CHAPTER 21

MASONRY

780 CMR 2101.0 GENERAL

2101.1 Scope: The provisions of 780 CMR 21 shall govern the materials, design, construction and quality of masonry.

2101.1.1 Engineered masonry design: All masonry shall conform to the engineered masonry design requirements of Chapters 1 through 8 of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

Exception: Where permitted by 780 CMR 2104.3, empirically designed masonry shall conform to 780 CMR 21 and Chapters 1 through 4 and Chapter 9 of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

2101.2 Seismic requirements: Masonry shall comply with the requirements of 780 CMR 2104.

780 CMR 2102.0 DEFINITIONS

2102.1 General: The following words and terms shall, for the purposes of 780 CMR 21 and as used elsewhere in 780 CMR, have the meanings shown herein.

Anchor: Metal rod, wire or strap that secures masonry to its structural support.

Architectural terra cotta: Plain or ornamental hard-burned plastic clay units, larger in size than brick, with glazed or unglazed ceramic finish.

Area, gross cross-sectional: The areas delineated by the out-to-out dimensions of masonry in the plane under consideration.

Bed joint: The horizontal layer of mortar on which a masonry unit is laid

Brick

Calcium silicate brick (sand lime brick): A building unit made of sand and lime.

Clay or shale: A solid masonry unit made of clay or shale, usually formed into a rectangular prism while in the plastic state and burned or fired in a 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 in any plane parallel to the loadbearing surface is not less than 75% of its gross cross-sectional area measured in the same plane.

Buttress: A projecting part of a masonry wall built integrally therewith to furnish lateral stability which is supported on proper foundations.

Chimney: A primarily vertical enclosure containing one or more passageways.

Chimney, masonry: A field-constructed chimney of solid masonry units, stones or reinforced concrete (see 780 CMR 2114.0).

Collar joint: Vertical longitudinal joint between wythes of masonry or between masonry and back-up construction which is permitted to be filled with mortar or grout.

Connector: A mechanical device for securing two or more pieces, parts or members together, including anchors, wall ties and fasteners.

Diaphragm: A roof or floor system designed to transmit lateral forces to shear walls or other vertical resisting elements.

Dimensions, nominal: Equal to the actual dimension plus the width of the mortar joint. Dimensions and thicknesses specified in this chapter are nominal dimensions.

Effective height: Clear height of a braced member between lateral supports and used for calculating the slenderness ratio of a member. Effective height for unbraced members shall be calculated.

Head joint: Vertical mortar joint placed between masonry units within the wythe at the time the masonry units are laid.

Header (Bonder): A masonry unit that connects two or more adjacent wythes of masonry.

Height, walls: The vertical distance from the foundation wall or other immediate support of such wall to the top of the wall.

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 mortar or monolithic

concrete. Reinforced concrete is not classified as

Ashlar facing masonry: Facing of solid rectangular units larger in size than brick and made of burned clay or shale, natural or cast stone, with sawed, dressed and squared beds and mortar joints.

Ashlar masonry: Masonry composed of bonded, rectangular units, larger in size than brick, with sawed, dressed or squared beds and mortar joints.

Solid masonry: Masonry consisting of solid masonry units laid contiguously with the joints between the units filled with mortar, or consisting of plain concrete.

Masonry unit

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 4 by 4 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 loadbearing 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 loadbearing 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 (see 780 CMR 2105.0).

Mortar, surface-bonding: A mixture used to bond concrete masonry units which contains: hydraulic cement; glass fiber reinforcement with or without inorganic fillers or organic modifiers; and water (see 780 CMR 2105.8).

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-defined joints.

Rough or ordinary rubble: Masonry composed of unsquared field stones laid without regularity of coursing but well bonded.

Running bond: The placement of masonry units such that head joints in successive courses are horizontally offset at least one-quarter the unit length.

Stack bond: The placement of masonry units in a bond pattern is such that head joints in successive courses are vertically aligned. For the purpose of masonry.

this code, requirements for stack bond shall apply to all masonry laid in other than running bond.

Stone masonry: Masonry composed of field, quarried or caststone units bonded by mortar.

1. **Stone masonry, ashlar**: Stone masonry composed of rectangular units having sawed, dressed or squared bed surfaces and bonded by mortar.
2. **Stone masonry, rubble**: Stone masonry composed of irregular-shaped units bonded by mortar.

Tile, wall: Metal connector that connects wythes of masonry walls together.

Tile: A ceramic surface unit, usually relatively thin in relation to facial area, made from clay or a mixture of clay and 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 (see 780 CMR 2105.0).

Tile, structural clay: A hollow masonry unit composed of burned clay, shale, fire clay or mixtures thereof, and having parallel cells (see 780 CMR 2105.0).

Wall

Cavity wall: A wall built of masonry units or of plain concrete, or a combination of these materials, arranged to provide an air space within the wall, and in which the inner and outer parts of the wall are tied together with metal ties.

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

Dry-stacked, surface-bonded walls: 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 (see 780 CMR 2106.3).

Faced wall: A wall in which the masonry facing and backing are so bonded as to exert common action under *load*.

Hollow wall: A wall built of masonry units so arranged as to provide an air space within the wall, and in which the facing and backing of the wall are bonded together with masonry units.

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

Wythe: Each continuous, vertical section of a wall, one masonry unit in thickness.

780 CMR 2103.0 CONSTRUCTION DOCUMENTS

2103.1 Drawings: The drawings and details shall show all the items required to be shown on the drawings by 780 CMR including the following:

1. Specified size, grade, type and location of reinforcement, anchors and wall ties;
2. Reinforcing bars to be welded and welding procedure;
3. Size and location of all structural elements; and
4. Provision for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture.

2103.2 Fireplace drawings: The *construction documents* shall describe in sufficient detail the location, size and construction of all masonry fireplaces. The thickness and characteristics of all material and the clearances from walls, partitions and ceilings shall be clearly indicated.

780 CMR 2104.0 SEISMIC REQUIREMENTS

2104.1 Scope: Seismic design requirements apply to the design of masonry and the construction of masonry building elements, except masonry veneers. Seismic requirements for masonry veneers shall comply with Chapter 12 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***. All masonry shall be designed to comply with the requirements of Chapter 7 of the ACI 530/ ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***, except as otherwise permitted herein.

2104.2 General: Masonry structures and masonry elements shall comply with the requirements of 780 CMR 2104.3 through 2104.5. In addition, masonry structures and masonry elements shall comply with either the allowable stress design requirements of Section 5.1 of the ACI 530/ASCE 5/TMS 402 Masonry Code, listed in ***Appendix A*** and with 780 CMR 2104.2.2 and 2104.2.3, or the strength design requirements of 780 CMR 2104.2.1 and 780 CMR 2104.2.3.

2104.2.1 Strength requirements: For masonry structures that are not designed in accordance with Section 5.1 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***, the provisions of 780 CMR 2104.0 shall apply. The design strength of masonry structures and masonry elements shall be at least equal to the required strength determined in accordance with this section except for masonry elements designed in accordance with the provisions of Chapter 9 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***.

1. **Required strength**: Required strength, U, to resist seismic forces in such combinations with gravity and other loads including load factors shall be as required in 780 CMR 1616 except that non-bearing masonry walls shall be designed for the seismic force applied perpendicular to the plane of the wall and uniformly distributed over the wall area.
2. **Nominal strength**: The nominal strength of masonry shall be taken as 2½ times the allowable stress value. The allowable stress value shall be determined in accordance with Chapter 7 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***.
3. **Design strength**: The design strength of masonry provided by a member, its connections to other members and its cross sections in terms of flexure, axial *load*, and shear shall be taken as the nominal strength multiplied by a strength reduction factor Φ, as follows;
   a. Axial load and flexure except for flexural tension in unreinforced masonry Φ = 0.8.
   b. Flexural tension in unreinforced masonry Φ = 0.4
   c. Shear Φ = 0.6
   d. Shear and tension on anchor bolts embedded in masonry Φ = 0.6

2104.2.2 Shear Factor: When calculating shear or diagonal tension stresses using allowable stress design, shear walls and beams which resist seismic forces shall be designed to resist 1.33 times the seismic shear forces obtained from an analysis of the building.

2104.2.3 Drift limits: The design story drift of masonry structures due to the combination of seismic forces and gravity loads shall not exceed 0.007 times the story height. The drift shall be calculated using load combinations 7 or 8 for strength design in 780 CMR 1616.3 1 with the seismic deflections multiplied by the seismic amplification factor, C_d, given in Table 1612.4.4.

2104.3 Design of elements that are not part of lateral force resisting system:

2104.3.1 Masonry elements that are listed in 780 CMR 2104.3 and isolated from the structure so that vertical and lateral forces are not imparted to these elements and that are not part of the lateral force resisting system shall comply with the provisions of 780 CMR 2104.3 and may be designed in accordance with the provisions of Chapter 9 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***.

2104.3.2 *Load* bearing frames or columns that are not part of the lateral force resisting system shall

be analyzed as to their effect on the response of the system. Such frames or columns shall be adequate for vertical *load* carrying capacity and induced moment due to the design story drift.

2104.3.3 Anchorage Of Masonry Walls: Masonry walls shall be anchored to the roof and all floors that provide lateral support out of plane for the wall. The anchorage shall provide a direct connection between the walls and the floor or roof construction. The connections shall be capable of resisting the greater of the seismic lateral force induced by the wall or 120 pounds per lineal foot of wall (allowable stress design), or 200 pounds per lineal foot of wall (strength design).

2104.3.4 Masonry partition walls 16 feet or less in height, masonry screen walls and other masonry elements, except those listed in 780 CMR 2104.3.6, that are not designed to resist vertical or lateral loads, other than those induced by their own mass, shall be isolated from the structure so that vertical and lateral forces are not imparted to these elements. Isolation joints and connectors between these elements and the structure shall be designed to accommodate the design story drift. Masonry elements listed in 780 CMR 2104.3.4 shall be reinforced in either the horizontal or vertical direction in accordance with the following;

1. Horizontal reinforcement: Horizontal reinforcement shall consist of at least two longitudinal W1.7 wires spaced not more than 16 in. (vertically) for walls greater than four inches in width and at least one longitudinal Wl.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; OR

2. Vertical reinforcement: Vertical reinforcement shall consist of at least one No. 4 bar spaced not more than 48 inches Vertical reinforcement shall be located within 16 inches of the ends of masonry walls.

2104.3.5 Masonry partition walls, greater than 16 feet in height, masonry screen walls and other masonry elements except those listed in 780 CMR 2104.3.6, that are not designed to resist vertical or lateral loads, other than those induced by their own mass, shall be isolated from the structure so that the vertical and lateral forces are not imparted to these elements. Isolation joints and connectors between these elements and the structure shall be designed to accommodate the design story drift. Masonry elements listed in 780 CMR 2104.3.5 shall be reinforced in accordance with the following:

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 eight inches of the ends of walls, and at a maximum spacing of eight feet.

2. Horizontal reinforcement: Horizontal reinforcement shall consist of at least two wires of W1.7 spaced not more than 16 inches. Horizontal reinforcement of at least 0.2 square inches in cross sectional areas 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 eight feet.

2104.3.6 Nonstructural masonry partition walls that are isolated from the structure in accordance with 780 CMR 2104.3.4, and 2104.3.5, which enclose stairwells, exit discharges, exits and elevator shafts shall be designed for the code required lateral loads and at a minimum in accordance with the following:

1. Vertical reinforcement: Vertical reinforcement 0.31 square inches in cross sectional area shall be provided at corners, within 16 inches of each side of openings, within eitght inches of each side of movements joints, and within eight inches of the ends of walls and at a maximum spacing of six feet.

2. Horizontal reinforcement: Horizontal reinforcement shall consist of at least two wires of W1.7 spaced not more that 16 inches Horizontal reinforcement of at least 0.20 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; and within 16 inches of the top of walls; or

3. Walls spanning horizontally: Walls which are designed to span horizontally, shall comply with 780 CMR 2104.3.6 and the following: horizontal reinforcement shall consist of at least two wires of W.1.7 spaced not more than 16 inches. Horizontal reinforcement of at least 0.31 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. Horizontal reinforcement of at least 0.31 square inches shall be provided continuously at structurally connected roof and floor levels, within 16 inches of the top of walls and at a maximum of six feet.

2104.4 Design of elements which are part of the lateral force resisting system, bearing walls, exterior walls, parapets and chimneys.

2104.4.1 Connections to masonry shear walls: Connectors shall he provided to transfer forces between horizontal elements and masonry walls in accordance with the requirements, of Section 5.11 of the ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***. Connectors shall be designed to transfer horizontal design forces acting either perpendicular or parallel to the wall, but not less than 200 pounds per lineal foot of wall (allowable stress design) or 335 pounds per lineal foot of wall (strength design). The maximum spacing between connectors shall be four feet.

2104.4.2 Connections to masonry columns: Connectors shall be provided to transfer forces between masonry columns and horizontal elements in accordance with the requirements of Section 5.11 of ACI 530/ASCE 5/TMS 402 Masonry Code listed in ***Appendix A***. Where anchor bolts are used to connect horizontal elements to the tops of columns, anchor bolts shall be placed within lateral ties. Lateral tics 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 of the column.

2104.4.3 Minimum reinforcement requirements for bearing walls, exterior walls, shear walls, parapets and chimneys: These walls shall be reinforced in both the vertical and horizontal direction. The sum of the cross-sectional area of horizontal and vertical reinforcement shall be at least 0.002 times the gross cross-sectional area of the wall, and the minimum cross-sectional area in each direction shall he not less than 0.0007 times the gross cross-sectional area of the wall. Reinforcement shall be uniformly distributed. The maximum spacing of reinforcement shall be 48 inches The maximum spacing of reinforcement for stack bond masonry shall be 24".

2104.4.4 Shear wall additional reinforcing requirements for buildings classified in Seismic Performance Category D: The maximum spacing of vertical and horizontal reinforcement shall be the smaller of; one-third the length of the shear wall, one-third the height of the shear wall, or 48 inches The minimum cross-sectional area of vertical reinforcement per horizontal foot of shear wall shall be one-third of the required shear reinforcement per vertical foot of shear wall. Shear reinforcing shall be anchored around vertical reinforcing bars with a standard hook.

2104.3.7 Masonry walls listed in 780 CMR 2104.3, that are NOT isolated from the structure as required in 780 CMR 2104.3.4 and 2104.3.5, shall be designed to withstand the induced forces.

2104.4.5 Minimum reinforcement for masonry columns: Lateral ties in masonry columns shall be spaced not more than eight inches on center and shall be at least _ inches diameter. Lateral ties shall be embedded in grout.

2104.4.6 Material requirement: Neither Type N mortar nor masonry cement shall be used as part of the lateral force resisting system.

2104.4.7 Lateral tie anchorage: Standard hooks for lateral tie anchorage shall be either a 135 degree standard hook or a 180 degree standard hook.

2104.5 Inspection: Masonry shall be inspected in accordance with 780 CMR 1705.7.

780 CMR 2105.0 MASONRY CONSTRUCTION MATERIALS

2105.1 Concrete masonry units: Concrete masonry units shall conform to the following standards listed in ***Appendix A***: ASTM C55 for concrete brick; ASTM C73 for calcium silicate face brick; ASTM C90 for loadbearing concrete masonry units; or ASTM C744 for prefaced concrete and calcium silicate masonry units.

2105.2 Clay or shale masonry units: Clay or shale masonry units shall conform to the following standards listed in ***Appendix A***: ASTM C34 for structural clay loadbearing wall tile; ASTM C56 for structural clay nonloadbearing wall tile; ASTM C62 for building brick (solid masonry units made from clay or shale); ASTM C1088 for solid units of thin veneer brick; ASTM C126 for ceramic-glazed structural clay facing tile, facing brick and solid masonry units; ASTM C212 for structural clay facing tile; ASTM C216 for facing brick (solid masonry units made from clay or shale); and ASTM C652 for hollow brick (hollow masonry units made from clay or shale).

Exception: Structural clay tile for nonstructural use in fireproofing of structural members and in

wall furring shall not be required to meet the compressive strength specifications. The fireresistance rating shall be determined in accordance with ASTM E119 listed in ***Appendix A*** and shall comply with the requirements of Table 602.

2105.3 Stone masonry units: Stone masonry units shall conform to the following standards listed in ***Appendix A***: ASTM C503 for marble building stone (exterior); ASTM C568 for limestone building stone; ASTM C615 for granite building stone; ASTM C616 for sandstone building stone; or ASTM C629 for slate building stone.

2105.4 Ceramic tile: Ceramic tile shall be as defined in ANSI A137.1 listed in ***Appendix A*** and shall conform to the requirements of ANSI A137.1 listed in ***Appendix A***.

2105.5 Glass block: Glass block shall be partially evacuated, hollow masonry units made of clear, colorless glass (with or without a highly reflective oxide surface coating), having a thickness of not less than 3_ inches or shall be solid glass-block units, having a thickness of not less than three inches.

2105.6 Second-hand units: Second-hand masonry units shall not be reused unless the units conform to the requirements for new units. The units shall be of whole, sound material and be free from cracks and other defects that will interfere with proper laying or use. All old mortar shall be cleaned from the units before reuse.

2105.7 Mortar: Mortar for masonry construction shall conform to ASTM C270 listed in ***Appendix A***.

2105.8 Surface-bonding mortar: Surface-bonding mortar shall comply with ASTM C887 listed in ***Appendix A***. Surface bonding of concrete masonry units shall comply with ASTM C946 listed in ***Appendix A***.

2105.9 Metal reinforcement and accessories: Metal reinforcement and accessories shall conform to 780 CMR 2105.9.1 through 2105.9.7. Where unidentified reinforcement is approved for use, such reinforcement shall be tested in accordance with 780 CMR 2208.1.

2105.9.1 Deformed reinforcing bars: Deformed reinforcing bars shall conform to the following standards listed in ***Appendix A***: ASTM A615 for deformed and plain billet-steel bars for concrete reinforcement; ASTM A616 for rail-steel deformed and plain bars for concrete reinforcement; ASTM A617 for axle-steel deformed and plain bars for concrete reinforcement; and ASTM A706 for low-alloy-steel deformed bars for concrete reinforcement.

2105.9.2 Joint reinforcement: Joint reinforcing wire shall conform to the following standards listed in ***Appendix A***: ASTM A82 for steel wire, plain, for concrete reinforcement; and ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip.

Longitudinal wires shall be deformed. One set of two deformations shall occur around the perimeter of the wire at a maximum spacing of 0.7 times the diameter of the wire but not less than eight sets per one inch (25 mm) of length. The overall length of each deformation within the set shall be such that the summation of gaps between the ends of the deformations shall not exceed 33% of the perimeter of the wire. The indentation depth of the deformations shall be 0.006 inch (0.15 mm) plus or minus 0.003 inch (0.08 mm).

2105.9.3 Deformed reinforcing wire: Deformed reinforcing wire shall conform to ASTM A496 listed in ***Appendix A***.

2105.9.4 Wire fabric: Wire fabric shall conform to ASTM A185 listed in ***Appendix A*** for plain steel-welded wire fabric for concrete reinforcement or ASTM A497 listed in ***Appendix A*** for welded deformed steel wire fabric for concrete reinforcement.

2105.9.5 Anchors, ties and accessories: Anchors, ties and accessories shall conform to the following standards listed in ***Appendix A***: ASTM A36 for structural steel; ASTM A82 for plain steel wire for concrete reinforcement; ASTM A185 for plain steel-welded wire fabric for concrete reinforcement; ASTM A167, Type 304, for stainless and heat-resisting chromium-nickel steel plate, sheet and strip; and ASTM A366 for cold-rolled carbon steel sheet, commercial quality.

2105.9.6 Corrosion protection: Joint reinforcement anchors, wall ties and accessories, except those of Type 304 stainless steel complying with ASTM A 167 listed in ***Appendix A***, shall be protected from corrosion by galvanizing as follows.

Metal accessories for use in exterior wall construction shall be hot-dipped galvanized after fabrication with a minimum coating of 1.5 ounces per square foot (458 g/m^2) in accordance with ASTM A153 listed in ***Appendix A***. Metal accessories for use in interior wall construction shall be mill galvanized with a minimum coating of 0.1 ounce per square foot (31 g/m^2) in accordance with the standards listed in ***Appendix A*** as follows: ASTM A641 for joint reinforcement, wire anchors and ties; and ASTM A525, Class G-60, for sheet metal anchors and ties.

2105.9.7 Tests: Where unidentified reinforcement is approved for use, not less than three tension and three bending tests shall be made on representative specimens of the reinforcement from each shipment and grade of reinforcing steel proposed for use in the work.

2105.10 Mortars for ceramic wall and floor tile: Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1 listed in ***Appendix A*** and be of the compositions indicated in Table 2105.10.

2105.10.1 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 listed in ***Appendix A*** The shear bond strength for tile set in such mortar shall be as required in accordance with ANSI A118.1 listed in ***Appendix A***. Tile set in dry-set portland cement mortar shall be installed in accordance with ANSI A108.5 listed in ***Appendix A***.

2105.10.2 Electrically conductive dry-set mortars: Premixed prepared portland cement mortars, which require only the addition of water and which comply with ANSI A118.2 listed in ***Appendix A***, 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 listed in ***Appendix A***.

Table 2105.10
CERAMIC TILE MORTAR COMPOSITIONS

Walls	Scratchcoat	1 cement; 1/5 hydrated lime; 4 dry or 5 damp sand
	Setting bed and leveling coat	1 cement; ½ hydrated lime; 5 damp sand; to 1 cement; 1 hydrated lime; 7 damp sand
Floors	Setting bed	1 cement; 1/10 hydrated lime; 5 dry or 6 damp sand; or 1 cement; 5 dry or 6 damp sand
Ceilings	Scratchcoat and sand bed	1 cement;½ hydrated lime; 2½ dry sand or 3 damp sand

2105.10.3 Latex-modified portland cement mortars: 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-which are used for the installation of ceramic tile shall comply with ANSI A118.4 listed in ***Appendix A***. Tile set in latex-modified portland cement shall be installed in accordance with ANSI A108.5 listed in ***Appendix A***.

2105.10.4 Epoxy mortar: Ceramic tile set and grouted with chemical-resistant epoxy shall comply with ANSI A118.3 listed in ***Appendix A***. Tile set and grouted with epoxy shall be installed in accordance with ANSI A108.6 listed in ***Appendix A***.

2105.10.5 Furan mortar and grout: Chemical-resistant furan mortar and grout which are used to install ceramic tile shall comply with ANSI A118.5 listed in ***Appendix A***. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8 listed in ***Appendix A***.

2105.10.6 Modified epoxy-emulsion mortar and grout: Modified epoxy-emulsion mortar and grout which are used to install ceramic tile shall comply with ANSI A118.8 listed in ***Appendix A***. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9 listed in ***Appendix A***.

2105.10.7 Organic adhesives: Water-resistant organic adhesives used for the installation of ceramic tile shall comply with ANSI A136.1 listed in ***Appendix A***. The shear bond strength after water immersion shall not be less than 40 psi (0.028 kg/mm^2) for Type I adhesive, and not less than 20 psi (0.014 kg/mm^2) for Type II adhesive, when tested in accordance with ANSI A136.1 listed in ***Appendix A***. Tile set in organic adhesives shall be installed in accordance with ANSI A108.4 listed in ***Appendix A***.

2105.10.8 Portland cement grouts: Portland cement grouts used for the installation of ceramic tile shall comply with ANSI A 118.6 listed in ***Appendix A***. Portland cement grouts for tilework shall be installed in accordance with ANSI A108.10 listed in ***Appendix A***.

2105.11 Grout: Grout shall conform to ASTM C476 listed in ***Appendix A***.

780 CMR 2106.0 LATERAL STABILITY

2106.1 Shear walls: Where the structure depends upon masonry walls for lateral stability, shear walls shall be provided parallel to the direction of the lateral forces resisted.

2106.1.1 Shear wall thickness: Minimum nominal thickness of masonry shear walls shall be eight inches.

Exception: Shear walls of one-story buildings are permitted to be a minimum nominal thickness of six inches.

2106.1.2 Cumulative length of shear walls: In each direction in which shear walls are required for lateral stability, the minimum cumulative length of shear walls provided shall be 0.4 times the long dimension of the building. Cumulative length of shear walls shall not include openings.

2106.1.3 Maximum diaphragm ratio: Masonry shear walls shall be provided so that the span-to-width (or depth) ratio of floor or roof diaphragms does not exceed that indicated in Table 2106.1.3.

Table 2106.1.3
MAXIMUM SPAN-TO-WIDTH (DEPTH) RATIO OF FLOOR AND ROOF DIAPHRAGMS

Floor or roof diaphragm construction	Maximum span-to-width (depth) ratio of Diaphragm
Cast-in-place concrete	5:1
Precast concrete	4:1
Metal deck with concrete fill	3:1
Metal deck without fill	2:1
Wood diaphragm	2:1

2106.2 Roofs: The roof construction shall be designed so as not to impart out-of-plane lateral thrust to the walls under roof gravity *load*.

2106.3 Surface-bonded walls: Dry-stacked, surface-bonded concrete masonry walls shall comply with the requirements of 780 CMR for masonry wall construction, except where otherwise noted in 780 CMR 2106.

2106.3.1 Strength: Dry-stacked, surface-bonded concrete masonry walls shall be of adequate strength and proportions to support all superimposed *loads* without exceeding the allowable stresses listed in Table 2106.3.1. Allowable stresses not specified in Table 2106.3.1 shall comply with the requirements of ACI 530/ASCE 5/TMS 402 listed in ***Appendix A***.

Table 2106.3.1
ALLOWABLE STRESS GROSS CROSS-SECTIONAL AREA FOR DRY-STACKED, SURFACE-BONDED CONCRETE MASONRY WALLS

Compression	
standard block	45 psi
Shear	10 psi
Flexural tension	
Vertical span	18 psi
Horizontal span	30 psi

2106.4 Construction: Construction of dry-stacked, surface-bonded masonry walls, including stacking and leveling of units, mixing and application of mortar, and curing and protection, shall comply with ASTM C946 listed in ***Appendix A***.

780 CMR 2107.0 COMPRESSIVE STRESS REQUIREMENTS

2107.1 Vertical dead plus live loads: Compressive stresses in masonry due to vertical *dead* plus *live loads* (excluding *wind* or seismic *loads*) shall be determined in accordance with 780 CMR 2107.2.1. *Dead* and *live loads* shall be in accordance with 780 CMR 16, with such *live load* reductions as are permitted in 780 CMR 1608.0.

2107.2 Maximum values: The compressive stresses in masonry shall not exceed the values given in Table 2107.2. Stress shall be calculated based on actual rather than nominal dimensions.

2107.2.1 Calculated compressive stresses: Calculated compressive stresses for single-wythe walls and for multiple-wythe composite masonry walls shall be determined by dividing the design *load* by the gross cross-sectional area of the member. The area of openings, chases or recesses in walls shall not be included in the gross cross-sectional area of the wall.

2107.2.2 Multiple-wythe walls: The allowable stress shall be as given in Table 2107.2 for the weakest combination of the units and mortar used in each wythe.

Table 2107.2
ALLOWABLE COMPRESSIVE STRESSES FOR EMPIRICAL DESIGN OF MASONRY

Construction; compressive strength of unit, gross area, psi	Allowable compressive stresses[a] gross cross-sectional area, psi	
	Type M or S mortar	Type N mortar
Solid masonry of brick and other solid units of clay or shale; sand-lime or concrete brick:		
8,000 or greater	350	300
4,500	225	200
2,500	160	140
1,500	115	100
Grouted masonry of clay or shale, sand-lime or		

concrete:		
4,500 or greater	225	200
2,500	160	140
1,500	115	100
Solid masonry of solid concrete masonry units:		
3,000 or greater	225	200
2,000	160	140
1.200	115	100
Masonry of hollow loadbearing units:		
2,000 or greater	140	120
1,500	115	100
1,000	75	70
750	60	55
Hollow walls (noncomposite masonry bonded[b])		
Solid units:		
2,500 or greater	160	140
1,500	115	100
Hollow units	75	70
Stone ashlar masonry:		
Granite	720	640
Limestone or marble	450	400
Sandstone or cast stone	360	320
Rubble stone masonry		
Coursed, rough or random	120	100

Note a . Linear interpolation for determining allowable stresses for masonry units having compressive strengths which are intermediate between those given in the table is permitted.

Note b. Where floor and roof loads are carried upon one wythe, the gross cross-sectional area is that of the wythe under load; if both wythes are loaded, the gross cross-sectional area is that of the wall minus the area of the cavity between the wythes. Walls bonded with metal ties shall be considered as noncomposite walls unless collar joints are filled with mortar or grout.

780 CMR 2108.0 LATERAL SUPPORT

2108.1 General: Masonry walls shall be laterally supported in either the horizontal or the vertical

direction at intervals not exceeding those given in Table 2108.1.

2108.1.1 Thickness: Except for cavity walls and cantilever walls, the thickness of a wall shall be the nominal thickness measured perpendicular to the face of the wall. For cavity walls, the thickness shall be determined as the sum of the nominal thicknesses of the individual wythes. For cantilever walls, except for parapets, the ratio of height to nominal thickness shall not exceed 6:1 for solid masonry or 4:1 for hollow masonry. The thickness and height of parapets shall conform to 780 CMR 2109.2.

2108.2 Lateral support: Lateral support shall be provided by cross walls, pilasters, buttresses or structural frame members where the limiting distance is taken horizontally, or by floors, or roofs acting as diaphragms or structural frame members where the limiting distance is taken vertically.

Table 2108.1
WALL LATERAL SUPPORT REQUIREMENTS

Construction	Maximum ratio of wall length to thickness or wall height to thickness
Loadbearing walls	
Solid or solid grouted	20
All other	18
Nonloadbearing walls	
Exterior	18
interior	36

780 CMR 2109.0 THICKNESS OF MASONRY

2109.1 Thickness of walls: The nominal thickness of masonry walls shall conform to the requirements of 780 CMR 2109.

2109.1.1 Minimum thickness: The minimum thickness of masonry loadbearing walls more than one story high shall be eight inches. The minimum thickness of masonry loadbearing walls of one-story buildings shall not be less than six inches.

2109.1.2 Rubble stone walls: The minimum thickness of rough or random or coursed rubble stone walls shall be 16 inches.

2109.1.3 Change in thickness: Where a wall of masonry of hollow units or a masonry-bonded hollow wall is decreased in thickness, a course or courses of solid masonry shall be interposed between the wall below and the thinner wall above, or special units or construction shall be used to transmit the *loads* from face shells or wythes above to those below.

2109.2 Parapet walls: Parapet walls shall be at least eight inches thick, and the height shall not exceed three times the thickness. Parapet walls shall be reinforced in accordance with 780 CMR 2104.4.3.

780 CMR 2110.0 BOND

2110.1 General: The facing and backing of multiple-wythe masonry walls shall be bonded in accordance with 780 CMR 2110.2, 2110.3 or 2110.4.

2110.2 Bonding with masonry headers: Bonding with solid or hollow masonry headers shall comply with 780 CMR 2110.2.1 and 2110.2.2.

2110.2.1 Solid units: Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, not less than 4% of the wall surface of each face shall be composed of headers extending not less than three inches (76 mm) into the backing. The distance between adjacent full-length headers shall not exceed 24 inches (610 mm) either vertically or horizontally. In walls in which a single header does not extend through the wall, headers from the opposite sides shall overlap at least three inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least three inches (76 mm).

2110.2.2 Hollow units: Where two or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding 34 inches (864 mm) by lapping at least three inches (76 mm) over the unit below, or by lapping at vertical intervals not exceeding 17 inches (432 mm) with units which are at least 50% greater in thickness than the units below.

2110.3 Bonding with wall ties or joint reinforcement: Bonding with wall ties or joint reinforcement shall comply with 780 CMR 2110.3.1 through 2110.3.2.

2110.3.1 Bonding with wall ties: Except as required by 780 CMR 2110.3.1.1, where the facing and backing (adjacent wythes) of masonry walls are bonded with 3/16-inch diameter wall ties or metal wire of equivalent stiffness embedded in the horizontal mortar joints, there shall be at least one metal tie for each 4½ square feet (0.42 m^2) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance between ties shall not exceed 24 inches (610 mm), and the maximum horizontal distance shall not exceed 36 inches (914 mm). Rods or ties bent to rectangular shape shall be used with hollow masonry units laid with the cells vertical. ln other

walls, the ends of ties shall be bent to 90-degree (1.57 rad) angles to provide hooks not less than two inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than three feet (914 mm) apart around the perimeter and within 12 inches (305 mm) of the opening.

2110.3.1.1 Bonding with adjustable wall ties: Where the facing and backing (adjacent wythes) of masonry are bonded with adjustable wall ties, there shall be at least one tie for each 1.77 square feet (0.16 m^2) of wall area. Neither the vertical nor horizontal spacing of the adjustable wall ties shall exceed 16 inches (406 mm). The maximum vertical offset of bed joints from one wythe to the other shall be 1¼ inches (32 mm). The maximum clearance between connecting parts of the ties shall be 1/16 inch (1.6 mm). Where pintle legs are used, ties shall have at least two 3/16-inch (5 mm) diameter legs.

2110.3.2 Bonding with prefabricated joint reinforcement: Where the facing and backing (adjacent wythes) of masonry are bonded with prefabricated joint reinforcement, there shall be at least one cross wire serving as a tie for each 2_ square feet (0.25 m^2) of wall area. The vertical spacing of the joint reinforcement shall not exceed 16 inches (406 mm). Cross wires on prefabricated joint reinforcement shall not be smaller than No. 9 gage. The longitudinal wires shall be embedded in the mortar.

2110.4 Bonding with natural or cast stone: Bonding with natural or cast stone shall conform to 780 CMR 2110.4.1 and 2110.4.2.

2110.4.1 Ashlar masonry: In ashlar masonry, uniformly distributed bonder units shall be provided to the extent of not less than 10% of the wall area. Such bonder units shall extend not less than four inches (102 mm) into the backing wall.

2110.4.2 Rubble stone masonry: Rubble stone masonry 24 inches or less in thickness shall have bonder units with a maximum spacing of 3 feet (914 mm) vertically and three feet (914 mm) horizontally. Rubble stone masonry greater than 24 inches in thickness shall have one bonder unit for each six square feet (0.56 m^2) of wall surface on both sides.

2110.5 Masonry bonding pattern: Masonry laid in running and stack bond shall conform to 780 CMR 2110.5.1 and 2110.5.2.

2110.5.1 Masonry laid in running bond: In each wythe of masonry laid in running bond, head joints in successive courses shall be offset by not less than one-fourth the unit length, or the masonry walls shall be reinforced longitudinally as required in 780 CMR 2110.5.2.

2110.5.2 Masonry laid in stack bond: Where unit masonry is laid with less head joint offset than in 780 CMR 2110.5.1, the minimum area of horizontal reinforcement placed in mortar bed joints or in bond beams spaced not more than 48 inches (1219 mm) apart shall be 0.0007 times the vertical cross-sectional area of the wall.

780 CMR 2111.0 ANCHORAGE

2111.1 General: Masonry elements shall be anchored in accordance with 780 CMR 2111.0.

2111.2 Intersecting walls: Masonry walls depending upon one another for lateral support shall be anchored or bonded at locations where the walls meet or intersect by one of the following methods indicated in 780 CMR 2111.2.1 through 2111.2.5.

2111.2.1 Bonding pattern: 50% of the units at the intersection shall be laid in an overlapping masonry bonding pattern, with alternate units having a bearing of not less than three inches (76 mm) on the unit below.

2111.2.2 Steel connectors: Walls shall be anchored by steel connectors having a minimum cross section of ¼-inch by 1½ inches with ends bent up at least two inches (51 mm), or with cross pins to form anchorage. Such anchors shall be at least 24 inches (610 mm) long and the maximum spacing shall be four feet (1219 mm).

2111.2.3 Joint reinforcement: Walls shall be anchored by joint reinforcement spaced at a maximum distance of eight inches (203 mm). Longitudinal reinforcement shall be at least No. 9 gage and shall extend at least 30 inches (762 mm) in each direction at the intersection.

2111.2.4 Interior nonloadbearing walls: Interior nonloadbearing walls shall be anchored at the intersection of the walls at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement or ¼-inch galvanized mesh hardware cloth.

2111.2.5 Ties, joint reinforcement and anchors: Other metal ties, joint reinforcement or anchors, if used, shall-be spaced to provide equivalent area of anchorage to that required by 780 CMR 2111.0.

2111.3 Floor and roof anchorage: Floor and roof diaphragms providing lateral support to masonry shall comply with 780 CMR 1612.4.7.1.2 and shall

be connected to the masonry by one of the methods specified in 780 CMR 2111.3.1 through 2111.3.3.

2111.3.1 Wood floor joists: Wood floor joists supported by masonry walls shall be anchored to the wall at intervals not to exceed six feet (1829 mm) by metal strap anchors. Joists parallel to the

2111.3.2 Steel floor joists: Steel floor joists shall be anchored to masonry walls with _-inch round bars, or their equivalent, spaced not more than six feet (1829 mm) on center. Where joists are parallel to the wall, anchors shall be located at joist cross bridging.

2111.3.3 Roof structures: Roof structures shall be anchored to masonry walls with ½-inch bolts six feet (1829 mm) on center. Bolts shall extend and be embedded at least 15 inches (381 mm) into the masonry, or be hooked or welded to not less than 0.2 square inches (129 mm^2) of bond beam reinforcement placed not less than six inches (152 mm) from the top of the wall.

2111.4 Walls adjoining structural framing: Walls that are dependent upon the structural frame for lateral support shall be anchored to the structural members with metal anchors or otherwise keyed to the structural members. Metal anchors shall consist of ½-inch bolts spaced at four feet (1219 mm) on center embedded four inches (102 mm) into the masonry, or of other bolts of equivalent area.

780 CMR 2112.0 MASONRY CONSTRUCTION

2112.1 Masonry construction: Masonry construction shall comply with the requirements of 780 CMR 2112.1.1 through 2112.5.

2112.1.1 Tolerances: Masonry shall be constructed within the tolerances specified in ACI 530.1/ASCE 6/TMS 602 listed in ***Appendix A***.

2112.1.2 Placing mortar and units: Placement of mortar and units shall comply with 780 CMR 2112.1.2.1 through 2112.1.2.4.

2112.1.2.1 Bed and head joints: Unless otherwise required or indicated on the project drawings, head and bed joints shall be _ inch (10 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than ¼-inch (6 mm) and not more than ¾-inch (19 mm).

2112.1.2.2 Hollow units: Hollow units shall be placed such that face shells of bed joints are fully mortared, webs are fully mortared in all courses of piers, column and pilasters, in the starting course on foundations, where adjacent wall shall be anchored with metal straps spaced not more than six feet (1829 mm) on centers extending over or under and secured to at least three joists. Blocking shall be provided between joists at each strap anchor.

cells or cavities are to be grouted and where otherwise required, and head joints are mortared a minimum distance from each face equal to the face shell thickness of the unit.

2112.1.2.3 Solid units: Unless otherwise required or indicated on the project drawings, solid units shall be placed in fully mortared bed and head joints. The ends of the units shall be completely buttered. Head joints shall not be filled by slushing with mortar. Head joints shall be constructed by shoving mortar tight against the adjoining unit. Bed joints shall not be furrowed deep enough to produce voids.

2112.1.2.4 All units: Units shall be placed while the mortar is soft and plastic. Any unit disturbed to the extent that the initial bond is broken after initial positioning shall he removed andrelaid in fresh mortar.

2112.1.3 Installation of wall ties: The ends of wall ties shall be embedded in mortar joints. Wall tie ends shall engage outer face shells of hollow units by at least ½-inch (13 mm). Wire wall ties shall be embedded at least 1½ inches (38 mm) into the mortar bed of solid masonry units or solid-grouted hollow units. Wall ties shall not be bent after being embedded in grout or mortar.

2112.1.4 Chases: Chases shall be constructed as masonry units are laid.

2112.1.5 Bracing of masonry: Bracing that will assure stability of masonry during construction shall be provided and installed.

2112.1.6 Construction loads: Construction *loads* shall not exceed the superimposed *loads* that the masonry, with supplemental supports, is capable of supporting safely.

2112.1.7 Masonry protection: The top of unfinished masonry work shall be covered to protect the masonry from the weather

2112.2 Corbeled masonry: Solid masonry units shall be used for corbeling. The maximum corbeled projection beyond the face of the wall shall not be more than ½ of the wall thickness nor ½ the wythe thickness for hollow walls. The maximum projection of one unit shall neither exceed ½ the height of the unit nor _ the thickness at right angles to the wall.

2112.2.1 Molded cornices: Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of all projecting masonry or molded cornices shall lie within the middle one-third 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.

2112.3 Cold-weather construction: The following cold-weather procedures shall be implemented when either the ambient temperature falls below 40°F (4°C) or the temperature of masonry units is below 40°F (4°C):

1. Temperatures of masonry units shall not be less than 20°F (-7°C) when laid in the masonry. Visible ice on masonry units shall be removed before the unit is laid in the masonry.
2. Masonry units shall be laid within one minute after mortar placement.
3. Mortar sand or mixing water shall be heated to produce mortar temperatures between 40°F (4°C) and 120°F (49°C) at the time of mixing. Mortar shall be maintained above freezing until used in masonry.
4. Heat sources shall be used where ambient temperatures are between 20°F (-7°C) and 25°F (-4°C) on both sides of the masonry under construction and wind breaks shall be installed when wind velocity is in excess of 15 mph (6.7 m/s).
5. Where ambient temperatures are below 20°F (-7°C), an enclosure for the masonry under construction shall be provided and heat sources shall be used to maintain temperatures above 32°F (0°C) within the enclosure.
6. Where mean daily temperatures are between 32°F (0°C), and 40°F (4°C), completed masonry shall be protected from rain or snow by covering with a weather-resistant membrane for 24 hours after construction.
7. Where mean daily temperatures are between 25°F (-4°C) and 32°F (0°C), completed masonry shall be completely covered with a weather-resistant membrane for 24 hours after construction.
8. Where mean daily temperatures are between 20°F (-7°C) and 25°F (-4°C), completed masonry shall be completely covered with insulating blankets or equal protection for 24 hours after construction.
9. Where mean daily temperatures are below 20°F (-7°C), masonry temperature shall be maintained above 32°F (0°C) for 24 hours after construction by enclosure with supplementary heat, by electric heating blankets, by infrared heat lamps or by other approved methods.

2112.4 Hot-weather construction: The following hot-weather procedures shall be implemented when either of the following conditions exist: the ambient temperature equals or exceeds 100°F (38°C) or the ambient temperature equals or exceeds 90°F (32°C) with a wind velocity greater than eight mph (3.6 m/s).

1. Mortar beds shall not be spread more than four feet (1219 mm) ahead of masonry.

2112.5 Wetting of brick: Brick (clay or shale) at the time of laying shall require wetting if the unit's initial rate of water absorption exceeds 30 grams per 30 square inches per minute (30 g/323 mm^2) or 0.035 ounces per square inch (0.0015 g/mm^2), as determined by ASTM C67 listed in ***Appendix A***.

780 CMR 2113.0 MISCELLANEOUS REQUIREMENTS

2113.1 Chases and recesses: Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels.

2113.2 Lintels: The design for lintels shall be in accordance with the engineered masonry design provisions of 780 CMR 2101.1.1. Minimum length of end support shall be four inches (102 mm).

2113.3 Support on wood: Masonry shall not be supported on wood girders or other form of wood construction.

Exception: Glass-block panels complying with 780 CMR 2115.0 are permitted to be supported by wood members.

780 CMR 2114.0 FIREPLACES AND CHIMNEYS

2114.1 Scope: The provisions of 780 CMR 2114.0 shall govern the design, installation, maintenance, repair and approval of all masonry fireplaces and chimneys.

2114.2 Mechanical code: All masonry fireplaces and chimneys shall conform to the applicable requirements of the BOCA national mechanical code listed in ***Appendix A***.

2114.3 Dimensions: The firebox of a masonry fireplace shall have a minimum depth of 20 inches (508 mm). The size of the chimney connection shall have a minimum cross-sectional area of 50 square

inches (32258 mm^2). The minimum cross-sectional area of the fireplace shall equal the cross-sectional area of the chimney connection.

2114.3.1 Rumford fireplaces: Rumford fireplaces shall be permitted provided that the depth of the fireplace is at least 12 inches (305 mm) and is at least _ of the width of the fireplace opening; and that the throat is at least 12 inches (305 mm) above the lintel, and is at least 1/20th of the cross-sectional area of the fireplace opening.

2114.4 Wall construction: Fireplace walls lined with a minimum of two inches (51 mm) of approved low-duty refractory brick shall have a minimum total thickness of eight inches (203 mm) of solid masonry. Approved medium-duty fire-clay mortar or an equivalent shall be utilized with the low-duty refractory brick. Unlined fireplace walls shall be constructed of solid masonry having a minimum total thickness of 12 inches (305 mm).

2114.4.1 Extension of liners: The liner of the fireplace walls shall extend a minimum of four inches (102 mm) into the throat of the fireplace.

2114.4.2 Throat and smoke chamber: The walls of the throat and smoke chamber shall be constructed of solid masonry having a minimum thickness of eight inches (203 mm). The throat and smoke chamber walls are permitted to be reduced in thickness to four inches (102 mm) of solid masonry provided that such walls are lined with at least one inch (25 mm) of insulating refractory masonry so that the heat transferred through this wall is not more than the heat transferred through eight inches (203 mm) of solid masonry.

2114.4.3 Heat exchanger: Gravity-fed heat exchangers installed in the walls of masonry fireplaces shall not reduce the total thickness of solid masonry.

2114.5 Foundation and hearth: The foundation of a fireplace shall be constructed of noncombustible materials and shall conform to the requirements of 780 CMR 18. The hearth and hearth extension shall be constructed of solid masonry having a minimum thickness of four inches (102 mm).

2114.5.1 Hearth extension: The hearth shall extend a minimum of 16 inches (406 mm) beyond the face of the fireplace opening and a minimum of eight inches (203 mm) on each side of the fireplace opening for fireplaces having an opening of less than six square feet (0.56 m^2). The hearth of larger-sized fireplaces shall extend a minimum of 20 inches (508 mm) beyond the face of the fireplace opening and a minimum of 12 inches (305 mm) on each side of the fireplace opening. Combustible forms used during construction of the hearth and hearth extension shall be removed.

2114.6 Clearance to combustibles (also see 780 CMR 3610 as applicable):

1. Fireplaces - the exterior surface of fireplace walls shall have a minimum of four inches (102mm) clearance to combustibles.
2. Fireplaces - combustible materials attached to a fireplace face, such as trim and mantels, shall have a minimum clearance of six inches (152 mm) from a fireplace opening.
3. Fireplaces - combustible materials above and projecting more than 1½ inches (38mm) from a fireplace face shall have a minimum clearance of 12 inches (305mm) above a fireplace opening.
4. Chimneys - combustible materials, including framing and sheathing shall have a minimum clearance of two inches (51mm) from the exterior surface of smoke chamber walls and chimney walls.

2114.7 Opening to the chimney: Means shall be provided to shut off the opening to the chimney when the fireplace is not in operation.

2114.7.1 Dampers: Dampers shall be constructed of metal having a minimum thickness of No. 12 Manufacturer's Standard Gage (0.105 inch).

2114.8 Chimneys with metal hoods: Metal hoods shall extend a minimum of six inches (152 mm) beyond the firebox. The hoods shall comply with the requirements for metal chimneys.

2114.9 Existing masonry chimneys: Existing masonry chimneys are permitted to vent open fireplaces only-even if the existing chimneys lack the clearances to combustibles as required by the BOCA national mechanical code listed in ***Appendix A*** - provided that such chimneys otherwise conform to the requirements of the BOCA national mechanical code listed in ***Appendix A*** or are made to conform to such requirements through repair or relining.

780 CMR 2115.0 GLASS-BLOCK WALLS

2115.1 General: Masonry of glass blocks used in nonloadbearing exterior or interior walls and in window openings, either isolated or in continuous bands, shall have a minimum thickness of three inches at the mortar joint and all the mortared surfaces of the glass block shall be treated for mortar bonding. Sizes of structural members supporting glass-block panels shall be determined by structural

analysis to avoid excessive or harmful deflection. Maximum deflection of such members shall not exceed 1/600 of the span of the supporting members.

Solid or hollow approved glass blocks shall not be used in *fire walls*, party walls, *fire separation assemblies* or *fire partitions*, or for loadbearing construction. Such blocks shall be erected with mortar and reinforcement in metal-channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors as provided for both exterior and interior walls or other approved joint materials. Wood strip framing shall not be used in *fire separation assemblies* that are required to be fireresistance rated.

Exceptions:

1. Glass-block assemblies having a fireresistance rating of not less than ¾ hour shall be permitted as opening protectives in *fire separation assemblies* or in *fire partitions* which have a required fireresistance rating of 1 hour or less and do not enclose *exit stairways* or *exit* passageways.

The maximum area of all solid glass-block wall panels in both exterior and interior walls shall not be more than 100 square feet (9.3 m^2).

2115.3 Joint materials: Glass block shall be laid up in Type S or N mortar. Both vertical and horizontal mortar joints shall be at least ¼ inch (6 mm) and not more than ½ inch (13 mm) thick and shall be completely filled. The sills of glass-block panels shall be coated with approved water-based asphaltic emulsion, or other elastic waterproofing material, prior to laying the first mortar course. All individually framed glass-block panels shall be provided with _-inch-thick (10 mm) expansion joints at the sides and top. Expansion joints shall be entirely free of mortar and shall be caulked to a depth of not less than ½ inch (13 mm) with nonhardening caulking compound on both faces, or other approved expansion joints shall be provided.

2115.4 Reinforcement: Glass-block panels shall have joint reinforcement in every other mortar bed joint, extending the entire length of the panel, but not across expansion joints. Joint reinforcement is permitted to be spliced by lapping longitudinal wires

2. Glass-block assemblies as permitted in 780 CMR 404.5, Exception 2.

2115.2 Size of panels: The maximum dimensions of all hollow glass-block wall panels in both exterior and interior walls, where used singly or in multiples to form continuous bands of glass blocks between structural supports, shall be 25 feet (7620 mm) in length and 20 feet (6096 mm) in height between structural supports and expansion joints; and the area of each individual panel shall not be more than 144 square feet (13.39 m^2) for exterior panels and 250 square feet (23.25 m^2) for interior panels. Intermediate structural supports shall be provided to support the *dead load* of the wall and all other superimposed *loads*. Where individual panels are more than the maximum area permitted for those panels, a supplementary structural stiffener shall be provided to anchor the panels to the structural supports.

at least six inches (152 mm). Joint reinforcement shall be placed in the bed joint immediately below and above any opening in the panel. Joint reinforcement shall be hot-dipped galvanized after fabrication.

2115.5 Wind and earthquake loads: Exterior wall panels shall be held in place in the wall opening to resist both the internal and external pressures due to *wind* and *earthquake loads* as specified in 780 CMR 1611.0 and 1612.0, with metal-channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors at the sides and top. Where recess type of framing is used, glass block shall be recessed within the framing not less than one inch (25 mm).