hour per cubic foot of room content.

(e). Water heaters installed in bath rooms, bed rooms, or any occupied room normally kept closed.

(f). Space heaters in sleeping quarters for use of transients.

(g). All house heating steam and hot water boilers and warm air furnaces including floor furnaces.

2. **Types of flues.**

(a). **Type A flues:** Chimneys or metal smokestacks, as provided for in sections 1002 and 1003. Type A flues are required for:

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(1) all incinerators; (2) all appliances which may be converted readily to the use of solid or liquid fuel; (3) all boilers and furnaces, other than attic furnaces; (4) all other appliances except approved appliances which produce flue gas temperatures not in excess of 550° F. at the outlet of the draft hood when burning gas at the manufacturer's input rating.

(b). **Type B gas vents:** Approved vent piping of noncombustible, corrosion-resistant material of adequate strength and heat insulating value, and having bell and spigot or other acceptable joints. Type B gas vents shall be used only with approved gas appliances which are not required by paragraph (a) above to be vented to type A flues, except that they may be used when extended through an existing non-used chimney, whether the chimney is lined or not lined.

(c). **Type C gas vents:** Vent pipes of sheet copper of not less than 24 U. S. gauge or of galvanized iron of not less than 20 U. S. gauge or of other approved corrosion-resistant material, may be used for runs directly from the space in which the appliance is located through a roof or exterior wall to the outer air. Such vent pipes shall not pass through any attic or concealed space nor through any floor. This shall not be construed as prohibiting the use of such vent pipes to vent attic furnaces installed in accordance with the provisions of this code. Installation with reference to clearance from combustible material and passage through wall or roof shall comply with the provisions of subsection 4 of this section.

3. Installation of type B gas vents.

(a). Type B gas vents shall be made up with tight joints.

(b). Type B gas vents shall be installed with a clearance to combustible material or construction whether plastered or unplastered, of not less than one inch, provided that for vents of floor furnaces such clearance shall be not less than 3 inches for a distance of not less than 3 feet from the outlet of the draft hood, measured along the center line of the vent piping.

(c). Suitable provision shall be made to prevent mechanical injury to type B gas vents where they extend through walls, floors or roofs.

(d). Type B gas vents shall not be used with solid or liquid fuel burning appliances.

4. Installation of gas vents other than type B.

(a). Gas appliance vent piping other than approved type B gas vents shall not pass through any attic or concealed space nor through any combustible floor, and shall not pass through any combustible roof except as specified in section 1006-2(c).

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Where passing through combustible roofs in accordance with section 1006-2(c) they shall be guarded at the point of passage as specified for passage through combustible walls or partitions in paragraph (b) below. Vent piping may extend through any existing chimney whether the chimney is lined or not.

(b). Gas appliance vent piping other than approved type B gas vents shall not pass through combustible walls or partitions unless they are guarded at the point of passage (1) by metal ventilated thimbles not less than 6 inches larger in diameter than the pipe, or (2) by metal thimbles not less than 4 inches larger in diameter than the pipe with the annular space filled with mineral wool or other approved noncombustible insulating material; or in lieu of such protection all combustible material in the wall or partition shall be cut away from the vent pipe a sufficient distance to provide the clearance required from such vent pipe to combustible material—any material used to close up such opening shall be noncombustible.

(c). Clearances from combustible material to gas appliance vent piping other than approved type B gas vents shall be in accordance with standard practice for safe installation and use as required by section 1100.

5. Flue mortar. All flue mortar for flues or vent pipes from gas-burning appliances shall be acid resisting.

6. Draft hoods. Every flue connected appliance except an incinerator, unless its construction serves the same purpose, shall be equipped with an effective draft hood which either (1) has been approved as part of the appliance or (2) complies with nationally recognized standards for draft hoods. The draft hood shall be attached to the flue collar of the appliance or as near to the appliance as conditions permit and in a position for which it is designed with reference to horizontal and vertical planes. The draft hood shall be so located that the relief opening is not obstructed by any part of the appliance or adjacent construction.

7. Interconnection of vents. No vent pipe from a gas appliance shall be inter-connected with any other vent pipe, smoke pipe, or flue, unless such gas appliance is equipped with an automatic device to prevent the escape of unburned gas at the main burner or burners. Where a gas appliance vent pipe is joined with a smoke pipe from an appliance burning some other type of fuel, for connection into a single flue opening, they shall be joined by a Y fitting located as close as practicable to the chimney. With liquefied petroleum gases the automatic device to prevent the escape of unburned gas shall shut off the pilot light as well as the main burner or burners.