

CHAPTER 21

MASONRY

SECTION 2101 GENERAL

2101.1 Scope. 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 Sections 2103 through 2105, 2107, 2108, 2110, 2114 and Sections 2119 through 2122.

2101.2 Design methods. Masonry shall comply with the provisions of TMS 402, TMS 403 or TMS 404 as well as applicable requirements of this chapter.

2101.2.1 Masonry veneer. Masonry veneer shall comply with the provisions of Chapter 14.

2101.3 Special inspection. Reserved.

SECTION 2102 DEFINITIONS AND NOTATIONS

2102.1 General. The following terms are defined in Chapter 2:

AAC MASONRY.

ADOBE CONSTRUCTION.

Adobe, stabilized.

Adobe, unstabilized.

AREA.

Gross cross-sectional.

Net cross-sectional.

AUTOCLAVED AERATED CONCRETE (AAC).

BED JOINT.

BRICK.

Calcium silicate (sand lime brick).

Clay or shale.

Concrete.

CAST STONE.

CELL.

CHIMNEY.

CHIMNEY TYPES.

High-heat appliance type.

Low-heat appliance type.

Masonry type.

Medium-heat appliance type.

COLLAR JOINT.

DIMENSIONS.

Nominal.

Specified.

FIREPLACE.

FIREPLACE THROAT.

FOUNDATION PIER.

HEAD JOINT.

MASONRY.

Glass unit masonry.

Plain masonry.

Reinforced masonry.

Solid masonry.

Unreinforced (plain) masonry.

MASONRY UNIT.

Hollow.

Solid.

MORTAR.

MORTAR, SURFACE-BONDING.

PRESTRESSED MASONRY.

RUNNING BOND.

SPECIFIED COMPRESSIVE STRENGTH OF MASONRY, f'_m .

STONE MASONRY.

STRENGTH.

Design strength.

Nominal strength.

Required strength.

TIE, WALL.

TILE, STRUCTURAL CLAY.

WALL.

Cavity wall.

Dry-stacked, surface-bonded wall.

Parapet wall.

WYTHER.

NOTATIONS.

d_b = Diameter of reinforcement, inches (mm).

F_s = Allowable tensile or compressive stress in reinforcement, psi (MPa).

f_r = Modulus of rupture, psi (MPa).

f'_{AAC} = Specified compressive strength of AAC masonry, the minimum compressive strength for a class of AAC masonry as specified in ASTM C1386, psi (MPa).

f'_m = Specified compressive strength of masonry at age of 28 days, psi (MPa).

MASONRY

f'_{mi} = Specified compressive strength of masonry at the time of prestress transfer, psi (MPa).

K = The lesser of the masonry cover, clear spacing between adjacent reinforcement, or five times d_b , inches (mm).

L_s = Distance between supports, inches (mm).

l_d = Required development length or lap length of reinforcement, inches (mm).

P = The applied load at failure, pounds (N).

S_t = Thickness of the test specimen measured parallel to the direction of load, inches (mm).

S_w = Width of the test specimen measured parallel to the loading cylinder, inches (mm).

SECTION 2103

MASONRY CONSTRUCTION MATERIALS

2103.1 Masonry units. Concrete masonry units, clay or shale masonry units, stone masonry units, glass unit masonry and AAC masonry units shall comply with Article 2.3 of TMS 602. Architectural cast stone shall conform to ASTM C1364 and TMS 504. Adhered manufactured stone masonry veneer units shall conform to ASTM C1670.

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 ASTM E119 or UL 263 and shall comply with the requirements of Table 602.

2103.1.1 Second-hand units. Second-hand masonry units shall not be reused unless they conform to the requirements of new units. The units shall be of whole, sound materials and free from cracks and other defects that will interfere with proper laying or use. Old mortar shall be cleaned from the unit before reuse.

2103.2 Mortar. Mortar for masonry construction shall comply with Section 2103.2.1, 2103.2.2, 2103.2.3 or 2103.2.4.

2103.2.1 Masonry mortar. Mortar for use in masonry construction shall conform to Articles 2.1 and 2.6 A of TMS 602.

2103.2.2 Surface-bonding mortar. Surface-bonding mortar shall comply with ASTM C887. Surface bonding of concrete masonry units shall comply with ASTM C946.

2103.2.3 Mortars for ceramic wall and floor tile. Portland cement mortars for installing ceramic wall and floor tile shall comply with ANSI A108.1A and ANSI A108.1B and be of the compositions indicated in Table 2103.2.3.

**TABLE 2103.2.3
CERAMIC TILE MORTAR COMPOSITIONS**

LOCATION	MORTAR	COMPOSITION
Walls	Scratchcoat	1 cement; $\frac{1}{5}$ hydrated lime; 4 dry or 5 damp sand
	Setting bed and leveling coat	1 cement; $\frac{1}{2}$ hydrated lime; 5 damp sand to 1 cement 1 hydrated lime, 7 damp sand
Floors	Setting bed	1 cement; $\frac{1}{10}$ hydrated lime; 5 dry or 6 damp sand; or 1 cement; 5 dry or 6 damp sand
Ceilings	Scratchcoat and sand bed	1 cement; $\frac{1}{2}$ hydrated lime; $2\frac{1}{2}$ dry sand or 3 damp sand

2103.2.3.1 Dry-set Portland cement mortars. Pre-mixed prepared Portland cement mortars, which require only the addition of water and are used in the installation of ceramic tile, shall comply with ANSI A118.1. The shear bond strength for tile set in such mortar shall be as required in accordance with ANSI A118.1. Tile set in dry-set Portland cement mortar shall be installed in accordance with ANSI A108.5.

2103.2.3.2 Latex-modified Portland cement mortar. Latex-modified Portland cement thin-set mortars in which latex is added to dry-set mortar as a replacement for all or part of the gauging water that are used for the installation of ceramic tile shall comply with ANSI A118.4. Tile set in latex-modified Portland cement shall be installed in accordance with ANSI A108.5.

2103.2.3.3 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.

2103.2.3.4 Furan mortar and grout. Chemical-resistant furan mortar and grout that are used to install ceramic tile shall comply with ANSI A118.5. Tile set and grouted with furan shall be installed in accordance with ANSI A108.8.

2103.2.3.5 Modified epoxy-emulsion mortar and grout. Modified epoxy-emulsion mortar and grout that are used to install ceramic tile shall comply with ANSI A118.8. Tile set and grouted with modified epoxy-emulsion mortar and grout shall be installed in accordance with ANSI A108.9.

2103.2.3.6 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 be not less than 40 psi (275 kPa) for Type I adhesive and not less than 20 psi (138 kPa) for Type II adhesive when tested in accordance

with ANSI A136.1. Tile set in organic adhesives shall be installed in accordance with ANSI A108.4.

2103.2.3.7 Portland cement grouts. Portland cement grouts used for the installation of ceramic tile shall comply with ANSI A118.6. Portland cement grouts for tile work shall be installed in accordance with ANSI A108.10.

2103.2.4 Mortar for adhered masonry veneer. Mortar for use with adhered masonry veneer shall conform to ASTM C270 for Type N or S, or shall comply with ANSI A118.4 for latex-modified Portland cement mortar.

2103.3 Grout. Grout shall comply with Article 2.2 of TMS 602.

2103.4 Metal reinforcement and accessories. Metal reinforcement and accessories shall conform to Article 2.4 of TMS 602. Where provided in exterior walls, joint reinforcement shall be a minimum No. 9-gauge ladder-type stainless steel, hot dipped galvanized, or epoxy coated in accordance with TMS 602 Section 2.4E1, 2.4F1b, or 2.4F2a as appropriate. 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.

SECTION 2104 CONSTRUCTION

2104.1 Masonry construction. Masonry construction shall comply with the requirements of Sections 2104.1.1 and 2104.1.2 and with the requirements of either TMS 602 or TMS 604.

2104.1.1 Support on wood. Masonry shall not be supported on wood girders or other forms of wood construction except as permitted in Section 2304.12.

2104.1.2 Molded cornices. Unless structural support and anchorage are provided to resist the overturning moment, the center of gravity of projecting masonry or molded cornices shall lie within the middle 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.

SECTION 2105 QUALITY ASSURANCE

2105.1 General. A quality assurance program shall be used to ensure that the constructed masonry is in compliance with the *approved construction documents*.

The quality assurance program shall comply with the inspection and testing requirements of TMS 602.

Exception: Unless otherwise specified by the designing architect or engineer, where plan review and inspections are performed by a local building department in accordance with Sections 107 and 110, the quality assurance program of TMS 402 and TMS 602 shall not apply.

SECTION 2106 SEISMIC DESIGN

2106.1 Seismic design requirements for masonry. Masonry structures and components shall comply with the requirements in Chapter 7 of TMS 402 depending on the structure's *seismic design category*.

SECTION 2107 ALLOWABLE STRESS DESIGN

2107.1 General. The design of masonry structures using *allowable stress design* shall comply with Section 2106 and the requirements of Chapters 1 through 8 of TMS 402 except as modified by Sections 2107.2 through 2107.5.

Exception: Where plan review and inspections are performed by a local building department in accordance with Sections 107 and 110, the provisions of TMS 402, Chapter 3 Section 3.1 and TMS 602 Sections 1.5 and 1.6 shall not apply unless specified by the architect or engineer, or the building official.

2107.2 TMS 402, Section 6.1.6.1.1, lap splices. As an alternative to Section 6.1.6.1.1, it shall be permitted to design lap splices in accordance with Section 2107.2.1.

2107.2.1 Lap splices. The minimum length of lap splices for reinforcing bars in tension or compression, l_d , shall be

$$l_d = 0.002d_b f_s \quad (\text{Equation 21-1})$$

For SI: $l_d = 0.29d_b f_s$

but not less than 12 inches (305 mm). In no case shall the length of the lapped splice be less than 40 bar diameters.

where:

d_b = Diameter of reinforcement, inches (mm).

f_s = Computed stress in reinforcement due to design loads, psi (MPa).

In regions of moment where the design tensile stresses in the reinforcement are greater than 80 percent of the allowable steel tension stress, F_s , the lap length of splices shall be increased not less than 50 percent of the minimum required length, but need not be greater than $72 d_b$. Other equivalent means of stress transfer to accomplish the same 50 percent increase shall be permitted. Where epoxy coated bars are used, lap length shall be increased by 50 percent.

2107.3 TMS 402, Section 6.1.6.1, splices of reinforcement. Modify Section 6.1.6.1 as follows:

6.1.6.1 – Splices of reinforcement. Lap splices, welded splices or mechanical splices are permitted in accordance with the provisions of this section. All welding shall conform to AWS D1.4. Welded splices shall be of ASTM A706 steel reinforcement. Reinforcement larger than No. 9 (M#29) shall be spliced using mechanical connections in accordance with Section 6.1.6.1.3.

2107.4 Reserved.

2107.5 TMS 402, Section 5.4 Pilasters. Modify Section 5.4 as follows:

MASONRY

5.4 — Pilasters

5.4.3 Where vertical pilaster reinforcement is not provided to resist axial compressive stress, lateral ties are not required.

2107.6 TMS 402, Section 6.1.5.1.1 Development of bar reinforcement in tension or compression. Modify Section 6.1.5.1.1 as follows:

6.1.5.1.1 The required development length of reinforcing bars shall be determined by Equation (6-1), but shall not be less than 12 inches (305 mm) or $40 d_b$ and need not be greater than $72 d_b$.

Equation 6-1, including the notations from TMS 402, is unchanged. Gamma factors are changed as follows:

$\gamma = 1.0$ for No. 3 (M#10) through No. 5 (M#16) bars

$\gamma = 1.04$ for No. 6 (M#19) through No. 7 (M#22) bars

$\gamma = 1.2$ for No. 8 (M#25) through No. 11 (M#36) bars

SECTION 2108 STRENGTH DESIGN OF MASONRY

2108.1 General. The design of masonry structures using strength design shall comply with Section 2106 and the requirements of Chapters 1 through 7 and Chapter 9 of TMS 402, except as modified by Sections 2108.2 through 2108.4.

Exceptions:

1. AAC masonry shall comply with the requirements of Chapters 1 through 7 and Chapter 11 of TMS 402.
2. Where plan review and inspections are performed by a local building department in accordance with Sections 107 and 110, the provisions of TMS 402, Chapter 3, Section 3.1 and TMS 602 Sections 1.5 and 1.6 shall not apply unless specified by the architect or engineer.

2108.2 Reserved.

2108.3 Reserved.

2108.4 TMS 402, Section 6.1.5.1.1 Development of bar reinforcement in tension or compression. Modify Section 6.1.5.1.1 as follows:

6.1.5.1.1 The required development length of reinforcing bars shall be determined by Equation (6-1), but shall not be less than 12 inches or $40 d_b$ and need not be greater than $72 d_b$.

Equation 6-1, including the notations from TMS 402, is unchanged. Gamma factors are changed as follows:

$\gamma = 1.0$ for No. 3 (M#10) through No. 5 (M#16) bars

$\gamma = 1.04$ for No. 6 (M#19) through No. 7 (M#22) bars

$\gamma = 1.2$ for No. 8 (M#25) through No. 11 (M#36) bars

SECTION 2109 DRY-STACK MASONRY

2109.1 General. The design of dry-stack masonry structures shall comply with the requirements of Chapters 1 through 8

of TMS 402 except as modified by Sections 2109.2 through 2109.5.

2109.2 Limitations. Dry-stack masonry shall be prohibited in Risk Category IV structures.

2109.3 Materials. Concrete masonry units complying with ASTM C90 shall be used.

2109.4 Strength. Dry-stack masonry shall be of adequate strength and proportions to support all superimposed loads without exceeding the allowable stresses listed in Table 2109.4. Allowable stresses not specified in Table 2109.4 shall comply with the requirements of Chapter 8 of TMS 402.

**TABLE 2109.4
GROSS CROSS-SECTIONAL AREA ALLOWABLE
STRESS FOR DRY-STACK MASONRY**

DESCRIPTION	MAXIMUM ALLOWABLE STRESS (psi)
Compression	45
Flexural tension	
Horizontal span	30
Vertical span	18
Shear	10

For SI: 1 pound per square inch = 0.006895 MPa.

2109.5 Construction. Construction of dry-stack masonry shall comply with ASTM C946.

SECTION 2110 GLASS UNIT MASONRY

2110.1 General. Glass unit masonry construction shall comply with Chapter 13 of TMS 402 and this section.

2110.1.1 Limitations. Solid or hollow *approved* glass block shall not be used in fire walls, party walls, fire barriers, fire partitions or smoke barriers, or for load-bearing construction. Such blocks shall be erected with mortar and reinforcement in metal channel-type frames, structural frames, masonry or concrete recesses, embedded panel anchors as provided for both exterior and interior walls or other *approved* joint materials. Wood strip framing shall not be used in walls required to have a fire-resistance rating by other provisions of this code.

Exceptions:

1. Glass-block assemblies having a fire protection rating of not less than $\frac{3}{4}$ hour shall be permitted as opening protectives in accordance with Section 716 in fire barriers, fire partitions and smoke barriers that have a required fire-resistance rating of 1 hour or less and do not enclose exit stairways and ramps or exit passageways.
2. Glass-block assemblies as permitted in Section 404.6, Exception 2.

SECTION 2111 MASONRY FIREPLACES

2111.1 General. The construction of masonry fireplaces, consisting of concrete or masonry, shall be in accordance with this section.

2111.2 Fireplace drawings. The *construction documents* shall describe in sufficient detail the location, size and construction of masonry fireplaces. The thickness and characteristics of materials and the clearances from walls, partitions and ceilings shall be indicated.

2111.3 Footings and foundations. Footings for masonry fireplaces and their chimneys shall be constructed of concrete or solid masonry at least 12 inches (305 mm) thick and shall extend at least 6 inches (153 mm) beyond the face of the fireplace or foundation wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth. In areas not subjected to freezing, footings shall be at least 12 inches (305 mm) below finished grade.

2111.3.1 Ash dump cleanout. Cleanout openings, located within foundation walls below fireboxes, when provided, shall be equipped with ferrous metal or masonry doors and frames constructed to remain tightly closed, except when in use. Cleanouts shall be accessible and located so that ash removal will not create a hazard to combustible materials.

2111.4 Seismic reinforcement. In structures assigned to *Seismic Design Category A* or *B*, seismic reinforcement is not required. In structures assigned to *Seismic Design Category C* or *D*, masonry fireplaces shall be reinforced and anchored in accordance with Sections 2111.4.1, 2111.4.2 and 2111.5. In structures assigned to *Seismic Design Category E* or *F*, masonry fireplaces shall be reinforced in accordance with the requirements of Sections 2101 through 2108.

2111.4.1 Vertical reinforcing. For fireplaces with chimneys up to 40 inches (1016 mm) wide, four No. 4 continuous vertical bars, anchored in the foundation, shall be placed in the concrete between wythes of solid masonry or within the cells of hollow unit masonry and grouted in accordance with Section 2103.3. For fireplaces with chimneys greater than 40 inches (1016 mm) wide, two additional No. 4 vertical bars shall be provided for each additional 40 inches (1016 mm) in width or fraction thereof.

2111.4.2 Horizontal reinforcing. Vertical reinforcement shall be placed enclosed within $\frac{1}{4}$ -inch (6.4 mm) ties or other reinforcing of equivalent net cross-sectional area, spaced not to exceed 18 inches (457 mm) on center in concrete; or placed in the bed joints of unit masonry at a minimum of every 18 inches (457 mm) of vertical height. Two such ties shall be provided at each bend in the vertical bars.

2111.5 Seismic anchorage. Masonry fireplaces and foundations shall be anchored at each floor, ceiling or roof line more than 6 feet (1829 mm) above grade with two $\frac{3}{16}$ -inch by 1-inch (4.8 mm by 25 mm) straps embedded a minimum of 12 inches (305 mm) into the chimney. Straps shall be hooked around the outer bars and extend 6 inches (152 mm) beyond the bend. Each strap shall be fastened to a minimum of four floor joists with two $\frac{1}{2}$ -inch (12.7 mm) bolts.

Exception: Seismic anchorage is not required for the following:

1. In structures assigned to *Seismic Design Category A* or *B*.
2. Where the masonry fireplace is constructed completely within the exterior walls.

2111.6 Firebox walls. Masonry fireboxes shall be constructed of solid masonry units, hollow masonry units grouted solid, stone or concrete. When a lining of firebrick at least 2 inches (51 mm) in thickness or other *approved* lining is provided, the minimum thickness of back and sidewalls shall each be 8 inches (203 mm) of solid masonry, including the lining. The width of joints between firebricks shall be not greater than $\frac{1}{4}$ inch (6.4 mm). When no lining is provided, the total minimum thickness of back and sidewalls shall be 10 inches (254 mm) of solid masonry. Firebrick shall conform to ASTM C27 or ASTM C1261 and shall be laid with medium-duty refractory mortar conforming to ASTM C199.

2111.6.1 Steel fireplace units. Steel fireplace units are permitted to be installed with solid masonry to form a masonry fireplace provided they are installed according to either the requirements of their listing or the requirements of this section. Steel fireplace units incorporating a steel firebox lining shall be constructed with steel not less than $\frac{1}{4}$ inch (6.4 mm) in thickness, and an air-circulating chamber which is ducted to the interior of the building. The firebox lining shall be encased with solid masonry to provide a total thickness at the back and sides of not less than 8 inches (203 mm), of which not less than 4 inches (102 mm) shall be of solid masonry or concrete. Circulating air ducts employed with steel fireplace units shall be constructed of metal or masonry.

2111.7 Firebox dimensions. The firebox of a concrete or masonry fireplace shall have a minimum depth of 20 inches (508 mm). The throat shall be not less than 8 inches (203 mm) above the fireplace opening. The throat opening shall not be less than 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 that the depth of the fireplace is not less than 12 inches (305 mm) and at least one-third of the width of the fireplace opening, and the throat is not less than 12 inches (305 mm) above the lintel, and at least $\frac{1}{20}$ the cross-sectional area of the fireplace opening.

2111.8 Lintel and throat. Masonry over a fireplace opening shall be supported by a lintel of noncombustible material. The minimum required bearing length on each end of the fireplace opening shall be 4 inches (102 mm). The fireplace throat or damper shall be located not less than 8 inches (203 mm) above the top of the fireplace opening.

2111.8.1 Damper. Masonry fireplaces shall be equipped with a ferrous metal damper located not less than 8 inches (203 mm) above the top of the fireplace opening. Dampers shall be installed in the fireplace or at the top of the flue venting the fireplace, and shall be operable from the room containing the fireplace. Damper controls shall be permitted to be located in the fireplace.

MASONRY

2111.9 Smoke chamber walls. Smoke chamber walls shall be constructed of solid masonry units, hollow masonry units grouted solid, stone or concrete. The total minimum thickness of front, back and sidewalls shall be 8 inches (203 mm) of solid masonry. The inside surface shall be parged smooth with refractory mortar conforming to ASTM C199. When a lining of firebrick not less than 2 inches (51 mm) thick, or a lining of vitrified clay not less than $\frac{5}{8}$ inch (15.9 mm) thick, is provided, the total minimum thickness of front, back and sidewalls shall be 6 inches (152 mm) of solid masonry, including the lining. Firebrick shall conform to ASTM C1261 and shall be laid with refractory mortar conforming to ASTM C199. Vitrified clay linings shall conform to ASTM C315.

2111.9.1 Smoke chamber dimensions. The inside height of the smoke chamber from the fireplace throat to the beginning of the flue shall be not greater than the inside width of the fireplace opening. The inside surface of the smoke chamber shall not be inclined more than 45 degrees (0.76 rad) from vertical when prefabricated smoke chamber linings are used or when the smoke chamber walls are rolled or sloped rather than corbeled. When the inside surface of the smoke chamber is formed by corbeled masonry, the walls shall not be corbeled more than 30 degrees (0.52 rad) from vertical.

2111.10 Hearth and hearth extension. Masonry fireplace hearths and hearth extensions shall be constructed of concrete or masonry, supported by noncombustible materials, and reinforced to carry their own weight and all imposed loads. No combustible material shall remain against the underside of hearths or hearth extensions after construction.

2111.10.1 Hearth thickness. The minimum thickness of fireplace hearths shall be 4 inches (102 mm).

2111.10.2 Hearth extension thickness. The minimum thickness of hearth extensions shall be 2 inches (51 mm).

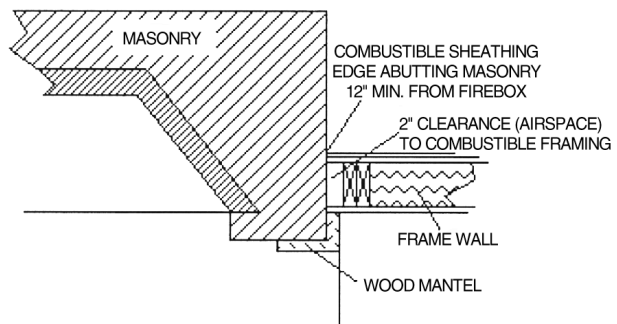
Exception: When the bottom of the firebox opening is raised not less than 8 inches (203 mm) above the top of the hearth extension, a hearth extension of not less than $\frac{3}{8}$ -inch-thick (9.5 mm) brick, concrete, stone, tile or other *approved* noncombustible material is permitted.

2111.11 Hearth extension dimensions. Hearth extensions shall extend not less than 16 inches (406 mm) in front of, and not less than 8 inches (203 mm) beyond, each side of the fireplace opening. Where the fireplace opening is 6 square feet (0.557 m²) or larger, the hearth extension shall extend not less than 20 inches (508 mm) in front of, and not less than 12 inches (305 mm) beyond, each side of the fireplace opening.

2111.12 Fireplace clearance. Any portion of a masonry fireplace located in the interior of a building or within the *exterior wall* of a building shall have a clearance to combustibles of not less than 2 inches (51 mm) from the front faces and sides of masonry fireplaces and not less than 4 inches (102 mm) from the back faces of masonry fireplaces. The airspace shall not be filled, except to provide fireblocking in accordance with Section 2111.13.

Exceptions:

1. Masonry fireplaces *listed and labeled* for use in contact with combustibles in accordance with UL 127 and installed in accordance with the manufacturer's instructions are permitted to have combustible material in contact with their exterior surfaces.
2. When masonry fireplaces are constructed as part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete walls less than 12 inches (306 mm) from the inside surface of the nearest firebox lining.
3. Exposed combustible *trim* and the edges of sheathing materials, such as wood siding, flooring and dry-wall, are permitted to abut the masonry fireplace sidewalls and hearth extension, in accordance with Figure 2111.12, provided such combustible *trim* or sheathing is not less than 12 inches (306 mm) from the inside surface of the nearest firebox lining.
4. Exposed combustible mantels or *trim* is permitted to be placed directly on the masonry fireplace front surrounding the fireplace opening, provided such combustible materials shall not be placed within 6 inches (153 mm) of a fireplace opening. Combustible material directly above and within 12 inches (305 mm) of the fireplace opening shall not project more than $\frac{1}{8}$ inch (3.2 mm) for each 1-inch (25 mm) distance from such opening. Combustible materials located along the sides of the fireplace opening that project more than $1\frac{1}{2}$ inches (38 mm) from the face of the fireplace shall have an additional clearance equal to the projection.



For SI: 1 inch = 25.4 mm.

FIGURE 2111.12
ILLUSTRATION OF EXCEPTION TO
FIREPLACE CLEARANCE PROVISION

2111.13 Fireplace fireblocking. All spaces between fireplaces and floors and ceilings through which fireplaces pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between wood joists, beams or headers shall be to a depth of 1 inch (25 mm) and shall only be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

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

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

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

2111.14.3 Exterior air intake. The exterior air intake shall be capable of providing all combustion air from the exterior of the *dwelling*. The exterior air intake shall not be located within a garage, *attic*, basement or crawl space of the *dwelling* nor shall the air intake be located at an elevation higher than the firebox. The exterior air intake shall be covered with a corrosion-resistant screen of 1/4-inch (6.4 mm) mesh.

2111.14.4 Clearance. Unlisted combustion air ducts shall be installed with a minimum 1-inch (25 mm) clearance to combustibles for all parts of the duct within 5 feet (1524 mm) of the duct outlet.

2111.14.5 Passageway. The combustion air passageway shall be not less than 6 square inches (3870 mm²) and not more than 55 square inches (0.035 m²), except that combustion air systems for *listed* fireplaces or for fireplaces tested for emissions shall be constructed according to the fireplace manufacturer's instructions.

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

SECTION 2112 MASONRY HEATERS

2112.1 Definition. A masonry heater is a heating appliance constructed of concrete or solid masonry, hereinafter referred to as "masonry," which is designed to absorb and store heat from a solid fuel fire built in the firebox by routing the exhaust gases through internal heat exchange channels in which the flow path downstream of the firebox may include flow in a horizontal or downward direction before entering the chimney and which delivers heat by radiation from the masonry surface of the heater.

2112.2 Installation. Masonry heaters shall be installed in accordance with this section and comply with one of the following:

1. Masonry heaters shall comply with the requirements of ASTM E1602.

2. Masonry heaters shall be *listed* and *labeled* in accordance with UL 1482 or EN 15250 and installed in accordance with the manufacturer's instructions.

2112.3 Footings and foundation. The firebox floor of a masonry heater shall be a minimum thickness of 4 inches (102 mm) of noncombustible material and be supported on a noncombustible footing and foundation in accordance with Section 2113.2.

2112.4 Seismic reinforcing. In structures assigned to *Seismic Design Category* D, E or F, masonry heaters shall be anchored to the masonry foundation in accordance with Section 2113.3. Seismic reinforcing shall not be required within the body of a masonry heater with a height that is equal to or less than 3.5 times its body width and where the masonry chimney serving the heater is not supported by the body of the heater. Where the masonry chimney shares a common wall with the facing of the masonry heater, the chimney portion of the structure shall be reinforced in accordance with Section 2113.

2112.5 Masonry heater clearance. Combustible materials shall not be placed within 36 inches (914 mm) or the distance of the allowed reduction method from the outside surface of a masonry heater in accordance with NFPA 211, Section 12.6, and the required space between the heater and combustible material shall be fully vented to permit the free flow of air around all heater surfaces.

Exceptions:

1. Where the masonry heater wall thickness is at least 8 inches (203 mm) of solid masonry and the wall thickness of the heat exchange channels is not less than 5 inches (127 mm) of solid masonry, combustible materials shall not be placed within 4 inches (102 mm) of the outside surface of a masonry heater. A clearance of not less than 8 inches (203 mm) shall be provided between the gas-tight capping slab of the heater and a combustible ceiling.
2. Masonry heaters *listed* and *labeled* in accordance with UL 1482 or EN 15250 and installed in accordance with the manufacturer's instructions.

SECTION 2113 MASONRY CHIMNEYS

2113.1 General. The construction of masonry chimneys consisting of solid masonry units, hollow masonry units grouted solid, stone or concrete shall be in accordance with this section.

2113.2 Footings and foundations. Footings for masonry chimneys shall be constructed of concrete or solid masonry not less than 12 inches (305 mm) thick and shall extend at least 6 inches (152 mm) beyond the face of the foundation or support wall on all sides. Footings shall be founded on natural undisturbed earth or engineered fill below frost depth. In

MASONRY

areas not subjected to freezing, footings shall be not less than 12 inches (305 mm) below finished grade.

2113.3 Seismic reinforcement. In structures assigned to *Seismic Design Category A* or *B*, seismic reinforcement is not required. In structures assigned to *Seismic Design Category C* or *D*, masonry chimneys shall be reinforced and anchored in accordance with Sections 2113.3.1, 2113.3.2 and 2113.4. In structures assigned to *Seismic Design Category E* or *F*, masonry chimneys shall be reinforced in accordance with the requirements of Sections 2101 through 2108 and anchored in accordance with Section 2113.4.

2113.3.1 Vertical reinforcement. For chimneys up to 40 inches (1016 mm) wide, four No. 4 continuous vertical bars anchored in the foundation shall be placed in the concrete between wythes of solid masonry or within the cells of hollow unit masonry and grouted in accordance with Section 2103.3. Grout shall be prevented from bonding with the flue liner so that the flue liner is free to move with thermal expansion. For chimneys greater than 40 inches (1016 mm) wide, two additional No. 4 vertical bars shall be provided for each additional 40 inches (1016 mm) in width or fraction thereof.

2113.3.2 Horizontal reinforcement. Vertical reinforcement shall be placed enclosed within $\frac{1}{4}$ -inch (6.4 mm) ties, or other reinforcing of equivalent net cross-sectional area, spaced not to exceed 18 inches (457 mm) on center in concrete, or placed in the bed joints of unit masonry, at not less than every 18 inches (457 mm) of vertical height. Two such ties shall be provided at each bend in the vertical bars.

2113.4 Seismic anchorage. Masonry chimneys and foundations shall be anchored at each floor, ceiling or roof line more than 6 feet (1829 mm) above grade with two $\frac{3}{16}$ -inch by 1-inch (4.8 mm by 25 mm) straps embedded not less than 12 inches (305 mm) into the chimney. Straps shall be hooked around the outer bars and extend 6 inches (152 mm) beyond the bend. Each strap shall be fastened to not less than four floor joists with two $\frac{1}{2}$ -inch (12.7 mm) bolts.

Exception: Seismic anchorage is not required for the following:

1. In structures assigned to *Seismic Design Category A* or *B*.
2. Where the masonry fireplace is constructed completely within the exterior walls.

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

2113.6 Changes in dimension. The chimney wall or chimney flue lining shall not change in size or shape within 6 inches (152 mm) above or below where the chimney passes

through floor components, ceiling components or roof components.

2113.7 Offsets. Where a masonry chimney is constructed with a fireclay flue liner surrounded by one wythe of masonry, the maximum offset shall be such that the centerline of the flue above the offset does not extend beyond the center of the chimney wall below the offset. Where the chimney offset is supported by masonry below the offset in an *approved* manner, the maximum offset limitations shall not apply. Each individual corbeled masonry course of the offset shall not exceed the projection limitations specified in Section 2113.5.

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

2113.9 Termination. Chimneys shall extend not less than 2 feet (610 mm) higher than any portion of the building within 10 feet (3048 mm), but shall not be less than 3 feet (914 mm) above the highest point where the chimney passes through the roof.

2113.9.1 Chimney caps. Masonry chimneys shall have a concrete, metal or stone cap, sloped to shed water, a drip edge and a caulked bond break around any flue liners in accordance with ASTM C1283.

2113.9.2 Spark arrestors. Where a spark arrestor is installed on a masonry chimney, the spark arrestor shall meet all of the following requirements:

1. The net free area of the arrestor shall be not less than four times the net free area of the outlet of the chimney flue it serves.
2. The arrestor screen shall have heat and corrosion resistance equivalent to 19-gage galvanized steel or 24-gage stainless steel.
3. Openings shall not permit the passage of spheres having a diameter greater than $\frac{1}{2}$ inch (12.7 mm) nor block the passage of spheres having a diameter less than $\frac{3}{8}$ inch (9.5 mm).
4. The spark arrestor shall be accessible for cleaning and the screen or chimney cap shall be removable to allow for cleaning of the chimney flue.

2113.9.3 Rain caps. Where a masonry or metal rain cap is installed on a masonry chimney, the net free area under the cap shall be not less than four times the net free area of the outlet of the chimney flue it serves.

2113.10 Wall thickness. Masonry chimney walls shall be constructed of concrete, solid masonry units or hollow masonry units grouted solid with not less than 4 inches (102 mm) nominal thickness.

2113.10.1 Masonry veneer chimneys. Where masonry is used as veneer for a framed chimney, through flashing and weep holes shall be provided as required by Chapter 14.

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

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

1. Clay flue lining complying with the requirements of ASTM C315.
2. *Listed* chimney lining systems complying with UL 1777.
3. Factory-built chimneys or chimney units *listed* for installation within masonry chimneys.
4. Other *approved* materials that will resist corrosion, erosion, softening or cracking from flue gases and condensate at temperatures up to 1,800°F (982°C).

2113.11.1.1 Flue linings for specific appliances. Flue linings other than those covered in Section 2113.11.1 intended for use with specific appliances shall comply with Sections 2113.11.1.2 through 2113.11.1.4 and Sections 2113.11.2 and 2113.11.3.

2113.11.1.2 Gas appliances. Flue lining systems for gas appliances shall be in accordance with the *Florida Building Code, Fuel Gas*.

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

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

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

2113.11.2 Concrete and masonry chimneys for medium-heat appliances.

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

2113.11.2.2 Construction. Chimneys for medium-heat appliances shall be constructed of solid masonry units or of concrete with walls not less than 8 inches (203 mm) thick, or with stone masonry not less than 12 inches (305 mm) thick.

2113.11.2.3 Lining. Concrete and masonry chimneys shall be lined with an *approved* medium-duty refractory brick not less than 4¹/₂ inches (114 mm) thick laid on the 4¹/₂-inch bed (114 mm) in an *approved* medium-

duty refractory mortar. The lining shall start 2 feet (610 mm) or more below the lowest chimney connector entrance. Chimneys terminating 25 feet (7620 mm) or less above a chimney connector entrance shall be lined to the top.

2113.11.2.4 Multiple passageway. Concrete and masonry chimneys containing more than one passageway shall have the liners separated by a minimum 4-inch-thick (102 mm) concrete or solid masonry wall.

2113.11.2.5 Termination height. Concrete and masonry chimneys for medium-heat appliances shall extend not less than 10 feet (3048 mm) higher than any portion of any building within 25 feet (7620 mm).

2113.11.2.6 Clearance. A minimum clearance of 4 inches (102 mm) shall be provided between the exterior surfaces of a concrete or masonry chimney for medium-heat appliances and combustible material.

2113.11.3 Concrete and masonry chimneys for high-heat appliances.

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

2113.11.3.2 Construction. Chimneys for high-heat appliances shall be constructed with double walls of solid masonry units or of concrete, each wall to be not less than 8 inches (203 mm) thick with a minimum airspace of 2 inches (51 mm) between the walls.

2113.11.3.3 Lining. The inside of the interior wall shall be lined with an *approved* high-duty refractory brick, not less than 4¹/₂ inches (114 mm) thick laid on the 4¹/₂-inch bed (114 mm) in an *approved* high-duty refractory mortar. The lining shall start at the base of the chimney and extend continuously to the top.

2113.11.3.4 Termination height. Concrete and masonry chimneys for high-heat appliances shall extend not less than 20 feet (6096 mm) higher than any portion of any building within 50 feet (15 240 mm).

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

2113.12 Clay flue lining (installation). Clay flue liners shall be installed in accordance with ASTM C1283 and extend from a point not less than 8 inches (203 mm) below the lowest inlet or, in the case of fireplaces, from the top of the smoke chamber to a point above the enclosing walls. The lining shall be carried up vertically, with a maximum slope no greater than 30 degrees (0.52 rad) from the vertical.

Clay flue liners shall be laid in medium-duty nonwater-soluble refractory mortar conforming to ASTM C199 with tight mortar joints left smooth on the inside and installed to maintain an airspace or insulation not to exceed the thickness of the flue liner separating the flue liners from the interior face of the chimney masonry walls. Flue lining shall be sup-

MASONRY

ported on all sides. Only enough mortar shall be placed to make the joint and hold the liners in position.

2113.13 Additional requirements.

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

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

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

2113.14 Multiple flues. When two or more flues are located in the same chimney, masonry wythes shall be built between adjacent flue linings. The masonry wythes shall be at least 4 inches (102 mm) thick and bonded into the walls of the chimney.

Exception: When venting only one appliance, two flues are permitted to adjoin each other in the same chimney with only the flue lining separation between them. The joints of the adjacent flue linings shall be staggered not less than 4 inches (102 mm).

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

Exceptions:

1. Chimney flues serving oil-fired appliances sized in accordance with NFPA 31.
2. Chimney flues serving gas-fired appliances sized in accordance with the *Florida Building Code, Fuel Gas*.

2113.16 Flue area (masonry fireplace). Flue sizing for chimneys serving fireplaces shall be in accordance with Section 2113.16.1 or 2113.16.2.

2113.16.1 Minimum area. Round chimney flues shall have a minimum net cross-sectional area of not less than $\frac{1}{12}$ of the fireplace opening. Square chimney flues shall have a minimum net cross-sectional area of not less than $\frac{1}{10}$ of the fireplace opening. Rectangular chimney flues with an aspect ratio less than 2 to 1 shall have a minimum net cross-sectional area of not less than $\frac{1}{10}$ of the fireplace opening. Rectangular chimney flues with an aspect ratio of 2 to 1 or more shall have a minimum net cross-sectional area of not less than $\frac{1}{8}$ of the fireplace opening.

2113.16.2 Determination of minimum area. The minimum net cross-sectional area of the flue shall be determined in accordance with Figure 2113.16. A flue size providing not less than the equivalent net cross-sectional area shall be used. Cross-sectional areas of clay flue lin-

ings are as provided in Tables 2113.16(1) and 2113.16(2) or as provided by the manufacturer or as measured in the field. The height of the chimney shall be measured from the firebox floor to the top of the chimney flue.

**TABLE 2113.16(1)
NET CROSS-SECTIONAL AREA OF ROUND FLUE SIZES^a**

FLUE SIZE, INSIDE DIAMETER (inches)	CROSS-SECTIONAL AREA (square inches)
6	28
7	38
8	50
10	78
10 $\frac{3}{4}$	90
12	113
15	176
18	254

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm².

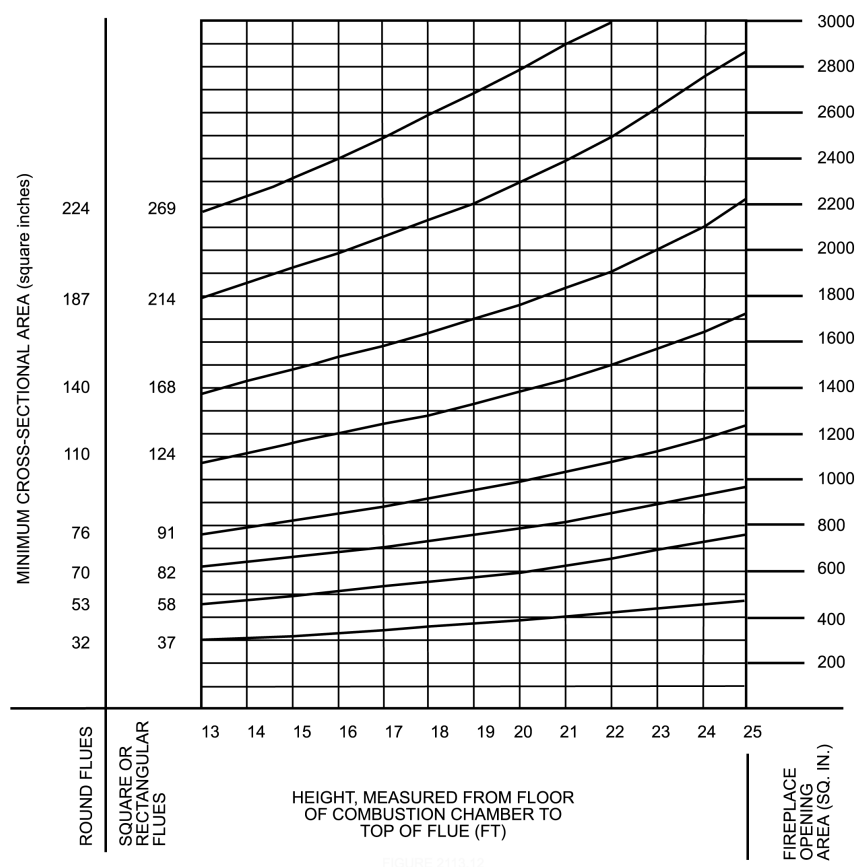
a. Flue sizes are based on ASTM C315.

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

FLUE SIZE, OUTSIDE NOMINAL DIMENSIONS (inches)	CROSS-SECTIONAL AREA (square inches)
4.5 × 8.5	23
4.5 × 13	34
8 × 8	42
8.5 × 8.5	49
8 × 12	67
8.5 × 13	76
12 × 12	102
8.5 × 18	101
13 × 13	127
12 × 16	131
13 × 18	173
16 × 16	181
16 × 20	222
18 × 18	233
20 × 20	298
20 × 24	335
24 × 24	431

For SI: 1 inch = 25.4 mm, 1 square inch = 645.16 mm².

2113.17 Inlet. Inlets to masonry chimneys shall enter from the side. Inlets shall have a thimble of fireclay, rigid refractory material or metal that will prevent the connector from



For SI: 1 inch = 25.4 mm, 1 square inch = 645 mm².

FIGURE 2113.16
FLUE SIZES FOR MASONRY CHIMNEYS

pulling out of the inlet or from extending beyond the wall of the liner.

2113.18 Masonry chimney cleanout openings. Cleanout openings shall be provided within 6 inches (152 mm) of the base of each flue within every masonry chimney. The upper edge of the cleanout shall be located not less than 6 inches (152 mm) below the lowest chimney inlet opening. The height of the opening shall be not less than 6 inches (152 mm). The cleanout shall be provided with a noncombustible cover.

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

2113.19 Chimney clearances. Any portion of a masonry chimney located in the interior of the building or within the exterior wall of the building shall have a minimum airspace clearance to combustibles of 2 inches (51 mm). Chimneys located entirely outside the exterior walls of the building, including chimneys that pass through the soffit or cornice, shall have a minimum airspace clearance of 1 inch (25 mm).

The airspace shall not be filled, except to provide fireblocking in accordance with Section 2113.20.

Exceptions:

1. Masonry chimneys equipped with a chimney lining system listed and labeled for use in chimneys in contact with combustibles in accordance with UL 1777, and installed in accordance with the manufacturer's instructions, are permitted to have combustible material in contact with their exterior surfaces.
2. Where masonry chimneys are constructed as part of masonry or concrete walls, combustible materials shall not be in contact with the masonry or concrete wall less than 12 inches (305 mm) from the inside surface of the nearest flue lining.
3. Exposed combustible trim and the edges of sheathing materials, such as wood siding, are permitted to abut the masonry chimney sidewalls, in accordance with Figure 2113.19, provided such combustible

MASONRY

trim or sheathing is not less than 12 inches (305 mm) from the inside surface of the nearest flue lining. Combustible material and *trim* shall not overlap the corners of the chimney by more than 1 inch (25 mm).

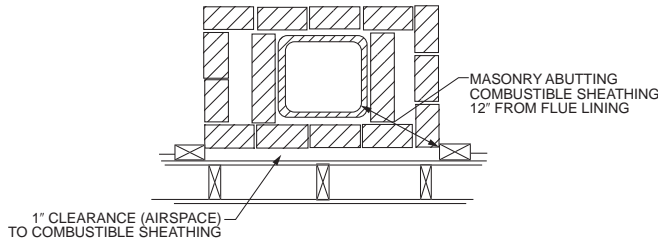


FIGURE 2113.19
ILLUSTRATION OF EXCEPTION THREE
CHIMNEY CLEARANCE PROVISION

2113.20 Chimney fireblocking. All spaces between chimneys and floors and ceilings through which chimneys pass shall be fireblocked with noncombustible material securely fastened in place. The fireblocking of spaces between wood joists, beams or headers shall be self-supporting or be placed on strips of metal or metal lath laid across the spaces between combustible material and the chimney.

SECTION 2114 TERMITE INSPECTION

2114.1 Cleaning. Cells and cavities in masonry units and air gaps between brick, stone or masonry veneers and the structure shall be cleaned of all nonpreservative treated or nonnaturally 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.

2114.2 Concrete bearing ledge. Brick, stone or other veneer shall be supported by a concrete bearing ledge at least equal to the total thickness of the brick, stone or other veneer, 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 shelf, angle or lintel secured to the foundation sidewall in accordance with TMS 402, 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 2115 SPECIAL WIND PROVISIONS FOR MASONRY

2115.1 Gable endwalls.

2115.1.1 General. Gable endwalls shall be structurally continuous between points of lateral support.

2115.1.2 Cathedral endwalls. Gable endwalls adjacent to cathedral ceilings shall be structurally continuous from the uppermost floor to the ceiling diaphragm or to the roof diaphragm.

SECTIONS 2116 and 2117 RESERVED

SECTION 2118 HIGH-VELOCITY HURRICANE ZONES— DESIGN RESERVED

SECTION 2119 HIGH-VELOCITY HURRICANE ZONES— QUALITY, TESTS AND APPROVALS

2119.1 Quality. Reserved.

2119.2 Tests. Reserved.

2119.3 Approvals.

2119.3.1 Only such masonry units that 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 one 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. Reserved.

2119.5 Stone. Reserved.

2119.6 Cast stone. Reserved.

2119.7 Concrete blocks. Reserved.

2119.8 Structural clay tile. Reserved.

2119.9 Gypsum tile. Reserved.

2119.10 Plain concrete. Reserved.

2119.11 Plain gypsum concrete. Reserved.

2119.12 Mortar. Reserved.

**SECTION 2120
HIGH-VELOCITY HURRICANE ZONES—
ALLOWABLE UNIT STRESSES IN UNIT MASONRY
RESERVED**

**SECTION 2121
HIGH-VELOCITY HURRICANE ZONES—
CONSTRUCTION DETAILS**

2121.1 General.

2121.1.1 Reserved.

2121.1.2 Reserved.

2121.1.3 Reserved.

2121.1.4 Reserved.

2121.1.5 Reserved.

2121.1.6 Minimum No. 9 gauge truss-type horizontal joint reinforcing at every alternate course (16-inch (406 mm) spacing], 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. In addition, horizontal joint reinforcement shall comply with TMS 602 Sections 2.4C through 2.4F and Section 3.4B.7.

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 Sections 2121.2.11.

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 square feet (22.3 m²), except as set forth in Section 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 pro-

vided 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 four #5 vertical bars for 8 inch by 12 inch (203 mm by 305 mm) columns nor less than four #6 vertical bars for 12 inch by 12 inch (305 mm by 305 mm) columns nor less reinforcing steel than 0.01 of the cross-sectional area for columns of other dimension nor less than may be required to resist axial loads or bending forces. Vertical reinforcing shall be doweled to the footing and splices shall be lapped 30 bar diameters. Columns shall be tied with #2 hoops spaced not more than 12 inches (305 mm) apart.

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 Section 2121.2.2.1, has been satisfied and structural columns of skeleton frame construction are spaced as specified in Section 2121.2.2.5, provision for

MASONRY

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) on center at corners and at each bend and at 48 inches (1219 mm) on center elsewhere. A tie beam shall be not less in dimension or reinforcing than required for the conditions 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 bottom of the pour.
4. Beam block shall provide not less than 14 inches (356 mm) vertical dimension or less than 4¹/₂ 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.

2121.2.3.3 The tie beam shall be continuous. Continuity of the reinforcing in straight runs shall be provided by lapping splices not less than 30 inches (762 mm). Continuity shall be provided at corners by bending two bars from each direction around the corner 30 inches (762 mm) or by adding two #5 bent bars which extend 30 inches (762 mm) each way from the corner. Continuity at columns shall be provided by continuing horizontal reinforcing through columns or by bending horizontal reinforcing in the columns a distance of 18 inches (457 mm).

2121.2.3.4 A tie beam shall not be required where floor or roof systems provide a rigid diaphragm of reinforced concrete with a minimum thickness of 4 inches (102 mm) or where a floor or roof system has an equivalent stiffness factor of not less than 0.5 cubic inches, as

determined by the moment of inertia divided by the length. (Per foot of width, measured normal to the plane of the diaphragm and adequately anchored.)

2121.2.3.5 Changes in level of the beams or structural concrete beams (beam) shall be made at tie columns or structural concrete columns and said tie columns or structural concrete columns shall be continuous from beam to beam.

2121.2.3.6 A tie beam may follow the rake of a gable or shed end if the slope does not exceed 3:12 and the requirements of Sections 2121.2.1.2 and 2121.2.1.3 are met.

2121.2.3.7 The concrete in tie beams shall be placed to bond to the masonry units immediately below and shall not be separated therefrom by wood, felt or any other material which may prevent bond. Felt paper no wider than the width of the cells of the block may be used provided that it is depressed a minimum of 2 inches (51 mm) in one cell of each block.

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 Section 2121.2.3.6 above, and designed in accordance with Sections 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 (0.04 m²) 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 Section 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 (0.04 m²) 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 inches 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 mm²) in the 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 sixth 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 (0.05 m²) 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:($n-1$) where n is defined as the modular ratio of elasticity ($e_{\text{steel}}/e_{\text{concrete}}$).

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 inches by 8 inches (203 mm by 203 mm) dimension reinforced with two #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 m²), 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 (203 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 inch by 8 inch (102 mm by 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 unit masonry. Reserved.

2121.2.13 Grill block. Reserved.

MASONRY

2121.3 Interior bearing walls. Reserved.

2121.4 Fire walls. Reserved.

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 Section 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. Reserved.

2121.7 Partitions. Reserved.

2121.8 Fences. Reserved.

2121.9 Other masonry walls. Reserved.

SECTION 2122 HIGH-VELOCITY HURRICANE ZONES— REINFORCED UNIT MASONRY

2122.1 Standards. The provisions of TMS 402 and TMS 602 are hereby adopted as a minimum for the design and construction of reinforced unit masonry. In addition to TMS 402 and TMS 602, reinforced unit masonry structures shall comply with Sections 2122.2 through 2122.10.

Exception: Unless otherwise specified by the designing architect or engineer, where plan review and inspections are performed by a local building department in accordance with Sections 107 and 110, the provisions of TMS 402, Chapter 3, Section 3.1 and TMS 602, Sections 1.5 and 1.6 shall not apply.

2122.2 General.

2122.2.1 Section 2121 shall not apply where design and construction are in accordance with the provisions of this section.

2122.2.2 The design of buildings and structures of reinforced unit masonry shall be by a professional engineer or registered architect.

2122.2.3 Minimum No. 9 gauge ladder-type hot-dipped galvanized, stainless steel, or epoxy coating horizontal joint reinforcing at every alternate course [16-inch (406 mm) spacing], for reinforced masonry shall be provided. This reinforcement shall be tied to structural columns with approved methods. In addition, horizontal joint reinforcement shall comply with TMS 602 Sections 2.4C through 2.4F and Section 3.4B.10.

2122.2.4 Special inspector. A Florida-registered architect or professional engineer shall furnish inspection of all reinforced unit masonry structures.

2122.3 Concrete masonry strength. Concrete masonry strength shall be determined by unit strength method from TMS 602 Section 1.4 or in accordance with ASTM C1314.

2122.4 Reinforcement. Reinforcement shall comply with TMS 402 and TMS 602 except as modified herein Sections 2107 and 2108.

2122.5 Concentrated loads. Bearing area and concentrated loads shall be in accordance with TMS 402 Sections 4.3.4 and 5.1.3.

2122.6 Reinforced masonry bearing walls. Reinforced masonry bearing walls shall have a nominal thickness of not less than 8 inches (203 mm).

2122.7 Anchorage requirements. Anchorage shall be in accordance with TMS 402. Loading shall comply with TMS 402 Section 4.1 and the following.

2122.7.1 Reinforced masonry walls shall be securely anchored to adjacent structural members such as roofs, floors, columns, pilasters, buttresses and intersection walls.

2122.7.2 Masonry walls shall be anchored to all floors and roofs that provide lateral support to such walls.

2122.7.3 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.

2122.7.4 Required anchors shall be embedded in reinforced grouted cells. Anchor bolts shall be installed in accordance with TMS 602 Section 3.4D.

2122.7.5 Wood framing connected by nails shall not be considered as acceptable anchorage.

2122.8 Mortar and grout.

2122.8.1 Mortar materials shall comply with TMS 602 Section 2.1. Grout materials shall comply with TMS 602 Section 2.2.

2122.8.2 Vertical alignment of cells to be grouted shall maintain clear, unobstructed, continuous, vertical cores measuring not less than 2¹/₂ inches by 3 inches (51 mm by 76 mm) for fine aggregate grout and 3 inches by 3 inches (76 mm by 76 mm) for coarse aggregate grout as defined by ASTM C476. The architect or engineer may specify other grout space sizes which shall be permitted provided they comply with TMS 402 Section 1.203.2.1 and TMS 602 Section 3.5C.

2122.8.3 Placing of mortar and masonry units shall comply with TMS 602 Section 3.3.

2122.8.4 Grout placement. Grout placement shall be in accordance with TMS 402 and TMS 602.

2122.8.5 Confinement. Confine grout to the areas indicated on the project drawings. Use material to confine grout that permits bond between masonry units and mortar.

2122.8.6 Unless otherwise required, mix grout other than self-consolidating grout to a consistency that has a slump between 8 and 11 inches (203 and 279 mm). Self-consolidating grout shall comply with TMS 602.

2122.8.7 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.

2122.8.8 Grout placement shall comply with Section 3.5 of TMS 602. Grouting shall be a continuous operation with grout pour height in accordance with Section 3.5C of TMS 602 and with grout lift height in accordance with Section 3.5D of TMS 602.

2122.8.9 Grouting shall be consolidated between lifts by puddling, rodding or mechanical vibration.

2122.8.10 Grout keys shall be formed between grout pours. Grout keys shall be formed between grout lifts when the first lift is permitted to set prior to placement of the subsequent lift.

1. Form a grout key by terminating the grout a minimum of 1½ inches (38.1 mm) below a mortar joint.
2. Do not form grout keys within beams.
3. At beams or lintels laid with closed bottom units, terminate the grout pour at the bottom of the beam or lintel without forming a grout key.

2122.9 Bearing. Precast floor and roof units supported on masonry walls shall provide minimum bearing of 3 inches (76 mm) and anchorage in accordance with Section 2122.7.

2122.10 Intersecting walls. Intersecting walls shall comply with TMS 402 Section 5.1.1.