CHAPTER 21
MASONRY

SECTION 2101
GENERAL

2101.1 Scope
2101.1.1 The provisions of this chapter shall govern the materials, design, construction and quality of masonry.

Exception: Buildings and structures located within the High Velocity Hurricane Zone shall comply with the provisions of 2116 and 2118 through 2122.

2101.1.2 Masonry shall comply with 2103.1 or 2103.2.

2101.2 Construction documents. Drawings and details shall show all the items required to be shown on the drawings by this code 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.
4. Provision for dimensional changes resulting from elastic deformation, creep, shrinkage, temperature and moisture.

2101.3 Support
2101.3.1 Lintels. Masonry directly above chases or recesses wider than 12 inches (305 mm) shall be supported on lintels. The design for lintels shall be in accordance with 2103.1. Minimum end bearing shall be 4 inches (102 mm).

2101.3.2 Support on wood. Masonry shall not be supported on wood girders or other form of wood construction.

Exceptions:
1. Prefabricated partitions weighing not more than 30 psf (146 kg/m²) may be supported on combustible construction provided the supporting construction has been designed to carry such loads. Partitions shall be properly strapped or reinforced and provided with proper nailing devices for attachment.
2. Glass block units may be installed in accordance with 2112, provided the supporting construction has been designed to carry such loads.
3. Masonry veneers having an installed weight of 40 psf (195 kg/m²) or less may be used as an interior wall finish when installed in conformance with the provisions of 1403.2. When the masonry veneer is supported by wood floor construction, the floor shall be designed to limit deflection to 1/600 of the span of the supporting members.
4. Exterior masonry veneers having an installed weight of 40 psf (195 kg/m²) or less are permitted to be supported on wood construction when installed in conformance with the provisions of 1403.2. When masonry veneer supported by wood construction adjoins masonry veneer supported by the foundation, there shall be a movement joint between the veneer supported by the wood construction and that supported by the foundation. The wood construction supporting the masonry veneer shall be designed for dead loads and live loads to limit deflection to 1/600 of the span for the supporting members.

SECTION 2102
DEFINITIONS

For definitions, see Chapter 2.

SECTION 2103
DESIGN

2103.1 Engineered masonry design. Engineered masonry shall conform to the requirements of Chapters 1 through 3 of ACI 530/ASCE 5/TMS 402 or BIA Building Code Requirements for Engineered Brick Masonry.

Exceptions:
1. Masonry columns used only to support roofs of carports, porches, sheds or similar light structures may be constructed as follows:
   1.1 Concrete masonry materials shall be in accordance with 2104.1. Clay or shale masonry units shall be in accordance with 2104.2.
   2.1 The nominal cross-sectional dimension of columns shall not be less than 8 inches (203 mm).
   3.1 Columns shall be reinforced with not less than one No. 4 bar centered in the column.
   4.1 Columns shall be grouted solid.
   5.1 Columns shall not exceed 12 ft (3.6 m) in height.
   6.1 Roofs shall be anchored to the columns. Such anchorage shall be capable of resisting the design loads specified in Chapter 16.
7.1 Where such columns are required to resist uplift loads, the columns shall be anchored to their footings with two No. 4 bars extending a minimum of 24 inches (610 mm) into the columns and bent horizontally a minimum of 15 inches (381 mm) in opposite directions into the footings. One of these bars may be the reinforcing bar specified in item 3 above. The total weight of a column and its footing shall not be less than 1.5 times the design uplift load.
2. Masonry construction in accordance with the standards adopted in 1606.1.
3. Where inspections are performed by a local building department in accordance with 105, the provisions of ACI 530/ASCE 5/TMS 402, Chapter 1, Section 1.14, shall not apply unless specified by the architect or engineer.

2103.2 Empirical masonry design

2103.2.1 Empirically designed masonry shall conform to this chapter or Chapter 1 and Chapter 5 of ACI 530/ASCE 5/TMS 402.

Exception:

1. Masonry veneer designed and constructed in accordance with 1403.2 and 1403.3.
2. Where inspections are performed by a local building department in accordance with 105, the provisions of ACI 530/ASCE 5/TMS 402, Chapter 1, Section 1.14, shall not apply unless specified by the architect or engineer.

2103.2.2 Empirical masonry design is permitted provided the building conforms to the following criteria:

1. The building is subject to design wind loads not exceeding 25 psf (1.2 kPa) according to 1606.
2. The building is located in Exposure Category A or B in accordance with 1606.1.8 with a basic wind speed of 100 mph or less in accordance with Figure 1606; and,
3. If greater than 35 feet (10.7 m) in height, the building does not rely on masonry walls for lateral load resistance.

2103.2.3 One- and two-family dwellings of masonry construction in areas with a basic wind speed of 100 mph or less in accordance with Figure 1606 in Exposure Category C in accordance with 1606.1.8 shall comply with the following or shall be designed in accordance with 2103.1,

1. Exterior walls shall be not less than a nominal thickness of 8 inches (203 mm).

Exception: Solid brick masonry walls in one story residential buildings and one story private garages shall be permitted to be of 6 inch (152 mm) nominal thickness, provided the wall height is limited to a maximum of 8 feet (2438 mm) between lateral supports as measured from the top of floor to the top of bond beam.

2. A reinforced bond beam shall be placed around the perimeter at each floor and roof level on exterior walls of masonry units. Reinforcing shall be not less than one No. 5 reinforcing bar located at the top of the bond beam. Bond beam depth shall not be less than a nominal 8 inches (203 mm).
3. Walls of unreinforced masonry construction, hollow masonry units, masonry bonded walls and cavity walls shall resist the loads in 1606 and in no case shall exceed 240 sq ft (22.3 m²) without approved vertical and horizontal support where the nominal wall thickness is 8 inches (203 mm) and units are laid in Type M, N or S mortar. Such walls, when a nominal thickness of 12 inches (305 mm) and laid in Type M, N or S mortar, shall not exceed 360 sq ft (33.4 m²) without approved vertical and horizontal support.
4. Grouted brick masonry, when laid in Type M, N or S mortar, shall be supported vertically and horizontally in areas not to exceed 1.20 times that allowed for hollow unit masonry of comparable wall thickness.
5. Plain solid masonry, when laid in Type M, N or S mortar, shall be supported vertically and horizontally in areas not to exceed 1.10 times that allowed for hollow unit masonry of comparable wall thickness.
6. In hollow masonry unit construction, at least one No. 5 reinforcing bar shall be provided in a fully grouted cell at all corners. Reinforcement shall be properly tied to the bond beam and foundation with standard hooks embedded a minimum of 6 inches (152 mm).
7. In solid masonry unit construction, the bond beam shall be anchored to the footing in an approved manner.
8. Roof members shall be securely fastened to the exterior walls with approved anchors capable of resisting the loads of 1606.

2103.2.4 Buildings which do not comply with one or more of the above shall be designed in accordance with the engineered design provisions of 2103.1. Members which are not part of the lateral-force-resisting system of the building may be designed in accordance with the empirical design provisions of 2103.2.

SECTION 2104 MATERIALS

2104.1 Concrete masonry units. Concrete masonry units shall conform to one of the following standards: ASTM C 55, ASTM C 73, ASTM C 90 and ASTM C 744.

2104.2 Clay or shale masonry units. Clay or shale masonry units shall conform to the following standards for the intended uses specified therein: ASTM C 34, ASTM C 56, ASTM C 62, ASTM C 126, ASTM C 212, ASTM C 216, ASTM C 530, ASTM C 652 and ASTM C 1088.

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 fire resistance rating shall be determined in accordance with 701.2 and comply with the requirements of Table 600.
2104.3 Stone masonry units. Stone masonry units shall conform to one of the following standards: ASTM C 503, ASTM C 568, ASTM C 615, ASTM C 616 and ASTM C 629.

2104.4 Ceramic tile. Ceramic tile shall be as defined in ANSI A 137.1 and shall conform to the requirements of ANSI A 137.1.

2104.5 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 3⅛ inches (79 mm) or shall be solid glass block units, having a thickness of not less than 3 inches (76 mm).

2104.6 Secondhand units. Secondhand 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 would interfere with proper laying or use. All old mortar shall be cleaned from the units before reuse.

2104.7 Mortar and grout

2104.7.1 Mortar for use in masonry construction shall comply with ASTM C 270.

2104.7.1.1 Mortar shall conform to the proportion specifications of Table 2104.7A or the property specifications of Table 2104.7B.

2104.7.2 Grout for use in masonry construction shall comply with ASTM C 476.

2104.7.2.1 Grout shall conform to the proportion specifications of Table 2104.7C.

<table>
<thead>
<tr>
<th>Table 2104.7A</th>
<th>MORTAR PROPORTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortar Type</td>
<td>Portland Cement or Blended Cement</td>
</tr>
<tr>
<td>Cement-lime</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Masonry cement</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>O</td>
</tr>
</tbody>
</table>

For SI: 1 lb = 0.4536 kg, 1 cu ft = 0.02832 m³.

Notes:
1. For the purpose of these specifications, the weight of 1 cu ft of the respective materials shall be considered to be as follows:
   - Portland Cement 94 lb
   - Masonry Cement 70 lb
   - Hydrated Lime 40 lb
   - Lime Putty (Quicklime) 80 lb
   - Sand, damp and loose 80 lb of dry sand

2104.8 Surface-bonding mortar. Surface-bonding mortar shall comply with ASTM C 887. Surface bonding of concrete masonry units shall comply with ASTM C 946.
2104.9 Metal reinforcement and accessories

2104.9.1 Deformed reinforcing bars. Deformed reinforcing bars shall conform to the following standards: ASTM A 615, ASTM A 616, ASTM A 617 and ASTM A 706.

2104.9.2 Joint reinforcement

2104.9.2.1 Joint reinforcing wire shall conform to the following standards: ASTM A 82 and ASTM A 167, Type 304.

2104.9.2.2 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 inch (25.4 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 percent of the perimeter of the wire. The indentation depth of the deformations shall be 0.006 inch ± 0.003 inch (0.15 ± 0.076 mm).

2104.9.3 Deformed reinforcing wire. Deformed reinforcing wire shall conform to ASTM A 496.

2104.9.4 Wire fabric. Wire fabric shall conform to ASTM A 185 or ASTM A 497.

2104.9.5 Anchors, ties and accessories. Anchors, ties and accessories shall conform to ASTM A 36, ASTM A 82, ASTM A 167, Type 304, ASTM A 185 or ASTM A 366.

2104.9.6 Corrosion protection. Joint reinforcement, anchors, wall ties and accessories, except those of stainless steel (ASTM A 167, Type 304), 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 1.50 ounces per sq ft (0.458 kg/m²) in accordance with ASTM A 153. Metal accessories for use in interior wall construction shall be mill galvanized with a minimum coating of 0.1 ounce per sq ft (0.031 kg/m²) in accordance with ASTM A 641 or ASTM A 525, Class G-60.

2104.9.7 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.

2104.10 Mortars for ceramic wall and floor tile. Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1 and be of the compositions indicated in Table 2104.10.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>COAT</th>
<th>COMPOSITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floors</td>
<td>Setting bed</td>
<td>1 cement; 1/2 hydrated lime; 5 damp sand to 1 cement; 1 hydrated lime; 7 damp sand</td>
</tr>
<tr>
<td>Ceilings</td>
<td>Scratchcoat and sand bed</td>
<td>1 cement; 1/2 hydrated lime; 2 1/2 dry sand or 3 damp sand</td>
</tr>
</tbody>
</table>

2104.10.1 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. The shear bond strength for tile set in such mortar shall be as required in accordance with that standard. Tile set in dry-set portland cement mortar shall be installed in accordance with ANSI A108.5.

2104.10.2 Electrically conductive dry-set mortars. Premixed prepared portland cement mortars, which require only the addition of water and which comply with ANSI A118.2, 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.

2104.10.3 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 gaging water, which 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.

2104.10.4 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.

2104.10.5 Furan mortar and grout. Chemical-resistant furan mortar and grout which are used to install ceramic tile shall comply with ANSI A118.5. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8.

2104.10.6 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. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9.

2104.10.7 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 (1915 N/m²).
for Type I adhesives, and not less than 20 psi (958 N/m²) 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.

2104.10.8 Portland cement grouts. Portland cement grouts used for the installation of ceramic tile shall comply with ANSI All8.6. Portland cement grouts for tile-work shall be installed in accordance with ANSI A108.10.

SECTION 2105
LATERAL STABILITY

2105.1 Shear walls. Where the structure depends on masonry walls for lateral stability, shear walls shall be provided parallel to the direction of the lateral forces resisted.

2105.1.1 Shear wall thickness. Minimum nominal thickness of masonry shear walls shall be 8 inches (203 mm).

Exception: Shear walls of one story buildings are permitted to be a minimum nominal thickness of 6 inches (152 mm).

2105.1.2 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.

2105.1.3 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 2105.1.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MAXIMUM ALLOWABLE STRESS, psi (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression standard block</td>
<td>45 (0.31)</td>
</tr>
<tr>
<td>Shear</td>
<td>10 (0.069)</td>
</tr>
<tr>
<td>Flexural tension</td>
<td></td>
</tr>
<tr>
<td>vertical span</td>
<td>18 (0.12)</td>
</tr>
<tr>
<td>horizontal span</td>
<td>30 (0.21)</td>
</tr>
</tbody>
</table>

2105.4 Construction. Construction of dry-stacked, surface-bonded masonry walls, including stacking and leveling of units, mixing and application of mortar, curing and protection, shall comply with ASTM C 946.

SECTION 2106
COMPRESSIVE STRESS REQUIREMENTS

2106.1 Vertical dead plus live loads. Compressive stresses in masonry caused by vertical dead plus live loads, excluding wind or seismic loads, shall be determined in accordance with 2106.2.1. Dead and live loads shall be in accordance with Chapter 16, with live load reductions as permitted in 1604.2.

2106.2 Maximum values. The compressive stresses in masonry shall not exceed the values given in Table 2106.2. Stress shall be calculated based on actual rather than nominal dimensions.

2106.2.1 Calculated compressive stresses. Calculated compressive stresses for single wythe walls and for multiwythe 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.

2106.2.2 Multiwythe walls. The allowable stress shall be as given in Table 2106.2 for the weakest combination of the units and mortar used in each wythe.
### Table 2106.2
**Allowable Compressive Stresses for Empirical Design of Masonry**

<table>
<thead>
<tr>
<th>Construction</th>
<th>Allowable Compressive Stresses&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Gross Cross-Sectional Area, psi (MPa)</th>
<th>Type M or S Mortar</th>
<th>Type N Mortar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid masonry of brick and</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>other solid units of clay or</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shale; sand-lime or concrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>brick:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8,000 (55) or greater</td>
<td></td>
<td></td>
<td>350 (2.4)</td>
<td>300 (2.1)</td>
</tr>
<tr>
<td>4,500 (31)</td>
<td></td>
<td></td>
<td>225 (1.6)</td>
<td>200 (1.4)</td>
</tr>
<tr>
<td>2,500 (17)</td>
<td></td>
<td></td>
<td>160 (1.1)</td>
<td>140 (0.97)</td>
</tr>
<tr>
<td>1,500 (10)</td>
<td></td>
<td></td>
<td>115 (0.79)</td>
<td>100 (0.69)</td>
</tr>
</tbody>
</table>

| Grouted masonry, of clay or  |                                           |                                       |                    |               |
| shale, sand-lime or concrete:|                                           |                                       |                    |               |
| 4,500 (31) or greater        |                                           |                                       | 225 (1.55)         | 200 (1.4)     |
| 2,500 (17)                   |                                           |                                       | 160 (1.10)         | 140 (0.97)    |
| 1,500 (10)                   |                                           |                                       | 115 (0.792)        | 100 (0.69)    |

| Solid masonry of solid       |                                           |                                       |                    |               |
| concrete masonry units:      |                                           |                                       |                    |               |
| 3,000 (21) or greater        |                                           |                                       | 225 (1.55)         | 200 (1.4)     |
| 2,000 (14)                   |                                           |                                       | 160 (1.10)         | 140 (0.97)    |
| 1,200 (8.3)                  |                                           |                                       | 115 (0.792)        | 100 (0.69)    |

| Masonry or hollow load bearing units: | | | | |
| 2,000 (14) or greater           | 140 (0.97) | 120 (0.83) |
| 1,500 (10)                      | 115 (0.79) | 100 (0.69) |
| 1,000 (6.9)                     | 75 (0.52)  | 70 (0.48)  |
| 700 (4.8)                       | 60 (0.41)  | 55 (0.38)  |

| Hollow walls (noncomposite masonry bonded): | | | | |
| Solid units                          | | | | |
| 2,500 (17) or greater               | 160 (1.10) | 140 (0.97) |
| 1,500 (10)                          | 115 (0.79) | 100 (0.69) |
| Hollow units                        | 115 (0.79) | 100 (0.69) |
| | 75 (0.52)  | 70 (0.48)  |

| Stone ashlar masonry:            | | | | |
| Granite                            | 720 (5.0)  | 640 (4.4)  |
| Limestone or marble               | 450 (3.1)  | 400 (2.8)  |
| Sandstone or cast stone           | 360 (2.5)  | 320 (2.2)  |

| Rubble stone masonry:            | | | | |
| Coarse, rough, or random         | 120 (0.83) | 100 (0.69) |

Notes:
1. Linear interpolation for determining allowable stresses for masonry units having compressive strengths which are intermediate between those given in the table is permitted.
2. 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 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.

### Section 2107
**Lateral Support**

#### 2107.1 General
Masonry walls shall be laterally supported in either the horizontal or the vertical direction at intervals not exceeding those given in Table 2107.1.

#### 2107.1.1 Thickness
Except for cavity walls and cantilever walls, the thickness of a wall shall be its 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 for solid masonry or 4 for hollow masonry. For parapets see 2108.2.

#### 2107.2 Lateral support
Lateral support shall be provided by cross walls, pilasters, buttresses or structural frame members when the limiting distance is taken horizontally, or by floors or roofs acting as diaphragms or structural frame members when the limiting distance is measured vertically.

| Table 2107.1
<table>
<thead>
<tr>
<th>Construction</th>
<th>Maximum Wall Length to Thickness or Wall Height to Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing walls</td>
<td></td>
</tr>
<tr>
<td>Solid or solid grouted</td>
<td>20</td>
</tr>
<tr>
<td>All other</td>
<td>18</td>
</tr>
<tr>
<td>Nonbearing walls</td>
<td></td>
</tr>
<tr>
<td>Exterior</td>
<td>18</td>
</tr>
<tr>
<td>Interior</td>
<td>36</td>
</tr>
</tbody>
</table>

### Section 2108
**Thickness of Masonry**

#### 2108.1 Thickness of walls
The nominal thickness of masonry walls shall conform to the requirements of 2108.

#### 2108.1.1 Minimum thickness
The minimum thickness of masonry bearing walls more than one story high shall be 8 inches (203 mm). Bearing walls of one story buildings shall not be less than 6 inches (152 mm) thick.

#### 2108.1.2 Rubble stone walls
The minimum thickness of rough or random or coursed rubble stone walls shall be 16 inches (406 mm).

#### 2108.1.3 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.
2108.2 Parapet walls
2108.2.1 Unreinforced parapet walls shall be at least 8 inches (203 mm) thick, and their height shall not exceed three times their thickness.

2108.2.2 Additional provisions for parapet walls are contained in 1511.6.

2108.3 Foundation Walls. For the minimum thicknesses of masonry foundation walls, see 1804.6.

SECTION 2109
BOND

2109.1 General. The facing and backing of multiple wythe masonry walls shall be bonded in accordance with 2109.2, 2109.3 or 2109.4.

2109.2 Bonding with masonry headers
2109.2.1 Solid units. Where the facing and backing (adjacent wythes) of solid masonry construction are bonded by means of masonry headers, no less than 4 percent of the wall surface of each face shall be composed of headers extending not less than 3 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 3 inches (76 mm), or headers from opposite sides shall be covered with another header course overlapping the header below at least 3 inches (76 mm).

2109.2.2 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 3 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 percent greater in thickness than the units below.

2109.2.3 Masonry bonded hollow walls. In masonry bonded hollow walls, the facing and backing shall be bonded so that not less than 4 percent of the wall surface of each face is composed of masonry bonding units extending not less than 3 inches (76 mm) into the backing. The distance between adjacent bonders shall not exceed 24 inches (610 mm) either vertically or horizontally.

2109.3 Bonding with wall ties or joint reinforcement
2109.3.1 Bonding with wall ties. Except as required by 2109.3.1.1, where the facing and backing (adjacent wythes) of masonry walls are bonded with 3/16 inch (4.8 mm) 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 4 1/2 sq ft (0.42 m²) of wall area. Ties in alternate courses shall be staggered. The maximum vertical distance 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. In other walls, the ends of ties shall be bent to 90 degrees (1.57 rad) angles to provide hooks no less than 2 inches (51 mm) long. Additional bonding ties shall be provided at all openings, spaced not more than 3 feet (914 mm) apart around the perimeter and in 12 inches (305 mm) of the opening.

2109.3.1.1 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 sq ft (0.164 m²) of wall area. Neither the vertical nor the 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 1 1/4 inches (32 mm). The maximum clearance between connecting parts of the ties shall be 1/16 inch (1.6 mm). When pintle legs are used, ties shall have at least two 3/16 inch (4.8 mm) diameter legs.

2109.3.2 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 1/2 sq ft (0.25 m²) of wall area. The vertical spacing of the joint reinforcement shall not exceed 16 inches (406 mm). Cross wires on prefabricated joint reinforcement shall be not less than W 1.7 (11 mm²). The longitudinal wires shall be embedded in the mortar.

2109.4 Bonding with natural or cast stone
2109.4.1 Ashlar masonry. In ashlar masonry, bonder units, uniformly distributed, shall be provided to the extent of not less than 10 percent of the wall area. Such bonder units shall extend not less than 4 inches (102 mm) into the backing wall.

2109.4.2 Rubble stone masonry. Rubble stone masonry 24 inches (610 mm) or less in thickness shall have bonder units with a maximum spacing of 3 feet (914 mm) vertically and 3 feet (914 mm) horizontally and, if the masonry is of greater thickness than 24 inches (610 mm), shall have one bonder unit for each 6 sq ft (0.56 m²) of wall surface on both sides.

2109.5 Masonry bonding pattern
2109.5.1 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 quarter the unit length, or the masonry walls shall be reinforced longitudinally as required in 2109.5.2.

2109.5.2 Masonry laid in stack bond. Where unit masonry is laid with less head joint offset than in 2109.5.1, 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 0.0003 times the vertical cross-sectional area of the wall.
SECTION 2110
ANCHORAGE

2110.1 General. Masonry elements shall be anchored in accordance with 2110.

2110.2 Intersecting walls. Masonry walls depending upon one another for lateral support shall be anchored or bonded at locations where they meet or intersect by one of the following methods indicated in 2110.2.1 through 2110.2.5.

2110.2.1 Bonding pattern. Fifty percent 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 3 inches (76 mm) on the unit below.

2110.2.2 Steel connectors. Walls shall be anchored by steel connectors having a minimum cross section of 1/4 inch (6.4 mm) by 1-1/2 inches (38 mm) with ends bent up at least 2 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 4 feet (1219 mm).

2110.2.3 Joint reinforcement. Walls shall be anchored by joint reinforcement spaced at a maximum distance of 8 inches (203 mm). Longitudinal reinforcement shall be at least W1.7 (11 mm²) and shall extend at least 30 inches (762 mm) in each direction at the intersection.

2110.2.4 Interior nonbearing walls. Interior nonbearing walls shall be anchored at their intersection at vertical intervals of not more than 16 inches (406 mm) with joint reinforcement or 1/4 inch (6.4 mm) galvanized mesh hardware cloth.

2110.2.5 Ties, joint reinforcement, anchors. Other metal ties, joint reinforcement or anchors, if used, shall be spaced to provide equivalent area of anchorage to that required by this section.

2110.3 Floor and roof anchorage. Floor and roof diaphragms providing lateral support to masonry shall be connected to the masonry in accordance with 2110.3.1 through 2110.3.3.

2110.3.1 Wood floor joists. Wood floor joists bearing on masonry walls shall be anchored to the wall at intervals not to exceed 6 feet (1829 mm) by metal strap anchors. Joists parallel to the wall shall be anchored with metal straps spaced not more than 6 feet (1829 mm) on centers extending over or under and secured to at least 3 joists. Blocking shall be provided between joists at each strap anchor.

2110.3.2 Steel floor joists. Steel floor joists shall be anchored to masonry walls with 3/8 inch (9.5 mm) round bars, or their equivalent, spaced not more than 6 feet (1829 mm) on center. Where joists are parallel to the wall, anchors shall be located at joist cross bridging.

2110.3.3 Roof structures. Roof structures shall be anchored to masonry walls with 1/2 inch (12.7 mm) bolts 6 feet (1829 mm) on center or their equivalent. 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 mm²) of bond beam reinforcement placed not less than 6 inches (152 mm) from the top of the wall.

2110.4 Walls adjoining structural framing. Where walls are dependent upon the structural frame for lateral support, they shall be anchored to the structural members with metal anchors or otherwise keyed to the structural members. Metal anchors shall consist of 1/2 inch (12.7 mm) bolts spaced at 4 feet (1219 mm) on center embedded 4 inches (102 mm) into the masonry, or their equivalent area.

SECTION 2111
MASONRY CONSTRUCTION

2111.1 Masonry construction. Masonry construction shall comply with the requirements of 2111.1.1 through 2111.5.

2111.1.1 Tolerances. Masonry shall be constructed within the tolerances specified in ACI 530.1/ASCE 6/TMS 602.

2111.1.2 Placing mortar and units

2111.1.2.1 Head and bed joints. Unless otherwise required or indicated on the project drawings, head and bed joints shall be 3/8 inch (9.5 mm) thick, except that the thickness of the bed joint of the starting course placed over foundations shall not be less than 1/4 inch (6.4 mm) and not more than 3/4 inch (19 mm).

2111.1.2.2 Hollow units. Hollow units shall be placed such that:

1. Face shells of bed joints are fully mortared.
2. Webs are fully mortared in all courses of piers, columns and pilasters, in the starting course on foundations, where adjacent cells or cavities are to be grouted and when otherwise required.
3. Head joints are mortared a minimum distance from each face equal to the face shell thickness of the unit.

2111.1.2.3 Solid units. Unless otherwise required or indicated on the project drawings, place solid units in fully mortared bed and head joints, and:

1. Completely butter the ends of the units. Head joints are not to be filled by slushing with mortar.
2. Construct head joints by shoving mortar tight against the adjoining unit.
3. Do not furrow bed joints deep enough to produce voids.

2111.1.2.4 All units. Place units while the mortar is soft and plastic. Any unit disturbed to the extent that
2111.1.2.4 All units. Place units while the mortar is soft and plastic. Any unit disturbed to the extent that initial bond is broken after initial positioning shall be removed and relaid in fresh mortar.

2111.1.3 Weepholes. Weepholes shall be provided in masonry veneer and in the outside wythe of masonry walls at a maximum spacing of 4 ft (1219 mm) on center by omitting mortar in the head joints. Weepholes shall be located in the first course above the foundation wall or slab, and other points of support, including structural floors, shelf angles and lintels.

2111.1.4 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 1/2 inch (12.7 mm). Wire wall ties shall be embedded at least 1 1/2 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.

2111.1.5 Chases. Chases shall be constructed as masonry units are laid.

2111.1.6 Bracing of masonry. Bracing that will assure stability of masonry during construction shall be provided and installed. Bracing shall be in accordance with the Standard Practice for Bracing Masonry Walls Under Construction.

Exceptions:
1. Bracing shall not be required for the unsupported wall heights specified in the Standard Practice for Bracing Masonry Walls Under Construction, Appendix A, when an evacuation system complying with the Standard Practice for Bracing Masonry Walls Under Construction with Commentary is provided.
2. Walls 8 ft (2438 mm) and less in height above grade shall not require bracing.

2111.1.7 Construction loads. Construction loads shall not exceed the superimposed loads the masonry with supplemental supports is capable of supporting safely.

2111.1.8 Masonry protection. The top of unfinished masonry work shall be covered to protect it from the weather.

2111.2 Corbelled masonry. Solid masonry units shall be used for corbelling. The maximum corbelled projection beyond the face of the wall shall be not more than one-half of the wall thickness or 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 its thickness at right angles to the wall.

2111.2.1 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.

2111.3 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):

2111.3.1 Temperature of masonry units shall not be less than 20°F (-7°C) when laid in the masonry. Remove visible ice on masonry units before the unit is laid in the mortar.

2111.3.2 Heat mortar sand or mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C) at the time of mixing. Maintain mortar above freezing until used in masonry.

2111.3.3 Use heat sources where ambient temperatures are between 25°F (-4°C) and 20°F (-7°C), on both sides of the masonry under construction and install wind breaks when wind velocity is in excess of 15 mph (6.7 m/s).

2111.3.4 Where ambient temperatures are below 20°F (-7°C), provide an enclosure for the masonry under construction and use heat sources to maintain temperatures above 32°F (0°C) within the enclosure.

2111.3.5 Where mean daily temperatures are between 40°F (4°C) and 32°F (0°C), protect completed masonry from rain or snow by covering with a weather resistive membrane for 24 hours after construction.

2111.3.6 Where mean daily temperatures are between 32°F (0°C) and 25°F (-4°C), completely cover completed masonry with a weather resistive membrane for 24 hours after construction.

2111.3.7 Where mean daily temperatures are between 25°F (-4°C) and 20°F (-7°C), completely cover completed masonry with insulating blankets or equal protection for 24 hours after construction.

2111.3.8 Where mean daily temperatures are below 20°F (-7°C), maintain masonry temperature above 32°F (0°C) for 24 hours after construction by enclosure with a weather resistive membrane and heat lamps, or by other approved methods.

2111.4 Hot weather construction. The following hot weather procedures shall be implemented when either 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 8 mph (3.58 m/s):

2111.4.1 Mortar beds shall not be spaced more than 4 ft (1219 mm) ahead of masonry.

2111.4.2 Masonry units shall be laid within 1 minute after mortar placement.

2111.5 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 (30 g/194 cm$^2$) per minute or 0.035 ounce per square inch (0.0015 g/mm$^2$), as determined by ASTM C 67.

SECTION 2112

GLASS BLOCK WALLS

2112.1 General

2112.1.1 Masonry of glass blocks used in nonbearing exterior or interior walls and in window openings, either isolated or in continuous bands, shall have a minimum thickness of 3 inches (76 mm) at the mortar joint and all the mortar-bearing 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.

2112.1.2 Solid or hollow approved glass blocks shall not be used in fire rated 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 rated partitions.

Exceptions:
1. Glass block assemblies having a fire resistance rating of not less than 3/4 hour shall be permitted as opening protectives in fire-rated partitions which have a required fire resistance rating of 1 hour or less and do not enclose exit stairways or exit passageways.
2. Glass block assemblies as permitted in 414.5, Paragraph 2.

2112.2 Size of panels

2112.2.1 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 ft (7.6 m) in length and 20 ft (6 m) in height between structural supports and expansion joints; and the area of each individual panel shall not be more than 144 sq ft (13.4 m$^2$) for exterior panels and 250 sq ft (23.2 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.

2112.2.2 The maximum area of all solid glass block wall panels in both exterior and interior walls shall not be more than 100 sq ft (9.3 m$^2$).

2112.3 Joint materials. Glass block shall be laid up in Type S or N mortar. Both vertical and horizontal mortar joints shall be at least 1/4 inch (6.4 mm) and not more than 1/2 inch (12.7 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 3/8-inch (9.5 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 1/2 inch (12.7 mm) with nonhardening caulking compound on both faces, or other approved expansion joints shall be provided.

2112.4 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 may be spliced by lapping longitudinal wires at least 6 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.

2112.5 Wind loads. Exterior wall panels shall be held in place in the wall opening to resist both the internal and external pressures from wind loads as specified in 1606 with metal-channel-type frames, structural frames, masonry or concrete recesses or embedded panel anchors at the sides and top. Where recess type framing is used, glass block shall be recessed within the framing not less than 1 inch (25.4 mm).

SECTION 2113

MASONRY CHIMNEYS

2113.1 General. Masonry chimneys shall be built in accordance with 2113 and 2804.

2113.2 Support

2113.2.1 Masonry chimneys shall be supported on properly designed foundations of masonry or reinforced concrete. Noncombustible material having a fire resistance rating of not less than 3 hours may be used to support masonry chimneys where such supports are independent of the floor construction and the load is transferred to the ground.

2113.2.2 Masonry chimneys shall not be corbeled from a wall or foundation more than 6 inches (152 mm), nor shall a chimney be corbeled from a wall or foundation which is less than 12 inches (305 mm) thick unless it projects equally on each side of the wall provided that in the second story of two story dwellings corbeling of chimneys on the exterior of the enclosing walls may equal the wall thickness. Individual corbels or the maximum projection of one unit shall not exceed one-half the height of the unit nor one-third its bed depth. Corbeled smoke chambers shall be parged with fireclay mortar or refractory mortar.

2113.3 Construction

2113.3.1 A chimney or chimney flue shall not change in size or shape within 6 inches (152 mm) above or below where the chimney passes through floor components, ceiling components or roof components.
2113.3.2 Masonry chimneys shall be constructed of solid masonry units or reinforced concrete with the walls not less than 4 inches (102 mm) thick or rubble stone masonry not less than 12 inches (305 mm) thick.

2113.3.3 Masonry chimneys shall be lined with approved fireclay liners not less than 3/8 inch (5.9 mm) thick, or with other approved liner of material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800°F (982.2°C). Fireclay tile liners shall be installed ahead of the construction of the chimney as it is carried up, carefully bedded one on the other in fireclay mortar or refractory air-setting mortar with close-fitting joints left smooth on the inside.

2113.3.4 Liners shall be separated from the chimney wall by a minimum of 1/2 inch (12.7 mm) and a maximum of 1 inch (25.4 mm) of air space. The air space shall not be filled and only enough mortar shall be used to make a good joint to hold the liners in position.

2113.3.5 Flue liners shall start from a point not less than 8 inches (203 mm) below the intake. They shall extend as vertical as possible, with a maximum slope no greater than 30 degrees (0.524 rad) from vertical. The liner shall extend at least 4 inches (102 mm) above the crown of the chimney, but not more than 6 inches (152 mm).

2113.3.6 Where two adjoining flues in the same chimney are separated only by flue liners, the joints of the adjacent flue liners shall be staggered at least 7 inches (178 mm).

2113.3.7 Where more than two flues are located in the same chimney, masonry wythes (partitions) at least 4 inches (102 mm) wide and bonded into the masonry walls of the chimney shall be built at such points between adjacent flue linings that there are not more than two flues in a group of adjoining flues without such wythe separation.

2113.3.8 Listed lining systems. Lining systems other than fire clay tile flue liners shall be listed in accordance with UL 1777 or equivalent, and shall be installed in accordance with the terms of the listing and the manufacturer's instructions.

2113.3.9 All damper assemblies in chimney structures shall be capable of opening and closing manually.

2113.3.10 The space surrounding a flue lining system, or other vent installed within a masonry chimney, shall not be used to vent any other appliance. This shall not prevent installation of a separate flue lining in accordance with the manufacturer's instructions and this code.

2113.4 Fireblocking. All spaces between chimneys and floors and ceilings through which chimneys may pass shall be fireblocked with noncombustible material. The fireblocking of spaces between chimneys and wood joists, beams or headers shall be to a depth of 1 inch (25.4 mm) only, placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

2113.5 Separation from combustibles. Any portion of a masonry chimney located within the outside face of the exterior wall shall have a minimum air space clearance of 2 inches (51 mm) to combustible materials. 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 1 inch (25.4 mm). The air space shall not be filled, except to provide fireblocking in accordance with 2113.4.

Exception: Air space clearance shall not be required where the masonry chimney is equipped with a chimney lining system listed for use in chimneys in contact with combustibles in accordance with UL 1777, and the lining system is installed in accordance with the manufacturer's instructions. Noncombustible fireblocking shall be provided in accordance with 2113.4.

2113.6 Cleanouts. Cleanout openings shall be provided within 6 inches (153 mm) of the base of each flue within every masonry chimney. The upper edge of the cleanout opening shall be located at least 6 inches (153 mm) below the lowest chimney inlet opening. The height of the opening shall be at least 6 inches (153 mm). Cleanout openings shall be equipped with noncombustible covers and frames arranged to remain tightly closed when not in use. Adequate clearance between cleanout doors and combustible material shall be provided.

Exception: A separate cleanout opening shall not be required for chimney flues serving masonry fireplaces, provided the flue is accessible for removal of debris through the fireplace opening.

2113.7 Smoke test. Masonry chimneys shall be proven tight by a smoke test after erection and before being put into use.

SECTION 2114
MASONRY FIREPLACES AND BARBECUES

2114.1 General. The provisions of this section shall govern the construction of masonry fireplaces and barbecues.

2114.2 Definitions. For definitions, see Chapter 2.

2114.3 Masonry fireplaces

2114.3.1 Fireplaces shall be constructed of solid masonry or of reinforced concrete with back and sides of the thickness specified in this paragraph, except as provided in 2806.1. Where a lining of firebrick at least 2 inches (51 mm) thick or other approved lining is provided, the total thickness of back and sides, including the lining, shall be not less than 8 inches (203 mm) of solid masonry or reinforced concrete. Where no such lining is provided, the thickness of back and sides shall be not less than 12 inches (305 mm) of solid masonry or reinforced concrete.

2114.3.2 The firebox of a masonry fireplace shall have a minimum depth of 20 inches (508 mm). The throat shall be at least 8 inches (203 mm) above the fireplace opening. The throat opening shall be at least 4 inches (102 mm) in depth. The cross-sectional area of the passageway above
the firebox, including the throat, damper and smoke chamber, shall be not less than the cross-sectional area of the flue.

**Exception:** Rumford fireplaces shall be permitted provided the depth of the fireplace is a minimum of 12 inches (305 mm) and a minimum of \(\frac{1}{3}\) of the width of the fireplace opening. The throat shall be a minimum of 12 inches (305 mm) above the lintel and shall be a minimum of \(\frac{1}{20}\) of the cross-sectional area of the fireplace opening.

**2114.3.3** The front and side walls of the throat and smoke chamber shall be constructed of solid masonry having a minimum total thickness of 8 inches (203 mm). The back wall of the throat and smoke chamber shall be constructed of solid masonry having a minimum thickness of 6 inches (152 mm). A minimum \(\frac{\sqrt{2}}{2}\) inch (16 mm) thick clay flue lining, complying with ASTM C 315, shall be permitted to form the inside surface of the smoke chamber walls to which the minimum total thickness applies.

**2114.3.4** 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. When the inside surface of the smoke chamber is formed by corbeled masonry, the walls shall not be corbeled more than 30 degrees from vertical.

**2114.3.5** The net cross-sectional area of the chimney flue shall be determined in accordance with Figure 2114.3.5. A flue size providing at least the equivalent net cross-sectional area shall be used. Flue size and net cross-sectional area shall be as given in Tables 2114.3.5A and 2114.3.5B or as provided by the manufacturer and as measured in the field. The height of the chimney shall be measured from the firebox floor to the top of the last chimney flue tile.

For SI: 1 inch = 25.4 mm; 1 in\(^2\) = 645.16 mm\(^2\).

**Note:**
1. When using Figure 2114.3.5, select the smaller flue size when the opening and height selected for the fireplace and chimney, respectively, intersect between standard flue sizes.

<table>
<thead>
<tr>
<th>FLUE SIZE OUTSIDE DIMENSIONS (in.)</th>
<th>CROSS-SECTIONAL AREA (sq in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 1/2 x 13</td>
<td>34</td>
</tr>
<tr>
<td>7 1/2 x 7 1/2</td>
<td>37</td>
</tr>
<tr>
<td>8 1/2 x 8 1/2</td>
<td>47</td>
</tr>
<tr>
<td>7 1/2 x 11 1/2</td>
<td>58</td>
</tr>
<tr>
<td>8 1/2 x 13</td>
<td>74</td>
</tr>
<tr>
<td>7 1/2 x 15 1/2</td>
<td>82</td>
</tr>
<tr>
<td>11 1/2 x 11 1/2</td>
<td>91</td>
</tr>
<tr>
<td>8 1/2 x 17 3/4</td>
<td>101</td>
</tr>
<tr>
<td>13 x 13</td>
<td>122</td>
</tr>
<tr>
<td>11 1/2 x 15 1/2</td>
<td>124</td>
</tr>
<tr>
<td>13 x 17 3/4</td>
<td>165</td>
</tr>
<tr>
<td>15 1/2 x 15 1/2</td>
<td>168</td>
</tr>
<tr>
<td>15 1/2 x 19 1/2</td>
<td>214</td>
</tr>
<tr>
<td>17 3/4 x 17 3/4</td>
<td>226</td>
</tr>
<tr>
<td>19 1/2 x 19 1/2</td>
<td>269</td>
</tr>
<tr>
<td>20 x 20</td>
<td>286</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm; 1 in\(^2\) = 645.16 mm\(^2\).

**Note:**
1. Flue sizes are based on ASTM C 315.

<table>
<thead>
<tr>
<th>FLUE SIZE INSIDE DIAMETER (in.)</th>
<th>CROSS-SECTIONAL AREA (sq in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>7</td>
<td>38</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>78</td>
</tr>
<tr>
<td>10 3/4</td>
<td>90</td>
</tr>
<tr>
<td>12</td>
<td>113</td>
</tr>
<tr>
<td>15</td>
<td>176</td>
</tr>
<tr>
<td>18</td>
<td>254</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm; 1 in\(^2\) = 645.16 mm\(^2\).

**Note:**
1. Flue sizes are based on ASTM C 315.

**2114.3.6** Steel fireplace units incorporating a firebox liner of not less than \(\frac{1}{4}\)-inch (6.4 mm) thick steel and an air chamber may be installed with masonry to provide a total thickness at the back and sides of not less than 8 inches (203 mm), not less than 4 inches (102 mm) of which shall be solid masonry.
2114.3.7 Warm air ducts employed with steel fireplace units of the circulating air type shall be constructed of metal or masonry.

2114.3.8 Fireplace hearth extensions shall be of approved noncombustible material for all fireplaces. Where the fireplace opening is less than 6 sq ft (0.56 m$^2$), the hearth extension shall extend at least 16 inches (406 mm) in front of the facing material and at least 8 inches (203 mm) beyond each side of the fireplace opening. Where the fireplace opening is 6 sq ft (0.56 m$^2$) or larger, the hearth extension shall extend at least 20 inches (508 mm) in front of the facing material and at least 12 inches (305 mm) beyond each side of the fireplace opening. Where a fireplace is elevated above or overhangs a floor, the hearth extension shall also extend over the area under the fireplace.

2114.3.9 Fireplaces constructed of masonry or reinforced concrete shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported and with no combustible material against the underside thereof. Wooden forms or centers used during the construction of a hearth and hearth extension shall be removed when the construction is completed.

**Exception:** A header of combustible material may be used to support the hearth extension provided that it is located more than 12 inches (305 mm) from the face of the fireplace.

2114.3.10 All combustible wood beams, joists, and studs shall be maintained a minimum of 2 inches (51 mm) from the outside face of chimney or fireplace masonry. Headers supporting trimmer arches at fireplaces shall be not less than 20 inches (508 mm) from the face of the chimney breast. Trimmers shall be not less than 6 inches (152 mm) from the inside face of the nearest flue lining.

2114.3.11 Woodwork shall not be placed within 4 inches (102 mm) of the back of a fireplace, but this shall not prevent plastering directly on the masonry or on metal lath and metal furring.

2114.3.12 All combustible mantles and similar trim shall be kept at least 6 inches (152 mm) from the fireplace opening. Parts of the mantle assembly located along the sides of the fireplace opening, which project more than 11/2 inches (38 mm) from the face of the fireplace, shall have additional clearance equal to the projection. Parts of the mantle assembly located above and projecting more than 11/2 inches (38 mm) from the fireplace opening shall be placed not less than 12 inches (305 mm) from the top of the fireplace opening.

2114.4 Masonry built barbecues. Masonry-built barbecues shall meet the applicable requirements of 2114.3.

### SECTION 2115 (Reserved)

### SECTION 2116 TERMITE INSPECTION

2116.1 Cleaning. Cells and cavities in masonry units and air gaps between brick, stone or masonry veneers and the structure shall be cleaned of all non-preservative treated or non-naturally durable wood, or other cellulose-containing material prior to concrete placement.

**Exception:** Inorganic material manufactured for closing cells in foundation concrete masonry unit construction or clean earth fill placed in concrete masonry unit voids below slab level before termite treatment is performed.

2116.2 Concrete bearing ledge. Brick, stone or other veneer shall be supported by a concrete bearing ledge of such thickness as required in Chapter 14, which is poured integrally with the concrete foundation. No supplemental concrete foundation pours which will create a hidden cold joint shall be used without supplemental treatment in the foundation unless there is an approved physical barrier. An approved physical barrier shall also be installed from below the wall sill plate or first block course horizontally to embed in a mortar joint. If masonry veneer extends below grade, a termite protective treatment must be applied to the cavity created between the veneer and the foundation, in lieu of a physical barrier.

**Exception:** Veneer supported by a structural member secured to the foundation sidewall as provided in 1403, provided at least a 6 inch (152 mm) clear inspection space of the foundation sidewall exterior exist between the veneer and the top of any soil, sod, mulch or other organic landscaping component, deck, apron, porch, walk or any other work immediately adjacent to or adjoining the structure.

### SECTION 2117 SPECIAL WIND PROVISIONS FOR MASONRY

2117.1 Gable endwalls.

2117.1.1 General. Gable endwalls shall be structurally continuous between points of lateral support.

2117.1.2 Cathedral endwalls. Gable endwalls adjacent to cathedral ceilings shall be continuous from the uppermost floor to the ceiling diaphragm or to the roof diaphragm.

### SECTION 2118 HIGH VELOCITY HURRICANE ZONES DESIGN

2118.1 Masonry shall be designed by a method admitting of rational analysis based on established principles of mechanics.
SECTION 2119
HIGH VELOCITY HURRICANE ZONEs
QUALITY, TESTS, AND APPROVALS

2119.1 Quality. The quality of materials assembled into masonry and the method and manner of their assembly shall conform to the requirements of this chapter.

2119.1.1 Workmanship. Masonry construction shall be in conformance with the tolerances, quality and methods of construction as set forth in standards referenced in this chapter; the Portland Cement Association Concrete Masonry Handbook, ANSI A41.1, A41.2 and AWS Structural Welding Code: Reinforcing Steel (D1.4).

2119.1.2 Other materials. A material of masonry, other than set forth herein, which is incombustible and otherwise sufficiently embodies the characteristics and satisfies the requirements of one of the materials herein may be approved by the building official, subject to such tests as may be prescribed.

2119.2 Tests

2119.2.1 The building official may require materials to be subjected to tests to determine their quality whenever there is reason to believe that a material is no longer up to the standards on which the approval was based. The cost of such tests shall be borne by the person or persons proposing to use or continue to use such material or product.

2119.2.2 Materials shall be tested in accordance with the standard specifications of the American Society for Testing Materials (ASTM) as such standard specifications are noted in this chapter.

2119.3 Approvals.

2119.3.1 Only such masonry units as bear the approval of the building official and are manufactured or fabricated by plants having a Certificate of Competency issued by the Authority Having Jurisdiction, shall be considered acceptable for the construction of buildings or other structures.

2119.3.2 Approval of masonry units and manufacturing or fabricating plants shall be for periods not to exceed 1 year and may be obtained upon application and the submission of certificates of tests in accordance with the provisions of this chapter.

2119.3.3 The provisions for tests for approval of masonry units shall not be construed as in lieu of any tests otherwise required under this chapter.

2119.3.4 Failure of a manufacturer of masonry units to obtain approval or to submit tests as required in this chapter, or such additional tests as the building official may require, shall be cause for rejection of such masonry units.

2119.4 Brick

2119.4.1 General. Brick shall include masonry units usually 2 1/4 inches (57 mm) thick, 3 3/4 inches (95 mm) wide, and 8 inches (203 mm) long, and not less than 75 percent solid.

2119.4.2 Tests. Tests shall be conducted in accordance with Standard Methods of Testing Brick, ASTM C 67.

2119.4.3 Quality.

2119.4.3.1 Burned clay or shale brick shall conform to the Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale), ASTM C 62.

2119.4.3.2 Sand-lime brick shall conform to the Standard Specification for Concrete Building Brick, ASTM C 55.

2119.4.3.3 Concrete brick shall conform to the Standard Specification for Concrete Building Brick, ASTM C 55.

2119.5 Stone. Stone for masonry shall be hard and durable.

2119.6 Cast stone. Cast stone shall be made of portland cement, aggregates and water with or without admixtures. Cast stone for load-bearing masonry or where exposed to the weather shall have an average compressive strength, at 28 days, of at least 3000 pounds psi (20.7 MPa) and shall have not more than 7 percent water absorption by weight.

2119.7 Concrete blocks

2119.7.1 General.

2119.7.1.1 Concrete blocks shall be made of portland cement, water and approved aggregates. The materials shall conform to the requirements for the materials of concrete specified in Chapter 19 (High Velocity Hurricane Zones), and the finished units shall meet the requirements of this section.

2119.7.1.2 Concrete blocks used for fire-resistive walls rated 2 hours or more, or used for load-bearing or exterior walls, shall have a minimum face shell thickness of 1 1/4 inches (32 mm), a minimum web thickness of 1 inch (25.4 mm), and shall have a net cross-sectional area not less than 50 percent of the gross section.

2119.7.1.3 Concrete blocks for other purposes shall have wall and web thickness of not less than 3/4 inch (19 mm).

2119.7.1.4 Where masonry walls are required by this code to be 8 inch (203 mm) thickness, hollow concrete blocks units may be 7 5/8 x 7 5/8 x 15 3/8 inches (195 x 195 x 398 mm) modular dimension with corresponding widths for tie columns and tie beams.

2119.7.2 Quality. Standard units of hollow concrete block shall conform to the Standard Specification for Hollow Load-Bearing Concrete Masonry Units, ASTM...
C 90, except that the maximum moisture content shall not exceed 50 percent of the total absorption.

2119.8 Structural clay tile.
2119.8.1 Limitations. All hollow burned clay wall tile used for fire-resistant walls rated 2 hours or more, load-bearing or exterior walls shall be load bearing tile.

2119.8.2 Tests. Tests shall be conducted in accordance with the Standard Methods of Sampling and Testing Structural Clay Tile, ASTM C 212.

2119.8.3 Quality
2119.8.3.1 Structural clay load-bearing wall tile shall conform to the Standard Specification of Structural Clay Load-Bearing Wall Tile, ASTM C 34.

2119.8.3.2 Structural clay floor tile shall conform to the Standard Specification for Structural Clay Floor Tile, ASTM C 57.

2119.8.3.3 Structural clay nonload-bearing tile shall conform to the Standard Specification for Structural Clay Non-Load-Bearing Tile, ASTM C 56.

2119.9 Gypsum tile.
2119.9.1 Limitations. Precast gypsum shall not be used in load-bearing masonry or in any masonry that will be exposed to the weather.


2119.10 Plain concrete. Plain concrete is concrete cast in place and not reinforced, or reinforced only for shrinkage or change of temperature. Plain concrete shall be mixed, placed and cured as specified for concrete in Chapter 19 (High Velocity Hurricane Zones). The minimum strength of regular concrete shall be not less than 2000 psi (13.8 MPa) in 28 days. The minimum strength of lightweight aggregate concrete shall be not less than 500 psi (3.5 MPa) in 28 days.

2119.11 Plain Gypsum concrete. Plain gypsum concrete is gypsum concrete cast in place and either un reinforced or reinforced for shrinkage.

2119.12 Mortar
2119.12.1 General. Except as otherwise set forth herein, all mortars and the materials therein shall conform to the Standard Specifications for Mortar of Masonry Units, ASTM C 270.

2119.12.1.1 The gradation of aggregates for masonry mortar shall be such that the fineness modulus is between 1.20 and 2.35 when determined in accordance with the Standard Specifications for Aggregate for Masonry Mortar, ASTM C 144.

2119.12.1.2 Aggregates shall be quarried or washed in fresh water and shall contain not more than 1/20 of 1 percent salt by weight.

<table>
<thead>
<tr>
<th>MORTAR STRENGTH PROPERTY SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>M</td>
</tr>
<tr>
<td>S</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>O</td>
</tr>
</tbody>
</table>

2119.12.1.3 Mortar used to bond unit masonry shall be of Type M, S, N or O and shall comply with either the property specifications set forth hereinafter or the proportion specifications of the standard set forth in 2119.12.1.

2119.12.1.4 The type of mortar based on consideration of the location of the unit masonry shall be as follows:

<table>
<thead>
<tr>
<th>Use of location</th>
<th>Type of Mortar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below grade foundations and walls</td>
<td>M</td>
</tr>
<tr>
<td>Swimming pool walls and retaining walls</td>
<td>M</td>
</tr>
<tr>
<td>Fire resistive walls rated 2 hours or more</td>
<td>M or S</td>
</tr>
<tr>
<td>Exterior walls and load bearing walls</td>
<td>M or S</td>
</tr>
<tr>
<td>Piers less than 32 inches wide</td>
<td>M, S or N</td>
</tr>
<tr>
<td>Partitions</td>
<td>One classification less than that above</td>
</tr>
<tr>
<td>Solid masonry units</td>
<td></td>
</tr>
<tr>
<td>Mortar or grout under concentrated loads</td>
<td>M</td>
</tr>
<tr>
<td>Fences</td>
<td>M, S, N or O</td>
</tr>
<tr>
<td>Gypsum</td>
<td>Gypsum</td>
</tr>
</tbody>
</table>

2119.12.1.5 All solid unit masonry shall be laid in full beds with full end joints. All hollow unit masonry shall be laid with full mortar coverage of the face shells in both horizontal and vertical joints.
SECTION 2120
HIGH VELOCITY HURRICANE ZONES
ALLOWABLE UNIT STRESSES IN UNIT MASONRY

2120.1 Compression.
2120.1.1 Allowable working compressive stresses in masonry walls shall not exceed the limits in pounds per square inch (MPa) of gross area in the following table:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Type N or O Mortar</th>
<th>Type M or S Mortar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brick</td>
<td>200 (1.4)</td>
<td>300 (2.1)</td>
</tr>
<tr>
<td>Stone</td>
<td>450 (3.1)</td>
<td>600 (4.1)</td>
</tr>
<tr>
<td>Rubble Stone</td>
<td>200 (1.4)</td>
<td>300 (2.1)</td>
</tr>
<tr>
<td>Concrete Blocks</td>
<td>100 (0.7)</td>
<td>150 (1.0)</td>
</tr>
<tr>
<td>Clay Tile</td>
<td>80 (0.55)</td>
<td>100 (0.7)</td>
</tr>
</tbody>
</table>

2120.1.2 The maximum allowable working stress in plain concrete shall be the following percentage of the ultimate strength of the concrete in compression:

- Compression: 0.20 f’c
- Shear and diagonal tension: 0.02 f’c

Where f’c represents the ultimate compressive strength.

2120.2 The shear in unit masonry shall not exceed 1/10 the allowable compressive stress.

2120.3 Unreinforced unit masonry shall be assumed to have no value in resisting tension.

2120.4 Concentrations. Walls of hollow masonry units shall not directly support concentrated loads.

SECTION 2121
HIGH VELOCITY HURRICANE ZONES
CONSTRUCTION DETAILS

2121.1 General.
2121.1.1 Masonry walls of hollow or solid units or plain concrete shall be constructed as specified in this section.

2121.1.2 Designed reinforced concrete walls, columns and beams shall be as specified in Chapter 19 (High Velocity Hurricane Zones), except that such designed columns and beams shall be not less than the equivalent of the minimums herein set forth.

2121.1.3 Reinforced concrete required in this section shall comply with Chapter 19 (High Velocity Hurricane Zones), Reinforced Concrete.

2121.1.4 Second-hand masonry units shall not be used unless they conform to the requirements of this code, are sound and have been thoroughly cleaned and are approved for use by the building official.

2121.1.5 Bond shall be provided by lapping ends in successive vertical courses.

2121.1.6 Minimum No. 9 gage horizontal joint reinforcing, ladder type for reinforced masonry and truss type for all others shall be provided. This reinforcement shall extend 4 inches (102 mm) into tie columns or be tied to structural columns with approved methods where structural columns replace the tie columns.

2121.2 Exterior walls.
2121.2.1 General
2121.2.1.1 Exterior walls of unit masonry shall have a minimum thickness of 8 inches (203 mm) except as otherwise set forth in 2121.2.11 and in 2119.7.1.4.

2121.2.1.2 No roof or other members shall be placed to develop direct horizontal thrust on walls unless such walls are specifically designed.

2121.2.1.3 The maximum area of wall panels of 8 inch (203 mm) thick unit masonry, as measured between the concrete members which frame the panel such as the beams and tie columns, shall not exceed 240 sq ft (22.3 m²), except as set forth in 2121.2.2.

2121.2.2 Tie columns.
2121.2.2.1 Concrete tie columns shall be required in exterior walls of unit masonry. Concrete tie columns shall be required at all corners, at intervals not to exceed 16 feet (4.9 m) center-to-center of columns, adjacent to any corner opening exceeding 4 feet (1219 mm) in width, and at the ends of free-standing walls exceeding 2 feet (610 mm) in length. When openings exceed 8 feet (2.4 m) in width, tie columns shall be provided on each side of all such openings. All gable and shed end corners shall have tie columns.

2121.2.2.2 When openings are between 3 and 8 feet (914 mm and 2.4 m) in width, such openings shall have one #5 vertical reinforcing bar at each side. The vertical bars shall be placed in concrete filled cells and shall extend into footings and into tie beams. All such bars shall be continuous from footing to tie beam. All splices, where needed, shall be 30 inches (762 mm) minimum.

2121.2.2.3 Tie columns shall be not less than 12 inches (305 mm) in width. Tie columns having an unbraced height not exceeding 15 feet (4.6 m) shall be not less in thickness than the wall or less than a nominal 8 inches (203 mm), and, where exceeding 15 feet (4.6 m) in unbraced height, shall be not less in thickness than 12 inches (305 mm). The unbraced height shall be taken at the point of positive lateral support in the direction of consideration or the column may be designed to resist applicable lateral loads based on rational analysis.

2121.2.2.4 Tie columns shall be reinforced with not less than 4 #5 vertical bars for 8 x 12 inch (203 x 305...
2121.2.3 Tie beams

2121.2.3.1 A tie beam of reinforced concrete shall be placed in all walls of unit masonry, at each floor or roof level, and at such intermediate levels as may be required to limit the vertical heights of the masonry units to 16 feet (4.9 m). Well compacted and confined soil below grade may be considered lateral restraint but only above a point 1 foot (305 mm) below the grade where such restraint begins.

2121.2.3.2 Unless otherwise required by design, all tie beams shall have four #3 ties at 12 inches (305 mm) o.c. at corners and at each bend and at 48 inches (1219 mm) o.c. elsewhere. A tie beam shall not be less in dimension or reinforcing than required for the condition of loading nor less than the following minimums:

A tie beam shall have a width of not less than a nominal 8 inches (203 mm), shall have a height of not less than 12 inches (305 mm) and shall be reinforced with not less than four #5 reinforcing bars placed two at the top and two at the bottom of the beam except that a tie beam using "U" type beam block may be used with the following limitations:

1. Limited to one-story Group R3 occupancy.
2. Limited to unsupported spans of 7 feet (2.1 m).
3. Beam block shall be reinforced with one #7 bar in the top and one #7 bar in the top of the pour.
4. Beam block shall provide not less than 14 inches (356 mm) vertical dimension or less than 4½ inches (114 mm) horizontal dimension of poured-in-place beam cross-section.
5. Where beam blocks are used, consideration of resistance to uplift caused by wind forces shall be based on only that portion of the dead load above the topmost mortar joint in the wall.

2121.2.2.5 The concrete tie columns set forth herein are a minimum to limit masonry panel areas and provide an integrated framework for masonry. The spacing of concrete columns for skeleton frame construction, designed as specified in Chapter 19 (High Velocity Hurricane Zones), may exceed the spacing herein set forth provided the masonry panels have an area less than 240 square feet (22.3 m²) and the structural system is designed to transmit horizontal wind loads to the columns.

2121.2.2.6 Concrete tie columns designed to limit masonry panel areas may be offset at tie beams or other horizontal members to avoid openings, but the maximum spacing shall not be exceeded.

2121.2.2.7 Concrete columns in load-bearing walls shall be poured only after masonry units are in place. Where masonry walls of skeleton frame construction are laid up after the frame has been erected, adequate anchorage designed by a Professional Engineer shall be provided. Where structural steel members are made fire-resistive with masonry units, the panel walls shall be bonded to the fire-resistive materials.

2121.2.2.8 Where the minimum spacing of tie columns, as set forth in 2121.2.2.1, has been satisfied and where structural columns of skeleton frame construction are spaced as specified in 2121.2.2.5, provision for resisting the horizontal and vertical loads at the edges of masonry panels abutting door and window openings in masonry walls where openings are not bounded by such reinforced concrete columns shall be considered and, where necessary, transfer the forces through the materials of assembly to the ground.

2121.2.3 Tie beams

2121.2.3.1 A tie beam of reinforced concrete shall be placed in all walls of unit masonry, at each floor or roof level, and at such intermediate levels as may be required to limit the vertical heights of the masonry units to 16 feet (4.9 m). Well compacted and confined soil below grade may be considered lateral restraint but only above a point 1 foot (305 mm) below the grade where such restraint begins.

2121.2.3.2 Unless otherwise required by design, all tie beams shall have four #3 ties at 12 inches (305 mm) o.c. at corners and at each bend and at 48 inches (1219 mm) o.c. elsewhere. A tie beam shall not be less in dimension or reinforcing than required for the condition of loading nor less than the following minimums:

A tie beam shall have a width of not less than a nominal 8 inches (203 mm), shall have a height of not less than 12 inches (305 mm) and shall be reinforced with not less than four #5 reinforcing bars placed two at the top and two at the bottom of the beam except that a tie beam using "U" type beam block may be used with the following limitations:

1. Limited to one-story Group R3 occupancy.
2. Limited to unsupported spans of 7 feet (2.1 m).
3. Beam block shall be reinforced with one #7 bar in the top and one #7 bar in the top of the pour.
4. Beam block shall provide not less than 14 inches (356 mm) vertical dimension or less than 4½ inches (114 mm) horizontal dimension of poured-in-place beam cross-section.
5. Where beam blocks are used, consideration of resistance to uplift caused by wind forces shall be based on only that portion of the dead load above the topmost mortar joint in the wall.

2121.2.2.5 The concrete tie columns set forth herein are a minimum to limit masonry panel areas and provide an integrated framework for masonry. The spacing of concrete columns for skeleton frame construction, designed as specified in Chapter 19 (High Velocity Hurricane Zones), may exceed the spacing herein set forth provided the masonry panels have an area less than 240 square feet (22.3 m²) and the structural system is designed to transmit horizontal wind loads to the columns.

2121.2.2.6 Concrete tie columns designed to limit masonry panel areas may be offset at tie beams or other horizontal members to avoid openings, but the maximum spacing shall not be exceeded.

2121.2.2.7 Concrete columns in load-bearing walls shall be poured only after masonry units are in place. Where masonry walls of skeleton frame construction are laid up after the frame has been erected, adequate anchorage designed by a Professional Engineer shall be provided. Where structural steel members are made fire-resistive with masonry units, the panel walls shall be bonded to the fire-resistive materials.

2121.2.2.8 Where the minimum spacing of tie columns, as set forth in 2121.2.2.1, has been satisfied and where structural columns of skeleton frame construction are spaced as specified in 2121.2.2.5, provision for resisting the horizontal and vertical loads at the edges of masonry panels abutting door and window openings in masonry walls where openings are not bounded by such reinforced concrete columns shall be considered and, where necessary, transfer the forces through the materials of assembly to the ground.
2121.2.3.8 Tie beams subject to uplift and lateral wind forces shall be sized and designed to resist all such forces. Tie beams over openings shall be sized and designed to resist dead and live loads combined with wind loads, whichever governs.

2121.2.4 Gable end and shed end walls. All masonry structures with gable end and shed end (half gable) walls shall have such end walls constructed of masonry, only in accordance with this section. A horizontal tie beam shall be provided in line with the lower ends of the gables and sheds, except as permitted in 2121.2.3.6 above, and designed in accordance with 2121.2.1.2 and 2121.2.1.3, and load requirements as set forth in Chapter 16 (High Velocity Hurricane Zones). A concrete coping following the rake of the gable, not less than 64 square inches (413 cm$^2$) in area reinforced with two #5 bars shall be provided. Tie columns at gable and shed ends shall be provided. Any intermediate tie columns required within the gable shall extend to the coping beam. Tie beams resting on masonry which are not subject to uplift and lateral wind forces shall be provided according to 2121.2.3.2.

2121.2.5 Parapet walls.
2121.2.5.1 Masonry parapet walls shall be not less than 8 inches (203 mm) thick, shall be reinforced with minimum tie columns and shall be coped with a concrete beam not less than 64 square inches (413 cm$^2$) in cross-section, reinforced with two #4 reinforcing bars.

2121.2.5.2 A parapet wall exceeding 5 feet (1524 mm) in height above a tie beam or other point of lateral support shall be specifically designed to resist horizontal wind loads.

2121.2.6 Piers.
2121.2.6.1 In any section of a masonry wall of an enclosed structure where openings are arranged to leave sections of walls less than 16 inches (406 mm), such sections shall be steel or reinforced concrete.

2121.2.6.2 Isolated masonry piers of unenclosed structures shall be so constructed that the height of such piers shall not exceed 10 times the least dimension, that the cells are filled with cement grout and reinforced with not less than two #5 bars anchoring the beam to the foundation.

2121.2.7 Cavity walls.
2121.2.7.1 Cavity walls consisting of two separate walls with an air space of not less than 2 nor more than 6 inches (51 to 152 mm) may be constructed of solid or hollow-unit masonry provided such walls meet the specific requirements for tie columns and beams set forth in this section and are bonded together at intervals not more than 24 inches (610 mm) apart, vertically and horizontally, by masonry ties or by durable, rigid metal ties 0.10 square inch (64.5 mm$^2$) in cross-section.

2121.2.7.2 The minimum thickness of the separate walls of cavity wall construction shall be 4 inches (102 mm), and units shall be laid in full beds of portland cement mortar with full-end joints.

2121.2.8 Brick and stone walls. Walls of brick and stone shall be laterally supported by tie columns and beams, or the equivalent thereof, as provided in this section and shall meet these additional requirements:
1. In all brick walls at least every 6th course on both sides of the wall shall be a header course or there shall be at least one full header in every 72 square inches (465 cm$^2$) of each wall surface.
2. In walls more than 12 inches (305 mm) thick, the inner joints of header courses shall be covered with another header course that shall break joints with the course below.
3. Solid-unit masonry shall comply with the standard Building Code Requirements for Masonry, ANSI A41.1.
4. Rubble stone walls shall be 4 inches (102 mm) thicker than is required for solid brick or concrete walls of the same respective heights, but in no part less than 16 inches (406 mm).

2121.2.9 Substitutions.
2121.2.9.1 Where, for architectural reasons or otherwise, it is desirable to reduce the area of any required tie column or tie beam below the specified requirements, the building official may grant such reduction, provided that the area of concrete omitted shall be replaced by reinforcing or structural steel in the ratio 1:(n-l) where “n” is defined as the Modular Ratio of Elasticity (Esteel/Econcrete).

2121.2.9.2 Where it is desired to substitute for the #5 reinforcing as required by this section, three #4 bars may be substituted to replace two #5 bars.

2121.2.10 Wall additions. Where new walls are connected to existing walls, such connection shall be by means of a starter column of minimum 8 x 8 inches (203 x 203 mm) dimension reinforced with 2 #5 bars.

2121.2.11 Chases, recesses and openings.
2121.2.11.1 Unit masonry walls required to be a minimum of 8 inches (203 mm) thick, such as exterior walls, fire walls and bearing walls, may be chased or recessed not deeper than one-half the wall thickness for an area not exceeding 8 square feet (0.74 m$^2$), provided the horizontal dimension of the chase or recess does
not exceed 4 feet (1219 mm) and provided the chasing shall not reduce the dimension of tie beams and tie columns to less than herein required, except as follows:

**Exception.** Four-inch (102 mm) deep chases or recesses in 8 inch (703 mm) unit masonry walls may be constructed with 4 inch (102 mm) unit masonry panels provided such 4 inch (102 mm) unit masonry panel does not exceed 5 feet (1524 mm) in width, does not exceed 8 feet (2.4 m) in height, is bonded on one vertical side to 8 inch (203 mm) masonry or a tie column, and is not load bearing. Where such panel exceeds 2 feet (610 mm) in width at locations 20 feet (6.1 m) or more above grade in exterior walls, resistance to wind load shall be considered in the design, and a minimum of 4 × 8 inch (102 × 203 mm) tie column with two #5 vertical bars shall be provided in the free standing end of such 4 inch (102 mm) wall.

2121.2.11.2 Openings shall have lintels of reinforced concrete. Where such lintel is precast or formed separately from a tie beam, it shall bear not less than nominal 8 inches (203 mm) on the masonry, at each end except as may otherwise be approved for compliance with this code by product approval, or after rational analysis, but not less than 4 inches (102 mm). Where such lintel is formed integrally with the tie beam by deepening the tie beam above the opening, and the tie beam itself is capable of safely supporting all loads, the beam may span up to 6 feet (1.8 m) in length and may be deepened not to exceed 8 inches (203 mm) without additional reinforcing. Where the tie beam is deepened in excess of 8 inches (203 mm) with a span less than 6 feet (1.8 m) in length, and the tie beam itself is capable of supporting all loads, the dropped portion shall contain a #3 horizontal bar at the bottom, bent up at each end and fastened to the upper tie beam steel or two #4 horizontal bars. The dropped portion shall bear at least 4 inches (102 mm) on the masonry at each end. Where the span is in excess of 6 feet (1.8 m), the principal beam reinforcing shall be at the bottom of the beam.

2121.2.12 Glass block.

2121.2.12.1 Masonry of glass blocks may be used in non-load-bearing exterior or interior walls and in openings which might otherwise be filled with windows, either isolated or in continuous bands, provided the glass block panels have a thickness of not less than 31/2 inches (89 mm) at the mortar joint and the mortared surfaces of the blocks are satisfactorily treated for mortar bonding.

2121.2.12.2 Glass block panel for exterior walls shall have a Product Approval, NOA.

2121.2.12.3 Exterior glass-block panels shall be set in recesses at the jambs and, for panels exceeding 10 feet (3 m) in horizontal dimension between supports, at the head as well, to provide a bearing surface at least 1 inch (25 mm) wide along the panel edges, except that when approved by the building official for panels exceeding neither 100 square feet (9.3 m²) in area nor 10 feet (3 m) in either horizontal or vertical dimension, and situated four stories or less, and less than 52 feet (15.8 m) above grade level, anchorage may be provided by means of non-corrodible perforated metal strips.

2121.2.12.4 Glass-block panels shall have reinforcement in the mortar joints spaced not more than 2 feet (610 mm) apart vertically and below and above any openings within a pane. The reinforcement shall consist of 2 parallel longitudinal galvanized steel wires, No. 9 gage or larger, spaced 2 inches (51 mm) apart, and welded to No. 14 or heavier cross wires at intervals not exceeding 8 inches (203 mm), or the equivalent approved by the building official.

2121.2.12.5 Glass block shall be laid in only Type M or S mortar or equivalent approved material. Both vertical and horizontal mortar joints shall be at least 1/4 inch (6 mm) and not more than 3/8 inch (9.5 mm) thick and shall be completely filled.

2121.2.12.6 Every exterior glass block panel shall be provided with expansion joints at the sides and top. Expansion joints shall be entirely free of mortar, and shall be filled with resilient material.

2121.2.12.7 View panels in 1 hour fire resistant walls shall be limited to glass block panels installed in steel channels, or panel anchor framing may be used where a 1/2-hour fire rating is required. Three and seven-eighths inch (98 mm) thick glass block shall be limited to 120 square feet (1.1 m²) with no dimension greater than 12 feet (3.7 m) for masonry wall construction or to 94 square feet (8.7 m²) with no dimension greater than 10.75 ft (3.3 m) for non-masonry wall construction. Three and one-eighths inch (79 mm) thick glass block shall be limited to 100 square feet (9.3 m²) with no dimension greater than 10 feet (3 m) for masonry wall construction or to 94 square feet (8.7 m²) with no dimension greater than 10.75 ft (3.3 m) for non-masonry wall construction. Three inch (76 mm) thick glass block shall be limited to 100 square feet (9.3 m²) with no dimension greater than 12 feet (3.7 m) for masonry wall construction or to 94 square feet (8.7 m²) with no dimension greater than 10 feet (3 m) for non-masonry wall construction.

View panels in 2-hour fire resistant walls shall be limited to glass blocks installed in steel channels and with a water curtain in conformance with NFPA 13 on each side at interior walls or at the interior of exterior walls. Three and seven-eighths inch (98 mm) thick glass block shall be limited to 100 square feet (9.3 m²) with no dimension greater than 10 feet (3 m) for non-masonry wall construction.

The view panel assembly shall not exceed 25 percent of the wall separating a tenancy from a corridor or a corridor from an enclosed vertical opening or one fire rated area from another fire rated area.
Maximum 3/4 hour fire rated glass block construction shall be used at non-masonry wall construction. Panel anchors shall be provided at sill and jambs in non-masonry wall construction using panel anchor framing. A fire retardant sealant shall be used at all channel and panel anchor framing. Expansion material at heads and jambs shall be either fibrous glass or mineral wool. All fire rated glass block and panels shall conform to UL No. 9 and ASTM E163.

2121.2.12.8 Interior glass block panels having thickness of 3/8 inches (98 mm) shall not exceed 250 square feet (23.2 m²) of unsupported wall surface and interior glass block panels having thickness of 3/8 inches (79 mm) shall not exceed 150 square feet (13.9 m²) of unsupported wall surface nor more than 25 feet (7.6 m) in length nor more than 20 feet (6.1 m) in height between supports.

2121.2.13 Grill block

2121.2.13.1 Decorative grills or screens constructed of unit masonry laid with cells open through the wall shall be as set forth herein or designs shall be based on rational analysis to resist applicable loads and computations shall be submitted to the building official for approval.

2121.2.13.2 Unit masonry grills or screens as described in this paragraph shall not be load bearing.

2121.2.13.3 Unit masonry in exterior wall shall be laid in Type M or S mortar.

2121.3 Interior bearing walls. Interior-bearing walls shall be constructed as specified in 2121.2 for exterior walls, except that interior bearing walls in one-story building of Group II or I Occupancy, where not required to be more than 1-hour fire-resistive, may be constructed of 4 inch (162 mm) concrete block not exceeding 9 feet (2.7 m) in height, capped with a reinforced concrete beam not less than 4 inches (102 mm) in width nor less than 12 inches (305 mm) in height, reinforced with two 1/2 inch rods (12.7 mm), and such walls shall support only a roof or ceiling not in excess of 700 pounds per lineal foot (10.2 kN/m) with no chases or recesses.

2121.4 Fire walls. Firewalls shall be constructed as set forth in 2121.2 for exterior walls.

2121.5 Panel walls.

2121.5.1 Panel walls of unit-masonry shall be not less than 8 inches (203 mm) thick and shall be limited in panel dimension as set forth in 2121.2.

2121.5.2 Panel walls of reinforced concrete shall be not less than 4 inches (102 mm) thick nor less than required by design as specified in Chapter 19 (High Velocity Hurricane Zones).

2121.6 Veneered walls

2121.6.1 Masonry backing

2121.6.1.1 Veneering or facing on masonry backing shall not be considered as adding any strength to such walls and shall be limited in height above foundations or between proper and adequate supports to 30 feet (9.1 m). Veneering shall be securely anchored to masonry backing by means of substantial, noncorroding metal wall ties, spaced not farther apart than 16 inches (406 mm) vertically or 24 inches (610 mm) horizontally.

2121.6.1.2 Tile veneering, not more than 1 inch (25 mm) thick with individual units not exceeding 20 inches (508 mm) in any dimension and having not more than 200 square inches (1290 cm²) of surface area with corrugations or scoring on the back side thereof, need not be anchored in accordance with the above requirements but shall be cementsed solid to the backing with Portland cement mortar so as to provide a continuous integral support to the backing.

2121.6.2 Wood backing

2121.6.2.1 In all cases, before applying masonry veneer, a substantial waterproofed paper or asphalt-saturated felt, weighing not less than 14 pounds per 100 square feet (0.68 kg/m²) shall be applied horizontally, shingle fashion, over diagonal sheathing. Horizontal joints in the paper or felt shall be lapped not less than 4 inches (102 mm) and vertical end joints not less than 6 inches (152 mm).

2121.6.2.2 Masonry veneer shall be not less than 3/4 inches (95 mm) thick and shall be bonded to the backing by means of substantial noncorroding metal wall ties spaced not farther apart than 16 inches (406 mm) vertically and 24 inches (610 mm) horizontally.

2121.7 Partitions

2121.7.1 The requirements specified herein shall apply to non-bearing interior separations, other than firewalls, of unit masonry construction.

2121.7.2 The lateral distance between vertical supports of non-bearing interior partitions of unit-masonry shall not exceed 72 times the actual thickness of the partition, including plaster.

2121.7.3 The height of unit masonry partitions shall not exceed 36 times the actual thickness, including plaster.

2121.7.4 All interior unit masonry partitions shall be designed to meet the lateral live load requirements with corresponding perimeter anchorage supports, in accordance with 1617.8.

2121.8 Fences

2121.8.1 Masonry fences so located on a property that such fence, at the proposed height or by a future addition to height, could be used as a wall of a building shall be constructed with foundations and tie columns as provided
for an exterior wall. Such fence shall be capped with a coping beam not less than 64 square inches (413 cm$^2$) in cross-section reinforced with a minimum of two #4 rods, when not exceeding a height of 5 feet (1.5 m), or shall be capped by a tie beam as provided for exterior walls if exceeding a height of 5 feet (1.5 m).

2121.8.2 Masonry fences, so located on a property that by zoning regulation such fence could not be used as a wall of a building, shall be constructed as follows:

2121.8.2.1 Fences not exceeding 5 feet (1.5 m) in height shall be 8 inches (203 mm) thick and shall not be required to have tie columns, but shall be required to have a coping as provided herein; or such fences may be 4 inches (102 mm) thick with tie columns and coping not less than 8 inches (203 mm) thick.

2121.8.2.2 Fences exceeding 5 feet (1.5 m) in height shall be not less than 8 inches (203 mm) thick and shall have tie columns and tie beams as required for exterior walls.

2121.9 Other masonry walls. Walls of masonry materials or arrangements of masonry units other than those specifically set forth in this chapter shall be in conformance with the general provisions of this code, may be classified by the subject to all or any of the requirements therefor to and any such additional requirements as the building official may prescribe.

SECTION 2122
HIGH VELOCITY HURRICANE ZONES
REINFORCED UNIT MASONRY

2122.1 Standards. The provisions of ACI 530-95/ASCE 5-95, Building Code Requirements For Masonry Structures, and the commentary on Building Code Requirements for Masonry Structures, are hereby adopted as a minimum; however, the requirement of the standard shall not supersede the specific requirements of this chapter.

2122.2 General.
2122.2.1 Tie columns and tie beams as set forth in 2121.2 shall be not required where design and construction are in accordance with the provisions of this section.

2122.2.2 Reinforced unit masonry shall be steel reinforced solid-unit masonry or steel reinforced grouted hollow-unit masonry as set forth herein.

2122.3 The design of buildings and structures of reinforced unit masonry shall be by a Professional Engineer or Registered Architect.

2122.4 Special inspector. A Florida Registered Architect or Professional Engineer shall furnish inspection of all reinforced masonry structures.

2122.5 Concrete masonry strength
2122.5.1 In each test of 3 prisms, the average of the three may be used as the assumed value of $f'_{m}$.

2122.5.2 In no case shall the value of $f'_{m}$ exceed the lowest break multiplied by 1.25 in any test.

2122.6 Reinforced masonry columns and walls
2122.6.1 The minimum length of lap for deformed bars in grout, in tension or compression, shall be 48 bar diameters, but not less than 12 inches (305 mm).

2122.6.2 Concentrated loads shall not be assumed distributed across continuous vertical joints, including stack bond joints, unless reinforcing elements are designed and provided to distribute such loads.

2122.6.3 Reinforced masonry bearing walls shall have a nominal thickness of at least 1/30 of the unsupported height or width, whichever is the shorter, but not less than 8 inches (203 mm).

2122.6.4 Anchorage requirements
2122.6.4.1 Reinforced masonry walls shall be securely anchored to adjacent structural members such as roofs, floors, columns, pilasters, buttresses and intersection walls.

2122.6.4.2 Masonry walls shall be anchored to all floors and roofs that provide lateral support to such walls.

2122.6.4.3 Such anchorage shall provide a positive direct connection capable of resisting the horizontal forces as required in Chapter 16 (High Velocity Hurricane Zones), or a minimum force of 200 pounds per lineal foot (2919 N/m) of wall, whichever is greater.

2122.6.4.4 Required anchors shall be embedded in reinforced grouted cells.

2122.6.4.5 Wood framing connected by nails shall not be considered as acceptable anchorage.

2122.6.5 Mortar and grout
2122.6.5.1 Vertical cells to be grouted shall provided vertical alignment sufficient to maintain clear, unobstructed, continuous, vertical cores measuring not less than 2 x 3 inches (51 x 76 mm).

2122.6.5.2 Vertical grout barriers or dams of solid masonry spaced not more than 25 feet (7.6 m) apart shall be provided across the grout space in the entire height of the wall to control the flow of grout horizontally.

2122.6.5.3 Grout shall be a plastic mix having a maximum slump of 9 inches ± 1 inch (229 ± 25 mm).
2122.6.5.4 Grout shall be placed before any initial set has occurred, but in no case more than 1½ hours after the mix-designed water has been added.

2122.6.5.5 Grouting shall be a continuous operation in lifts not exceeding 4 feet (1.2 m) and a maximum pour of 12 feet (23.7 m).

2122.6.5.6 Grouting shall be consolidated between lifts by puddling, rodding or mechanical vibration.

2122.6.5.7 The grouting of any section of wall between control barriers shall be completed in one operation with no interruptions exceeding 1 hour.

2122.6.6 Bearing. Precast floor and roof units supported on masonry walls shall provide minimum bearing of 3 inches (76 mm) and anchorage in accordance with 2122.6.4.

2122.6.7 Protection of masonry. Unfinished work shall be stopped back for joining with new work; tothing being permitted only with the approval of the special inspector.