780 CMR 21.00

MASONRY

780 CMR 21.00 is unique to Massachusetts

780 CMR 2101.0 GENERAL

2101.1 General Masonry shall be designed and constructed in accordance with ACI 530/ASCE 5/TMS 402 (referred to as ACI 530) and ACI 530.1/ASCE 6/TMS 602 (referred to as ACI 530.1), except as provided otherwise in 780 CMR 21.00.

2101.2 Design. All masonry shall be designed as reinforced masonry using the allowable stress design method or the strength design method, except as follows:

1. Masonry veneer shall be designed in accordance with 780 CMR 1405.5 through 1405.9 and ACI 530, Chapter 6. Where there is a conflict between the provisions of ACI 530, Chapter 6 and 780 CMR 1405.6 through 1405.9, the more stringent requirements shall prevail.
2. Glass block masonry shall be designed in accordance with ACI 530, Chapter 7.
3. As specified otherwise in 780 CMR 2100.0.

2101.3 Lateral Load Resisting System. The lateral load resisting system shall include all masonry walls that are not structurally isolated from imposed in-plane loads other than from their own mass. All such walls shall be considered to be shear walls.

Exception. Elements not isolated from in-plane shear, such as narrow masonry walls and masonry wall piers between openings or between openings and the ends of the wall, which each have an in-plane stiffness less than 5% of the total stiffness of the lateral load resisting system in the same direction, may be omitted from the lateral load resisting system in that direction provided that the sum of the stiffnesses of the omitted elements is not greater than 10% of the total stiffness of the lateral load resisting system in that direction.

780 CMR 2102.0 DEFINITIONS AND NOTATIONS

2102.1 General. The following words and terms are not defined in ACI 530 or ACI 530.1; they shall, for the purposes of 780 CMR 2102.0 and as used elsewhere in 780 CMR, have the meanings shown in 780 CMR 2101.1.

ARCHITECTURAL TERRA COTTA. Plain or ornamental hard-burned modified clay units, larger in size than brick, with glazed or unglazed ceramic finish.

BOND BEAM. Same as *bond course*.

BOND COURSE. A horizontal grouted element within masonry in which reinforcement is embedded.

BRICK:

Calcium Silicate Brick (Sand Lime Brick). A masonry unit made of sand and lime.

Clay or Shale Brick. A masonry unit made of clay or shale, usually formed into a rectangular prism while in the plastic state and burned or fired in kiln.

Concrete Brick. A solid masonry unit having the approximate shape of a rectangular prism and composed of inert aggregate particles embedded in a hardened cementitious matrix.

Hollow Brick A masonry unit made of clay or shale whose net cross-sectional area is less than 75% of its gross cross-sectional area.

BUTTRESS. A projecting part of a masonry wall built integrally therewith to provide lateral stability.

CAST STONE. A building stone manufactured from portland cement concrete and used as a trim, veneer or facing on or in buildings or structures.

CELL. A void space having a gross cross-sectional area greater than 1½ square inches (967 mm^2).

CHIMNEY. A primarily vertical enclosure containing one or more passageways for conveying flue gases to the outside atmosphere.

CHIMNEY TYPES:

High-heat Appliance Type. An approved chimney for removing the products of combustion from fuel-burning, high-heat appliances producing combustion gases in excess of 2,000°F (1093°C) measured at the appliance flue outlet (see 780 CMR 2113.11.3).

Low-heat Appliance Type. An approved chimney for removing the products of combustion from fuel-burning, low-heat appliances producing combustion gases not in excess of 1,000°F (538°C) under normal operating conditions, but capable of producing combustion gases of 1,400°F (760°C) during intermittent forced firing for periods up to one hour. Temperatures shall be measured at the appliance flue outlet.

Masonry Type. A field-constructed chimney of solid masonry units or stones.

Medium-heat Appliance Type. An approved chimney for removing the products of combustion from fuel-burning, medium-heat appliances producing combustion gases not exceeding 2,000°F (1093°C) measured at the appliance flue outlet (see 780 CMR 2113.11.2).

CLEANOUT. An opening to the bottom of a grout space of sufficient size and spacing to allow the removal of debris.

COVER. Distance between surface of reinforcing bar and edge of member.

FACE SHELL. The outer portion of a hollow masonry unit as placed in masonry.

FIREPLACE. A hearth and fire chamber or similar prepared place in which a fire may be made and which is built in conjunction with a chimney.

FIREPLACE THROAT. The opening between the top of the firebox and the smoke chamber.

GROUTED MASONRY:

Grouted Hollow-unit Masonry. That form of grouted masonry construction in which certain designated cells of hollow units are continuously filled with grout.

Grouted Multi-wythe Masonry. That form of grouted masonry construction in which the space between the wythes is solidly or periodically filled with grout.

HEIGHT, WALLS. The vertical distance from the foundation wall or other intermediate support of such wall to the top of the wall, or where walls are divided into panels by relieving joints, the height of the panel. Where walls are infilled between framing members, the height is the height of the infilled panel.

LENGTH, WALLS. The distance from end to end of a wall, or when vertical control joints are present, the distance from an end to a control joint or the distance between control joints. Where walls are infilled between framing members, the length is the length of the infilled panel.

MASONRY. A built-up construction or combination of building units or materials of clay, shale, concrete, glass, gypsum, stone or other approved units bonded together with or without mortar or grout or other accepted method of joining.

Ashlar Masonry. Masonry composed of various sized, rectangular units having sawed, dressed or squared bed surfaces, properly bonded and laid in mortar.

Coursed Ashlar. Ashlar masonry laid in courses of stone of equal height for each course, although different courses shall be permitted to be of varying height.

Glass Unit Masonry. Nonload-bearing masonry composed of glass units bonded by mortar.

Plain Masonry. Masonry which is not reinforced.

Random Ashlar. Ashlar masonry laid in courses of stone set without continuous joints and laid up without drawn patterns. When composed of material cut into modular heights, discontinuous but aligned horizontal joints are discernible.

Reinforced Masonry. Masonry construction in which reinforcement acting in conjunction with the masonry is used to resist forces.

Solid Masonry. Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar.

MASONRY UNIT. Brick, tile, stone, glass block or concrete block.

Clay. A building unit larger in size than a brick, composed of burned clay, shale, fire clay or mixtures thereof.

Concrete. A building unit or block larger in size than 12 by four by four inches (305 mm by 102 mm by 102 mm) made of cement and suitable aggregates.

Hollow. A masonry unit whose net cross-sectional area in any plane parallel to the load-bearing surface is less than 75% of its gross cross-sectional area measured in the same plane.

Solid. A masonry unit whose net cross-sectional area in every plane parallel to the load-bearing surface is 75% or more of its gross cross-sectional area measured in the same plane.

MORTAR. A plastic mixture of approved cementitious materials, fine aggregates and water used to bond masonry or other structural units.

MORTAR, SURFACE-BONDING. A mixture to bond concrete masonry units that contain hydraulic cement, glass fiber reinforcement with or without inorganic fillers or organic modifiers, and water.

PRISM. An assemblage of masonry units and mortar with or without grout used as a test specimen for determining properties of the masonry.

RUBBLE MASONRY. Masonry composed of roughly shaped stones.

Coursed Rubble. Masonry composed of roughly shaped stones fitting approximately on level beds and well bonded.

Random Rubble. Masonry composed of roughly shaped stones laid without regularity of coursing but well bonded and fitted together to form well-divided joints.

Rough or Ordinary Rubble. Masonry composed of unsquared field stones laid without regularity of coursing but well bonded.

SPECIFIED. Required by construction documents.

STIRRUP. Shear reinforcement in a beam or flexural member.

STRENGTH:

Design Strength. Nominal strength multiplied by a strength reduction factor.

Nominal Strength. Strength of a member or cross section calculated in accordance with these provisions before application of any strength reduction factors.

Required Strength. Strength of a member or cross section required to resist factored loads.

TILE. A ceramic surface unit, usually relatively thin in relation to facial area, made from clay or a mixture of clay or other ceramic materials, called the

body of the tile, having either a "glazed" or "unglazed" face and fired above red heat in the course of manufacture to a temperature sufficiently high enough to produce specific physical properties and characteristics.

TILE, STRUCTURAL CLAY. A hollow masonry unit composed of burned clay, shale, fire clay or mixture thereof, and having parallel cells.

WALL.

Composite Wall. A wall built of a combination of two or more masonry units bonded together, one forming the backup and the other forming the facing elements.

Dry-stacked, Surface-bonded Wall. A wall built of concrete masonry units where the units are stacked dry, without mortar on the bed or head joints, and where both sides of the wall are coated with a surface-bonding mortar.

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

WEB. An interior solid portion of a hollow-masonry unit as placed in masonry.

780 CMR 2103.0 MODIFICATIONS TO ACI 530

Underlined numbers refer to the sections or clauses of ACI 530.

1.6 At the end of the definition of *pier*, add "This definition does not apply to piers in masonry walls between openings and between openings and ends of walls.

1.11 Replace this section with the requirements for stack bond masonry in 780 CMR 2106.0.

1.12.2 Substitute Clause 3.2.3.1 for Clauses 1.12.2.1 and 1.12.2.2 (limitations to size of reinforcing steel bars).

2.1.3.3.1 Substitute 780 CMR 16.00" for "ASCE 7-98."

2.3.5 Substitute: "Members that are not subject to flexural tension shall be designed in accordance with the following:"

780 CMR 2104.0 MASONRY CONSTRUCTION MATERIALS

The requirements of 780 CMR 2104.0 are not covered in ACI 530 nor in ACI 530.1

2104.1 Clay or Shale Masonry Units for Fireproofing. Structural clay tile for nonstructural use in fireproofing of structural members and in wall furring shall not be required to meet the compressive strength requirements of the specifications cited in ACI 530.1, Clause 2.3B. The fire-resistance rating shall be determined in accordance with ASTM E 119 and shall comply with the requirements of Table 602.

2104.2 Ceramic Tile. Ceramic tile shall be as defined in ANSI A137.1 and shall conform to the requirements of ANSI A137.1.

2104.3 Second-hand Units. Second-hand masonry units shall not be reused unless the units conform to the requirements of new units. The units shall be of whole, sound materials and be free from cracks and other defects that will interfere with proper laying or use. Old mortar shall be cleaned from the unit before reuse.

2104.4 Surface-bonding Mortar. Surface-bonding mortar shall comply with ASTM C 887. Surface bonding of concrete masonry units shall comply with ASTM C 946.

2104.5 Mortars for Ceramic Wall and Floor Tile. Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1A and A108.1B and be of the compositions indicated in Table 2104-1.

TABLE 2104-1 CERAMIC TILE MORTAR COMPOSITIONS

LOCATION	MORTAR	COMPOSITION
Walls	Scratchcoat	one cement; $^1/_5$ hydrated lime; four dry or five damp sand
	Setting bed and leveling coat	one cement; ½ hydrated lime; five damp sand to one cement one hydrated lime, seven damp sand
Floors	Setting bed	one cement; $^1/_{10}$ hydrated lime; five dry or six damp sand; or one cement; fie dry or six damp sand
Ceilings	Scratchcoat and sand bed	one cement; ½ hydrated lime; 2½ dry sand or three damp sand

2104.5.1 Dry-set Portland Cement Mortars. Premixed prepared portland cement mortars, which require only the addition of water and which are used in the installation of ceramic tile, shall comply with ANSI A118.1. The shear bond strength for tile set in such mortar shall be as required in accordance with ANSI A118.1. Tile set in dry-set portland cement mortar shall be installed in accordance with ANSI A108.5.

2104.5.2 Electrically Conductive Dry-set Mortars. Premixed prepared portland cement mortars, which require only the addition of water and which comply with ANSI A118.2, shall be used in the installation of electrically conductive ceramic tile. Tile set in electrically conductive dry-set mortar shall be installed in accordance with ANSI A108.7.

2104.5.3 Latex-modified Portland Cement Mortar. Latex-modified portland cement thin-set mortars in which latex is added to dry-set mortar as a replacement for all or part of the gauging water that are used for the installation of ceramic tile shall comply with ANSI A118.4. Tile set in latex-modified portland cement shall be installed in accordance with ANSI A108.5.

2104.5.4 Epoxy Mortar. Ceramic tile set and grouted with chemical-resistant epoxy shall comply with ANSI A118.3. Tile set and grouted with epoxy shall be installed in accordance with ANSI A108.6.

2104.5.5 Furan Mortar and Grout. Chemical-resistant furan mortar and grout that are used to install ceramic tile shall comply with ANSI A118.5. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8.

2104.5.6 Modified Epoxy-emulsion Mortar and Grout. Modified epoxy-emulsion mortar and grout that are used to install ceramic tile shall comply with ANSI A118.8. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9.

2104.5.7 Organic Adhesives. Water-resistant organic adhesives used for the installation of ceramic tile shall comply with ANSI A136.1. The shear bond strength after water immersion shall not be less than 40 psi (275 kPa) for Type I adhesive, and not less than 20 psi (138 kPa) for Type II adhesive, when tested in accordance with ANSI A136.1. Tile set in organic adhesives shall be installed in accordance with ANSI A108.4.

2104.5.8 Portland Cement Grouts. Portland cement grouts used for the installation of ceramic tile shall comply with ANSI A118.6. Portland cement grouts for tile work shall be installed in accordance with ANSI A108.10.

780 CMR 2105.0 CONSTRUCTION

Requirements in 780 CMR 2105.0 are in addition to those of ACI 530 and ACI 530.1.

2105.1 Open-end Units. Open-end units with beveled ends shall be fully grouted. Head joints of open-end units with beveled ends need not be mortared. The beveled ends shall form a grout key that permits grouts within ⅝ inch (15.9 mm) of the face of the unit. The units shall be tightly butted to prevent leakage of the grout.

2105.2 Chases and Recesses. Chases and recesses shall be constructed as masonry units are laid. Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels.

2105.3 Lintels. Minimum length of end support shall be four inches (102 mm).

2105.4 Support on Wood. Masonry shall not be supported on wood girders or other forms of wood construction except as permitted in 780 CMR 2304.7.

2105.5 Weep Holes. Weep holes provided in the outside wythe of masonry walls shall be at a maximum spacing of 33 inches (838 mm) on center. Weep holes shall not be less than $^{3}/_{16}$ inch (4.8 mm) in diameter.

2105.6 Corbelled Masonry. The maximum corbelled projection beyond the face of the wall shall not be more than one-half of the wall thickness nor one-half the wythe thickness for hollow walls. The maximum projection of one unit shall neither exceed one-half the height of the unit nor one-third the thickness at right angles to the wall.

2105.6.1 Molded Cornices. Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of projecting masonry or molded cornices shall lie within the middle ⅓ of the supporting wall. Terra cotta and metal cornices shall be provided with a structural frame of approved noncombustible material anchored in an approved manner.

780 CMR 2106.0 SEISMIC DESIGN FOR SHEAR WALLS

2106.1 Seismic Requirements for Masonry Shear Walls. Replace the requirements for masonry shear walls of ACI 530, Section 1.13 with the requirements of 780 CMR 2106.0.

2106.1.1 Design of Shear Walls. Design of shear walls for the forces specified in 780 CMR 16 shall be in accordance with the strength design method. The design shall comply with the requirements of ACI 530, Sections 3.1 and 3.2, and for prestressed shear walls with the additional requirements of ACI 530, Chapter 4.

2106.1.2 Seismic Design Categories B and C. Masonry shear walls for Seismic Design Categories B and C shall be intermediate reinforced masonry shear walls or special reinforced masonry shear walls.

2106.1.3 Seismic Design Category D. Masonry shear walls for Seismic Design Category D shall be special reinforced masonry shear walls.

2106.2 Minimum Masonry Wall Thickness. Shear walls shall have a minimum nominal thickness of six inches.

2106.3 Restrictions on Mortar. Masonry cement is not permitted for shear walls. Mortar shall be Type M or S.

2106.4 Stack Bond. For shear walls laid in stack bond, the head joints shall be solidly filled and cells shall be fully grouted.

2106.5 Connections of Shear Walls to Roof and Floor Diaphragms.

2106.5.1 In-plane Shear Transfer. The connections between a shear wall and a floor or roof shall be capable of transferring the design in-plane shear force, but not less than 280 lbs/ft of wall for strength design or 190 lbs/ft of wall for allowable stress design.

2106.5.2 Out-of-plane Connection. The connections between a wall and a floor or roof shall

be capable of resisting the out-of-plane design forces in accordance with 780 CMR 1615.0.

2106.6 Piers Between Openings in Shear Walls. The minimum length of pier between openings in shear walls or at the side of an opening at the end of a shear wall shall be 24 inches.

2106.7 Reinforcement Requirements.

2106.7.1 General. Except as provided otherwise in 780 CMR 2106.10, reinforcement shall be steel reinforcing bars in grouted vertical cells or grouted horizontal bond courses of hollow unit masonry, or in grouted collar joints between two masonry wythes.

2106.7.2 Vertical Reinforcement. Provide vertical reinforcement of at least 0.2 $in.^2$ at wall corners, within 8 in. of each side of expansion and control joints, within eight in. of the ends of walls, and within 16 in. of each side of openings that are larger than 16 in. in either the horizontal or vertical direction. For openings that interrupt distributed reinforcement, provide reinforcement on each side of the opening regardless of its size. The vertical reinforcement at corners, at ends of walls, and to each side of expansion and control joints shall be continuous from bottom to top of the wall. Vertical reinforcement to each side of openings shall extend from the bond course at the bottom of wall or floor framing below the opening to the bond course at the floor framing above the opening, but not less than the reinforcement development length above and below the opening unless at the bottom or top of the wall. For openings that align vertically, reinforcement to each side of the openings shall be spliced or otherwise constructed continuous between levels.

2106.7.3 Horizontal Reinforcement. Provide continuous horizontal reinforcement of at least 0.2 $in.^2$ in a bond course at the bottom of a wall, at floor and roof levels connected to the wall, and within 16 in. of the top of the wall. Provide horizontal reinforcement of at least 0.2 $in.^2$ at the top and bottom of openings larger than 16 in. in either the horizontal or vertical direction. Extend reinforcement a development length but not less than 24 in. beyond the edges of openings.

2106.7.4 Piers Between Openings in Shear Walls. The spacing of horizontal reinforcing bars in piers between openings in a shear wall or in piers between an opening and the end of a shear wall, that are part of the lateral load resisting system, shall not be more than ⅓ the height of the pier, ⅓ the length of the pier, or the spacing required for the wall a a whole, whichever is less.

2106.8 Special Reinforced Masonry Shear Walls.

2106.8.1 Reinforcement Requirements. In addition to the reinforcement required by 780 CMR 2106.7, provide minimum distributed reinforcement as required by 780 CMR 2106.8.1.1 and 2106.8.1.2.

2106.8.1.1 Minimum Cross-sectional Area of Distributed Reinforcement.

1. The minimum total cross-sectional area provided by the reinforcing bars in the vertical and horizontal directions shall be 0.002 times the gross cross-sectional area of the wall.
2. The minimum cross-sectional area of horizontal reinforcing bars for running bond shall be 0.0007 times the gross cross-sectional area of the wall.
3. The minimum cross-sectional area of horizontal reinforcing bars for stack bond shall be 0.0015 times the gross cross-sectional area of the wall.
4. The minimum cross-sectional area of vertical reinforcing bars shall be 0.0007 times the gross cross-sectional area of the wall, but shall not be less than ⅓ of the cross-sectional area of horizontal reinforcement that is required for running bond.

2106.8.1.2. Maximum Spacing for Distributed Vertical Reinforcement. The maximum spacing of distributed vertical reinforcing bars shall be ⅓ the length of the wall, ⅓ the height of the wall, or four feet-zero inches, whichever is less.

2106.8.1.3 Maximum Spacing for Distributed Horizontal Reinforcement. The maximum spacing of horizontal reinforcing bars for running bond shall be ⅓ the length of the wall, ⅓ the height of the wall, or four feet-zero inches, whichever is less. The maximum spacing of horizontal reinforcing bars for stack bond shall be ⅓ the length of the wall, ⅓ the height of the wall, or two feet-zero inches, whichever is less.

2106.8.1.4 Anchorage of Reinforcement. All horizontal reinforcing bars in shear walls shall be anchored around the vertical reinforcement at the ends of the walls or at the jambs of openings with a standard 180° hook, except that a 90° hook shall be used at wall intersections. All vertical reinforcement terminating above or below an opening shall be anchored around a horizontal reinforcing bar with a standard 180° hook

2106.9 Intermediate Reinforced Masonry Shear Walls.

2106.9.1 Reinforcement Requirements. In addition to the reinforcement required by 780 CMR 2106.7, provide minimum distributed reinforcement as required by 780 CMR 2106.9.1.1 and 2106.9.1.2.

2106.9.1.1 Minimum Cross-sectional Area of Distributed Reinforcement.

1. The minimum total cross-sectional area provided by the reinforcing bars in the

vertical and horizontal directions shall be 0.002 times the gross cross-sectional area of the wall.

2. The minimum cross-sectional area of horizontal reinforcing bars for running bond shall be 0.0007 times the gross cross-sectional area of the wall.

3. The minimum cross-sectional area of horizontal reinforcing bars for stack bond shall be 0.0015 times the gross cross-sectional area of the wall.

4. The minimum cross-sectional area of vertical reinforcing bars shall be 0.0007 times the gross cross-sectional area of the wall, but shall not be less than one-third of the cross-sectional area of horizontal reinforcement that is required for running bond.

2106.9.1.2.Maximum Spacing for Distributed Vertical Reinforcement. The maximum spacing of distributed vertical reinforcing bars shall be ⅓ the length of the wall, ⅓ the height of the wall, or four feet-zero inches, whichever is less.

2106.9.1.3 Maximum Spacing for Distributed Horizontal Reinforcement. The maximum spacing of horizontal reinforcing bars for running bond shall be shall be ⅓ the length of the wall, ⅓ the height of the wall, or four feet-zero inches, whichever is less. The maximum spacing of horizontal reinforcing bars for stack bond shall be ⅓ the length of the wall, ⅓ the height of the wall, or two feet-zero inches, whichever is less.

2106.10 Prestressed Masonry Shear Walls.

2106.10.1 Reinforcement. Provide minimum distributed reinforcement as required by 780 CMR 2106.9. The cross-sectional area of bonded pre-stressing tendons shall be considered to contribute to the minimum reinforcement requirements.

2106.10.2 Shear Design. The design for in-plane shear shall rely on bonded reinforcement and shall be in accordance with ACI 530, Section 3.2.

2106.11 Elements Excluded from Lateral Load Resisting System. Elements not isolated from in-plane shear which are not considered to be part of the lateral load resisting system in accordance with the exception in 780 CMR 2101.3 shall be designed with sufficient strength and ductility to maintain vertical load carrying capacity when displaced to the design story drift The minimum reinforcing for walls or wall segments shall be in accordance with that required for Class A walls in 780 CMR 2107.4.1 .

780 CMR 2107.0 WALLS ISOLATED FROM THE LATERAL LOAD RESISTING SYSTEM

Replace the requirements of ACI 530, Section 1.13 for masonry walls that are isolated from the lateral load resting system with the requirements of 780 CMR 2107.0.

2107.1 Glass Block Unit Masonry. Glass unit masonry walls shall be designed in accordance with ACI 530, Chapter 7. Glass Masonry walls shall be structurally isolated from imposed in-plane forces other than that due to their own mass. Glass masonry walls shall have horizontal and vertical reinforcement located not more than 48 inches on center, located in mortar joints, and extending the entire length and width of the panel but not across expansion joints.

The minimal cross-sectional area of the horizontal reinforcing bars shall be 0.0015 times the gross cross-sectional area of the wall.

The minimal cross-sectional area of the vertical reinforcing shall be 0.0007 times the gross cross-sectional area of the wall.

2107.2 Isolation from In-plane Force. Walls that are isolated from the lateral load resisting system shall have connections to the structure that do not transfer in-plane forces from the structure to the walls. These connections shall be designed to accommodate the design story drift and provide lateral support.

2107.3 Classification of Walls Isolated from the Lateral Load Resisting System. Walls that are isolated from the lateral load resisting system shall be classified as follows:

Class A: Exterior walls, walls enclosing exits, and walls enclosing elevator shafts.

Class B: Walls not classified as Class A and which are more than 16 feet in height.

Class C: Walls not classified as Class A and which are 16 feet in height or less.

2107.4 Design of Walls Isolated from the Lateral Force Resisting System. Design walls that are isolated from the lateral force resisting system to resist applicable out-of-plane forces defined in 780 CMR 16.00. The design shall meet the Allowable Stress Design provisions in ACI 530, Chapter 2 or the Strength Design provisions in ACI 530, Chapter 3. The reinforcement shall not be less than required by 780 CMR 2107.4.1, 2107.4.2, or 2107.4.3 for the applicable class of wall. Anchorage of a wall to a structure shall be consistent with the direction that the wall is designed to span.

2107.4.1 Class a Wall Minimum Reinforcement.

2107.4.1.1 In direction of Span. The minimum reinforcement in the direction of the span shall be bed joint reinforcement or reinforcing steel bars in grouted cells, grouted bond courses, or grouted collar joints. The minimum cross-sectional area of the reinforcement shall be 0.0007 times the gross cross-sectional area of the wall. The maximum

spacing of reinforcing bars shall be the lesser of ⅓ of the span or four feet-zero inches.

2107.4.1.2 Perpendicular to Span. The minimum quantity of reinforcement perpendicular to the span shall be No. 5 bars in grouted cells, grouted bond courses, or grouted collar joints spaced at the lesser of ⅓ of the span or six feet-zero inches o.c., or, alternatively in the case of vertically spanning walls, horizontal joint reinforcement consisting of a minimum of 2 – W1.7 wires at a maximum spacing of 16 inches o.c.

2107.4.1.3 Additional Reinforcement. Additional reinforcement shall be bars in grouted cells, grouted bond courses, or grouted collar joints. Horizontal bars shall be provided at the bottom or top of wall openings, extending 24 inches or 40 bar diameters, whichever is more, past the opening; and continuously at structurally connected floor and roof levels. Vertical bars shall be provided at corners, within 16 inches of the sides of openings, within eight inches of each side of movement joints, and within eight inches of the ends of walls.

2107.4.2 Class B Wall Minimum Reinforcement.

2107.4.2.1 Vertical Reinforcement. Vertical reinforcement of at least 0.2 square inches in cross-sectional area shall be provided at corners, within 16 inches of each side of openings, within eight inches of each side of movement joints, within eoght inches of the ends of walls, and at a maximum spacing of 48 inches.

2107.4.2.2 Horizontal Reinforcement. Horizontal reinforcement shall consist of at least 2- W1.7 wires spaced not more than 16 inches o.c. Horizontal reinforcement of at least 0.2 square inches in cross-sectional area shall also be provided at the bottom and top of wall openings and shall extend not less than 24 inches nor less than 40 bar diameters past the opening; continuously at structurally connected roof and floor levels; within 16 inches of the top of walls; and at a maximum spacing of 48 inches.

2107.4.3 Class C wall minimum reinforcement. Walls shall be reinforced in the vertical direction when the walls span vertically and in the horizontal direction when the walls span horizontally, in accordance with the following:

2107.4.3.1 In the Horizontal Direction. Horizontal reinforcement shall consist of at least two longitudinal W1.7 wires spaced not more than 16 in. (vertical) for walls greater than four inches in width and at least one longitudinal W1.7 wire spaced not more than 16 inches for walls not exceeding four inches in width; or at least one No. 4 bar spaced not more than 48 inches. Where two longitudinal wires of joint reinforcement are used, the space between these wires shall be the widest that the mortar joint will accommodate. Horizontal reinforcement shall be provided within 16 inches of the top and bottom of these masonry elements.

2107.4.3.2 In the Vertical Direction. No. 4 bars spaced not more than 48 inches o.c. and within 16 inches from the ends of walls, in grouted cells or collar joints.

780 CMR 2108.0 ADDITIONAL REQUIREMENTS

2108.1 Connections to Masonry Columns. Connectors shall be provided to transfer forces between masonry columns and horizontal elements. Where anchor bolts are used to connect horizontal elements to the tops of columns, anchor bolts shall be placed within lateral ties. Lateral ties shall enclose both the vertical bars in the column and the anchor bolts. There shall be a minimum of two No. 4 lateral ties provided in the top five inches (127 mm) of the column.

2108.2 Column Displacement. Columns shall have sufficient ductility to maintain vertical load carrying capacity when displaced to the design story drift.

2108.3 Discontinuous Members. Columns and pilasters supporting reactions from discontinuous stiff members such as walls shall be provided with transverse reinforcement spaced at no more than one-fourth of the least nominal dimension of the column or pilaster. The minimum transverse reinforcement ratio shall be 0.0015. Beams supporting reactions from discontinuous walls or frames shall be provided with transverse reinforcement spaced at no more than ½ of the nominal depth of the beam. The minimum transverse reinforcement ratio shall be 0.0015.

2108.4 Parapet Walls. Parapet walls shall be at least eight inches thick and the height shall not be greater than three times its thickness. Parapet walls shall be reinforced the same as masonry shear walls.

780 CMR 2109.0 AND 2110.0: RESERVED

780 CMR 2111.0 MASONRY FIREPLACES

2111.1 Definition. A masonry fireplace is a fireplace constructed of concrete or masonry. Masonry fireplaces shall be constructed in accordance with 780 CMR 2109.0, Table 2111.1 and Figure 2111.1.

2111.1.1 Fireplace Drawings. The construction documents shall describe in sufficient detail the location, size and construction of masonry

fireplaces. The thickness and characteristics of materials and the clearances from walls, partitions and ceilings shall be clearly indicated.

2111.2 Footings and Foundations. Foundations for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least 12 inches (305 mm) thick, and shall extend at least six inches (152 mm) beyond the face of the fireplace or foundation wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth.

2111.2.1 Ash Dump Cleanout. Cleanout openings located within foundation walls below fireboxes, when provided, shall be equipped with ferrous metal or masonry doors and frames constructed to remain tightly closed, except when in use. Cleanouts shall be accessible and located so that ash removal will not create a hazard to combustible materials.

2111.3 Seismic Reinforcing. Masonry or concrete fireplaces shall be constructed, anchored, supported and reinforced as required in 780 CMR 21.00. Masonry and concrete fireplaces shall be reinforced and anchored as detailed in 780 CMR 2111.3.1, 2111.3.2, 2111.4 and 2111.4.1 for chimneys serving fireplaces.

2111.3.1 Vertical Reinforcing. For fireplaces with chimneys up to 40 inches (1016 mm) wide, four No. 4 continuous vertical bars, anchored in the foundation, shall be placed in the concrete, between wythes of solid masonry or within the cells of hollow unit masonry and grouted. For fireplaces with chimneys greater than 40 inches (1016 mm) wide, two additional No. 4 vertical bars shall be provided for each additional 40 inches (1016 mm) in width or fraction thereof.

2111.3.2 Horizontal Reinforcing. Vertical reinforcement shall be placed enclosed within ¼-inch (6.4 mm) ties or other reinforcing of equivalent net cross-sectional area, spaced not to exceed 18 inches (457 mm) on center in concrete; or placed in the bed joints of unit masonry at a minimum of every 18 inches (457 mm) of vertical height. Two such ties shall be provided at each bend in the vertical bars.

2111.4 Seismic Anchorage. Masonry and concrete chimneys shall be anchored at each floor, ceiling or roof line more than six feet (1829 mm) above grade, except where constructed completely within the exterior walls. Anchorage shall conform to the following requirements.

2111.4.1 Anchorage. Two $^{3}/_{16}$-inch by one-inch (4.8 mm by 25.4 mm) straps shall be embedded a minimum of 12 inches (305 mm) into the chimney. Straps shall be hooked around the outer bars and extend six inches (152 mm) beyond the bend. Each strap shall be fastened to a minimum of four floor joists with two ½-inch (12.7 mm) bolts.

TABLE 2111.1 SUMMARY OF REQUIREMENTS FOR MASONRY FIREPLACES AND CHIMNEYS[a]

ITEM	LETTER	REQUIREMENTS	SECTION
Hearth and hearth extension thickness	A	4-inch minimum thickness for hearth, 2-inch minimum thickness for hearth extension.	2111.9
Hearth extension (each side of opening)	B	8 inches for fireplace opening less than 6 square feet. 12 inches for fireplace opening greater than or equal to 6 square feet.	2111.1
Hearth extension (front of opening)	C	16 inches for fireplace opening less than 6 square feet. 20 inches for fireplace opening greater than or equal to 6 square feet.	2111.1
Firebox dimensions	—	20-inch minimum firebox depth. 12-inch minimum firebox depth for Rumford fireplaces.	2111.6
Hearth and hearth extension reinforcing	D	Reinforced to carry its own weight and all imposed loads.	2111.9
Thickness of wall of firebox	E	10 inches solid masonry or 8 inches where firebrick lining is used.	2111.5
Distance from top of opening to throat	F	8 inches minimum.	2111.1 111.7.1
Smoke chamber wall thickness dimensions	G	6 inches lined; 8 inches unlined. Not taller than opening width; walls not inclined more than 45 degrees from vertical for prefabricated smoke chamber linings or 30 degrees from vertical for corbeled masonry.	2111.8
Chimney vertical reinforcing	H	Four No. 4 full-length bars for chimney up to 40 inches wide. Add two No. 4 bars for each additional 40 inches or fraction of width, or for each additional flue.	2111.3.1, 2113.3.1
Chimney horizontal reinforcing	J	¼-inch ties at each 18 inches, and two ties at each bend in vertical steel.	2111.3.2, 2113.3.2
Fireplace lintel	L	Noncombustible material with 4-inch bearing length of each side of opening.	2111.7
Chimney walls with flue lining	M	4-inch-thick solid masonry with ⅝-inch fireclay liner or equivalent. ½-inch grout or airspace between fireclay liner and wall.	2113.11.1
Effective flue area (based on area of fireplace opening and chimney)	P	See 780 CMR 2113.16.	2113.16
Clearances From chimney From fireplace From combustible trim or materials Above roof	R	2 inches interior, 1 inch exterior or 12 inches from lining. 2 inches back or sides or 12 inches from lining. 6 inches from opening 3 feet above roof penetration, 2 feet above part of structure within 10 feet.	2113.19 2111.11 2111.12 2113.9
Anchorage strap Number required Embedment into chimney Fasten to Number of bolts	S	3/16 inch by 1 inch Two 12 inches hooked around outer bar with 6-inch extension. 4 joists Two ½-inch diameter.	2111.4 2113.4.1
Footing Thickness Width	T	12-inch minimum. 6 inches each side of fireplace wall.	2111.2

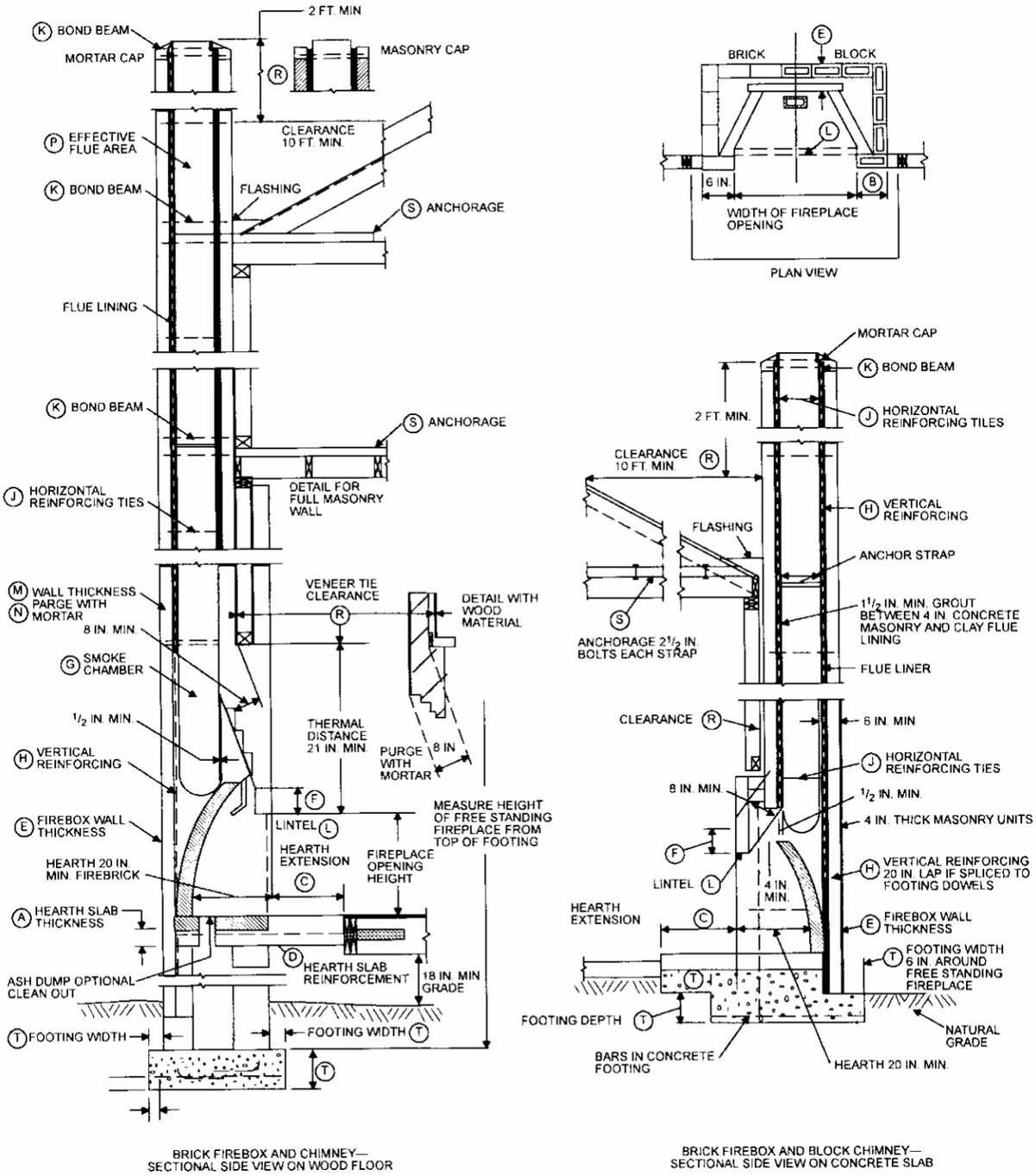
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square foot = 0.0929 m^2

a. Table 2111.1 provides a summary of major requirements for the construction of masonry chimneys and fireplaces. Letter references are to Figure 2111.1, which shows examples of typical construction. Table 21111.1 does not cover all requirements, nor does it cover all aspects of the indicated requirements. For the actual mandatory requirements of780 CMR, see the indicated section of text.

2111.5 Firebox Walls. Masonry fireboxes shall be constructed of solid masonry units, hollow masonry units grouted solid, stone, or concrete. When a lining of firebrick at least two inches (51 mm) in thickness or other approved lining is provided, the minimum thickness of back and side walls shall be eight inches (203 mm) of solid masonry, including the lining. The width of joints between firebricks shall not be greater than ¼ inch (6.4 mm). When no lining is provided, the total minimum thickness of back and side walls shall be ten inches (254 mm) of solid masonry. Firebrick shall conform to ASTM C 27 or ASTM C 1261 and shall be laid with medium-duty refractory mortar conforming to ASTM C 199.

2111.5.1 Steel Fireplace Units. Steel fireplace units are permitted to be installed with solid masonry to form a masonry fireplace when installed according to either the requirements of their listing or the requirements of this section. Steel fireplace units incorporating a steel firebox liner shall be constructed with steel not less than ¼ inch (6.4 mm) in thickness, and an air-circulating which is ducted to the interior of the building. The firebox lining shall be encased with solid masonry to provide a total thickness at the back and sides of not less than eight inches (203 mm), of which not less than four inches (102 mm) shall be of solid masonry or concrete. Circulating air ducts employed with steel fireplace units shall be constructed of metal or masonry.

FIGURE 2111.1 FIREPLACE AND CHIMNEY DETAILS



Fir SI: 1 inch = 25.4 mm. 1 foot = 304.8 mm.

2111.6 Firebox Dimensions. The firebox of a concrete or masonry fireplace shall have a minimum depth of 20 inches (508 mm). The throat shall not be less than eight inches (203 mm) above the fireplace opening. The throat opening shall not be less than four inches (102 mm) in depth. The cross-sectional area of the passageway above the firebox, including the throat, damper and smoke chamber, shall not be less than the cross-sectional area of the flue.

Exception: Rumford fireplaces shall be permitted provided that the depth of the fireplace is at least 12 inches (305 mm) and at least ⅓ of the width of the fireplace opening, and the throat is at least 12 inches (305 mm) above the lintel, and at least 1/20 the cross-sectional area of the fireplace opening.

2111.7 Lintel and throat. Masonry over a fireplace opening shall be supported by a lintel of noncombustible material. The minimum required bearing length on each end of the fireplace opening shall be four inches (102 mm). The fireplace throat or damper shall be located a minimum of eight inches (203 mm) above the top of the fireplace opening.

2111.7.1 Damper. Masonry fireplaces shall be equipped with a ferrous metal damper located at least eight inches (203 mm) above the top of the fireplace opening. Dampers shall be installed in the fireplace or at the top of the flue venting the fireplace, and shall be operable from the room containing the fireplace. Damper controls shall be permitted to be located in the fireplace.

2111.8 Smoke Chamber Walls. Smoke chamber

walls shall be constructed of solid masonry units, hollow masonry units grouted solid, stone or concrete. Corbelling of masonry units shall not leave unit cores exposed to the inside of the smoke chamber. The inside surface of corbelled masonry shall be parged smooth. Where no lining is provided, the total minimum thickness of front, back and sidewalls shall be eight inches (203 mm) of solid masonry. When a lining of firebrick at least two inches (51 mm) thick, or a lining of vitrified clay at least ⅝ inch (15.9 mm) thick, is provided, the total minimum thickness of front, back and sidewalls shall be six inches (152 mm) of solid masonry, including the lining. Firebrick shall conform to ASTM C 27 or ASTM C 1261 and shall be laid with refractory mortar conforming to ASTM C 199.

2111.8.1 Smoke Chamber Dimensions. The inside height of the smoke chamber from the fireplace throat to the beginning of the flue shall not be greater than the inside width of the fireplace opening. The inside surface of the smoke chamber shall not be inclined more than 45 degrees from vertical when prefabricated smoke chamber linings are used or when the smoke chamber walls are rolled or sloped rather than corbelled. When the inside surface of the smoke chamber is formed by corbelled masonry, the walls shall not be corbelled more than 30 degrees from vertical.

2111.9 Hearth and Hearth Extension. Masonry fireplace hearths and hearth extensions shall be constructed of concrete or masonry, supported by noncombustible materials, and reinforced to carry their own weight and all imposed loads. No combustible material shall remain against the underside of hearths or hearth extensions after construction.

2111.9.1 Hearth Thickness. The minimum thickness of fireplace hearths shall be four inches (102 mm).

2111.9.2 Hearth Extension Thickness. The minimum thickness of hearth extensions shall be two inches (51 mm).

Exception. When the bottom of the firebox opening is raised at least eight inches (203 mm) above the top of the hearth extension, a hearth extension of not less than ⅜-inch-thick (9.5 mm) brick, concrete, stone, tile or other approved noncombustible material is permitted.

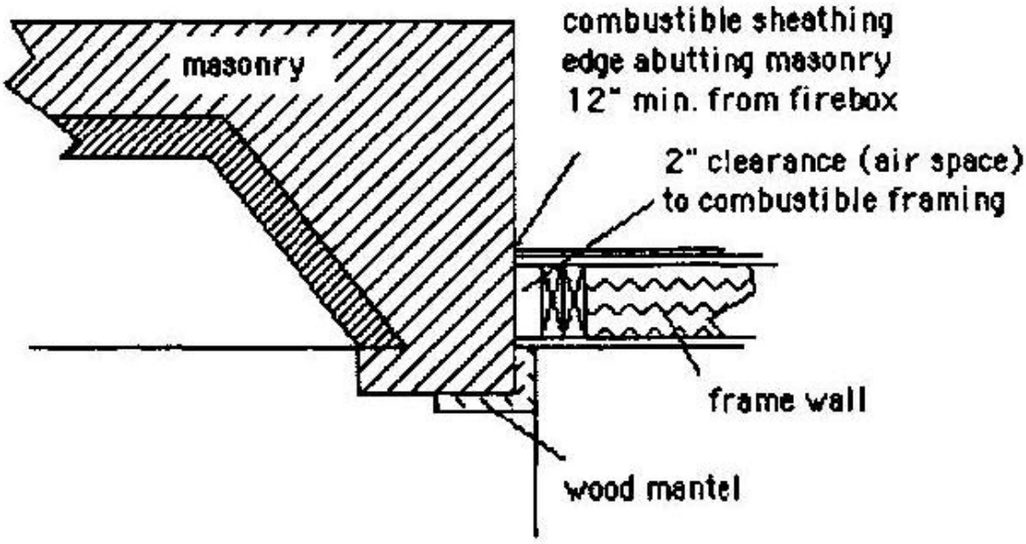
2111.10 Hearth Extension Dimensions. Hearth extensions shall extend at least 16 inches (406 mm) in front of, and at least eight inches (203 mm) beyond, each side of the fireplace opening. Where the fireplace opening is six square feet (0.557 M^2) or larger, the hearth extension shall extend at least 20 inches (508 mm) in front of, and at least 12 inches (305 mm) beyond, each side of the fireplace opening.

2111.11 Fireplace Clearance. Any portion of a masonry fireplace located in the interior of a building or within the exterior wall of a building shall have a clearance to combustibles of not less than two inches (51 mm) from the front faces and sides of masonry fireplaces and not less than 4 inches (102 mm) from the back faces of masonry fireplaces. The air space shall not be filled, except to provide fire blocking in accordance with 780 CMR 2111.13.

Exceptions:

1. Masonry fireplaces listed and labeled for use in accordance with UL 127, and installed in accordance with the manufacturer's installation instructions, are permitted to have combustible material in contact with their exterior surfaces.
2. When masonry fireplaces are constructed as part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete walls less than 12 inches (306 mm) from the inside surface of the nearest firebox lining.
3. Exposed combustible trim and the edges of sheathing materials, such as wood siding, flooring and drywall, are permitted to abut the masonry fireplace side walls and hearth extension, in accordance with Figure 2111.11, provided such combustible trim or sheathing is a minimum of 12 inches (306 mm) from the inside surface of the nearest firebox lining.
4. Exposed combustible mantels or trim is permitted to be placed directly on the masonry fireplace front surrounding the fireplace opening provided such combustible materials shall not be placed within six inches (153 mm) of the fireplace opening. Combustible materials within 12 inches (306 mm) of the fireplace opening shall not project more than ⅛-inch (3.2mm) for each one-inch (25 mm) distance from such opening.

FIGURE 2111.11 ILLUSTRATION OF EXCEPTION TO FIREPLACE CLEARANCE PROVISION



For SI: 1 inch - 25.4 mm

2111.12 Mantel and Trim. Woodwork or other combustible materials shall not be placed within six inches (152 mm) of a fireplace opening. Combustible material within 12 inches (305 mm) of the fireplace opening shall not project more than ⅛ inch (3.2 mm) for each one-inch (25 mm) distance from such opening.

2111.13 Fireplace Fire Blocking. All spaces between fireplaces and floors and ceilings through which fireplaces pass shall be fire blocked with noncombustible material securely fastened in place. The fire blocking of spaces between wood joists, beams or headers shall be to a depth of one inch (25 mm) and shall only be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

2111.14 Exterior Air. Factory-built or masonry fireplaces covered in 780 CMR 2111.14 shall be equipped with an exterior air supply to ensure proper fuel combustion unless the room is mechanically ventilated and controlled so that the indoor pressure is neutral or positive.

2111.14.1 Factory-built Fireplaces. Exterior combustion air ducts for factory-built fireplaces shall be a listed component of the fireplace and shall be installed according to the fireplace manufacturer's instructions.

2111.14.2 Masonry Fireplaces. Listed combustion air ducts for masonry fireplaces shall be installed according to the terms of their listing and manufacturer=s instructions.

2111.14.3 Exterior Air Intake. The exterior air intake shall be capable of providing all combustion air from the exterior of the dwelling. The exterior air intake shall not be located within the garage, attic, basement or crawl space of the dwelling nor shall the air intake be located at an elevation higher than the firebox. The exterior air intake shall be covered with a corrosion-resistant screen of ¼-inch (6.4 mm) mesh.

2111.14.4 Clearance. Unlisted combustion air ducts shall be installed with a minimum one-inch (25 mm) clearance to combustibles for all parts of the duct within five feet (1524 mm) of the duct outlet.

2111.14.5 Passageway. The combustion air passageway shall be a minimum of six square inches (3870 mm^2) and not more than 55 square inches (0.035 m^2), except that combustion air systems for listed fireplaces or for fireplaces tested for emissions shall be constructed according to the fireplace manufacturer=s instructions.

2111.14.6 Outlet. The exterior air outlet is permitted to be located in the back or sides of the firebox chamber or within 24 inches (610 mm) of the firebox opening on or near the floor. The outlet shall be closable and designed to prevent burning material from dropping into concealed combustible spaces.

780 CMR 2112.0 MASONRY HEATERS

2112.1 Definition. A masonry heater is a heating appliance constructed of concrete or solid masonry, hereinafter referred to as masonry, having a mass of at least 1,760 pounds (800 kg) excluding the chimney and foundation, which is designed to absorb and store heat from a solid fuel fire built in the firebox by routing the exhaust gases through internal heat exchange channels in which the flow path downstream of the firebox includes at least one 180 degree (3.14 rad) change in flow direction before entering the chimney, and that delivers heat by radiation from the masonry surface of the heater that shall not exceed 230°F (110°C) except within eight inches (203 mm) surrounding the fuel loading door(s).

2112.2 Installation. Masonry heaters shall be listed or installed in accordance with ASTM E 1602.

2112.3 Seismic Reinforcing. Seismic reinforcing shall not be required within the body of a masonry heater whose height is equal to or less than 2.5 times its body width and where the masonry chimney serving the heater is not supported by the body of the heater. Where the masonry chimney shares a common wall with the facing of the masonry heater, the chimney portion of the structure shall be reinforced in accordance with 780 CMR 2113.0 and 2113.4.

2112.4 Masonry Heater Clearance. Wood or other combustible framing shall not be placed within four inches (102 mm) of the outside surface of a masonry heater, provided the wall thickness of the firebox is not less than eight inches (203 mm) and the wall thickness of the heat exchange channels is not less than five inches (127 mm). A clearance of at least eight inches (203 mm) shall be provided between the gas tight capping slab of the heater and a combustible ceiling. The required space between the heater and combustible material shall be fully vented to permit the free flow of air around all heater surfaces.

780 CMR 2113.0 MASONRY CHIMNEYS

2113.1 General. A masonry chimney is a chimney constructed of concrete or masonry, hereinafter referred to as masonry. Masonry chimneys shall be constructed, anchored, supported and reinforced as required in 780 CMR 21.00.

2113.2 Footings and Foundations. Foundations for masonry chimneys shall be constructed of concrete or solid masonry at least 12 inches (305 mm) thick and shall extend at least six inches (152 mm) beyond the face of the foundation or support wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth.

2113.3 Seismic Reinforcing. Masonry or concrete chimneys shall be constructed, anchored, supported and reinforced as required in this chapter. Masonry and concrete chimneys shall be reinforced and anchored as detailed in 780 CMR 2113.3.1 and 2113.3.2.

2113.3.1 Vertical Reinforcing. For chimneys up to 40 inches (1016 mm) wide, four No. 4 continuous vertical bars anchored in the foundation shall be placed in the concrete, between wythes of solid masonry or within the cells of hollow unit masonry and grouted. Grout shall be prevented from bonding with the flue liner so that the flue liner is free to move with thermal expansion. For chimneys greater than 40 inches (1016 mm) wide, two additional No. 4 vertical bars shall be provided for each additional 40 inches (1016 mm) in width or fraction thereof.

2113.3.2 Horizontal Reinforcing. Vertical reinforcement shall be placed enclosed within ¼-inch (6.4 mm) ties, or other reinforcing of equivalent net cross-sectional area, spaced not to exceed 18 inches (457 mm) on center in concrete, or placed in the bed joints of unit masonry, at a minimum of every 18 inches (457 mm) of vertical height. Two such ties shall be provided at each bend in the vertical bars.

2113.4 Seismic Anchorage. Masonry and concrete chimneys and foundations in shall be anchored at each floor, ceiling or roof line more than six feet (1829 mm) above grade, except where constructed completely within the exterior walls. Anchorage shall conform to the following requirements.

2113.4.1 Anchorage. Two $^{3}/_{16}$-inch by one-inch (4.8 mm by 25.4 mm) straps shall be embedded a minimum of 12 inches (305 mm) into the chimney. Straps shall be hooked around the outer bars and extend six inches (152 mm) beyond the bend. Each strap shall be fastened to a minimum of four floor joists with two ½-inch (12.7 mm) bolts.

2113.5 Corbelling. Masonry chimneys shall not be corbelled more than half of the chimney's wall thickness from a wall or foundation, nor shall a chimney be corbelled from a wall or foundation that is less than 12 inches (305 mm) in thickness unless it projects equally on each side of the wall, except that on the second story of a two-story dwelling, corbelling of chimneys on the exterior of the enclosing walls is permitted to equal the wall thickness. The projection of a single course shall not exceed ½ the unit height or ⅓ of the unit bed depth, whichever is less.

2113.6 Changes in Dimension. The chimney wall or chimney flue lining shall not change in size or shape within six inches (152 mm) above or below where the chimney passes through floor components, ceiling components or roof components.

2113.7 Offsets. Where a masonry chimney is constructed with a fireclay flue liner surrounded by one wythe of masonry, the maximum offset shall be such that the centerline of the flue above the offset does not extend beyond the center of the chimney wall below the offset. Where the chimney offset is supported by masonry below the offset in an approved manner, the maximum offset limitations shall not apply. Each individual corbelled masonry course of the offset shall not exceed the projection limitations specified in 780 CMR 2113.2.

2113.8 Additional Load. Chimneys shall not support loads other than their own weight unless they are designed and constructed to support the additional load. Masonry chimneys are permitted to be constructed as part of the masonry walls or concrete walls of the building

.

2113.9 Termination. Chimneys shall extend at least two feet (610 mm) higher than any portion of the building within ten feet (3048 mm), but shall not be less than three feet (914 mm) above the highest point where the chimney passes through the roof.

2113.9.1 Spark Arrestors. Where a spark arrestor is installed on a masonry chimney, the spar arrestor shall meet all of the following requirements:

1. The net free area of the arrestor shall not be less than four times the net free area of the outlet of the chimney flue it serves.
2. The arrestor screen shall have heat and corrosion resistance equivalent to 19 gage galvanized steel or 24 gage stainless steel
3. Openings shall not permit the passage of spheres having a diameter greater than ½ inch (13 mm) nor block the passage of sphere having a diameter of less than ⅜-inch (11 mm).
4. The spark arrestor shall be accessible for cleaning and the screen or chimney cap shall be removable to allow for cleaning of the flue.

2113.10 Wall Thickness. Masonry chimney walls shall be constructed of concrete, solid masonry units, or hollow masonry units grouted solid with not less than four inches (102 mm) nominal thickness.

2113.11 Flue Lining (Material). Masonry chimneys shall be lined. The lining material shall be appropriate for the type of appliance connected, according to the terms of the appliance listing and manufacturer's instructions.

2113.11.1 Residential-type Appliances (General). Flue lining systems shall comply with one of the following:

1. Clay flue lining complying with the requirements of ASTM C 315, Specifications for Clay Flue Linings, or equivalent.
2. Listed chimney lining systems complying with UL 1777, Chimney Liners.
3. Factory-built chimneys or chimney units listed for installation within masonry chimneys.
4. Other approved materials that will resist corrosion, erosion, softening, or cracking from flue gasses and condensate at temperatures up to 1,800° F (982° C).

2113.11.1.1 Flue Linings for Specific Appliances. Flue linings other than covered in 780 CMR 2113.11.1 intended for use with specific appliances shall comply with780 CMR 2113.11.1.2 through 2113.11.1.4 and 780 CMR 2113.11.2 and 2113.11.3.

2113.11.1.2 Gas Appliances. Flue lining systems for gas appliances shall be in accordance with 248 CMR.

2113.11.1.3 Pellet Fuel-burning Appliances. Flue lining and vent systems for use in masonry chimneys with pellet fuel-burning appliances shall be limited to flue lining systems complying with 780 CMR 2113.11.1 and pellet vents listed for installation within masonry chimneys. (See 780 CMR 2113.11.1.5 for marking.)

2113.11.1.4 Oil-fired Appliances Approved for Use with L-vent. Flue lining and vent systems for use in masonry chimneys with oil-fired appliances approved for use with Type L vent shall be limited to flue lining systems complying with 780 CMR 2113.11.1 and listed chimney liners complying with UL 641. (See 780 CMR 2113.11.1.5 for marking.)

2113.11.1.5 Notice of Usage. When a flue is relined with a material not complying with 780 CMR 2113.11.1, the chimney shall be plainly and permanently identified by a label attached to a wall ceiling or other conspicuous location adjacent to where the connector enters the chimney. The label shall include the following message or equivalent language: "This chimney is for use only with (Type or category of appliance) that burns (type of fuel). Do not connect other types of appliances."

2113.11.2 Concrete and Masonry Chimneys for Medium Heat Appliances.

2113.11.2.1 General. Concrete and masonry chimneys for medium-heat appliances shall comply with 780 CMR 2113.1 through 2113.5.

2113.11.2.2 Construction. Chimneys for medium-heat appliances shall be constructed of solid masonry units or of concrete with walls a minimum of eight inches (203 mm) thick, or with stone masonry a minimum of 12 inches (305 mm) thick.

2113.11.2.3 Lining. Concrete and masonry chimneys shall be lined with an approved medium-duty refractory brick a minimum of 4½ inches (114 mm) thick laid on the 4½-inch bed (114 mm) in an approved medium-duty refractory mortar. The lining shall start two feet (610 mm) or more below the lowest chimney connector entrance. Chimneys terminating 25 feet (7620 mm) or less above a chimney connector entrance shall be lined to the top.

2113.11.2.4 Multiple Passageway. Concrete and masonry chimneys containing more than one passageway shall have the liners separated by a minimum four-inch-thick (102 mm) concrete or solid masonry wall.

2113.11.2.5 Termination Height. Concrete and masonry chimneys for medium-heat appliances shall extend a minimum of ten feet (3048 mm) higher than any portion of any building within 25 feet (7620 mm).

2113.11.2.6 Clearance. A minimum clearance

of four inches (102 mm) shall be provided between the exterior surfaces of a concrete or masonry chimney for medium-heat appliances and combustible material.

2113.11.3 Concrete and Masonry Chimneys for High-heat Appliances.

2113.11.3.1 General. Concrete and masonry chimneys for high-heat appliances shall comply with 780 CMR 2113.1 through 2113.5.

2113.11.3.2 Construction. Chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or of concrete, each wall to be a minimum of eight inches (203 mm) thick with a minimum air space of two inches (51 mm) between the walls.

2113.11.3.3 Lining. The inside of the interior wall shall be lined with an approved high-duty refractory brick, a minimum of 4½ inches (114 mm) thick laid on the 4½-inch bed (114 mm) in an approved high-duty refractory mortar. The lining shall start at the base of the chimney and extend continuously to the top.

2113.11.3.4 Termination Height. Concrete and masonry chimneys for high-heat appliances shall extend a minimum of 20 feet (6096 mm) higher than any portion of any building within 50 feet (15240 mm).

2113.11.3.5 Clearance. Concrete and masonry chimneys for high-heat appliances shall have approved clearance from buildings and structures to prevent overheating combustible materials, permit inspection and maintenance operations on the chimney, and prevent danger of burns to persons.

2113.12 Flue Lining (Installation). Flue liners shall be installed in accordance with ASTM C 1283 and extend from a point not less than eight inches (203 mm) below the lowest inlet or, in the case of fireplaces, from the top of the smoke chamber, to a point above the enclosing walls. The lining shall be carried up vertically, with a maximum slope no greater than 30 degrees from the vertical.

Fireclay flue liners shall be laid in medium-duty refractory mortar conforming to ASTM C 199, with tight mortar joints left smooth on the inside and installed to maintain an air space or insulation not to exceed the thickness of the flue liner separating the flue liners from the interior face of the chimney masonry walls. Flue lining shall be supported on all sides. Only enough mortar shall be placed to make the joint and hold the liners in position.

2113.13 Additional Requirements.

2113.13.1 Listed Materials. Listed materials used as flue linings shall be installed in accordance with the terms of their listings and manufacturer's instructions.

2113.13.2 Space Around Lining. The space surrounding a chimney lining system or vent installed within a masonry chimney shall not be used to vent any other appliance.

Exception. This shall not prevent the installation of a separate flue lining in accordance with the manufacturer's installation instructions.

2113.14 Multiple Flues. When two or more flues are located in the same chimney, masonry wythes shall be built between adjacent flue linings. The masonry wythes shall be at least four inches (102 mm) thick and bonded into the walls of the chimney.

Exception. When venting only one appliance, two flues are permitted to adjoin each other in the same chimney with only the flue lining separation between them. The joints of the adjacent flue linings shall be staggered at least four inches (102 mm).

2113.15 Flue Area (Appliance). Chimney flues shall not be smaller in area than of the area of the connector from the appliance. Chimney flues connected to more than one appliance shall not be less than the area of the largest connector plus 50% of the areas of the additional chimney connectors.

Exceptions:
1. Chimney flues serving oil-fired appliances sized in accordance with NFPA 31.
2. Chimney flues serving gas-fired appliances sized in accordance with the International Fuel Gas Code.

2113.16 Flue Area (Masonry Fireplace). Flue sizing for chimneys serving fireplaces shall be in accordance with 780 CMR 2113.16.1 or 780 CMR 2113.16.2.

2113.16.1 Minimum Area. Round chimney flues shall have a minimum net cross-sectional area of at least $^1/_{12}$ of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of at least $^1/_{10}$ of the fireplace opening. Rectangular chimney flues with an aspect ratio less than two to one shall have a minimum net cross-sectional area of at least $^1/_{10}$ of the fireplace opening. Rectangular chimney flues with an aspect ratio of two to one or more shall have a minimum net cross-sectional area of at least ⅛ of the fireplace opening.

2113.16.2 Determination of Minimum Area. The minimum net cross-sectional area of the flue shall be determined in accordance with Figure 2113.16. A flue size providing at least the equivalent net cross-sectional area shall be used. Cross-sectional areas of clay flue linings are provided in Tables 2113.16(1) and 2113.16(2) or as provided by the manufacturer or as measured in the field. The height of the chimney shall be measured from the firebox floor to the top of the chimney flue.

TABLE 2113.16(1) NET-CROSS SECTIONAL AREA OF ROUND FLUE SIZES[a]

FLUE SIZE, INSIDE DIAMETER (inches)	CROSS-SECTIONAL AREA (square inches)
6	28
7	38
8	50
10	78
10¾	90
12	113
15	176
18	254

For SI: 1 inch = 25.4 mm, 1 square inch - 345.16 mm^2.
a. Flue sizes are based on ASTM C 315.

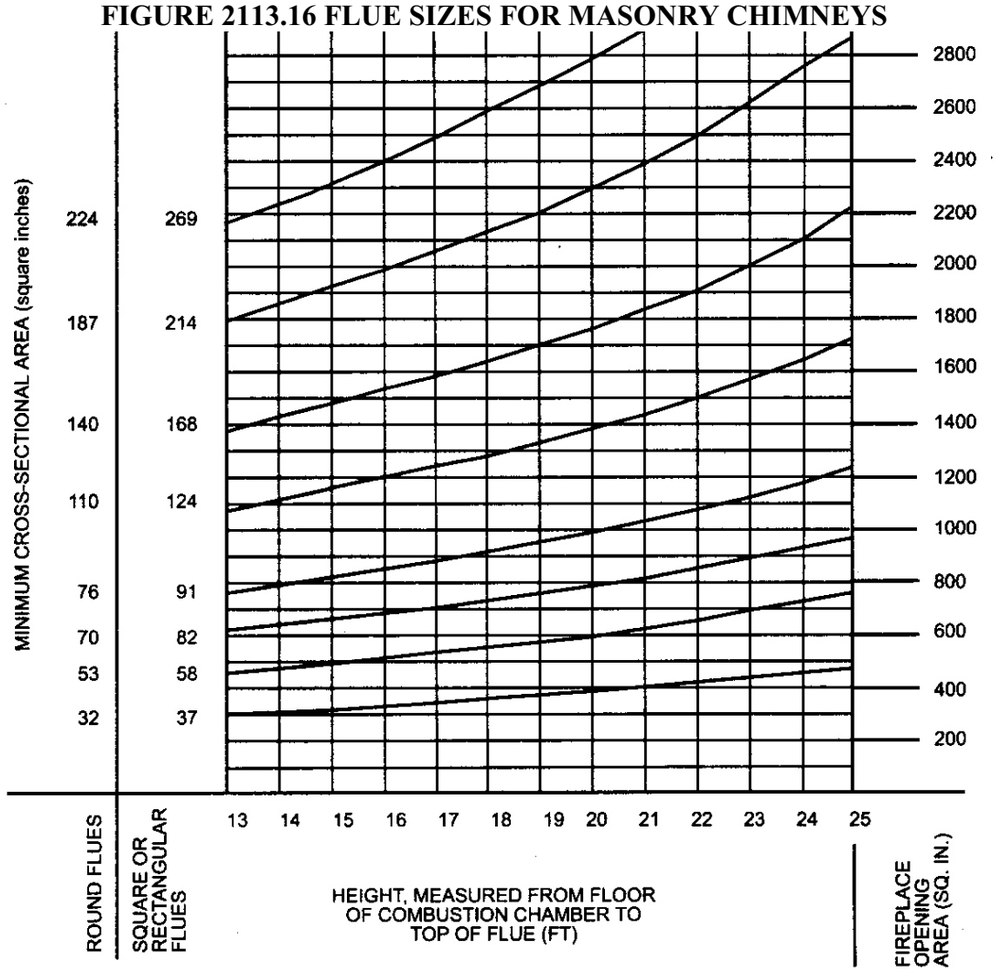
FLUE SIZES[a]

FLUE SIZE, INSIDE DIMENSION (inches)	CROSS-SECTIONAL AREA (square inches)
4½ x 13	34
7½ x 7½	37
8½ x 8½	47
7½ x 11½	58
8½ x 13	74
7½ x 15½	82
11½ x 11½	91
8½ x 17½	101
13x 13	122
11½ x 15½	124
13x 17½	165
15½ x 15½	168
15½ x 19½	214
17½ x 17½	226
19½ x 19½	269
20x 20	286

For SI: 1 inch = 25.4 mm, 1 square inch - 345.16 mm^2.
a. Flue sizes are based on ASTM C 315.

TABLE 2113.16(2) NET-CROSS SECTIONAL AREA OF SQUARE AND RECTANGULAR

FIGURE 2113.16 FLUE SIZES FOR MASONRY CHIMNEYS



For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm^2.

2113.17 Inlet. Inlets to masonry chimneys shall enter from the side. Inlets shall have a thimble of fireclay, rigid refractory material or metal that will prevent the connector from pulling out of the inlet or from extending beyond the wall of the liner.

2113.18 Masonry Chimney Cleanout Openings. Cleanout openings shall be provided within six inches (152 mm) of the base of each flue within every masonry chimney. The upper edge of the cleanout shall be located at least six inches (152 mm) below the lowest chimney inlet opening. The height of the opening shall be at least six inches (152 mm). The cleanout shall be provided with a noncombustible cover.

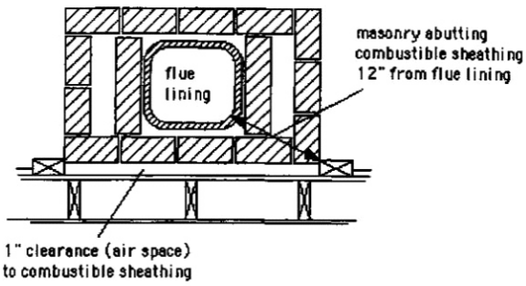
Exception. Chimney flues serving masonry fireplaces, where cleaning is possible through the fireplace opening.

2113.19 Chimney Clearances. Any portion of a masonry chimney located in the interior of the building or within the exterior wall of the building shall have a minimum air space clearance to combustibles of 2 inches (51 mm). Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum air space clearance of one inch (25 mm). The air space shall not be filled, except to provide fire blocking in accordance with 780 CMR 2113.20.

Exceptions.

1. Masonry chimneys equipped with a chimney lining system listed and labeled for use in chimneys in contact with combustibles in accordance with UL 1777, and installed in accordance with the manufacturer's installation instructions, are permitted to have combustible material in contact with their exterior surfaces.
2. Where masonry chimneys are constructed as part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete wall less than 12 inches (306 mm) from the inside surface of the nearest flue lining.
3. Exposed combustible trim and the edges of sheathing materials, such as wood siding, are permitted to abut the masonry chimney side walls, in accordance with Figure 2113.19, provided such combustible trim or sheathing is a minimum of 12 inches (306 mm) from the inside surface of the nearest flue lining. Combustible material and trim shall not overlap the corners of the chimney by more than one inch (25 mm).

FIGURE 2113.19 ILLUSTRATION OF EXCEPTION TO CHIMNEY CLEARANCE PROVISION



For SI: 1 inch - 25.4 mm

2113.20 Chimney Fire Blocking. All spaces between chimneys and floors and ceilings through which chimneys pass shall be fire blocked with noncombustible material securely fastened in place. The fire blocking of spaces between wood joists, beams or headers shall be to a depth of one inch (25 mm) and shall only be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

NON-TEXT PAGE